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Atomic cascade computations for astrophysics

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Atomic cascades are ubiquitous in nature and have therefore been explored within many different scenarios, from atoic precision measurements to the modeling of astrophysical spectra, and up to the radiation transport in neutron-star mergers. We here introduce and discuss a classification of atomic cascades and demonstrate how they can be modeled efficiently [1,2].

In practice, however, most atomic and ionic cascades are rather complex and have hampered in the past a detailed account owing to the large (or even huge) number of decay paths. To overcome these difficulties in modeling the ionic ionization, capture and decay processes, we make use of JAC, the Jena Atomic Calculator [3], that help analyze a wide range of atomic shell structures. Apart from first classifying the underlying processes, we here explain how cascade computations and simulations should be distinguished in order to keep the modeling of cascades feasible.

[1] Fritzsche S, Palmeri P and Schippers S 2021 Symmetry 13 520
[2] Fritzsche S et al., submitted to EPJD (2024).
[3] Fritzsche S 2019 Comp. Phys. Commun. 240 1; https://github.com/OpenJAC/JAC.jl

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