

PAPER • OPEN ACCESS

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

To cite this article: A. Borovik Jr. *et al* 2017 *J. Phys.: Conf. Ser.* **875** 052026

View the [article online](#) for updates and enhancements.

Related content

- [Photorecombination of berylliumlike \$Ti^{18+}\$: Hyperfine quenching of dielectronic resonances](#)
S Schippers, E W Schmidt, D Bernhardt et al.
- [Low-lying dielectronic resonances of Fe XXII for accurate energy determination of autoionising Rydberg levels on boronlike cores](#)
C Krantz, D A Orlov, D Bernhardt et al.
- [Linear polarization of x-rays emitted in the decay of highly-charged ions via overlapping resonances](#)
Z W Wu, A Surzhykov, N M Kabachnik et al.



IOP | ebooks™

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of every title for free.

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

A. Borovik, Jr.^{*†‡}, J. M. Dreiling^{*}, R. Silwal^{*§}, Dipti^{*}, E. Takács^{*§}, J. Gillaspy^{*¶}, R. Lomsadze^{†#},
V. Ovsyannikov[‡], K. Huber[‡], S. Schippers[†], A. Müller[‡], and Yu. Ralchenko^{*}

^{*} Quantum Measurement Division, National Institute of Standards and Technology, Gaithersburg MD, USA

[†] I. Physikalisches Institut, Justus-Liebig-Universität Gießen, 35392 Giessen, Germany

[‡] Institut für Atom- und Molekülphysik, Justus-Liebig Universität Gießen, 35392 Giessen, Germany

[§] Department of Physics and Astronomy, Clemson University, Clemson SC, USA

[¶] Division of Physics, National Science Foundation, Arlington VA, USA

[#] Department of Physics, Ivane Javakhishvili Tbilisi State University, Tbilisi, Georgia

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 methods 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 LNd 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.

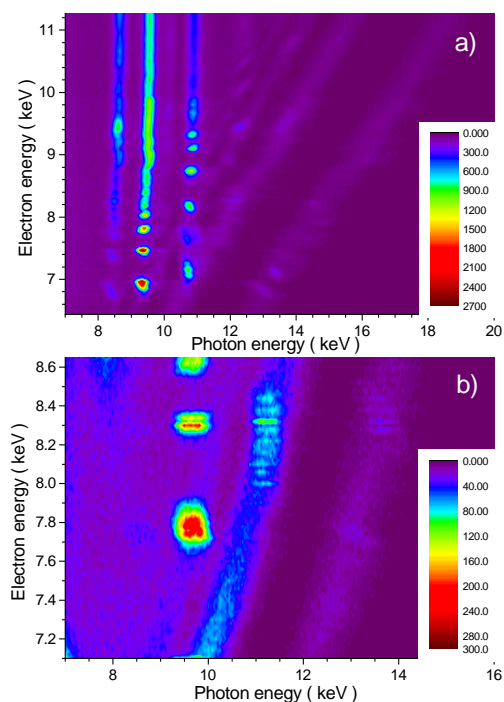


Figure 1. X-ray spectra from a) EBIT at NIST and b) MaMFIT in Giessen.

References

- [1] J. D. Gillaspy 2012 *AIP Conf. Proc.* **1438** 97
- [2] V. P. Ovsyannikov 2014 *arXiv*: 1403.2168
- [3] Yu. V. Ralchenko and Y. Maron 2001 *J. Quant. Spec. and Rad. Trans.* **71** 609

[†]E-mail: Alexander.Borovik@physik.uni-giessen.de

