Introduction to ALMA

George J. Bendo
UK ALMA Regional Centre Node
Jodrell Bank Centre for Astrophysics
The University of Manchester

This presentation/publication has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730562 [RadioNet].

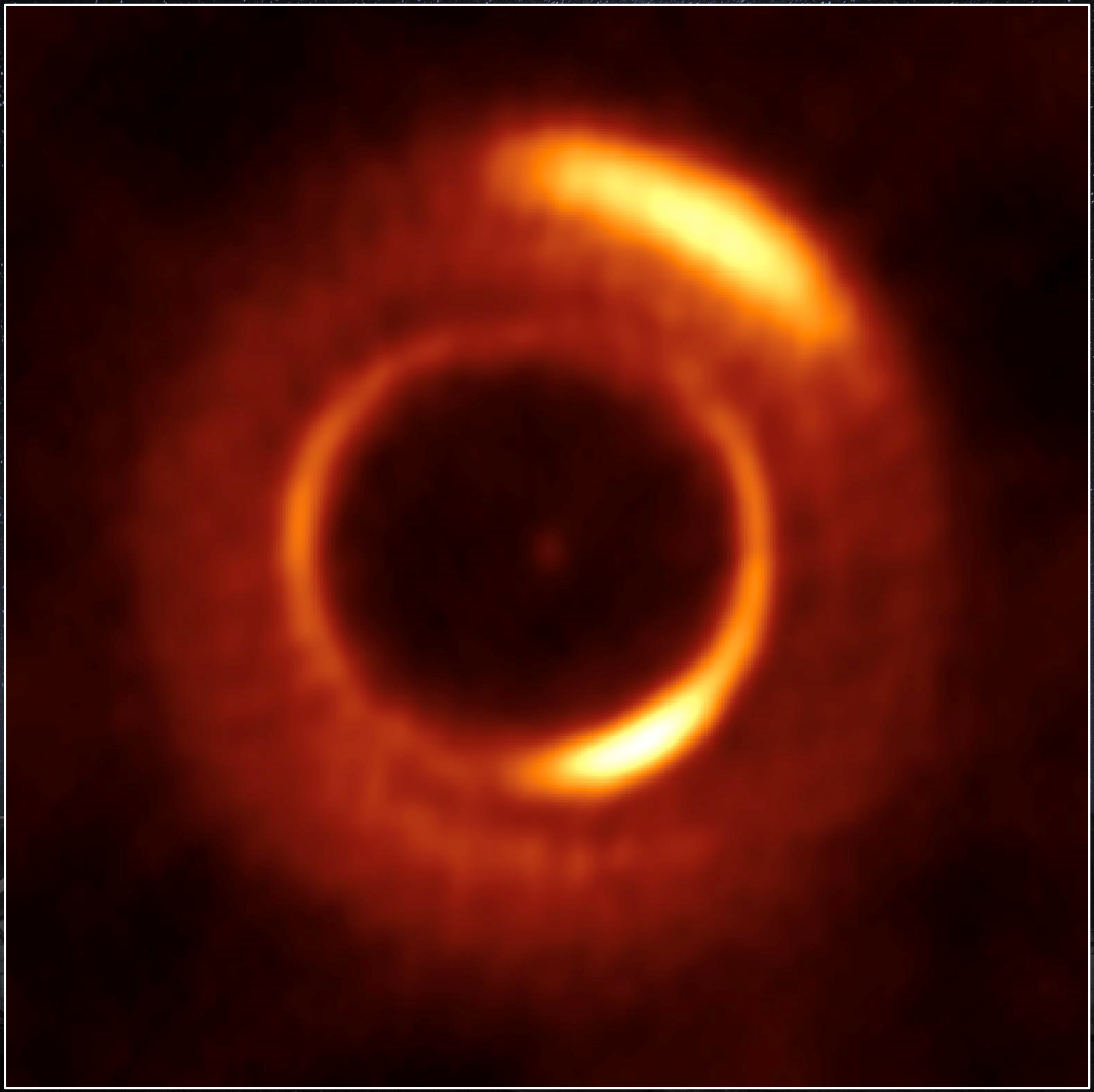
ALMA is a submillimetre/millimetre telescope in Chile designed to observe at 0.32–9.5 mm (31–950 GHz).

The primary emission sources it detects are:

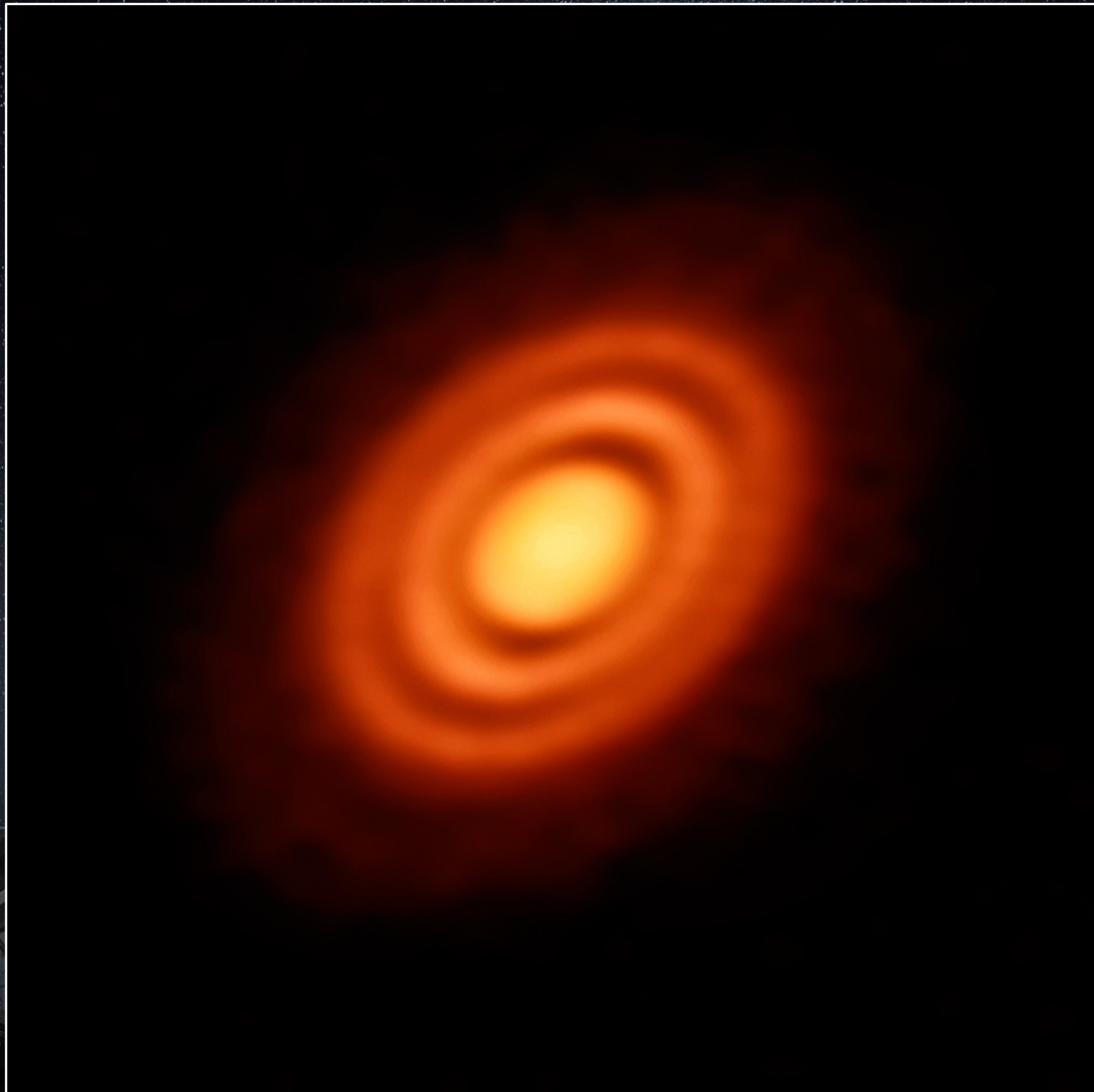
- Thermal (modified blackbody) dust continuum emission
- Molecular spectral line emission
- Free-free continuum emission

ALMA science goals

- Study objects in the solar system at millimetre wavelengths.
- Image the gas and dust in dense molecular clouds and protostellar discs.
- Observe the formation of dust and molecules around evolved stellar objects.
- Map dust and molecular gas in nearby galaxies.
- Detect dust and spectral line emission from high-redshift galaxies.

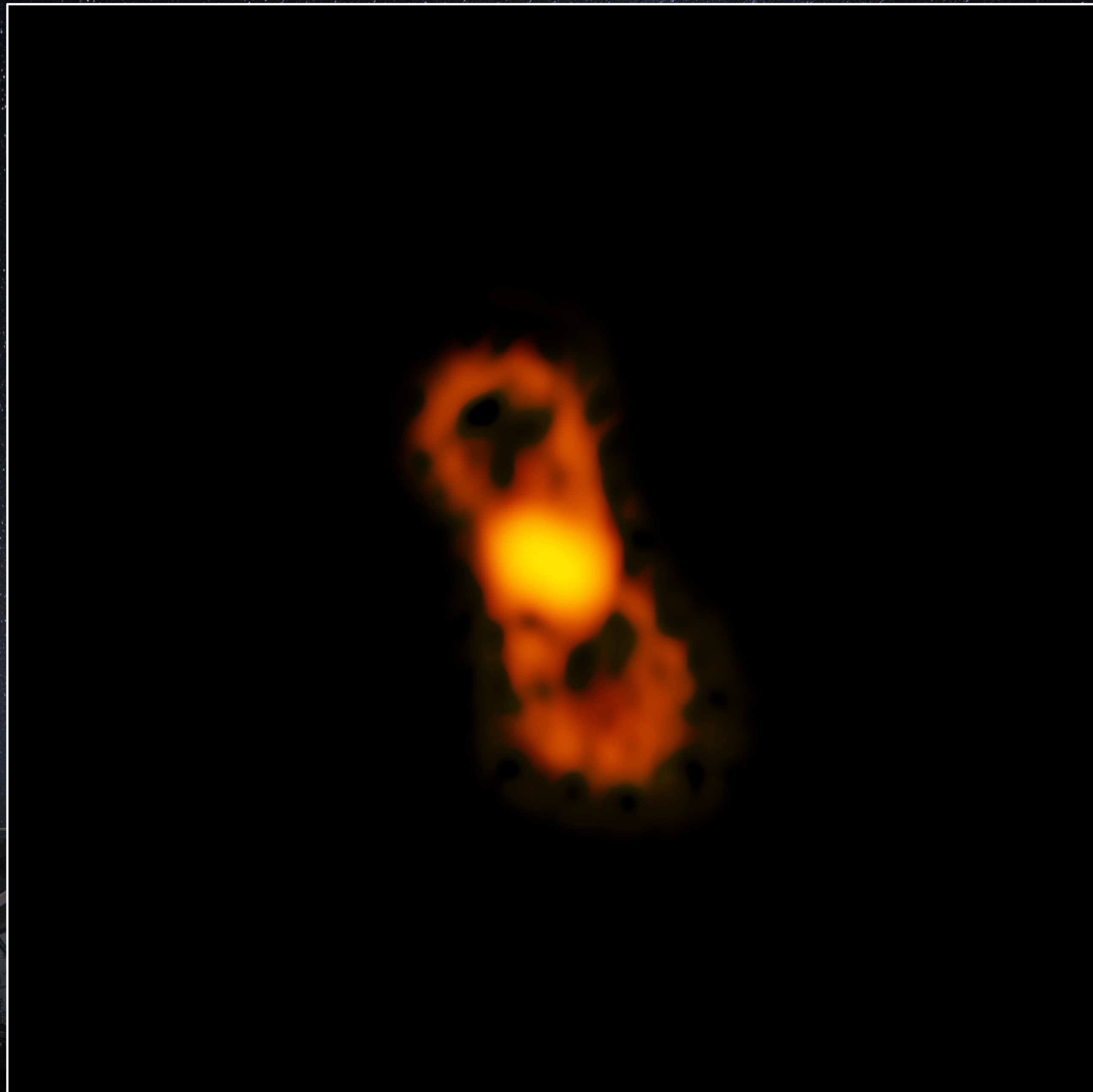


MWC 758
Credit: ALMA (ESO/NAOJ/NRAO)/Dong et al.



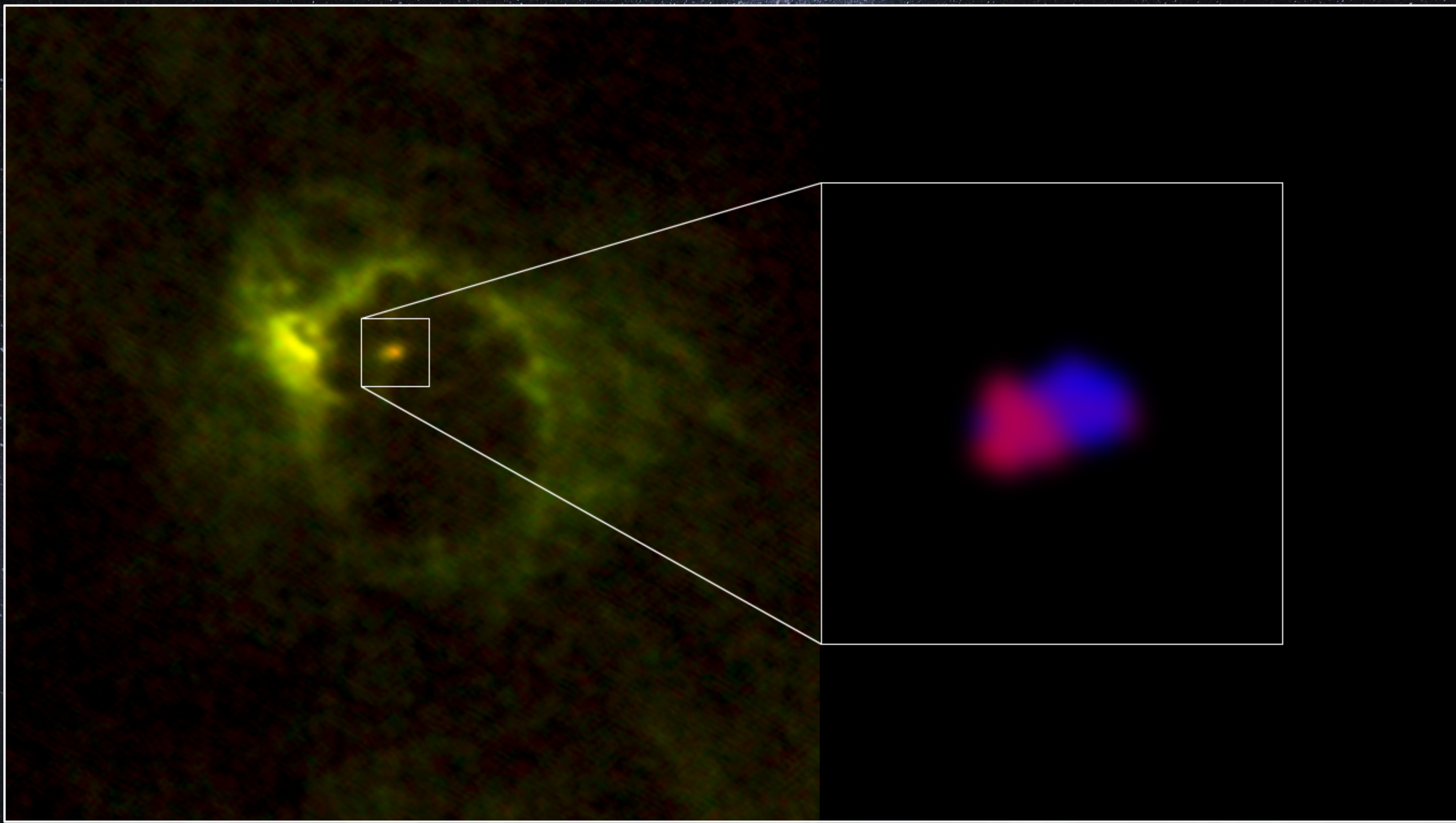
HD 163296

Credit: ESO, ALMA (ESO/NAOJ/NRAO); A. Isella; B. Saxton (NRAO/AUI/NSF)



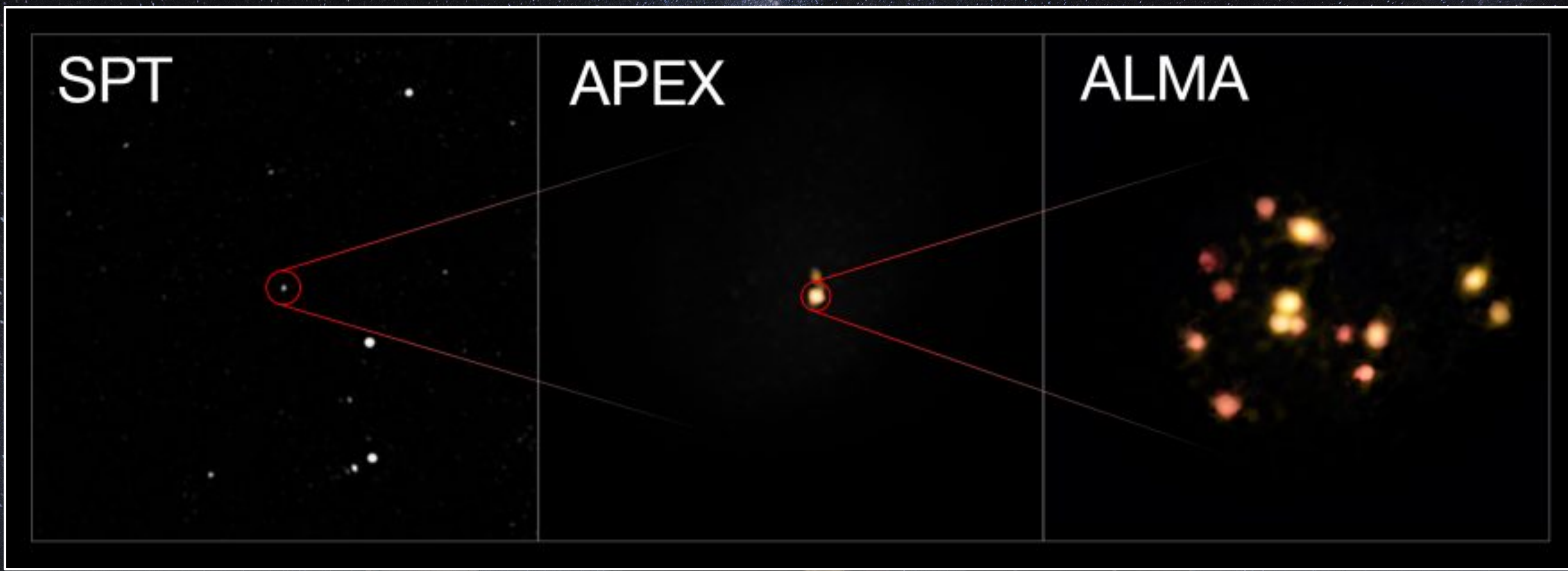
CK Vul

Credit: ALMA (ESO/NAOJ/NRAO); NRAO/AUI/NSF; B. Saxton



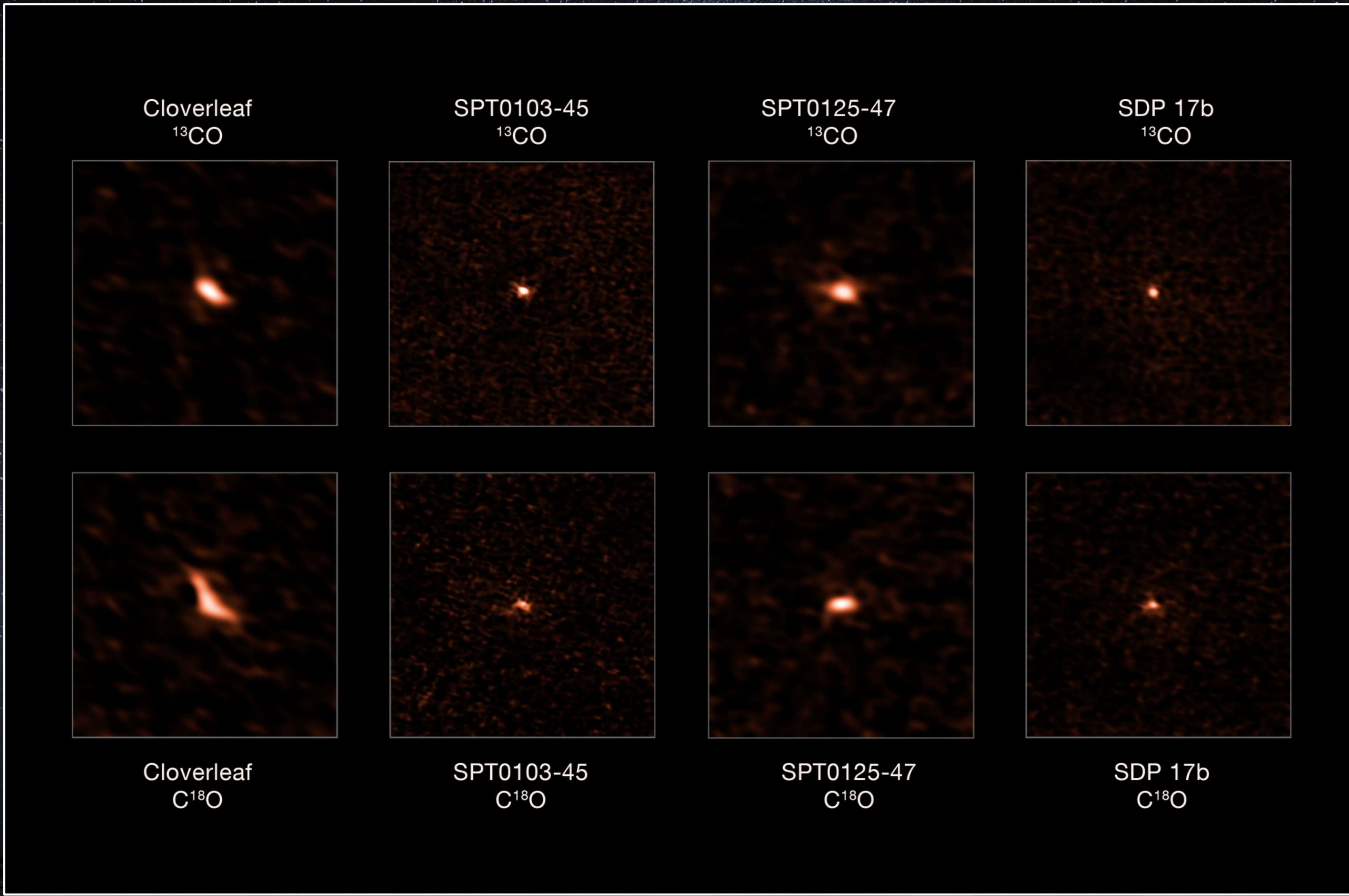
NGC 1068

Credit: ALMA (ESO/NAOJ/NRAO), Imanishi et al.



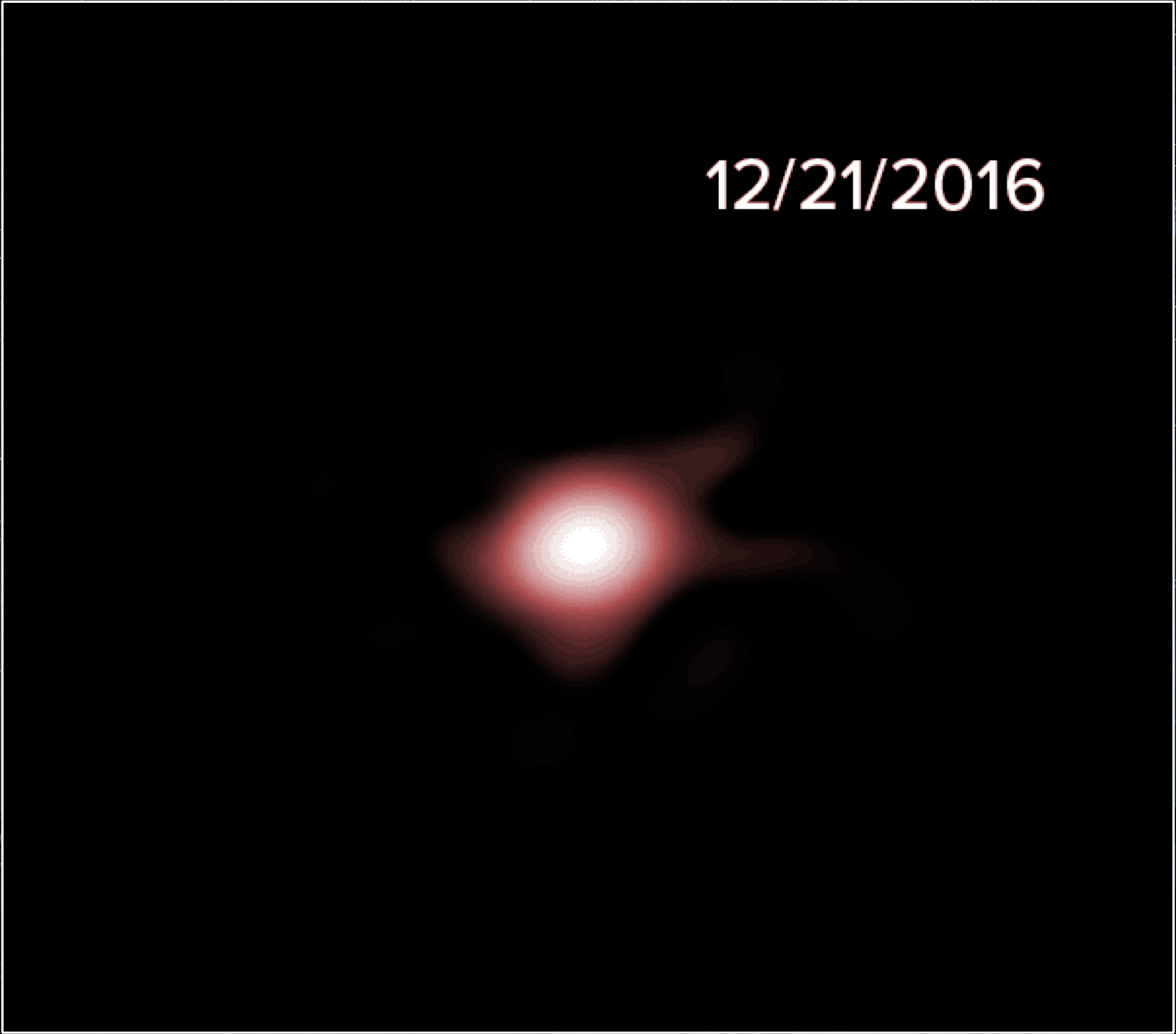
SPT2349-56

Credit: ESO/ALMA (ESO/NAOJ/NRAO)/Miller et al.



Multiple high-redshift starbursts

Credit: ESO/Zhang et al.; ALMA (ESO/NAOJ/NRAO)

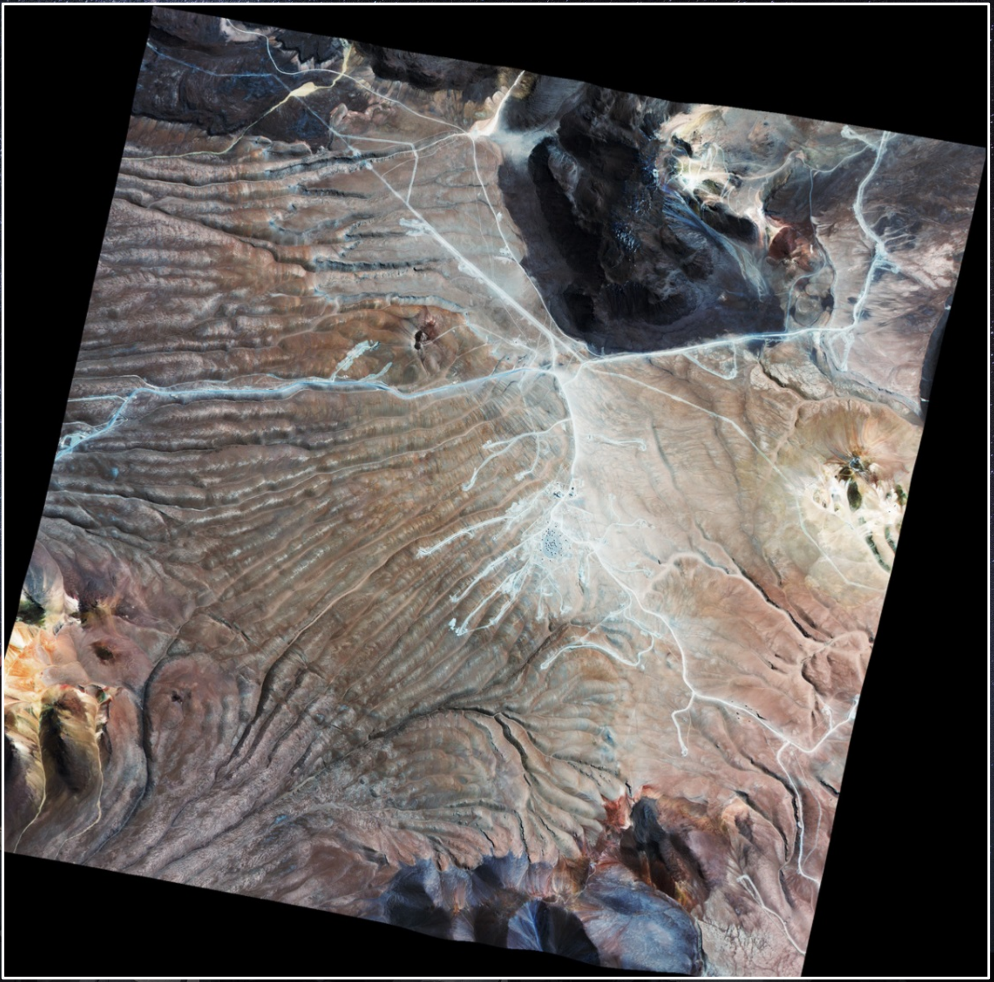


Gamma ray burst

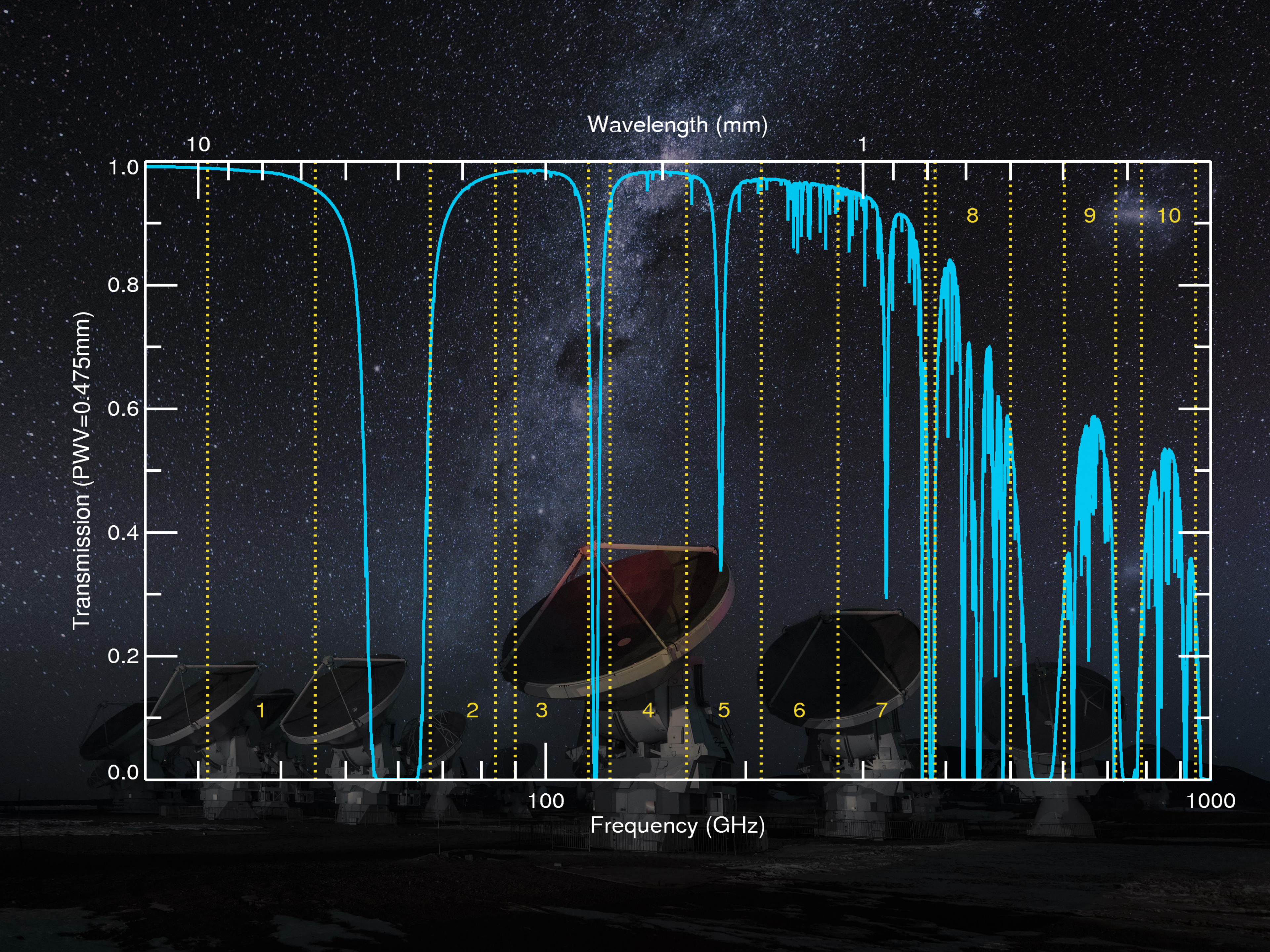
Credit: ALMA (ESO/NAOJ/NRAO), T. Laskar; NRAO/AUI/NSF, B. Saxton

ALMA is located in the Atacama Desert, a high-altitude desert in Chile.

Because the air is cold and dry, the site is ideal for observing in submillimetre and millimetre bands.



(Credit: Aerophotogrammetry Sevice, Chilean Air Force)



Wavelength (mm)
10
1
1.0
0.8
0.6
0.4
0.2
0.0
Transmission (PWV=0.475mm)
1
2
3
4
5
6
7
8
9
10
100
1000
Frequency (GHz)

Band	Frequency (GHz)	Wavelength (mm)	Primary Beam (arcsec)	Angular Resolution (arcsec)	
				Compact Configuration	Extended Configuration
3	84-116	2.6-3.6	63	3.4	0.042
4	125-163	1.8-2.4	43	2.3	0.028
5	163-211	1.4-1.9	30	1.8	0.023
6	211-275	1.1-1.4	25	1.5	0.018
7	275-373	0.80-1.09	19	1.0	0.028
8	385-500	0.60-0.78	14	0.74	0.046
9	602-720	0.42-0.50	9.2	0.52	0.033
10	787-950	0.32-0.38	7.1	0.39	0.024

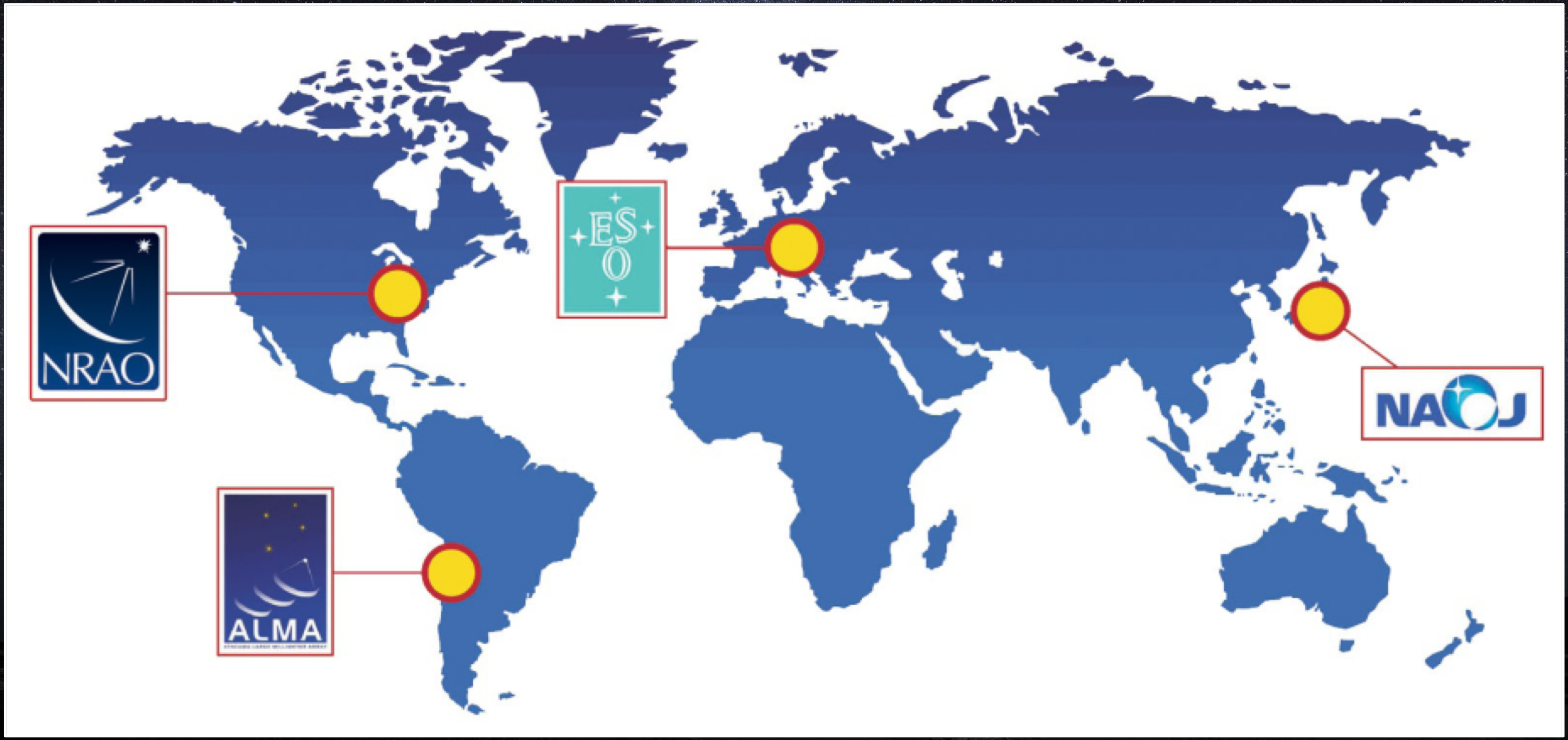
ALMA has three subarrays that observe different-sized structures:

- The main array (50 antennas with 12m diameters)
- The Atacama Compact Array (12 antennas with 7m diameters)
- The total power antennas (4 antennas with 12m diameters)

(Credit: ESO)

ALMA is operated by a collaboration between North America, Europe, and East Asia.

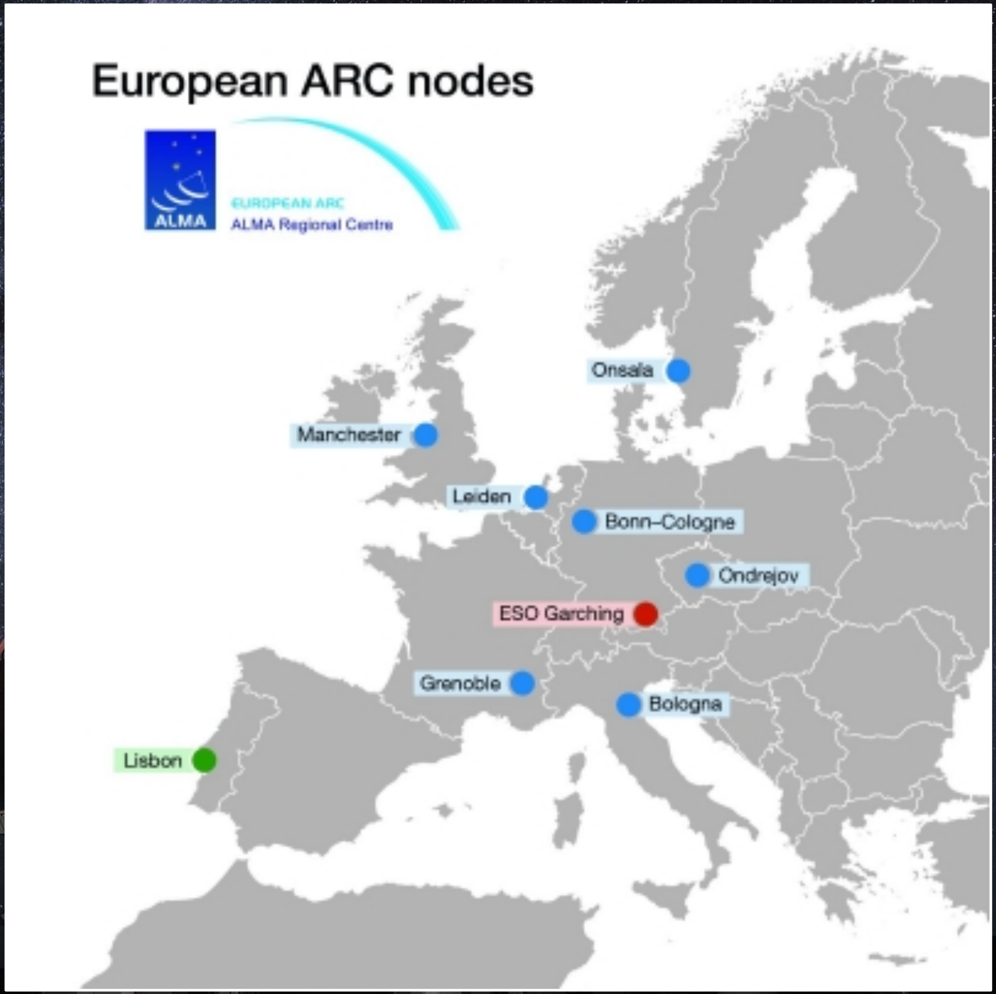
The Joint ALMA Observatory in Chile coordinates all activities.



The European Southern Observatory coordinates ALMA activities in Europe.

Multiple ALMA Regional Centre Nodes provide local user support. Staff at these nodes also participate in other support activities.

The University of Manchester hosts the ARC Node for the United Kingdom.



Cycle 6 capabilities

- 43 main array, 10 ACA, 3 total power antennas operational during observing
- Bands 3-10 operational
- Angular resolutions up to 0.025” possible
- Linear and circular polarization capabilities in bands 3-7
- ACA can be used by itself
- Large programs (up to 50 h) now being performed
- Very long baseline interferometry possible in bands 3 and 6
- Solar observations possible in bands 3 and 6

Typical yearly schedule

Mid-March	Call for proposals
Mid-April	Proposals due
August	Announcement of proposal review process
September	Submission of Phase 2 material
30 September	End of previous cycle
01 October	Beginning of next cycle
February	Shutdown for altiplanic winter