Progenitors and Explosions of White Dwarf Supernovae Revealed by JWST

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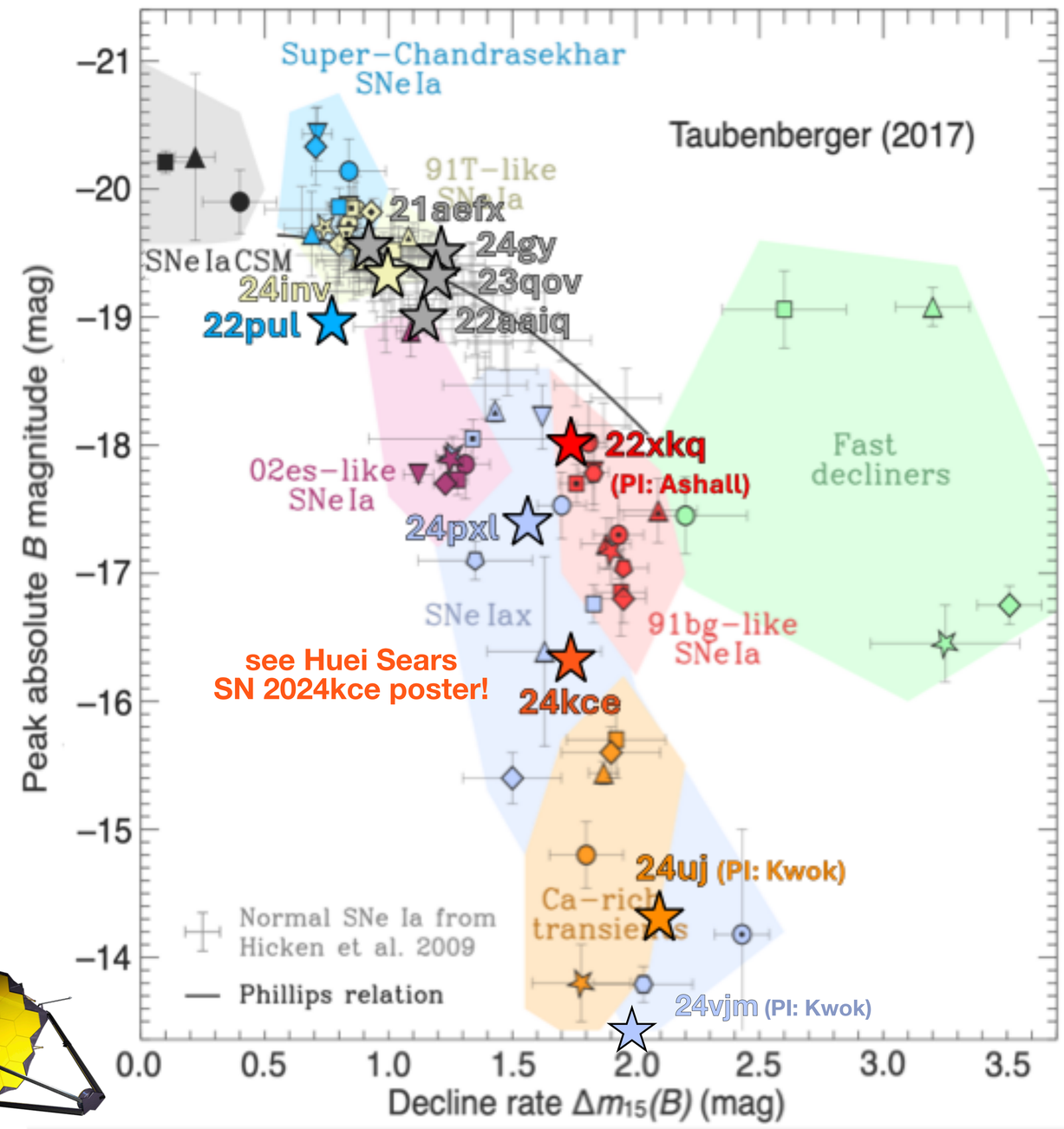
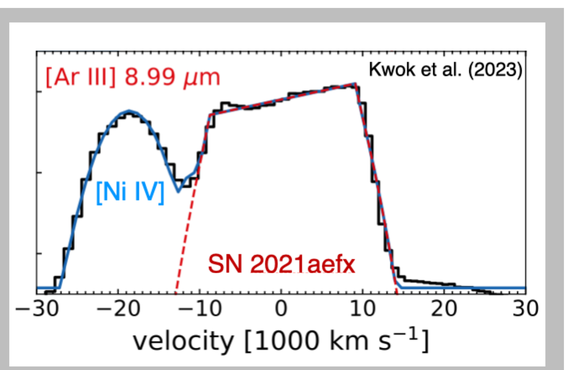
Infrared spectroscopy of supernovae in the nebular phase lets us "see through" the ejecta and probe a wide range of elements.

Our "See Through Supernovae" Cycles 1–3 JWST program (and others) have observed white dwarf supernovae across the diverse thermonuclear supernova zoo.



Normal SN Ia

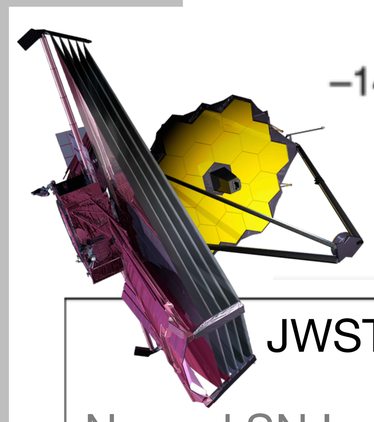
We see strong stable Ni emission, from high-density burning, perhaps favoring near-M_{Ch} WD explosions?

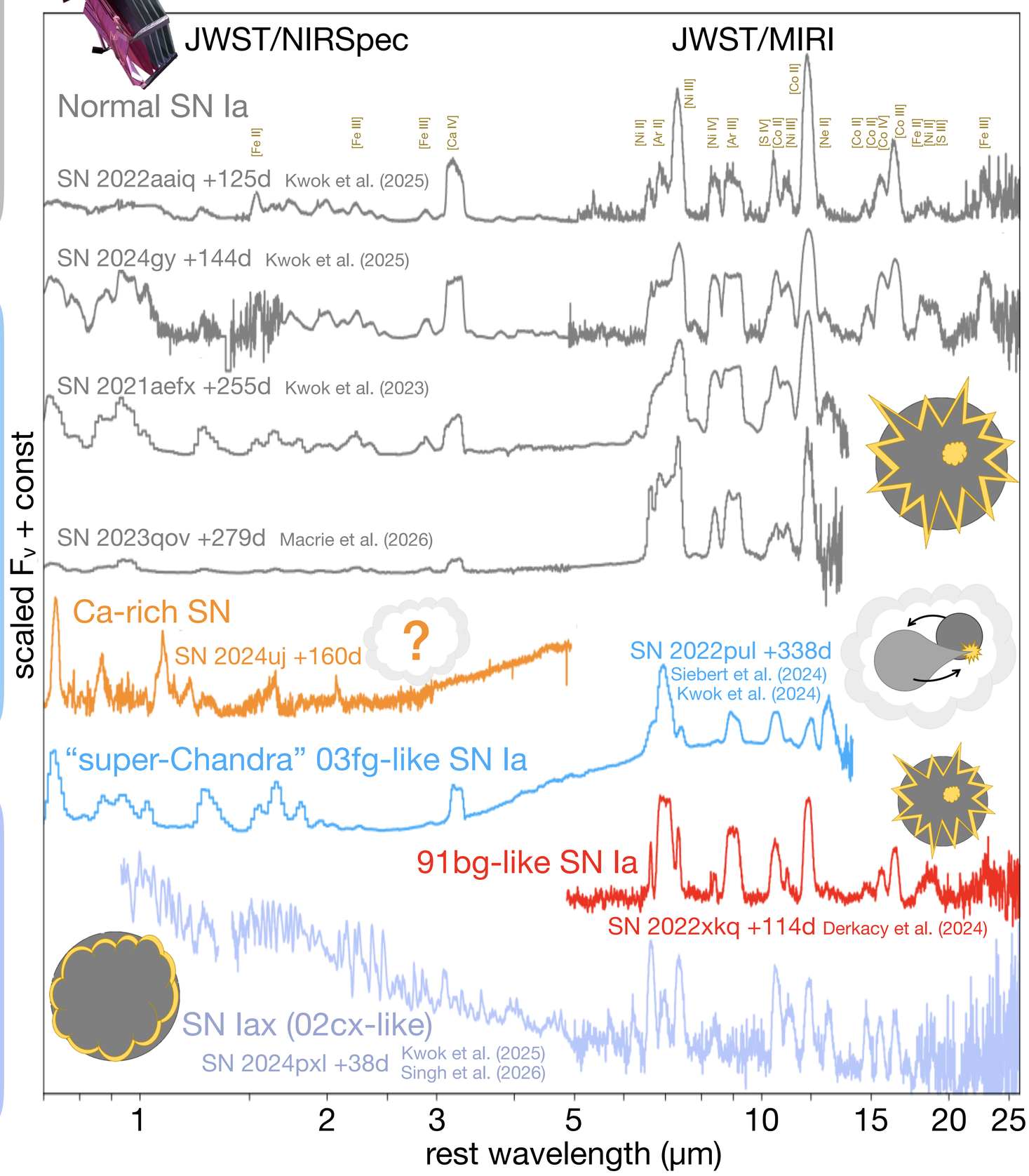


Line profiles show intermediate mass elements like Ar are in a shell *around* the iron group elements: a detonation (supersonic) explosion.

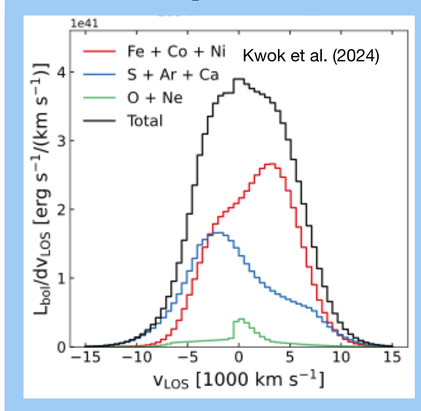
Analysis of the line profiles shows consistency with the *delayed detonation* (deflagration to detonation transition) model (Kwok et al. 2025).

Some objects, like SN 2023qov, show evidence for an infrared echo and circumstellar dust emission (Macrie et al. 2026).



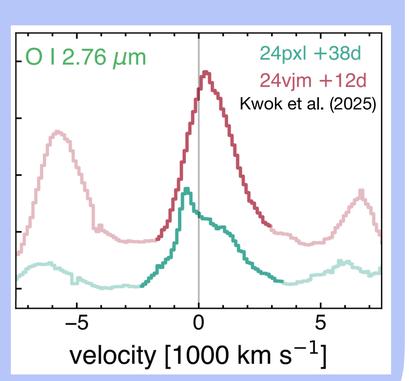


"super-Chandra" 03fg-like SN Ia



We see central O & Ne, *two* nucleosynthesis peaks in the line profiles, and strong circumstellar dust emission for SN 2022pul.

These match models for the *violent merger* of two white dwarfs (Pakmor et al. 2012, Blondin et al. 2023, Siebert et al. 2024, Kwok et al. 2024) within a dense C/O shell.

SN Iax (02cx-like)

We see *all lines* (O, Ne, Mg, S, Ar, Ca, Fe, Co, Ni) with similar, centrally peaked profiles. Mixed ejecta match the *weak deflagration* (subsonic explosion) model for SN Iax (Kwok et al. 2025).