Temperature conditions in the early solar nebula based on the ortho-to-para ratio in cometary molecules

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Ortho-to-para ratio of cometary molecules is thought to be one of important properties to give the information of temperature condition in the early solar nebula. Recent studies on the ortho-to-para ratio of ammonia show that the ortho-to-para ratios reflect the temperature condition in the early solar nebula. Ortho-to-para ratios are also used for the investigations on temperature conditions in molecular dark clouds. Thus, the link between molecular clouds to comets becames interesting from the viewpoint of chemical evolution of interstellar materials.

ALMA will reveal the properties of cometary molecules in a jet, in which the materials are emitted from more inner part of the cometary nucleus, and they are more primordial than observed in entire coma.

Furthermore, ALMA will be able to resolve the proto-planetary disks and observe the molecules at different parts of a disk.

We review the recent progress of this field and discuss on the determination of ortho-to-para ratios of cometary molecules by ALMA.