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## Probing Snow Surfaces/Lines in Protoplanetary Disks

*Tuesday, 15 October 2019 12:25 (15 minutes)*

Contributed talk

Abstract:

“Protoplanetary disk radial and vertical thermal temperature gradients result in 2D snow surfaces, or condensation fronts. These are analogous to 1D snowlines, which are located where snow surfaces intersect with the disk midplane. CO and N<sub>2</sub> are two of the most abundant disk molecules, and their snow surface locations could provide disk temperature structure diagnostics, while their snowline locations regulate the C/N/O ratios of outer Solar System planets and planetesimals. N<sub>2</sub>H<sup>+</sup> is expected to only be abundant between the CO and N<sub>2</sub> snow surfaces because it is destroyed by CO and formed from N<sub>2</sub>, and could therefore be used to probe the snow surfaces of both molecules in disks. Here we present Atacama Large Millimeter/submillimeter Array (ALMA) observations of N<sub>2</sub>H<sup>+</sup> 3-2 at 0.2”-0.4” resolution in a sample of protoplanetary disks. We find two distinctive emission morphologies: N<sub>2</sub>H<sup>+</sup> is either present in a bright narrow ring surrounded by the extended tenuous emission or in a single broad ring. These emission patterns can be explained by two different kinds of vertical temperature structures. Bright narrow N<sub>2</sub>H<sup>+</sup> rings are expected in disks with vertical isothermal disk midplanes, where vertical snow surfaces at the midplane CO and N<sub>2</sub> snow line locations produce a N<sub>2</sub>H<sup>+</sup> emission peak defined by the CO and N<sub>2</sub> snowline locations. Broad N<sub>2</sub>H<sup>+</sup> rings are expected in disks that lack vertical isothermal midplanes and therefore present little excess N<sub>2</sub>H<sup>+</sup> emission between the two snowline radii. For the first group, we use the inner and outer edges of the bright N<sub>2</sub>H<sup>+</sup> ring to constrain a first set of CO and N<sub>2</sub> snowline pairs in the disks. “

**Presenter:** Dr QI, Chunhua

**Session Classification:** Circumstellar Disks