# ALMAGAL: ALMA Evolutionary study of High Mass Protocluster Formation in the Galaxy

**2018.1.00435.L**

## ABSTRACT

High-mass stars form in clustered environments and have a prominent role in shaping galaxies, yet fundamental questions about the physics responsible to fragment molecular Clumps into Cores are still open. What is the number density of core fragments in dense clumps as a function of evolution? To what extent the fragmentation process is driven by larger-scale dynamics in clumps or filaments? ALMA was built to do transformational science and allows today for the first time to answer these questions with high statistical significance.

ALMAGAL will observe 1mm continuum and lines toward more than 1000 dense clumps with M>500 M_sun and d < 7 kpc. The sample covers all evolutionary stages from IRDC to HII regions from the tip of the Bar to the outskirts of the Galaxy. The C43-4/C43-1/ACA combination at 0.1 mJy sensitivity will enable a complete study of the clump-to-core fragmentation process down to at least 2500AU and 0.3 M_sun Galaxy-wide, mapping the temperature and the local/global infall velocity patterns of the cores-hosting clumps.

ALMAGAL publicly accessible data cubes and catalogs will be an unvaluable legacy of ALMA, that will allow numerous community followup studies.

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|---|---|---|---|---|---|
| **PI NAME:** | Sergio Molinari | | | **SCIENCE CATEGORY:** | ISM, star formation and astrochemistry |
| **ESTIMATED 12M TIME:** | **125.3 h** | **ESTIMATED ACA TIME:** | **222.1 h** | **ESTIMATED NON-STANDARD MODE TIME (12-M):** | **0.0 h** |
| **CO-PI NAME(S): (Large & VLBI Proposals only)** | Paul Ho; Edwin Bergin; Peter Schilke | | | | |
| **CO-INVESTIGATOR NAME(S):** | Alvaro Sanchez-Monge; Leonardo Bronfman; Melvin Hoare; Riccardo Cesaroni; Fumitaka Nakamura; Henrik Beuther; Davide Elia; Gary Fuller; Nicolas Peretto; Alessio Traficante; Qizhou Zhang; Rene Plume; Ralf Klessen; Stefanie Walch; Danae Polychroni; Hauyu Baobab Liu; Sheng-Yuan Liu; Maite Beltran; Manuel Merello; Leonardo Testi; Friedrich Wyrowski; John Bally; Dariusz Lis; Pamela Klaassen; Luke Maud; Yanett Contreras; Floris van der Tak; Aida Ahmadi; Hans Zinnecker; James Campbell; Katharine Johnston; Joseph Mottram; Stuart Lumsden; Patrick Koch; Michihiro Takami; Yi-Jehng Kuan; Yu-Nung Su; Oscar Morata; Ya-Wen Tang; Kuo-Song Wang; Vivien Chen; Sheng-Li Qin; Ricardo Finger; Kazi Rygl; Eugenio Schisano; Patricio Sanhueza; Thomas Henning; Luca Moscadelli; Rolf Kuiper; Crystal Brogan; Brian Svoboda; Cara Battersby; Quang Nguyen Luong; Kee-Tae Kim; Tie Liu; Patrick Hennebelle | | | | |
| **DUPLICATE OBSERVATION JUSTIFICATION:** | We have checked for duplication, and found none according to the criteria of ALMA. There are some source duplications, but either spectral or spatial resolution, frequencies or sensitivity were sufficiently different from our proposal not to count as as duplication. | | | | |

## REPRESENTATIVE SCIENCE GOALS (UP TO FIRST 30)

| SCIENCE GOAL | POSITION | BAND | ANG.RES.(") | LAS.(") | ACA? | NON-STANDARD MODE |
|---|---|---|---|---|---|---|
| High-mass stars 0 cluster 1 | ICRS 18:16:33.0000, -16:51:21.000 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 2 | ICRS 18:43:02.2500, -04:41:48.800 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 3 | ICRS 16:36:28.3000, -47:41:46.800 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 4 | ICRS 17:01:18.4000, -42:49:37.000 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 5 | ICRS 14:26:52.4000, -60:38:20.700 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 6 | ICRS 14:49:07.8000, -59:24:45.600 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 7 | ICRS 06:58:44.3500, -03:41:09.900 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 8 | ICRS 07:19:35.9300, -17:39:18.000 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 9 | ICRS 07:45:07.5000, -25:32:16.900 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 10 | ICRS 12:27:08.5000, -62:49:45.300 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 11 | ICRS 10:23:20.0000, -57:52:31.400 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 12 | ICRS 10:57:43.0000, -59:44:57.800 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 13 | ICRS 09:04:22.2000, -48:54:30.300 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 14 | ICRS 09:24:27.0000, -51:59:16.500 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 15 | ICRS 08:29:14.2000, -41:10:47.600 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 0 cluster 16 | ICRS 08:14:53.9000, -35:33:02.800 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 1 | ICRS 18:32:43.8000, -09:09:01.800 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 2 | ICRS 16:00:31.9000, -53:12:48.500 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 3 | ICRS 18:42:42.5000, -04:15:34.400 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 4 | ICRS 13:01:26.5000, -62:25:48.600 | 6 | 0.400 | 30.000 | Y | N |
| High-mass stars 5 | ICRS 15:43:22.5000, -54:21:33.200 | 6 | 0.400 | 30.000 | Y | N |
| Total # Science Goals : 21 | | | | | | |

| | | | |
|---|---|---|---|
| **SCHEDULING TIME CONSTRAINTS** | NONE | **TIME ESTIMATES OVERRIDDEN ?** | No |

# 1 Scientific Justification

## *1.1 Scientific Rationale*

High-mass stars dominate the feedback processes in galaxies, through input of mechanical (outflows, winds, supernovae) and radiative (UV creating HII regions, X-rays) energy. Particularly through supernova explosions, they can shape whole galaxies [4]. They also enrich the ISM with heavy elements, which in turn modifies the star formation process. Many low-mass stars, including our sun, formed in clusters containing high-mass stars [39]. Yet, their formation processes differ from low-mass stars in significant ways: while the Kelvin-Helmholtz timescale of low-mass stars is significantly longer than the time required to assemble them, for any reasonable accretion rate it is shorter for high-mass stars. Hence, high-mass stars will continue accreting up to and even after reaching the main sequence. The combination of being deeply embedded in dusty cores through most of their evolution, their scarcity and correspondingly high average distance together with evolution in clusters with many sources close together make the observations challenging.

In a recent review, Schilke [30] identified four main open questions in high-mass star formation which need investigation in a statistically relevant sample. Three of these questions we want to investigate with the current proposal in a large sample to provide, for the first time, statistically significant results (the fourth, about magnetic fields, cannot be tackled by ALMA in a large sample):

**Q1: What do the initial conditions look like - how fragmented are the cores and what are their density profiles?** ALMA mapping of dense cores in a large sample of high-mass clumps and sophisticated modeling are necessary.

**Q2: Are high-mass cores connected to a larger cloud mass reservoir?** This can be studied through observations of mass-flow and feedback in core-hosting clumps and filamentary structures.

**Q3: Are there disks around high-mass (O-type) stars and what do they look like?** A complete sample of reliable candidates for high-resolution ALMA follow-up is needed.

Most high-mass stars exist in a clustered environment ([20,34,2,31]), so their formation must involve breaking up of molecular **clumps** (linear scales of 0.5-1.0 pc) into **cores** (linear scales $\leq$ 0.1 pc), as indeed observed at high spatial resolution at mm wavelengths [33]. A full understanding of the **fragmentation process** and its role in allowing high-mass stars to collect material up to their final mass is still elusive. Thermal Jeans mass fragmentation leads to low-mass clumps/cores which are smaller than the observed masses of high-mass stars ($M \geq 8 M_\odot$). Mechanisms to stop fragmentation and delay collapse allowing the collection of enough gas in existing fragments to form massive stars are a possible solution. Turbulent support (e.g. [21]) or magnetic fields and radiation feedback (e.g. [10,19]) have been invoked. In this model family (hereafter monolithic collapse) the final stellar mass of the emerging stars is pre-assembled in the cores, and one would expect to find high-mass monolithic prestellar cores. Yet, the search for high-mass protostellar clumps without any sign of star formation has turned up only very few candidates (e.g. [40], [3]).

In the more dynamical scenario of competitive accretion, cores compete [37] for gas from the cloud mass reservoir that is not initially local to the core itself [5], and high-mass monolithic prestellar cores do not exist [38]. Infall motions would be dominated by accretion from the cloud onto the core. And indeed observations reveal **large scale infall motions** in massive star-forming regions, showing high-mass clumps not to be isolated from the cloud mass reservoir, but to globally accrete while star formation is internally ongoing (e.g [32,29,16,14]). Theory shows that infall motion is crucial both for initiating the formation of high-mass stars, and in subsequent evolutionary stages for maintaining accretion flows to increase the stellar mass (e.g. [44,45,46]). Millimeter interferometry has already started to tackle several of these issues by observing relatively small samples of intermediate and high-mass star forming regions with ALMA ([26,6,9,8,33,41], and approved ALMA Programs, e.g., by team members G. Fuller, L. Maud) and NOEMA (CORE, PI H. Beuther) covering several tens of

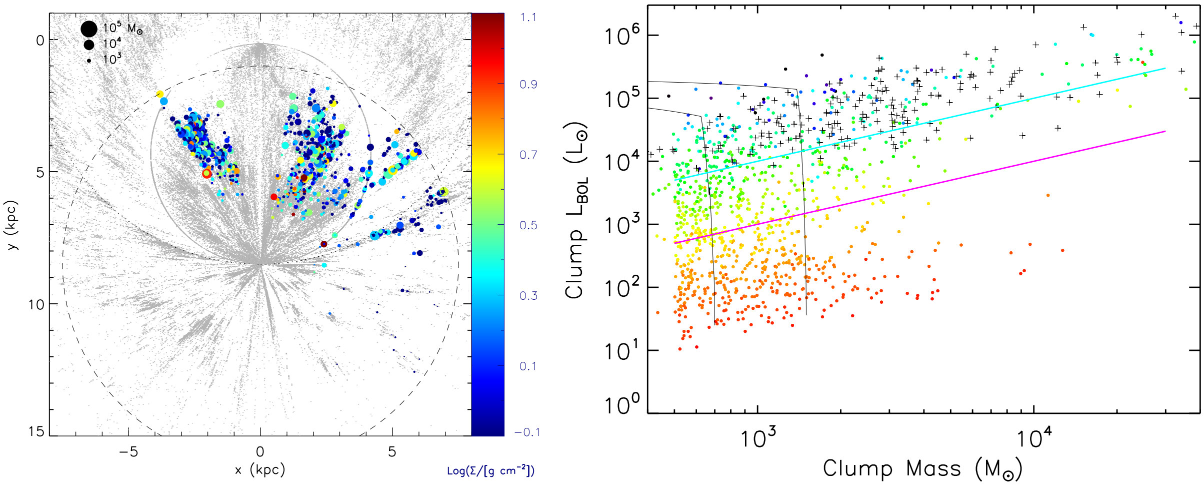

Figure 1: **a)** *(left) Galactic distribution of Hi-GAL clumps (thin grey dots) with ALMAGAL selected target clumps with symbol size* $\propto M_c$ *(clump mass) and color coded by* $\Sigma_c$ *(clump surface density). The Galactic Center is at the (0,0) position; the dashed circle is the limit of heliocentric distance in our sample.* ***b)*** *(right)* $L_{bol}-M_{clump}$ *plot for the 1062 selected clumps (color-coded by* $T_{dust}$ *from ∼8K (red) to ∼40K (blue); the black lines are the evolutionary tracks from [22] with plus-symbols indicating Hi-GAL sources associated with HII regions [7]. The magenta and cyan lines are the L/M=1 threshold for* $CH_3C_2H$ *detection found in [25], and the L/M=10 threshold above which* $T_{gas} \propto L/M$ *[25].*

objects from the early stage InfraRed Dark Clouds (IRDCs) to HII regions. Multiplicity of fragments in resolved clumps are found to vary considerably in different regions [42], and the notion of a Core Mass Function (CMF) resembling the stellar IMF [17] has been recently challenged in a very high-mass star formation region W43-MM1 [41]. Chemical diversity is found in 5 cores in which the G28.34+0.06 P1 clump is resolved [33], that can be traced to different evolutionary stages, similarly in about 20 cores in NGC6334I [6]. Ultimately, the **data obtained so far are not conclusive**, due to the **lack of a statistically relevant sample** of high spatial resolution observations of high-mass clumps, a situation we plan to rectify with this proposal.

### *1.2 Immediate objectives*

**To answer our questions, the spatial distribution of dense cores as a function of mass within dense clumps, their CMF and their evolution both in morphology and in total number, as well as the influence of global infall on clump-scales for the mass evolution** are the crucial observables that need to be measured from the nearly-quiescent stage (i.e. IRDCs) to the formation of the first ZAMS stars, and compared to predictions from numerical simulations.

**This objective can be pursued by mapping at 1.3 mm (Band 6) with large spatial dynamic range (see §2.2 for more details) a statistically significant sample of dense clumps with masses greater than 500$M_\odot$ within 7 kpc, spread over 3-14 kpc Galactocentric distance ranging from the near tip of the Galactic Bar to the outskirt of the Milky Way beyond the Solar circle (Fig. 1a), and over the full evolutionary path from the IRDC to the HII stage (Fig. 1b).** In the following, we will describe in detail how we intend to contribute to answering the questions Q1 to Q3 with this proposal:

1. To fully address **Q1**, we want to detect dense cores down to sub-solar mass and to a minimum linear scale of at least 2500 AU (i.e. the Jeans length for T∼15K and $n \sim 10^7 \mathrm{cm}^{-3}$) over the entire sample. We will be able to **determine from the continuum the census and mass function of dense cores** complete to $0.3M_\odot$ (at $3\sigma$) sufficient to reliably sample, e.g., the peak of the CMF in a low/intermediate-mass SF region like Aquila [17]. We will have minimal missing-flux problems because our setup (§2.2) ensures that emission is recovered from all scales up to $\sim 30''$.

The data are subject to biases, most important due to source confusion at the low-mass end, which will distort the resulting CMF. This is a well-known problem in galaxy surveys, and the well-established Bayesian *P(D)* method has been developed to recover the original distribution, which we intend to use (see e.g. [13]) , and our website[1] for preliminary studies). We will determine the core variance and evolution as a function of the evolutionary stage of the hosting dense clumps, their mass, surface density and location in the Galaxy. The complement of lines accessible with our setup is an adequate toolbox to determine these variables from early and cold cores (using e.g. DCN$(3-2)$), to warm (using e.g. $CH_3OH(4(2,2)-3(1,2))$) and hot cores (with $CH_3CN$). The detection of outflows will distinguish pre-stellar (no outflows) from protostellar (outflows) cores. The **variation in number of cores and in shape and slope at the high-mass end of the CMF** as a function of the host clump evolutionary stage will provide critical clues on the star formation history inside clumps (burst, accelerating, continuous), and a direct handle on the probability of core-merging during the evolution of the hosting clump with good statistics. For example, a top-heavy CMF dominated by early cores will point toward mini-starburst initial conditions (e.g. [41]), while an IMF-like CMF with distributed core evolutionary stages would be more suggestive of a continuous SF history. More quantitatively, observed CMFs will be compared to those provided by dedicated numerical simulations that include a fairly complete suite of physical processes (e.g. [49]), run with initial conditions taylored to the observed regions.

2. To fully address **Q2** and more in general the relationships between cores and their hosting clumps we will measure the **core-to-core velocity dispersion of all cores**, using the peak line velocities of $CH_3CN$ and/or $^{13}CO$ or $C^{18}O$, and relate that to the systemic velocity and the velocity dispersion of the hosting clumps gas traced by $^{13}CO$ or $C^{18}O$ picked up from cores-free clump locations. In this way we will determine if the velocity dispersion of the cores is more compatible with a relatively static evolution of isolated clumps, showing comparable line widths in cores and clump gas, or with a more dynamic picture where cores are connected to the ambient cloud structure, with the line width of the clump gas resulting from a composition of cores velocities as proposed by [43]. Our setup (§2.2) ensures that line emission will be recovered from all spatial scales from $0\farcs4$ up to $30''$.

We will use $CH_3CN$ and $H_2CO$ to model the **temperature** in cores and clumps. The $H_2CO$ thermometer is predominantly sensitive to dense (n $\sim 10^4$-$10^5$ cm$^{-3}$), warm ($T_G > 20$K) gas [36]. RADEX [12] radiative transfer modeling will provide accurate gas temperatures of the detected clumps at the target minimum linear scale of 2500 AU (see Fig. 2 for the expected S/N based on real ALMA data).

**Line profile analysis** of $H_2CO$ will not only characterize the degree of turbulence in the clump gas, but also **map and characterize infall-like patterns** using $C^{18}O$(2–1) and other optically thin tracers as reference spectra for systemic clump gas. Our setup including the ACA ensures that we will reliably detect global infall patterns. $^{13}CO$(2–1) and SiO(5–4) will serve to characterize outflows.

We will also perform clump-to-core multiscale simulations following the collapse of massive clumps [47] complete with photoionisation feedback and coupled to state of the art radiative transfer codes (such as RADMC) that we will use to predict line observables tracing the dynamics of clump gas as well density and temperature profiles in clumps and cores.

The observations will also reveal the inner part of **filamentary structures linking the surrounding cloud to the cores** (e.g.[23]) and thus assess the importance of mass flow from the parent cloud as well as connections between cores. Full exploration of this, however, will require larger maps in a follow-up project.

**3.** As a contribution to **Q3**, we will be able to detect **rotating toroidal structures** or **circumbinary disks** on scale of a few 1000 AU, and identify hundreds of Keplerian accretion disk candidates for future high resolution follow-up studies. With the current resolution we will not be able to resolve circumstellar disks around typical O- and B-type YSOs [1,8] for most source distances. Collimated outflows are indirect evidence for accretion disks, and will serve as a proxy for determining the accretion rate (related to Q2).

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[1] https://almagal.astro.uni-koeln.de

# 2 Description of observations

We will pursue our goals by analyzing a large and statistically significant data set of many clumps using one pointing per source. We are aware that the Cycle 5 large project ALMA-IMF (PI F. Motte) pursues similar goals with a different strategy: larger maps of a smaller number of sources. After exchange with the ALMA-IMF team, both teams are convinced that the two approaches are highly complementary and, since the ultimate study (large maps of a large number of sources) would require unrealistic amounts of time, both approaches are needed to understand the process of high-mass star formation. In case of success of our large proposal, we intend to stay in close scientific contact with the ALMA-IMF team to advance the field in a fruitful exchange of methods and results.

### *2.1 Target selection*

1062 targets were selected from the catalog of dense clumps ([35], Merello et al. in prep.) based on the Hi-GAL 70-500$\mu$m photometry [24] complemented with ancillary data at $\lambda \leq 24\mu$m and $\lambda \geq 870\mu$m, for distances $< 7$ kpc and masses $> 500\ M_\odot$, including the tip of the Bar (but excluding the CMZ). **The sample is complete for the selection criteria; its size for this proposal is justified by the need to have statistical significance for subsamples** defined e.g. by source mass, evolutionary status, galactocentric distance etc. This selection includes 180 well-studied mid-IR bright MYSOs from the RMS survey [47], representing the stage just prior to the UCHII region phase. Cross-comparison with CO surveys of the Galactic Plane allowed distance estimates following [28] and hence determination of clump masses ($M$) and bolometric luminosities ($L$). More details can be found on our website[1]. Both the $L/M$ and the shape of the SED for $\lambda \leq 70\mu$m can be used as a broad evolutionary classification of the clumps following [22]. Fig. 1b shows the $L - M$ plot for the 1062 target clumps. The plus-symbols in Fig. 1b mark the location of the Hi-GAL clumps with HII counterparts ([27,7]) in the CORNISH survey and occupy the region above L/M=10, showing that our sample of 1062 targets spans the entire path from IRDC-hosted clump to the HII region phase. Clumps surface densities are above the $\Sigma \geq 0.1$ g cm$^{-2}$ threshold that is critical for high-mass star formation [18,15] (see the website[1] for more information on sources).

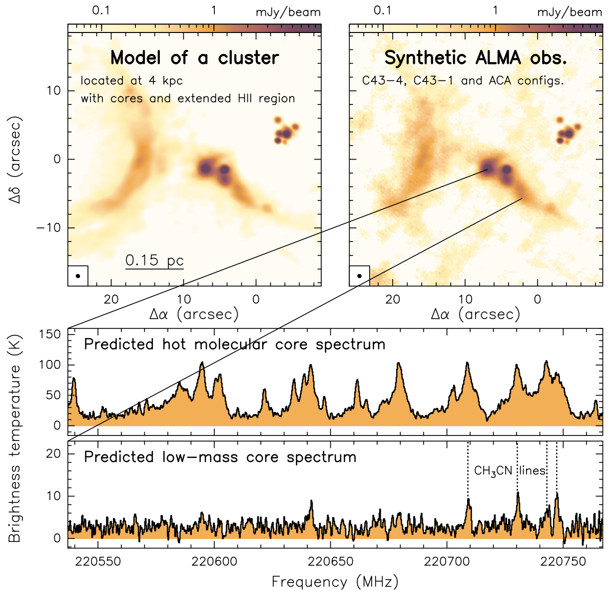

Figure 2: *Up-left: Model of a star-forming region based on ALMA data of G29.96 plus extended emission. Up-right: same data run through the ALMA simulator for our setup and integration time. The well-recovered sources structure is a fair representation of what our setup will provide. Bottom: simulated spectra of two cores. Even on the weaker core the lines can be detected and analyzed.*

### *2.2 Observing setup*

The 217-220GHz frequency range gives access to $^{13}$CO and C$^{18}$O (for column density and velocity structure), SiO (outflows), three H$_2$CO lines (temperature/density and infall tracer), CH$_3$CN (temperature, velocity structure), and several other species (DCN, OCS, ...). All targets will be observed in single-pointing using configurations C43-4, C43-1 and the ACA that, in band 6, provide a resolution of 0″.4 (corresponding to about 2500 AU at a distance of 7 kpc) and a largest recoverable scale of about 30″. The required 0.1 mJy continuum sensitivity is reached in 3.6 min in C43-4 and 2 min in C43-1. Fig. 2 shows that the noise level allows a profile analysis even for our short integration and weaker sources. Our setup optimizes the scientific return in both continuum and lines.

# 3 Scheduling feasibility

The LST range of our sources is fully compatible with accessible ranges in best observing conditions for both C43-1 and C43-4. The RA distribution of our sources has a peak around 16-17 h. The

ALMA Helpdesk (ticket # 12729) confirmed that sources can be observed in an hour angle range of ±3 hours, so that our 16-17 h RA sources peak can be effectively spread over a wider LST range. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no scheduling criticality for both requested configurations. See our website[1] for more details.

# 4 Data products

It is our goal to provide Data Products (DP) to the community that do justice to the enormous legacy value of the project. DPs, consisting of a Compact Source Catalog plus fully reduced and calibrated (combined over all configurations) continuum maps and spectral cubes for all lines detected, will be accompanied by appropriate quality explanatory notes also describing the product generation flow. For line analysis, we want to use the ESO-supported ALMA extension software XCLASS [2] (PI Schilke) developed by us, which will provide line identification and a first LTE excitation analysis. Data reduction (array combination and analysis) on such a large data set has not been done before for ALMA data. The methods and scripts developed within the project will be released with the data products through the ARC nodes. Computing and storage resources are estimated ∼30–40 TB including raw data, intermediate and final products, and can easily be managed with existing resources in Data Processing Nodes (DPNs, see Fig. 3). DPs will be made available for science exploitation to the Community within a year after final data delivery, via the VO-compatible VIALACTEA knowledge-base that will be released in May 2018 (`http://vialactea.iaps.inaf.it`, PI Molinari) and that will provide access to all the major continuum and spectroscopic Galactic Plane surveys from the near-IR to the radio, with 3D visualization capabilities, multi-layer overlays with catalogs of compact and extended structures and SED model fitting.

# 5 Management plan

### *5.1 Consortium Structure*

The end-to-end implementation of this project will go in uncharted territory for ALMA. The ALMAGAL Team (Fig. 3) is engineered ensuring that (i) critical work packages (WPs) will be identified and properly staffed, (ii) the interfaces among WPs will be efficiently designed, and (iii) flexibility and redundancy will be built in the system to avoid single-point failures.

*The Steering Group (SG)* consists of the Co-PIs, has bi-weekly videocons and (i) defines and monitors project schedule, deliverables and milestones, and (ii) identifies critical areas implementing appropriate recovery measures. An Extended SG (ESG) augmented with Science Working Group (SWG) and DPNs leads, (iii) designs a Science Exploitation Plan with a backbone set of top-level papers and an Early Science Plan and the procedures by which SWG members can propose science projects, (iv) coordinates follow-up studies with ALMA and other facilities, (v) defines the structure and contents of the ALMAGAL DPs, (vi) promotes initiatives to create a lively and productive Team working environment and solve controversies, and (vii) provides the liaison with ALMA-IMF and other relevant projects.

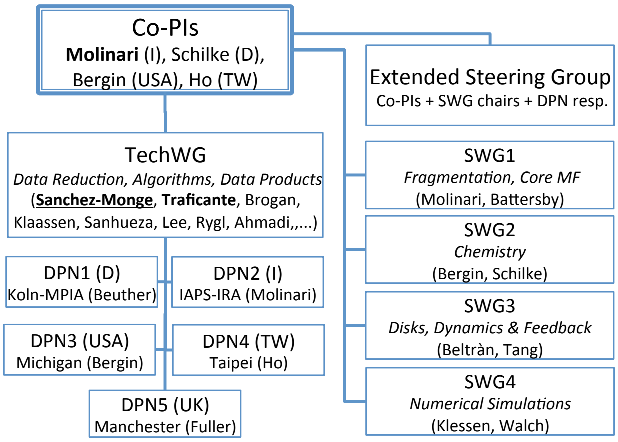

Figure 3: ALMAGAL OrgChart.

*The Technical Working Group (TWG)* is responsible for the detail design, implementation and maintenance of the ALMAGAL data reduction pipeline, as well as of the generation of the ALMAGAL DPs. The TWG Lead reports bi-weekly to the SG.

*The Science Working Groups (SWG)* implement the Science Exploitation Plan and collect inputs from ALMAGAL members for its continuous update and maintenance. All Co-Is will be members

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[2] https://xclass.astro.uni-koeln.de/

of at least one SWG. Besides world-class expertise in interferometric techniques, including scientist from ARC nodes, the proposing team has consolidated and proven capabilities in organizing and managing large photometric and spectroscopic survey projects from ground and space, and in delivering top-notch science and data products as well as automatic data analysis tools (Molinari Hi-GAL, Bergin HEXOS, Beuther THOR/CORE, Schilke XCLASS). Astrochemists and theorists in the team will provide customised numerical simulations to interpret the data in the framework of modern star formation theories. We plan yearly Consortium meetings. Gender balance and responsibility assignments to young researchers will be our guiding principles throughout the project. We currently have a 50/50 gender balance in the SWG Leads, and around 50% non-staff in SWG & TechWG leads.

### *5.2 Science Management*

The SWG Leads will make sure that all inputs and contributions from SWGs members are properly acquired, discussed and coordinated. While the science activity will be driven by SWG members, the SG(+ExtSG) will ensure that every group/individual is fairly treated in terms of work precedence and paper authorship, commensurate to the amount of effort devoted into the project; groups and regional balance will also be taken into account. Should conflicts arise, they will be brought to the SWGs Leads and eventually to the ExtSG that will take all necessary initiatives to come to a definitive, fair and binding decision. The ALMAGAL results will be disseminated via journal articles, conference talks and public outreach. We also envision a workshop on the results for the Community.

### *5.3 Data Processing Plan*

The ALMAGAL Pipeline (**AGP**) includes CASA data reduction and the product generation activities and will be distributed in five DPNs (fig. 3) with appropriate computing and storage resources. Each DPN will be equipped with an identical complement of scripts and SW tools maintained under configuration control in a central repository, providing a distributed infrastructure with high throughput and adequate redundancy. The AGP flow consists of (i) distribution of calibrated visibilities among the DPN and generation of quick-look CLEANed maps; (ii) creation of enhanced continuum and line images, using self-cal etc. of each configuration as the data come in, (iii) generation of early DPs (compact source catalogs, line lists) for rapid science exploitation, (iv) generation of final images, source catalogs, line lists, by combining all configurations, for public release.

## 6 References

[**1**] Beltrán+ 2016, ARA&A 24, 6; [**2**] Beuther+ 2007, PP V, 165; [**3**] Beuther+ 2015, A&A 581, 119; [**4**] Bolatto+ 2013, Nature 499, 450; [**5**] Bonnell+ 2006, MNRAS 370, 488; [**6**] Brogan+ 2016, ApJ 832, 187; [**7**] Cesaroni+ 2015, A&A 579, 71; [**8**] Cesaroni+ 2017, A&A 602, 59; [**9**] Csengeri+ 2017, A&A 600, 10; [**10**] Commerçon+, ApJ 742, L9; [**11**] Hennebelle 2018, A&A 611, 24; [**12**] Ginsburg+ 2016, A&A 586, 50; [**13**] Glenn+ 2010, MNRAS 409, 109 [**14**] He+ 2015, MNRAS 450, 1926; [**15**] Kauffmann+ 2010, ApJ 723, L7; [**16**] Klaassen+ 2012, A&A 538, 140; [**17**] Könyves+ 2010, A&A 518, 106; [**18**] Krumholz+ 2014, PP VI, 243; [**19**] Krumholz+ 2009, Science 323, 754; [**20**] Lada+ 2003, ARA&A 41, 57; [**21**] McKee+ 2003, ApJ 585, 850; [**22**] Molinari+ 2008, A&A 481, 345; [**23**] Molinari+ 2010, A&A 518, L100; [**24**] Molinari+ 2016, A&A 591, 149; [**25**] Molinari+ 2016, ApJL 826, 8; [**26**] Peretto+ 2013, A&A 555, 112; [**27**] Purcell+ 2013, ApJS 205, 1; [**28**] Russeil+ 2011, A&A 526, 151; [**29**] Rygl+ 2013, A&A 549, 5; [**30**] Schilke 2016, 6th Zermatt Symp., arXiv:1604.01156; [**31**] Tan+ 2014, PP VI, 149; [**32**] Wu+ 2003, ApJ 592, 79; [**33**] Zhang+ 2015, ApJ 804, 141; [**34**] Zinnecker+ 2007, ARA&A 45, 481; [**35**] Elia+ 2017, MNRAS 471, 100; [**36**] Magnum+ 1993, ApJS 89, 12; [**37**] Bonnell+ 2007, PP V, 149; [**38**] Smith+ 2009, MNRAS 396, 830; [**39**] Adams 2010, ARA&A 48, 47; [**40**] Cyganowski+ 2014, ApJ 796, L2; [**41**] Motte+ 2018, Nature Astr., arXiv:1804.02392; [**42**] Beuther+ 2017, MmSAI 88, 584; [**43**] Beuther+ 2013, A&A 553, 115; [**44**] Jijina+ 1996, ApJ 462, 864; [**45**] Yorke+ 2002, ApJ 569, 846; [**46**] Gong+ 2009, ApJ 699, 230; [**47**] Lumsden+ 2013, ApJS 208, 11; [**48**] Lee+ 2016, A&A 591, 30;

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SG : 1 of 6 High-mass stars 0 cluster 1 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.537 km/s, 3.7 GHz | 217.925000 GHz | 95.667 µJy, 15.4 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 4.7 h | 2.0 h | 1.2 h | 8.9 " | 44 | offset | 26.7 " | 181.1 s | 557.3 GB | 40.1 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 8.3 h | 8.3 h | 0.0 h | 15.3 " | 44 | offset | 45.8 " | 422.7 s | 21.8 GB | 0.9 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.3 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2554.9 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.7 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

44 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-62789 | 18:16:33, -16:51:21 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-79018 | 18:23:33, -13:49:54 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-68558 | 18:18:49, -15:49:06 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-66261 | 18:17:51, -16:13:47 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-78953 | 18:23:22, -13:49:34 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-75065 | 18:21:36, -14:24:35 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-G015.1288-00.6... | 18:20:34, -16:06:28 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-G010.3208-00.1... | 18:09:01, -20:05:08 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-65288 | 18:17:52, -16:27:50 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-G013.6562-00.... | 18:17:24, -17:22:14 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-G014.6087+00.... | 18:17:02, -16:14:28 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-66149 | 18:18:03, -16:17:09 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-73047 | 18:22:23, -14:59:28 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-G012.7879-00.... | 18:14:06, -17:56:06 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-63723 | 18:16:58, -16:42:14 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-70080 | 18:20:23, -15:37:44 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-62842 | 18:16:24, -16:49:52 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-73276 | 18:21:17, -14:48:00 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-67795 | 18:17:39, -15:49:03 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-G013.3310-00.... | 18:14:41, -17:23:27 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-64410 | 18:17:16, -16:34:33 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-65985 | 18:17:10, -16:12:39 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-G012.8909+00.... | 18:11:51, -17:31:30 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-71424 | 18:19:32, -15:05:34 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-65249 | 18:17:22, -16:24:57 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-66010 | 18:17:12, -16:12:36 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-63364 | 18:18:13, -16:57:22 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-64993 | 18:17:08, -16:26:13 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-G012.9090-00.... | 18:14:39, -17:52:02 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-67905 | 18:18:27, -15:53:45 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-65040 | 18:17:40, -16:29:57 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-G016.9270+00.... | 18:18:08, -13:45:07 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-G017.6380+00.... | 18:22:26, -13:30:12 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-68643 | 18:19:51, -15:56:10 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-74335 | 18:21:15, -14:33:02 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-75426 | 18:22:41, -14:27:40 | 1.00 km/s,lsrk,RADIO |
| 37 | 37-78999 | 18:23:27, -13:49:30 | 1.00 km/s,lsrk,RADIO |
| 38 | 38-72942 | 18:22:19, -15:00:17 | 1.00 km/s,lsrk,RADIO |
| 39 | 39-65799 | 18:18:18, -16:23:17 | 1.00 km/s,lsrk,RADIO |
| 40 | 40-G010.8856+00.... | 18:09:07, -19:27:24 | 1.00 km/s,lsrk,RADIO |
| 41 | 41-63437 | 18:18:03, -16:54:52 | 1.00 km/s,lsrk,RADIO |
| 42 | 42-69408 | 18:19:02, -15:39:36 | 1.00 km/s,lsrk,RADIO |
| 43 | 43-G014.9958-00.... | 18:20:19, -16:13:29 | 1.00 km/s,lsrk,RADIO |
| 44 | 44-73706 | 18:22:05, -14:48:46 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.9 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.5 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 95.73 µJy, 15.4 mK | 95.73 uJy - 96.11 uJy |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 2 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.494 km/s, 3.7 GHz | 217.925000 GHz | 97.088 µJy, 15.6 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 8.3 h | 3.6 h | 2.1 h | 8.9 " | 78 | offset | 26.7 " | 180.9 s | 956.8 GB | 39.5 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 14.7 h | 14.7 h | 0.0 h | 15.3 " | 78 | offset | 45.8 " | 422.0 s | 37.5 GB | 0.9 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.2 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2554.9 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.7 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

78 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-G027.7954-00.2... | 18:43:02, -04:41:48 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-G018.3706-00.3... | 18:25:48, -13:06:29 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-85482 | 18:25:23, -12:24:11 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-G019.9386-00.2... | 18:28:10, -11:38:21 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-98539 | 18:31:44, -09:22:12 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-89119 | 18:28:46, -11:51:54 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-81635 | 18:25:00, -13:15:35 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-123353 | 18:41:20, -04:44:33 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-82665 | 18:25:22, -13:04:24 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-123154 | 18:41:16, -04:47:21 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-88380 | 18:27:42, -11:57:03 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-82445 | 18:25:41, -13:10:16 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-85234 | 18:27:42, -12:44:51 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-84809 | 18:27:02, -12:44:37 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-123725 | 18:41:26, -04:39:01 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-121120 | 18:39:38, -05:07:17 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-124569 | 18:42:17, -04:28:53 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-91185 | 18:28:52, -11:09:59 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-94993 | 18:32:10, -10:28:41 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-97293 | 18:30:34, -09:34:46 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-82207 | 18:25:06, -13:08:52 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-99130 | 18:35:34, -09:43:01 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-96209 | 18:30:17, -09:51:32 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-96689 | 18:30:20, -09:43:42 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-98623 | 18:30:39, -09:12:45 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-97468 | 18:34:28, -10:01:57 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-119700 | 18:39:55, -05:34:59 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-85129 | 18:27:07, -12:41:35 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-84612 | 18:26:15, -12:41:34 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-97359 | 18:33:24, -09:55:36 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-G019.8922+00.... | 18:26:57, -11:32:09 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-89653 | 18:27:50, -11:33:53 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-119837 | 18:39:53, -05:32:25 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-85968 | 18:27:45, -12:36:06 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-92392 | 18:30:11, -11:00:57 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-122385 | 18:40:27, -04:52:08 | 1.00 km/s,lsrk,RADIO |
| 37 | 37-120324 | 18:39:23, -05:19:46 | 1.00 km/s,lsrk,RADIO |
| 38 | 38-122361 | 18:42:24, -05:07:24 | 1.00 km/s,lsrk,RADIO |
| 39 | 39-123371 | 18:41:19, -04:44:16 | 1.00 km/s,lsrk,RADIO |
| 40 | 40-89485 | 18:28:07, -11:39:41 | 1.00 km/s,lsrk,RADIO |
| 41 | 41-82529 | 18:26:58, -13:18:58 | 1.00 km/s,lsrk,RADIO |
| 42 | 42-124839 | 18:42:06, -04:22:20 | 1.00 km/s,lsrk,RADIO |
| 43 | 43-100244 | 18:33:49, -09:13:05 | 1.00 km/s,lsrk,RADIO |
| 44 | 44-120828 | 18:40:46, -05:20:58 | 1.00 km/s,lsrk,RADIO |
| 45 | 45-83968 | 18:25:10, -12:42:23 | 1.00 km/s,lsrk,RADIO |
| 46 | 46-99410 | 18:32:24, -09:14:30 | 1.00 km/s,lsrk,RADIO |
| 47 | 47-86859 | 18:26:34, -12:14:49 | 1.00 km/s,lsrk,RADIO |
| 48 | 48-91656 | 18:29:05, -11:03:25 | 1.00 km/s,lsrk,RADIO |
| 49 | 49-92527 | 18:29:16, -10:52:10 | 1.00 km/s,lsrk,RADIO |
| 50 | 50-81249 | 18:24:57, -13:20:28 | 1.00 km/s,lsrk,RADIO |
| 51 | 51-99811 | 18:34:09, -09:22:11 | 1.00 km/s,lsrk,RADIO |
| 52 | 52-92304 | 18:29:59, -11:00:23 | 1.00 km/s,lsrk,RADIO |
| 53 | 53-124103 | 18:41:48, -04:34:52 | 1.00 km/s,lsrk,RADIO |
| 54 | 54-84929 | 18:27:44, -12:48:41 | 1.00 km/s,lsrk,RADIO |
| 55 | 55-119364 | 18:40:57, -05:48:11 | 1.00 km/s,lsrk,RADIO |
| 56 | 56-84174 | 18:26:24, -12:49:06 | 1.00 km/s,lsrk,RADIO |
| 57 | 57-99085 | 18:30:56, -09:08:09 | 1.00 km/s,lsrk,RADIO |
| 58 | 58-87685 | 18:25:54, -11:54:44 | 1.00 km/s,lsrk,RADIO |
| 59 | 59-100662 | 18:34:31, -09:13:55 | 1.00 km/s,lsrk,RADIO |
| 60 | 60-99331 | 18:32:59, -09:19:58 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

| | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 12.08 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.3 | | | | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 96.1 µJy, 15.5 mK | 96.10 uJy - 96.48 uJy |

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 61 | 61-89442 | 18:28:55, -11:46:55 | 1.00 km/s,lsrk,RADIO |
| 62 | 62-86213 | 18:26:48, -12:26:23 | 1.00 km/s,lsrk,RADIO |
| 63 | 63-98101 | 18:31:40, -09:28:48 | 1.00 km/s,lsrk,RADIO |
| 64 | 64-119012 | 18:38:40, -05:35:03 | 1.00 km/s,lsrk,RADIO |
| 65 | 65-G019.9224-00.... | 18:28:18, -11:40:36 | 1.00 km/s,lsrk,RADIO |
| 66 | 66-124803 | 18:42:38, -04:27:11 | 1.00 km/s,lsrk,RADIO |
| 67 | 67-120736 | 18:39:49, -05:15:25 | 1.00 km/s,lsrk,RADIO |
| 68 | 68-121327 | 18:42:45, -05:27:31 | 1.00 km/s,lsrk,RADIO |
| 69 | 69-120995 | 18:41:39, -05:24:56 | 1.00 km/s,lsrk,RADIO |
| 70 | 70-124513 | 18:41:25, -04:23:34 | 1.00 km/s,lsrk,RADIO |
| 71 | 71-123751 | 18:41:18, -04:37:29 | 1.00 km/s,lsrk,RADIO |
| 72 | 72-88182 | 18:27:04, -11:54:44 | 1.00 km/s,lsrk,RADIO |
| 73 | 73-119213 | 18:39:37, -05:39:37 | 1.00 km/s,lsrk,RADIO |
| 74 | 74-89378 | 18:29:14, -11:50:24 | 1.00 km/s,lsrk,RADIO |
| 75 | 75-99822 | 18:34:33, -09:25:05 | 1.00 km/s,lsrk,RADIO |
| 76 | 76-124229 | 18:41:31, -04:29:57 | 1.00 km/s,lsrk,RADIO |
| 77 | 77-124177 | 18:41:49, -04:33:17 | 1.00 km/s,lsrk,RADIO |
| 78 | 78-118969 | 18:38:30, -05:34:34 | 1.00 km/s,lsrk,RADIO |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6  High-mass stars 0 cluster 3  Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.713 km/s, 3.7 GHz | 217.925000 GHz | 98.579 µJy, 15.9 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 14.4 h | 6.3 h | 3.6 h | 8.9 " | 129 | offset | 26.7 " | 180.4 s | 1625.4 GB | 39.1 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 25.5 h | 25.5 h | 0.0 h | 15.3 " | 129 | offset | 45.8 " | 421.3 s | 63.7 GB | 0.9 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.4 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.0 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.7 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

129 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-829328 | 16:36:28, -47:41:46 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-834066 | 16:38:08, -46:47:45 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-824994 | 16:27:52, -47:17:59 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-847926 | 16:51:18, -45:11:31 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-844608 | 16:47:03, -45:21:22 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-816070 | 16:24:16, -49:37:16 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-849833 | 16:51:58, -44:45:14 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-842092 | 16:46:36, -45:56:07 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-848944 | 16:54:11, -45:18:11 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-817925 | 16:23:44, -48:53:44 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-826927 | 16:34:12, -47:53:07 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-844742 | 16:49:08, -45:37:59 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-840049 | 16:40:45, -45:38:28 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-815466 | 16:23:17, -49:41:08 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-821687 | 16:30:58, -48:43:52 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-832986 | 16:37:21, -46:56:01 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-839678 | 16:40:13, -45:38:29 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-833177 | 16:38:52, -47:07:18 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-822181 | 16:33:43, -49:00:43 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-820769 | 16:28:10, -48:34:32 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-833781 | 16:40:52, -47:16:52 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-840570 | 16:44:19, -46:02:31 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-821659 | 16:30:35, -48:40:47 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-851044 | 16:52:37, -44:28:09 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-850946 | 16:52:23, -44:27:55 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-843968 | 16:43:38, -44:57:41 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-850088 | 16:52:11, -44:42:08 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-842823 | 16:45:05, -45:30:14 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-833734 | 16:39:57, -47:09:28 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-829066 | 16:35:14, -47:34:30 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-830599 | 16:36:30, -47:23:37 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-849780 | 16:49:36, -44:24:59 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-849495 | 16:51:47, -44:48:48 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-G337.0963-00.... | 16:39:57, -48:02:48 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-G341.2182-00.... | 16:52:17, -44:26:53 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-837491 | 16:41:15, -46:24:43 | 1.00 km/s,lsrk,RADIO |
| 37 | 37-836078 | 16:42:12, -46:54:43 | 1.00 km/s,lsrk,RADIO |
| 38 | 38-848491 | 16:48:29, -44:36:09 | 1.00 km/s,lsrk,RADIO |
| 39 | 39-829764 | 16:36:00, -47:30:56 | 1.00 km/s,lsrk,RADIO |
| 40 | 40-G339.6816-01.... | 16:51:05, -46:15:52 | 1.00 km/s,lsrk,RADIO |
| 41 | 41-839769 | 16:45:09, -46:22:19 | 1.00 km/s,lsrk,RADIO |
| 42 | 42-850981 | 16:52:32, -44:28:38 | 1.00 km/s,lsrk,RADIO |
| 43 | 43-817911 | 16:23:49, -48:54:49 | 1.00 km/s,lsrk,RADIO |
| 44 | 44-835278 | 16:39:43, -46:45:22 | 1.00 km/s,lsrk,RADIO |
| 45 | 45-846728 | 16:48:53, -45:10:20 | 1.00 km/s,lsrk,RADIO |
| 46 | 46-826894 | 16:34:05, -47:52:20 | 1.00 km/s,lsrk,RADIO |
| 47 | 47-818034 | 16:26:25, -49:17:25 | 1.00 km/s,lsrk,RADIO |
| 48 | 48-839003 | 16:40:21, -45:51:07 | 1.00 km/s,lsrk,RADIO |
| 49 | 49-830681 | 16:36:24, -47:21:15 | 1.00 km/s,lsrk,RADIO |
| 50 | 50-824798 | 16:33:01, -48:10:24 | 1.00 km/s,lsrk,RADIO |
| 51 | 51-848271 | 16:48:19, -44:38:35 | 1.00 km/s,lsrk,RADIO |
| 52 | 52-828645 | 16:35:09, -47:39:06 | 1.00 km/s,lsrk,RADIO |
| 53 | 53-828821 | 16:35:06, -47:36:28 | 1.00 km/s,lsrk,RADIO |
| 54 | 54-839428 | 16:40:23, -45:43:43 | 1.00 km/s,lsrk,RADIO |
| 55 | 55-840516 | 16:41:54, -45:41:15 | 1.00 km/s,lsrk,RADIO |
| 56 | 56-828032 | 16:35:27, -47:49:32 | 1.00 km/s,lsrk,RADIO |
| 57 | 57-G334.7302+00.... | 16:26:04, -49:08:41 | 1.00 km/s,lsrk,RADIO |
| 58 | 58-837611 | 16:41:06, -46:21:33 | 1.00 km/s,lsrk,RADIO |
| 59 | 59-824611 | 16:30:35, -47:50:32 | 1.00 km/s,lsrk,RADIO |
| 60 | 60-G337.1555-00.... | 16:37:49, -47:38:50 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 12.26 mJy, 2 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.1 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 99.01 µJy, 15.9 mK | 99.01 uJy - 99.42 uJy |

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 61 | 61-847376 | 16:50:05, -45:10:54 | 1.00 km/s,lsrk,RADIO |
| 62 | 62-831013 | 16:36:04, -47:12:43 | 1.00 km/s,lsrk,RADIO |
| 63 | 63-841437 | 16:43:43, -45:42:08 | 1.00 km/s,lsrk,RADIO |
| 64 | 64-820233 | 16:29:37, -48:59:01 | 1.00 km/s,lsrk,RADIO |
| 65 | 65-834297 | 16:39:22, -46:55:21 | 1.00 km/s,lsrk,RADIO |
| 66 | 66-835833 | 16:39:30, -46:34:13 | 1.00 km/s,lsrk,RADIO |
| 67 | 67-G338.9196+00.... | 16:40:34, -45:42:07 | 1.00 km/s,lsrk,RADIO |
| 68 | 68-816655 | 16:25:23, -49:35:00 | 1.00 km/s,lsrk,RADIO |
| 69 | 69-G340.7455-01.... | 16:54:04, -45:18:50 | 1.00 km/s,lsrk,RADIO |
| 70 | 70-816113 | 16:22:57, -49:23:51 | 1.00 km/s,lsrk,RADIO |
| 71 | 71-G337.4050-00.... | 16:38:50, -47:28:18 | 1.00 km/s,lsrk,RADIO |
| 72 | 72-839411 | 16:45:35, -46:31:06 | 1.00 km/s,lsrk,RADIO |
| 73 | 73-832138 | 16:37:40, -47:11:02 | 1.00 km/s,lsrk,RADIO |
| 74 | 74-815787 | 16:21:36, -49:18:01 | 1.00 km/s,lsrk,RADIO |
| 75 | 75-829483 | 16:35:34, -47:31:10 | 1.00 km/s,lsrk,RADIO |
| 76 | 76-826783 | 16:33:52, -47:51:37 | 1.00 km/s,lsrk,RADIO |
| 77 | 77-847247 | 16:50:01, -45:12:36 | 1.00 km/s,lsrk,RADIO |
| 78 | 78-827709 | 16:34:11, -47:42:07 | 1.00 km/s,lsrk,RADIO |
| 79 | 79-839208 | 16:44:03, -46:20:50 | 1.00 km/s,lsrk,RADIO |
| 80 | 80-842248 | 16:44:38, -45:35:49 | 1.00 km/s,lsrk,RADIO |
| 81 | 81-818686 | 16:27:26, -49:12:24 | 1.00 km/s,lsrk,RADIO |
| 82 | 82-844304 | 16:49:03, -45:42:27 | 1.00 km/s,lsrk,RADIO |
| 83 | 83-827218 | 16:33:01, -47:38:02 | 1.00 km/s,lsrk,RADIO |
| 84 | 84-837688 | 16:40:54, -46:18:25 | 1.00 km/s,lsrk,RADIO |
| 85 | 85-835723 | 16:39:26, -46:35:29 | 1.00 km/s,lsrk,RADIO |
| 86 | 86-G337.3071-00.... | 16:37:22, -47:22:05 | 1.00 km/s,lsrk,RADIO |
| 87 | 87-837452 | 16:42:15, -46:34:19 | 1.00 km/s,lsrk,RADIO |
| 88 | 88-845638 | 16:51:03, -45:43:22 | 1.00 km/s,lsrk,RADIO |
| 89 | 89-836457 | 16:38:09, -46:11:03 | 1.00 km/s,lsrk,RADIO |
| 90 | 90-819043 | 16:28:18, -49:12:57 | 1.00 km/s,lsrk,RADIO |
| 91 | 91-G339.6221-00.... | 16:46:05, -45:36:43 | 1.00 km/s,lsrk,RADIO |
| 92 | 92-817991 | 16:26:12, -49:16:09 | 1.00 km/s,lsrk,RADIO |
| 93 | 93-848368 | 16:52:06, -45:10:20 | 1.00 km/s,lsrk,RADIO |
| 94 | 94-818250 | 16:28:57, -49:36:28 | 1.00 km/s,lsrk,RADIO |
| 95 | 95-819803 | 16:29:50, -49:10:46 | 1.00 km/s,lsrk,RADIO |
| 96 | 96-837990 | 16:41:07, -46:15:29 | 1.00 km/s,lsrk,RADIO |
| 97 | 97-846909 | 16:49:43, -45:15:18 | 1.00 km/s,lsrk,RADIO |
| 98 | 98-836407 | 16:40:48, -46:36:32 | 1.00 km/s,lsrk,RADIO |
| 99 | 99-850026 | 16:51:55, -44:40:59 | 1.00 km/s,lsrk,RADIO |
| 100 | 100-G335.0611-00... | 16:29:22, -49:12:27 | 1.00 km/s,lsrk,RADIO |
| 101 | 101-832330 | 16:42:20, -47:50:40 | 1.00 km/s,lsrk,RADIO |
| 102 | 102-838005 | 16:42:13, -46:25:29 | 1.00 km/s,lsrk,RADIO |
| 103 | 103-824909 | 16:33:02, -48:08:36 | 1.00 km/s,lsrk,RADIO |
| 104 | 104-832316 | 16:36:35, -46:58:55 | 1.00 km/s,lsrk,RADIO |
| 105 | 105-843161 | 16:47:36, -45:46:30 | 1.00 km/s,lsrk,RADIO |
| 106 | 106-838925 | 16:46:48, -46:50:32 | 1.00 km/s,lsrk,RADIO |
| 107 | 107-847549 | 16:51:02, -45:15:38 | 1.00 km/s,lsrk,RADIO |
| 108 | 108-834656 | 16:41:22, -47:08:23 | 1.00 km/s,lsrk,RADIO |
| 109 | 109-839462 | 16:40:14, -45:41:44 | 1.00 km/s,lsrk,RADIO |
| 110 | 110-835584 | 16:38:45, -46:31:33 | 1.00 km/s,lsrk,RADIO |
| 111 | 111-847929 | 16:51:07, -45:09:52 | 1.00 km/s,lsrk,RADIO |
| 112 | 112-837913 | 16:43:20, -46:37:03 | 1.00 km/s,lsrk,RADIO |
| 113 | 113-837441 | 16:41:05, -46:23:50 | 1.00 km/s,lsrk,RADIO |
| 114 | 114-826627 | 16:31:54, -47:34:55 | 1.00 km/s,lsrk,RADIO |
| 115 | 115-830048 | 16:36:05, -47:27:24 | 1.00 km/s,lsrk,RADIO |
| 116 | 116-822214 | 16:29:16, -48:18:54 | 1.00 km/s,lsrk,RADIO |
| 117 | 117-830494 | 16:36:18, -47:23:20 | 1.00 km/s,lsrk,RADIO |
| 118 | 118-817958 | 16:23:41, -48:52:36 | 1.00 km/s,lsrk,RADIO |
| 119 | 119-833276 | 16:36:05, -46:40:21 | 1.00 km/s,lsrk,RADIO |
| 120 | 120-822761 | 16:29:47, -48:15:50 | 1.00 km/s,lsrk,RADIO |
| 121 | 121-835436 | 16:39:58, -46:45:04 | 1.00 km/s,lsrk,RADIO |
| 122 | 122-840609 | 16:42:59, -45:49:44 | 1.00 km/s,lsrk,RADIO |
| 123 | 123-G340.0543-00... | 16:48:13, -45:21:45 | 1.00 km/s,lsrk,RADIO |
| 124 | 124-826023 | 16:33:28, -47:57:58 | 1.00 km/s,lsrk,RADIO |
| 125 | 125-846390 | 16:48:17, -45:09:25 | 1.00 km/s,lsrk,RADIO |
| 126 | 126-840415 | 16:42:49, -45:51:25 | 1.00 km/s,lsrk,RADIO |
| 127 | 127-846634 | 16:49:00, -45:12:33 | 1.00 km/s,lsrk,RADIO |
| 128 | 128-815302 | 16:21:57, -49:31:26 | 1.00 km/s,lsrk,RADIO |
| 129 | 129-850568 | 16:52:33, -44:36:10 | 1.00 km/s,lsrk,RADIO |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 4 Band 6

## Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.679 km/s, 3.7 GHz | 217.925000 GHz | 94.234 µJy, 15.2 mK | 3.750 GHz | XX,YY | No |

## Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 6.6 h | 2.8 h | 1.7 h | 8.9 " | 59 | offset | 26.7 " | 193.1 s | 781.7 GB | 40.1 MB/s |

## Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 11.7 h | 11.7 h | 0.0 h | 15.3 " | 59 | offset | 45.8 " | 452.7 s | 30.6 GB | 0.9 MB/s |

## Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.3 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.0 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.7 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

## 59 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-859732 | 17:01:18, -42:49:37 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-859149 | 17:00:31, -42:53:54 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-G342.7057+00.1... | 16:56:02, -43:04:51 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-881240 | 17:20:03, -38:58:29 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-867071 | 17:01:01, -40:27:50 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-859271 | 17:00:18, -42:49:18 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-861762 | 17:03:57, -42:29:27 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-874341 | 17:09:54, -39:32:17 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-860232 | 17:00:30, -42:33:02 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-877212 | 17:14:31, -39:14:04 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-854214 | 16:52:32, -43:23:45 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-874429 | 17:09:46, -39:29:04 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-875896 | 17:11:31, -39:13:35 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-880472 | 17:14:45, -38:22:52 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-869399 | 17:06:59, -40:44:07 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-866806 | 17:03:23, -40:52:17 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-880433 | 17:19:10, -39:00:24 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-865468 | 17:05:11, -41:29:05 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-866406 | 17:04:48, -41:10:19 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-885108 | 17:17:32, -37:39:31 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-852832 | 16:52:42, -43:53:17 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-852473 | 16:51:46, -43:52:07 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-885094 | 17:17:39, -37:40:37 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-856381 | 16:55:12, -43:11:17 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-G345.5043+00.... | 17:04:22, -40:44:23 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-859739 | 16:59:20, -42:32:36 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-878610 | 17:12:33, -38:30:48 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-G349.6433-01.... | 17:23:01, -38:13:51 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-870595 | 17:07:00, -40:21:47 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-854306 | 16:52:38, -43:23:08 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-884356 | 17:17:08, -37:50:39 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-857352 | 16:57:06, -43:05:19 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-854680 | 16:54:02, -43:29:11 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-863312 | 17:02:09, -41:46:44 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-879199 | 17:12:43, -38:23:24 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-851424 | 16:50:53, -44:07:02 | 1.00 km/s,lsrk,RADIO |
| 37 | 37-884149 | 17:16:34, -37:50:01 | 1.00 km/s,lsrk,RADIO |
| 38 | 38-869652 | 17:07:08, -40:40:21 | 1.00 km/s,lsrk,RADIO |
| 39 | 39-G343.5213-00.... | 17:01:34, -42:50:19 | 1.00 km/s,lsrk,RADIO |
| 40 | 40-851446 | 16:51:32, -44:12:25 | 1.00 km/s,lsrk,RADIO |
| 41 | 41-883676 | 17:20:14, -38:28:17 | 1.00 km/s,lsrk,RADIO |
| 42 | 42-861674 | 17:03:17, -42:25:49 | 1.00 km/s,lsrk,RADIO |
| 43 | 43-G343.1261-00.... | 16:58:17, -42:52:07 | 1.00 km/s,lsrk,RADIO |
| 44 | 44-G343.9033-00.... | 17:03:30, -42:37:48 | 1.00 km/s,lsrk,RADIO |
| 45 | 45-876288 | 17:11:51, -39:09:28 | 1.00 km/s,lsrk,RADIO |
| 46 | 46-858568 | 16:58:34, -42:49:47 | 1.00 km/s,lsrk,RADIO |
| 47 | 47-881427 | 17:20:07, -38:57:17 | 1.00 km/s,lsrk,RADIO |
| 48 | 48-877566 | 17:15:18, -39:13:25 | 1.00 km/s,lsrk,RADIO |
| 49 | 49-883709 | 17:16:54, -38:00:05 | 1.00 km/s,lsrk,RADIO |
| 50 | 50-860646 | 17:00:49, -42:26:09 | 1.00 km/s,lsrk,RADIO |
| 51 | 51-852558 | 16:53:44, -44:07:32 | 1.00 km/s,lsrk,RADIO |
| 52 | 52-879552 | 17:14:25, -38:32:43 | 1.00 km/s,lsrk,RADIO |
| 53 | 53-882440 | 17:17:00, -38:19:28 | 1.00 km/s,lsrk,RADIO |
| 54 | 54-871384 | 17:07:53, -40:14:39 | 1.00 km/s,lsrk,RADIO |
| 55 | 55-876842 | 17:12:17, -39:02:39 | 1.00 km/s,lsrk,RADIO |
| 56 | 56-882131 | 17:15:10, -38:08:23 | 1.00 km/s,lsrk,RADIO |
| 57 | 57-G348.7342-01.... | 17:20:07, -38:57:14 | 1.00 km/s,lsrk,RADIO |
| 58 | 58-875950 | 17:11:42, -39:14:09 | 1.00 km/s,lsrk,RADIO |
| 59 | 59-860231 | 17:00:05, -42:29:26 | 1.00 km/s,lsrk,RADIO |

## Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.72 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.6 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

## 1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 93.53 µJy, 15.1 mK | 93.53 uJy - 93.91 uJy |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 5 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.837 km/s, 3.7 GHz | 217.925000 GHz | 94.167 µJy, 15.2 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 9.7 h | 4.0 h | 2.5 h | 8.9 " | 75 | offset | 26.7 " | 217.1 s | 1111.2 GB | 39.4 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 17.2 h | 17.2 h | 0.0 h | 15.3 " | 75 | offset | 45.8 " | 482.2 s | 43.5 GB | 0.9 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.4 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.1 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.7 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

75 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-738167 | 14:26:52, -60:38:20 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-728411 | 14:05:45, -61:41:35 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-727996 | 14:04:08, -61:19:57 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-727758 | 14:03:31, -61:15:03 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-720177 | 13:48:44, -62:13:31 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-722749 | 13:56:01, -62:14:18 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-716498 | 13:40:26, -61:47:41 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-737702 | 14:25:00, -60:22:59 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-723654 | 13:58:08, -62:06:11 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-721509 | 13:51:12, -61:32:09 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-726096 | 14:01:38, -61:35:13 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-719654 | 13:46:28, -61:42:52 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-732038 | 14:13:14, -61:16:51 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-730135 | 14:08:47, -61:25:58 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-730127 | 14:08:42, -61:24:45 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-716713 | 13:40:29, -61:35:22 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-G310.0135+00.... | 13:51:37, -61:39:07 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-727263 | 14:02:10, -61:03:21 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-721478 | 13:52:34, -62:15:23 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-737520 | 14:25:17, -60:35:49 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-737999 | 14:25:40, -60:23:18 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-719596 | 13:47:58, -62:34:17 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-737766 | 14:25:36, -60:32:11 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-728432 | 14:04:55, -61:20:07 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-732540 | 14:14:17, -61:12:18 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-730346 | 14:08:42, -61:12:45 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-732713 | 14:14:46, -61:11:36 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-729206 | 14:07:04, -61:28:52 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-721992 | 13:51:58, -61:15:39 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-G309.2203-00.... | 13:46:37, -62:39:27 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-726482 | 14:01:35, -61:22:05 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-G309.9796+00.... | 13:51:02, -61:30:14 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-728716 | 14:06:30, -61:43:56 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-G308.9176+00.... | 13:43:01, -62:08:51 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-727831 | 14:03:38, -61:14:42 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-718926 | 13:46:45, -62:39:03 | 1.00 km/s,lsrk,RADIO |
| 37 | 37-G311.4402+00.... | 14:03:07, -61:15:27 | 1.00 km/s,lsrk,RADIO |
| 38 | 38-733033 | 14:17:24, -61:51:10 | 1.00 km/s,lsrk,RADIO |
| 39 | 39-719557 | 13:47:24, -62:18:11 | 1.00 km/s,lsrk,RADIO |
| 40 | 40-G311.4925+00.... | 14:03:34, -61:15:52 | 1.00 km/s,lsrk,RADIO |
| 41 | 41-731221 | 14:11:23, -61:23:22 | 1.00 km/s,lsrk,RADIO |
| 42 | 42-732373 | 14:14:02, -61:16:10 | 1.00 km/s,lsrk,RADIO |
| 43 | 43-G311.5671+00.... | 14:04:22, -61:19:27 | 1.00 km/s,lsrk,RADIO |
| 44 | 44-721432 | 13:51:26, -61:45:01 | 1.00 km/s,lsrk,RADIO |
| 45 | 45-G314.3197+00.... | 14:26:26, -60:38:31 | 1.00 km/s,lsrk,RADIO |
| 46 | 46-727645 | 14:05:18, -62:02:07 | 1.00 km/s,lsrk,RADIO |
| 47 | 47-730655 | 14:10:34, -61:38:55 | 1.00 km/s,lsrk,RADIO |
| 48 | 48-737671 | 14:24:55, -60:23:01 | 1.00 km/s,lsrk,RADIO |
| 49 | 49-737815 | 14:26:08, -60:40:21 | 1.00 km/s,lsrk,RADIO |
| 50 | 50-728786 | 14:05:34, -61:17:38 | 1.00 km/s,lsrk,RADIO |
| 51 | 51-737588 | 14:25:13, -60:31:39 | 1.00 km/s,lsrk,RADIO |
| 52 | 52-737787 | 14:26:05, -60:40:50 | 1.00 km/s,lsrk,RADIO |
| 53 | 53-G311.5131-00.... | 14:05:45, -62:04:49 | 1.00 km/s,lsrk,RADIO |
| 54 | 54-716353 | 13:39:54, -61:41:15 | 1.00 km/s,lsrk,RADIO |
| 55 | 55-718521 | 13:45:51, -62:33:49 | 1.00 km/s,lsrk,RADIO |
| 56 | 56-721272 | 13:50:42, -61:35:12 | 1.00 km/s,lsrk,RADIO |
| 57 | 57-723759 | 13:58:21, -62:05:39 | 1.00 km/s,lsrk,RADIO |
| 58 | 58-721154 | 13:50:36, -61:40:19 | 1.00 km/s,lsrk,RADIO |
| 59 | 59-721199 | 13:51:01, -61:49:55 | 1.00 km/s,lsrk,RADIO |
| 60 | 60-725400 | 14:00:05, -61:23:31 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.71 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.6 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 94.51 µJy, 15.2 mK | 94.51 uJy - 94.94 uJy |

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 61 | 61-719342 | 13:47:58, -62:48:35 | 1.00 km/s,lsrk,RADIO |
| 62 | 62-716820 | 13:40:57, -61:45:44 | 1.00 km/s,lsrk,RADIO |
| 63 | 63-718270 | 13:44:38, -62:05:34 | 1.00 km/s,lsrk,RADIO |
| 64 | 64-724889 | 13:58:34, -61:05:43 | 1.00 km/s,lsrk,RADIO |
| 65 | 65-728443 | 14:04:59, -61:21:28 | 1.00 km/s,lsrk,RADIO |
| 66 | 66-730452 | 14:09:46, -61:32:51 | 1.00 km/s,lsrk,RADIO |
| 67 | 67-721229 | 13:50:54, -61:44:23 | 1.00 km/s,lsrk,RADIO |
| 68 | 68-732775 | 14:15:07, -61:16:02 | 1.00 km/s,lsrk,RADIO |
| 69 | 69-722061 | 13:52:12, -61:18:43 | 1.00 km/s,lsrk,RADIO |
| 70 | 70-737579 | 14:25:15, -60:32:46 | 1.00 km/s,lsrk,RADIO |
| 71 | 71-731606 | 14:12:32, -61:24:55 | 1.00 km/s,lsrk,RADIO |
| 72 | 72-721517 | 13:52:41, -62:15:26 | 1.00 km/s,lsrk,RADIO |
| 73 | 73-715349 | 13:38:23, -62:26:18 | 1.00 km/s,lsrk,RADIO |
| 74 | 74-720116 | 13:49:50, -62:51:34 | 1.00 km/s,lsrk,RADIO |
| 75 | 75-718642 | 13:45:58, -62:32:10 | 1.00 km/s,lsrk,RADIO |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 6 Band 6

## Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.82 km/s, 3.7 GHz | 217.925000 GHz | 93.562 µJy, 15.1 mK | 3.750 GHz | XX,YY | No |

## Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 4.5 h | 1.8 h | 1.1 h | 8.9 " | 34 | offset | 26.7 " | 217.4 s | 519.6 GB | 39.6 MB/s |

## Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 8.0 h | 8.0 h | 0.0 h | 15.3 " | 34 | offset | 45.8 " | 483.2 s | 20.4 GB | 0.9 MB/s |

## Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.4 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.1 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.7 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

## 34 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-746985 | 14:49:07, -59:24:45 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-765015 | 15:20:29, -56:27:21 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-G323.7410-00.2... | 15:31:45, -56:30:49 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-744588 | 14:45:00, -59:48:36 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-G316.5871-00.8... | 14:46:23, -60:35:47 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-749006 | 14:53:53, -59:27:28 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-G322.1729+00.6... | 15:18:38, -56:37:30 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-768300 | 15:31:00, -56:35:01 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-G323.7399-00.2... | 15:31:45, -56:30:50 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-744638 | 14:45:22, -59:52:39 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-743852 | 14:43:15, -59:50:10 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-G316.6412-00.... | 14:44:18, -59:55:10 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-757098 | 15:07:21, -57:49:24 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-G324.1581+00.... | 15:32:10, -55:51:59 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-746750 | 14:48:19, -59:19:36 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-753433 | 14:59:56, -57:51:09 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-759150 | 15:10:43, -57:44:45 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-G318.9480-00.... | 15:00:55, -58:58:52 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-744757 | 14:45:26, -59:49:16 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-G320.1542+00.... | 15:05:17, -57:31:40 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-G318.0489+00.... | 14:53:42, -59:08:52 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-764038 | 15:18:39, -56:39:07 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-G324.1594+00.... | 15:32:03, -55:50:35 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-754973 | 15:03:28, -57:40:41 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-744391 | 14:44:18, -59:44:14 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-760641 | 15:16:06, -58:11:41 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-760875 | 15:16:31, -58:09:00 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-768907 | 15:30:59, -56:11:21 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-767784 | 15:29:19, -56:31:21 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-747712 | 14:50:39, -59:22:54 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-756464 | 15:05:16, -57:30:01 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-759398 | 15:11:19, -57:45:37 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-754862 | 15:06:54, -58:32:56 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-772336 | 15:39:57, -56:04:07 | 1.00 km/s,lsrk,RADIO |

## Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.64 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.7 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

## 1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 93.73 µJy, 15.1 mK | 93.73 uJy - 94.15 uJy |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6  High-mass stars 0 cluster 7  Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5159.072 km/s, 3.7 GHz | 217.925000 GHz | 97.164 µJy, 15.6 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 0.7 h | 0.1 h | 0.2 h | 8.9 " | 3 | offset | 26.7 " | 181.3 s | 62.8 GB | 39.2 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 1.1 h | 1.1 h | 0.0 h | 15.3 " | 3 | offset | 45.8 " | 423.3 s | 2.2 GB | 0.8 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.5 km/s | 1.344 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.2 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.8 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.1 km/s | 0.332 km/s | 3 |

3 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-G217.0441-00.0... | 06:58:44, -03:41:09 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-G221.9605-01.9... | 07:00:50, -08:56:30 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-519248 | 07:00:57, -03:51:17 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 12.09 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.3 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3 | 217.924273 | 97.13 µJy, 15.6 mK | 97.13 uJy - 97.53 uJy |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 8 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5159.093 km/s, 3.7 GHz | 217.925000 GHz | 95.574 µJy, 15.4 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 0.9 h | 0.3 h | 0.2 h | 8.9 " | 6 | offset | 26.7 " | 181.3 s | 96.6 GB | 40.1 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 1.5 h | 1.5 h | 0.0 h | 15.3 " | 6 | offset | 45.8 " | 423.3 s | 3.5 GB | 0.8 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.5 km/s | 1.344 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.2 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.8 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.1 km/s | 0.332 km/s | 3 |

6 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-G231.7986-01.9... | 07:19:35, -17:39:18 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-543232 | 07:30:13, -18:31:57 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-545969 | 07:27:41, -20:20:07 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-G233.8306-00.1... | 07:30:16, -18:35:49 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-G232.0766-02.2... | 07:18:59, -18:02:41 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-545262 | 07:31:48, -19:18:11 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

| | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.89 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.5 | | | | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6 | 217.924273 | 95.48 µJy, 15.4 mK | 95.48 uJy - 95.85 uJy |

Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 9 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5159.09 km/s, 3.7 GHz | 217.925000 GHz | 95.475 µJy, 15.4 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 0.9 h | 0.3 h | 0.2 h | 8.9 " | 7 | offset | 26.7 " | 181.3 s | 106.5 GB | 40.3 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 1.7 h | 1.7 h | 0.0 h | 15.3 " | 7 | offset | 45.8 " | 423.3 s | 3.9 GB | 0.8 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.5 km/s | 1.344 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.2 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.8 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.1 km/s | 0.332 km/s | 3 |

7 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-554367 | 07:45:07, -25:32:16 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-548966 | 07:33:13, -22:07:51 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-552040 | 07:34:51, -24:36:16 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-549061 | 07:33:20, -22:10:59 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-G242.9402-00.4... | 07:48:43, -26:39:30 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-554507 | 07:45:24, -25:37:49 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-551585 | 07:34:42, -24:08:46 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.88 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.5 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7 | 217.924273 | 95.46 µJy, 15.4 mK | 95.46 uJy - 95.83 uJy |

### Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

### Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

### Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

### Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

### Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6  High-mass stars 0 cluster 10  Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.912 km/s, 3.7 GHz | 217.925000 GHz | 90.245 µJy, 14.5 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 2.7 h | 1.0 h | 0.7 h | 8.9 " | 18 | offset | 26.7 " | 241.7 s | 314.0 GB | 39.7 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 4.8 h | 4.8 h | 0.0 h | 15.3 " | 18 | offset | 45.8 " | 483.5 s | 12.3 GB | 0.9 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.5 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.1 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.8 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

18 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-690556 | 12:27:08, -62:49:45 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-G300.3412-00.2... | 12:28:35, -62:58:35 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-685630 | 12:10:02, -62:53:36 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-691350 | 12:29:42, -62:13:12 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-693364 | 12:36:51, -63:03:03 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-687329 | 12:14:41, -62:37:12 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-696378 | 12:46:43, -62:35:14 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-G301.8147+00.7... | 12:41:53, -62:04:14 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-683688 | 12:03:16, -63:11:17 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-694812 | 12:42:20, -62:08:08 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-694272 | 12:40:34, -62:36:00 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-695243 | 12:43:31, -62:36:14 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-694475 | 12:41:11, -62:34:43 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-691590 | 12:29:55, -62:52:20 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-694144 | 12:39:57, -63:04:43 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-692212 | 12:32:22, -62:41:36 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-694823 | 12:42:20, -62:14:28 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-693050 | 12:35:35, -63:02:32 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.23 mJy, 1.8 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 11.1 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 90.14 µJy, 14.5 mK | 90.14 uJy - 90.54 uJy |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 11 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.985 km/s, 3.7 GHz | 217.925000 GHz | 92.932 µJy, 15 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 4.7 h | 1.9 h | 1.2 h | 8.9 " | 36 | offset | 26.7 " | 217.4 s | 544.7 GB | 39.8 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 8.3 h | 8.3 h | 0.0 h | 15.3 " | 36 | offset | 45.8 " | 483.2 s | 21.3 GB | 0.9 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.5 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.2 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.8 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.1 km/s | 0.332 km/s | 3 |

36 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-641028 | 10:23:20, -57:52:31 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-641210 | 10:24:08, -57:46:31 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-638752 | 10:18:59, -57:42:22 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-646022 | 10:33:30, -58:55:20 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-645113 | 10:30:33, -58:53:51 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-645152 | 10:30:46, -58:52:21 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-644237 | 10:31:15, -58:03:57 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-G281.9780-01.3... | 10:05:31, -57:19:50 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-638974 | 10:18:01, -58:00:41 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-641440 | 10:24:22, -57:49:41 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-637349 | 10:16:57, -57:24:25 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-637550 | 10:17:16, -57:26:27 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-645690 | 10:35:57, -58:08:15 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-633219 | 10:09:26, -56:43:46 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-641469 | 10:24:10, -57:52:34 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-646390 | 10:29:50, -59:58:26 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-641310 | 10:24:27, -57:45:20 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-631754 | 10:04:55, -56:46:36 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-633013 | 10:06:34, -57:11:46 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-641463 | 10:24:32, -57:47:49 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-647452 | 10:37:37, -58:47:01 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-641402 | 10:24:13, -57:50:36 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-639498 | 10:19:28, -57:56:17 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-638718 | 10:17:33, -57:58:44 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-644284 | 10:31:29, -58:02:19 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-647876 | 10:38:41, -58:44:37 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-644273 | 10:31:24, -58:03:03 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-640046 | 10:20:14, -58:03:06 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-641014 | 10:24:03, -57:43:17 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-G282.2988-00.... | 10:10:00, -57:02:07 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-632469 | 10:03:40, -57:26:37 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-646708 | 10:35:26, -58:55:51 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-G283.9146-01.... | 10:18:49, -58:10:11 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-G286.2086+00.... | 10:38:32, -58:19:14 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-640076 | 10:20:15, -58:03:55 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-640255 | 10:20:21, -58:08:30 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.56 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.8 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 93.01 µJy, 15.0 mK | 93.01 uJy - 93.41 uJy |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 12 Band 6

### Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.964 km/s, 3.7 GHz | 217.925000 GHz | 93.707 µJy, 15.1 mK | 3.750 GHz | XX,YY | No |

### Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 4.9 h | 2.1 h | 1.2 h | 8.9 " | 39 | offset | 26.7 " | 217.4 s | 582.4 GB | 40.0 MB/s |

### Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 8.7 h | 8.7 h | 0.0 h | 15.3 " | 39 | offset | 45.8 " | 493.2 s | 22.8 GB | 0.9 MB/s |

### Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.5 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.2 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.8 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.1 km/s | 0.332 km/s | 3 |

### 39 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-658966 | 10:57:43, -59:44:57 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-667888 | 11:15:06, -61:17:57 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-673961 | 11:32:44, -61:26:18 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-665815 | 11:12:35, -60:53:30 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-667912 | 11:15:11, -61:16:59 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-675564 | 11:36:02, -61:58:30 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-654025 | 10:45:09, -59:48:23 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-G294.5117-01.6... | 11:35:32, -63:14:42 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-672346 | 11:25:43, -62:10:49 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-664813 | 11:06:33, -61:44:13 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-655455 | 10:46:52, -59:53:30 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-658980 | 10:56:19, -60:07:36 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-667671 | 11:15:02, -61:13:20 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-665718 | 11:12:21, -60:52:59 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-659353 | 10:57:37, -59:58:39 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-658015 | 10:53:44, -59:53:53 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-661269 | 10:57:25, -61:19:50 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-666100 | 11:11:34, -61:21:13 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-659152 | 10:56:57, -60:02:07 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-666114 | 11:11:39, -61:20:16 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-660866 | 10:59:17, -60:34:12 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-666989 | 11:14:16, -61:06:59 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-659030 | 10:56:33, -60:05:16 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-G287.4929-00.... | 10:44:34, -59:35:04 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-666242 | 11:12:01, -61:18:27 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-667879 | 11:15:08, -61:16:57 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-666101 | 11:11:39, -61:19:41 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-667551 | 11:14:59, -61:11:37 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-678141 | 11:40:29, -63:27:59 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-G287.8768-01.... | 10:44:17, -60:27:46 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-667958 | 11:15:14, -61:17:27 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-G293.5607-00.... | 11:30:07, -62:03:12 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-667557 | 11:15:05, -61:09:40 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-653755 | 10:45:03, -59:41:09 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-659110 | 10:56:26, -60:09:00 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-663282 | 11:03:54, -61:02:45 | 1.00 km/s,lsrk,RADIO |
| 37 | 37-658676 | 10:57:51, -59:29:27 | 1.00 km/s,lsrk,RADIO |
| 38 | 38-658675 | 10:56:51, -59:45:23 | 1.00 km/s,lsrk,RADIO |
| 39 | 39-661786 | 10:59:37, -61:01:53 | 1.00 km/s,lsrk,RADIO |

### Expected Source Properties

| | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.66 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.7 | | | | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

### 1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 94.61 µJy, 15.2 mK | 94.61 uJy - 95.04 uJy |

### Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

### Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

### Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

### Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

### Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 13 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5159.04 km/s, 3.7 GHz | 217.925000 GHz | 98.653 µJy, 15.9 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 0.9 h | 0.3 h | 0.2 h | 8.9 " | 6 | offset | 26.7 " | 181.3 s | 96.6 GB | 40.1 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 1.5 h | 1.5 h | 0.0 h | 15.3 " | 6 | offset | 45.8 " | 423.3 s | 3.5 GB | 0.8 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.5 km/s | 1.344 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.2 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.8 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.1 km/s | 0.332 km/s | 3 |

6 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-606650 | 09:04:22, -48:54:30 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-G268.3957-00.4... | 09:03:25, -47:28:27 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-G270.8247-01.1... | 09:10:30, -49:41:29 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-605160 | 09:03:32, -48:28:20 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-605300 | 09:03:26, -48:31:02 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-604868 | 09:05:36, -48:05:23 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

| | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 12.27 mJy, 2 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.1 | | | | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6 | 217.924273 | 98.87 µJy, 15.9 mK | 98.87 uJy - 99.28 uJy |

Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 14 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5159.026 km/s, 3.7 GHz | 217.925000 GHz | 99.563 µJy, 16 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 0.8 h | 0.2 h | 0.2 h | 8.9 " | 4 | offset | 26.7 " | 181.3 s | 74.6 GB | 39.7 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 1.2 h | 1.2 h | 0.0 h | 15.3 " | 4 | offset | 45.8 " | 453.5 s | 2.7 GB | 0.8 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.5 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.2 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.8 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.1 km/s | 0.332 km/s | 3 |

4 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-615347 | 09:24:27, -51:59:16 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-615483 | 09:24:40, -52:00:29 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-G279.4100-01.6... | 09:49:26, -55:59:32 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-G274.0649-01.1... | 09:24:42, -52:01:50 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 12.39 mJy, 2 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.0 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4 | 217.924273 | 99.57 µJy, 16.0 mK | 99.57 uJy - 99.99 uJy |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 15 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5159.066 km/s, 3.7 GHz | 217.925000 GHz | 96.95 µJy, 15.6 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 1.1 h | 0.4 h | 0.3 h | 8.9 " | 9 | offset | 26.7 " | 181.3 s | 123.3 GB | 39.1 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 2.0 h | 2.0 h | 0.0 h | 15.3 " | 9 | offset | 45.8 " | 423.2 s | 4.8 GB | 0.9 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.5 km/s | 1.344 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.2 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.8 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.1 km/s | 0.332 km/s | 3 |

9 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-580833 | 08:29:14, -41:10:47 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-G259.0453-01.5... | 08:26:17, -40:48:40 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-580720 | 08:29:07, -41:07:18 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-575097 | 08:25:26, -37:59:04 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-580687 | 08:29:03, -41:06:28 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-586092 | 08:32:08, -43:13:46 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-575465 | 08:25:16, -38:19:39 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-580615 | 08:30:36, -40:51:35 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-583287 | 08:32:07, -42:02:48 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 12.06 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.3 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9 | 217.924273 | 97.1 µJy, 15.6 mK | 97.10 uJy - 97.50 uJy |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 1 of 6 High-mass stars 0 cluster 16 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5159.076 km/s, 3.7 GHz | 217.925000 GHz | 96.146 µJy, 15.5 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 0.8 h | 0.2 h | 0.2 h | 8.9 " | 5 | offset | 26.7 " | 181.3 s | 83.0 GB | 40.0 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 1.3 h | 1.3 h | 0.0 h | 15.3 " | 5 | offset | 45.8 " | 423.3 s | 3.0 GB | 0.8 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.5 km/s | 1.344 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.2 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.8 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.1 km/s | 0.332 km/s | 3 |

5 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-569314 | 08:14:53, -35:33:02 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-565926 | 08:02:43, -34:31:47 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-569408 | 08:16:00, -35:25:53 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-561782 | 07:59:20, -30:43:44 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-571105 | 08:15:57, -36:08:06 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.96 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.4 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5 | 217.924273 | 95.71 µJy, 15.4 mK | 95.71 uJy - 96.09 uJy |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 2 of 6 High-mass stars 1 Band 6

## Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.508 km/s, 3.7 GHz | 217.925000 GHz | 96.549 µJy, 15.5 mK | 3.750 GHz | XX,YY | No |

## Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 15.4 h | 6.6 h | 3.9 h | 8.9 " | 141 | offset | 26.7 " | 180.4 s | 1755.3 GB | 39.2 MB/s |

## Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 27.4 h | 27.4 h | 0.0 h | 15.3 " | 141 | offset | 45.8 " | 421.3 s | 68.7 GB | 0.9 MB/s |

## Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.3 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2554.9 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.7 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

## 141 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-99964 | 18:32:43, -09:09:01 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-100132 | 18:31:13, -08:54:37 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-100309 | 18:33:33, -09:10:25 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-100992 | 18:31:24, -08:45:26 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-101073 | 18:34:29, -09:08:17 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-101377 | 18:34:16, -09:02:58 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-101767 | 18:33:09, -08:50:14 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-101899 | 18:34:40, -09:00:37 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-102131 | 18:32:12, -08:39:26 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-102393 | 18:35:08, -08:59:29 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-102456 | 18:33:54, -08:49:21 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-102460 | 18:34:45, -08:55:52 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-102723 | 18:34:56, -08:54:10 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-103319 | 18:33:37, -08:36:32 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-103357 | 18:33:52, -08:38:00 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-103421 | 18:33:23, -08:33:34 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-103459 | 18:34:36, -08:42:26 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-103708 | 18:34:00, -08:34:27 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-103916 | 18:34:54, -08:38:26 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-103932 | 18:33:29, -08:27:27 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-104013 | 18:32:25, -08:18:22 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-104080 | 18:32:16, -08:16:31 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-104193 | 18:34:45, -08:34:13 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-104242 | 18:34:48, -08:33:53 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-104316 | 18:34:39, -08:31:39 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-104344 | 18:32:26, -08:14:20 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-104431 | 18:33:48, -08:23:47 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-104579 | 18:33:44, -08:21:23 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-104846 | 18:34:23, -08:22:57 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-104999 | 18:32:07, -08:03:37 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-105009 | 18:32:29, -08:06:17 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-105028 | 18:34:11, -08:19:08 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-105201 | 18:33:39, -08:12:25 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-105295 | 18:33:46, -08:12:01 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-105314 | 18:34:13, -08:15:13 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-105334 | 18:34:25, -08:16:28 | 1.00 km/s,lsrk,RADIO |
| 37 | 37-105388 | 18:33:41, -08:10:01 | 1.00 km/s,lsrk,RADIO |
| 38 | 38-105642 | 18:35:12, -08:17:37 | 1.00 km/s,lsrk,RADIO |
| 39 | 39-105657 | 18:33:53, -08:07:13 | 1.00 km/s,lsrk,RADIO |
| 40 | 40-105702 | 18:33:35, -08:04:11 | 1.00 km/s,lsrk,RADIO |
| 41 | 41-105855 | 18:32:35, -07:54:03 | 1.00 km/s,lsrk,RADIO |
| 42 | 42-106156 | 18:34:13, -08:02:12 | 1.00 km/s,lsrk,RADIO |
| 43 | 43-106164 | 18:32:52, -07:51:39 | 1.00 km/s,lsrk,RADIO |
| 44 | 44-106267 | 18:35:12, -08:08:17 | 1.00 km/s,lsrk,RADIO |
| 45 | 45-106339 | 18:35:21, -08:08:26 | 1.00 km/s,lsrk,RADIO |
| 46 | 46-106475 | 18:33:23, -07:51:16 | 1.00 km/s,lsrk,RADIO |
| 47 | 47-106679 | 18:33:27, -07:48:44 | 1.00 km/s,lsrk,RADIO |
| 48 | 48-106706 | 18:35:52, -08:06:58 | 1.00 km/s,lsrk,RADIO |
| 49 | 49-106756 | 18:34:24, -07:54:53 | 1.00 km/s,lsrk,RADIO |
| 50 | 50-106819 | 18:35:22, -08:01:23 | 1.00 km/s,lsrk,RADIO |
| 51 | 51-106921 | 18:35:20, -07:59:42 | 1.00 km/s,lsrk,RADIO |
| 52 | 52-106974 | 18:34:28, -07:52:19 | 1.00 km/s,lsrk,RADIO |
| 53 | 53-107003 | 18:34:54, -07:55:07 | 1.00 km/s,lsrk,RADIO |
| 54 | 54-107025 | 18:33:18, -07:42:23 | 1.00 km/s,lsrk,RADIO |
| 55 | 55-107085 | 18:34:22, -07:49:45 | 1.00 km/s,lsrk,RADIO |
| 56 | 56-107142 | 18:34:23, -07:48:43 | 1.00 km/s,lsrk,RADIO |
| 57 | 57-107167 | 18:35:53, -07:59:55 | 1.00 km/s,lsrk,RADIO |
| 58 | 58-107225 | 18:34:17, -07:46:37 | 1.00 km/s,lsrk,RADIO |
| 59 | 59-107427 | 18:35:52, -07:55:19 | 1.00 km/s,lsrk,RADIO |
| 60 | 60-107612 | 18:33:55, -07:37:27 | 1.00 km/s,lsrk,RADIO |

## Expected Source Properties

| | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 12.01 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.4 | | | | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

## 1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 96.73 µJy, 15.6 mK | 96.73 uJy - 97.11 uJy |

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 61 | 61-108110 | 18:33:57, -07:29:41 | 1.00 km/s,lsrk,RADIO |
| 62 | 62-108121 | 18:34:13, -07:31:40 | 1.00 km/s,lsrk,RADIO |
| 63 | 63-108273 | 18:36:10, -07:44:08 | 1.00 km/s,lsrk,RADIO |
| 64 | 64-108441 | 18:36:12, -07:41:41 | 1.00 km/s,lsrk,RADIO |
| 65 | 65-108490 | 18:34:41, -07:29:07 | 1.00 km/s,lsrk,RADIO |
| 66 | 66-108506 | 18:34:00, -07:23:40 | 1.00 km/s,lsrk,RADIO |
| 67 | 67-108513 | 18:34:44, -07:29:20 | 1.00 km/s,lsrk,RADIO |
| 68 | 68-108668 | 18:33:52, -07:20:22 | 1.00 km/s,lsrk,RADIO |
| 69 | 69-108711 | 18:35:31, -07:32:44 | 1.00 km/s,lsrk,RADIO |
| 70 | 70-108768 | 18:35:27, -07:31:30 | 1.00 km/s,lsrk,RADIO |
| 71 | 71-108801 | 18:34:57, -07:27:11 | 1.00 km/s,lsrk,RADIO |
| 72 | 72-108815 | 18:35:23, -07:30:25 | 1.00 km/s,lsrk,RADIO |
| 73 | 73-108898 | 18:34:56, -07:26:17 | 1.00 km/s,lsrk,RADIO |
| 74 | 74-108933 | 18:36:40, -07:39:15 | 1.00 km/s,lsrk,RADIO |
| 75 | 75-109047 | 18:35:11, -07:26:27 | 1.00 km/s,lsrk,RADIO |
| 76 | 76-109085 | 18:34:58, -07:24:23 | 1.00 km/s,lsrk,RADIO |
| 77 | 77-109223 | 18:36:05, -07:31:23 | 1.00 km/s,lsrk,RADIO |
| 78 | 78-109264 | 18:35:46, -07:28:32 | 1.00 km/s,lsrk,RADIO |
| 79 | 79-109432 | 18:36:30, -07:32:25 | 1.00 km/s,lsrk,RADIO |
| 80 | 80-109442 | 18:37:02, -07:36:27 | 1.00 km/s,lsrk,RADIO |
| 81 | 81-109444 | 18:34:52, -07:19:42 | 1.00 km/s,lsrk,RADIO |
| 82 | 82-109526 | 18:34:55, -07:19:05 | 1.00 km/s,lsrk,RADIO |
| 83 | 83-109559 | 18:36:55, -07:34:13 | 1.00 km/s,lsrk,RADIO |
| 84 | 84-109560 | 18:37:01, -07:34:58 | 1.00 km/s,lsrk,RADIO |
| 85 | 85-109588 | 18:36:31, -07:30:50 | 1.00 km/s,lsrk,RADIO |
| 86 | 86-109669 | 18:34:52, -07:17:09 | 1.00 km/s,lsrk,RADIO |
| 87 | 87-109815 | 18:35:22, -07:19:09 | 1.00 km/s,lsrk,RADIO |
| 88 | 88-109975 | 18:36:33, -07:26:01 | 1.00 km/s,lsrk,RADIO |
| 89 | 89-110009 | 18:36:36, -07:25:52 | 1.00 km/s,lsrk,RADIO |
| 90 | 90-110233 | 18:36:49, -07:24:41 | 1.00 km/s,lsrk,RADIO |
| 91 | 91-110318 | 18:36:46, -07:23:07 | 1.00 km/s,lsrk,RADIO |
| 92 | 92-110346 | 18:36:34, -07:21:18 | 1.00 km/s,lsrk,RADIO |
| 93 | 93-110376 | 18:36:47, -07:22:35 | 1.00 km/s,lsrk,RADIO |
| 94 | 94-110522 | 18:35:50, -07:13:27 | 1.00 km/s,lsrk,RADIO |
| 95 | 95-110664 | 18:36:06, -07:13:45 | 1.00 km/s,lsrk,RADIO |
| 96 | 96-110679 | 18:36:44, -07:18:23 | 1.00 km/s,lsrk,RADIO |
| 97 | 97-110831 | 18:36:08, -07:11:35 | 1.00 km/s,lsrk,RADIO |
| 98 | 98-111106 | 18:36:41, -07:12:16 | 1.00 km/s,lsrk,RADIO |
| 99 | 99-111167 | 18:36:36, -07:10:50 | 1.00 km/s,lsrk,RADIO |
| 100 | 100-111597 | 18:36:59, -07:07:30 | 1.00 km/s,lsrk,RADIO |
| 101 | 101-111983 | 18:38:36, -07:14:31 | 1.00 km/s,lsrk,RADIO |
| 102 | 102-112169 | 18:36:54, -06:58:04 | 1.00 km/s,lsrk,RADIO |
| 103 | 103-112582 | 18:38:09, -07:02:32 | 1.00 km/s,lsrk,RADIO |
| 104 | 104-112597 | 18:36:33, -06:50:06 | 1.00 km/s,lsrk,RADIO |
| 105 | 105-112687 | 18:36:28, -06:48:01 | 1.00 km/s,lsrk,RADIO |
| 106 | 106-112942 | 18:36:16, -06:43:17 | 1.00 km/s,lsrk,RADIO |
| 107 | 107-113041 | 18:36:48, -06:46:25 | 1.00 km/s,lsrk,RADIO |
| 108 | 108-113073 | 18:38:11, -06:56:35 | 1.00 km/s,lsrk,RADIO |
| 109 | 109-113510 | 18:37:38, -06:46:55 | 1.00 km/s,lsrk,RADIO |
| 110 | 110-113869 | 18:38:15, -06:47:52 | 1.00 km/s,lsrk,RADIO |
| 111 | 111-113872 | 18:38:08, -06:46:55 | 1.00 km/s,lsrk,RADIO |
| 112 | 112-113972 | 18:38:08, -06:45:54 | 1.00 km/s,lsrk,RADIO |
| 113 | 113-114043 | 18:37:16, -06:38:29 | 1.00 km/s,lsrk,RADIO |
| 114 | 114-114577 | 18:37:20, -06:31:56 | 1.00 km/s,lsrk,RADIO |
| 115 | 115-114632 | 18:38:40, -06:41:23 | 1.00 km/s,lsrk,RADIO |
| 116 | 116-115156 | 18:38:28, -06:32:06 | 1.00 km/s,lsrk,RADIO |
| 117 | 117-115242 | 18:37:12, -06:21:23 | 1.00 km/s,lsrk,RADIO |
| 118 | 118-115327 | 18:38:35, -06:30:40 | 1.00 km/s,lsrk,RADIO |
| 119 | 119-115552 | 18:37:33, -06:20:10 | 1.00 km/s,lsrk,RADIO |
| 120 | 120-115679 | 18:37:30, -06:18:10 | 1.00 km/s,lsrk,RADIO |

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 121 | 121-115936 | 18:37:30, -06:14:15 | 1.00 km/s,lsrk,RADIO |
| 122 | 122-115945 | 18:38:46, -06:23:52 | 1.00 km/s,lsrk,RADIO |
| 123 | 123-115961 | 18:38:56, -06:24:52 | 1.00 km/s,lsrk,RADIO |
| 124 | 124-115972 | 18:38:31, -06:21:37 | 1.00 km/s,lsrk,RADIO |
| 125 | 125-116088 | 18:39:03, -06:24:10 | 1.00 km/s,lsrk,RADIO |
| 126 | 126-116178 | 18:39:48, -06:28:46 | 1.00 km/s,lsrk,RADIO |
| 127 | 127-116415 | 18:39:08, -06:20:04 | 1.00 km/s,lsrk,RADIO |
| 128 | 128-116752 | 18:38:54, -06:12:30 | 1.00 km/s,lsrk,RADIO |
| 129 | 129-117372 | 18:39:49, -06:10:27 | 1.00 km/s,lsrk,RADIO |
| 130 | 130-117538 | 18:38:32, -05:57:47 | 1.00 km/s,lsrk,RADIO |
| 131 | 131-117544 | 18:38:28, -05:57:12 | 1.00 km/s,lsrk,RADIO |
| 132 | 132-117904 | 18:38:49, -05:53:36 | 1.00 km/s,lsrk,RADIO |
| 133 | 133-117909 | 18:37:55, -05:46:32 | 1.00 km/s,lsrk,RADIO |
| 134 | 134-118203 | 18:38:51, -05:49:11 | 1.00 km/s,lsrk,RADIO |
| 135 | 135-118234 | 18:39:30, -05:53:44 | 1.00 km/s,lsrk,RADIO |
| 136 | 136-118357 | 18:39:17, -05:50:01 | 1.00 km/s,lsrk,RADIO |
| 137 | 137-G023.3891+0... | 18:33:14, -08:23:57 | 1.00 km/s,lsrk,RADIO |
| 138 | 138-G023.6566-00... | 18:34:51, -08:18:21 | 1.00 km/s,lsrk,RADIO |
| 139 | 139-G023.8176+0... | 18:33:19, -07:55:37 | 1.00 km/s,lsrk,RADIO |
| 140 | 140-G024.6343-00... | 18:37:22, -07:31:41 | 1.00 km/s,lsrk,RADIO |
| 141 | 141-G025.6498+0... | 18:34:20, -05:59:42 | 1.00 km/s,lsrk,RADIO |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 3 of 6 High-mass stars 2 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.757 km/s, 3.7 GHz | 217.925000 GHz | 100.216 µJy, 16.1 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 14.4 h | 6.5 h | 3.7 h | 8.9 " | 130 | offset | 26.7 " | 180.4 s | 1635.7 GB | 39.1 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 25.6 h | 25.6 h | 0.0 h | 15.3 " | 130 | offset | 45.8 " | 441.3 s | 64.1 GB | 0.9 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.4 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.1 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.7 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

130 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-790635 | 16:00:31, -53:12:48 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-790672 | 16:00:16, -53:09:18 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-791907 | 16:02:22, -53:06:04 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-792053 | 16:00:39, -52:45:23 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-792192 | 16:02:37, -53:02:56 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-792265 | 16:00:48, -52:42:40 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-792278 | 16:02:45, -53:02:43 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-792355 | 16:03:32, -53:09:26 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-792397 | 16:00:54, -52:41:23 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-792437 | 16:02:19, -52:55:21 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-792499 | 16:00:31, -52:35:12 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-792543 | 16:01:08, -52:40:52 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-792545 | 15:59:38, -52:24:56 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-792650 | 15:59:36, -52:22:55 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-792829 | 16:01:32, -52:39:02 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-792881 | 16:01:45, -52:40:13 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-793196 | 16:02:13, -52:38:16 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-793695 | 15:58:07, -51:43:31 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-793710 | 15:58:07, -51:43:03 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-793728 | 15:58:49, -51:49:57 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-793779 | 15:59:27, -51:55:32 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-794763 | 16:00:37, -51:42:58 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-795321 | 16:04:32, -52:08:15 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-795664 | 16:03:43, -51:51:45 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-795789 | 16:07:53, -52:31:33 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-796767 | 16:07:16, -52:01:28 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-797087 | 16:09:23, -52:14:51 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-797095 | 16:09:31, -52:15:58 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-797972 | 16:10:23, -52:06:54 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-798252 | 16:10:44, -52:05:49 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-798299 | 16:10:07, -51:58:43 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-798398 | 16:10:18, -51:58:43 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-798710 | 16:09:47, -51:48:40 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-798822 | 16:11:16, -52:01:51 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-799153 | 16:11:47, -52:02:30 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-799161 | 16:08:21, -51:27:54 | 1.00 km/s,lsrk,RADIO |
| 37 | 37-799461 | 16:09:47, -51:38:22 | 1.00 km/s,lsrk,RADIO |
| 38 | 38-799475 | 16:10:59, -51:50:23 | 1.00 km/s,lsrk,RADIO |
| 39 | 39-799483 | 16:11:53, -51:59:14 | 1.00 km/s,lsrk,RADIO |
| 40 | 40-799503 | 16:12:15, -52:02:32 | 1.00 km/s,lsrk,RADIO |
| 41 | 41-799832 | 16:12:14, -51:57:33 | 1.00 km/s,lsrk,RADIO |
| 42 | 42-799915 | 16:10:42, -51:40:32 | 1.00 km/s,lsrk,RADIO |
| 43 | 43-800055 | 16:05:52, -50:48:07 | 1.00 km/s,lsrk,RADIO |
| 44 | 44-800079 | 16:11:19, -51:43:47 | 1.00 km/s,lsrk,RADIO |
| 45 | 45-800202 | 16:06:02, -50:47:47 | 1.00 km/s,lsrk,RADIO |
| 46 | 46-800419 | 16:08:57, -51:15:12 | 1.00 km/s,lsrk,RADIO |
| 47 | 47-800751 | 16:12:26, -51:46:16 | 1.00 km/s,lsrk,RADIO |
| 48 | 48-800891 | 16:06:24, -50:43:07 | 1.00 km/s,lsrk,RADIO |
| 49 | 49-800967 | 16:12:48, -51:47:28 | 1.00 km/s,lsrk,RADIO |
| 50 | 50-801000 | 16:11:33, -51:34:48 | 1.00 km/s,lsrk,RADIO |
| 51 | 51-801089 | 16:11:10, -51:29:42 | 1.00 km/s,lsrk,RADIO |
| 52 | 52-801184 | 16:11:11, -51:28:41 | 1.00 km/s,lsrk,RADIO |
| 53 | 53-801282 | 16:12:50, -51:43:28 | 1.00 km/s,lsrk,RADIO |
| 54 | 54-801518 | 16:12:30, -51:35:56 | 1.00 km/s,lsrk,RADIO |
| 55 | 55-801599 | 16:11:53, -51:28:30 | 1.00 km/s,lsrk,RADIO |
| 56 | 56-801651 | 16:12:07, -51:30:01 | 1.00 km/s,lsrk,RADIO |
| 57 | 57-801672 | 16:12:49, -51:36:44 | 1.00 km/s,lsrk,RADIO |
| 58 | 58-801753 | 16:12:09, -51:28:37 | 1.00 km/s,lsrk,RADIO |
| 59 | 59-801906 | 16:12:08, -51:25:45 | 1.00 km/s,lsrk,RADIO |
| 60 | 60-801981 | 16:12:26, -51:27:35 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 12.47 mJy, 2 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.0 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 99.81 µJy, 16.1 mK | 99.81 uJy - 100.23 uJy |

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 61 | 61-802233 | 16:11:48, -51:16:30 | 1.00 km/s,lsrk,RADIO |
| 62 | 62-802515 | 16:12:37, -51:18:38 | 1.00 km/s,lsrk,RADIO |
| 63 | 63-802647 | 16:10:01, -50:49:31 | 1.00 km/s,lsrk,RADIO |
| 64 | 64-802649 | 16:13:50, -51:27:50 | 1.00 km/s,lsrk,RADIO |
| 65 | 65-802843 | 16:10:01, -50:45:10 | 1.00 km/s,lsrk,RADIO |
| 66 | 66-803030 | 16:12:26, -51:04:54 | 1.00 km/s,lsrk,RADIO |
| 67 | 67-803218 | 16:13:51, -51:15:15 | 1.00 km/s,lsrk,RADIO |
| 68 | 68-804173 | 16:16:16, -51:18:24 | 1.00 km/s,lsrk,RADIO |
| 69 | 69-804190 | 16:14:58, -51:05:13 | 1.00 km/s,lsrk,RADIO |
| 70 | 70-804334 | 16:14:08, -50:54:04 | 1.00 km/s,lsrk,RADIO |
| 71 | 71-804675 | 16:15:00, -50:56:07 | 1.00 km/s,lsrk,RADIO |
| 72 | 72-804779 | 16:17:24, -51:17:45 | 1.00 km/s,lsrk,RADIO |
| 73 | 73-805077 | 16:15:45, -50:55:54 | 1.00 km/s,lsrk,RADIO |
| 74 | 74-805162 | 16:17:53, -51:15:13 | 1.00 km/s,lsrk,RADIO |
| 75 | 75-805178 | 16:14:38, -50:43:05 | 1.00 km/s,lsrk,RADIO |
| 76 | 76-805751 | 16:15:08, -50:38:42 | 1.00 km/s,lsrk,RADIO |
| 77 | 77-805970 | 16:18:26, -51:07:10 | 1.00 km/s,lsrk,RADIO |
| 78 | 78-806581 | 16:19:09, -51:03:47 | 1.00 km/s,lsrk,RADIO |
| 79 | 79-806896 | 16:19:36, -51:03:21 | 1.00 km/s,lsrk,RADIO |
| 80 | 80-806998 | 16:16:04, -50:27:36 | 1.00 km/s,lsrk,RADIO |
| 81 | 81-807111 | 16:19:48, -51:02:16 | 1.00 km/s,lsrk,RADIO |
| 82 | 82-807440 | 16:20:06, -51:00:02 | 1.00 km/s,lsrk,RADIO |
| 83 | 83-807635 | 16:17:31, -50:32:33 | 1.00 km/s,lsrk,RADIO |
| 84 | 84-807681 | 16:17:33, -50:32:26 | 1.00 km/s,lsrk,RADIO |
| 85 | 85-807707 | 16:20:06, -50:56:46 | 1.00 km/s,lsrk,RADIO |
| 86 | 86-808017 | 16:20:11, -50:53:12 | 1.00 km/s,lsrk,RADIO |
| 87 | 87-808125 | 16:13:53, -49:49:24 | 1.00 km/s,lsrk,RADIO |
| 88 | 88-808803 | 16:19:35, -50:36:41 | 1.00 km/s,lsrk,RADIO |
| 89 | 89-808999 | 16:15:05, -49:50:11 | 1.00 km/s,lsrk,RADIO |
| 90 | 90-809069 | 16:20:37, -50:43:49 | 1.00 km/s,lsrk,RADIO |
| 91 | 91-809113 | 16:21:37, -50:52:47 | 1.00 km/s,lsrk,RADIO |
| 92 | 92-809262 | 16:20:38, -50:41:46 | 1.00 km/s,lsrk,RADIO |
| 93 | 93-809324 | 16:20:35, -50:40:48 | 1.00 km/s,lsrk,RADIO |
| 94 | 94-809327 | 16:15:19, -49:48:48 | 1.00 km/s,lsrk,RADIO |
| 95 | 95-809444 | 16:18:47, -50:22:19 | 1.00 km/s,lsrk,RADIO |
| 96 | 96-809511 | 16:20:30, -50:38:10 | 1.00 km/s,lsrk,RADIO |
| 97 | 97-809780 | 16:20:39, -50:36:17 | 1.00 km/s,lsrk,RADIO |
| 98 | 98-809874 | 16:20:30, -50:33:39 | 1.00 km/s,lsrk,RADIO |
| 99 | 99-809977 | 16:18:54, -50:16:54 | 1.00 km/s,lsrk,RADIO |
| 100 | 100-810029 | 16:21:15, -50:39:05 | 1.00 km/s,lsrk,RADIO |
| 101 | 101-810154 | 16:21:35, -50:40:52 | 1.00 km/s,lsrk,RADIO |
| 102 | 102-810370 | 16:19:42, -50:19:52 | 1.00 km/s,lsrk,RADIO |
| 103 | 103-810788 | 16:21:17, -50:30:17 | 1.00 km/s,lsrk,RADIO |
| 104 | 104-810901 | 16:19:51, -50:15:10 | 1.00 km/s,lsrk,RADIO |
| 105 | 105-810984 | 16:19:23, -50:09:42 | 1.00 km/s,lsrk,RADIO |
| 106 | 106-811341 | 16:20:20, -50:15:28 | 1.00 km/s,lsrk,RADIO |
| 107 | 107-811356 | 16:21:32, -50:26:47 | 1.00 km/s,lsrk,RADIO |
| 108 | 108-811517 | 16:21:32, -50:25:01 | 1.00 km/s,lsrk,RADIO |
| 109 | 109-811713 | 16:20:37, -50:13:33 | 1.00 km/s,lsrk,RADIO |
| 110 | 110-812338 | 16:19:57, -49:58:29 | 1.00 km/s,lsrk,RADIO |
| 111 | 111-812487 | 16:21:20, -50:09:47 | 1.00 km/s,lsrk,RADIO |
| 112 | 112-812518 | 16:22:47, -50:23:13 | 1.00 km/s,lsrk,RADIO |
| 113 | 113-812921 | 16:23:03, -50:20:53 | 1.00 km/s,lsrk,RADIO |
| 114 | 114-813195 | 16:20:56, -49:57:18 | 1.00 km/s,lsrk,RADIO |
| 115 | 115-813698 | 16:23:24, -50:13:52 | 1.00 km/s,lsrk,RADIO |
| 116 | 116-813737 | 16:21:12, -49:52:17 | 1.00 km/s,lsrk,RADIO |
| 117 | 117-814133 | 16:22:38, -50:00:56 | 1.00 km/s,lsrk,RADIO |
| 118 | 118-814243 | 16:23:13, -50:04:52 | 1.00 km/s,lsrk,RADIO |
| 119 | 119-G329.2713+0... | 16:00:21, -52:48:47 | 1.00 km/s,lsrk,RADIO |
| 120 | 120-G329.6098+0... | 16:02:03, -52:35:33 | 1.00 km/s,lsrk,RADIO |
| 121 | 121-G330.0699+0... | 16:00:15, -51:34:24 | 1.00 km/s,lsrk,RADIO |
| 122 | 122-G331.2759-00... | 16:11:26, -51:41:57 | 1.00 km/s,lsrk,RADIO |
| 123 | 123-G331.5180-00... | 16:12:08, -51:28:02 | 1.00 km/s,lsrk,RADIO |
| 124 | 124-G331.6191-00... | 16:12:24, -51:21:42 | 1.00 km/s,lsrk,RADIO |
| 125 | 125-G332.7013-00... | 16:19:47, -51:00:06 | 1.00 km/s,lsrk,RADIO |
| 126 | 126-G332.9636-00... | 16:21:22, -50:52:58 | 1.00 km/s,lsrk,RADIO |
| 127 | 127-G333.0682-00... | 16:20:48, -50:38:40 | 1.00 km/s,lsrk,RADIO |
| 128 | 128-G333.1256-00... | 16:21:02, -50:35:55 | 1.00 km/s,lsrk,RADIO |
| 129 | 129-G333.3151+0... | 16:19:29, -50:04:40 | 1.00 km/s,lsrk,RADIO |
| 130 | 130-G333.9305-00... | 16:23:13, -49:48:42 | 1.00 km/s,lsrk,RADIO |

## Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

## Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

## Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

## Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

## Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 4 of 6 High-mass stars 3 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.492 km/s, 3.7 GHz | 217.925000 GHz | 94.146 µJy, 15.1 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 12.6 h | 5.3 h | 3.2 h | 8.9 " | 111 | offset | 26.7 " | 192.7 s | 1482.5 GB | 39.8 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 22.4 h | 22.4 h | 0.0 h | 15.3 " | 111 | offset | 45.8 " | 421.3 s | 58.1 GB | 0.9 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.2 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2554.9 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.7 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

111 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-125404 | 18:42:42, -04:15:34 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-125419 | 18:42:05, -04:10:40 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-125470 | 18:42:53, -04:16:03 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-125727 | 18:42:42, -04:09:46 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-125751 | 18:42:39, -04:08:50 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-125761 | 18:42:49, -04:09:54 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-125906 | 18:44:15, -04:17:55 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-126162 | 18:42:50, -04:03:09 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-126223 | 18:42:54, -04:02:30 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-126348 | 18:42:52, -03:59:53 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-126426 | 18:42:27, -03:55:28 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-126427 | 18:43:12, -04:01:13 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-126607 | 18:42:35, -03:53:20 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-126694 | 18:43:30, -03:58:27 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-127045 | 18:44:42, -04:01:34 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-127113 | 18:43:35, -03:51:59 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-127433 | 18:43:29, -03:46:55 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-127485 | 18:44:39, -03:54:41 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-127623 | 18:44:46, -03:53:34 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-127705 | 18:44:48, -03:52:43 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-127895 | 18:43:27, -03:39:44 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-127952 | 18:43:12, -03:37:02 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-128153 | 18:43:15, -03:35:06 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-128159 | 18:43:18, -03:35:25 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-128272 | 18:44:51, -03:45:46 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-128280 | 18:44:42, -03:44:30 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-128490 | 18:44:06, -03:36:47 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-128730 | 18:44:55, -03:40:25 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-128764 | 18:42:43, -03:23:02 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-128789 | 18:44:56, -03:39:45 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-128945 | 18:44:54, -03:37:38 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-129868 | 18:45:30, -03:32:21 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-129919 | 18:44:09, -03:21:13 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-129935 | 18:44:22, -03:22:46 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-130092 | 18:44:23, -03:21:23 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-130523 | 18:44:35, -03:17:10 | 1.00 km/s,lsrk,RADIO |
| 37 | 37-130634 | 18:44:27, -03:14:54 | 1.00 km/s,lsrk,RADIO |
| 38 | 38-131122 | 18:45:19, -03:15:40 | 1.00 km/s,lsrk,RADIO |
| 39 | 39-131178 | 18:46:30, -03:24:05 | 1.00 km/s,lsrk,RADIO |
| 40 | 40-131513 | 18:47:18, -03:25:45 | 1.00 km/s,lsrk,RADIO |
| 41 | 41-131655 | 18:45:40, -03:11:21 | 1.00 km/s,lsrk,RADIO |
| 42 | 42-131976 | 18:43:48, -02:52:31 | 1.00 km/s,lsrk,RADIO |
| 43 | 43-132381 | 18:47:31, -03:15:13 | 1.00 km/s,lsrk,RADIO |
| 44 | 44-132437 | 18:47:35, -03:14:49 | 1.00 km/s,lsrk,RADIO |
| 45 | 45-132444 | 18:47:25, -03:13:27 | 1.00 km/s,lsrk,RADIO |
| 46 | 46-133125 | 18:45:07, -02:45:50 | 1.00 km/s,lsrk,RADIO |
| 47 | 47-133246 | 18:46:36, -02:55:23 | 1.00 km/s,lsrk,RADIO |
| 48 | 48-133491 | 18:46:42, -02:52:35 | 1.00 km/s,lsrk,RADIO |
| 49 | 49-133522 | 18:47:28, -02:58:03 | 1.00 km/s,lsrk,RADIO |
| 50 | 50-133523 | 18:46:08, -02:47:46 | 1.00 km/s,lsrk,RADIO |
| 51 | 51-133563 | 18:45:47, -02:44:40 | 1.00 km/s,lsrk,RADIO |
| 52 | 52-133651 | 18:45:59, -02:45:05 | 1.00 km/s,lsrk,RADIO |
| 53 | 53-133674 | 18:45:43, -02:42:52 | 1.00 km/s,lsrk,RADIO |
| 54 | 54-133805 | 18:48:39, -03:03:56 | 1.00 km/s,lsrk,RADIO |
| 55 | 55-133859 | 18:46:40, -02:47:54 | 1.00 km/s,lsrk,RADIO |
| 56 | 56-134007 | 18:45:45, -02:38:59 | 1.00 km/s,lsrk,RADIO |
| 57 | 57-134152 | 18:45:28, -02:34:56 | 1.00 km/s,lsrk,RADIO |
| 58 | 58-134169 | 18:46:03, -02:39:21 | 1.00 km/s,lsrk,RADIO |
| 59 | 59-134196 | 18:48:49, -03:00:19 | 1.00 km/s,lsrk,RADIO |
| 60 | 60-134426 | 18:46:31, -02:39:34 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.71 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.6 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 94.21 µJy, 15.2 mK | 94.21 uJy - 94.59 uJy |

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 61 | 61-134457 | 18:45:58, -02:35:02 | 1.00 km/s,lsrk,RADIO |
| 62 | 62-134548 | 18:46:08, -02:35:18 | 1.00 km/s,lsrk,RADIO |
| 63 | 63-134902 | 18:47:11, -02:37:47 | 1.00 km/s,lsrk,RADIO |
| 64 | 64-135368 | 18:47:17, -02:30:27 | 1.00 km/s,lsrk,RADIO |
| 65 | 65-135457 | 18:47:22, -02:29:34 | 1.00 km/s,lsrk,RADIO |
| 66 | 66-135892 | 18:47:41, -02:25:22 | 1.00 km/s,lsrk,RADIO |
| 67 | 67-135972 | 18:45:44, -02:09:04 | 1.00 km/s,lsrk,RADIO |
| 68 | 68-136060 | 18:47:10, -02:18:48 | 1.00 km/s,lsrk,RADIO |
| 69 | 69-136318 | 18:48:14, -02:23:34 | 1.00 km/s,lsrk,RADIO |
| 70 | 70-136646 | 18:48:10, -02:18:36 | 1.00 km/s,lsrk,RADIO |
| 71 | 71-136865 | 18:48:46, -02:20:17 | 1.00 km/s,lsrk,RADIO |
| 72 | 72-137102 | 18:47:37, -02:08:19 | 1.00 km/s,lsrk,RADIO |
| 73 | 73-137144 | 18:46:33, -01:59:29 | 1.00 km/s,lsrk,RADIO |
| 74 | 74-137279 | 18:47:27, -02:04:38 | 1.00 km/s,lsrk,RADIO |
| 75 | 75-137309 | 18:47:21, -02:03:30 | 1.00 km/s,lsrk,RADIO |
| 76 | 76-137347 | 18:47:40, -02:05:28 | 1.00 km/s,lsrk,RADIO |
| 77 | 77-137435 | 18:47:46, -02:05:01 | 1.00 km/s,lsrk,RADIO |
| 78 | 78-137601 | 18:47:35, -02:01:48 | 1.00 km/s,lsrk,RADIO |
| 79 | 79-137633 | 18:47:53, -02:03:35 | 1.00 km/s,lsrk,RADIO |
| 80 | 80-137664 | 18:47:36, -02:01:10 | 1.00 km/s,lsrk,RADIO |
| 81 | 81-137707 | 18:47:00, -01:56:09 | 1.00 km/s,lsrk,RADIO |
| 82 | 82-138186 | 18:47:42, -01:56:12 | 1.00 km/s,lsrk,RADIO |
| 83 | 83-138401 | 18:46:36, -01:45:21 | 1.00 km/s,lsrk,RADIO |
| 84 | 84-138429 | 18:48:08, -01:56:50 | 1.00 km/s,lsrk,RADIO |
| 85 | 85-138497 | 18:47:01, -01:47:23 | 1.00 km/s,lsrk,RADIO |
| 86 | 86-138609 | 18:48:02, -01:53:53 | 1.00 km/s,lsrk,RADIO |
| 87 | 87-138641 | 18:46:56, -01:45:09 | 1.00 km/s,lsrk,RADIO |
| 88 | 88-138716 | 18:48:01, -01:52:34 | 1.00 km/s,lsrk,RADIO |
| 89 | 89-138741 | 18:47:28, -01:48:06 | 1.00 km/s,lsrk,RADIO |
| 90 | 90-138866 | 18:47:09, -01:44:12 | 1.00 km/s,lsrk,RADIO |
| 91 | 91-138939 | 18:45:11, -01:28:02 | 1.00 km/s,lsrk,RADIO |
| 92 | 92-138979 | 18:47:27, -01:44:59 | 1.00 km/s,lsrk,RADIO |
| 93 | 93-139064 | 18:48:48, -01:54:23 | 1.00 km/s,lsrk,RADIO |
| 94 | 94-139278 | 18:48:01, -01:46:00 | 1.00 km/s,lsrk,RADIO |
| 95 | 95-139715 | 18:47:26, -01:35:55 | 1.00 km/s,lsrk,RADIO |
| 96 | 96-140467 | 18:47:56, -01:29:17 | 1.00 km/s,lsrk,RADIO |
| 97 | 97-140704 | 18:49:30, -01:37:45 | 1.00 km/s,lsrk,RADIO |
| 98 | 98-141308 | 18:49:33, -01:29:04 | 1.00 km/s,lsrk,RADIO |
| 99 | 99-141636 | 18:48:06, -01:13:37 | 1.00 km/s,lsrk,RADIO |
| 100 | 100-142185 | 18:48:42, -01:09:59 | 1.00 km/s,lsrk,RADIO |
| 101 | 101-142250 | 18:50:11, -01:20:35 | 1.00 km/s,lsrk,RADIO |
| 102 | 102-142907 | 18:49:17, -01:03:39 | 1.00 km/s,lsrk,RADIO |
| 103 | 103-142916 | 18:48:45, -00:59:19 | 1.00 km/s,lsrk,RADIO |
| 104 | 104-143250 | 18:49:04, -00:57:14 | 1.00 km/s,lsrk,RADIO |
| 105 | 105-143913 | 18:49:22, -00:50:33 | 1.00 km/s,lsrk,RADIO |
| 106 | 106-G028.3271+0... | 18:42:26, -04:01:28 | 1.00 km/s,lsrk,RADIO |
| 107 | 107-G028.3373+0... | 18:42:37, -04:02:02 | 1.00 km/s,lsrk,RADIO |
| 108 | 108-G030.1981-00... | 18:47:03, -02:30:36 | 1.00 km/s,lsrk,RADIO |
| 109 | 109-G030.8715-00... | 18:48:02, -01:52:57 | 1.00 km/s,lsrk,RADIO |
| 110 | 110-G031.2803+0... | 18:48:12, -01:26:30 | 1.00 km/s,lsrk,RADIO |
| 111 | 111-G032.0518-00... | 18:50:09, -00:49:29 | 1.00 km/s,lsrk,RADIO |

Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 5 of 6 High-mass stars 4 Band 6

## Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.891 km/s, 3.7 GHz | 217.925000 GHz | 94.974 µJy, 15.3 mK | 3.750 GHz | XX,YY | No |

## Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 6.5 h | 2.8 h | 1.7 h | 8.9 " | 51 | offset | 26.7 " | 217.3 s | 753.7 GB | 39.4 MB/s |

## Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 11.6 h | 11.6 h | 0.0 h | 15.3 " | 51 | offset | 45.8 " | 503.0 s | 29.5 GB | 0.9 MB/s |

## Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.4 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.1 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.8 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

## 51 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-701007 | 13:01:26, -62:25:48 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-702356 | 13:05:31, -62:30:00 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-702472 | 13:05:52, -62:28:27 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-702831 | 13:06:59, -62:33:03 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-703167 | 13:07:53, -62:28:39 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-703373 | 13:08:25, -62:25:57 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-703396 | 13:08:27, -62:24:28 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-703465 | 13:08:37, -62:25:53 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-703466 | 13:08:31, -62:14:21 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-704225 | 13:10:21, -62:42:15 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-704454 | 13:10:42, -62:43:14 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-704779 | 13:11:14, -62:47:25 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-704792 | 13:11:13, -62:45:07 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-704824 | 13:11:11, -62:38:40 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-704833 | 13:11:09, -62:33:22 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-704955 | 13:11:18, -62:30:32 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-705051 | 13:11:29, -62:33:21 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-705084 | 13:11:32, -62:32:11 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-705194 | 13:11:53, -62:47:19 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-705229 | 13:11:44, -62:29:03 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-705424 | 13:12:15, -62:48:50 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-705450 | 13:11:48, -62:07:17 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-705483 | 13:11:51, -62:06:50 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-705723 | 13:12:32, -62:34:21 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-705736 | 13:12:35, -62:37:18 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-705768 | 13:12:36, -62:33:33 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-705852 | 13:12:42, -62:30:52 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-706044 | 13:13:05, -62:31:41 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-706276 | 13:13:45, -62:51:27 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-706291 | 13:13:26, -62:23:05 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-706608 | 13:13:57, -62:24:50 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-706708 | 13:14:20, -62:45:05 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-706733 | 13:14:22, -62:46:00 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-706785 | 13:14:26, -62:44:29 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-707313 | 13:15:25, -62:51:01 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-707463 | 13:15:31, -62:40:40 | 1.00 km/s,lsrk,RADIO |
| 37 | 37-707948 | 13:16:43, -62:58:32 | 1.00 km/s,lsrk,RADIO |
| 38 | 38-708080 | 13:16:48, -62:50:37 | 1.00 km/s,lsrk,RADIO |
| 39 | 39-708137 | 13:16:53, -62:48:38 | 1.00 km/s,lsrk,RADIO |
| 40 | 40-708358 | 13:17:15, -62:42:25 | 1.00 km/s,lsrk,RADIO |
| 41 | 41-708562 | 13:17:52, -62:52:50 | 1.00 km/s,lsrk,RADIO |
| 42 | 42-709153 | 13:19:08, -62:33:42 | 1.00 km/s,lsrk,RADIO |
| 43 | 43-709193 | 13:19:18, -62:33:55 | 1.00 km/s,lsrk,RADIO |
| 44 | 44-709982 | 13:21:28, -62:42:40 | 1.00 km/s,lsrk,RADIO |
| 45 | 45-711927 | 13:26:54, -62:03:01 | 1.00 km/s,lsrk,RADIO |
| 46 | 46-713364 | 13:32:32, -62:47:29 | 1.00 km/s,lsrk,RADIO |
| 47 | 47-713413 | 13:32:35, -62:45:29 | 1.00 km/s,lsrk,RADIO |
| 48 | 48-713784 | 13:32:53, -62:07:49 | 1.00 km/s,lsrk,RADIO |
| 49 | 49-G304.8872+00.... | 13:08:12, -62:10:22 | 1.00 km/s,lsrk,RADIO |
| 50 | 50-G305.2017+00.... | 13:11:10, -62:34:38 | 1.00 km/s,lsrk,RADIO |
| 51 | 51-G305.5393+00.... | 13:13:59, -62:25:07 | 1.00 km/s,lsrk,RADIO |

## Expected Source Properties

| | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.82 mJy, 1.9 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.5 | | | | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

## 1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 94.79 µJy, 15.3 mK | 94.79 uJy - 95.21 uJy |

Sensitivity Comments

Note that one or more of the S/N estimates are < 3. Please double-check the RMS and/or line fluxes entered and/or address the issue below.
Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
The S/N achieved for a resolution element that allows the line to be resolved will be lower than that reported.

Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources. This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

Justification of the chosen angular resolution and largest angular scale for the source(s) in this Science Goal.

We would like to get a resolution of about 0.4" to achieve a resolution of at least 2500 AU at all distances considered. This would allow to resolve the clusters sufficiently to determine the CMF, find large toroid-like rotating structures or circumbinary disks, and detect disk candidates for further studies. The largest scale is given by the desire to model the density and temperature structure on the clump scale, and to fully characterize the clumpßlevel

The configuration proposed by the OT for these requirements (C4-C1-ACA) has been verified to provide enough time for large programs to host our observations, if the sources can be spread out in an interval of +/- 3 h, as stated by the knowledge base, and verified by a helpdesk ticket. Thus, we do not exceed the time limit per LST interval for large programs, and our program poses no criticality in terms of scheduling feasibility for both requested configurations.

Correlator Comments

Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

Justification of the correlator set-up with particular reference to the number of spectral resolution elements per line width.

All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution. In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.

# 2018.1.00435.L

SG : 6 of 6 High-mass stars 5 Band 6

Science Goal Parameters

| Ang.Res. | LAS | Requested RMS | RMS Bandwidth | Rep.Freq. | Cont. RMS | Cont. Bandwidth | Poln.Prod. | Non-standard mode |
|---|---|---|---|---|---|---|---|---|
| 0.4000" | 30.0" | 100 µJy, 16.1 mK | 5158.77 km/s, 3.7 GHz | 217.925000 GHz | 91.725 µJy, 14.8 mK | 3.750 GHz | XX,YY | No |

Use of 12m Array (43 antennas)

| t_total(all configs) | t_science(C43-4) | t_total(C43-1) | Imaged area | #12m pointing | 12m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 9.9 h | 3.9 h | 2.5 h | 8.9 " | 77 | offset | 26.7 " | 217.1 s | 1135.8 GB | 39.5 MB/s |

Use of ACA 7m Array (10 antennas) and TP Array

| t_total(ACA) | t_total(7m) | t_total(TP) | Imaged area | #7m pointing | 7m Mosaic spacing | HPBW | t_per_point | Data Vol | Avg. Data Rate |
|---|---|---|---|---|---|---|---|---|---|
| 17.5 h | 17.5 h | 0.0 h | 15.3 " | 77 | offset | 45.8 " | 452.1 s | 44.5 GB | 0.9 MB/s |

Spectral Setup : Spectral Line

| BB | Center Freq Rest GHz | spw name | Eff #Ch p.p. | Bandwidth | Resolution | Vel. Bandwidth | Vel. Res. | Res. El. per FWHM |
|---|---|---|---|---|---|---|---|---|
| 1 | 217.925000 | Band 1 | 3840 | 1875.00 MHz | 0.977 MHz | 2579.4 km/s | 1.343 km/s | 1 |
| 2 | 220.000000 | Band 2 | 3840 | 1875.00 MHz | 0.977 MHz | 2555.1 km/s | 1.331 km/s | 1 |
| 3 | 218.300000 | H2CO lines | 3840 | 468.75 MHz | 244.141 kHz | 643.7 km/s | 0.335 km/s | 3 |
| 4 | 220.600000 | 13CO and CH3CN | 3840 | 468.75 MHz | 244.141 kHz | 637.0 km/s | 0.332 km/s | 3 |

77 Targets

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 1 | 1-776981 | 15:43:22, -54:21:33 | 1.00 km/s,lsrk,RADIO |
| 2 | 2-777339 | 15:42:00, -53:58:55 | 1.00 km/s,lsrk,RADIO |
| 3 | 3-777573 | 15:49:18, -55:16:52 | 1.00 km/s,lsrk,RADIO |
| 4 | 4-777707 | 15:47:50, -54:58:32 | 1.00 km/s,lsrk,RADIO |
| 5 | 5-777843 | 15:47:17, -54:50:35 | 1.00 km/s,lsrk,RADIO |
| 6 | 6-778177 | 15:45:53, -54:30:01 | 1.00 km/s,lsrk,RADIO |
| 7 | 7-778289 | 15:46:11, -54:31:16 | 1.00 km/s,lsrk,RADIO |
| 8 | 8-778664 | 15:43:33, -53:55:29 | 1.00 km/s,lsrk,RADIO |
| 9 | 9-778802 | 15:44:33, -54:05:31 | 1.00 km/s,lsrk,RADIO |
| 10 | 10-778839 | 15:44:16, -54:01:55 | 1.00 km/s,lsrk,RADIO |
| 11 | 11-778855 | 15:44:01, -53:58:45 | 1.00 km/s,lsrk,RADIO |
| 12 | 12-779459 | 15:45:39, -54:10:41 | 1.00 km/s,lsrk,RADIO |
| 13 | 13-779523 | 15:44:59, -54:02:21 | 1.00 km/s,lsrk,RADIO |
| 14 | 14-779698 | 15:45:26, -54:05:41 | 1.00 km/s,lsrk,RADIO |
| 15 | 15-779984 | 15:48:55, -54:40:38 | 1.00 km/s,lsrk,RADIO |
| 16 | 16-780104 | 15:46:21, -54:10:43 | 1.00 km/s,lsrk,RADIO |
| 17 | 17-780386 | 15:48:23, -54:29:15 | 1.00 km/s,lsrk,RADIO |
| 18 | 18-780504 | 15:48:33, -54:29:01 | 1.00 km/s,lsrk,RADIO |
| 19 | 19-780649 | 15:49:35, -54:37:54 | 1.00 km/s,lsrk,RADIO |
| 20 | 20-780892 | 15:49:56, -54:38:30 | 1.00 km/s,lsrk,RADIO |
| 21 | 21-781268 | 15:49:03, -54:23:34 | 1.00 km/s,lsrk,RADIO |
| 22 | 22-781345 | 15:49:07, -54:23:04 | 1.00 km/s,lsrk,RADIO |
| 23 | 23-781741 | 15:49:11, -54:17:30 | 1.00 km/s,lsrk,RADIO |
| 24 | 24-781827 | 15:50:40, -54:32:01 | 1.00 km/s,lsrk,RADIO |
| 25 | 25-781938 | 15:50:53, -54:31:47 | 1.00 km/s,lsrk,RADIO |
| 26 | 26-781946 | 15:47:14, -53:51:26 | 1.00 km/s,lsrk,RADIO |
| 27 | 27-782096 | 15:50:54, -54:28:41 | 1.00 km/s,lsrk,RADIO |
| 28 | 28-782264 | 15:51:00, -54:26:50 | 1.00 km/s,lsrk,RADIO |
| 29 | 29-782293 | 15:51:29, -54:31:22 | 1.00 km/s,lsrk,RADIO |
| 30 | 30-782519 | 15:52:28, -54:36:07 | 1.00 km/s,lsrk,RADIO |
| 31 | 31-782569 | 15:51:20, -54:22:57 | 1.00 km/s,lsrk,RADIO |
| 32 | 32-783177 | 15:50:24, -54:01:10 | 1.00 km/s,lsrk,RADIO |
| 33 | 33-783304 | 15:50:18, -53:57:05 | 1.00 km/s,lsrk,RADIO |
| 34 | 34-783350 | 15:49:19, -53:45:12 | 1.00 km/s,lsrk,RADIO |
| 35 | 35-783681 | 15:53:43, -54:24:44 | 1.00 km/s,lsrk,RADIO |
| 36 | 36-784256 | 15:53:57, -54:14:02 | 1.00 km/s,lsrk,RADIO |
| 37 | 37-784393 | 15:52:59, -54:00:47 | 1.00 km/s,lsrk,RADIO |
| 38 | 38-784481 | 15:51:34, -53:43:24 | 1.00 km/s,lsrk,RADIO |
| 39 | 39-784611 | 15:54:33, -54:12:33 | 1.00 km/s,lsrk,RADIO |
| 40 | 40-784674 | 15:55:21, -54:19:53 | 1.00 km/s,lsrk,RADIO |
| 41 | 41-784722 | 15:54:38, -54:11:26 | 1.00 km/s,lsrk,RADIO |
| 42 | 42-784793 | 15:49:08, -53:09:41 | 1.00 km/s,lsrk,RADIO |
| 43 | 43-784890 | 15:54:38, -54:08:09 | 1.00 km/s,lsrk,RADIO |
| 44 | 44-784966 | 15:52:33, -53:44:28 | 1.00 km/s,lsrk,RADIO |
| 45 | 45-784993 | 15:52:39, -53:45:16 | 1.00 km/s,lsrk,RADIO |
| 46 | 46-785085 | 15:52:35, -53:43:06 | 1.00 km/s,lsrk,RADIO |
| 47 | 47-785119 | 15:53:01, -53:47:06 | 1.00 km/s,lsrk,RADIO |
| 48 | 48-785411 | 15:52:57, -53:40:53 | 1.00 km/s,lsrk,RADIO |
| 49 | 49-785620 | 15:56:45, -54:16:25 | 1.00 km/s,lsrk,RADIO |
| 50 | 50-785707 | 15:56:21, -54:10:29 | 1.00 km/s,lsrk,RADIO |
| 51 | 51-786059 | 15:54:52, -53:47:24 | 1.00 km/s,lsrk,RADIO |
| 52 | 52-786316 | 15:52:13, -53:13:09 | 1.00 km/s,lsrk,RADIO |
| 53 | 53-786375 | 15:56:12, -53:54:45 | 1.00 km/s,lsrk,RADIO |
| 54 | 54-786495 | 15:54:27, -53:33:43 | 1.00 km/s,lsrk,RADIO |
| 55 | 55-786515 | 15:52:35, -53:12:59 | 1.00 km/s,lsrk,RADIO |
| 56 | 56-786608 | 15:52:38, -53:12:02 | 1.00 km/s,lsrk,RADIO |
| 57 | 57-786678 | 15:53:50, -53:24:03 | 1.00 km/s,lsrk,RADIO |
| 58 | 58-786900 | 15:54:31, -53:27:11 | 1.00 km/s,lsrk,RADIO |
| 59 | 59-787062 | 15:57:55, -54:00:09 | 1.00 km/s,lsrk,RADIO |
| 60 | 60-787212 | 15:57:59, -53:57:59 | 1.00 km/s,lsrk,RADIO |

Expected Source Properties

|  | Peak Flux | SNR | Linewidth | RMS (over 1/3 linewidth) | linewidth / bandwidth used for sensitivity | Pol. | Pol. SNR |
|---|---|---|---|---|---|---|---|
| Line | 1.00 mJy | 0.1 | 1 km/s | 11.41 mJy, 1.8 K | 0.0002 | 0.0% | 0.0 |
| Continuum | 1.00 mJy | 10.9 |  |  |  | 0.0% | 0.0 |

Dynamic range (cont flux/line rms): 0.1

1 Tuning

| Tuning | Target | Rep. Freq. Sky GHz | RMS (Rep. Freq.) | RMS Achieved |
|---|---|---|---|---|
| 1 | 1,2,3,4,5,6,7,8,9,1... | 217.924273 | 91.59 µJy, 14.7 mK | 91.59 uJy - 91.98 uJy |

| No. | Target | Ra,Dec ( ICRS ) | V,def,frame --OR--z |
|---|---|---|---|
| 61 | 61-787345 | 15:56:01, -53:34:35 | 1.00 km/s,lsrk,RADIO |
| 62 | 62-787536 | 15:54:18, -53:12:46 | 1.00 km/s,lsrk,RADIO |
| 63 | 63-787643 | 15:55:46, -53:26:50 | 1.00 km/s,lsrk,RADIO |
| 64 | 64-787699 | 15:58:08, -53:50:55 | 1.00 km/s,lsrk,RADIO |
| 65 | 65-787947 | 15:56:55, -53:32:39 | 1.00 km/s,lsrk,RADIO |
| 66 | 66-787998 | 15:54:02, -53:00:17 | 1.00 km/s,lsrk,RADIO |
| 67 | 67-788845 | 15:55:28, -52:55:58 | 1.00 km/s,lsrk,RADIO |
| 68 | 68-788890 | 15:56:36, -53:06:52 | 1.00 km/s,lsrk,RADIO |
| 69 | 69-789652 | 15:58:50, -53:14:35 | 1.00 km/s,lsrk,RADIO |
| 70 | 70-789993 | 15:57:28, -52:52:42 | 1.00 km/s,lsrk,RADIO |
| 71 | 71-790555 | 15:55:21, -52:18:57 | 1.00 km/s,lsrk,RADIO |
| 72 | 72-790568 | 15:55:29, -52:20:11 | 1.00 km/s,lsrk,RADIO |
| 73 | 73-G326.4755+00.... | 15:43:18, -54:07:35 | 1.00 km/s,lsrk,RADIO |
| 74 | 74-G326.6618+00.... | 15:45:02, -54:09:03 | 1.00 km/s,lsrk,RADIO |
| 75 | 75-G327.1192+00.... | 15:47:32, -53:52:39 | 1.00 km/s,lsrk,RADIO |
| 76 | 76-G327.9455-00.... | 15:54:34, -53:50:42 | 1.00 km/s,lsrk,RADIO |
| 77 | 77-G328.5487+00.... | 15:56:01, -53:09:43 | 1.00 km/s,lsrk,RADIO |

Sensitivity Comments

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Note that the bandwidth used for sensitivity is larger than 1/3 of the linewidth.
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Justification for requested RMS and resulting S/N (and for spectral lines the bandwidth selected) for the sensitivity calculation.

A sensitivity of 100 µJy at 1.37 mm wavelength delivers a mass sensitivity of nearly 0.1 Msun using dust opacities form Ossenkopf & Henning with beta=2 and dust temperature of 17 K at 7 kpc, the maximum distance to our sources.  This would allow to safely detect 0.3 M_sun sources, while our total source masses have a cutoff of 500 M_sun, so even with severe fragmentation we would discover all the fragments. With this, we will be able to sample the peak of a typical CMF in a low/intermediate-mass SF region like Aquila. Although in some cases we may be limited by the dynamic range, simulations are very successful in recovering all scales, as shown in Fig.2 in the proposal. Also, we found from past experience that self-cal can improve the dynamic range considerably.

For the lines maps, a spectral resolution of 0.5 km/s and a spatial resolution of 0.4" give a 1 sigma rms of 1.4 K, which is as shown in Fig. 2, is sufficient to analyze the line emission even in weaker cores, and could be further enhanced by spectral smoothing. Fig. 2 is based on real ALMA observations of a high-mass star-forming region. We will not be able to analyze the lines of all sources in that manner, but we expect that we will be able to do the analysis in enough sources to be worthwhile, and use 13CO in the ones weaker in H2CO or CH3CN.

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Note that the spectral resolution is larger than 1/3 of the the spectral line width and that your line may not be resolved.

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All lines are covered by wide correlator units (1.8 GHz each) to increase the continuum sensitivity. The velocity resolution offered by this configuration (1.3 km/s) is not quite good enough for line shape analysis though, so we have to add two higher resolution units to a subset of lines 13CO and CH3CN, and two H2CO lines, respectively) to get 0.5 km/s resolution.  In Fig. 2 we show that the noise level we will achieve does allow a profile analysis even for our short integration time, as the lines are going to be strong. This setup optimizes the scientific return in both continuum and lines.