Dielectronic resonances in highly-charged heavy ions observed in ion traps

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Synopsis Series of inner-shell dielectronic resonances were measured in the 7-20-keV x-ray spectra of highly charged tungsten and iridium ions produced in ion traps by highly dense electron beams. A detailed analysis of the spectra with a non-Maxwellian collisional-radiative model allowed us to reliably assign the experimentally observed features.

Satisfactory understanding of ionized-matter environments ranging from hot plasmas in laboratory devices to ionized gases in interstellar clouds in outer space requires reliable data on elementary atomic processes. Such data are routinely calculated using advanced methodes and codes that may provide good accuracy for simple atoms and ions. However, for multi-electron atomic systems, the accuracy of general theoretical approaches may not be sufficient to adequately interpret the observations. This calls for benchmark measurements of spectra from various multi-charged ions, in particular, those of heavy elements for which available spectroscopic data is very limited.

We present the x-ray spectra of highly-charged tungsten and iridium ions measured with the Electron-Beam Ion-Trap (EBIT) at the National Institute of Standards and Technology [1] and with the Main Magnetic Focus Ion Trap (MaMFIT) at the Justus-Liebig-Universität Gießen [2], respectively. The data are shown in Fig. 1. The NIST EBIT spectra (*a*), measured with a high-purity Ge detector at the electron beam energies between 6.44 and 11.27 keV, reveal series of resonances corresponding to LMn and LNn inner-shell dielectronic recombination (DR) involving stabilizing transitions $2\ell - 3\ell'$ and $2\ell - 4\ell'$ in Na-like through Ti-like tungsten. The spectra from the MaMFIT (*b*), measured at energies of 7.1 to 8.65 keV, show resonances corresponding to DR processes involving transitions between $2p - 3d$ subshells in K-like through Ni-like iridium. Detailed modeling of the observed spectra was performed employing the non-Maxwellian collisional radiative code NOMAD [3] which accounts for a large number of atomic levels and all important physical processes (radiative and collisional). Comparisons of the experimental and theoretical results show a good agreement for both the W^{q+} and Ir^{q+} spectra.

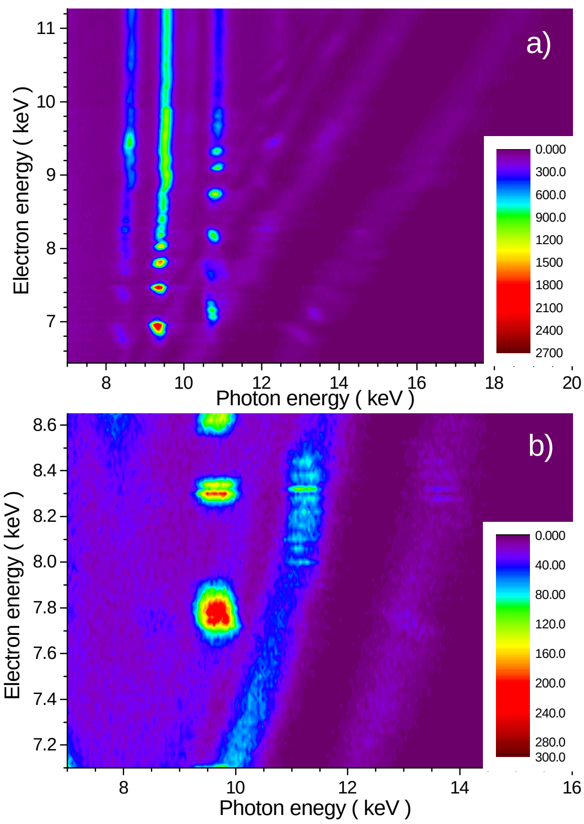

Figure 1. X-ray spectra from a) EBIT at NIST and b) MaMFIT in Giessen.

References

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