

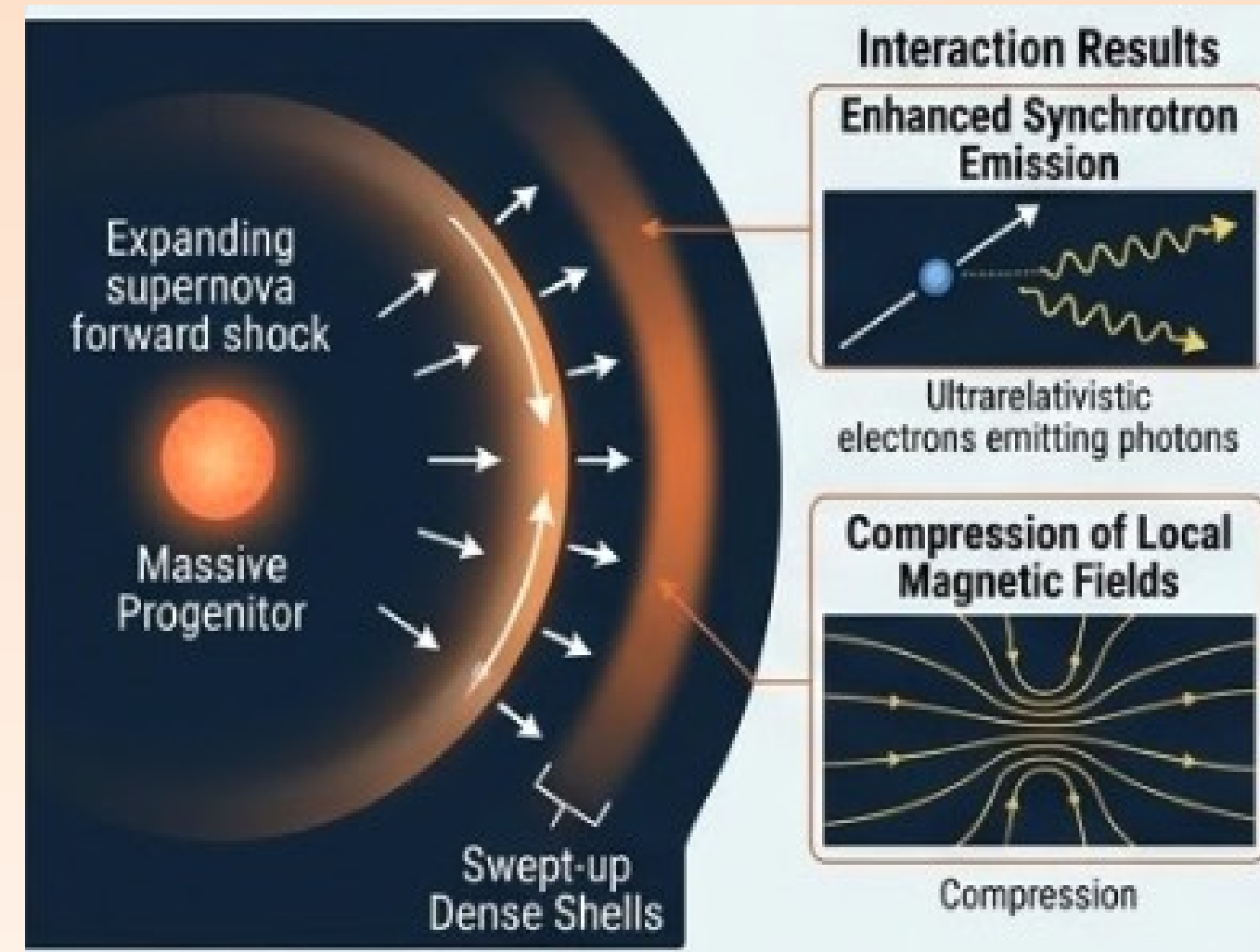
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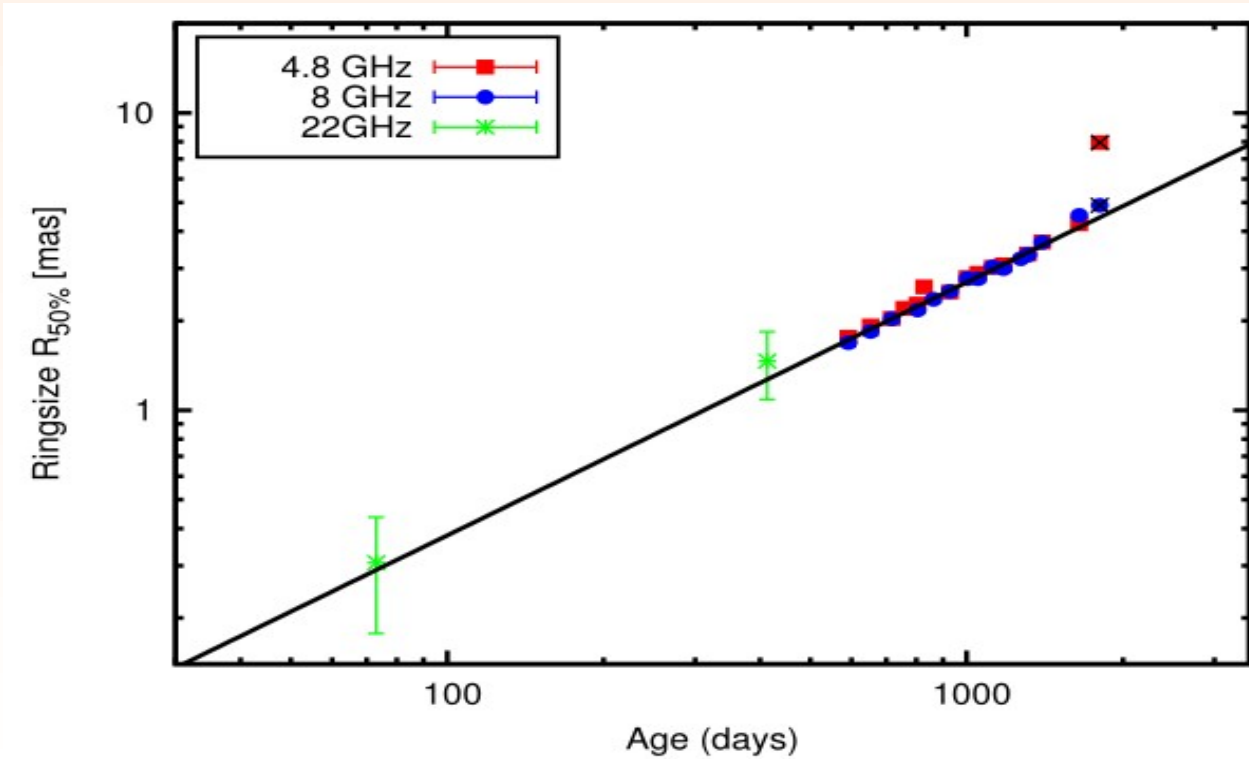
Introduction

- The 'Standard Model' (Chevalier 1982) successfully predicts early-time radio emission for RSNe expanding into steady-state winds
- Observations increasingly reveal late-time re-brightening (years after explosion) where the light curve deviates from standard power-law decay
- These re-brightening events become critical diagnostic tools revealing the progenitor's mass-loss history.

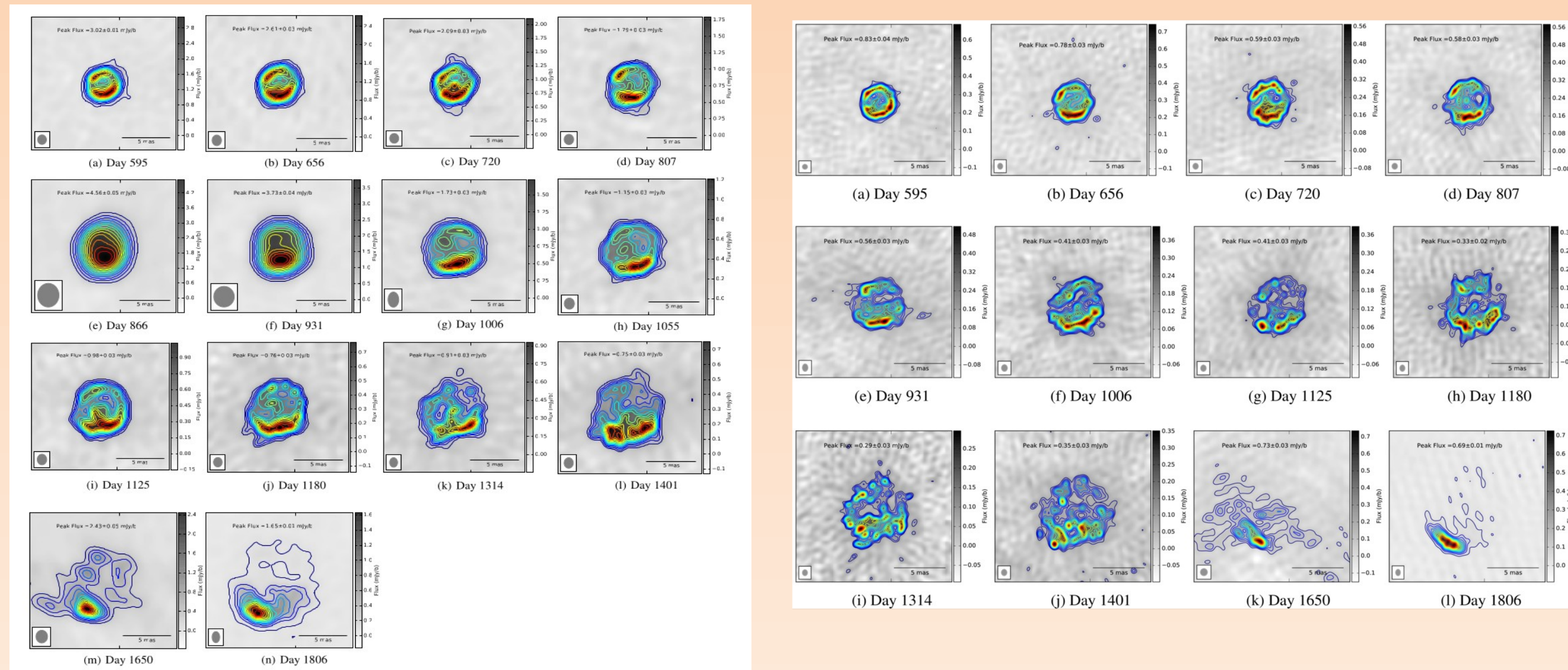
The Physics of RSNe Re-brightening



Deceleration of SN 2008iz derived from VLBA

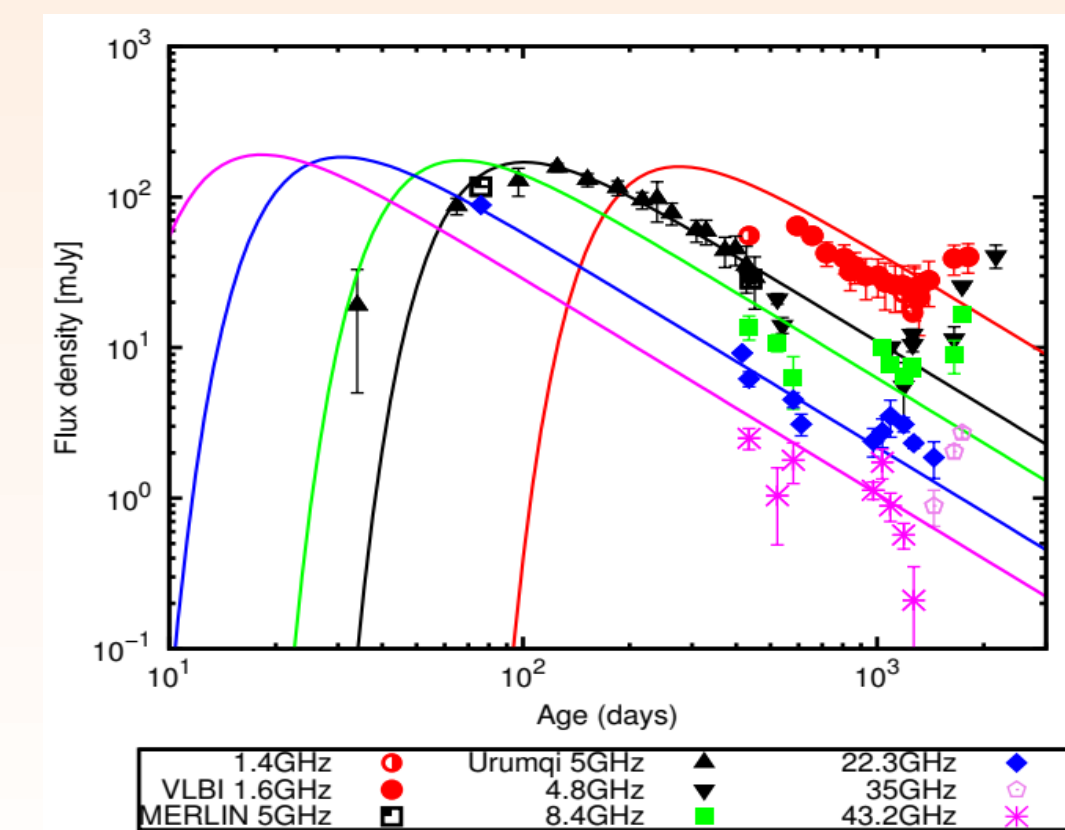


The shell evolution from the high resolution VLBI images

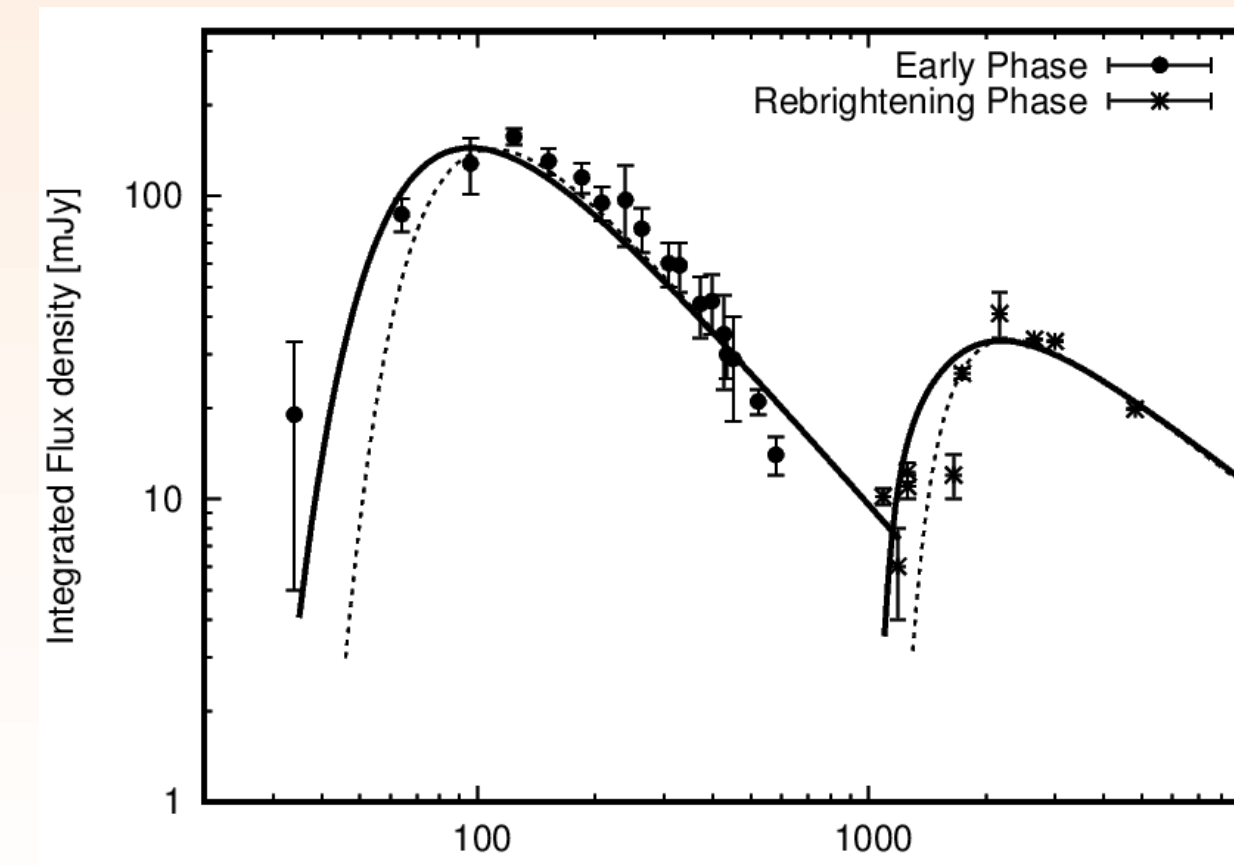


- A natural weighted 4.8 (Left) and 8.4GHz (Right) VLBI images of the expanding shell of SN2008iz. The linear gray scale images are overlaid with their contour maps that scale to the peak intensity at each epoch with the lowest contour at 6% of the peak intensity.
- The expansion starts with a shell like structure that later shell break-up and brightening of the lower part of the ring indicate presence of dense medium on that part.

Modeling SN2008iz light curve

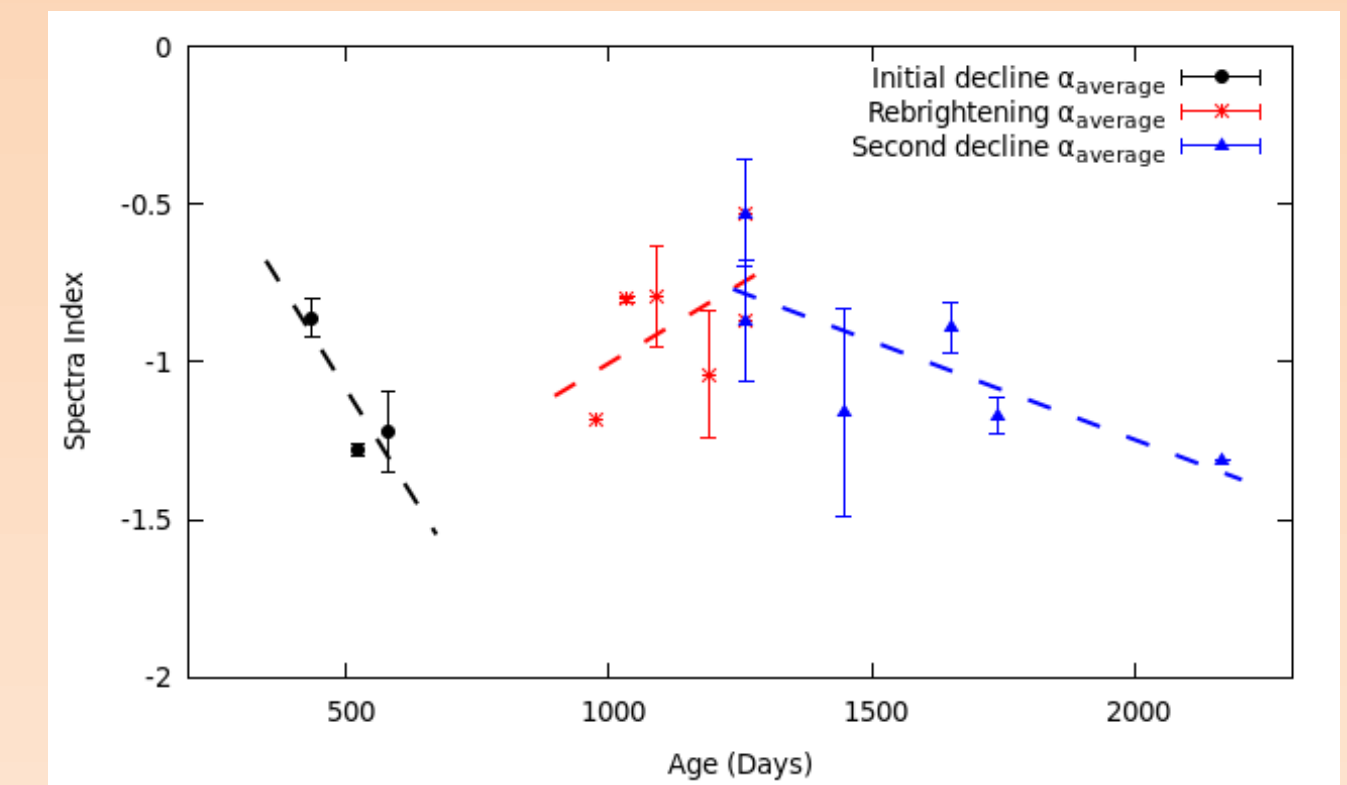


Standard steady-state wind Modeling



Multi-stage flux density modeling

Evolution of SN2008iz spectral index



The spectral index for freq 1.4 to 43GHz for the period ~430 to 2167 days after the explosion.

Breaking the Degeneracy

- ◆ Re-brightening events confirm that massive stars undergo episodic, violent mass-loss in their final stages, often creating inhomogeneous CSM structures.
- How can we remove the degeneracy between Density Enhancement vs. Magnetic Amplification?
- ✓ The flux increase can be modeled as a jump in CSM density such that:
 Stable spectral index: Suggests the shock hits a dense shell, increasing electron number density without changing the particle energy distribution
 Evolving Spectral Index: Suggests the interaction modifies the magnetic field amplification (B) or accelerates electrons with a new energy spectrum, indicating more complex turbulence