CONSTRAINING SUPERNOVA EXPLOSION MODELS WITH PHOTONS & NEUTRINOS: SN 1987A

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Supernovae

- Massive stars die in a giant explosion called a supernova (SN).
- SNe are responsible for the synthesis of many elements up to, and some even heavier than, iron.
- Stars with mass greater than ~8 solar masses form an iron core that succumbs to gravitational collapse, resulting in a core-collapse supernova (CCSN).

Photon Light Curves

- We can categorize SNe by how their energy output changes over time.
- Most CCSNe produce a Type II SN light curve, which can have an immediate linear decline or plateau first.
- Modelling a SN's light curve helps us understand the properties of the progenitor (or the star pre-explosion).

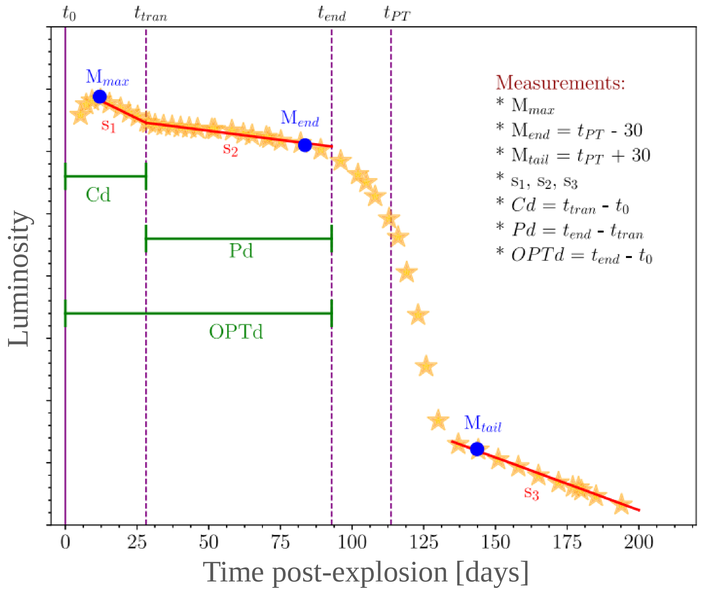

Fig 1. Measurable properties of a light curve [1].

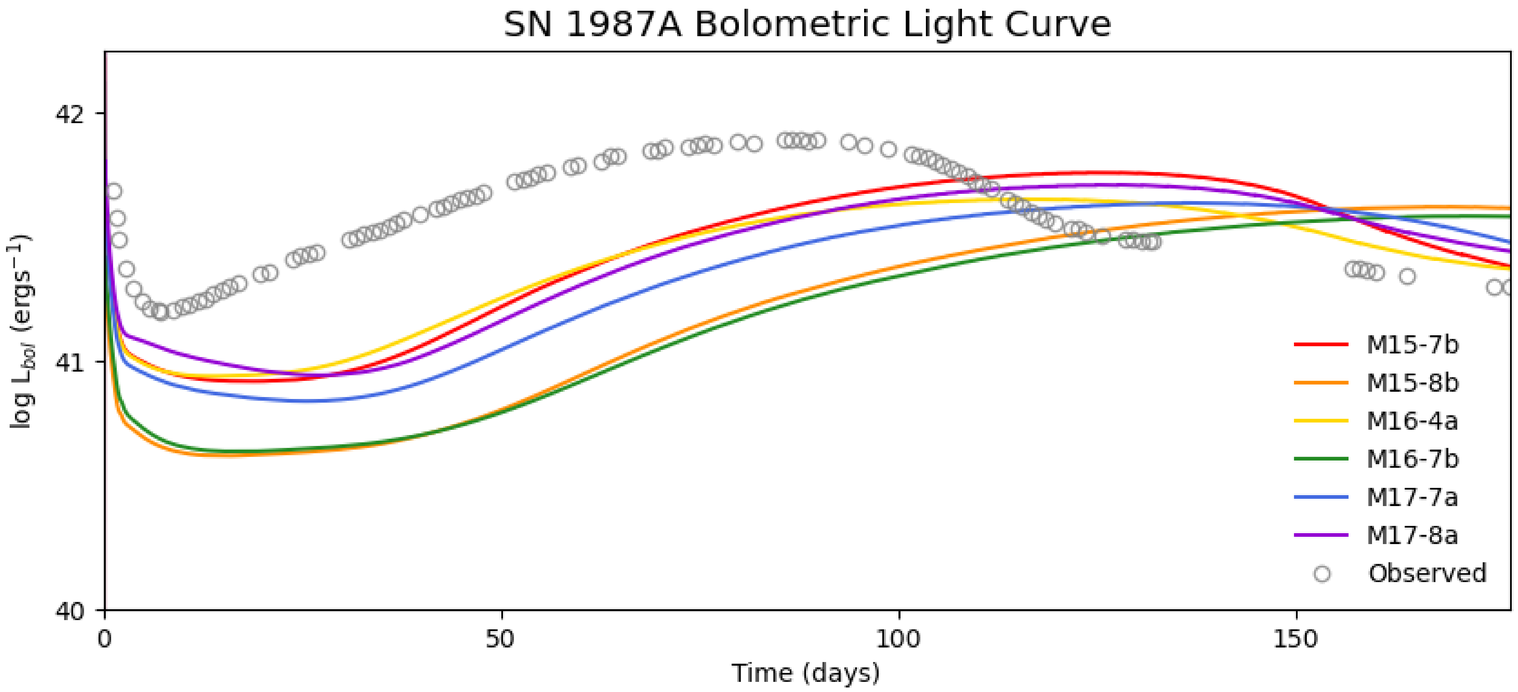

Fig 2. Light curve outputs from our simulations as compared to the observed light curve of SN 1987A [5].

SN 1987A

- SN 1987A took place in a satellite galaxy of the Milky Way, making it the closest SN to occur in modern astronomy and a great candidate for study.
- Its odd light curve makes it a Type II Peculiar SN.
- We use blue supergiant models from Menon & Heger [2] for simulation, using CCSN codes STIR [3] for computation and SNEC [4] for light curve generation.

Neutrinos

- SN 1987A was also close enough to have associated neutrino detections.
- My colleague, Erin Syerson, does similar work on these detections.

Results

- Our simulations are under-luminous, or too dim to match the observational data of SN 1987A.
- Knowing this, we can adjust parameters of our models to produce more energetic light curves, then repeat the process until our models match observations to best estimate the progenitor properties.

References

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[5] Hamuy, M., Suntzeff, N. B., Gonzalez, R., Martin, G. 1988, ApJ, 95, 1.

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