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A Link between Atomic Physics and Gravitational Wave Spectroscopy[1]

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Neutron star mergers are promising candidates for the observation of an electromagnetic (EM) signal coincident with gravitational waves. The recent observation of GW170817 [1] appears to be such an event, with gravitational waves confirmed by subsequent EM signals ranging from the infrared to x-ray portions of the spectrum. The properties of the ejecta produced during these events are predicted to play an important role in the electromagnetic transients called macronovae or kilonovae. Characteristics of the ejecta include large velocity gradients and the presence of heavy r-process elements, which pose significant challenges to the accurate calculation of radiative opacities and radiation transport. For example, these opacities include a dense forest of bound-bound features arising from near-neutral lanthanide and actinide elements. We use the Los Alamos suite of atomic physics and plasma modeling codes [2] to investigate the use of detailed, fine-structure opacities [3] to model the EM emission from macronovae. Our simulations [4] predict emission in a range of EM bands, depending on issues such as the presence of winds, elemental composition, and viewing angle. This talk emphasizes various atomic-physics aspects of the spectral modeling of neutron star mergers.

[1] B.P. Abbott et al, Astrophys. J. Lett. **848**, L12 (2017).
[2] C.J. Fontes, H.L. Zhang, J. Abdallah, Jr., R.E.H. Clark, D.P. Kilcrease, J. Colgan, R.T. Cunningham, P. Hakel, N.H. Magee and M.E. Sherrill, J. Phys. B **48**, 144014 (2015).
[3] C.J. Fontes, C.L. Fryer, A.L. Hungerford, R.T. Wollaeger, S. Rosswog and E. Berger, preprint, arXiv:1702.02990 (2017).
[4] R.T. Wollaeger, O. Korobkin, C.J. Fontes, S.K. Rosswog, W.P. Even, C.L. Fryer, J. Sollerman, A.L. Hungerford, D.R. van Rossum, A.B. Wollaber, preprint, arXiv:1705.07084 (2017)

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