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Absolute Rate Coefficients for Dielectronic Recombination of the Astrophysically Relevant Ne3+ Ion at CRYRING@ESR

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Neon, one of the most abundant elements in the universe, is frequently observed in the spectroscopic data of many astrophysical objects. Dielectronic recombination (DR) is a key process for the charge state distribution in astrophysical plasma environments. It is initiated by the resonant capture of a free electron with simultaneous excitation of a bound electron and completed by the emission of photons, which stabilizes the charge state of the recombined ion. We report on the preliminary results from our DR experiment with nitrogen-like Ne ions.
At CRYRING@ESR in Darmstadt, beams of specific elements and charge states are stored, cooled, and exposed to an almost monoenergetic electron beam for DR measurements [1]. The ultra-cold electron beam provided by the CRYRING electron cooler enables high-resolution DR rate coefficient measurements [2], particularly at low electron-ion collision energies, which are essential for understanding recombination rates in cold photoionized plasmas [3].
The ions were injected from an ECRIS at the local injector, accelerated to an energy of 2.23 MeV/u, stored and electron cooled with an average of 5.5×106 ions per cycle. The merged-beams DR spectrum was measured across several overlapping energy ranges, covering a total range of -0.5 to 25 eV in the center-of-mass frame, where the dominant resonances arise from Δn=0 transitions through 2s⟶2p core excitation into 2s2p4 4P levels. Notably, we observed strong DR resonances at energies below 0.5 eV, with the associated merged beam recombination rate coefficient nearly as strong as at the 2s2p4 4P1/2 series limit at 22.91 eV.
Additionally, the level population fractions as a function of storage time was modelled to compare theoretical DR of a mixed ion beam with the experimental data [4].

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