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TITLE: Astrochemical models of water in molecular clouds and protoplanetary disks

ABSTRACT BODY:

Abstract Body: In this presentation, I will review chemical reaction network models of water coupled with dynamical evolution of star forming regions. Infrared observations show that water ice is abundant (10^{-4} relative to hydrogen nuclei) even in molecular clouds with relatively low visual extinction ~ 3 mag, which indicates that water ice is formed in early stage of molecular clouds. We thus start from a possible formation site of molecular clouds, i.e. the converging flow of diffuse gas. Then we proceed to a dense cloud core and its gravitational collapse, during which significant deuterium enrichment occurs. The gas and ice accrete onto a forming circumstellar disk, which evolves to a protoplanetary disk in T Tauri phase. Since the disks are turbulent, at least in the regions with a sufficient ionization degree, water could be photodissociated in the disk surface and re-formed in deeper layers. Accretion and radial mixing could also play a role in determining the distribution of water and its isotope ratios. The models are compared with observational studies of objects at each evolutionary stage.

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