Searching for Ionized Jets from High-Mass Protostars with VLA SiO Observations

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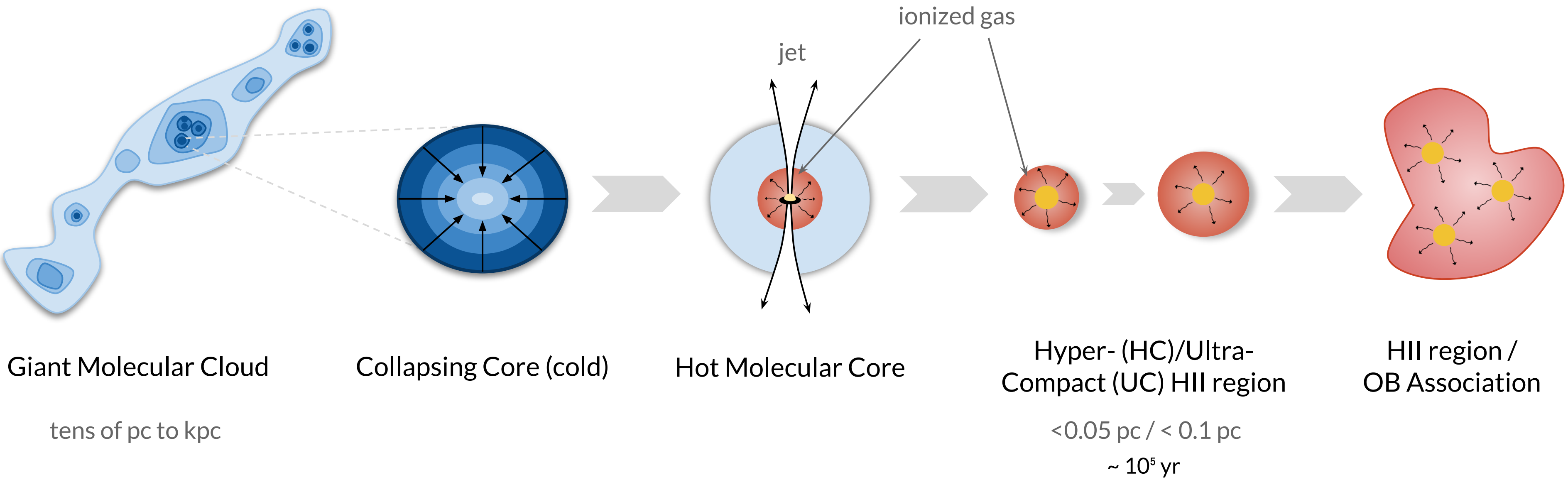
The Formation of High-Mass Stars ($M > 8\,M_{sun}$)



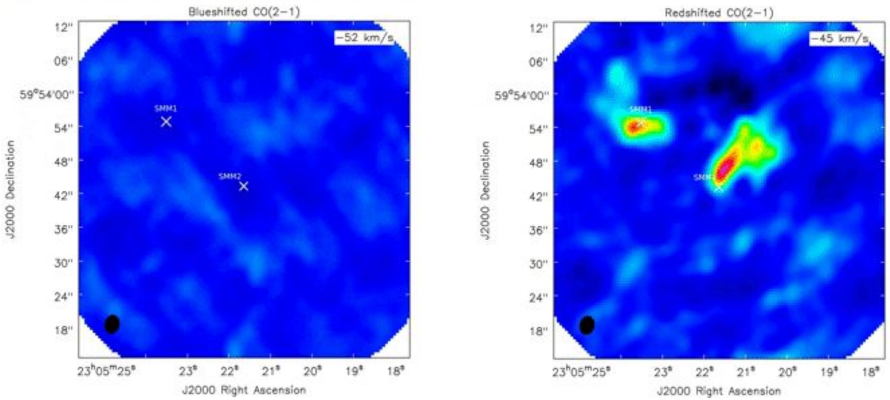
(Based on the original cartoon by Dr Cormac R. Purcell)

HH 111 - Spitzer

Jets play a key role: they shed excess angular momentum and allow accretion to proceed

HH 46/47 - HST

These impact their surrounding medium and give rise to **molecular outflows**



ISOSS J23053+5953 - SMA (Rodríguez et al. 2021)

The observation of jets and outflows supports the accretion formation scenario, and their study provides valuable **information**

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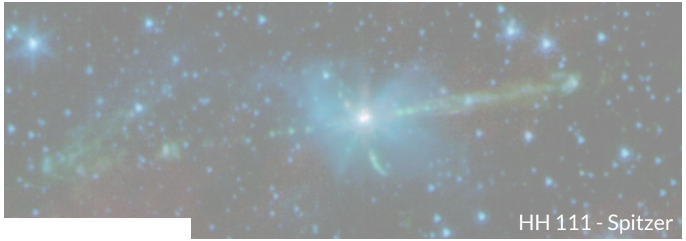

HH 111 - Spitzer

HH 46/47 - HST

However, since high-mass stars are less abundant, located at larger distances, and have shorter evolutionary timescales than low-mass stars, the number of known **ionized jets from high-mass protostars** is scarce

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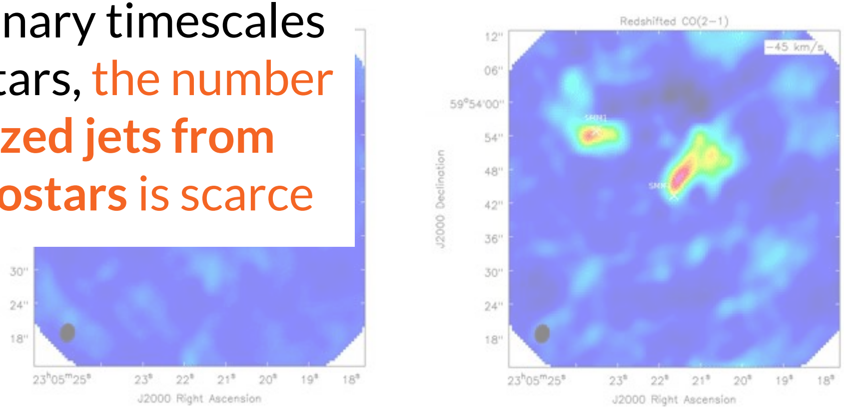
The observation of jets and supports the accretion form and their study provides valuable information



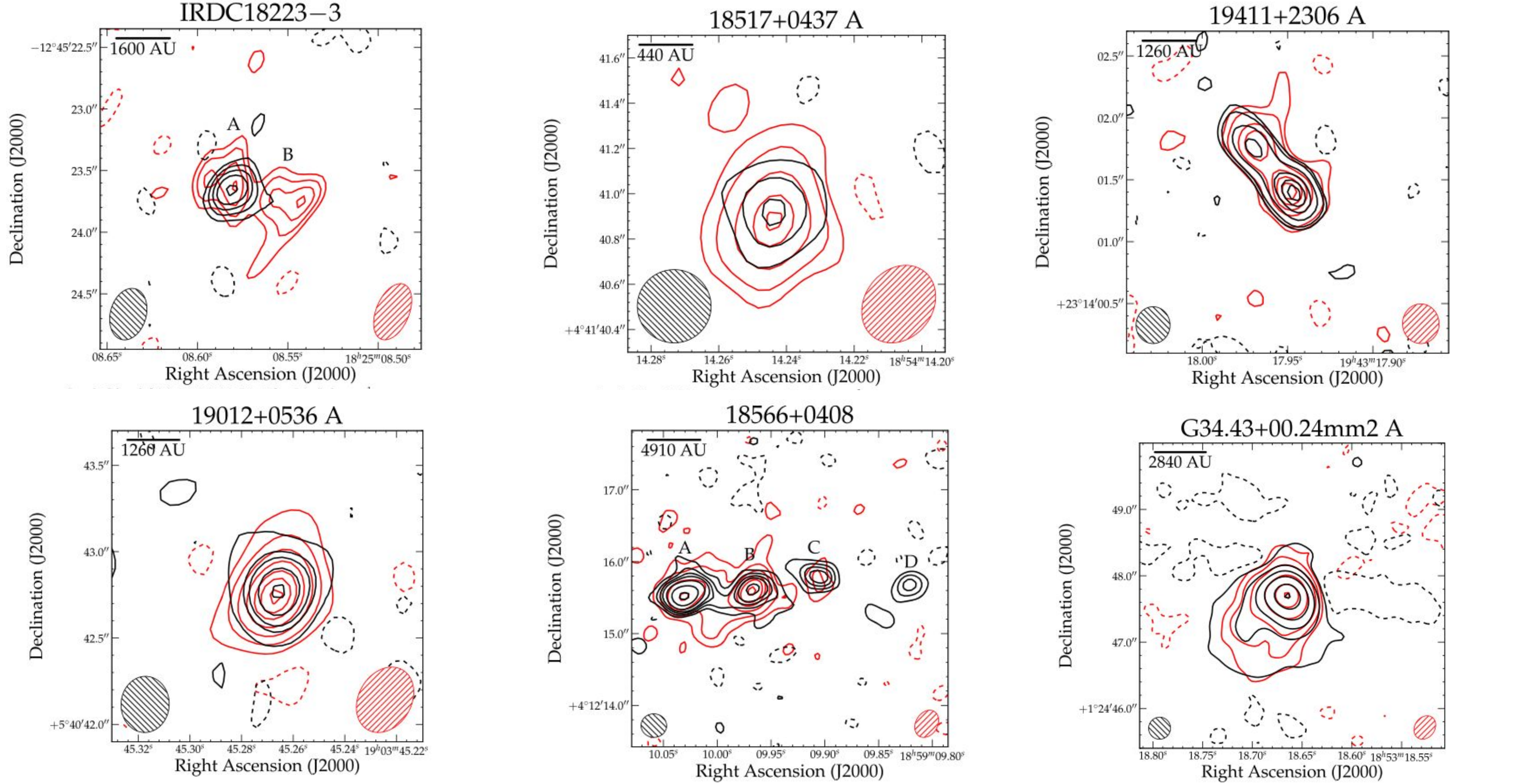
ISOSS J23053+5953 - SMA (Rodríguez et al. 2021)

Rosero et al. (2016, 2019)

Weak and Compact Radio Emission in Early High-mass Star-forming Regions

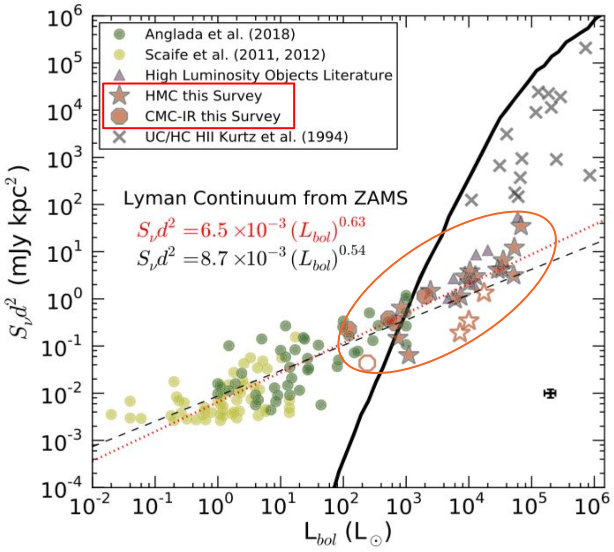
- Deep VLA observations at C- (6 cm) and K-band (1.3 cm)
  - θ_{syn} ~ 0.4”
  - rms ~ 3-10 μJy/beam
  - 58 regions observed
    - 18 Cold Molecular Cores (CMC): T < 25 K, M > 100 M_{sun}
    - 15 Cold Molecular Cores-IR (CMC-IR): T < 25 K, M > 100 M_{sun}, emission at 24 and 4.5 μm
    - 25 Hot Molecular COres (HMC): T > 50 K, M ~ 100 M_{sun}, n ~ $10^7 cm^{-3}$
  - 70 sources detected
    - 1 CMC, 13 CMC-IR, 56 HMC

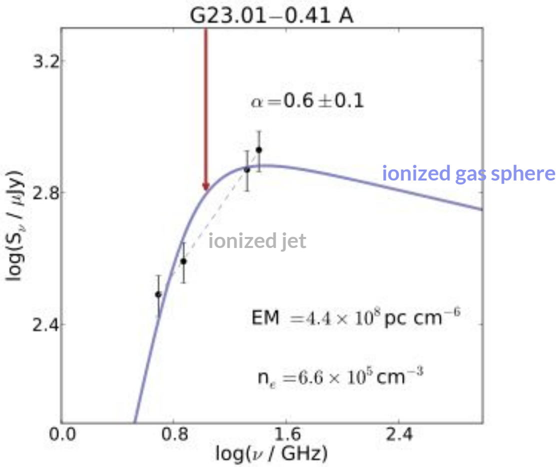
Some Examples



Rosero et al. (2016, 2019)

- 12 ionized jets → elongated morphology
- 49 unresolved sources
  - 13 jet candidates





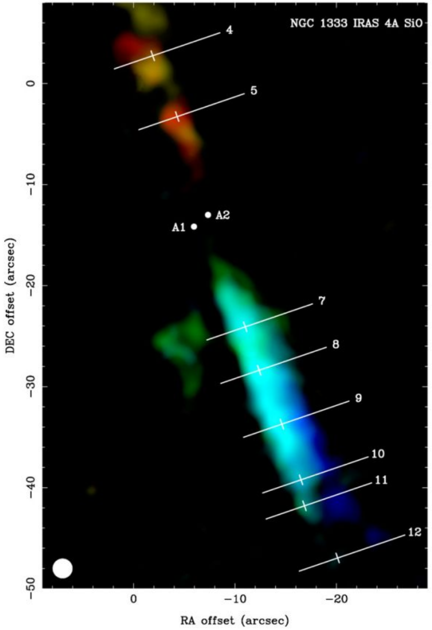
Both models fit the observations, we need **another probe** to confirm their jet nature

SiO as shock tracer

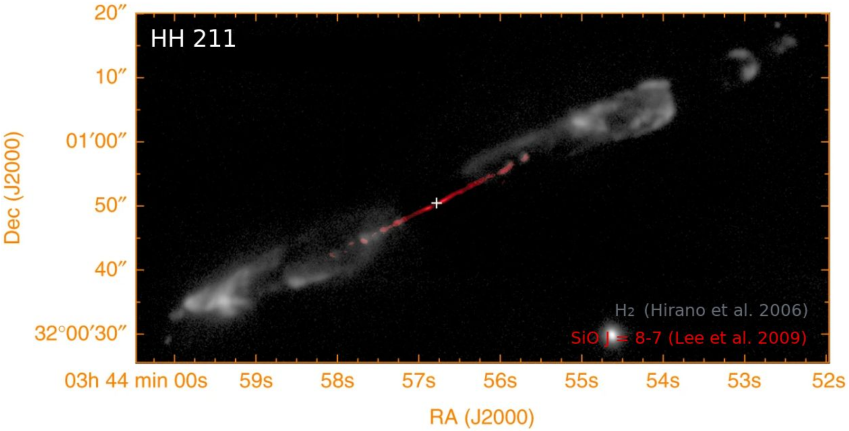
Si in dust grains → jet shock → sputtering of **Si** → **SiO** abundance highly enriched

(Caselli et al. 1997; Schilke et al. 1997)

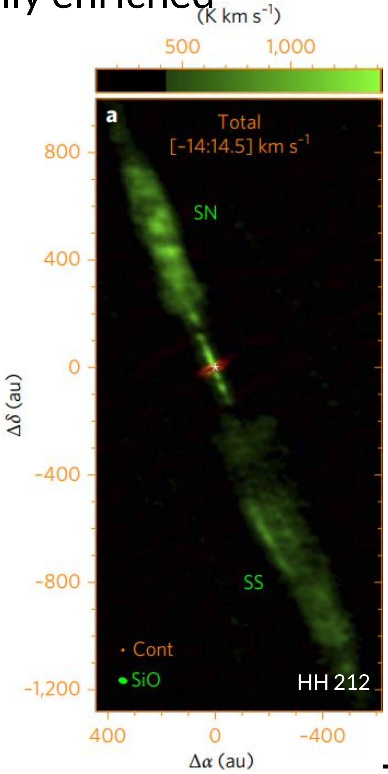
SiO is an excellent jet tracer!



Choi et al. 2011



Lee et al. 2018



Lee et al. 2017

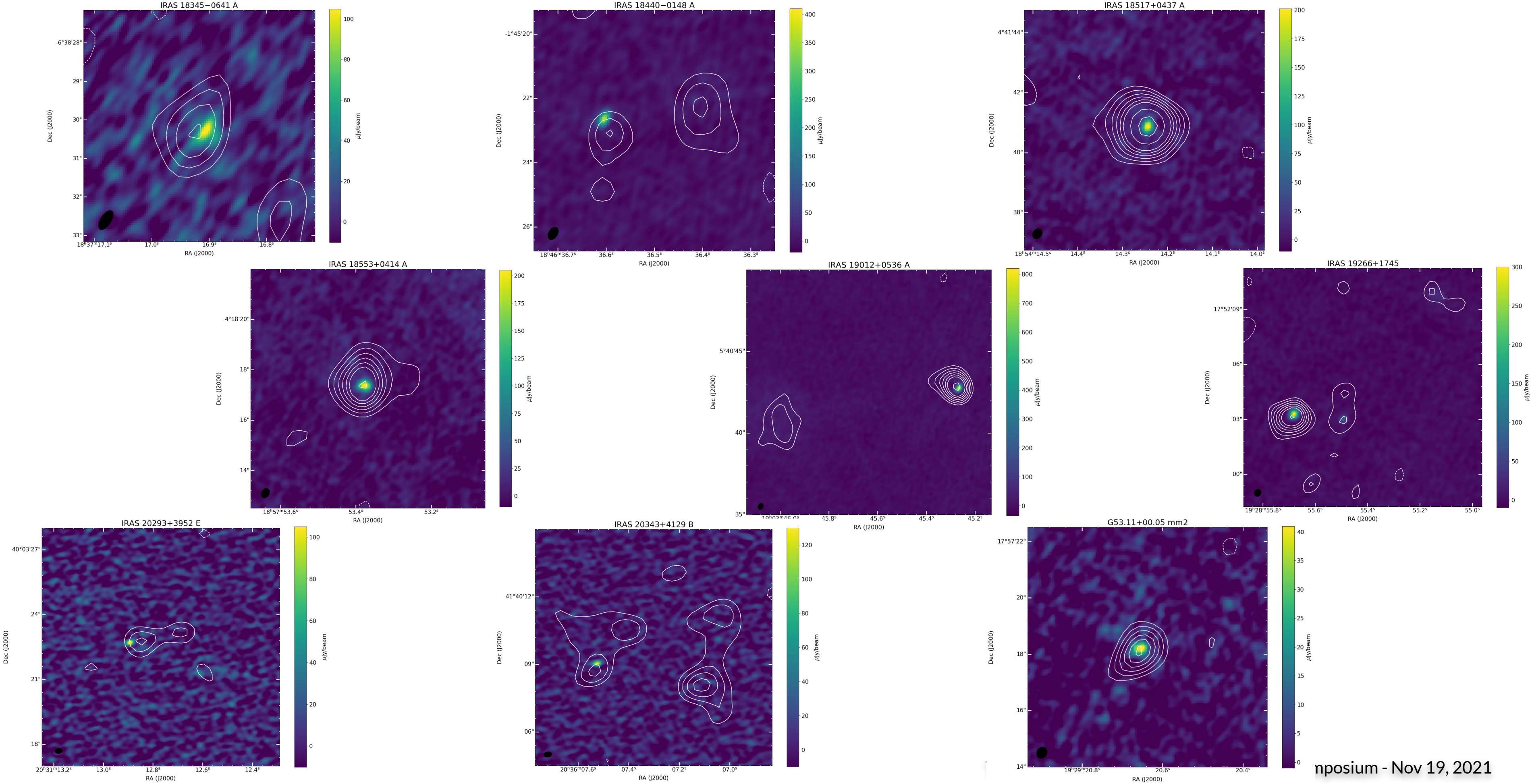
Our Work

We used the VLA to look for SiO emission in a subsample of 10 jet candidates from the Rosero et al. survey **to confirm their jet nature**

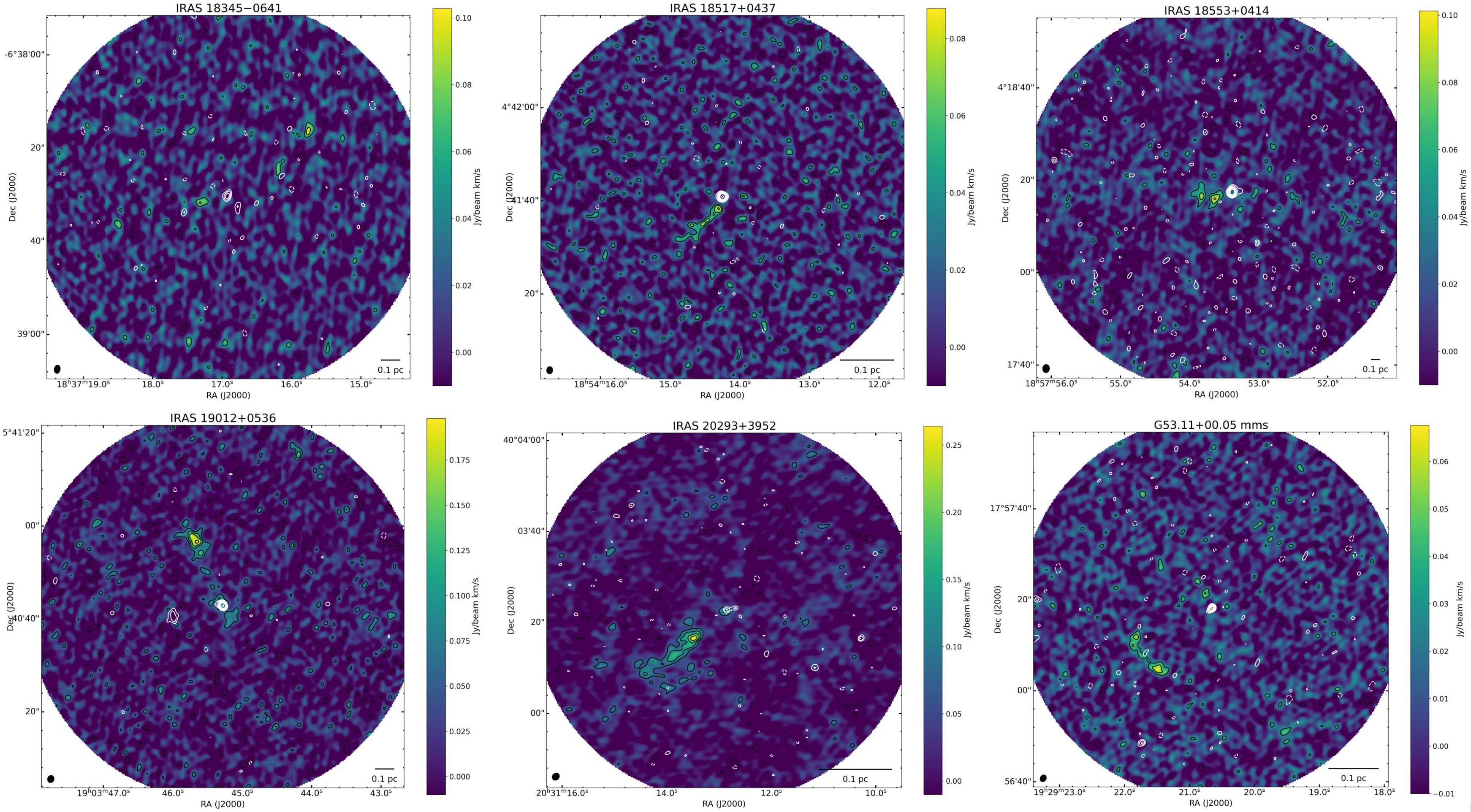
- Project ID: VLA/19B-158 (observed 3/28/2021)
  - 4 hr total → ~ 15’ on source
  - D-array
  - Q-band (7 mm)
- Θ_{syn} ~ 1.5”
- rms_{cont} ~ 0.1 mJy/beam

Here we present some **preliminary results**

We detected 7 mm **continuum emission in 9 of the 10** observed regions



And SiO(1-0) emission in 6 of the 10 observed regions



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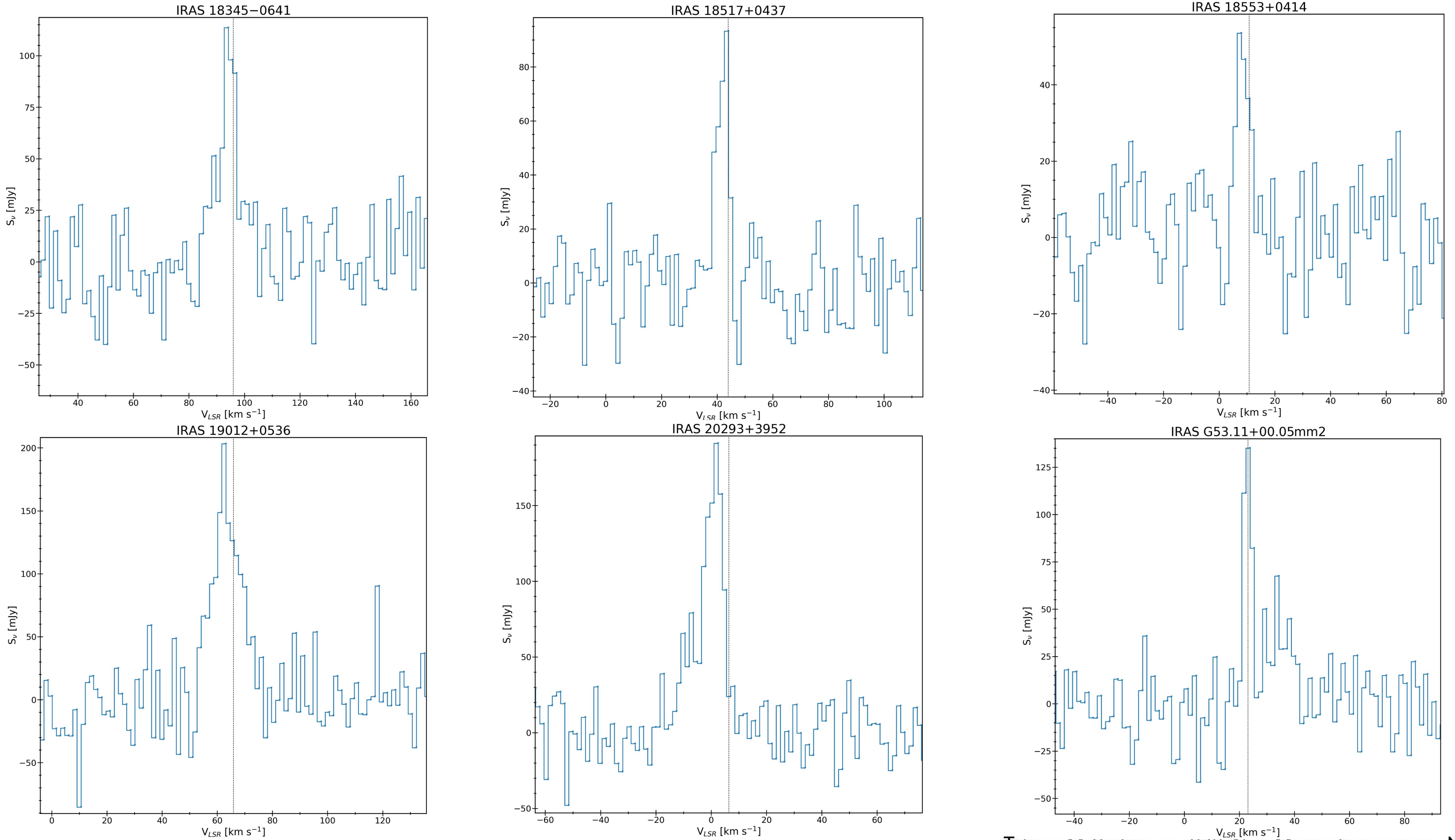
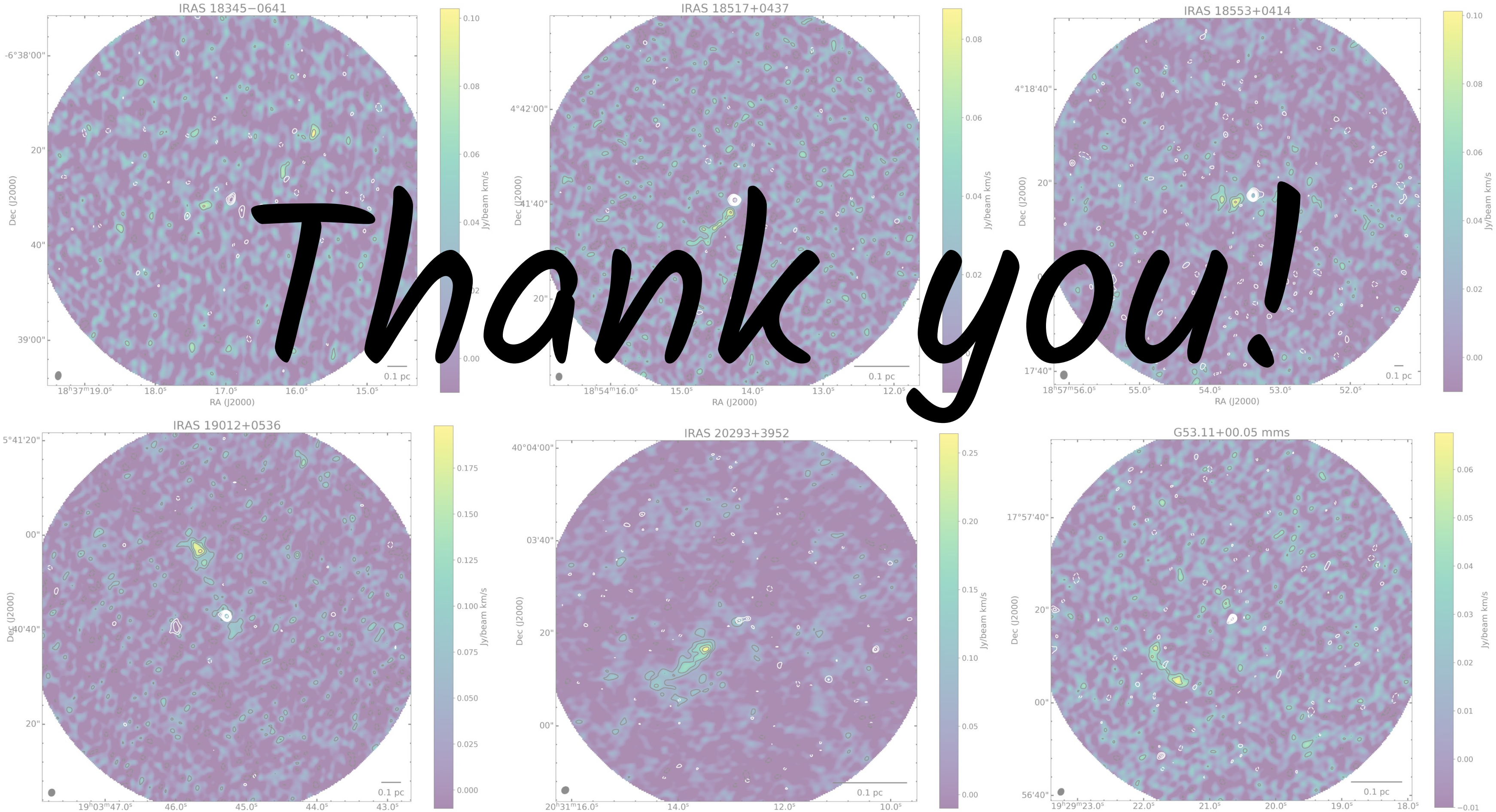


Conclusions and Final Remarks

- 7 mm continuum emission in 90% of the sample
  - A total of 19 cores were detected
- SiO emission detected in 60% of the sample
  - We can confirm the jet nature of 50% of the observed jet candidates
  - Argues in favor of the scenario that most of the Rosero et al. (2016, 2019) compact sources with rising spectrum are ionized jets
  - Most are monopolar/asymmetric
- Future work
  - Study of the energetic parameters of the flows
  - Propose to observe higher energy SiO transitions
  - **VLA/22A-092**: 23 unresolved sources with rising spectrum, A-array, K-band (1.3 cm), **~0.1”**

Thank you!



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