

Type IIn Supernovae

Type IIn Supernovae

How do they work and how do we get a handle on
their type of progenitor

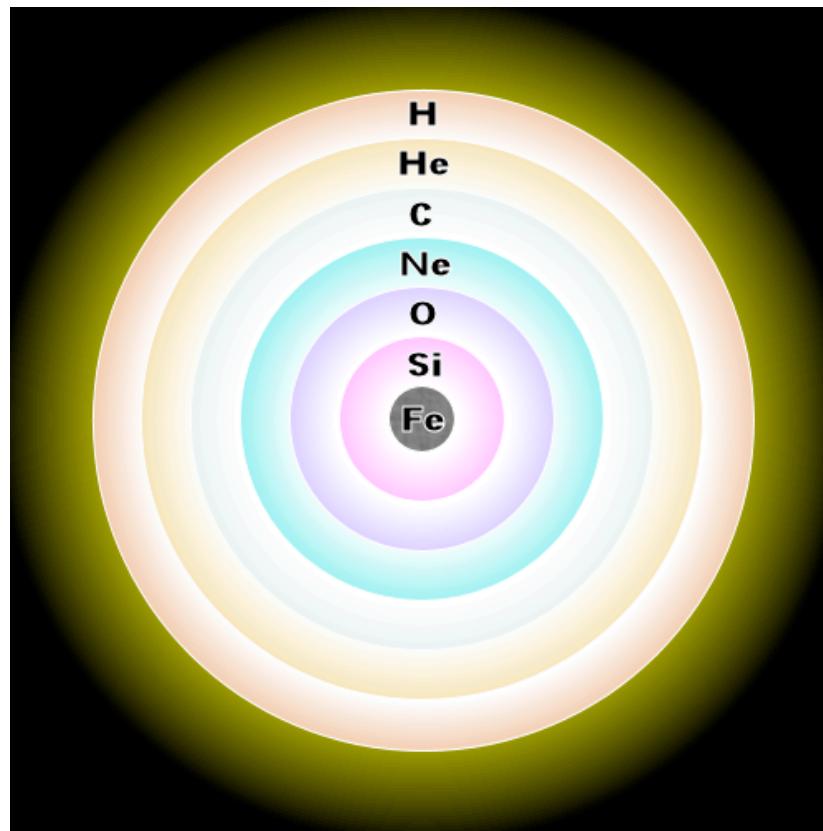
Michael Kiewe
Weizmann Institute of Science

Overview

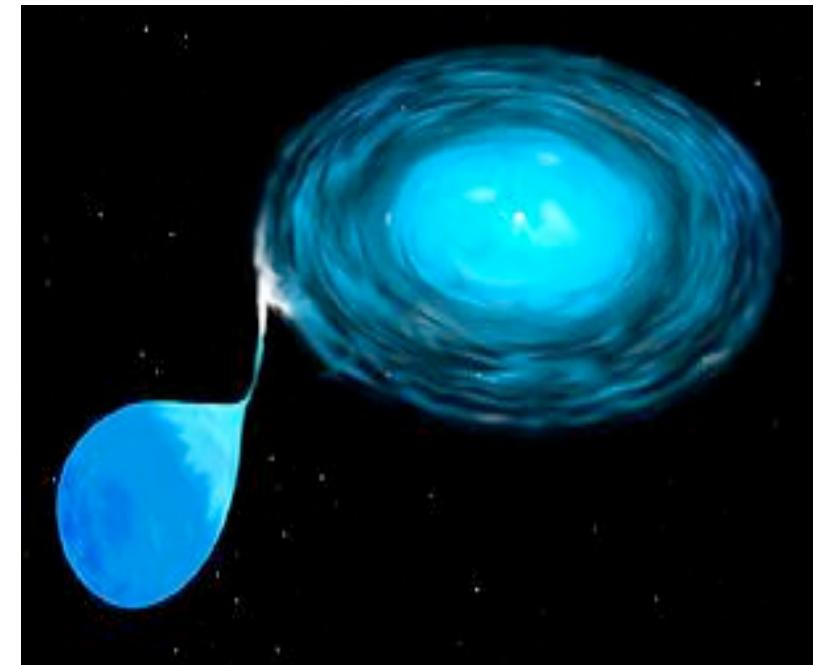
- 1. Recap of different SN types**
- 2. The type IIn SN model**
- 3. Possible IIn progenitors**
- 4. How to construct light curves and spectra**
- 5. Light curves + Spectra → constrain on progenitor possibilities**
- 6. The new stuff**

SN types

Core Collapse



Runaway
Nuclear Fusion



SN types

Explosion mechanism	Balmer Hydrogen lines in spectrum (II)	No Balmer Hydrogen lines in spectrum (I)
Core collapse	IIP, IIL, IIn	Ib, Ic
Runaway nuclear fusion		Ia

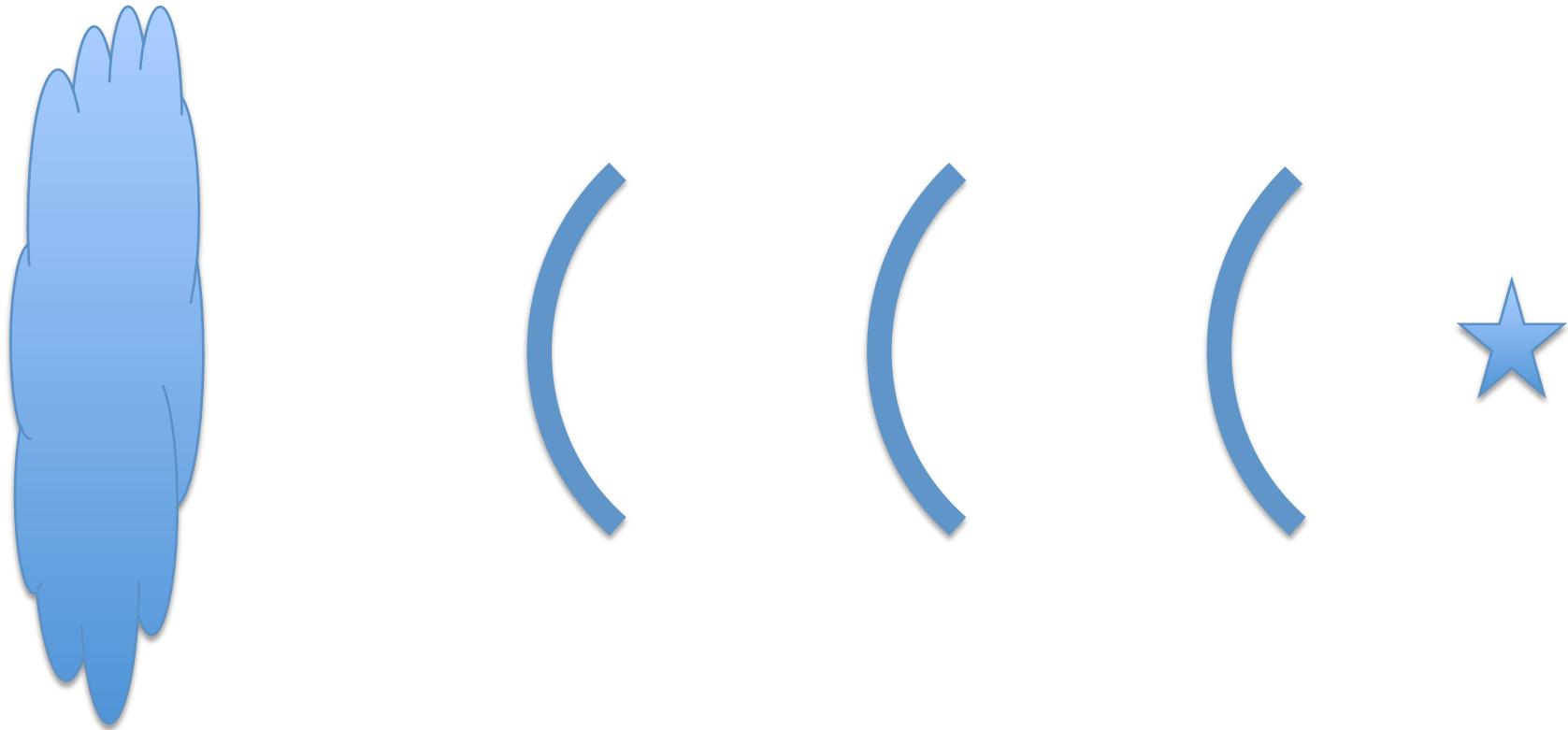
The magnitude of the SN Plateaus at a certain time interval

The magnitude of the SN decreases Linearly over time

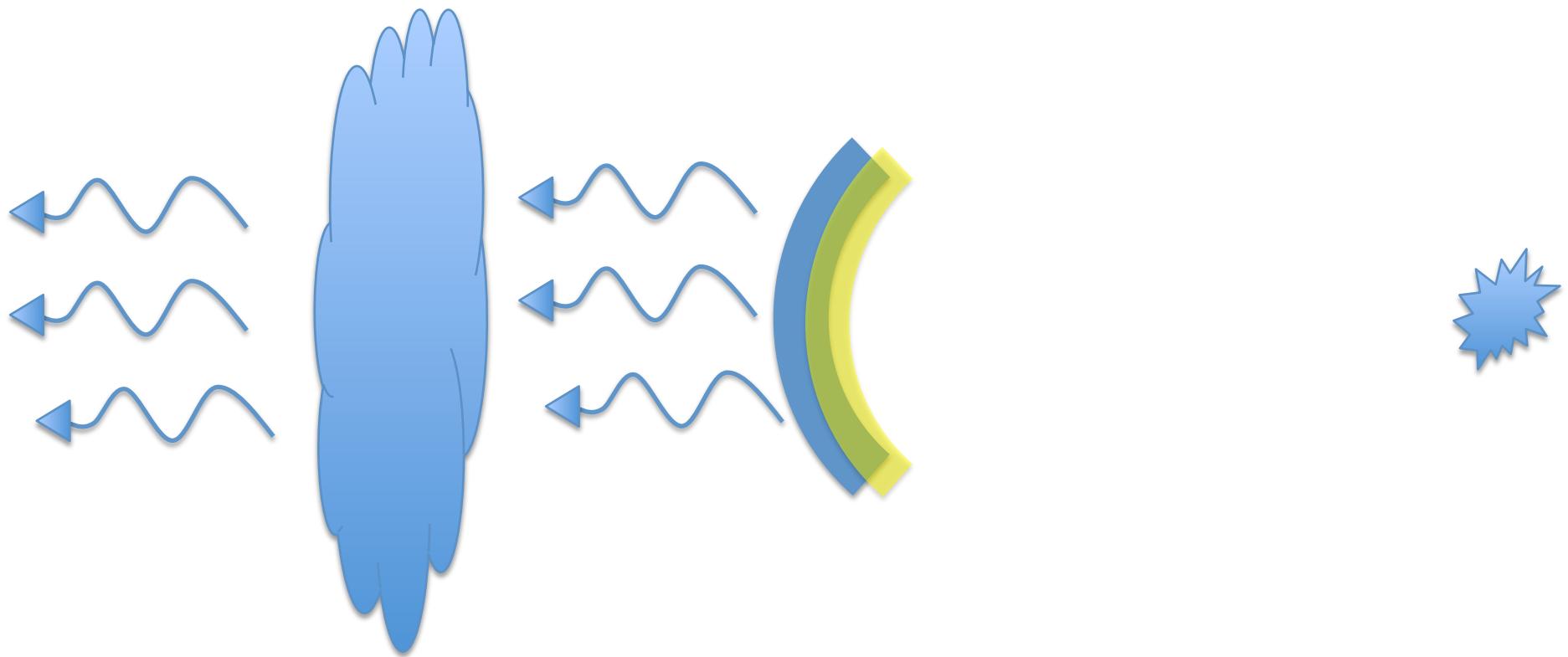
There are narrow Hydrogen lines in the spectrum

Differ in the appearance or lack of Helium and/or silicon lines in their spectrum

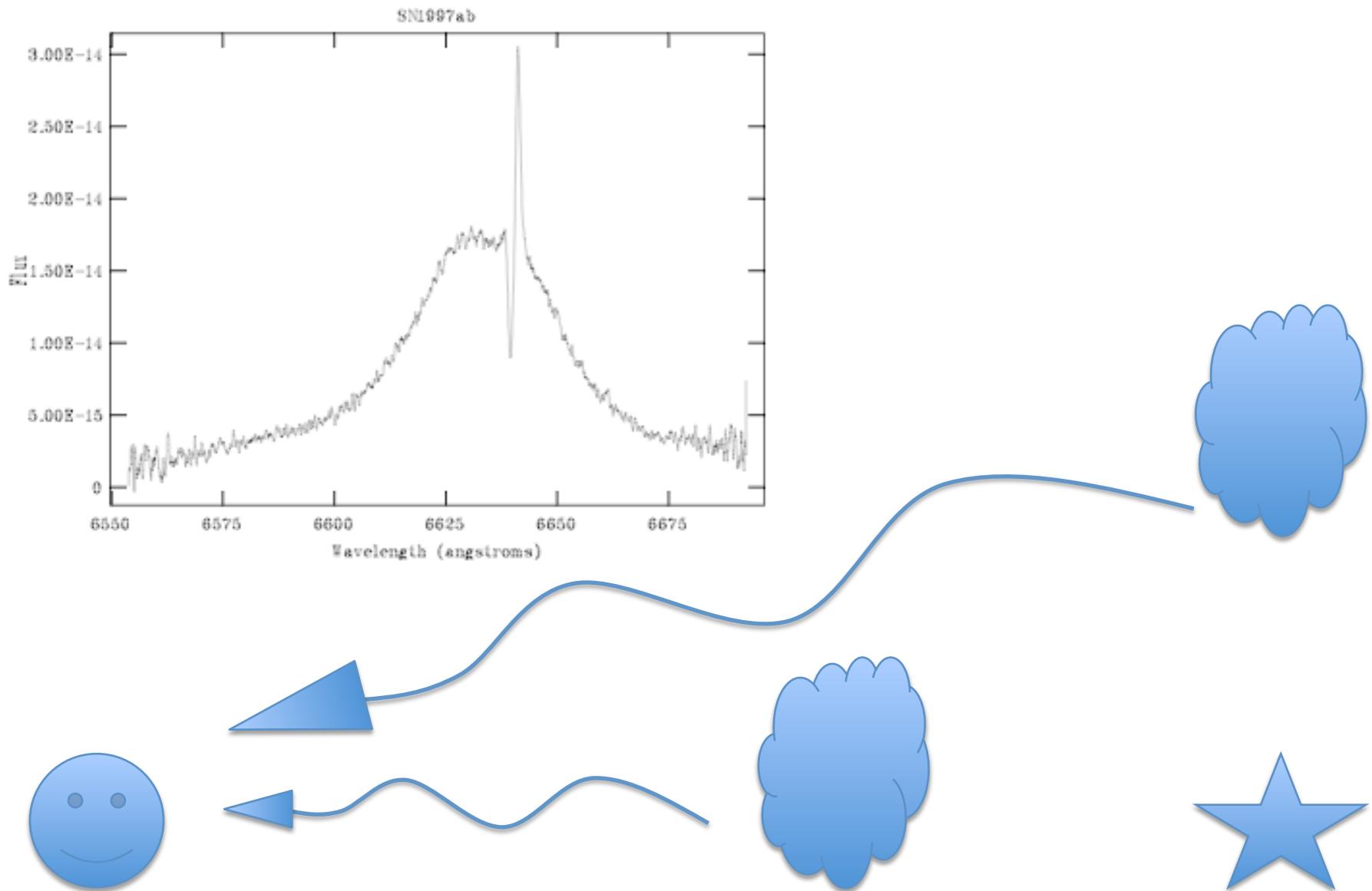
Type IIn SN Model



Type IIn SN Model

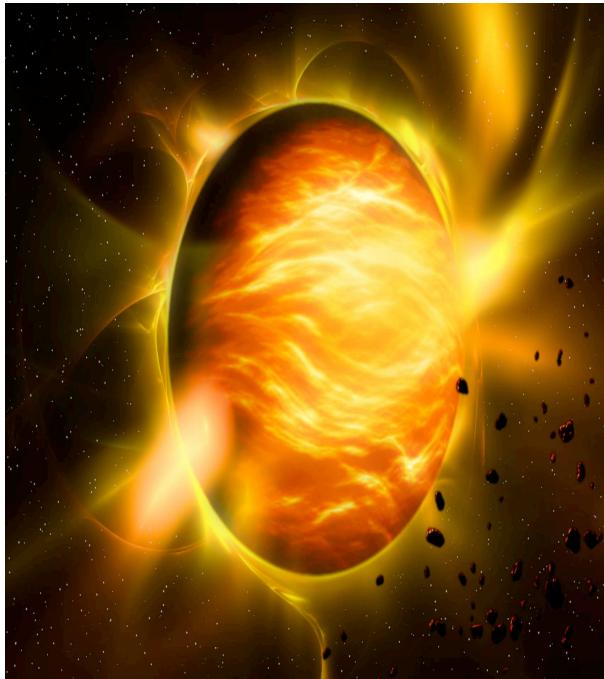


Why do we get lines with different widths in our spectrum?

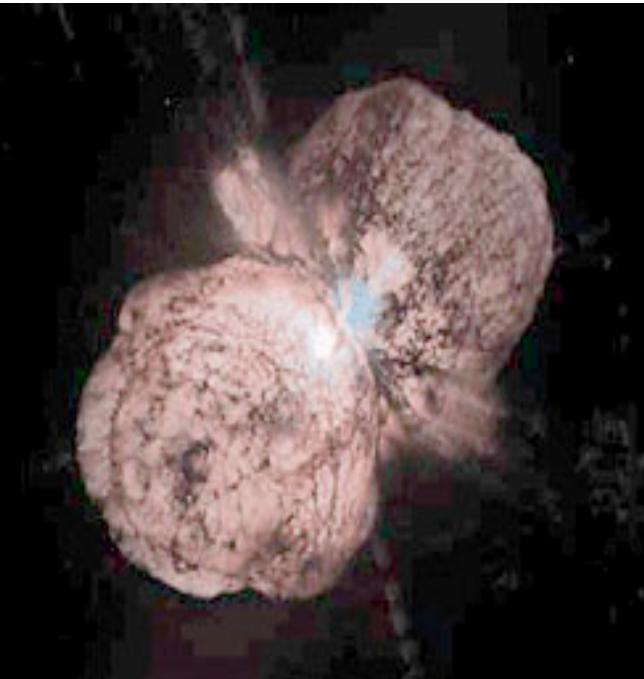


Possible progenitors

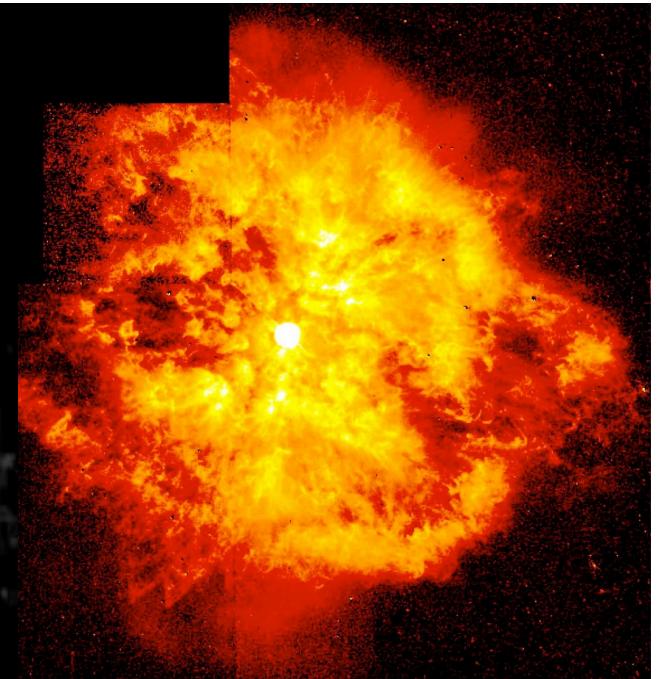
**Red
Supergiant**



**Luminous
Blue Variable
(LBV)**



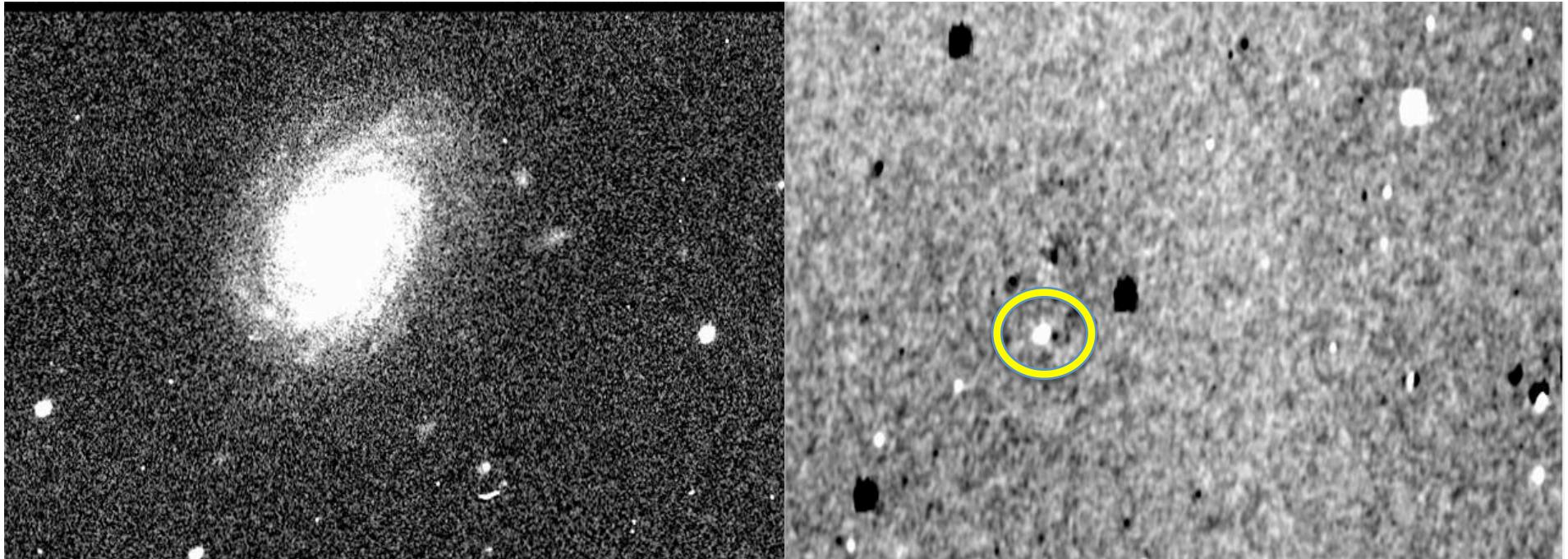
**Wolf-Rayet
star**



How can we deduce the type of the progenitor?

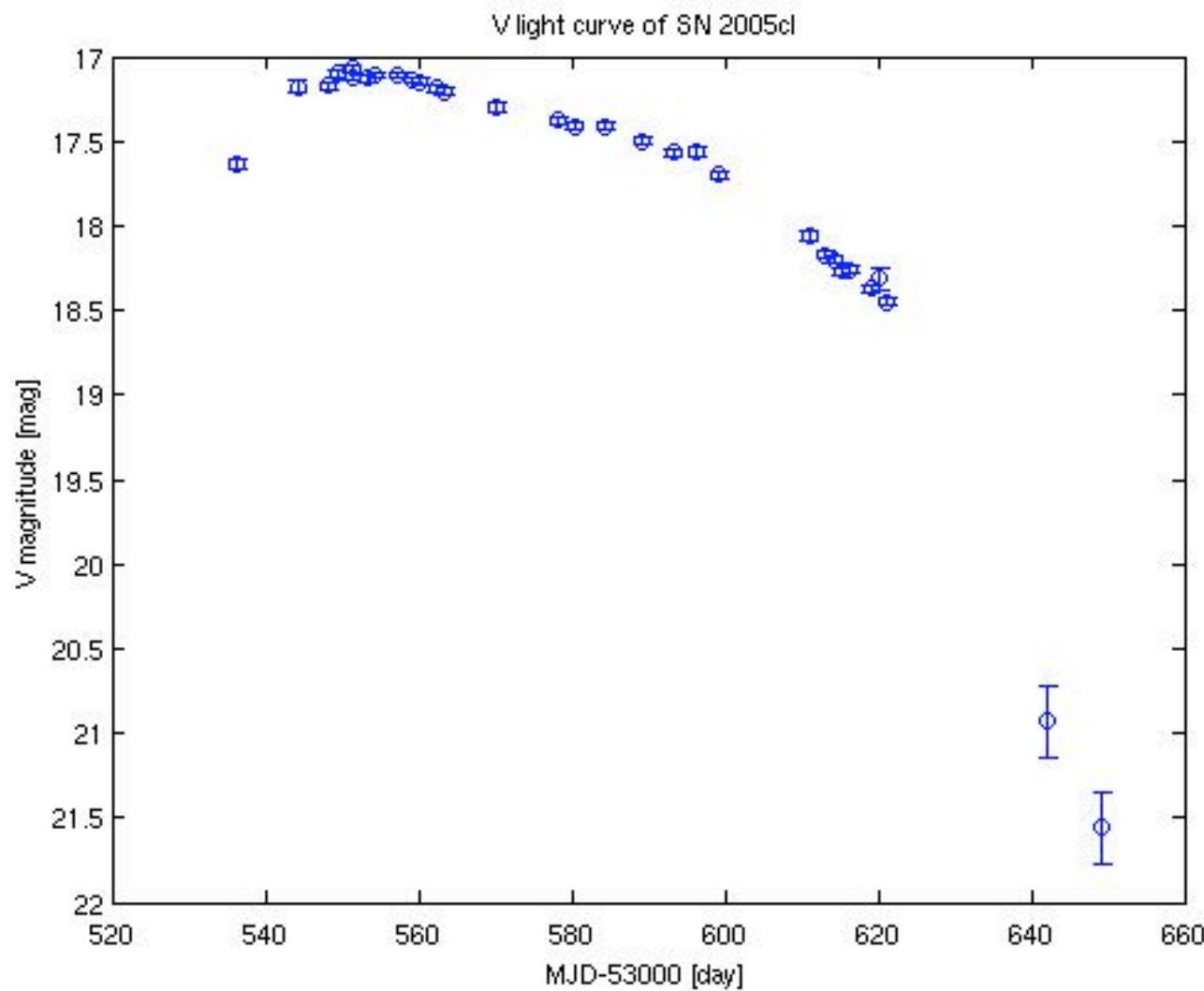
Spectrum & Light Curve

Constructing a light curve

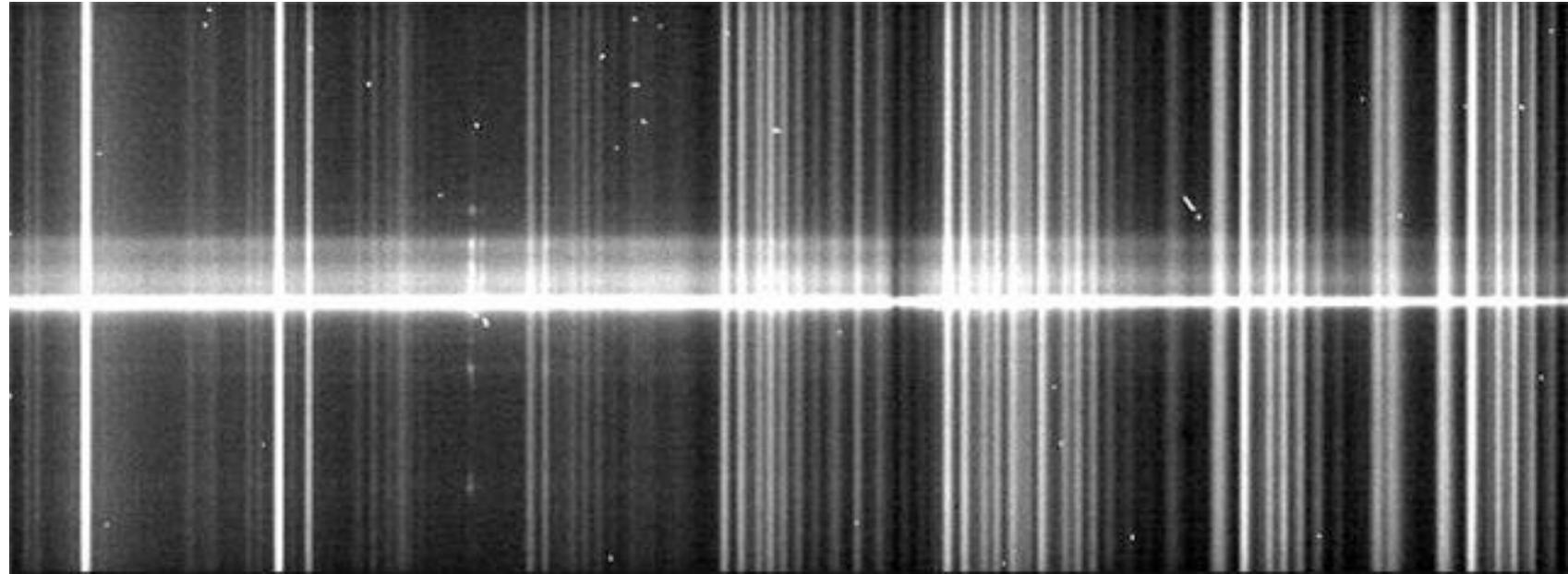


Problem	Solution
Images are not aligned	Use several stars in images for alignment
Different atmospheric conditions result in different broadening	Calculate the broadening factors in two images and subjecting one image to the other broadening factor
The measured magnitude is not calibrated	Use a few stars in the images for calibration

Constructing a light curve

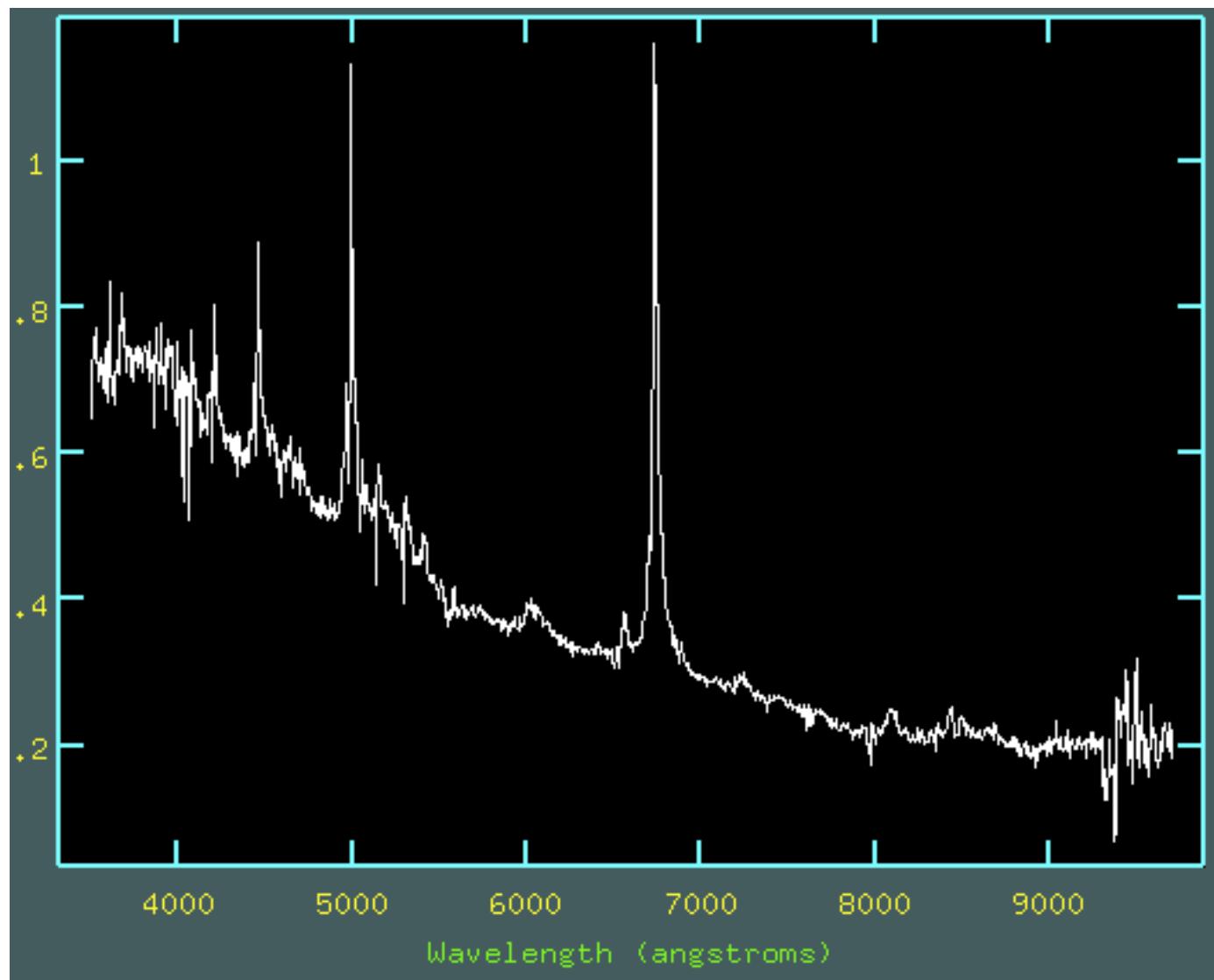


Constructing a spectrum



Problem	Solution
Translating pixel to wavelength	Use a lamp with known emission lines
Correct the flux for atmospheric disturbance	Take images of standard stars – stars for which you know the atmospherically corrected spectrum
Correct the flux for variations between pixels	Take an image of a homogenous background

Constructing a spectrum

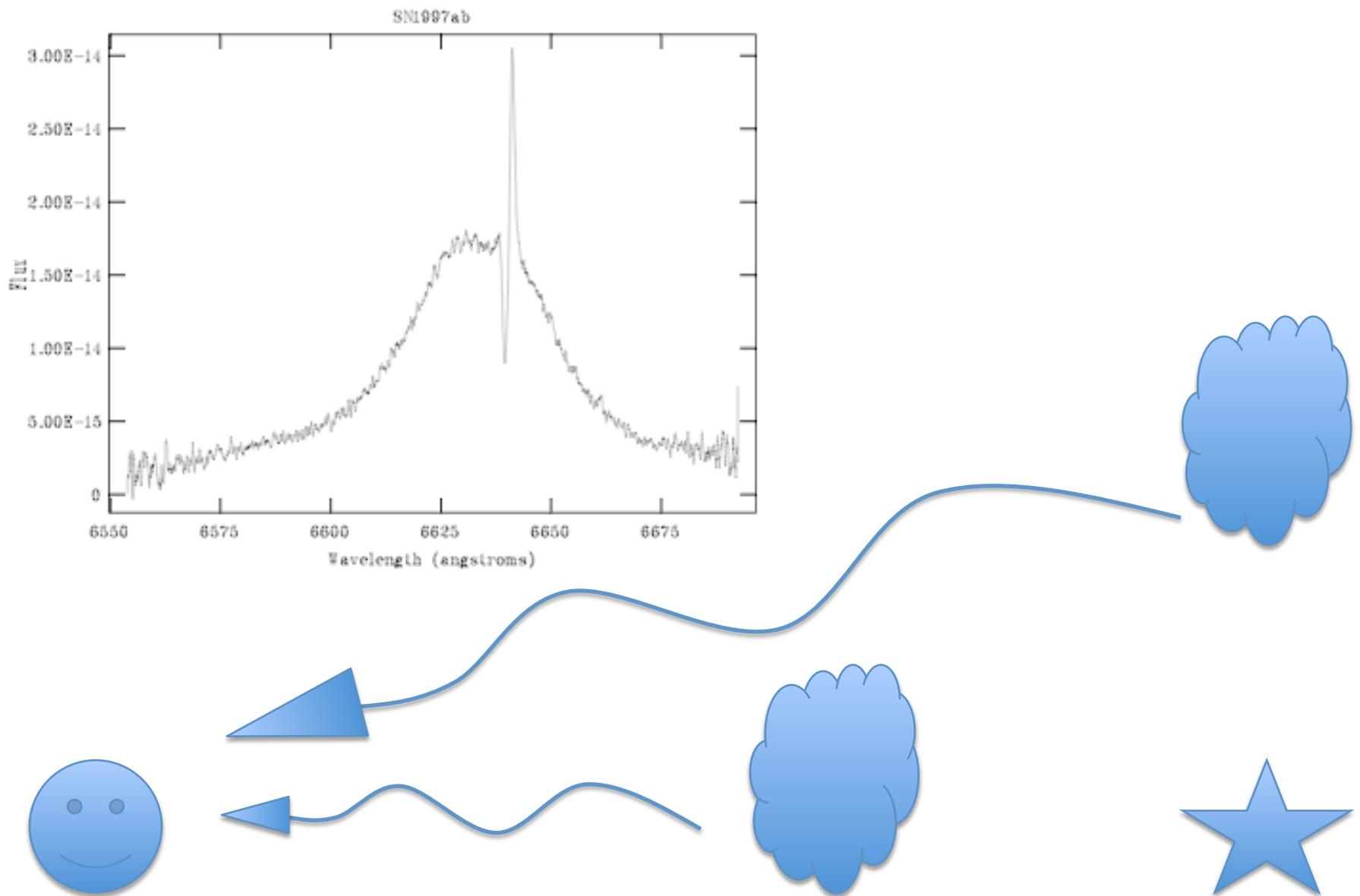


How can we deduce the type of the progenitor?

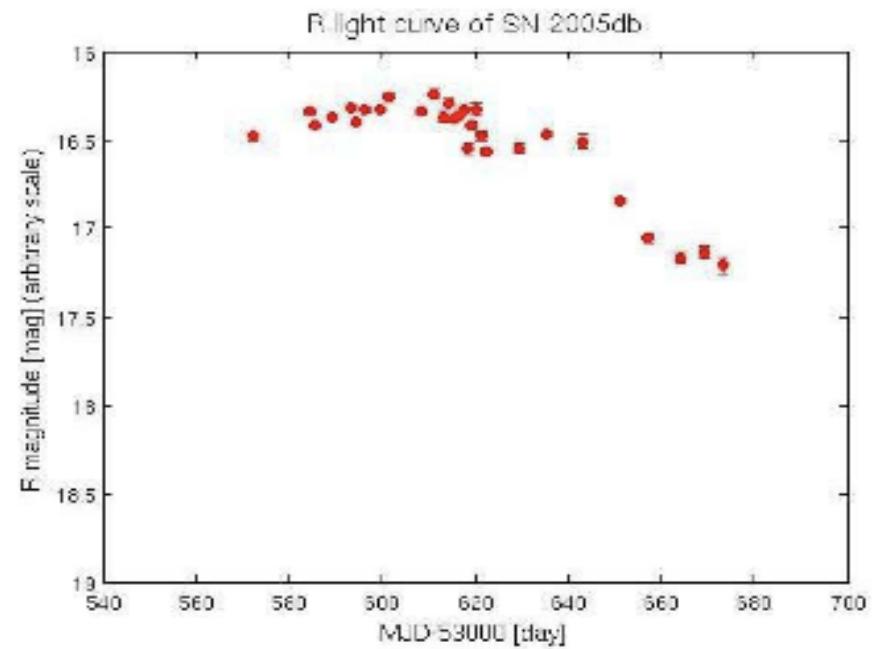
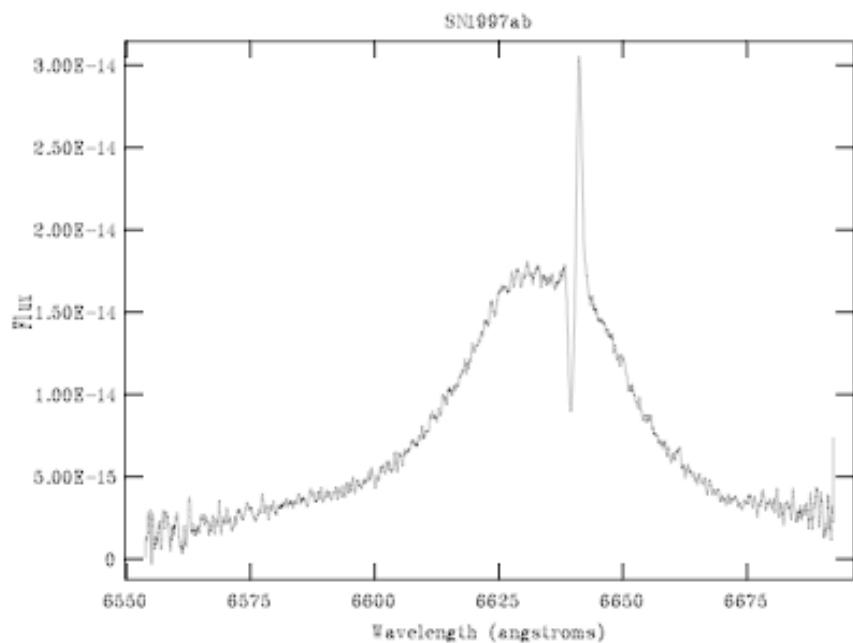
MASS LOSS
RATE of
material
expelled before
the explosion

&
VELOCITY of
material
expelled before
the explosion

How fast does the expelled material travel?



How do we get an estimate of the mass loss rate of the progenitor?



$$L_{high_mass_wind} = \frac{1}{2} \dot{M}_{high_mass_wind} v_{ejecta}^2 \left(\frac{v_{ejecta}}{v_{high_mass_wind}} \right)$$

(Terlevich 1994, Chugai 1991)

**So far approximately 10 type IIn SN
have been observed.**

Reference: "ON THE PROGENITOR OF SN 2005gl AND THE NATURE OF TYPE IIn SUPERNOVAE", Gal-Yam et al.

**Approximately 7 are unique
events**

**My sample of 4-5 type IIn SNe
is unbiased**

Summary

Type IIn SN ? Progenitor

Light Curve + → Mass ejection
Spectrum rate and velocity
of the progenitor

Larger sample → Better estimation
of Progenitor identity

Thank you