MOLECULAR HYDROGEN FORMATION IN THE EARLY UNIVERSE: NEW IMPLICATIONS FROM LABORATORY MEASUREMENTS

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We have performed the first energy-resolved measurement of the associative detachment (AD) reaction $H^- + H \rightarrow H_2 + e^-$. This reaction is the dominant formation pathway for $H_2$ during the epoch of first star formation in the early universe. Despite being the most fundamental anion-neutral reaction in chemistry, experiment and theory have failed to converge in both magnitude and energy dependence for this process. The uncertainty in the rate coefficient of the AD reaction severely limits our understanding of the formation of the first stars and protogalaxies.
To adress this issue we have developed a dedicated merged beams apparatus utilizing photodetachment to create a strong ground state H atom beam. Kinematical compression in a collinear beams arrangement allows us to cover the entire relevant collision energy range from 4 meV to 1 eV. We will give an overview of the technique and compare the experimental results to theoretical claculations. We will present a new experimentally confirmed thermal rate coefficient for the AD process and outline its implications for early universe cosmological models.

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