

What nebular Ni lines in SNe Ia teach us about their progenitors

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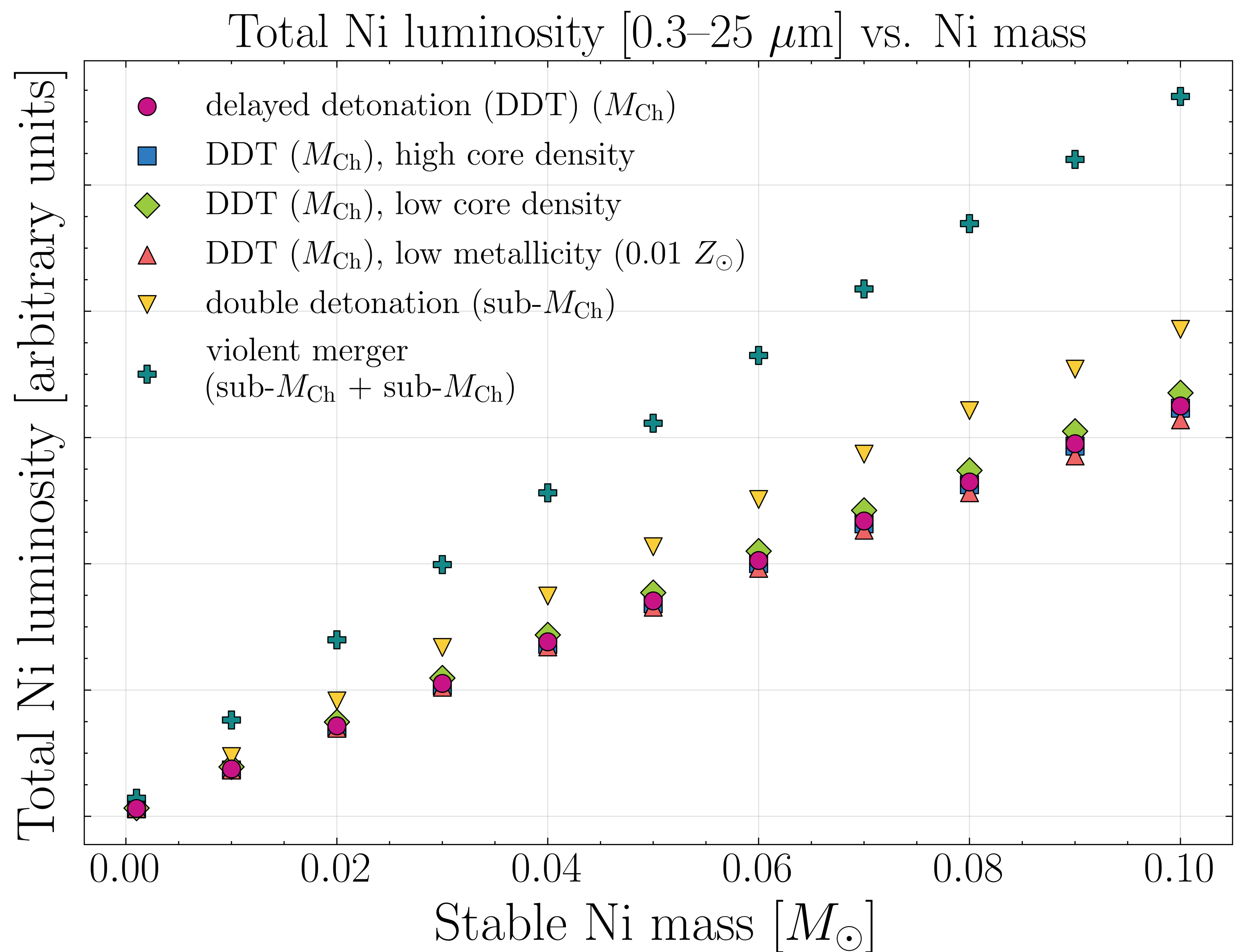
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Why nebular Ni lines?

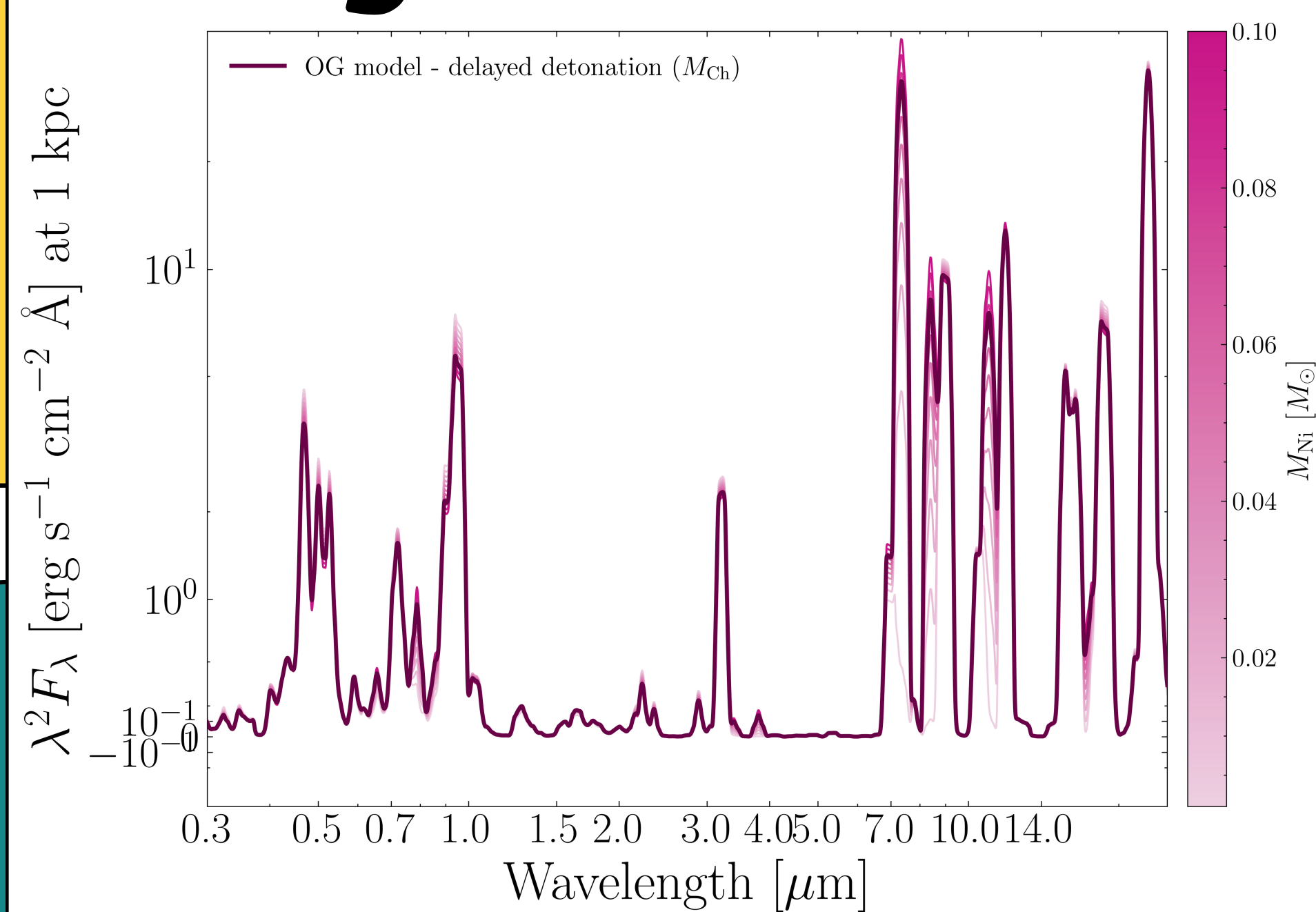
- The amount of stable nickel produced in a Type Ia supernova (SN Ia) is largely determined by the central density of the exploding white dwarf (WD)
- At late times ($\gg 100$ d post explosion), all of the radioactive ^{56}Ni has decayed to ^{56}Co and ^{56}Fe , so the entire flux emitted in Ni lines is due to stable isotopes of Ni only (especially ^{58}Ni)
- There are multiple progenitor scenarios for SNe Ia, each involving WDs with different masses, and hence different central densities at the time of explosion
- The stable Ni abundance could therefore serve as a tracer of the progenitor mass... but can we determine it precisely from Ni lines in late-time SN Ia spectra?

Ni Luminosity vs. stable Ni Mass

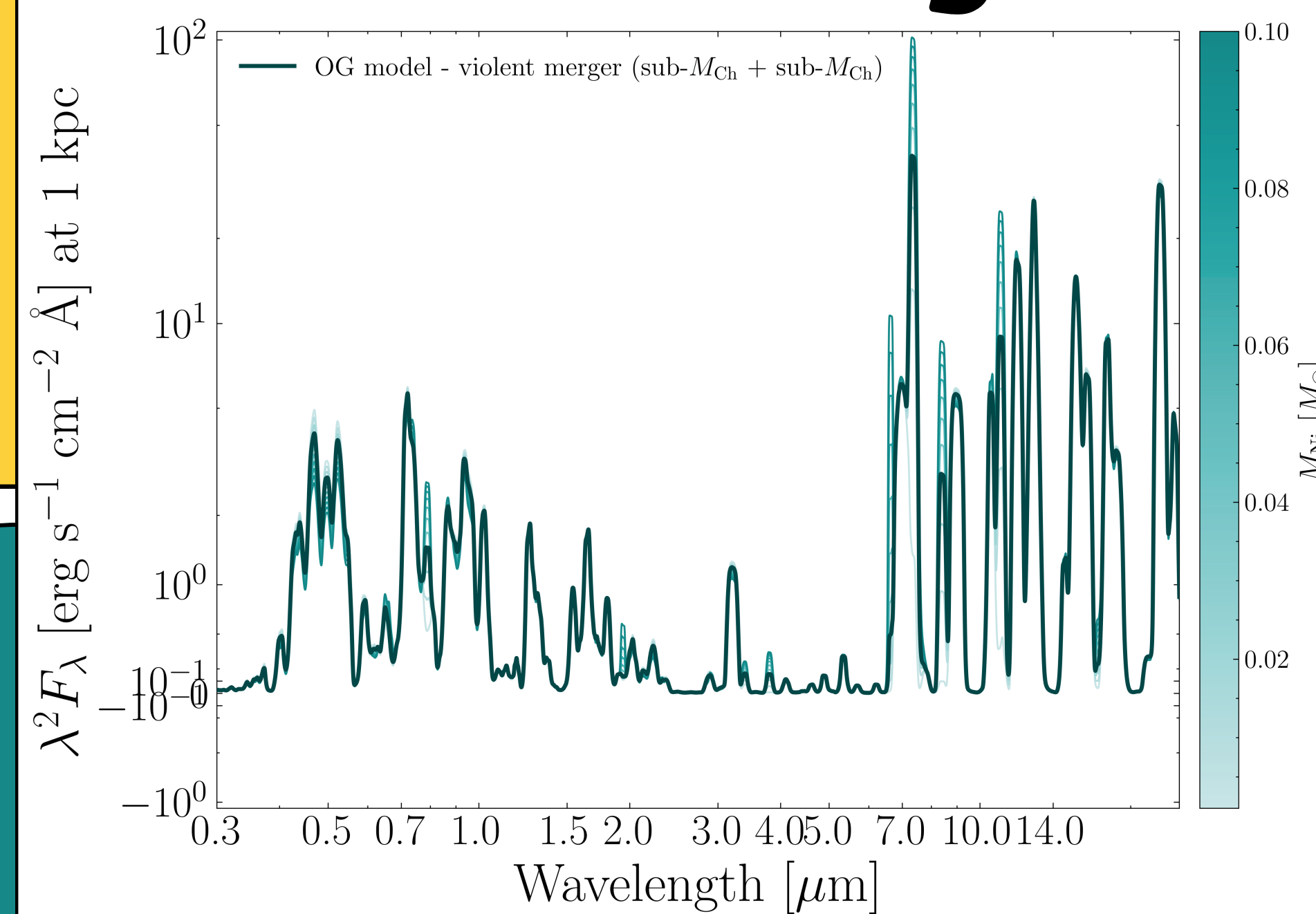


How does changing Ni mass affect the spectra of different models?

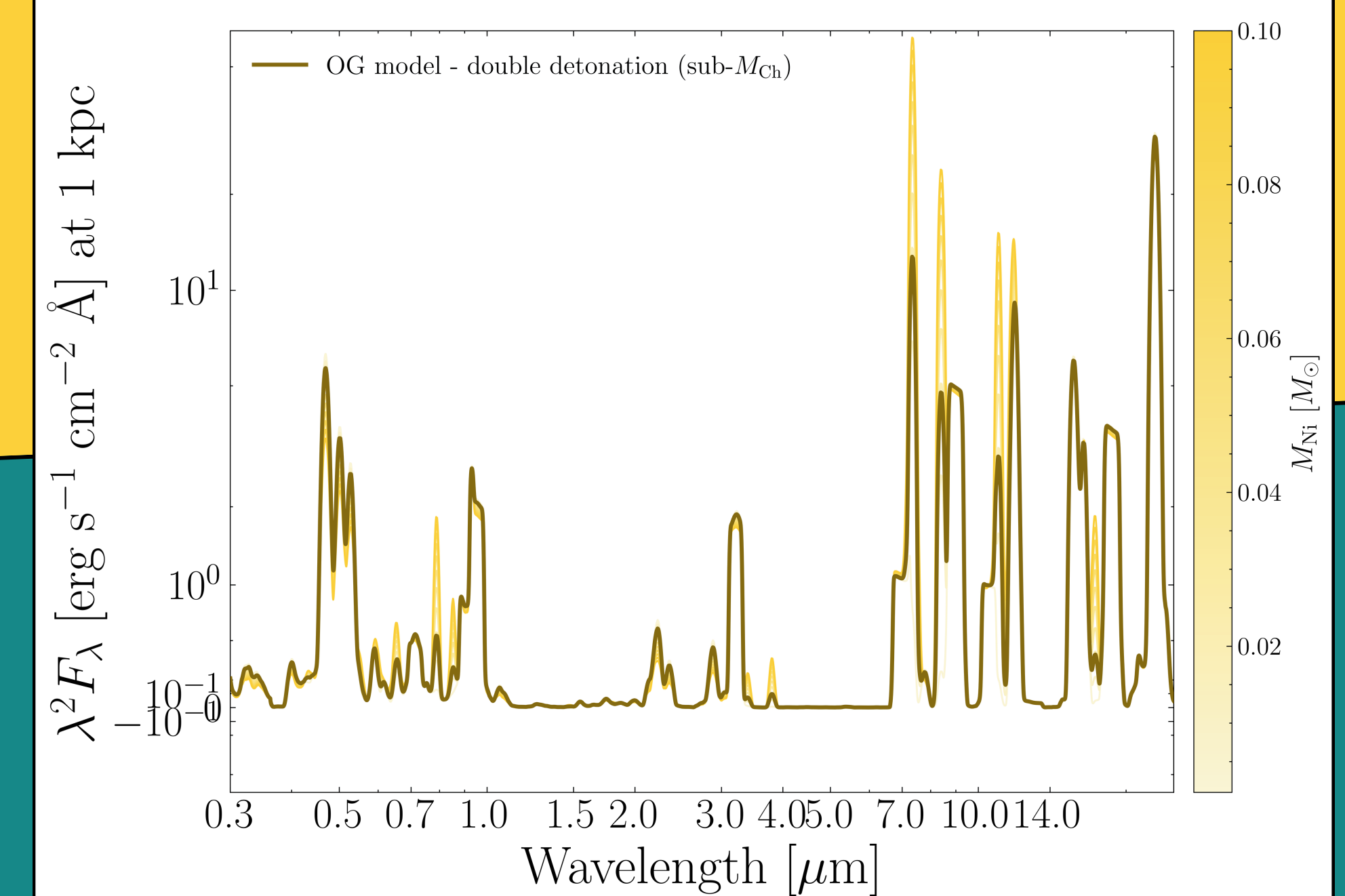
delayed detonation



violent merger



double detonation



Models & Methods

- Input models:** We use six different spherically averaged 3D models from the Heidelberg Supernova Model Archive (HESMA)^{*}, see main figure for details
- We use the 1D non-LTE radiative transfer code CMFGEN (Hillier & Dessart 2012) to simulate the spectra of these SNe Ia at 300 days post explosion

^{*} <https://hesma.h-its.org/>

Main Takeaways

- The total Ni luminosity scales linearly with stable Ni mass for all explosion models**, proving its potential as a diagnostic of the mass of the exploding WD
- However, **degeneracies remain between explosion models**, such that a given total Ni luminosity can correspond to different stable Ni masses depending on the progenitor scenario and explosion mechanism
- A paper summarising our results is currently in preparation... **stay tuned!**