P11

5p → nd, ms and 4f → nd EUV photoabsorption in Ir to Ir^{4+}

E. Doyle, E. Fagan, P. Hayden, and P. Dunne

UCD School of Physics, University College Dublin, D04 P7W1, Dublin 4, Ireland

Laboratory-based photoabsorption data are used to facilitate the identification of atomic transitions in astronomical rapid neutron-capture process (r-process) measurements [1]. Iridium is one of the elements in the third peak of the nucleosynthetic r-process, but very little knowledge is currently available for the inner-shell atomic structure of Ir ions [2].

Photoionization cross-section measurements of neutral Ir between 50-400 eV were recorded by direct photoabsorption of synchrotron radiation [3]. Subsequently, three lines due to Ir absorption and one line due to Ir^{+} were detected by the Space Telescope Imaging Spectrograph which is aboard the Hubble Space Telescope [4].

Photoabsorption transition arrays arising from Ir to Ir^{4+} ions have been recorded between 48-100 eV using the dual-laser plasma (DLP) technique [5], and were identified with the assistance of atomic structure calculations processed by the Cowan suite of atomic codes [6]. The theoretical absorption cross-section was determined by fitting each of the simulated electronic transitions with a Lorentzian profile [7], weighed by the Boltzmann population energy distribution for an electron temperature estimated by a collisional radiative model [8, 9], and convolved using a Gaussian of 0.05 eV linewidth to account for instrumental broadening.

The inner-shell spectra of laser-produced plasmas (LPPs) [10], which depend on initial laser and target conditions, will allow characterisation of the spatial and temporal evolution of the absorbing plasma. This determination will support the use of LPPs as sources of ions for spectroscopy in the UV, visible, and NIR regions of the spectrum, and will contribute to the interpretation of kilonova spectra in the future.

[1] J. J. Cowan, C. Sneden, J. E. Lawler, A. Aprahamian, M. Wiescher, K. Langanke, G. Martínez-Pinedo, and F. K. Thieleman, Rev. Mod. Phys. **93**, 015002 (2021).
[2] Kramida, Yu. Ralchenko, J. Reader, NIST ASD Team, NIST Atomic Spectra Database **5.11**, (2023).
[3] M. Cukier, P. Dhez, P. Jaeglé, and F. C. Farnoux, Phys. Lett. A **A 51**, 173–4 (1975).
[4] I. U. Roederer and J. E. Lawler, Astrophys. J. **750**, 76 (2012).
[5] L. Gaynor, N. Murphy, P. Dunne, G. O'Sullivan, J. Phys. B: At. Mol. Opt. Phys. **41**, 245002 (2008).
[6] A. Kramida, Atoms 7, **64**, (2019).
[7] E. Doyle, G. O'Sullivan, P. Hayden, P. Dunne, J. Phys. B: At. Mol. Opt. Phys. **56**, 135002 (2023).
[8] D. Colombant and G. F. Tonon, J. Appl. Phys. **44**, 3524–37 (1973).
[9] N. L. Wong, F. O'Reilly, E. Sokell, Atoms 8, **56**, (2020).
[10] P. K. Carroll and E. T. Kennedy, Contemp. Phys. **22**, 61-96 (1981).

This research was supported by the Irish Research Council under grant GOIPG/2018/2827 and Horizons Europe under grant 101071865_HEAVYMETAL.