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Absolute radiative and Auger transition rates of K-shell excited few-electron iron ions

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Synopsis The iron Kα lines are among the most prominent features in the x-ray spectra of many celestial sources. However, transition rates used to model these spectra were only known by theoretical calculations. Here we present an absolute measurement of iron K-shell transition rates for Li-like to C-like iron ions. These ions were created with an electron beam ion trap and excited with x rays from the PETRA III synchrotron source. Measuring x-ray fluorescence and Auger decay simultaneously allows to determine absolute decay rates independent of most experimental parameters.

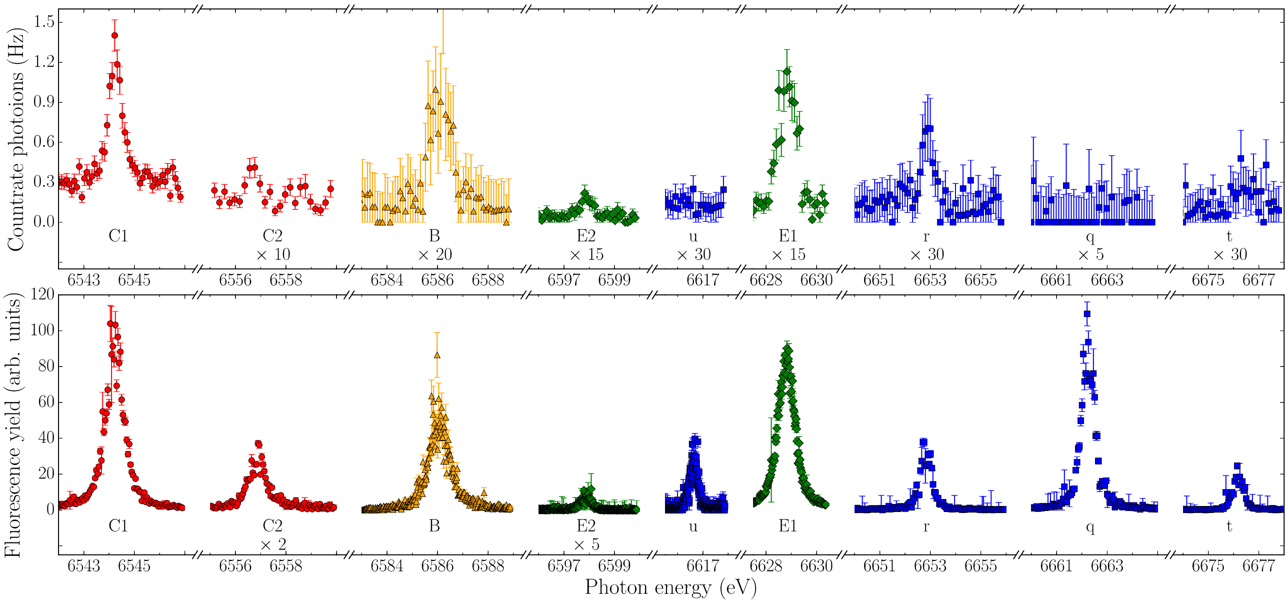

Figure 1. Measured photoionization (top) and fluorescence spectra (bottom) of highly charged iron ions [1]. Shown are resonances in C-like (red circles), B-like (yellow triangles), Be-like (green diamonds), and Li-like (blue squares) charge states. Part of the data is scaled up by the factors denoted below the labels.

The spectrum of highly charged iron ions provides rich information about the dynamics in X-ray binary stars and active galactic nuclei. To model measured spectra, a precise knowledge of the transition rates is needed. While transition energies have been accurately measured before, only theoretical values for transition rates were available. We present a measurement of radiative and Auger rates for K-shell transitions in Li-like to C-like iron ions. These were produced and trapped in the transportable electron beam ion trap FLASH-EBIT and resonantly excited with X-ray photons at PETRA III. The subsequent radiative decay was measured with semiconductor photon detectors, while the Auger decay was observed by detecting the change of the ion charge state. By taking ratios of the photoionization yield and the simultaneous recorded fluorescence, we suppress setup-dependent uncertainties. Together with natural line widths [2], this allows us to determine absolute values for the radiative and Auger transition rates. Furthermore, by analyzing the angular distribution of the fluorescence photons, we resolved different radiative decay channels in the Be-like and C-like system. Although only short measurement time was available, a better-than-10% accuracy could be achieved in the Li-like system [1]. The used method can easily be transferred to other charge states and elements.

References

[1] R. Steinbrügge *et al* 2015 *Phys. Rev.* A **91** 032502

[2] J. K. Rudolph *et al* 2013 *Phys. Rev. Lett.* **111** 103002

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