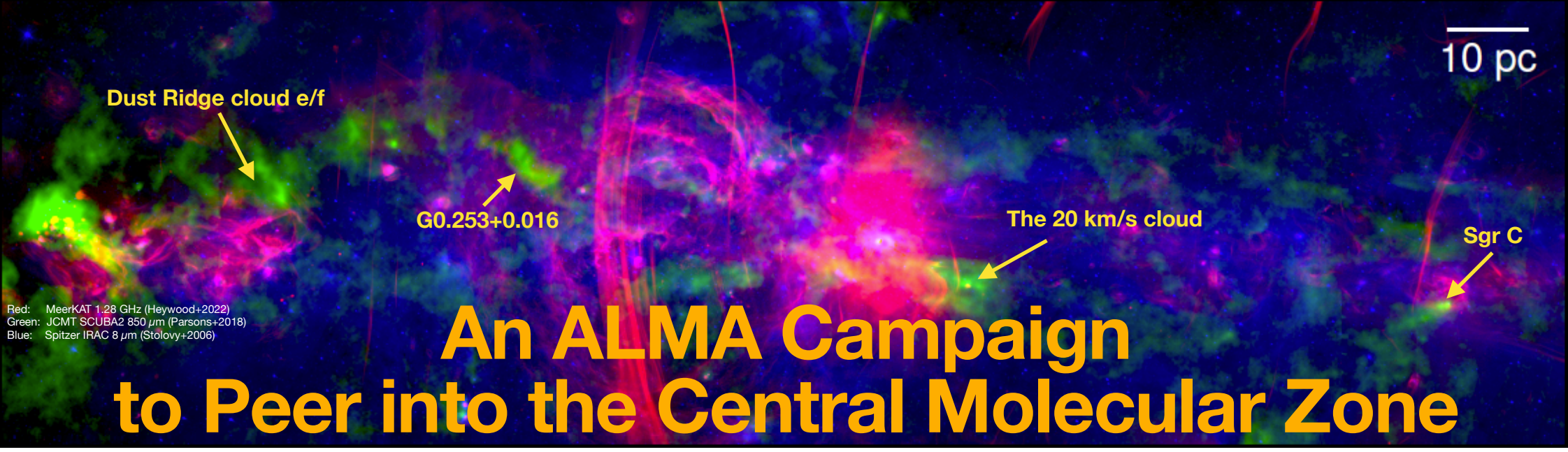


An ALMA Campaign to Peer into the Central Molecular Zone

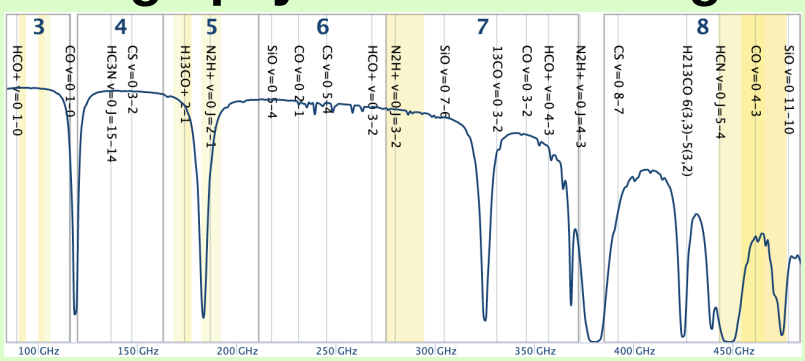
Xing Lu (Shanghai Astronomical Observatory) on behalf of the team: Qizhou Zhang, Guang-Xing Li, Junhao Liu, Yuxin Lin, Shanghuo Li, Adam Ginsburg, Steven N. Longmore, J. M. Diederik Kruijssen, Daniel L. Walker, Siyi Feng, Cara Battersby, Thushara Pillai, Elisabeth A. C. Mills, Jens Kauffmann, Yu Cheng, Shu-ichiro Inutsuka, et al.

TL;DR: We have a small sample, but we go deeper, finer, and multi-dimensional!

For patient readers: To complement the ongoing large/legacy programs (ALMA: ACES, JVLA: JACKS, SOFIA/HAWC+, …), we have pushed ALMA to its limit and explored various dimensions of the extreme physical conditions in the CMZ: very dense gas traced by *high-frequency* molecular lines, slim filamentary structures revealed by *deep mosaic imaging*, magnetic fields via the *polarization* mode, and accretion disks resolved by *long-baseline* observations.

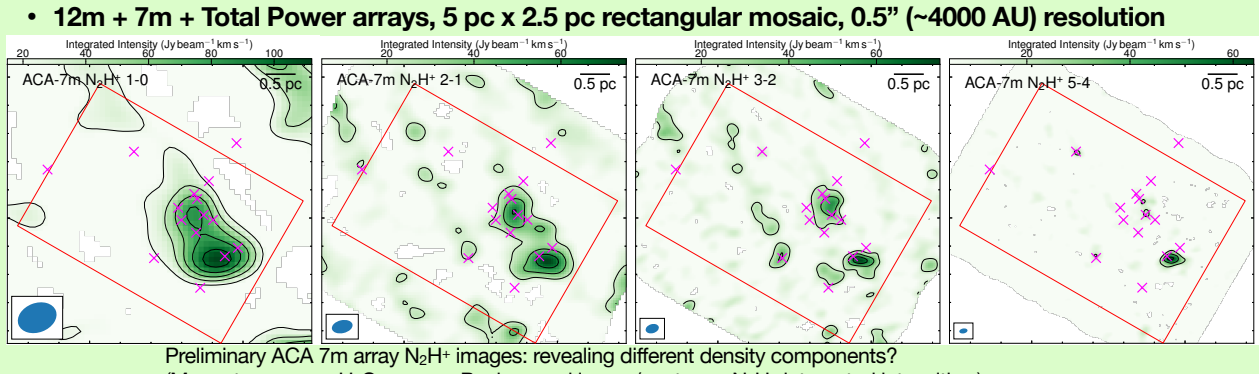
Spatial Scales

Tomography of a star-forming cloud with high-frequency bands



Covered lines include N_2H^+ 5-4, 3-2, 2-1, 1-0 (for tracing cold dense gas), HC_3N 50-49, 32-31, 19-18, 10-9 (for tracing warm dense gas), CH_3CCH 17-16, 11-10, 6-5 (for constraining temperatures), and the continuum emission at the four bands.

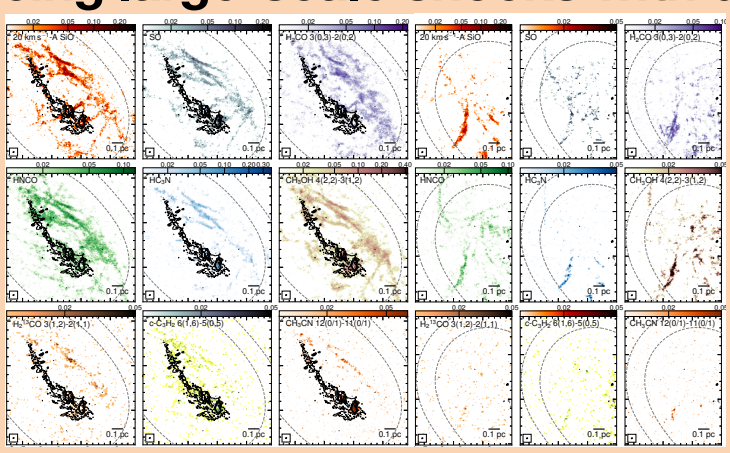
- **A comprehensive sampling of gas *densities* and *temperatures* of the star-forming Sgr C cloud**
- **12m + 7m + Total Power arrays, 5 pc x 2.5 pc rectangular mosaic, 0.5" (~4000 AU) resolution**



Preliminary ACA 7m array N_2H^+ images: revealing different density components?
(Magenta crosses: H_2O masers. Background image/contours: N_2H^+ integrated intensities.)

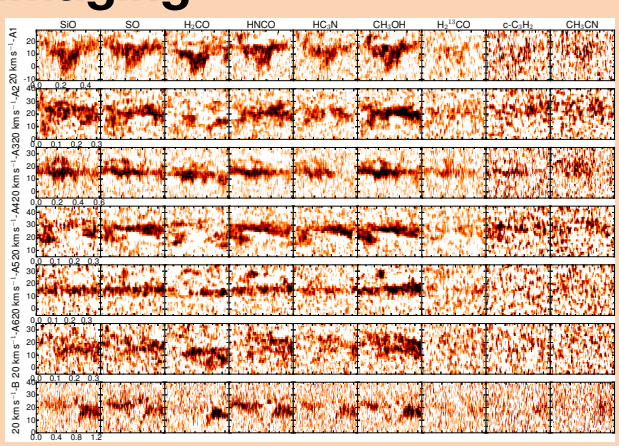
Slim filaments tracing large-scale shocks with deep mosaic imaging

- **Could be tracing pc-scale shocks, which have been suggested to be prevalent in the CMZ**
- **The origin of the shocks could be related to collision between clouds or shells of SNRs/HII regions**

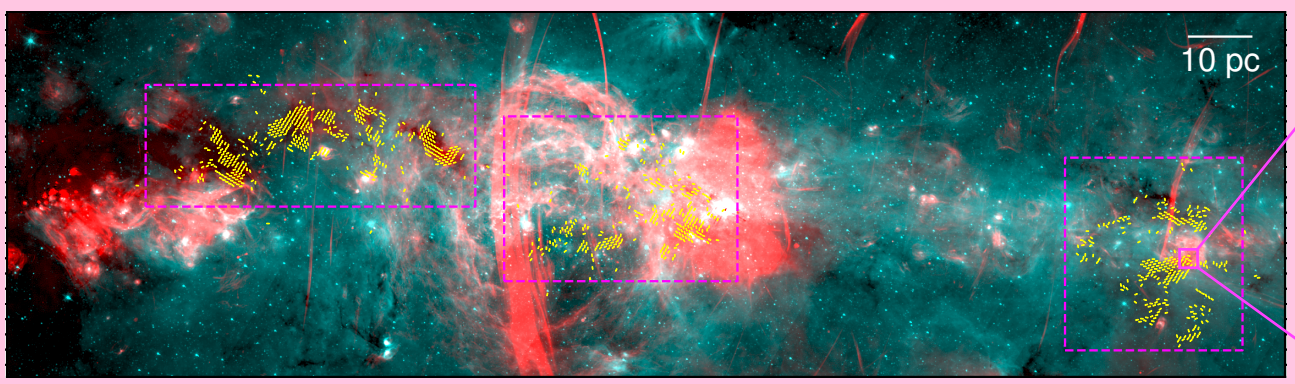


Intriguing filaments seen in various molecular line emission (colors), even in CH_3CN! Yet not in the continuum (contours). Typical length ~ pc, width <0.01 pc or 2000 AU.

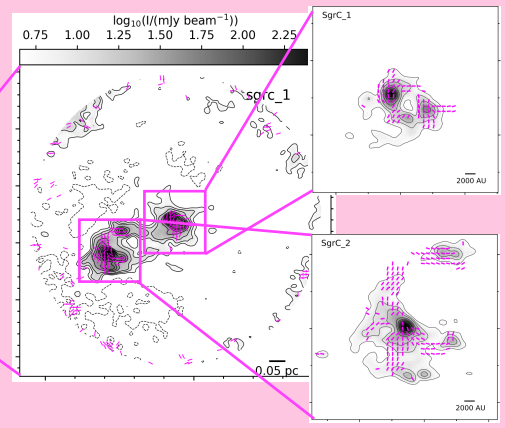
Coherent velocities along the filaments: not outflows or gas streamers



Magnetic fields inside dense cores with full-polarization capability

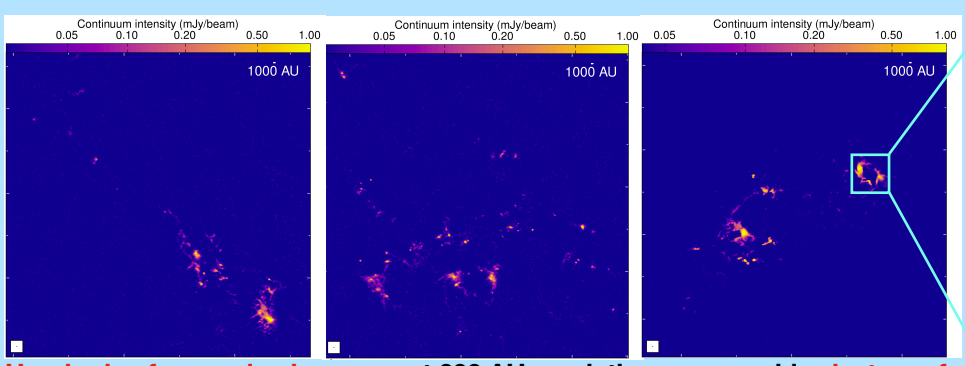


Yellow vectors: magnetic field morphologies in CMZ clouds deduced from JCMT/POL2



ALMA 0.2" resolution polarization observations:
Magnetic fields tracing spiral arms & outflow cavities?
[even higher resolution (0.03") observations underway, see below]

Fine structures in protostellar disks with long-baseline arrays

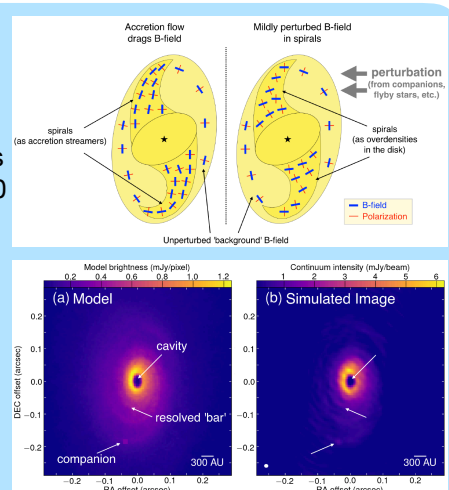


Hundreds of unresolved sources at 300 AU resolution, presumably clusters of disks/envelopes [one of them has flyby-induced spiral arms →]

Lu et al. 2022, Nature Astronomy (featured cover of the July issue)

Cycle 9 ongoing projects:

- Polarization observations at <300 AU resolution (30 mas) to trace magnetic fields in the disk
- Spatially resolving cavity, bar, and spirals in the disk at <100 AU resolution (10 mas)



Ideas of collaborations, comments, questions: xinglu@shao.ac.cn or xinglu.astro@gmail.com, or find me around this poster!