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HEAVY ELEMENT OPACITY CALCULATIONS FOR KILONOVA MODELING

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The production of elements heavier than iron in the Universe still remains an unsolved mystery. About half of them are thought to be notably produced by the astrophysical r-process (rapid neutron-capture process) [1], for which one of the most promising production sites are neutron star mergers (NSM) [2]. In August 2017, gravitational waves generated by a NSM event were detected by the LIGO detectors (event GW170817) [3], and the observation of its electromagnetic counterpart, the kilonova AT2017gfo, suggested the presence of heavy elements in the ejecta [4]. The luminosity and spectra of such kilonova emission depend significantly on the ejecta opacity, which is dominated by millions of lines from f-shell elements, i.e. lanthanides and actinides, produced by the r-process [5]. Atomic data and opacities for these elements are thus sorely needed to model and interpret kilonova light curves and spectra.

In this context, an overview of the different calculations that have been carried out in the present works on atomic data and corresponding opacities in open 4d, 5d, 4f and 5f-shell elements for typical ejecta conditions expected both in early-phase and in one day post-merger will be presented. These conditions correspond to the presence of ionization stages ranging from neutral up to nine times ionized. A multiplatform approach has been adopted in order to assess the accuracy of the atomic data where the pseudo-relativistic Hartree-Fock (HFR) method as implemented in the Cowan's codes [6], the multiconfiguration Dirac-Hartree-Fock (MCDHF) method as implemented in the last version of the GRASP2018 package [7] and the configuration interaction with many-body perturbation theory correction method (CI-MBPT) as implemented in the AMBiT code [8] have been used. The data sets produced by the first one have been chosen for the opacity computations. Our atomic data and expansion opacities will be discussed and compared with other studies available in the literature.

References

[1] J.J. Cowan, C. Sneden, J.E. Lawler et al., Reviews of Modern Physics 93, 015002 (2021)
[2] B.D. Metzger, G. Martinez-Pinedo, S. Darbha et al., MNRAS 406, 2650 (2010)
[3] B.P. Abbott, R. Abbott, T.D. Abbott et al., Phys. Rev. Lett. 119, 161101 (2017)
[4] D. Kasen, B. Metzger, J. Barnes et al., Nature 551, 80 (2017)
[5] O. Just, I. Kullmann, S. Goriely et al., MNRAS 510, 2820 (2022)
[6] R.D. Cowan, The Theory of Atomic Structure and Spectra, California University Press, Berkeley, 1981
[7] C. Froese Fischer, G. Gaigalas, P. Jönsson et al., Comput. Phys. Commun. 237, 184 (2019)
[8] E. V. Kahl, J. C. Berengut, Comput. Phys. Commun. 238, 232 (2019)

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