

Research Opportunities in Star Formation

John Bally

Feedback in the self-regulation of star & planet formation:

- Imaging protostellar outflows & explosions (APO 3.5m + ALMA)
- Multi-epoch, proper-motion monitoring of outflows and jets (Subaru 8-m prime focus; CTIO/KPNO 4m APO 3.5m).
- Searching for luminous, IR transients (SN “impostors”) in nearby galaxies (2 μm APO 3.5m / Spitzer)
- Galactic Center / Central Molecular Zone (Herschel, SMA, ALMA)

Skills:

- Familiarity with CCD and near-IR data reduction
- Python pipeline development
- Unix / IRAF
- SAO Image ds9

[illegible]

NTT

[OII] H α

μm

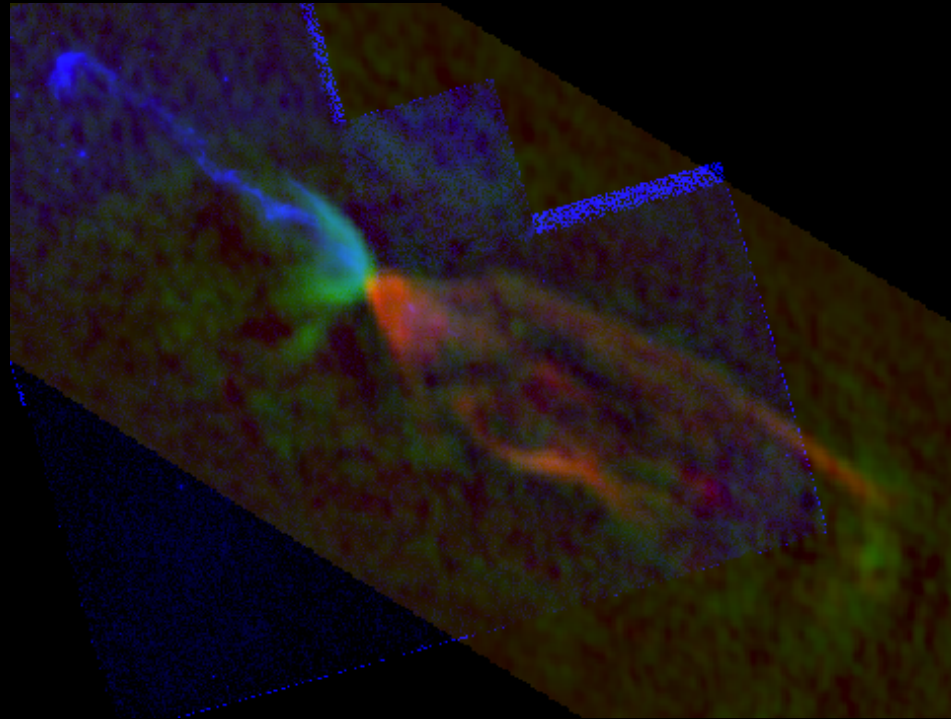
protostellar outflows



HH 46/47 Spitzer
(Noriega-Crespo+ 04)

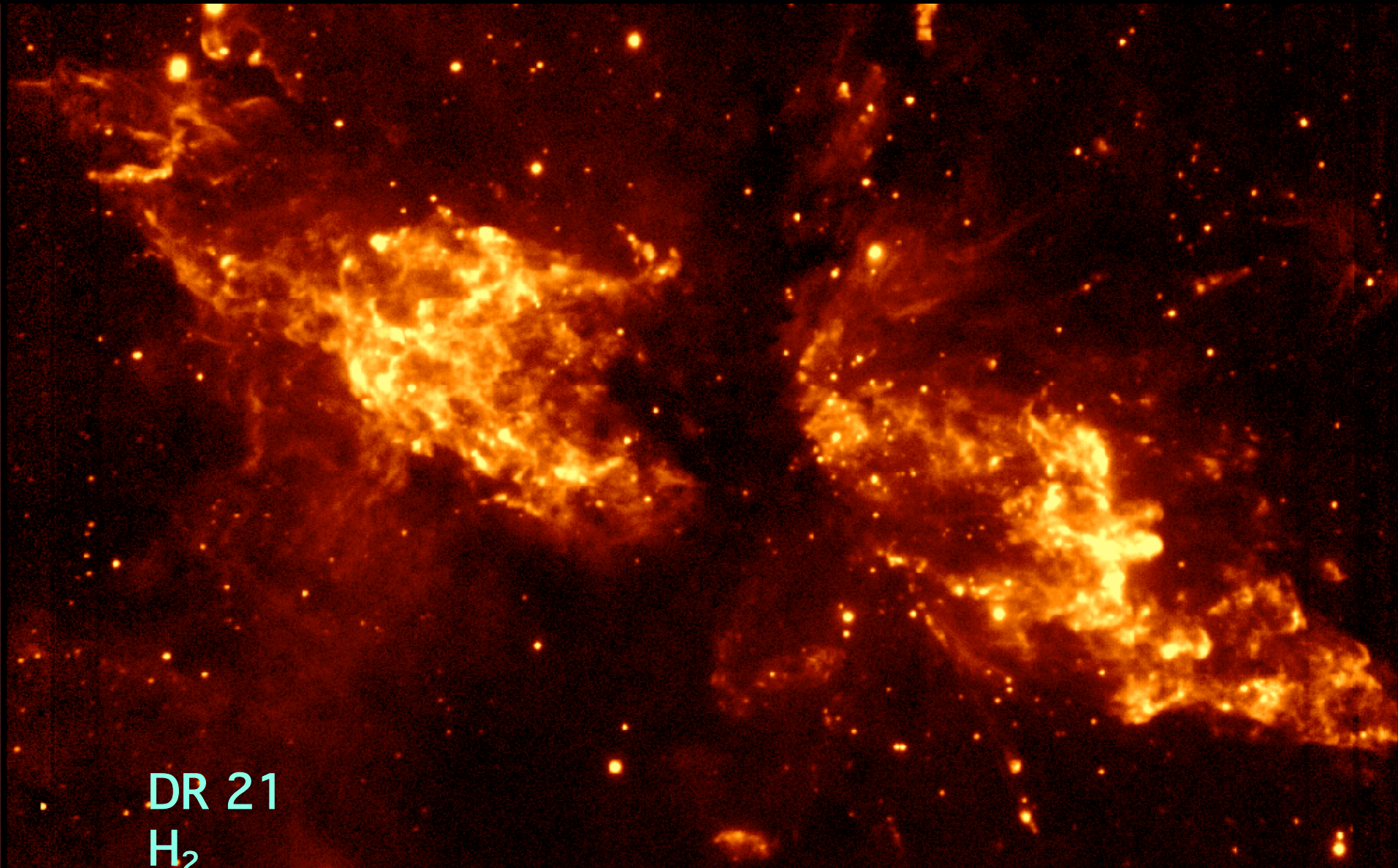
H₂ PAH 3.6, 4.5, 8 μ m

protostellar outflows



HH 46/47 CO CO (ALMA), [SII] (HST)
(Arce+ 2013)

Explosive protostellar outflows



DR 21

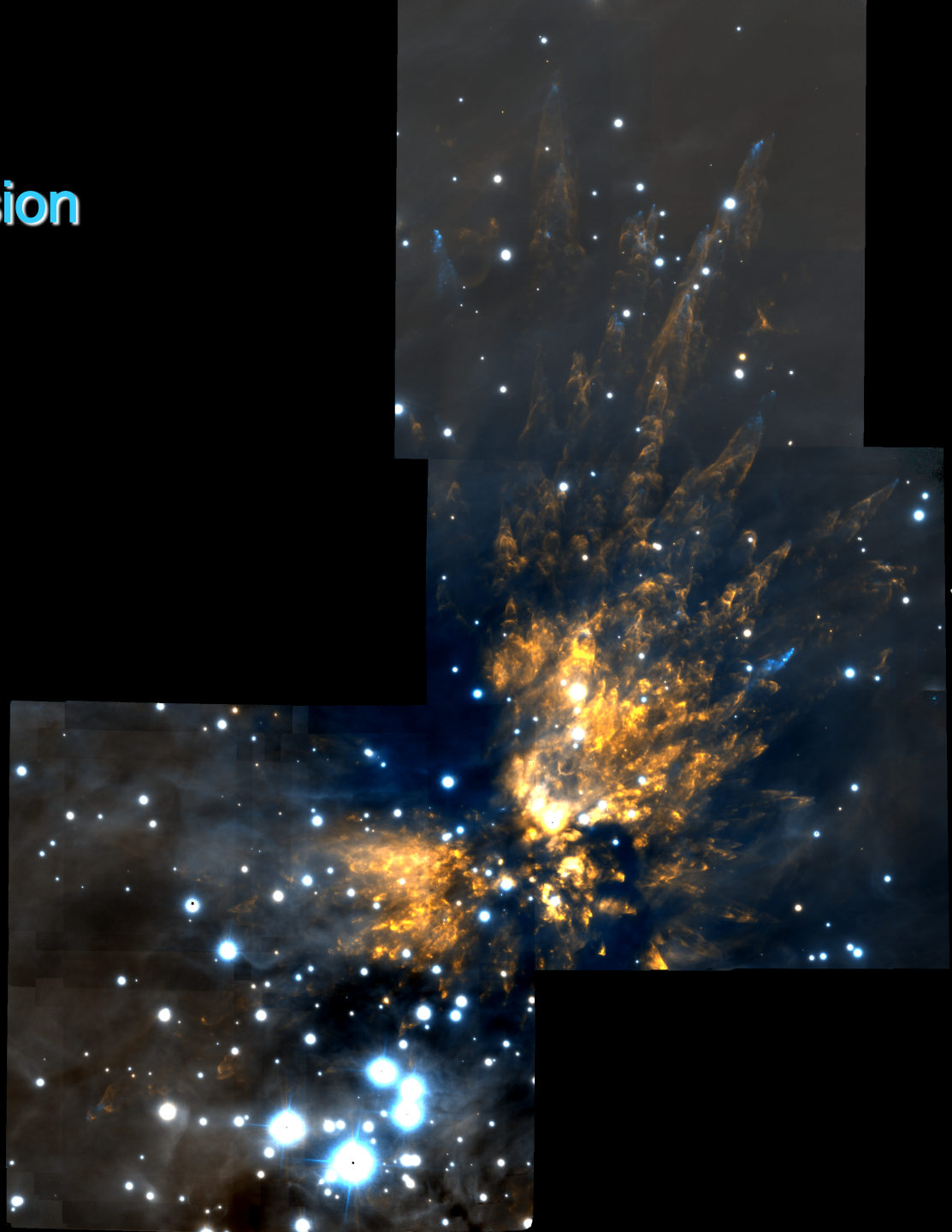
H₂

D ~ 1.3 kpc

The Orion Explosion

Near-infrared ($2\ \mu\text{m}$)

Gemini-S
GSAOI + GEMS



(Bally et al. 2015)

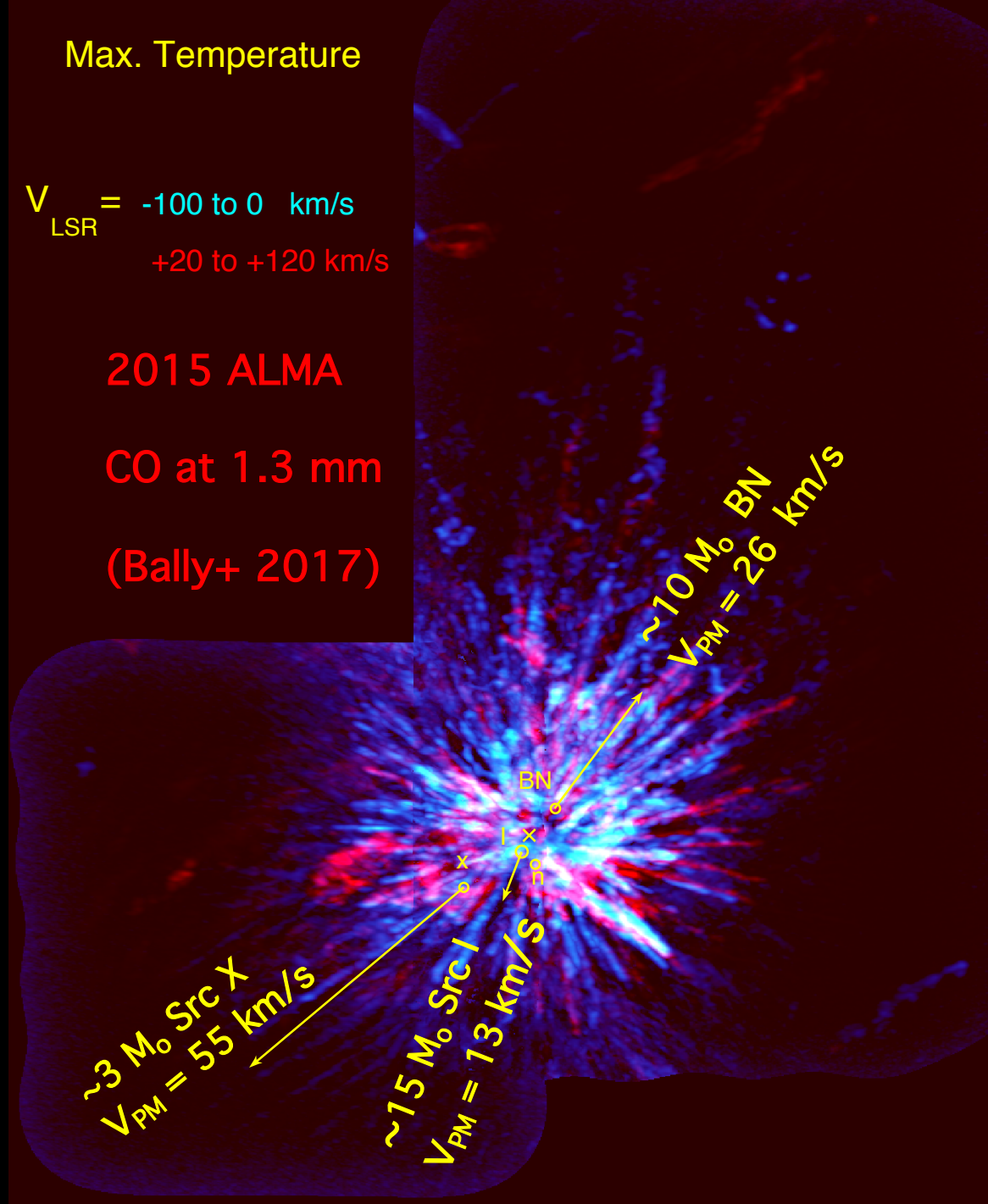
Max. Temperature

$$V_{\text{LSR}} = \begin{array}{l} -100 \text{ to } 0 \text{ km/s} \\ +20 \text{ to } +120 \text{ km/s} \end{array}$$

2015 ALMA

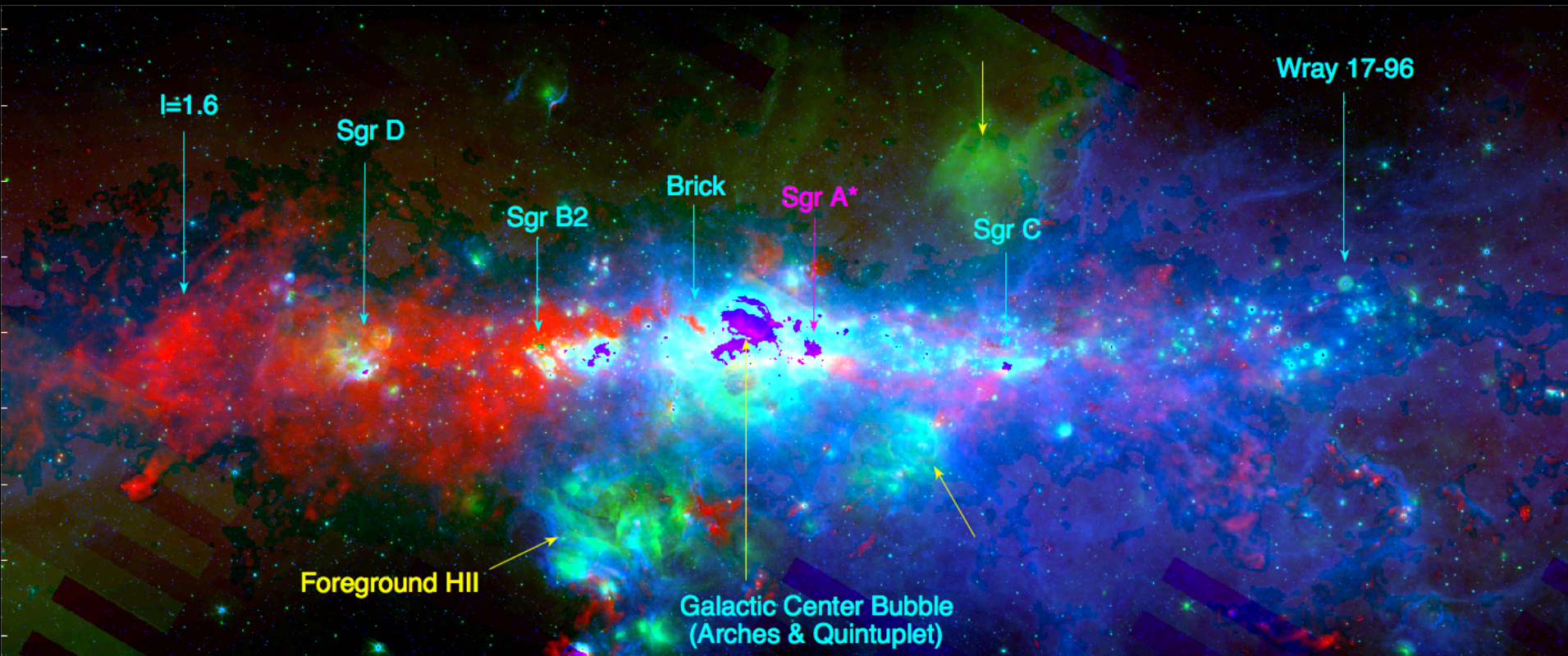
CO at 1.3 mm

(Bally+ 2017)



Inner Central Molecular Zone

8 μm 24 μm N(H_2)



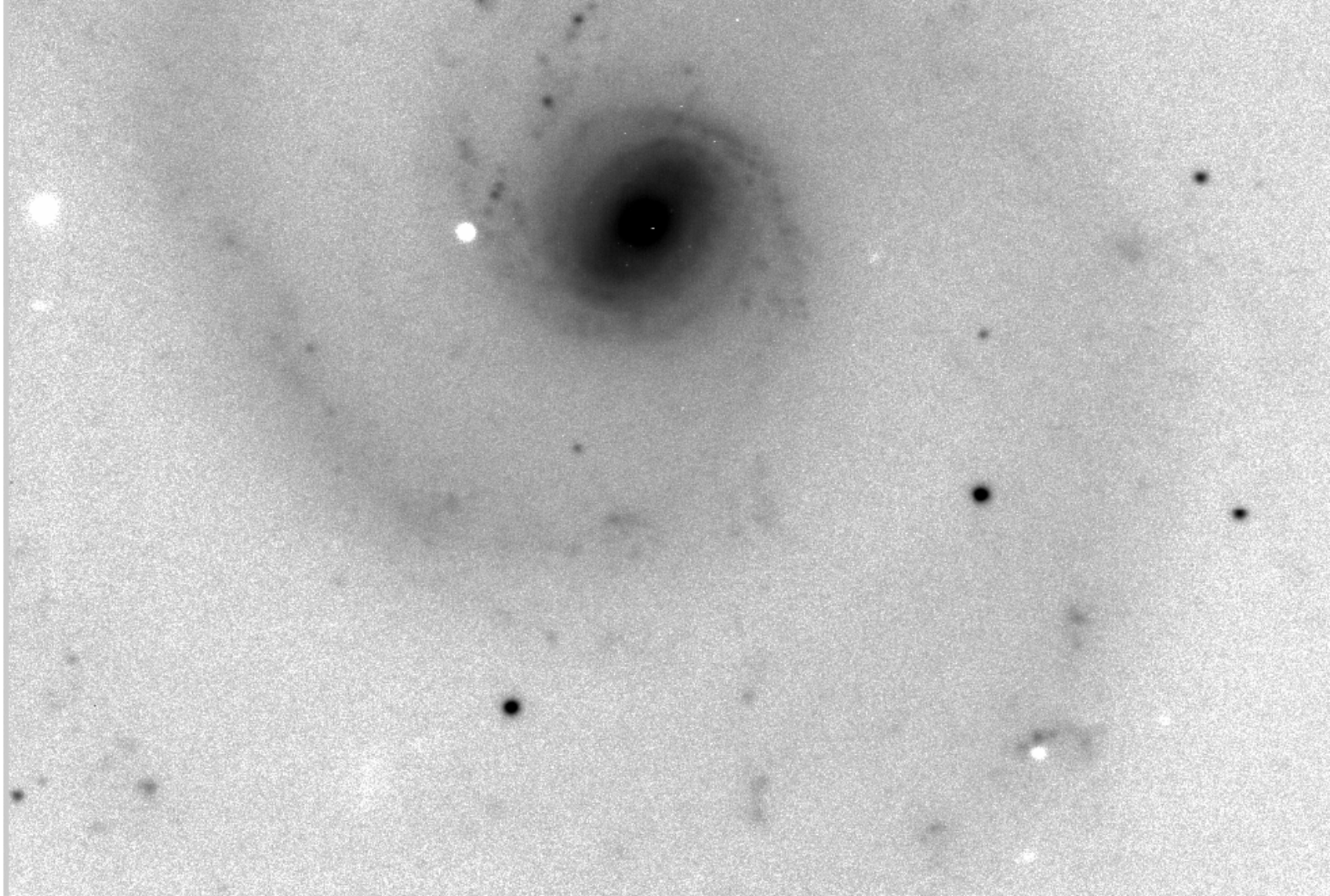
+2.0°

-2.0°

Inner CMZ ~ 1 GHz, 70 μm , 24 μm

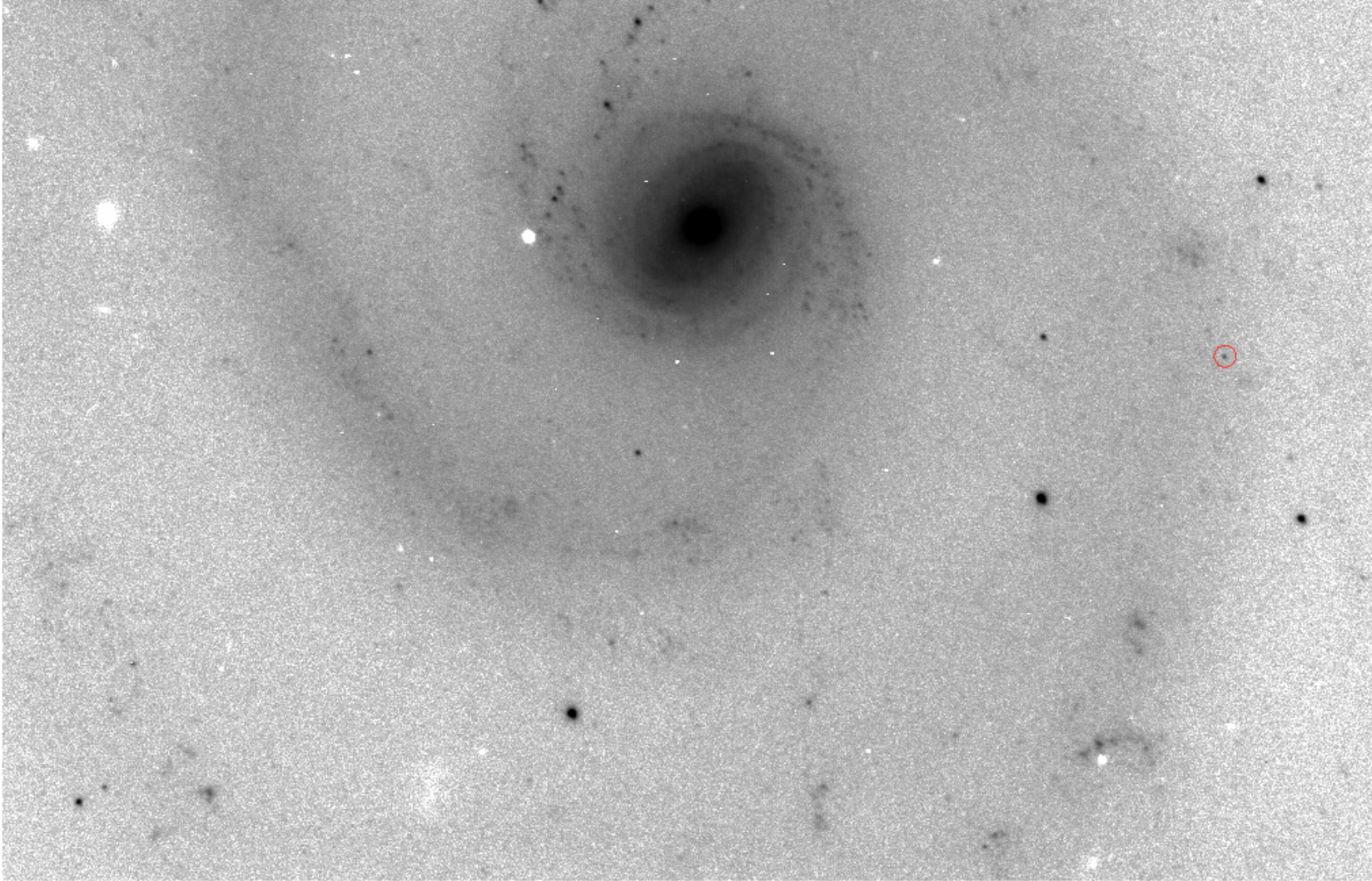


Messier 51 Optical Transient: AT2019abn 13 Apr 18 2 μm



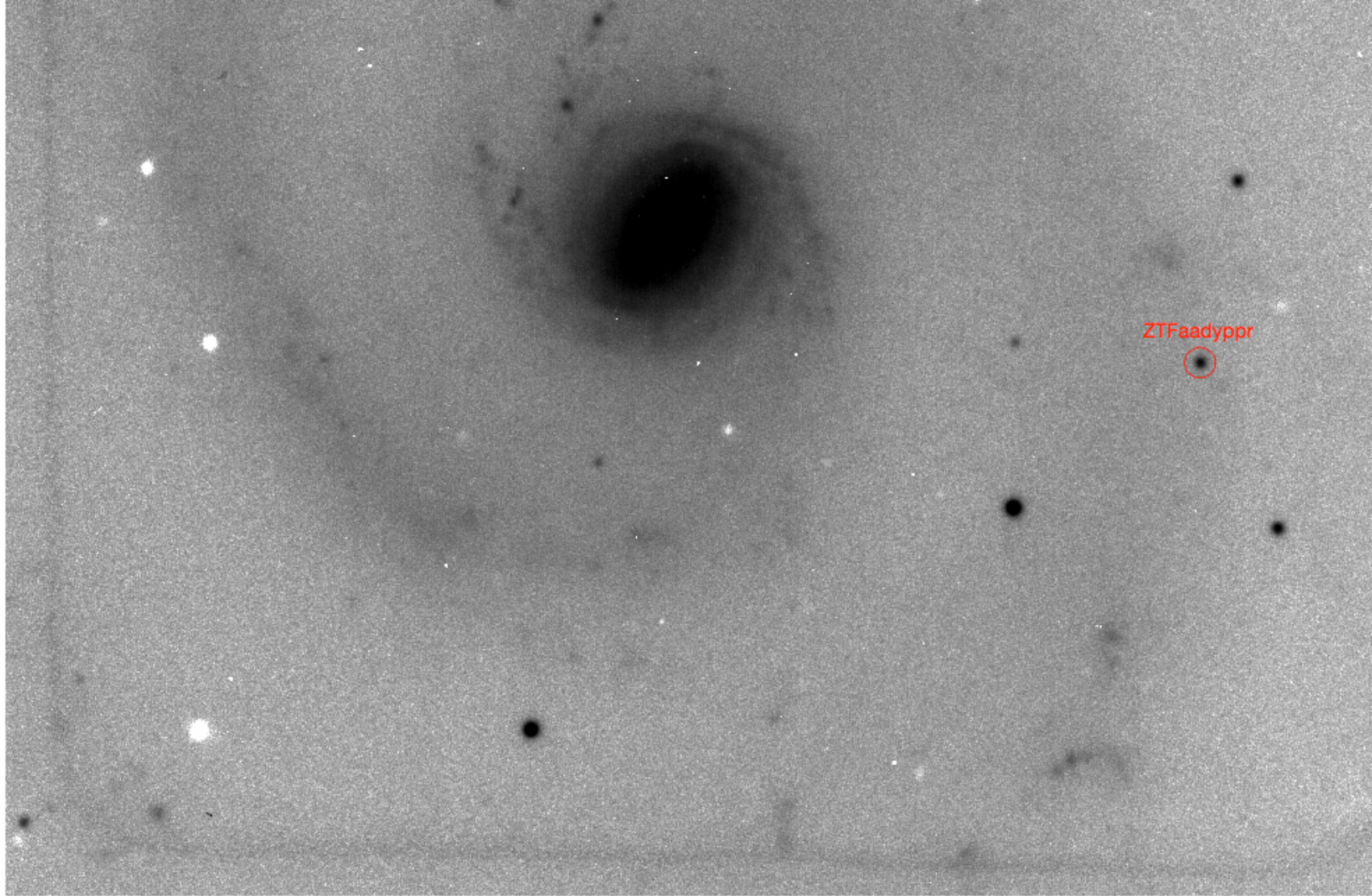
R.A. Dec. (J2000) = 13:29:42.38 +47:11:16.3

Messier 51 Optical Transient: AT2019abn 15 Jan 19



R.A. Dec. (J2000) = 13:29:42.38 +47:11:16.3

Messier 51 Optical Transient: AT2019abn 16 Feb 19



R.A. Dec. (J2000) = 13:29:42.38 +47:11:16.3

WeBo1:

$D \sim 1,600$ pc

Near the W4

(HII region)

A ring around
a barium star

(Bond+ 2003,
AJ, 125, 260)

Roche-lobe
overflow +
ejected disk +
stellar merger

10^5 years ago



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