

# Cosmological Implications of the Uncertainty in Astrochemical Rate Coefficients

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## Abstract

The cooling of neutral gas of primordial composition, or with very low levels of metal enrichment, depends crucially on the formation of molecular coolants, such as  $\text{H}_2$  and  $\text{HD}$  within the gas. Although the chemical reactions involved in the formation and destruction of these molecules are well known, the same cannot be said for the rate coefficients of these reactions, some of which are uncertain by an order of magnitude. In this presentation, we discuss two reactions for which large uncertainties exist – the formation of  $\text{H}_2$  by associative detachment of  $\text{H}^-$  with  $\text{H}$  and the destruction of  $\text{H}^-$  by mutual neutralization with protons. We show that these uncertainties can have a dramatic impact on the effectiveness of cooling during protogalactic collapse.

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