Mutual neutralization processes in cation-anion reactions

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The Double ElectroStatic Ion Ring ExpEriment, DESIREE, is a storage ring facility located at Stockholm University, Sweden [1,2]. The unique double ring structure of DESIREE shown in Figure 1 allows for merged beam studies of mutual neutralization using anion and cation beams stored in two separate storage rings with a common straight section. The storage rings are enclosed in a single vacuum chamber cryogenically cooled to 13 K, resulting in a vacuum on the order of 10^{-14} mbar. The excellent vacuum conditions allow for beam storage times up to about one hour [3]. The two ion beams are overlapped in the straight section where a system of up to seven drift tubes can be biased with a voltage in order to match the velocities of the two ion beams. This setup allows for studies of mutual neutralization processes at center of mass energies close to 0 eV. The resulting neutral products are detected by a position sensitive imaging detector system, and the difference in arrival times of the products on the detector are recorded simultaneously. The combination of positions and arrival times allows for final state resolved measurements of the mutual neutralization process. For molecular systems, the distribution of final states is highly dependent on the initial vibrational and rotational states of the ions. By storing the ions for extended periods of time in the cryogenic environment they are relaxed towards their vibrational and rotational ground state [4], allowing for simplified interpretation of the results and comparison to theoretical models. Initial studies so far have been focused on atomic species, and have been successful in separating final states of mutual neutralization reactions between C^- and N^+ as well as D^- and Li^+.

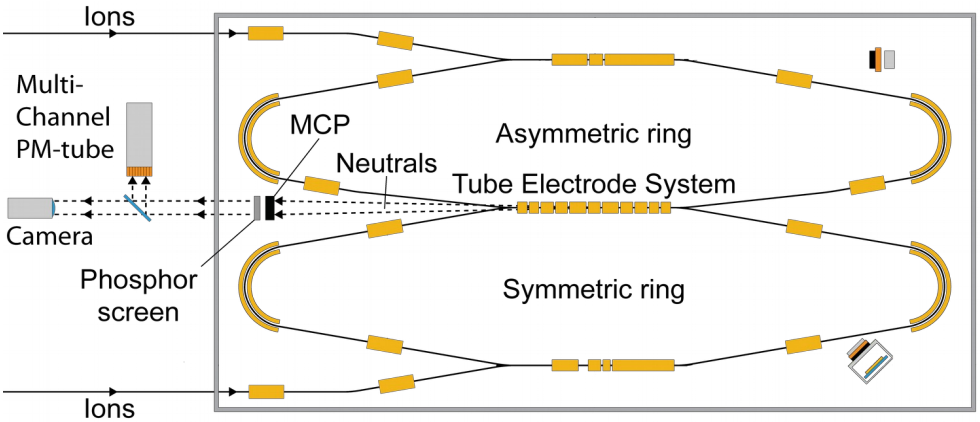

Figure 1: Schematic drawing of the DESIREE storage rings. The products from mutual neutralization occurring in the common straight section are detected using an imaging detector.

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References

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