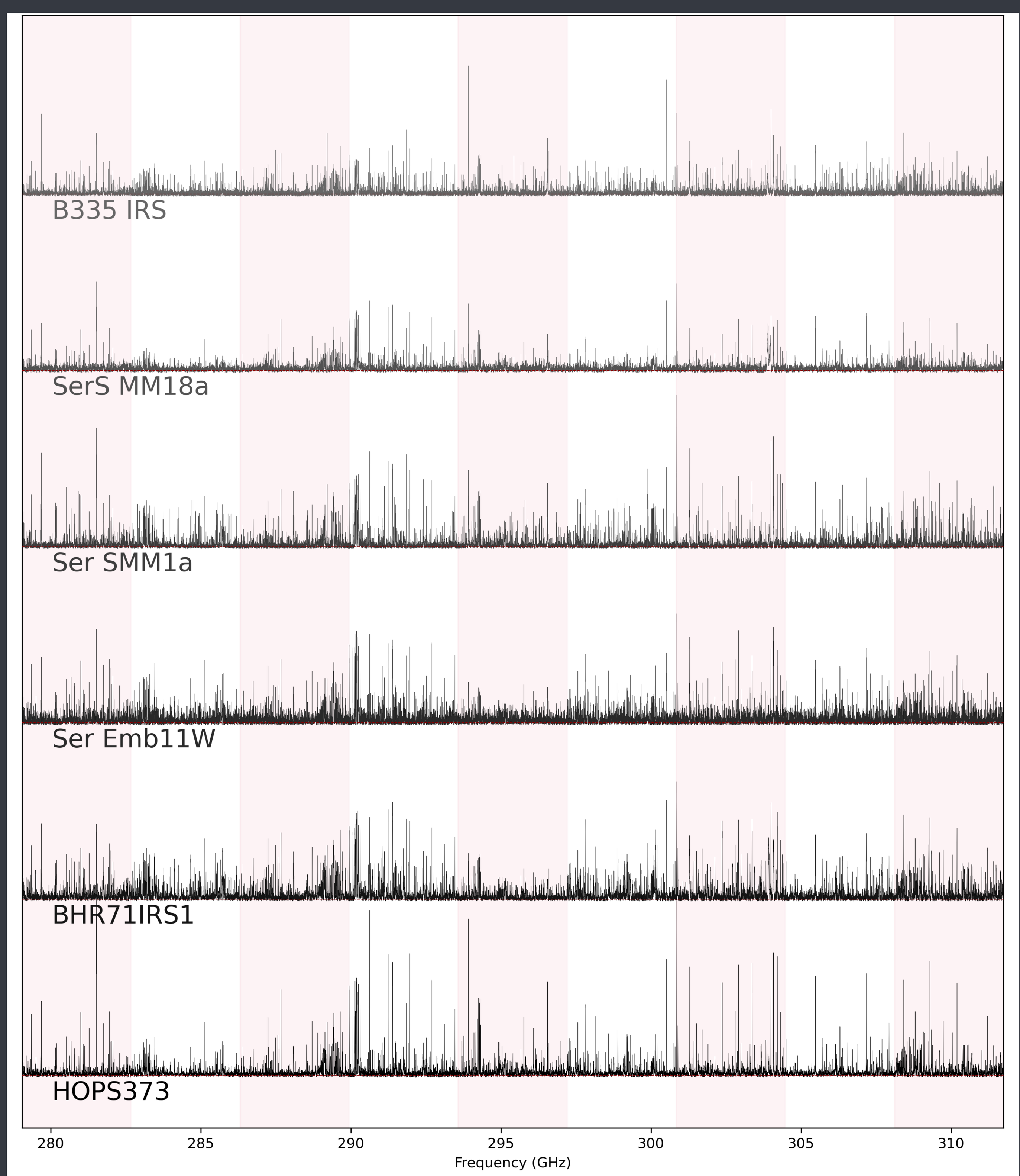
Complex Organic Molecules in Protostars with ALMA Spectral Surveys

An Approach to Data Reduction and Products for an ALMA Large Program



33 GHz

Figure 1: Sample spectra of 6 (of 11) sources targeted by COMPASS with ALMA.

Vertical shading roughly represents 9 tunings ("Scheduling Block") for each source, with ~0.5 km/s channels.

Adapted from Jorgensen et al. (in prep)

COMPASS frequency coverage is (coincidentally) comparable to the WSU expected B7 bandwidth.

On behalf of the COMPASS team

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*(**bold** indicates workshop SOC/ participants)*

About COMPASS

COMPASS (Complex Organic Molecules in Protostars with ALMA Spectral Surveys) is an unbiased spectral survey of 11 Class 0 and I protostellar sources in the spectral range between 279.0 and 311.7 GHz at 0.15-0.5" angular resolution with an ALMA Large Program (2022.1.00316.L). The regions encompass isolated and clustered sources within <500 pc, known to show compact emission from complex organic molecules.

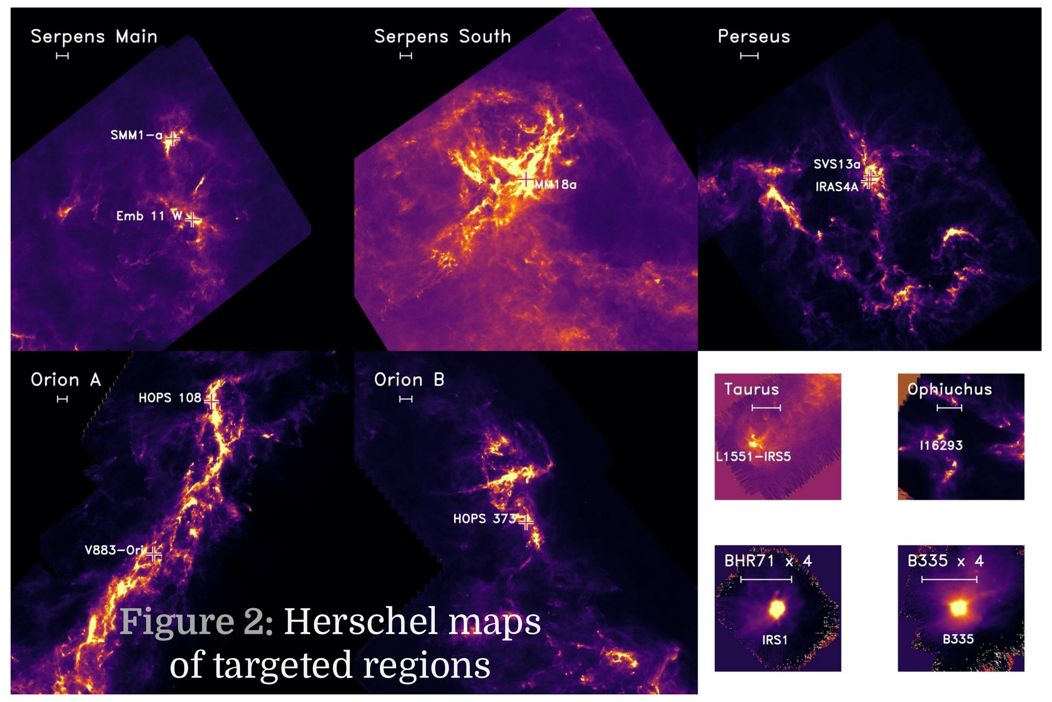


Figure 2: Herschel maps of targeted regions

Source	Phase center		$\overline{\mathrm{HPBW}}$	$\overline{\sigma}$
	RA (J2000)	Dec (J2000)	(″)	(mJy bm^{-1})
NGC 1333-SVS13A	03:29:03.756	31:16:03.73	0.16	2.20
NGC 1333-IRAS4A	03:29:10.432	31:13:32.05	0.33	2.51
L1551-IRS5	04:31:34.160	18:08:04.72	0.15	2.19
HOPS 108	05:35:27.084	−05:10:00.07	0.36	2.64
V883-Ori	05:38:18.100	−07:02:26.00	0.37	2.64
HOPS 373-B	05:46:30.905	−00:02:35.20	0.37	2.56
BHR71-IRS1	12:01:36.499	−65:08:49.38	0.39	2.17
Serpens emb 11 W	18:29:06.720	+00:30:34.30	0.37	2.64
Serpens SMM1a	18:29:49.793	+01:15:20.20	0.37	2.67
Serpens South-MM18a	18:30:04.118	−02:03:02.55	0.37	2.69
B335 IRS	19:37:00.894	+07:34:09.59	0.40	2.15

For a given source, $\overline{\mathrm{HPBW}}$ is the average "geometric mean" of the beamsize, and $\overline{\sigma}$ is the average noise.

See Plunkett et al., Jorgensen et al. in prep

Observations and Data Reduction

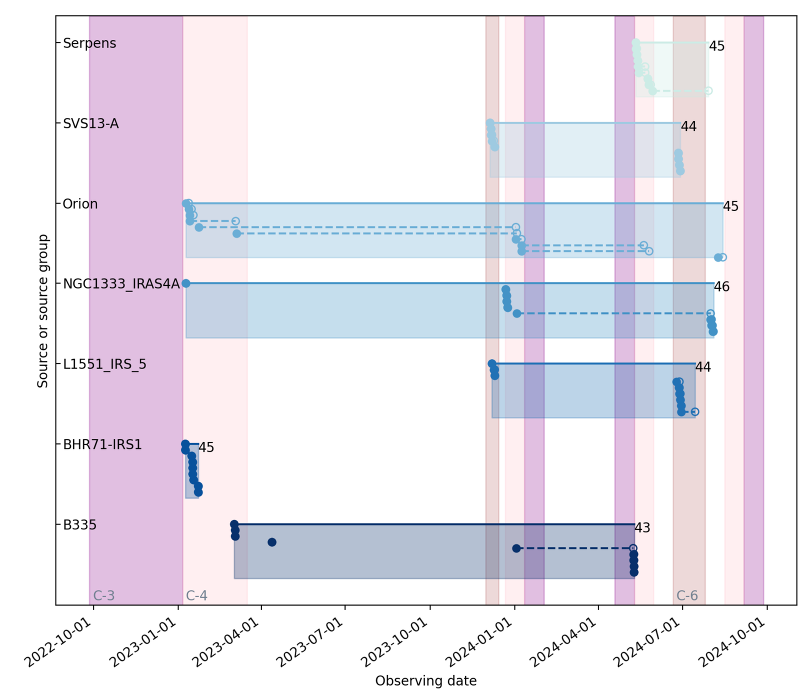


Figure 3: Observations were carried out over roughly 1.5 years and several configurations at ALMA. Each source was observed with 9 tunings; each tuning took ~1-3 hours total.

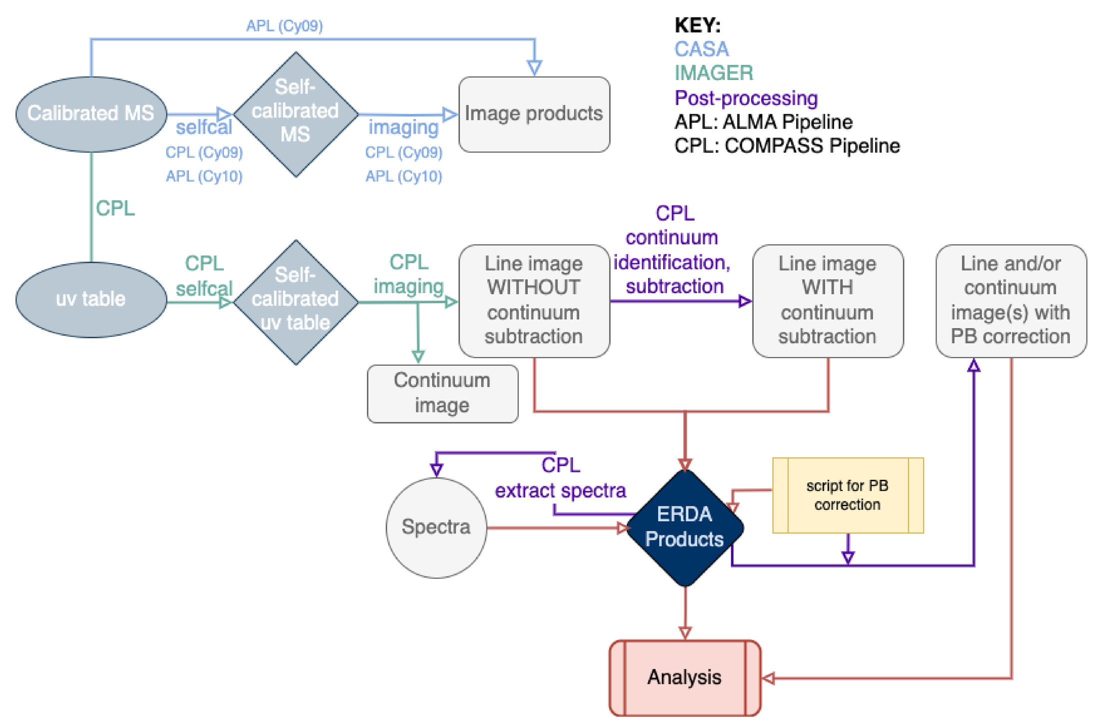
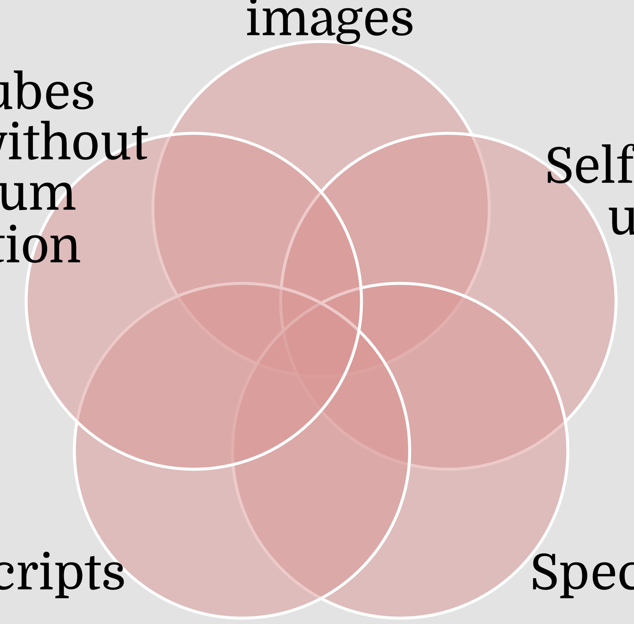


Figure 4: The data pipeline above utilized a combination of both CASA (calibration, CASA Team et al. 2022) and IMAGER (imaging, https://imager.oasu.u-bordeaux.fr). The IMAGER steps were run on the Dahu cluster at GRICAD (https://gricad.univ-grenoble-alpes.fr/index_en.html).

Data sets for analysis



Advanced data products will be delivered via the ALMA Science Archive and the team website.

Outlook

ALMA WSU in Band 7 (32 GHz bandwidth) will make a study like this possible with **~two tunings per source**, no longer requiring a Large Program to survey multiple sources.

Upcoming paper (Plunkett et al. in prep) describes complete data reduction process. See Jorgensen et al. (in prep) for project overview.

6+ other astrochemical studies among the "first generation" publications by the team expected in coming months!