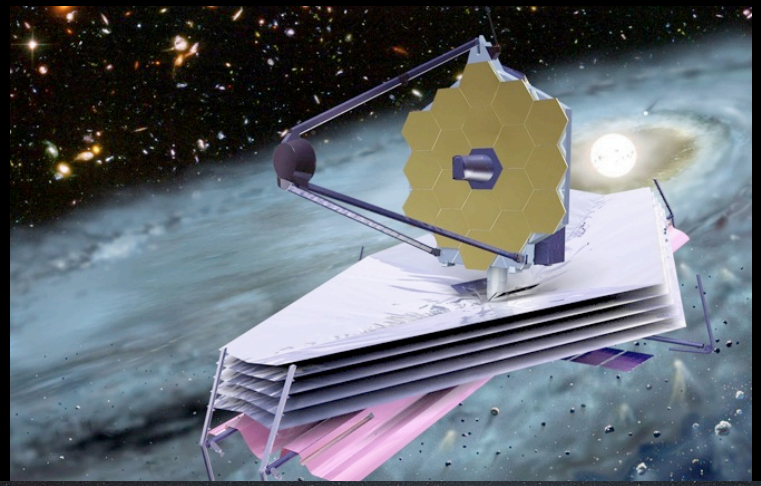
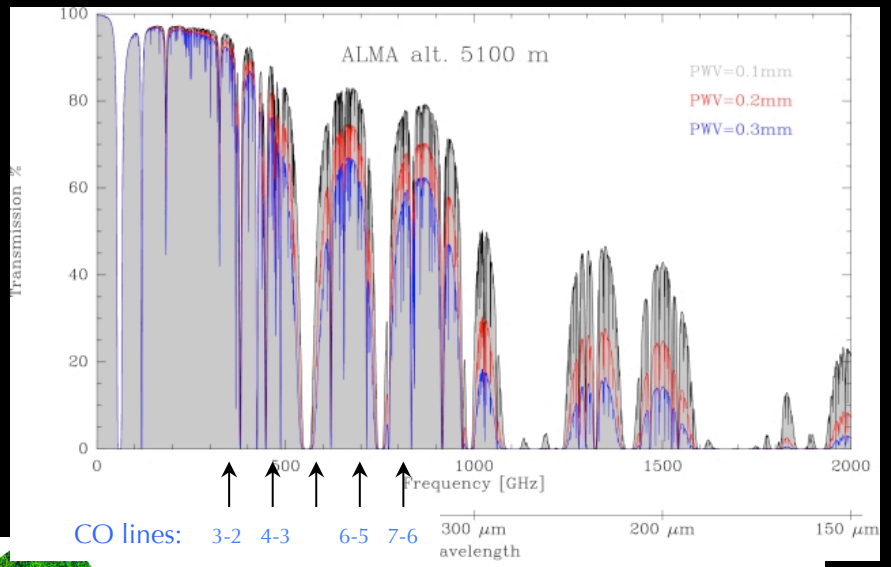
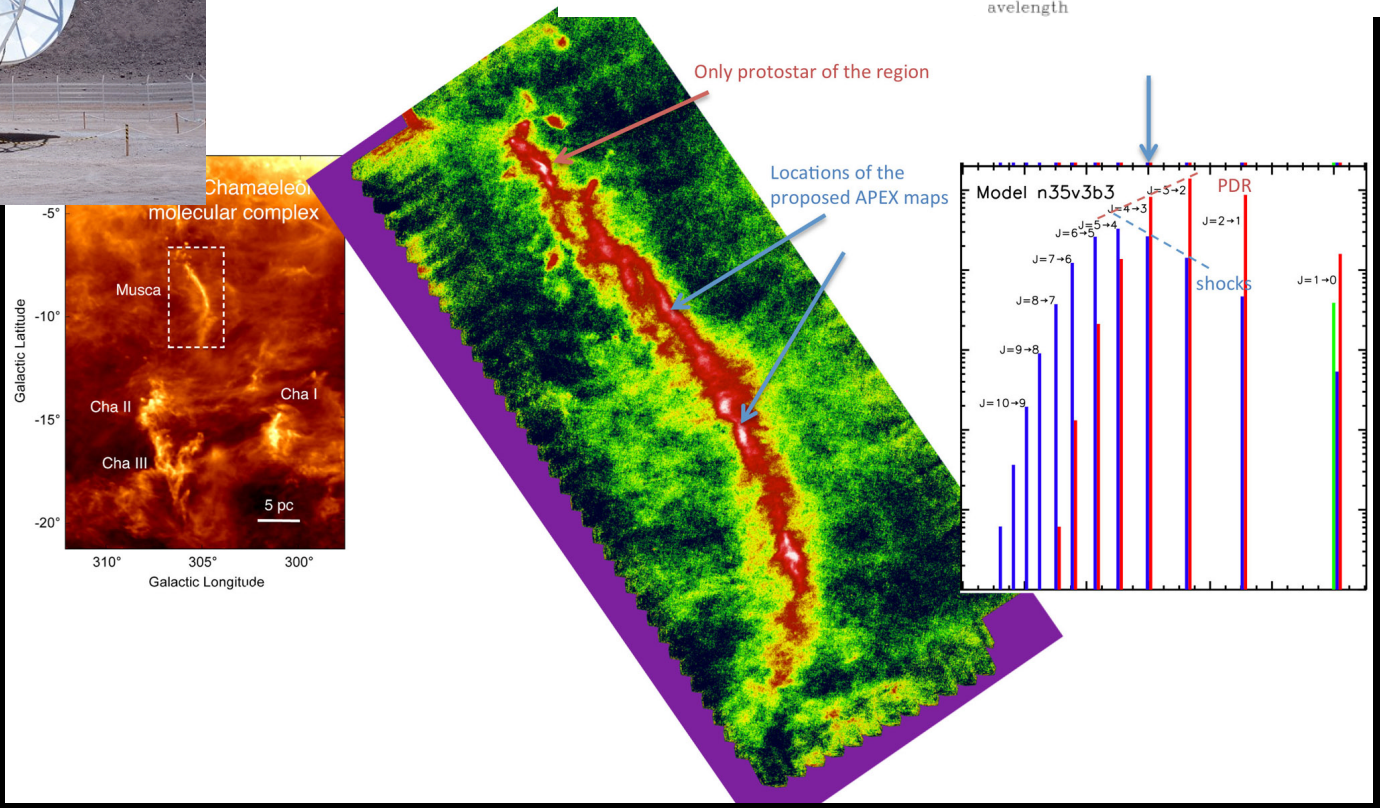
GENESIS – Observational opportunities



APEX


ALMA alt. 5100 m
PWV=0.1mm
PWV=0.2mm
PWV=0.3mm
Transmission %
Frequency [GHz]
CO lines: 3-2 4-3 6-5 7-6
300 μm
200 μm
150 μm
avelength


Only protostar of the region
Locations of the proposed APEX maps
Chamaeleon molecular complex
Musca
Cha I
Cha II
Cha III
5 pc
Galactic Latitude
Galactic Longitude
-5°
-10°
-15°
-20°
310°
305°
300°
Model n35v3b3
PDR
shocks
J=1→0
J=2→1
J=3→2
J=4→3
J=5→4
J=6→5
J=7→6
J=8→7
J=9→8
J=10→9

APEX

Facility instruments

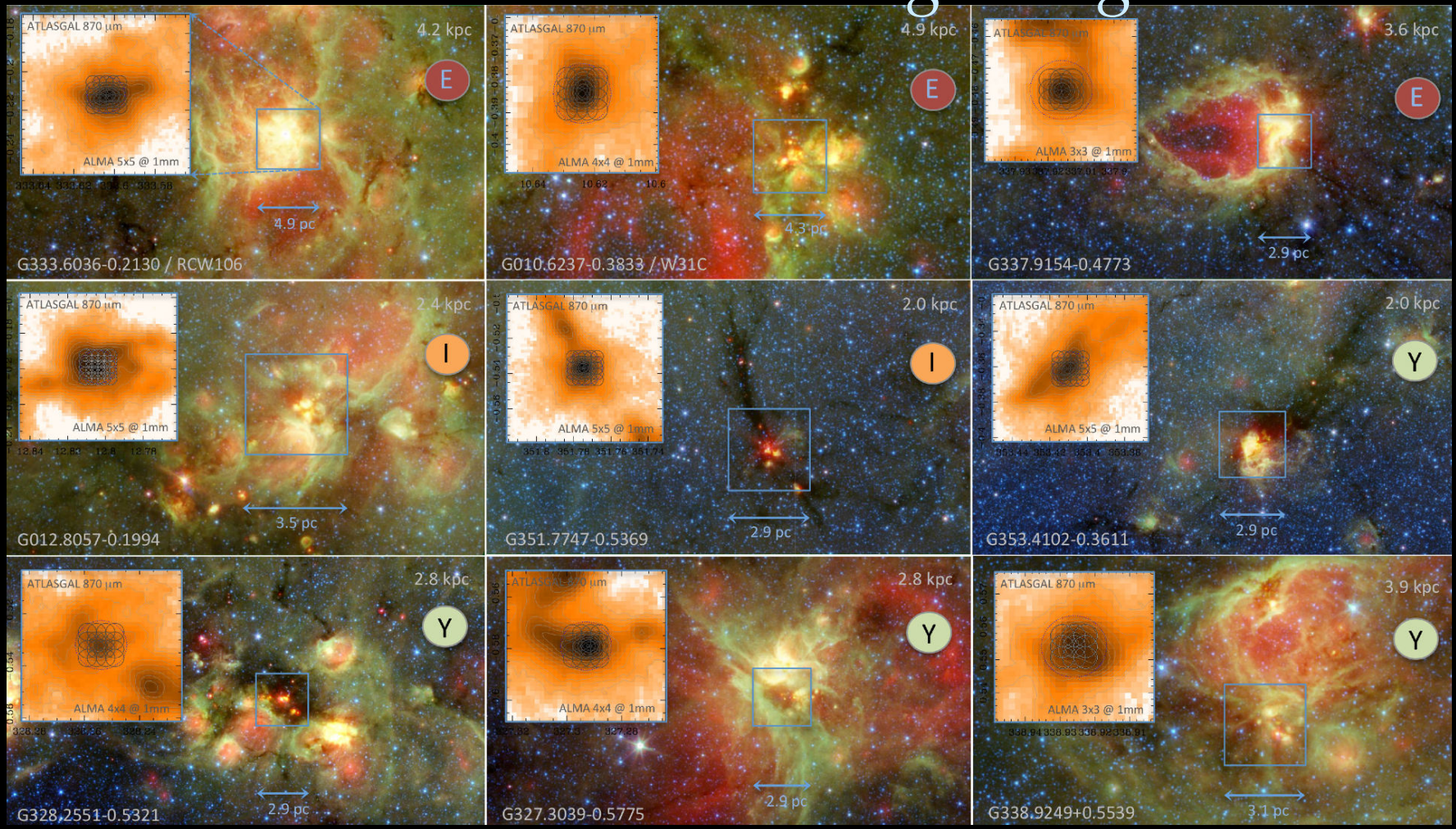
Instrument	Type	Mode	Frequency [GHz]	HPBW [arcsec]	IF range [GHz]	# of beams	Location	Status	Comment
APEX-1 *(SHeFI)*	Heterodyne SIS	SSB	213 - 275	30 - 25	4 - 8	1	Nasmyth-A	✓	Decommissioned from Oct 2017
APEX-2 *(SHeFI)*	Heterodyne SIS	SSB	267 - 378	23 - 17	4 - 8	1	Nasmyth-A	✓	Decommissioned from Oct 2017
APEX-3 *(SHeFI)*	Heterodyne SIS	DSB	385 - 506	17 - 13	4 - 8	1	Nasmyth-A	✓	Decommissioned from Oct 2017
APEX-T2 *(SHeFI)*	Heterodyne HEB	DSB	1250 - 1390	5	2 - 4	1	Nasmyth-A	✗	Science Verification pending
LABOCA	Bolometer array		345	19		295	Cassegrain	✓	
SABOCA	Bolometer array		850	8		39	Cassegrain	✗	warmed up
APEX-2A	Heterodyne SIS	DSB	279 - 381	18	4 - 8	1	Nasmyth-A	✗	Decommissioned in Feb 2008 and replaced by APEX-2

Instrument	Type	Usage	Frequency [GHz]	HPBW [arcsec]	# of beams	Location	Status	Comment
FLASH+	Heterodyne SIS	PI (MPIfR)	268-374	17-22	1	Nasmyth-A	✓	
			374-516	12-14	1		✓	
CHAMP+	Heterodyne SIS	PI (MPIfR)	620-720	9-7	7	Nasmyth-B	✓	
			780-950	7-6	7		✓	
ASZCA	Bolometer array	PI (MPIfR)	150	42	330	Cassegrain	✗	Decommissioned in December 201
ARTEMIS+	Bolometer array	PI (ESO)	1499 (200 µm)	4	288 * 8	Cassegrain	✗	not available yet
			856 (350 µm)	7			✓	Commissioning June 2013
			666 (450 µm)	9			✗	not available yet
PolKa	Polarimeter	PI (MPIfR)	345	19	295	Cassegrain	✗	Commissioning pending
SEPIA	Heterodyne SIS	PI (ESO/Swedish)	159-211 (Band 5)	30-39	1	Nasmyth-A	✓	Commissioning February/March 201
			272-376 (Band 7)	17-23	1	Nasmyth-A	✗	Installation in 2018
			600-722 (Band 9)	10-9	1	Nasmyth-A	✓	DSB version available

Possible ideas :

- A deep investigation of a piece of Musca-like case.
- Deep unbiased spectral survey with IRAM 30m to get hints on the possible chemical tracers of shocks.
- APEX large program in CO(4-3).
- ALMA-ACA in CO(6-5).
- JCMT H2 line imaging.

ALMA-IMF – ALMA large Program

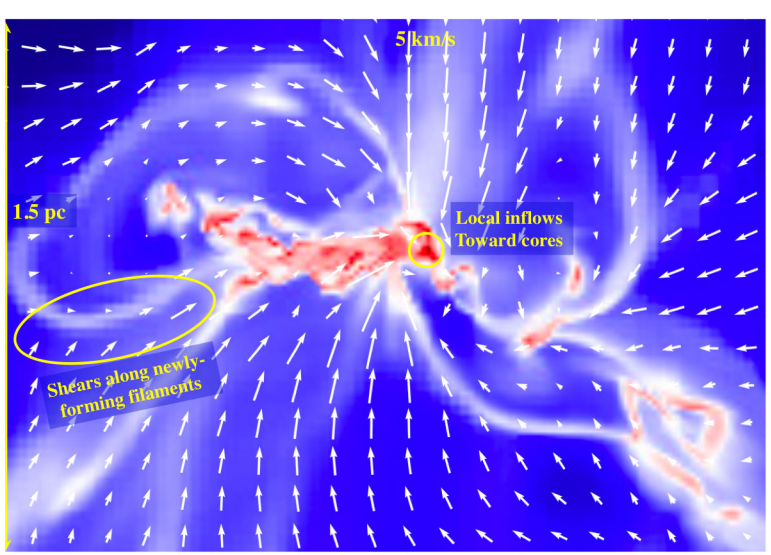


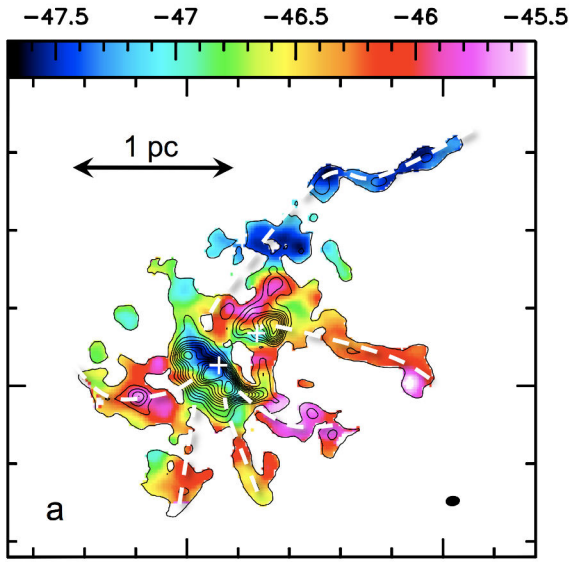
In a nutshell :

- 15 proto-clusters
- 65 hrs of 12m
- 1 and 3 mm mosaics; 2000 AU spatial resolution.

Table 1: *Complete sample of massive protoclusters at <6 kpc, of various evolutionary stages*

Name	d [kpc]	M(<pc^2) [$M_\odot$]	L_{bol}/M [$L_\odot/M_\odot$]	Mosaic, Resol ["×", "]	1σ 1/3mm [μJy/beam]	Req. time 1mm+3mm	Resp. region
Young protoclusters							
G030.82=W43-MM1	5.5	16×10^3	3.9	120 × 80, 0.37	−/30	0 + 5.3 hr	EU
G338.93	3.9	8.0×10^3	9.3	55 × 55, 0.51	200/60	1 + 1.2 hr	EA
G327.29	2.8	6.5×10^3	10	70 × 70, 0.67	300/90	0.6 + 0.7 hr	EA
G030.70=W43-MM2	5.5	13×10^3	11	60 × 60, 0.37	100/30	3.1 + 5.3 hr	CL
G328.25	2.8	4.2×10^3	13	70 × 70, 0.67	300/90	0.6 + 0.7 hr	EU
G353.41	2.0	3.3×10^3	13	100 × 100, 0.95	600/180	0.6 + 0.7 hr	NA
G008.67	3.4	2.7×10^3	16	70 × 70, 0.67	300/90	0.6 + 0.7 hr	EA
Intermed protoclusters							
G049.49M=W51-E	5.4	22×10^3	25	60 × 60, 0.37	100/30	3.6 + 4.1 hr	NA
G351.77	2.0	2.2×10^3	29	100 × 100, 0.95	600/180	0.6 + 0.7 hr	EU
G030.72=W43-MM3	5.5	6.6×10^3	30	60 × 60, 0.37	100/30	3.2 + 5.3 hr	EU
G012.80=W33	2.4	5.2×10^3	46	100 × 100, 0.95	600/180	0.6 + 0.7 hr	CL
Evolved protoclusters							
G337.92	3.6	3.0×10^3	50	55 × 55, 0.51	200/60	1.0 + 1.2 hr	EA
G010.62=W31C	4.9	7.4×10^3	54	60 × 60, 0.37	100/30	4.7 + 3.4 hr	NA
G049.49=W51-IRS2	5.4	14×10^3	69	60 × 60, 0.37	100/30	3.7 + 4.1 hr	NA
G333.60	4.2	13×10^3	130	110 × 110, 0.51	200/60	3.2 + 1.9 hr	CL





from detected cores. To resolve the ∼2000 AU typical diameter of cores (Bontemps et al. 2010; Palau et al. 2013) and image the ∼1–2 pc^2 protocluster extent, we will make 1 mm and 3 mm mosaics (extents in **Table 1**) with $0.4'' - 1''$ synthesized beams depending on the distance. We chose **1 mm and 3 mm spectral bands** primarily for their mostly optically thin emission in massive cores and their well-defined dust emissivity ($\kappa_{1\mathrm{mm}} = 0.01$ cm^2 g^{-1} and $\kappa_{3\mathrm{mm}} = 0.003$ cm^2 g^{-1}). The chosen setups cover, among the main lines, **^{12}CO(2-1) and N_2H^+(1-0)** to measure gas mass outflows and inflows, **^{13}CS and N_2D^+** to estimate core turbulence levels, the **H41α** recombination line to identify HII regions, and **CH_3OH, CH_3CN, and CH_3CCH** to probe gas temperature. Combining ALMA with ACA (+TP) is necessary for a proper analysis of outflows and inflows. For each protocluster, we will follow an analysis strategy in five steps, defined for the W43-MM1 project: