Spectral models for broad-lined Ic SNe

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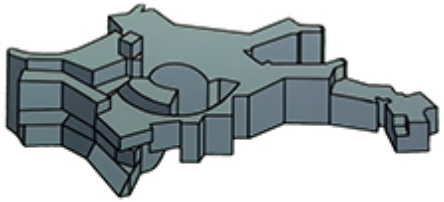
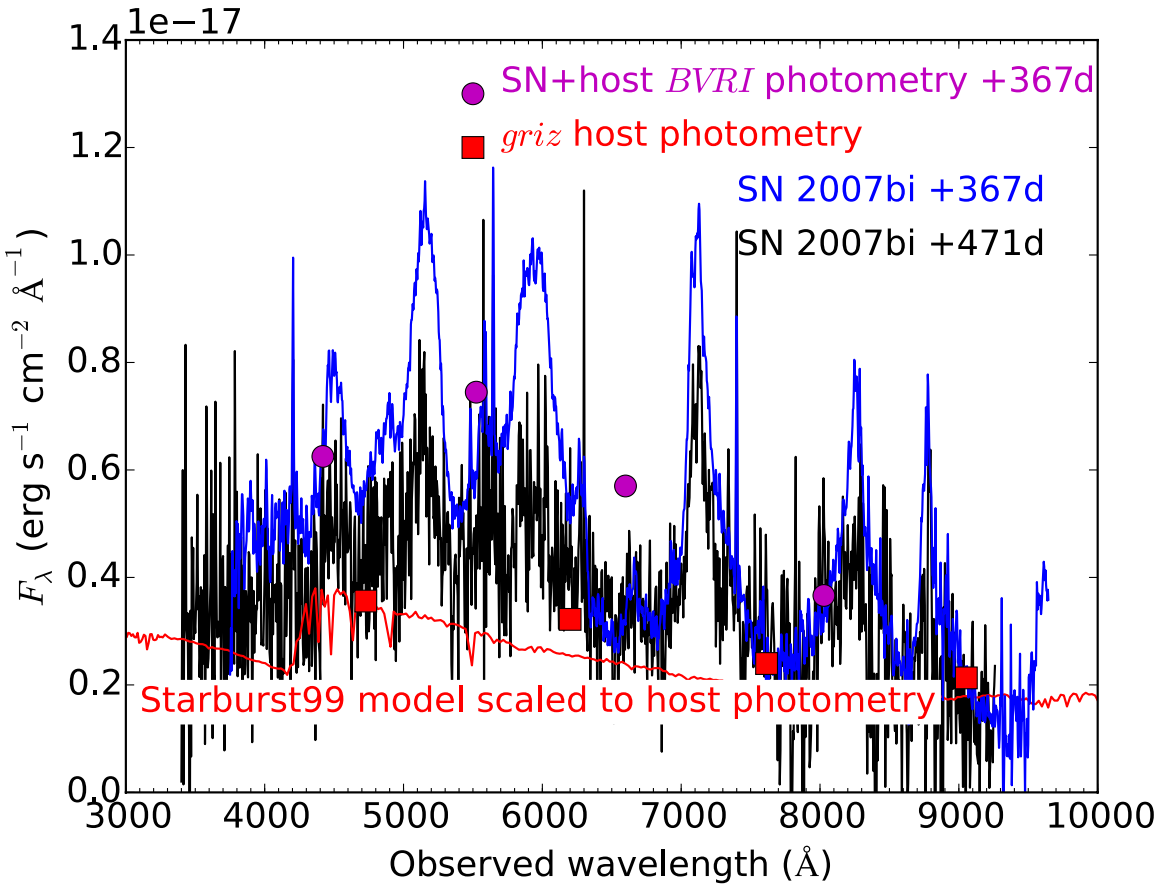


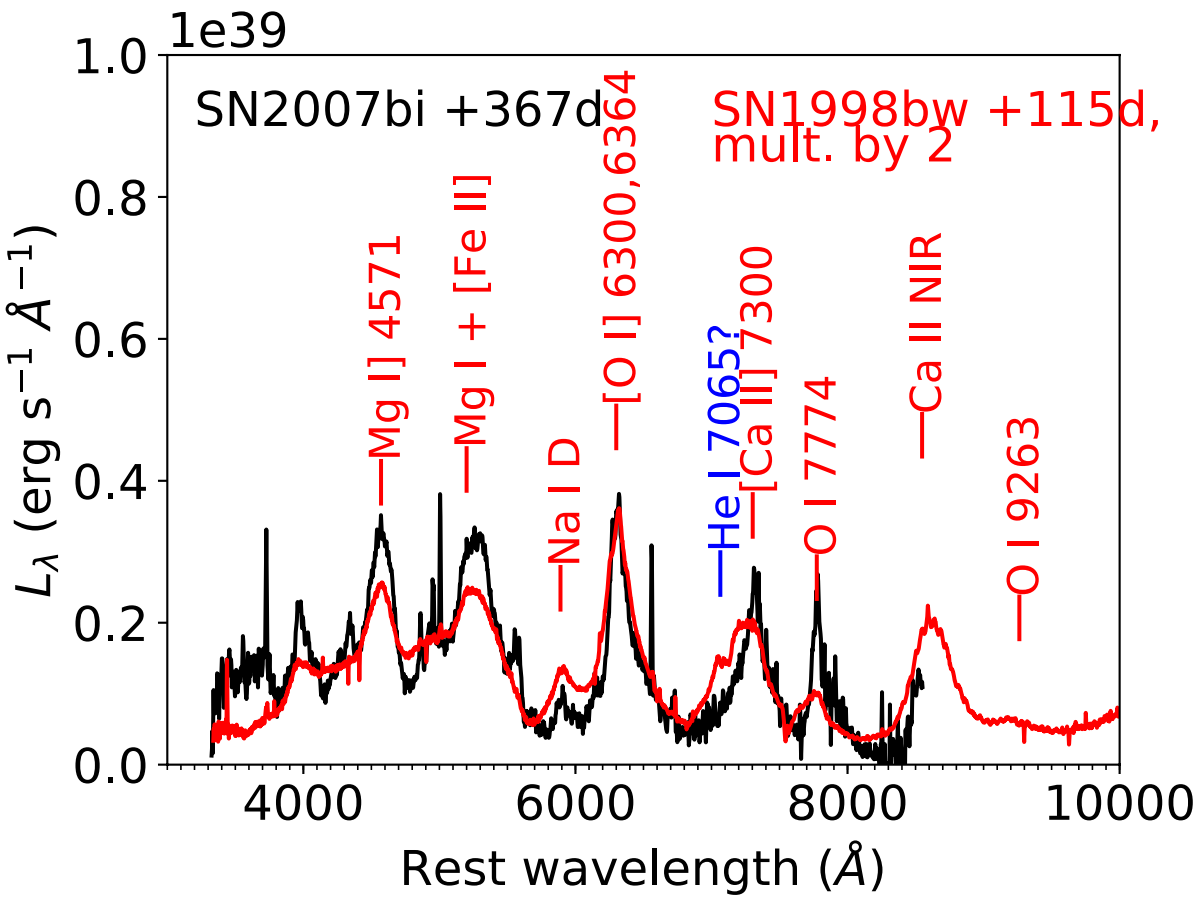
MARIE CURIE ACTIONS

SEVENTH FRAMEWORK PROGRAMME

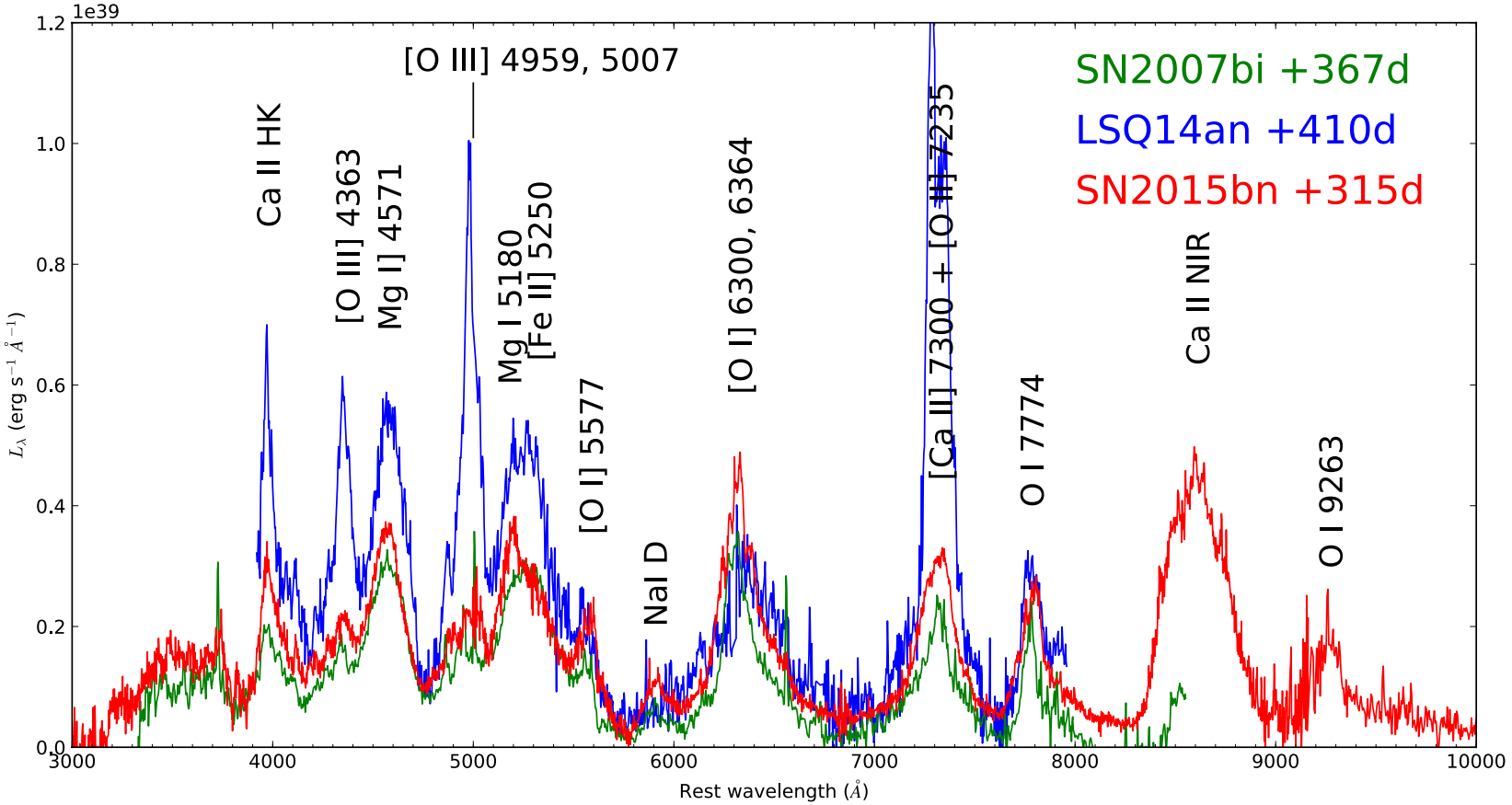
Nebular spectra of SLSN Ic: *with galaxy subtraction prototype SN 2007bi (Gal-Yam+2009) is very similar to SN 1998bw*



Jerkstrand+2017



Nebular data sample of SLSN Ic now 3

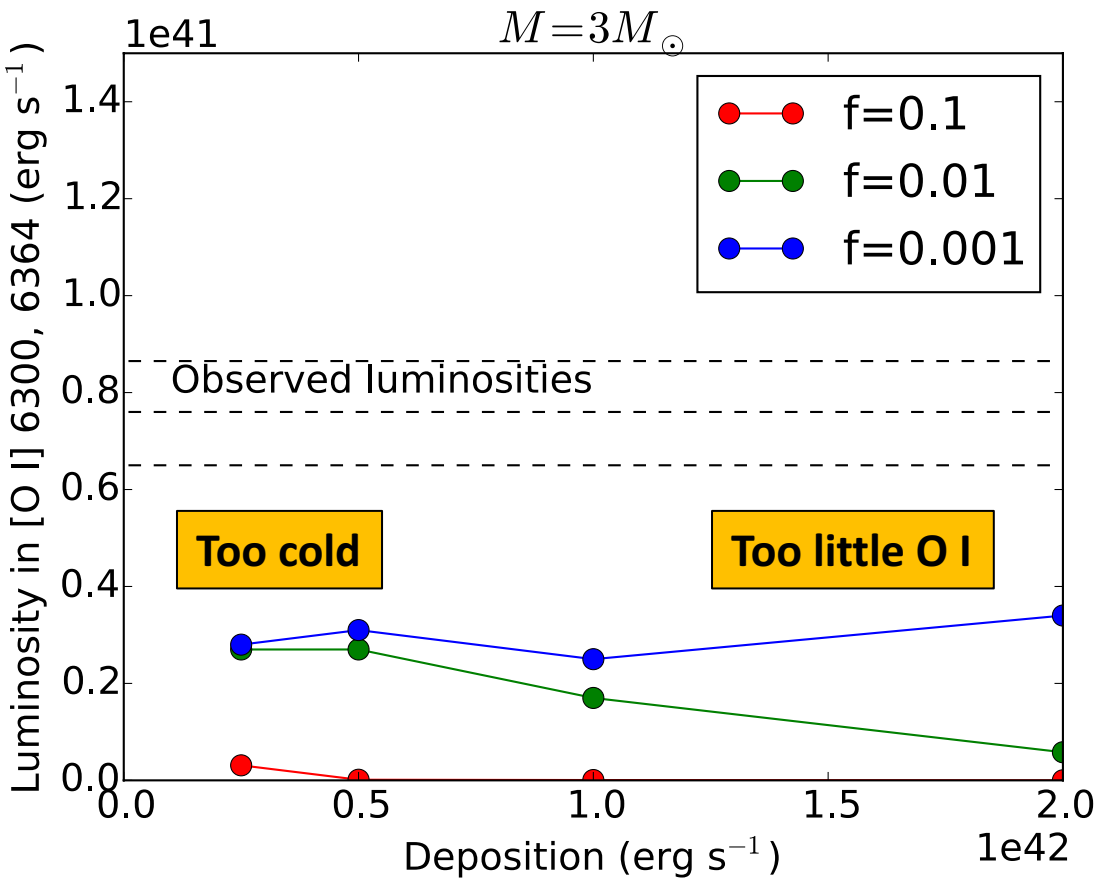


Jerkstrand+2017
z=0.11-0.16

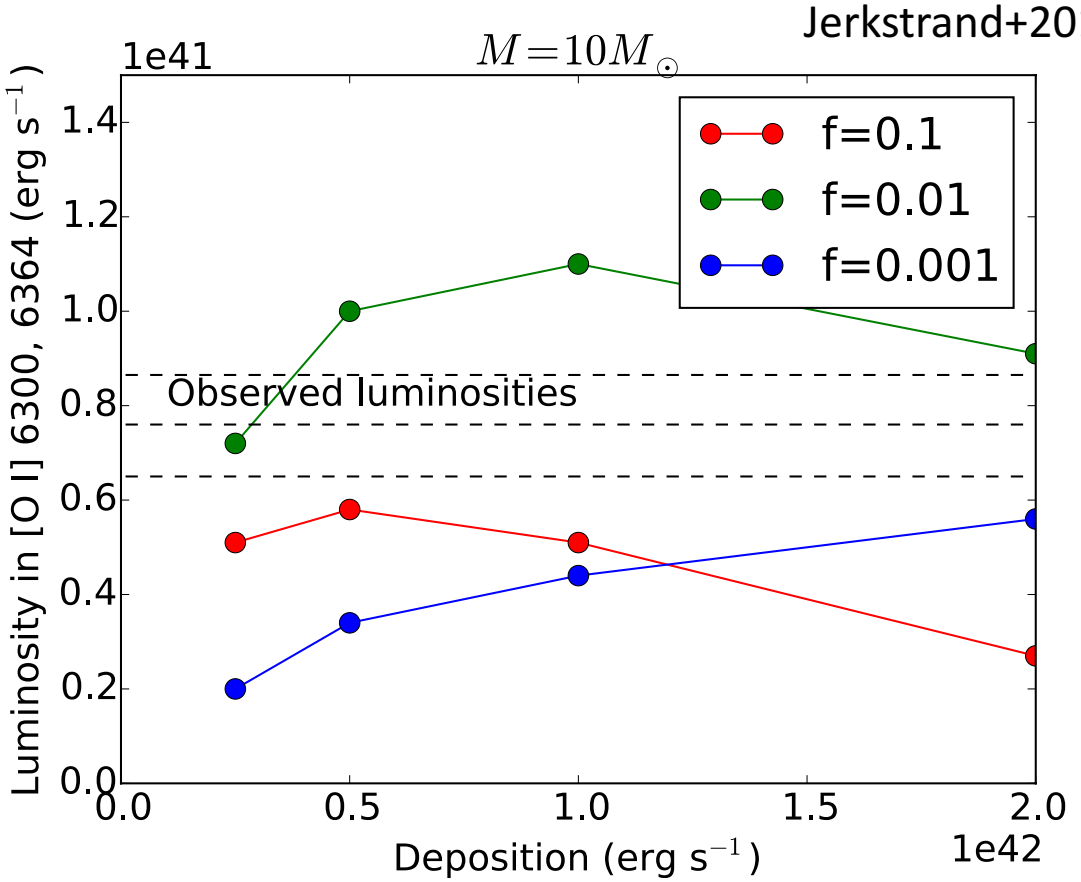
- SN 2015bn virtual clone of SN 2007bi (see also Nicholl+2016).
- LSQ14an: additional [O II] and [O III] lines (see also Lunnan+2016 for PS1-14bj case)

200-250d:
iPTF13ehe (Yan+2015) z = 0.34
PS1-14bj (Lunnan+2016) z= 0.52
iPTF15esb (Yan+2017) z = 0.22
iPTF16bad (Yan+2017) z= 0.25
Gaia16adp (Kangas+2017) z=0.10

Largest inferred O masses in any SN (>~ 10 M_{sun})
→ Origin in very massive stars



Jerkstrand+2017

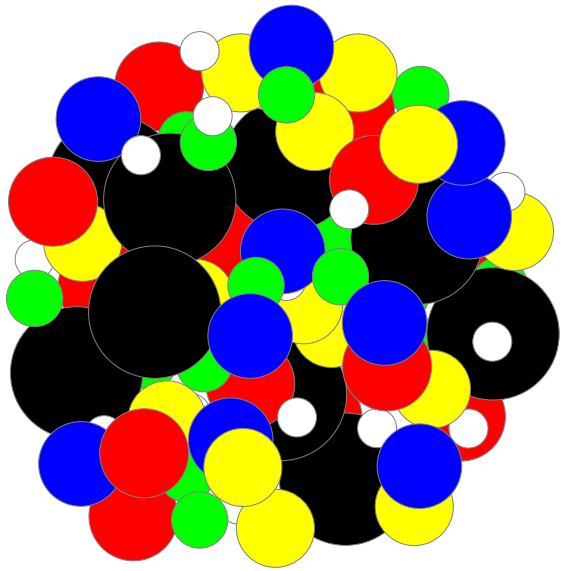


- Independent support from large Mg masses (1.5-15 M_{sun})
- Recombination lines suggest material is clumped or compressed in shells

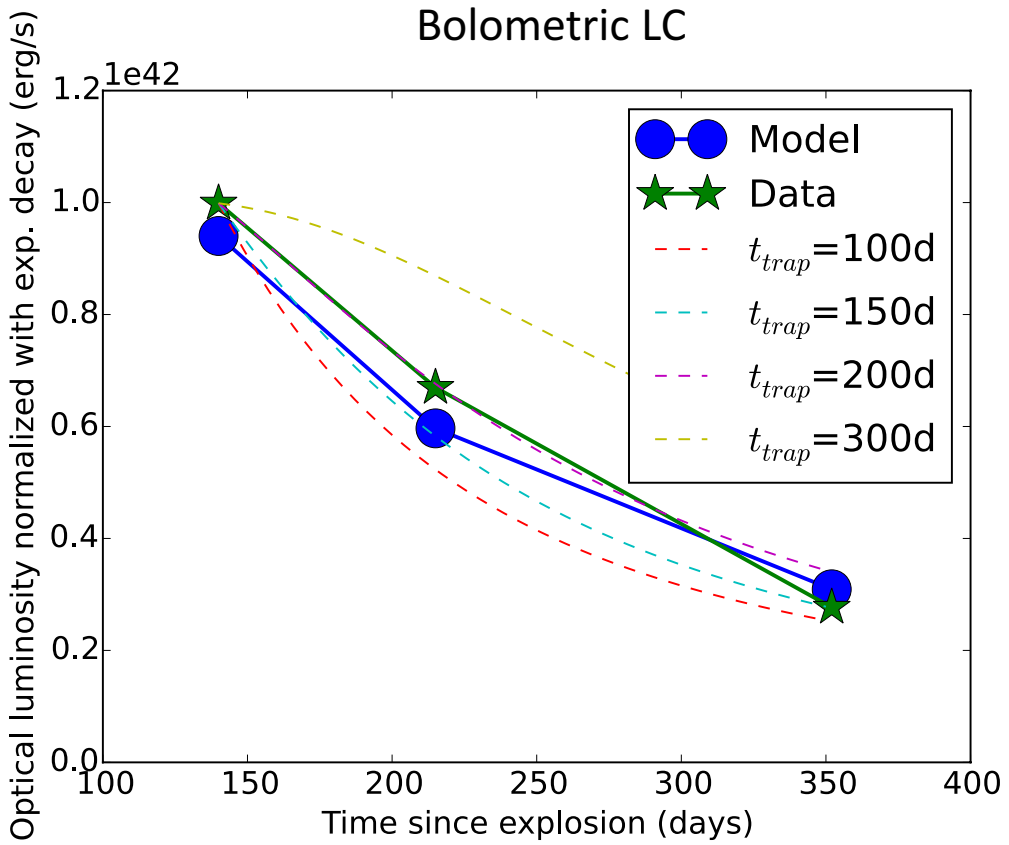
The long way around : lets start to understand SN 1998bw

- Model grid with M(CO) = 3, 6, 12 M_{sun} (M_{ej} =1.4, 4.2, 9.4 M_{sun}), M(^{56}Ni) = 0.2 & 0.8 M_{sun}, V = 6000 km/s

Jerkstrand in prep.



56Ni
Si
O/Si
O/Mg
O/C

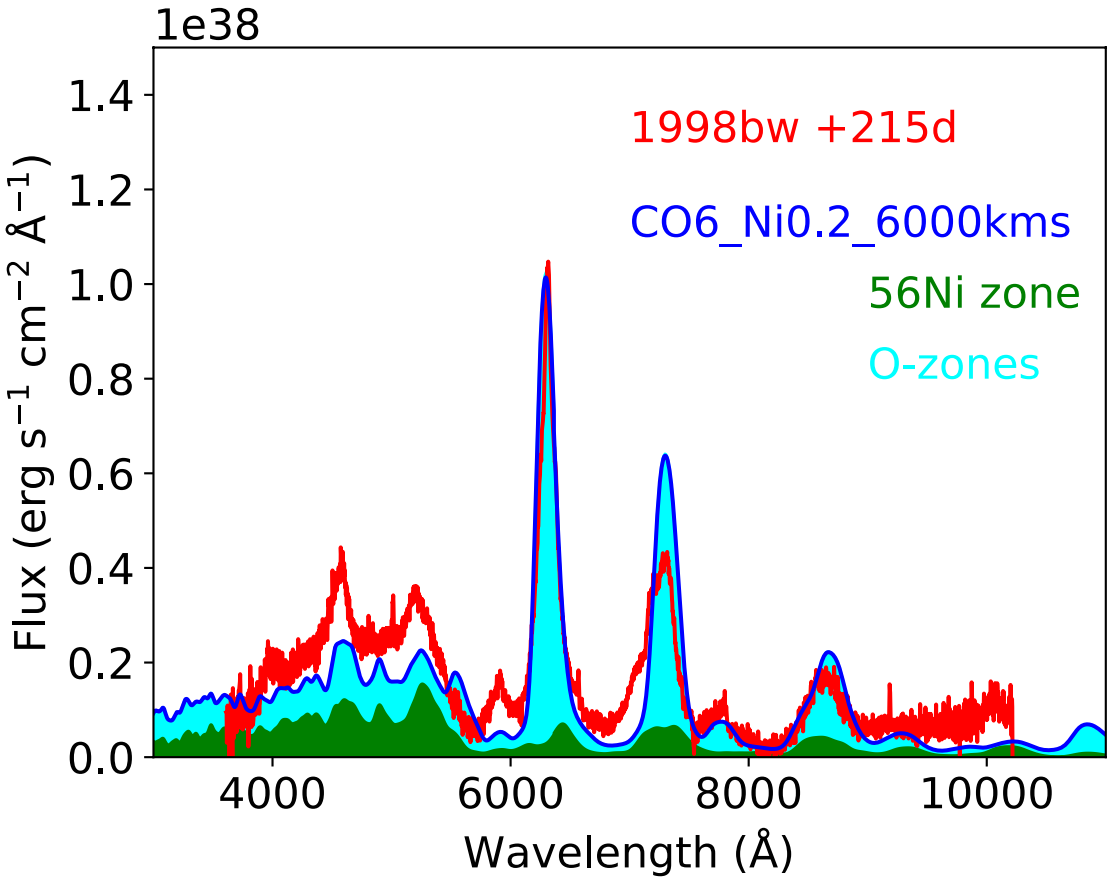


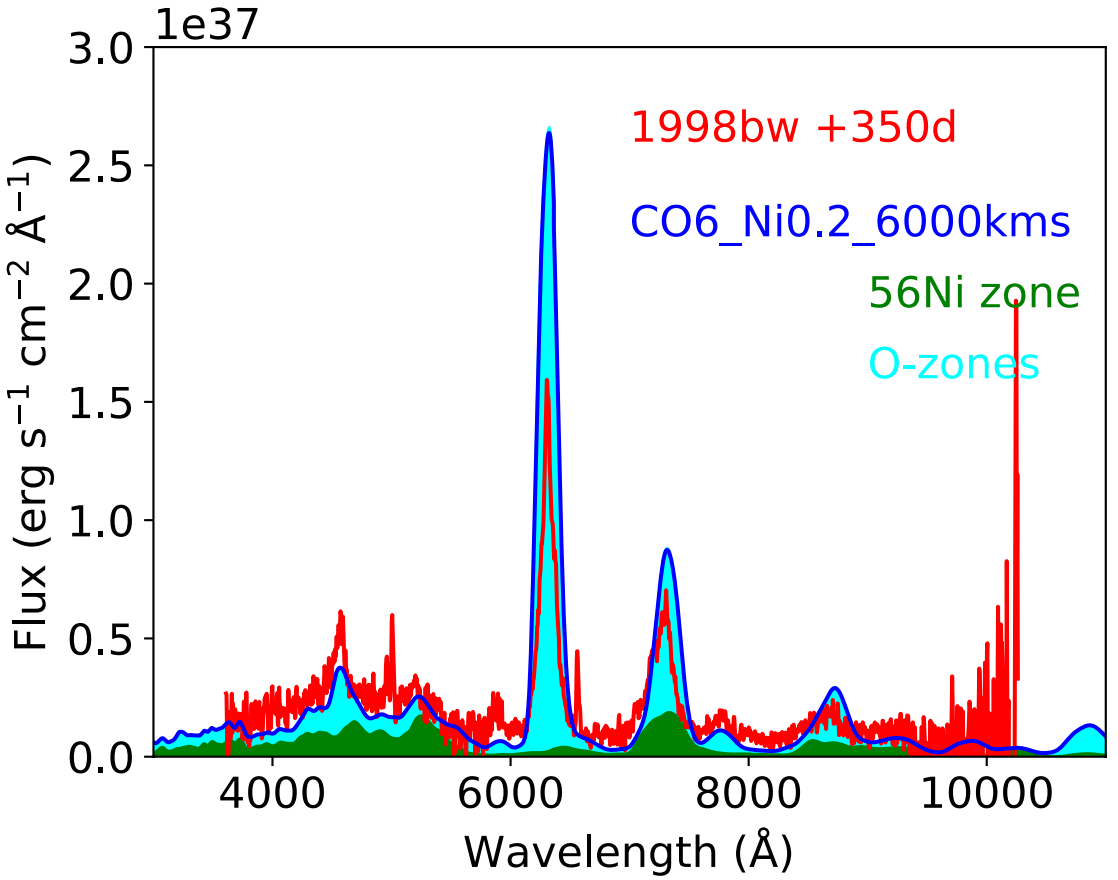
Inferred gamma ray escape constrains t_{trap} ~ 200d

M_{ej} = 7 M_{sun} (t_{trap}/200d)^2 (V/6000)^2

M(^{56}Ni) ~ 0.2 M_{sun} favoured

Standard ^{56}Ni powered models fit SN 1998bw quite well. However, difficult to get the 2 key bumps (4571 & 5200 Å) out at high enough contrast.

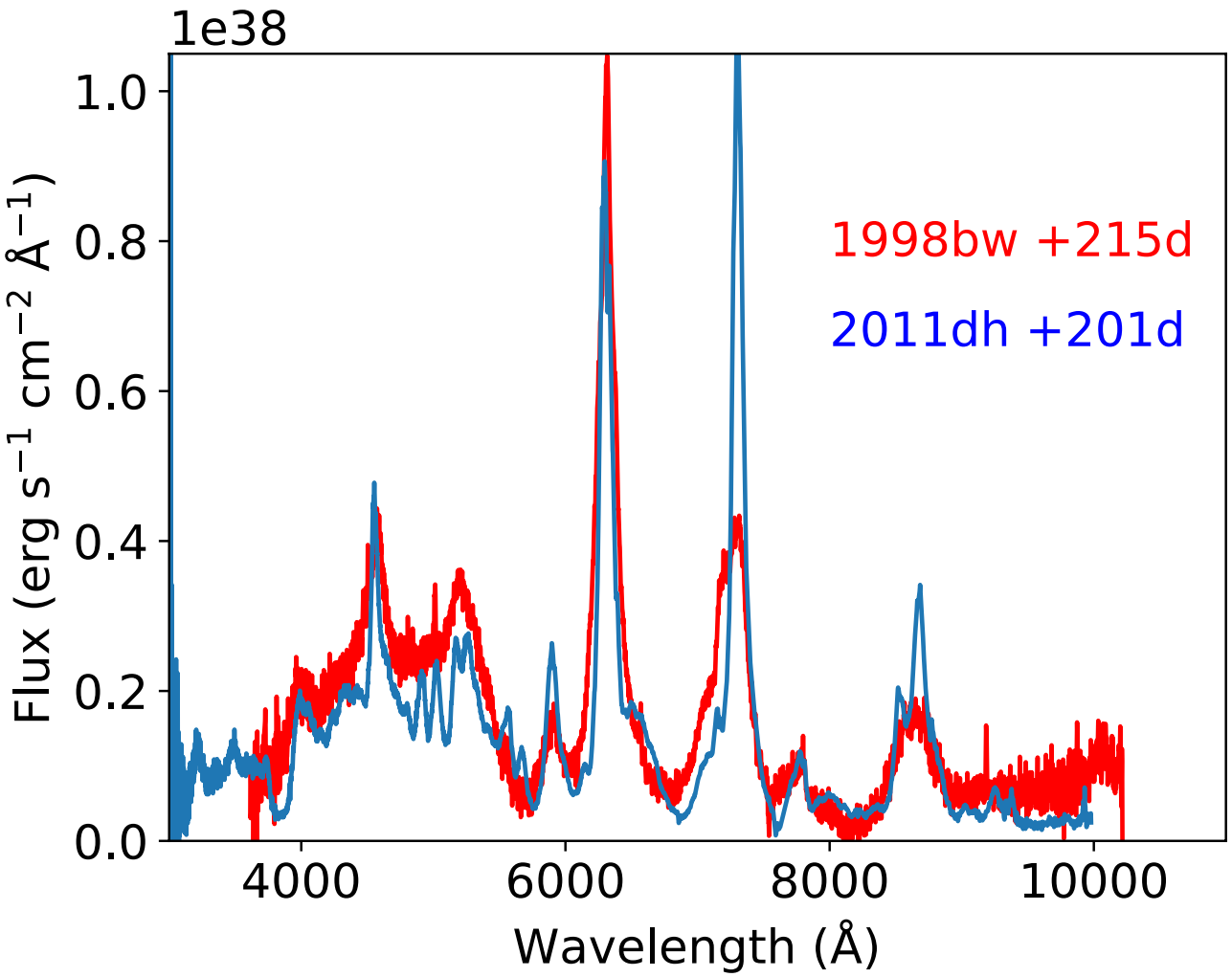


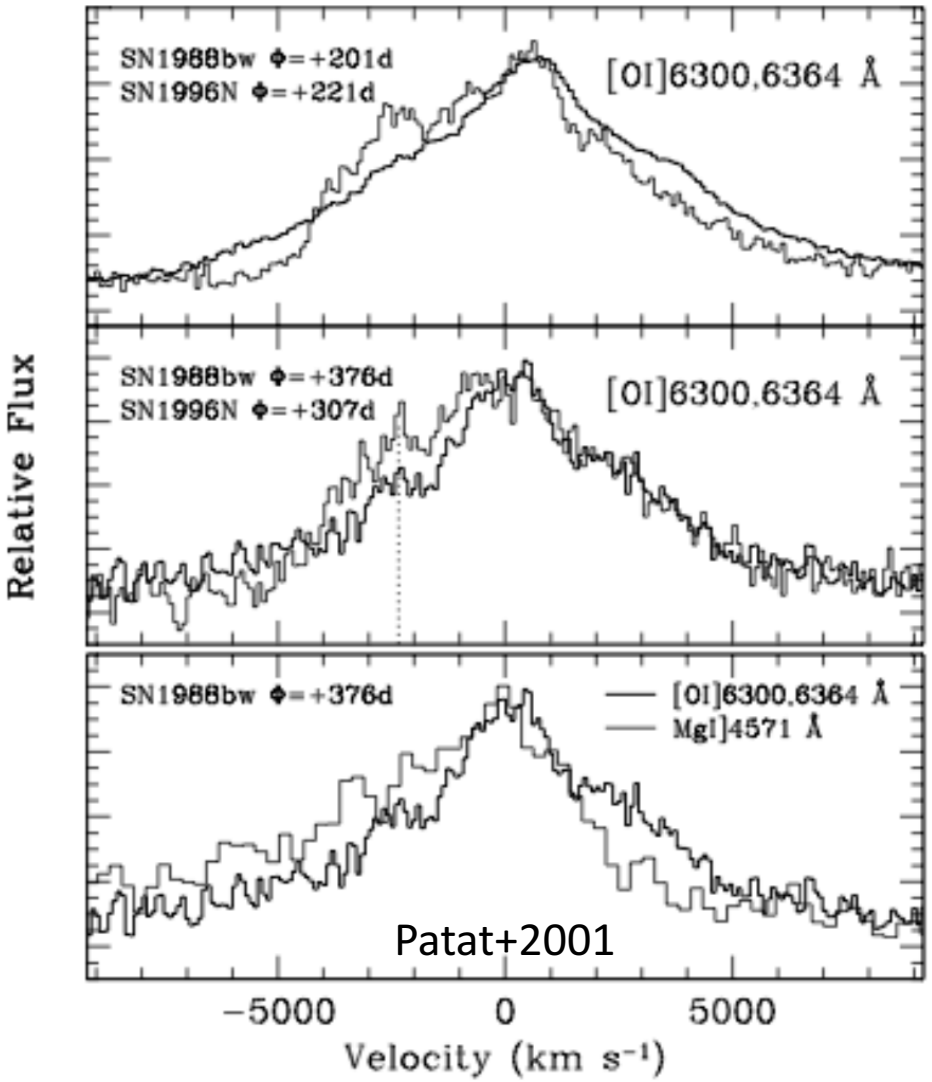


<5500 Å region dominated by radiative transfer effects

Jerkstrand in prep.

How different are these really from normal Ibc SNe?





Summary

- We have now several SLSNe studied in nebular phase.
- They are all similar to broad-lined Ic SN, but with time shifts.
- Broadlined Ic SNe have only broad lines early on: later look like any stripped-env SN.
- Standard models do quite well for SN 1998bw. Key question: What part of the ”blue plateau” is due to due hot iron?
- ***Ignoring strong asymmetries, and strong ^{56}Ni mixing, have we dismissed ^{56}Ni powered CCSN too quickly for SLSNe? If we invoke this for SN 1998bw, why not for SLSNe?***