Average opacity calculation for core-collapse supernovae

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Supernovae are among the most intensely studied objects of modern astrophysics. Due to their complex physical nature, theoretical models are essential to understand better the physics of exploding stars, as well as the properties of the variation of the emitted radiation. One possibility for modeling SNe light curves is the construction of simplified semi-analytic models, which can be used for getting order-of magnitude estimates of the SN properties.

One of the strongest simplification in most of these light curve models is the assumption of the constant opacity (κ), which is identified as the average opacity of the ejecta.

To study the average opacity for different core-collapse SNe, we generate AGB model stars using the 1D stellar evolution code MESA ([1]) by varying the input physical parameters (initial mass, metallicity, rotation) affecting the mass-loss history of the model star. We synthesize SN light curves from these stellar models with the hydrodynamic code SNEC (). We show that the calculated average opacities are in reasonably good agreement with the frequently used constant opacities in the literature. Choosing an appropriate opacity value is of key importance to get better estimates for the envelope mass and other physical parameters of SNe from their light curves.

[1] B. Paxton et al., ApJS **208**, 4 (2013).
[2] V. S. Morozova et al., ApJ **814**, 63 (2015).