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# Dissociative recombination of protonated methanol

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**Abstract.** The formation of interstellar methanol has puzzled scientists for a long time. Since grain surface processes were not thought to be able to produce the observed methanol densities (Allen & Robimnson 1977), gas phase reactions have been regarded as the major source of this molecule in space. Generally, it had been accepted that the first step of interstellar methanol formation is a radiative association of $CH_3^+$ and $H_2O$ followed by dissociative recombination leading to $CH_3OH$ and H.

It has been shown by ion trap experiments that the rate of the radiative recombination of $CH_3^+$ and $H_2O$ is at least a factor of 10 too low to explain the interstellar abundances of methanol if one applies the common astrochemical models used (Luca, Voulot & Gerlich 2002;Herbst 1985). However, since $CH_3^+$ has never been observed its abundances in interstellar clouds and other astronomical environments might differ considerably from model predictions. Therefore a substantial contribution of the proposed mechanism to the formation of interstellar methanol cannot yet been ruled out. Nevertheless, this only holds under the assumption that the dissociative recombination of $CH_3OH_2^+$ mostly or exclusively leads to methanol.

The branching ratios of the different reaction pathways and the overall rate of this process has been measured at the CRYRING storage ring located at the Manne Siegbahn Laboratory in Stockholm Sweden. A preliminary analysis of the data yielded that formation of methanol accounts for only 5 $\pm$ 2 percent of the total reaction rate. Largely, dissociative recombination of $CH_3OH_2^+$ involves fragmentation of the C-O bond, the major process being the three-body break-up forming $CH_3$, OH and H (branching ratio 0.52 $\pm$ 0.04). A non-negligible formation of interstellar methanol by the previously proposed mechanism is therefore very unlikely.
The astrophysical implications of these findings will be discussed in detail.

**Keywords.** molecular processes, methods: laboratory, ISM: molecules

## References

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