Nebular spectra from Type Ia supernova explosion models compared to JWST observations of SN 2021aefx

Recent JWST observations of the Type Ia supernova (SN Ia) 2021aefx in the nebular phase have paved the way for late-time studies covering the full optical to the mid-infrared (MIR) range, and with it the hope to better constrain SN Ia explosion mechanisms. We investigate whether previously published SN Ia explosion models can reproduce the full optical-MIR spectrum of SN 2021aefx at ∼270 days post explosion. We perform 1D steady-state non-LTE simulations with the radiative-transfer code CMFGEN, and compare the predicted spectra to SN 2021aefx. Taken as a whole, the models can explain the main features of this SN over the full wavelength range. However, no single model emerges as a preferred match. We discuss possible causes for the mismatch of the models, including ejecta asymmetries and ionisation effects. We highlight uncertainties in the atomic data, and present new calculations of the collisional strengths for Ni III. Our models suggest that key physical ingredients are missing from either the explosion models, or the radiative-transfer post-processing, or both. Nonetheless, they also show the potential of the near- and mid-infrared to uncover new spectroscopic diagnostics of SN Ia explosion mechanisms.