Electron-Ion Recombination Rate Coefficients of Iron M-Shell Ions for X-Ray Astronomy

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Recent observations of active galactic nuclei (AGN) have shown a prominent absorption feature in the 15–17 Å bandpass [1]. This has been identified as an unresolved transition array (UTA) of $2p \rightarrow 3d$ inner shell absorption by iron ions with an open M-shell (Fe I–Fe XVI). This UTA can be be used as a powerful diagnostic tool for the absorbing material surrounding the AGN's super massive black hole [2]. However, recent model calculations of the X-ray absorbing gas have failed to reproduce the shape of the UTA [3]. This has been attributed [4, 5] to the fact that the until-recently only-available theoretical dielectronic recombination (DR) rate coefficients of iron M-shell ions are too low at the low temperatures where these ions are formed in photoionized plasmas.

In a series of studies, aiming at providing reliable DR data for astrophysical modeling, we have measured DR rate coefficients of several iron M-shell ions ranging from Fe VIII to Fe XV using the ion storage ring TSR at the Max Planck Institute for Nuclear Physics in Heidelberg, Germany. Already in our first measurement for Fe XIV [6], we found unusually strong DR resonances at low electron-ion collision energies. The corresponding low-temperature plasma DR rate coefficient is orders of magnitude larger that the data used in Reference [3]. Our very recent finding has already stimulated new theoretical calculations [7, 8]. Further results also for Fe VIII and Fe IX will be presented and their astrophysical implications will be discussed.

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