The inherited molecular layer of a young disk: the case of TMC1A

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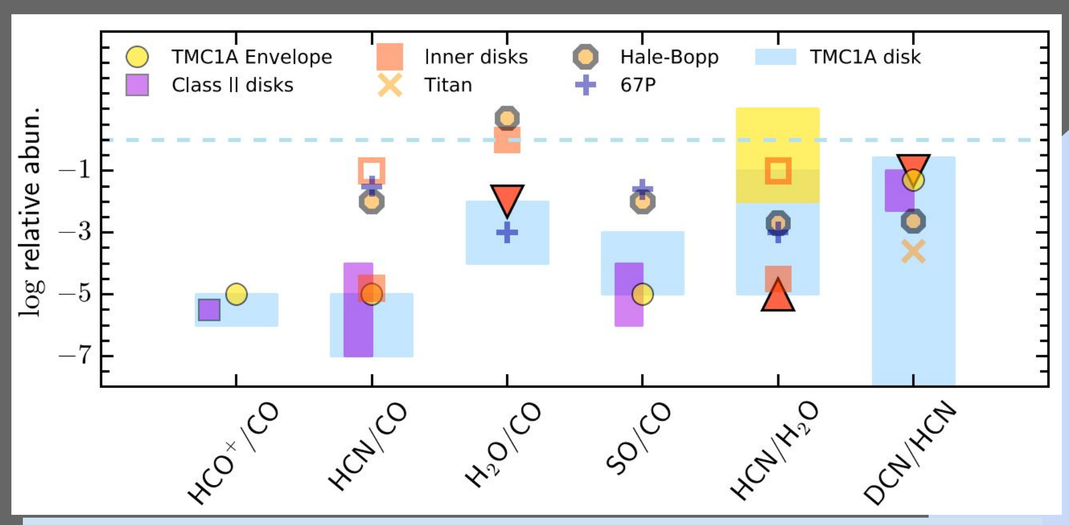
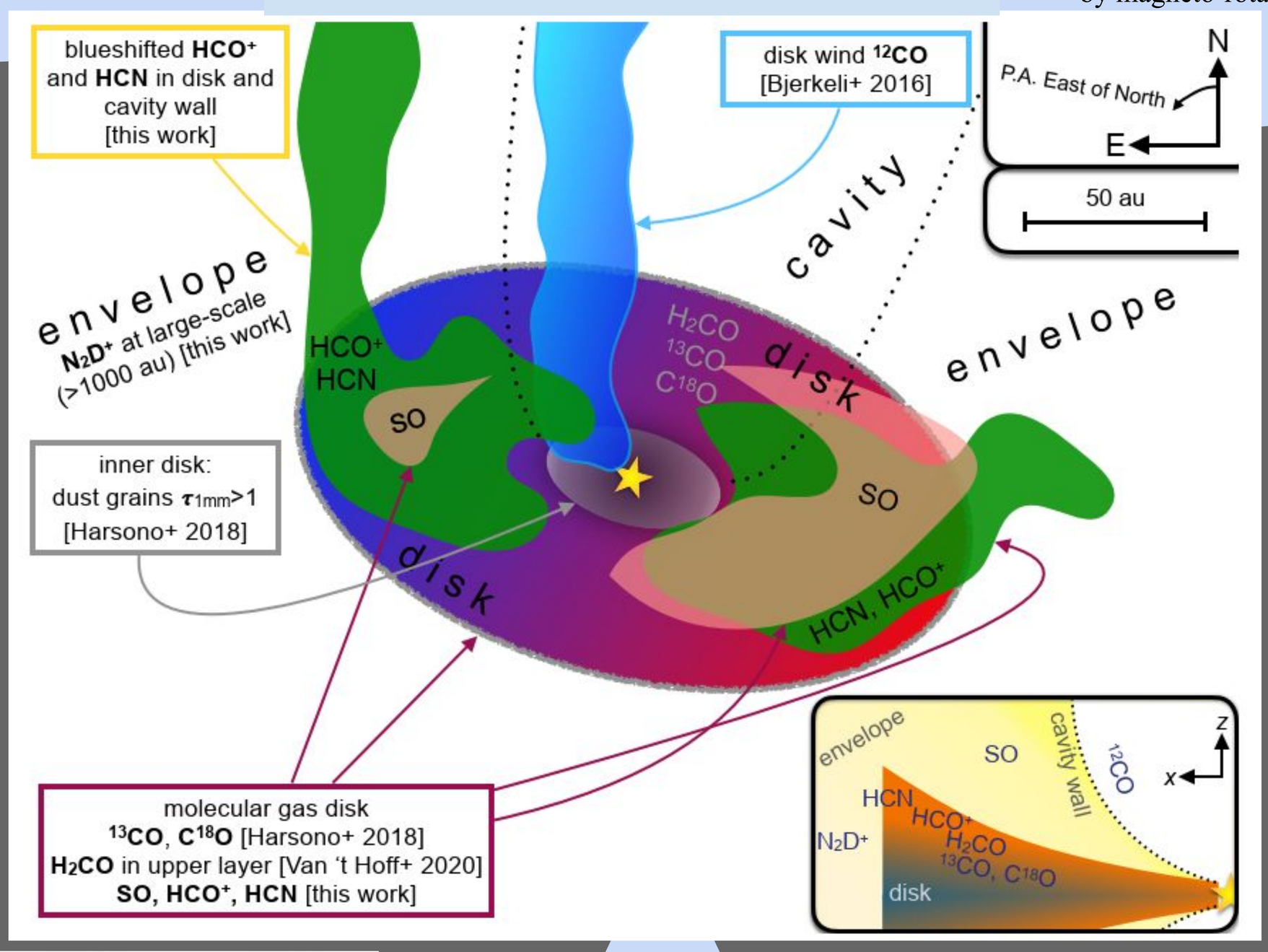
Disk assembly:

Embedded Keplerian disks are now routinely being characterized through millimeter interferometric observations. With spatially resolved molecular lines observations, it is possible to answer the following questions:

- Does the disk have the same composition as its own envelope?
- Which molecules trace the physics of disk formation?



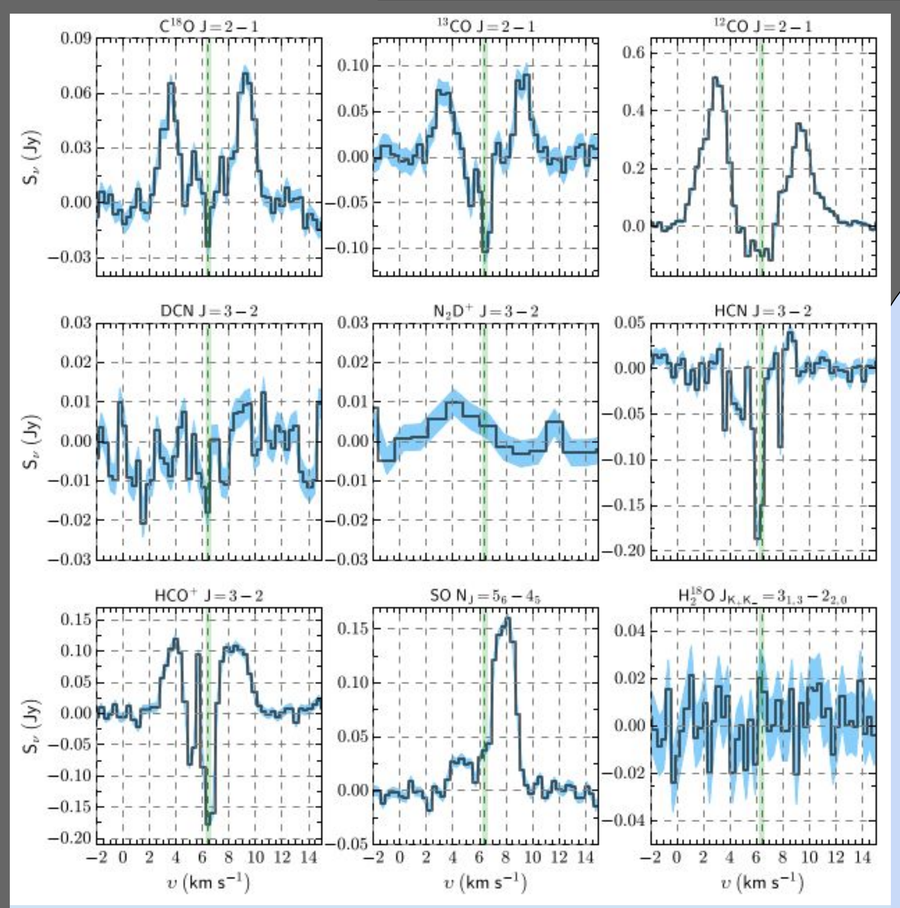
Comparison of the inferred molecular abundances of the TMC1A disk with its own envelope, Class II disks, and Solar System objects



Conclusions:

Young disk around TMC1A inherits the material of its natal envelope

- The planet-forming material is delivered to the disk unaltered without strong shocks.
- The composition of the young disk is similar to the older Class II disks.
- HCN and water molecules are the best tracers of the disk formation process.
- The accretion process is not powered by magneto-rotational instability.

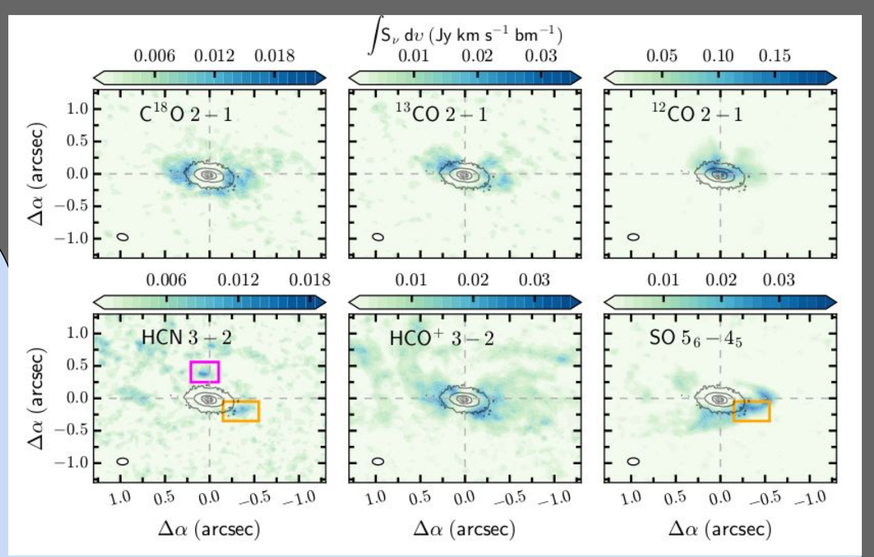


Molecular spectra of various molecular lines of interest taken from the central 1" square aperture. The molecular lines from top left to bottom right: $C^{18}O$, ^{13}CO, ^{12}CO, DCN, N_2D^+, HCN, HCO^+, SO, and $H_2{}^{18}O$.

Observational data

Three long baseline ALMA observations of the Class I protostellar system TMC1A are used to cover the dust continuum, ^{12}CO, ^{13}CO, $C^{18}O$, HCN, HCO^+, and DCN. NOEMA observations of the water $H_2{}^{18}O$ 203 GHz line is also used to constrain the water emission from the young disk.

Dust continuum data from the 203 GHz window up to the 260 GHz are used to constrain the orientation of the disk.



Zeroth moment maps of the strongly detected molecular lines integrated from 1 to 12 km s^{-1}. Two highlighted regions correspond to the line of sight toward disk wind location (pink) and the Keplerian disk (orange).

References:

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