

Development of a merged-beam apparatus to study the interstellar ion-neutral reactions

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Experimental determination of ion-neutral reaction cross sections and their internal state dependence is crucial to understanding interstellar gas-phase chemistry. A merged-beam experiment is capable of measuring the energy-dependent reaction cross-sections by merging the ion and neutral beams collinearly at low center-of-mass collision energies. We plan to conduct a merged-beam experiment on state-selective low-energy collisions of interstellar molecular ions with neutral atoms such as H, D, C, and O at 10 — 100 meV region.

An overview of the experiment is shown in Fig.1. The neutral beam of the ground-state atoms is produced by laser photo-detachment of a negative ion beam extracted from the duoplasmatron ion source, which generates about 100 nA of negative ions by a two-stage discharge process. The photo-detachment is done by an 808 nm laser diode array in a multi-reflection cavity. A cold-cathode PIG ion source is also under development for the production of molecular ion beams. The two beams are merged and mass-analyzed by electrostatic deflectors at the entrance and exit of the merged section.

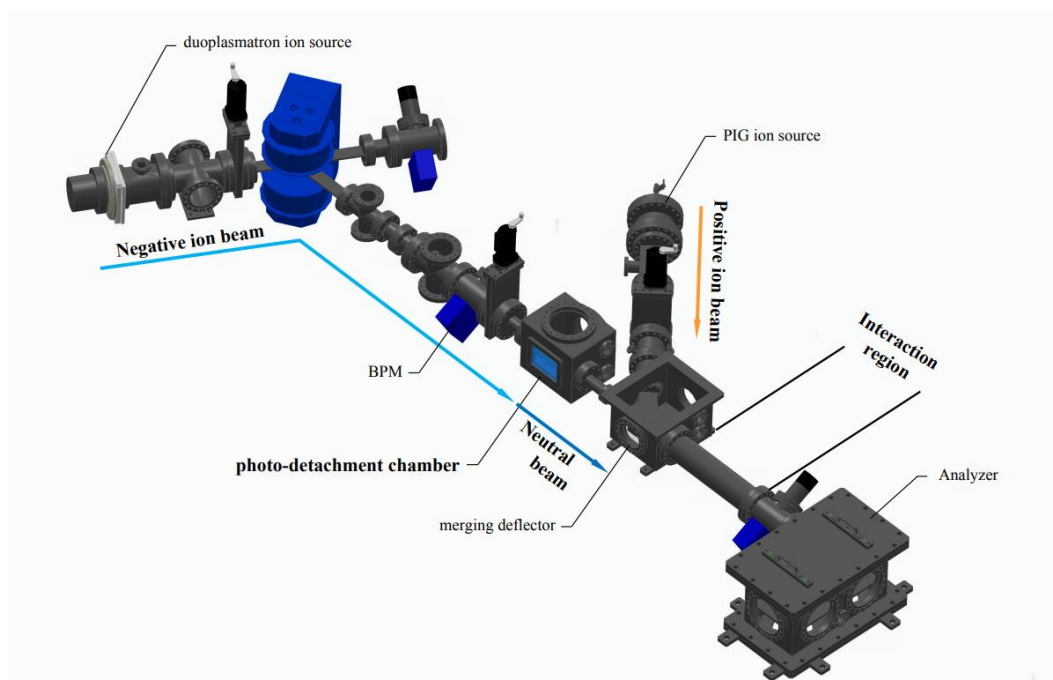


Fig1. Overview of the merged-beam apparatus