

Origin of cometary molecules: what is the real meaning of ortho-to-para ratio of cometary water and ammonia

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Since the first determination of ortho-to-para ratio (OPR) of cometary ammonia by the Subaru telescope with High Dispersion Spectrograph, we have continued to determine the OPRs in cometary ammonia. Now we have four samples for the OPRs of cometary ammonia. There are three samples for OPRs of cometary water which were investigated before our ammonia study. Thus, we know the spin temperatures for six comets (comet Hale-Bopp is included in both samples). All data show the spin temperature of about 30 K (26 -- 34 K). Especially, the spin temperature of both water and ammonia are consistent with each other, 28 K, in comet Hale-Bopp.

We present the latest our results and compare them with other studies. relationship between the spin temperature and the temperature in the solar nebula or in the presolar molecular cloud is discussed.