Topic No = 1

Invited Talk

KILONOVA EJECTA OPACITY FROM LARGE-SCALE ATOMIC DATA CALCULATIONS IN ALL HEAVY ELEMENTS

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ABSTRACT

About half of the existing heavy elements are thought to be produced by the astrophysical r-process, for which one of the most promising production sites are neutron star mergers (NSMs) [1]. Gravitational waves from a NSM were detected for the first time in 2017 (GW170817) [2]. The observation of its electromagnetic counterpart, the kilonova (KN) AT2017gfo, suggested the presence of heavy elements in its ejecta [3]. The KN luminosity and spectra depend significantly on the ejecta opacity, which is dominated by millions of lines from r-process heavy elements, in particular lanthanides and actinides [4]. Atomic data and opacities for these elements are thus sorely needed to model KN light curves and spectra. The present work consists in a large-scale computation of atomic data and opacities for all heavy elements ($Z \geq 20$), with a special effort on lanthanides and actinides, and for a grid of typical photospheric-phase KN ejecta conditions. To do so, we used the pseudo-relativistic Hartree-Fock (HFR) method [5], in which the choice of the configuration interaction model is of crucial importance [6]. In this talk, our HFR atomic data and opacities for all heavy elements will be presented and compared to other works. Besides, we will discuss the inferred KN ejecta opacity for given NSM models [7]. The impact of considering such atomic-physics based opacity data instead of approximate formulae on KN modeling [4] will also be discussed. All the atomic data from our work [8] are publicly available [9].

Keywords: Atomic data, Kilonova, Opacity, Heavy elements

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