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Low-Energy Mutual Neutralization Studies for Early Universe Hydrogen Chemistry[1]

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Low-energy interactions between light ions, as they occur in low density plasmas, are ideally studied under merged-beam conditions. This was the motivation for building the dual-source setup in operation at UCL, Louvain-la-Neuve, since the early eighties. Although initially developed for the study of charge exchange [1], mutual neutralization and transfer ionization, this machine has produced a host of total cross section measurements for a wide variety of associative ionization and other reactive processes involving charged reactants, from H^+ to CO^+, in collision with H^-, D^-, C^- and O^- [2]. A recent paper by Glover et al. [3] has revived the interest for mutual neutralization studies, by stressing the need of the astrophysical community for a precise determination of the low-energy cross section of the H^+/H^- reaction. The mutual neutralization acts as a sink for negative ions which otherwise dominate the primordial formation of H_2 by associative detachment with ground state H. Absolute measurements in the range 5 meV to 5 eV are needed to rule out earlier experimental work [4] contradicting the most recent theoretical predictions [5]. Our setup is currently modified to incorporate coincident imaging techniques, giving access to differential cross sections besides the branching among accessible neutral channels. Mutual neutralization reactions of H^- with H_2^+ and H_3^+ will also be investigated, for the role they play in laboratory plasmas [6].

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