iPTF14hls as a variable hyper-wind from a very massive star

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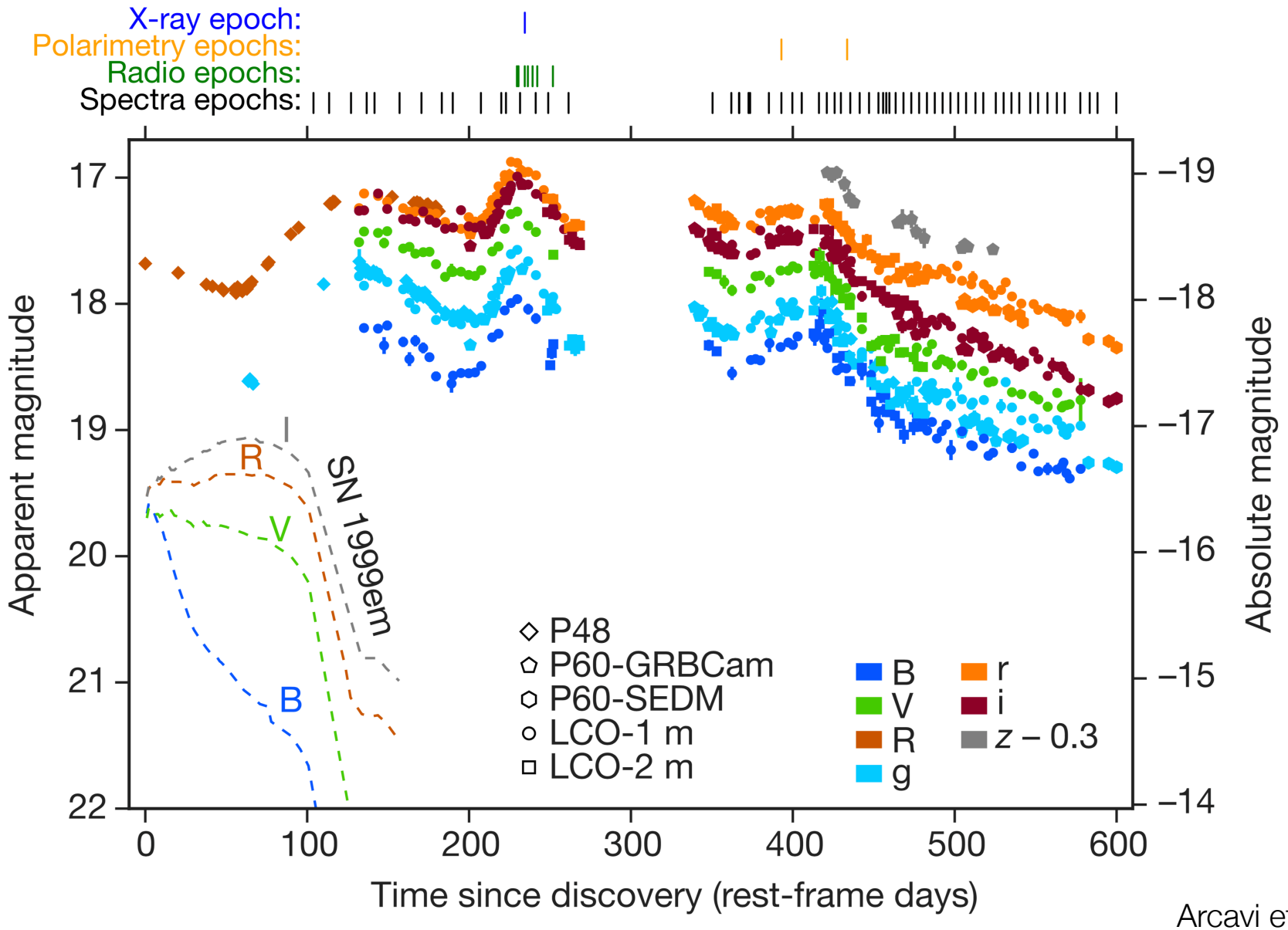
Moriya, Mazzali, & Pian, MNRAS, 491, 1384 (2020)

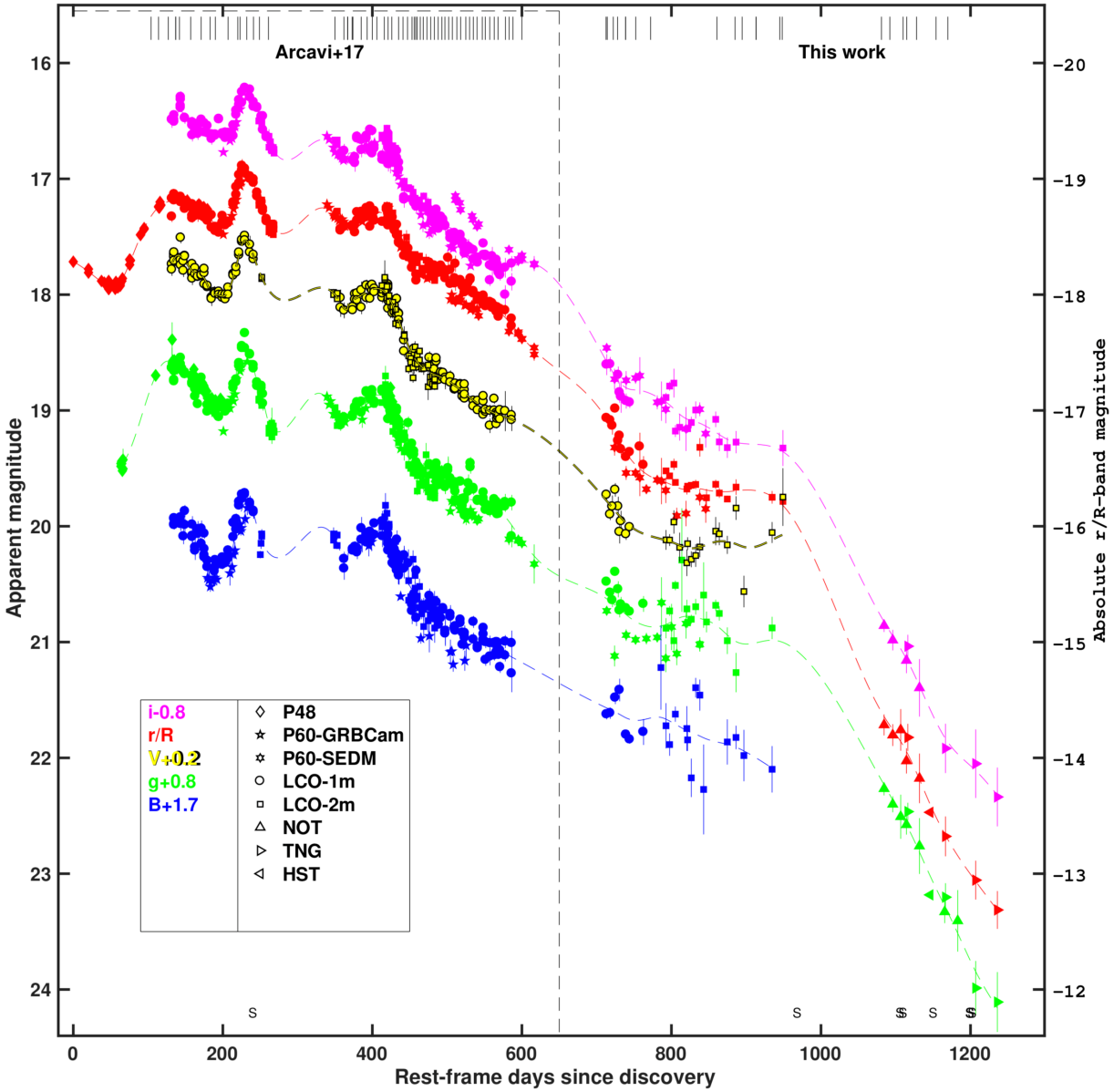


iPTF14hls



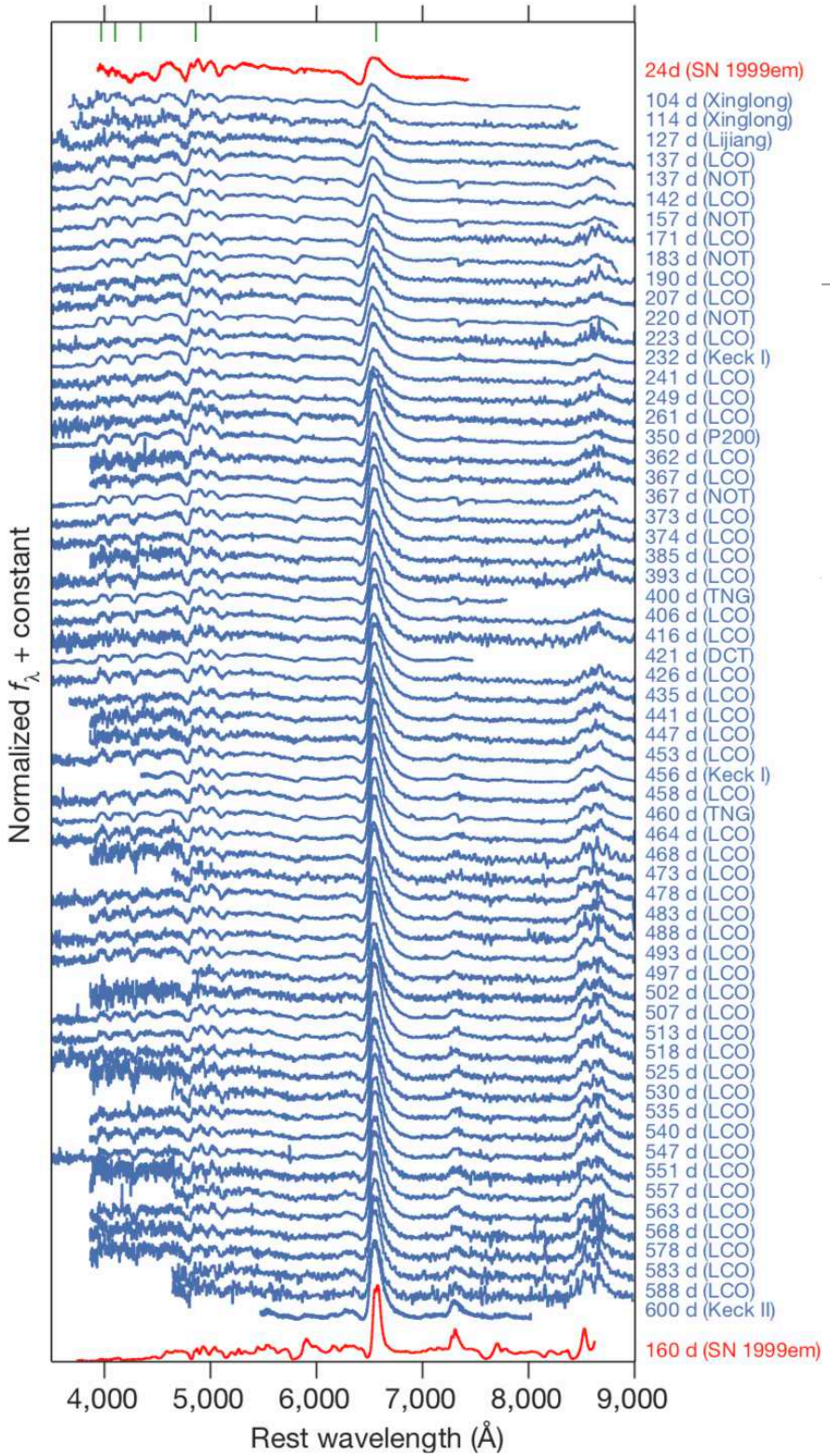
Arcavi et al. (2017)

iPTF14hls



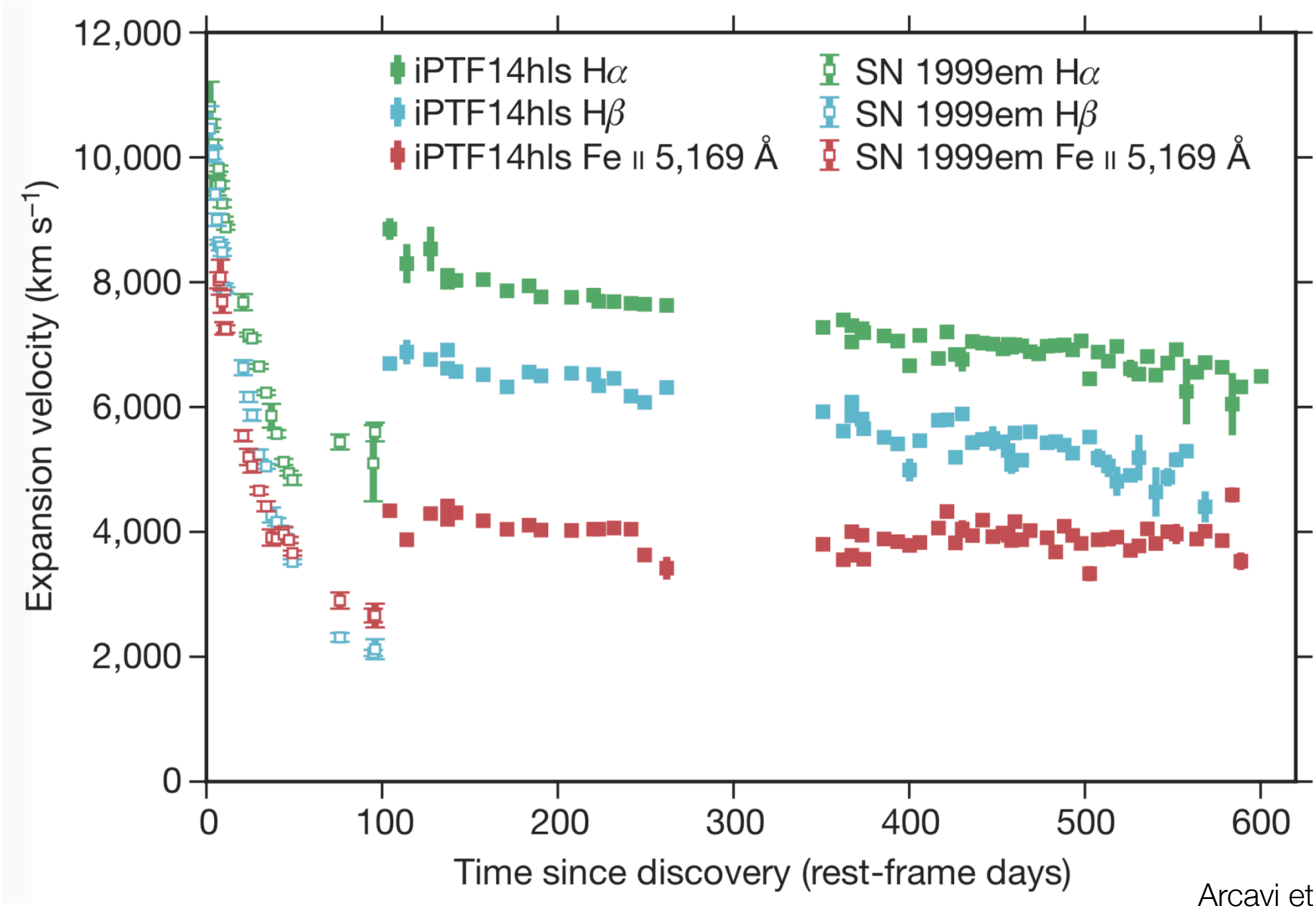
Sollerman et al. (2019)

iPTF14hls



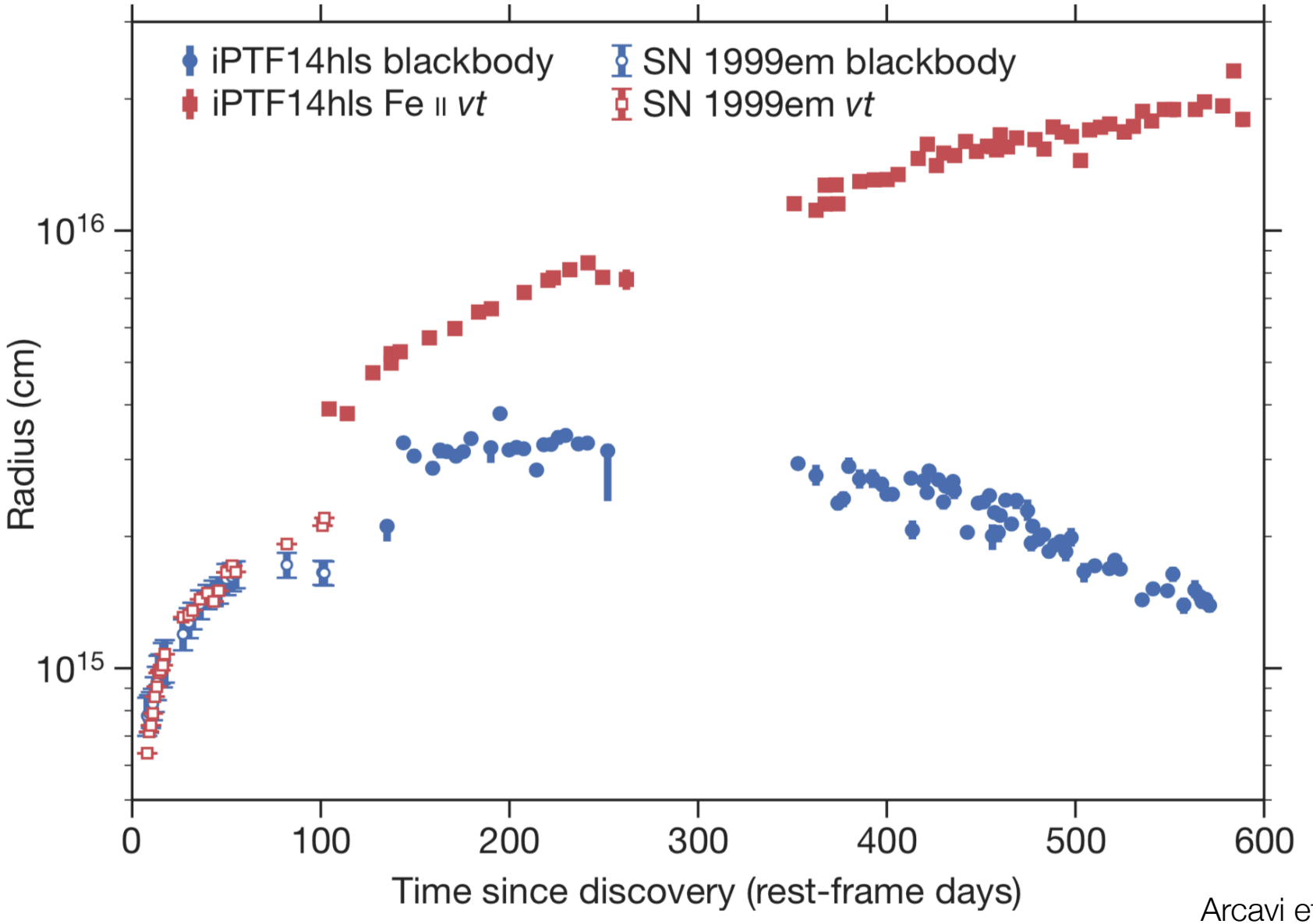
Arcavi et al. (2017)

Little evolution in velocity!



Arcavi et al. (2017)

Radius evolution



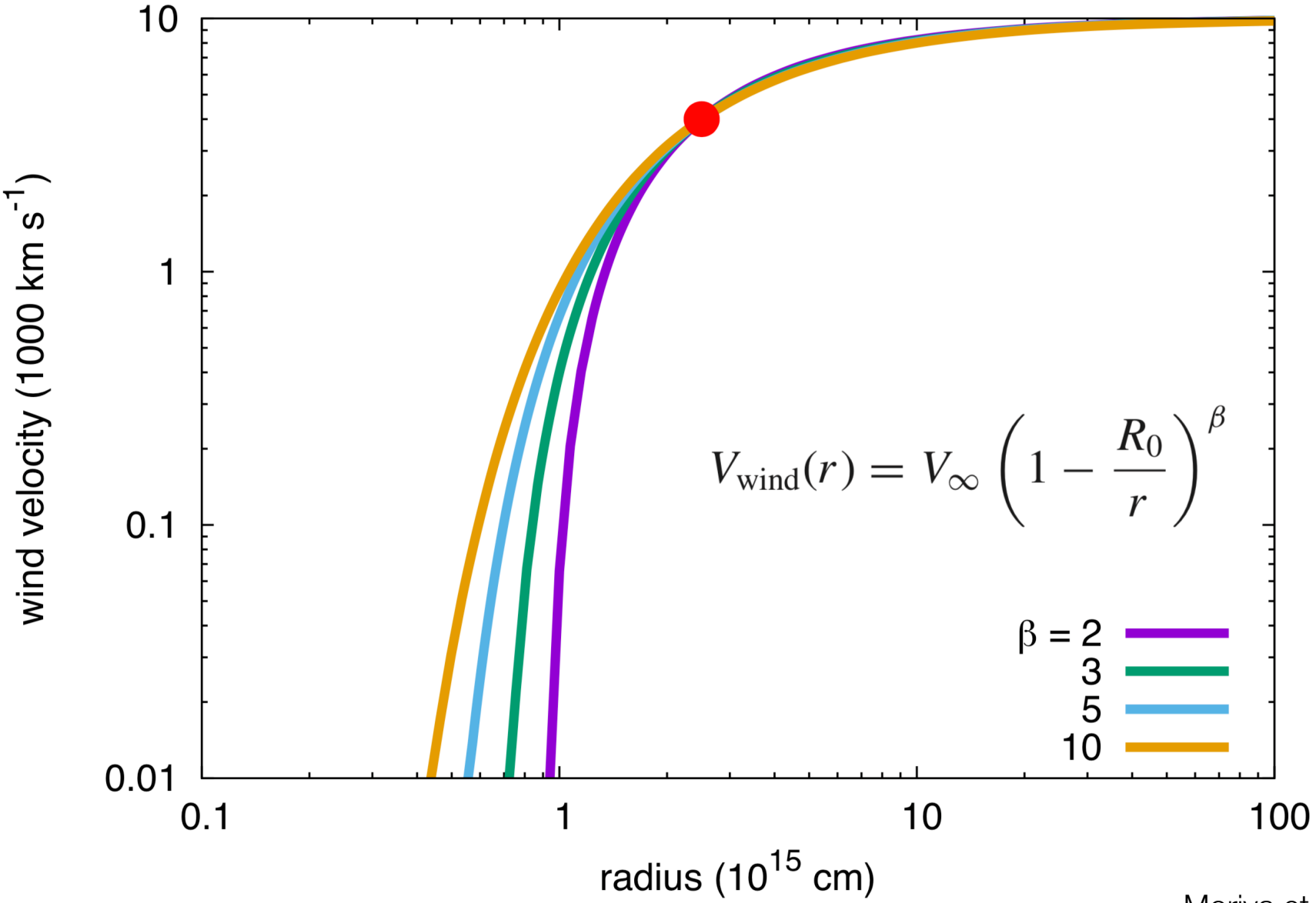
Arcavi et al. (2017)

iPTF14hls

- $v(r)$ is fixed with time
  - the same velocity is kept at the same radius
  - SN ejecta homologously expand
    - $v = r/t$
    - iPTF14hls spectral evolution is hard to be from SN ejecta
    - it is not a short-term eruptive event!

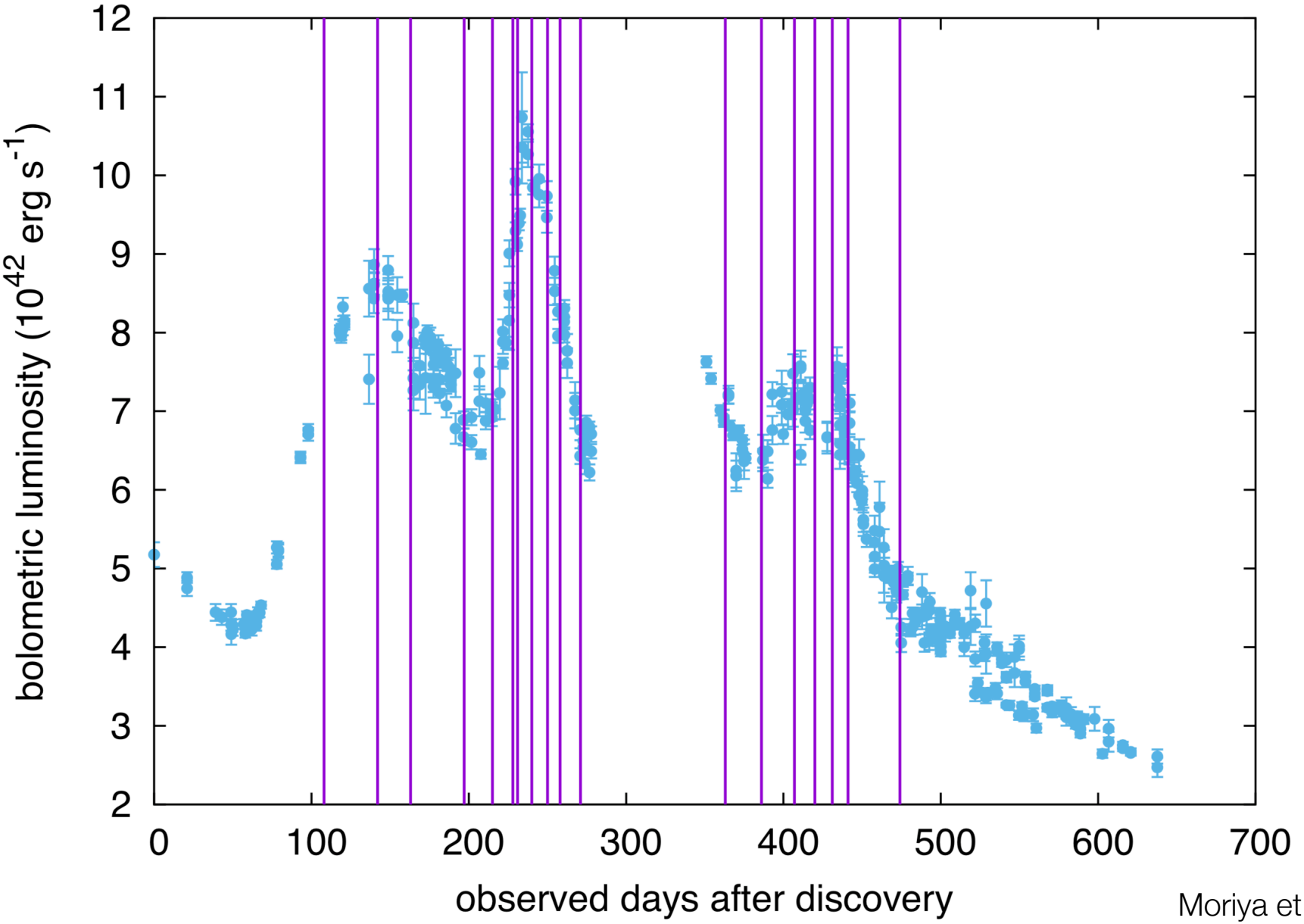
- we know phenomena having similar velocity properties
  - ***stellar wind!***
    - a long-term outflow

Velocity structure in stellar wind



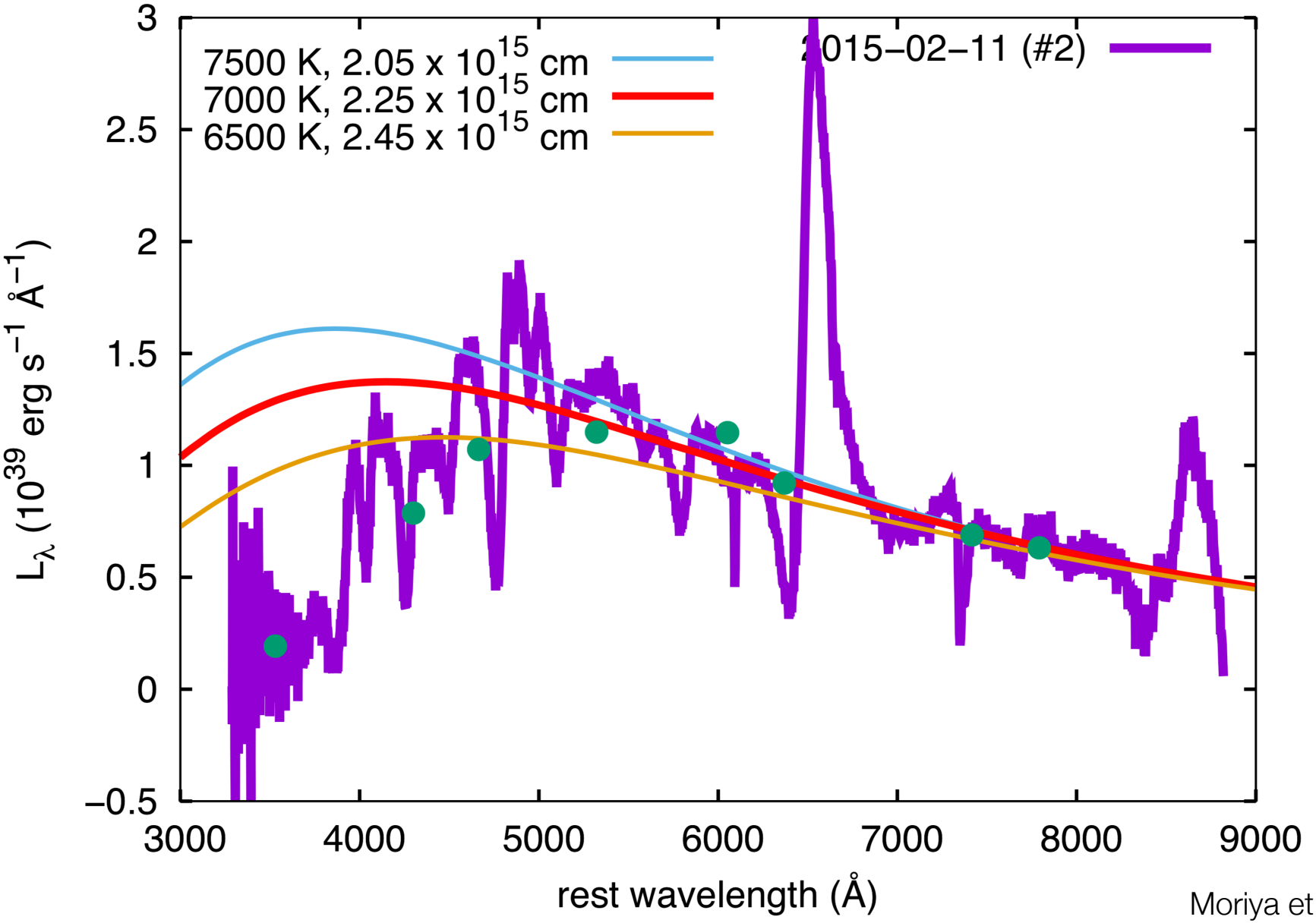
Moriya et al. (2020)

iPTF14hls as a stellar wind



Moriya et al. (2020)

iPTF14hls as a stellar wind



Moriya et al. (2020)

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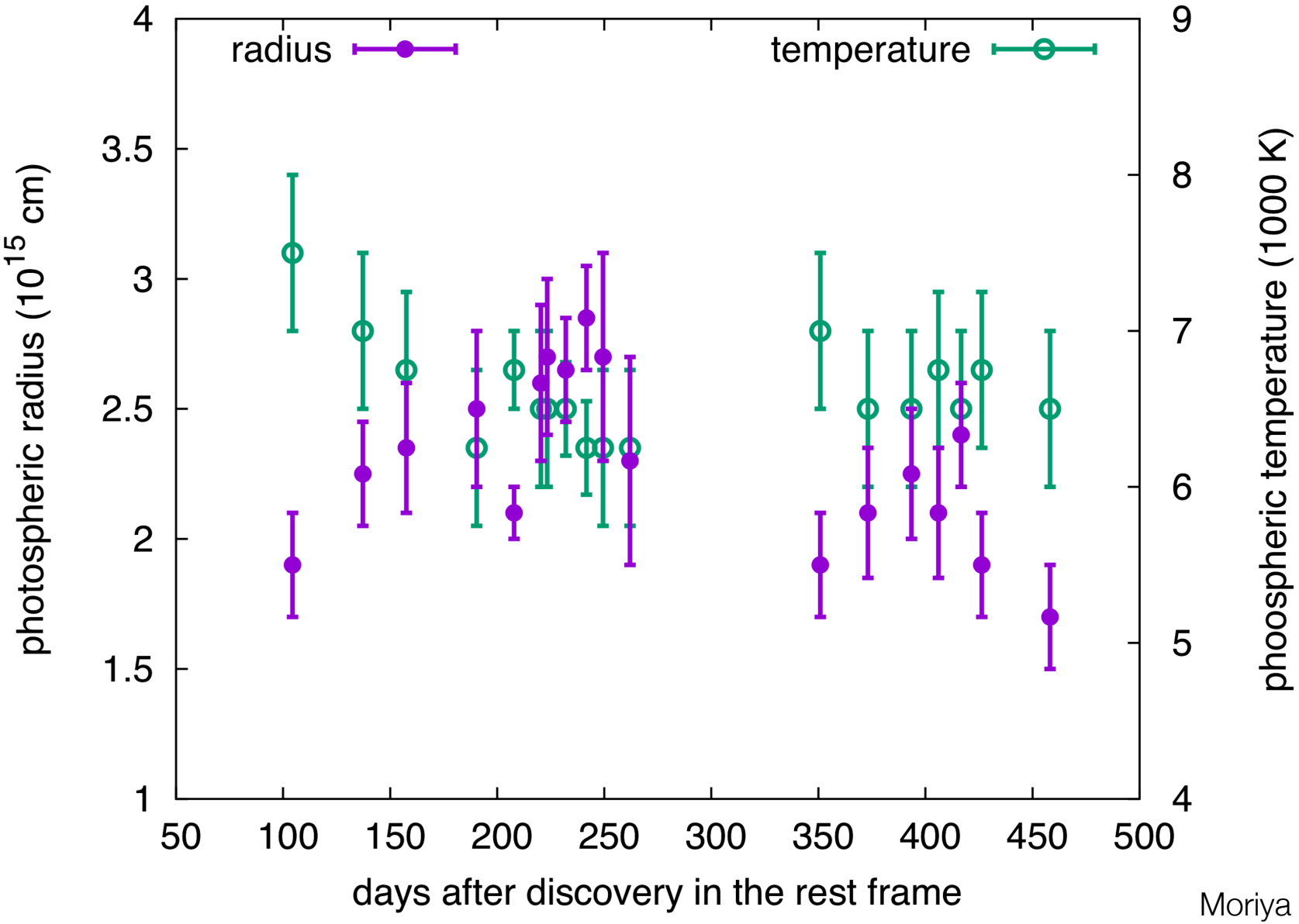
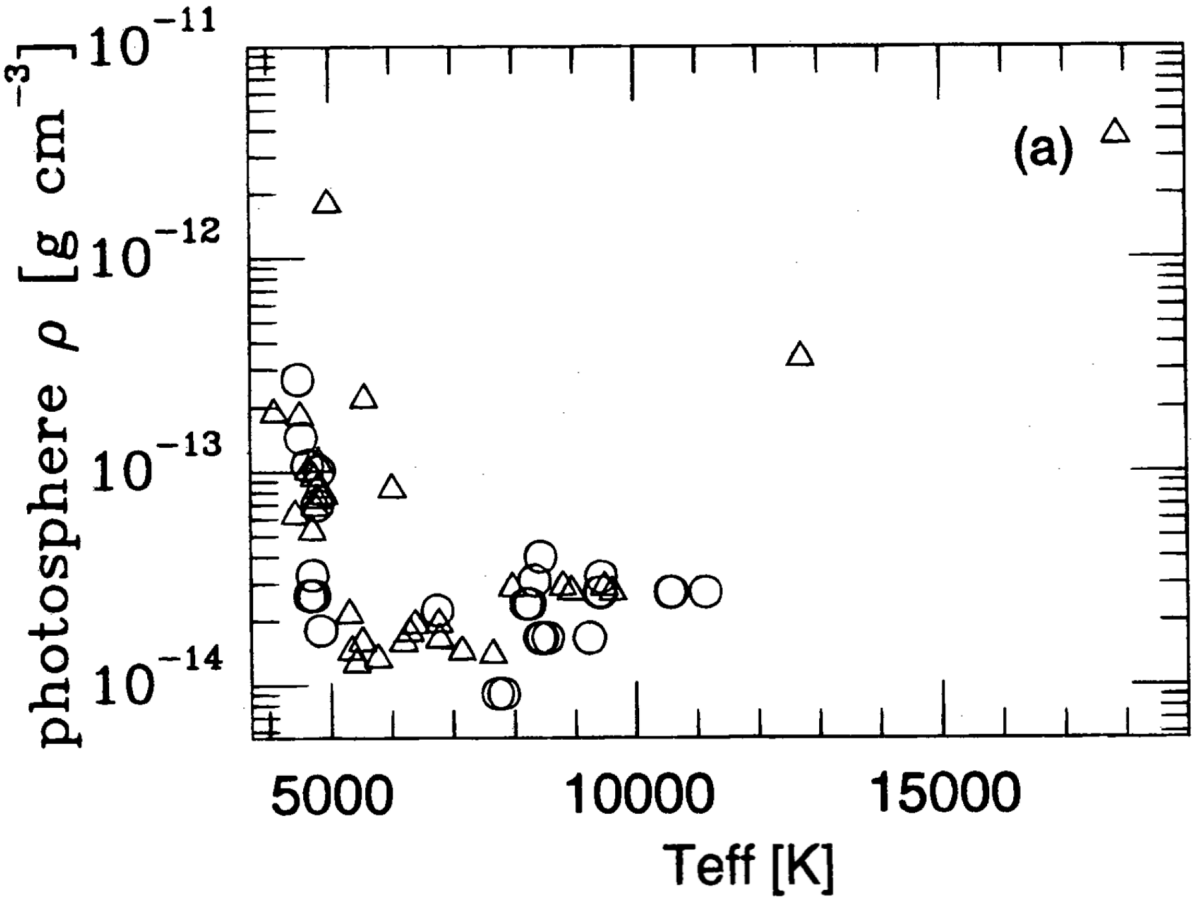


Moriya et al. (2020)

iPTF14hls as a stellar wind

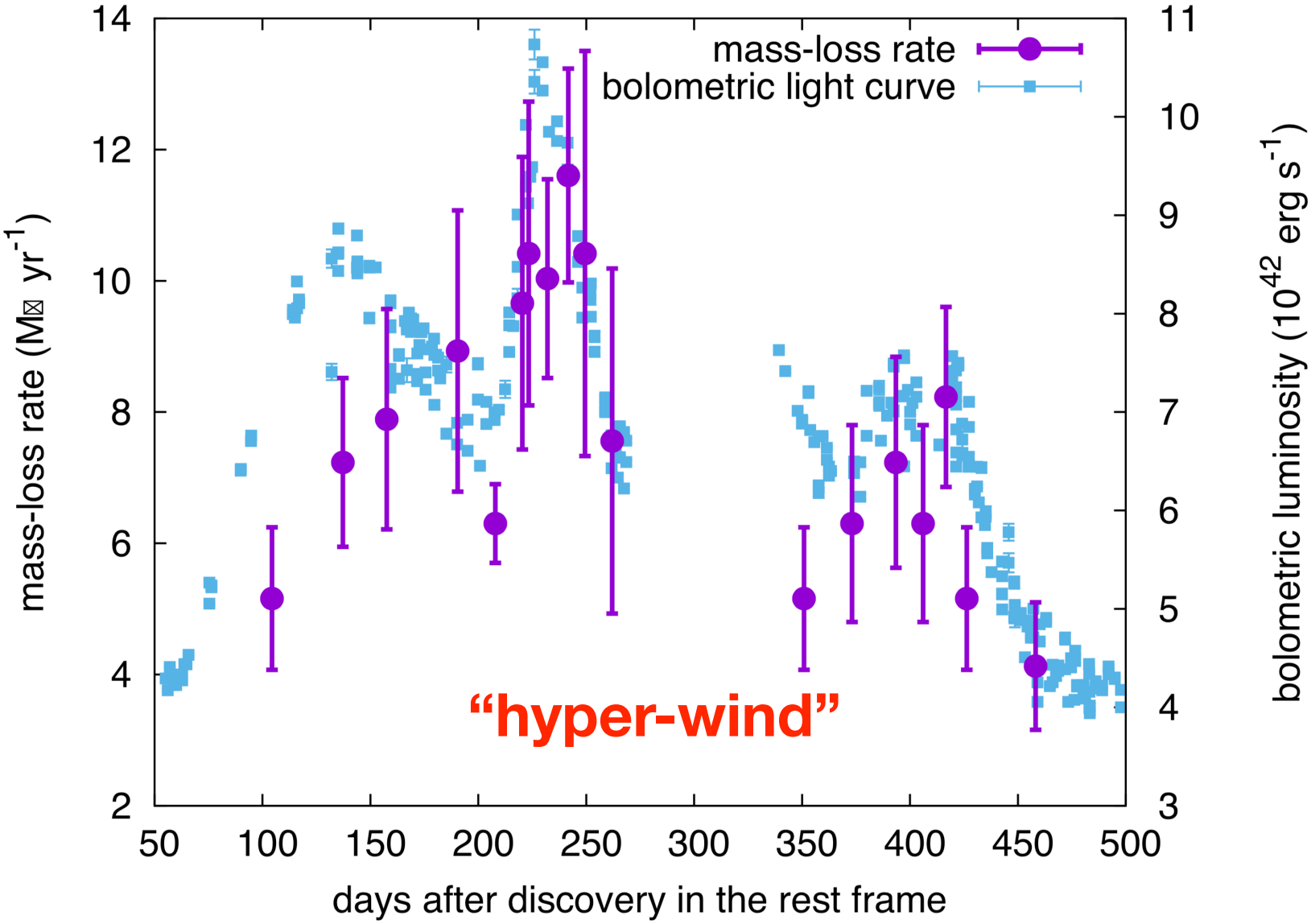
$$\dot{M} = 4\pi R_{\rm ph}^2 \rho_{\rm ph} V_{\rm ph}$$

- hydrogen recombination density



Eastman et al. (1996)

Mass-loss rate of iPTF14hls



Moriya et al. (2020)

iPTF14hls as a “hyper-wind”

- mass-loss rates above a few Msun/yr for ~ 2 years
  - total ejected mass ~ 10 Msun

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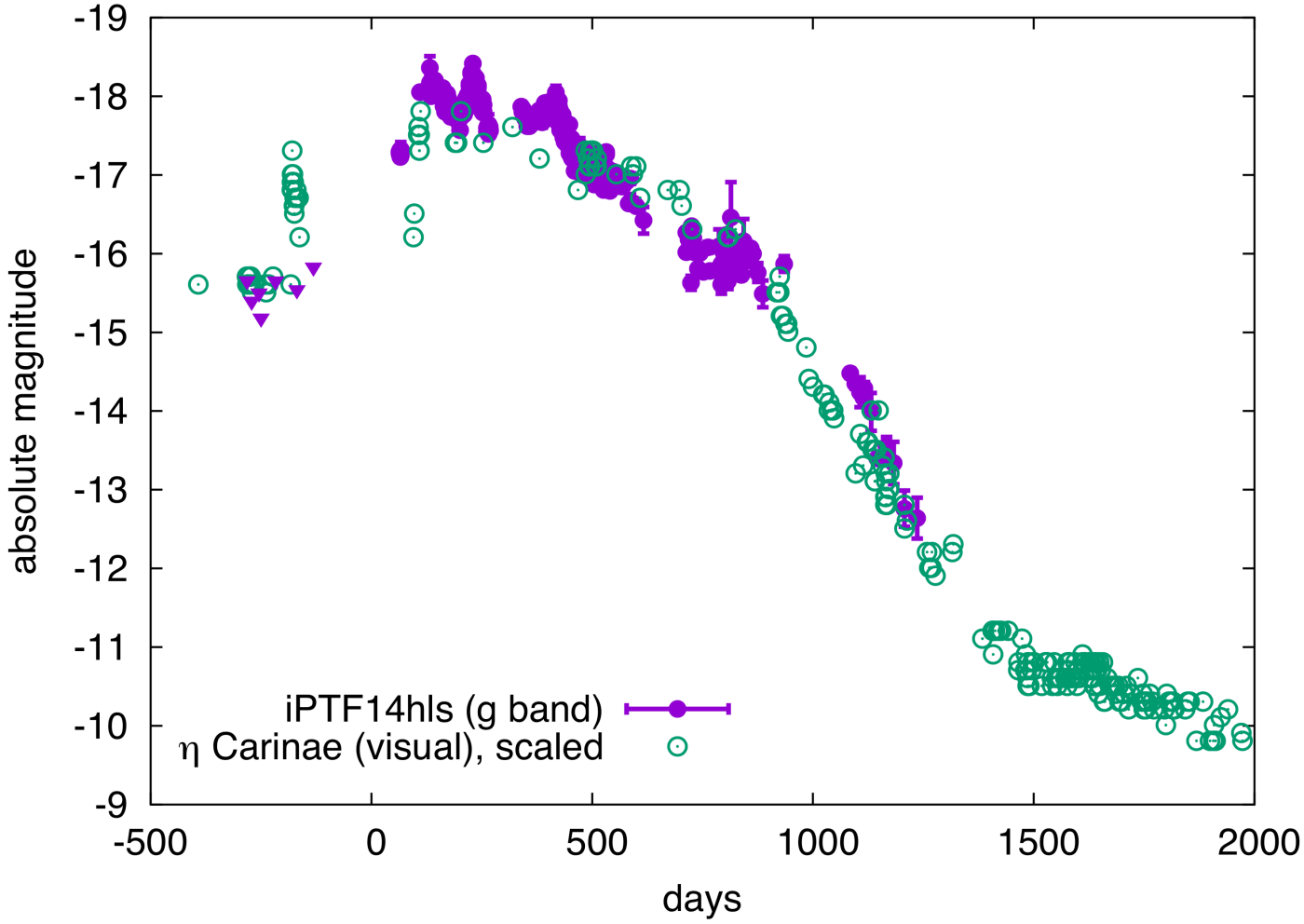
- Any similar events?
  - eta Carinae
    - ejected ~ 10 Msun in 10 years



iPTF14hls and eta Carinae

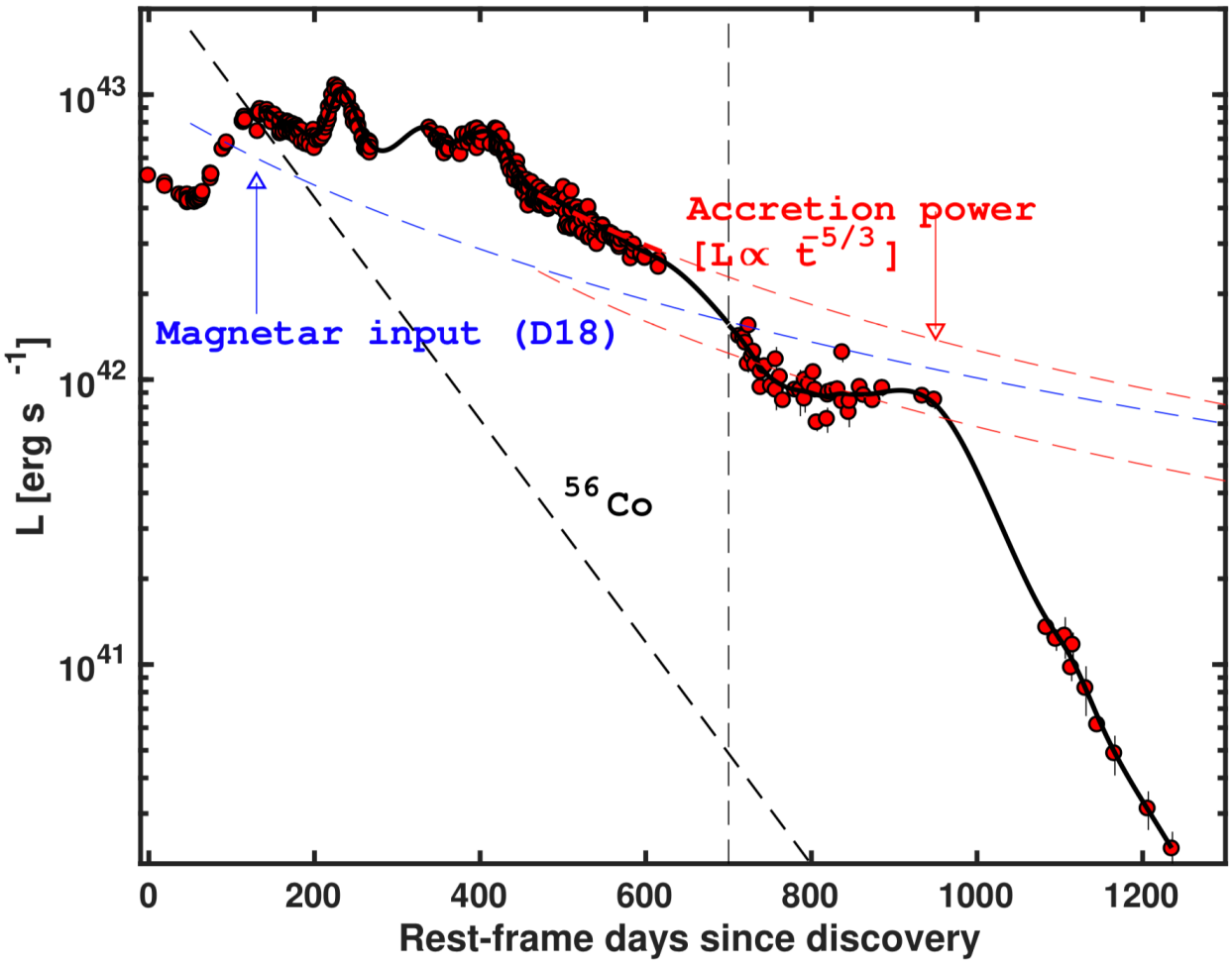
- scaled eta Carinae matches iPTF14hls
  - timescale x 0.15, luminosity x 100



Moriya et al. (2020)

Remaining star?

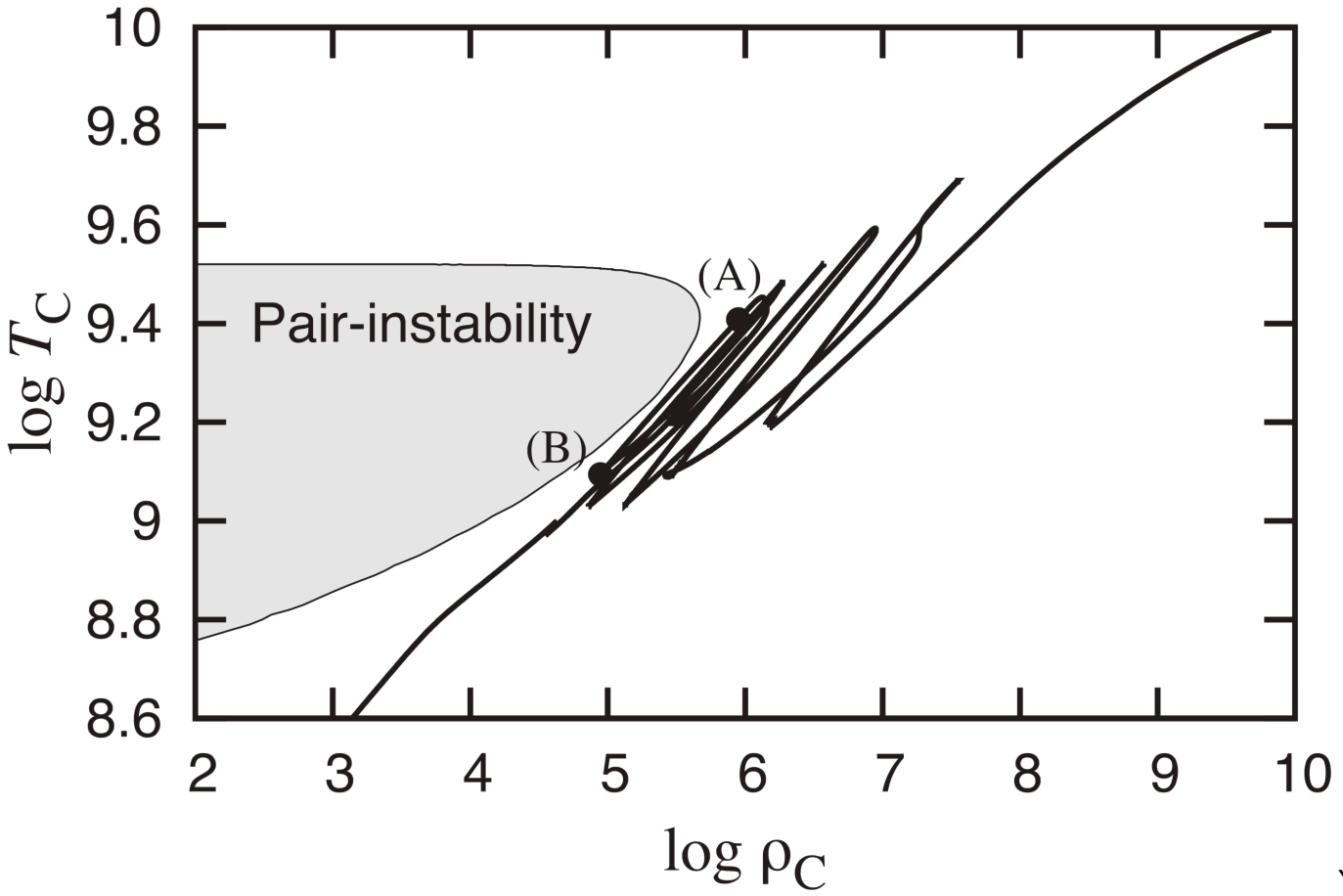
- last observed luminosity ~ 5e6 Lsun
  - less than 150 Msun if a star still exists



Sollerman et al. (2019)

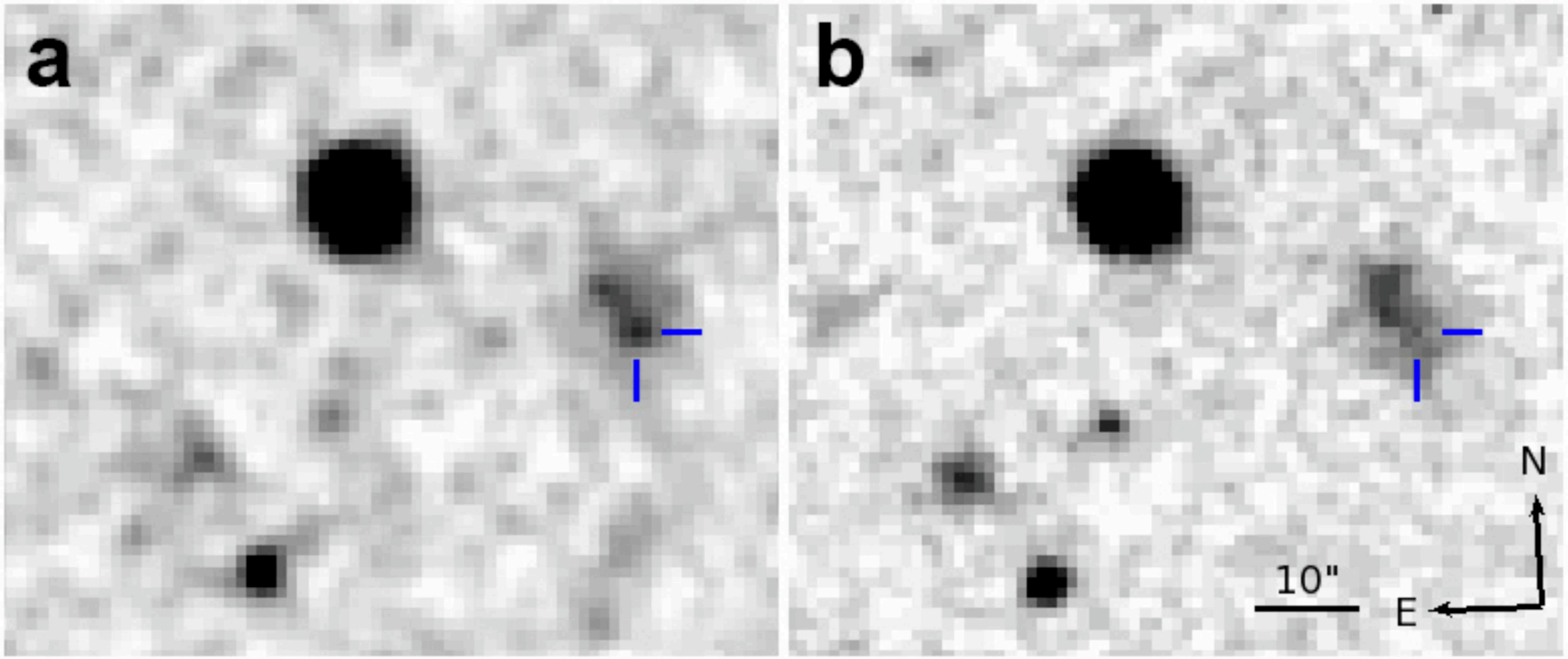
What is driving the “hyper-wind”?

- pulsational pair-instability?
- stellar merger?
- unknown mechanisms?



Yoshida et al. (2016)

Possible brightening of iPTF14hls in 1954



Arcavi et al. (2017)

Summary

- iPTF14hls is unlikely a SN
  - a short-term mass ejection

- iPTF14hls can be explained by a stellar wind
  - a long-term mass flow

