



DEPARTMENT OF ASTRONOMY
AND STEWARD OBSERVATORY

Polarization signature showing an elevated and asymmetric mass loss

In context of SN 2023ixf

Manisha Shrestha: mshrestha1@arizona.edu

In collaboration with: K. Azalee Bostroem, Griffin Hosseinzadeh,
Jeniveve Pearson, David J. Sand, .. many more

Stellar evolution-Mass loss rate



Credit: NASA/JPL-Caltech

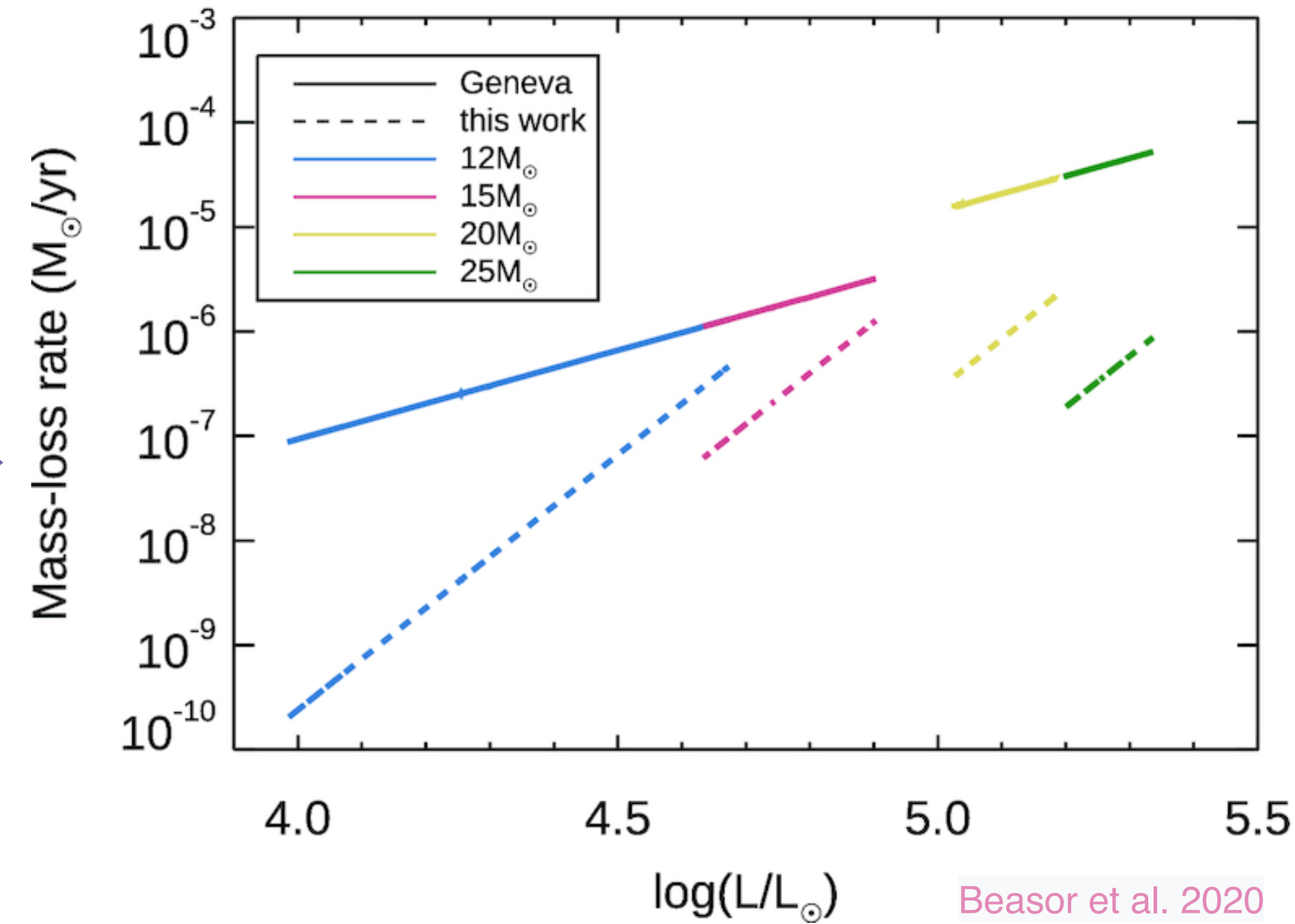
Stellar evolution-Mass loss rate



Credit: NASA/JPL-Caltech



Different models don't agree



Stellar evolution-Mass loss rate



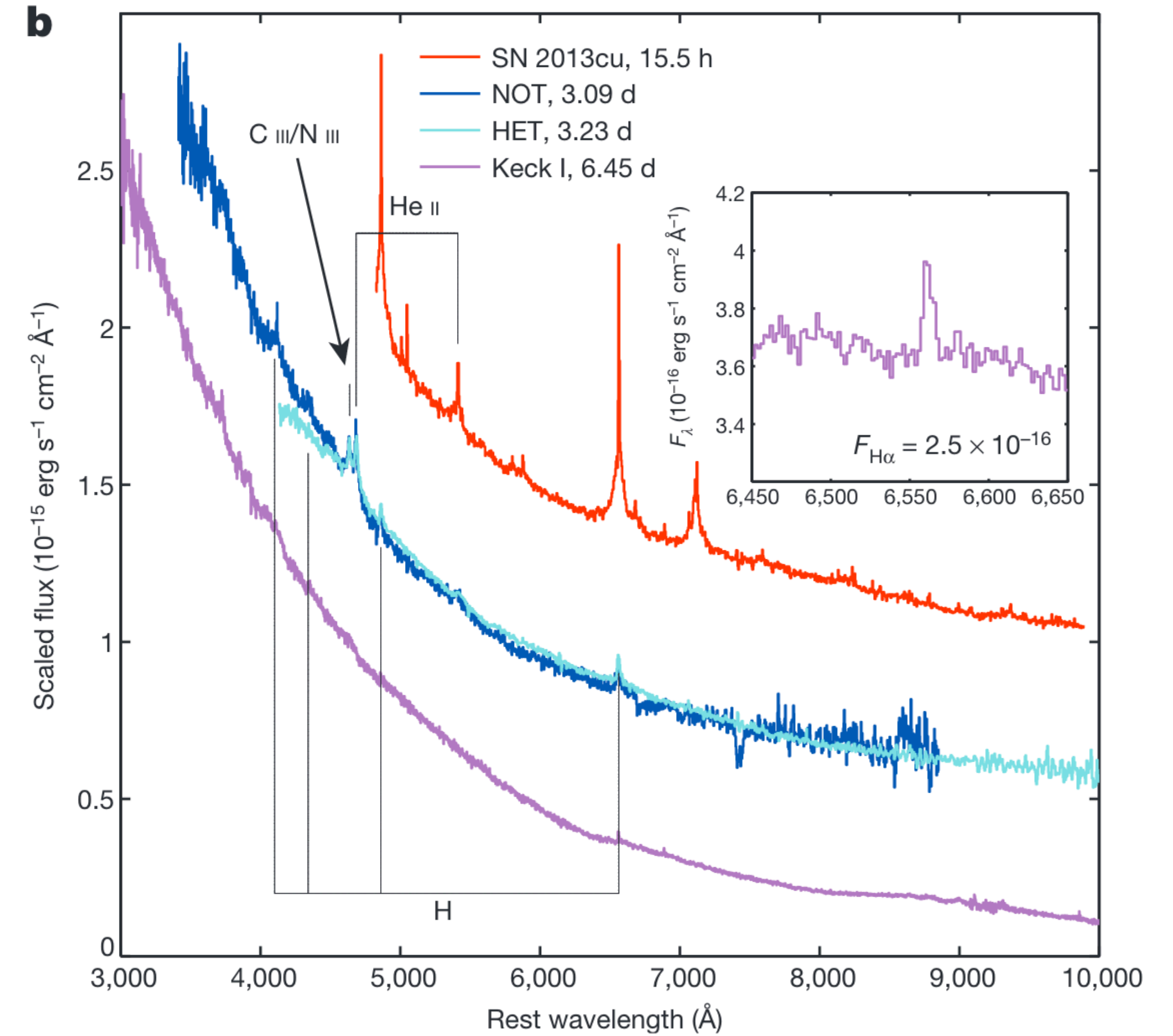
Credit: NASA/JPL-Caltech



Stellar evolution-Mass loss rate



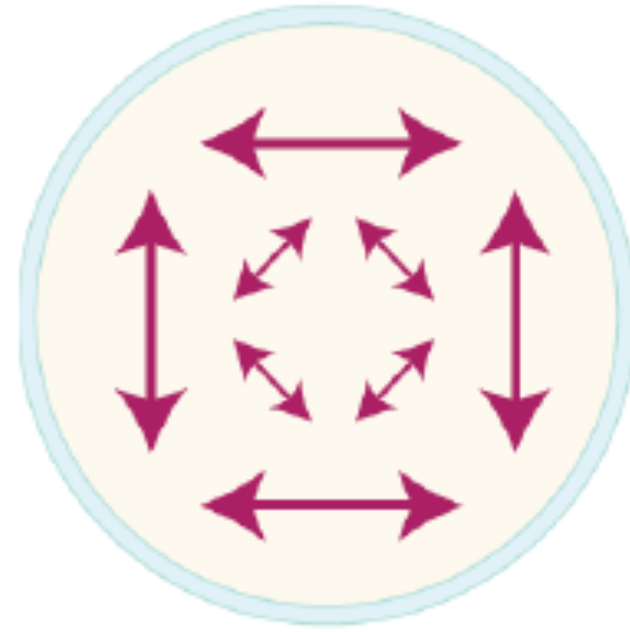
Credit: NASA/JPL-Caltech



Gal-Yam et al. 2014

Polarization

Spherical $P_{\text{net}} = 0\%$



(Image: Leonard 2007, Science, 315, 193)

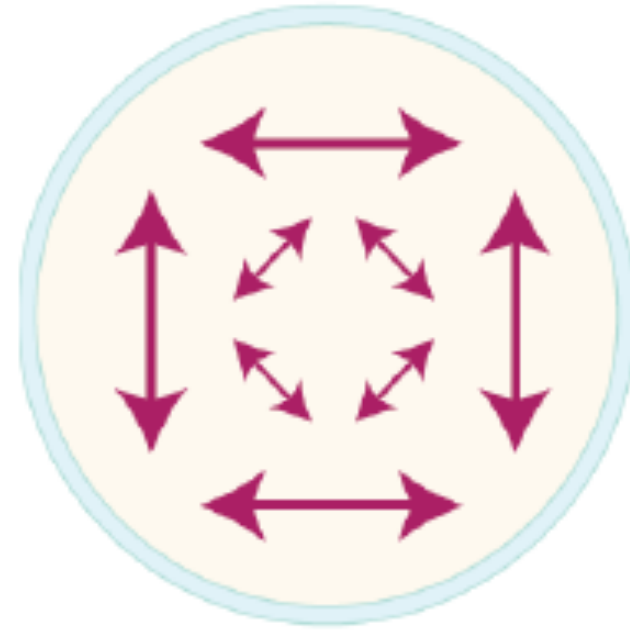
 = Direction of electric vector in plane of sky

Global asphericity: Continuum + line trough polarization (at same PA)

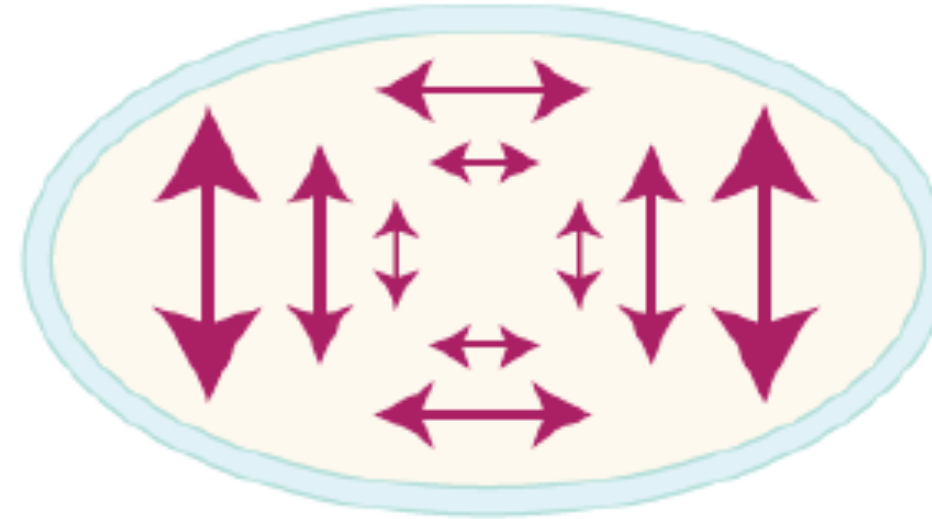
Clumpy ejecta: No continuum polarization + line trough polarization

Polarization

Spherical $P_{\text{net}} = 0\%$



Aspherical $P_{\text{net}} > 0\%$



(Image: Leonard 2007, Science, 315, 193)

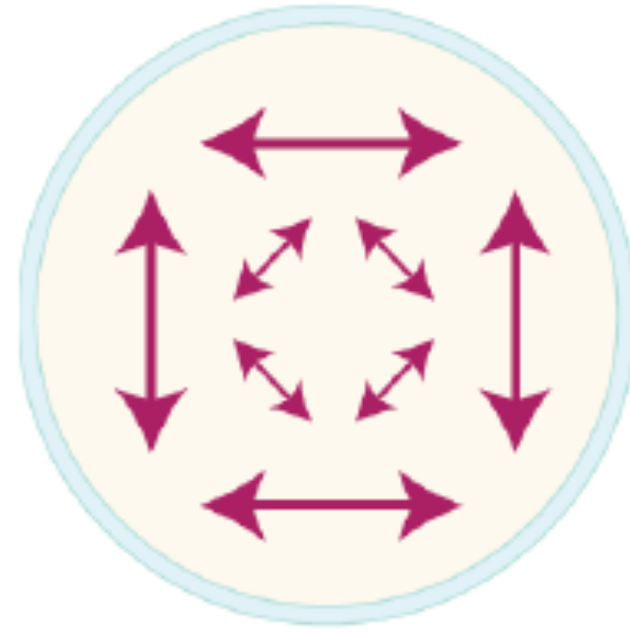
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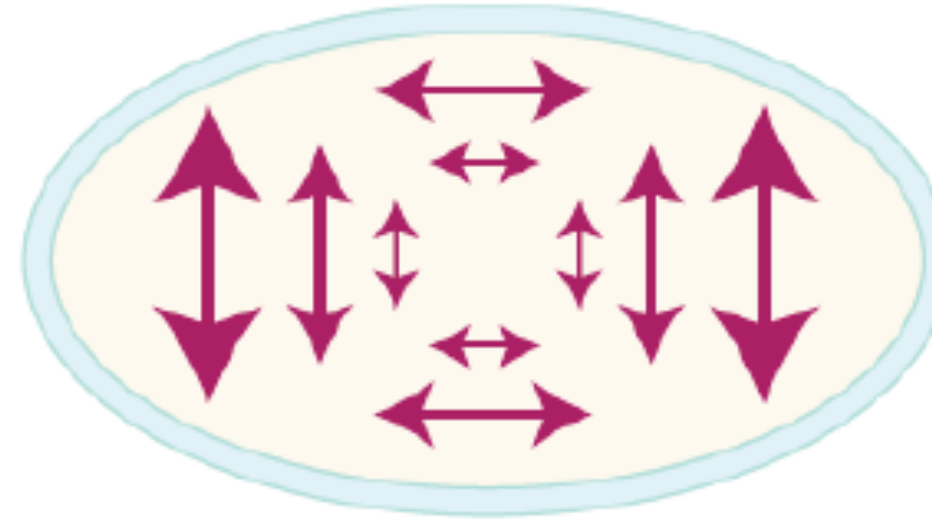
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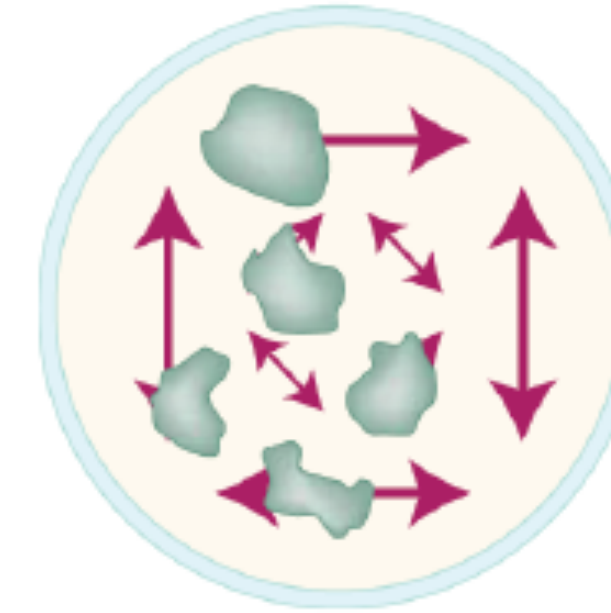
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Clumpy Ejecta



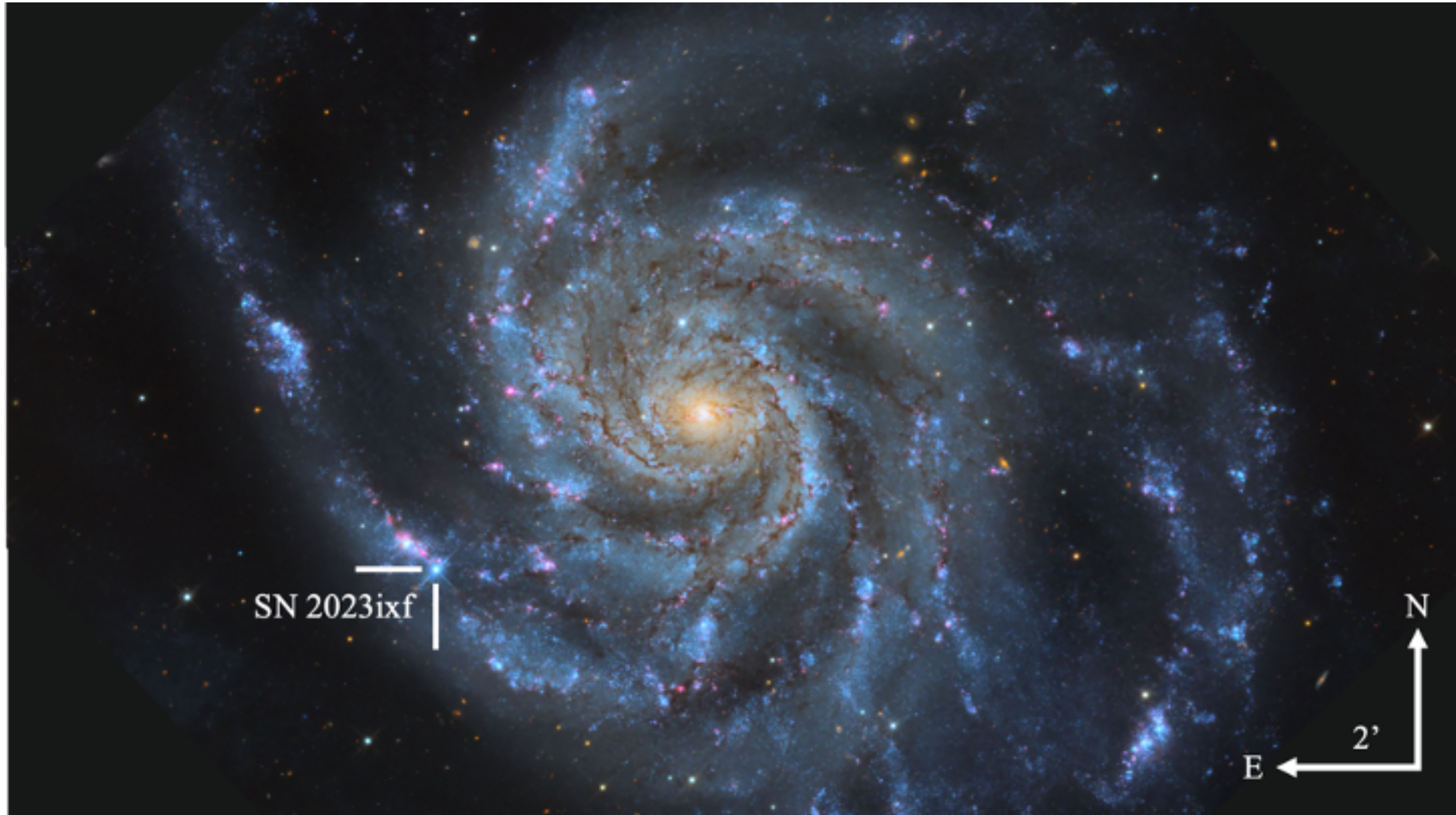
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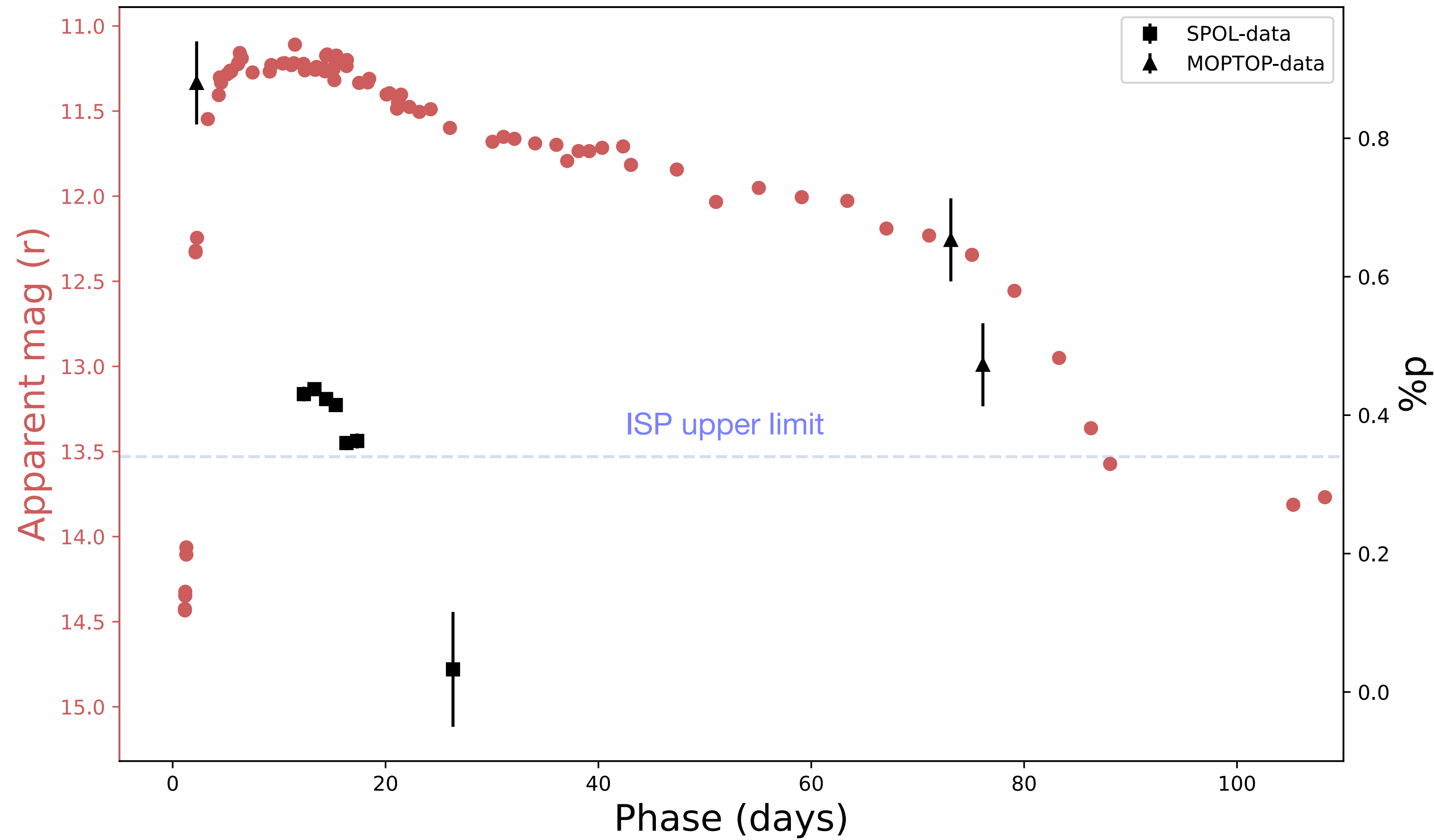
SN 2023ixf



Mount Lemmon Sky Center

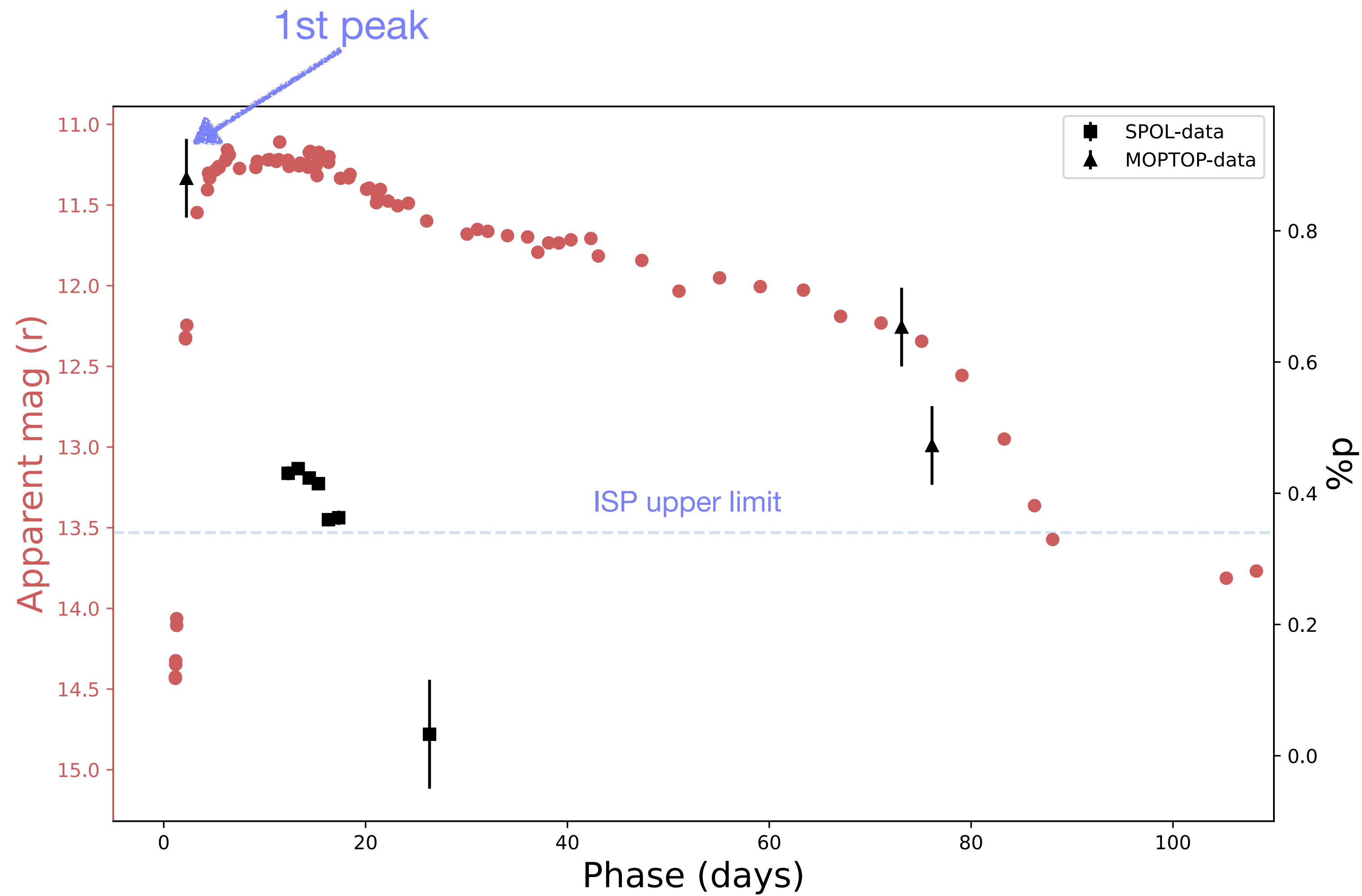
Hosseinzadeh et al. 2023

SN 2023ixf: significant polarization



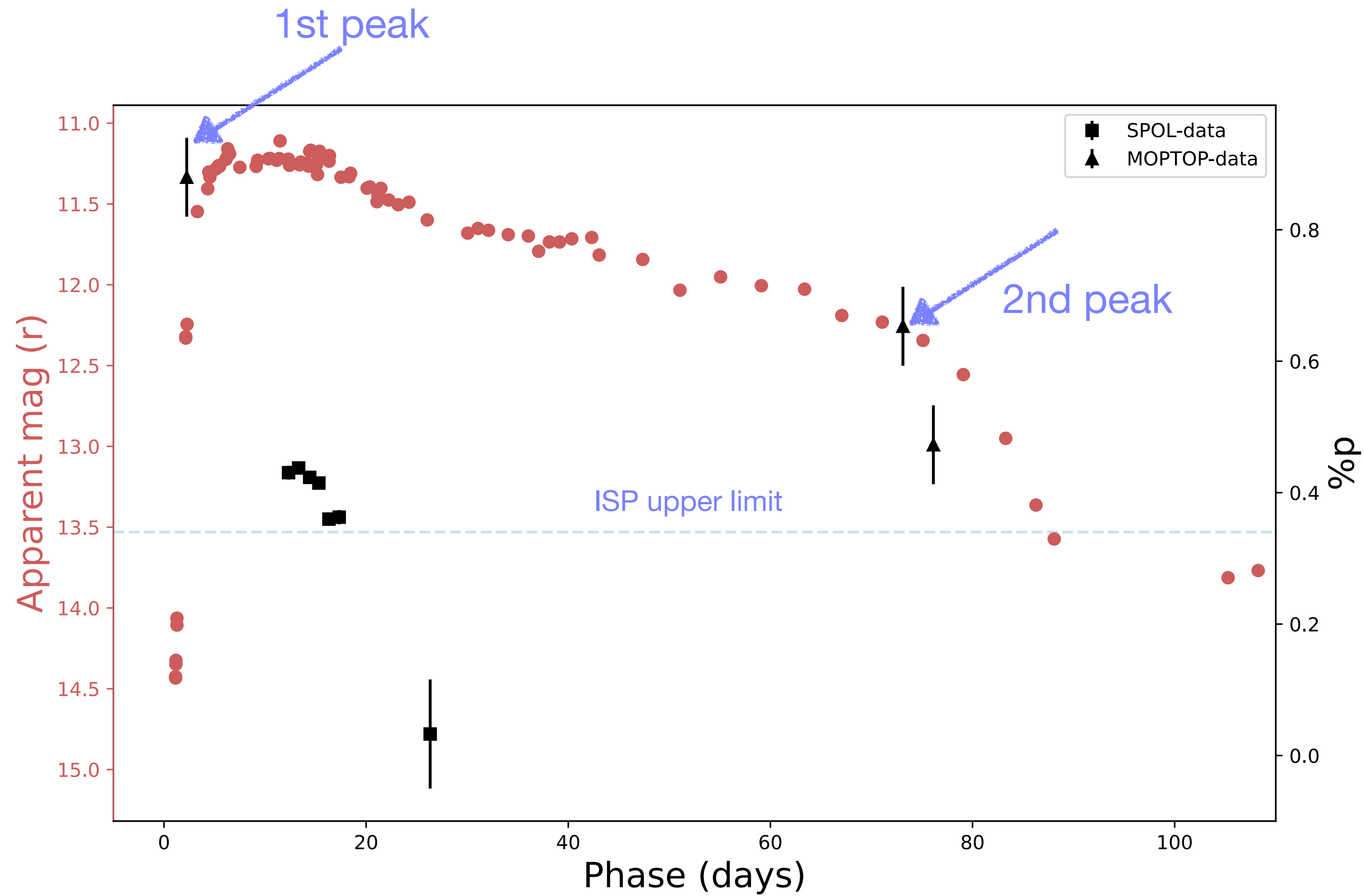
Shrestha et al. in prep

SN 2023ixf: significant polarization



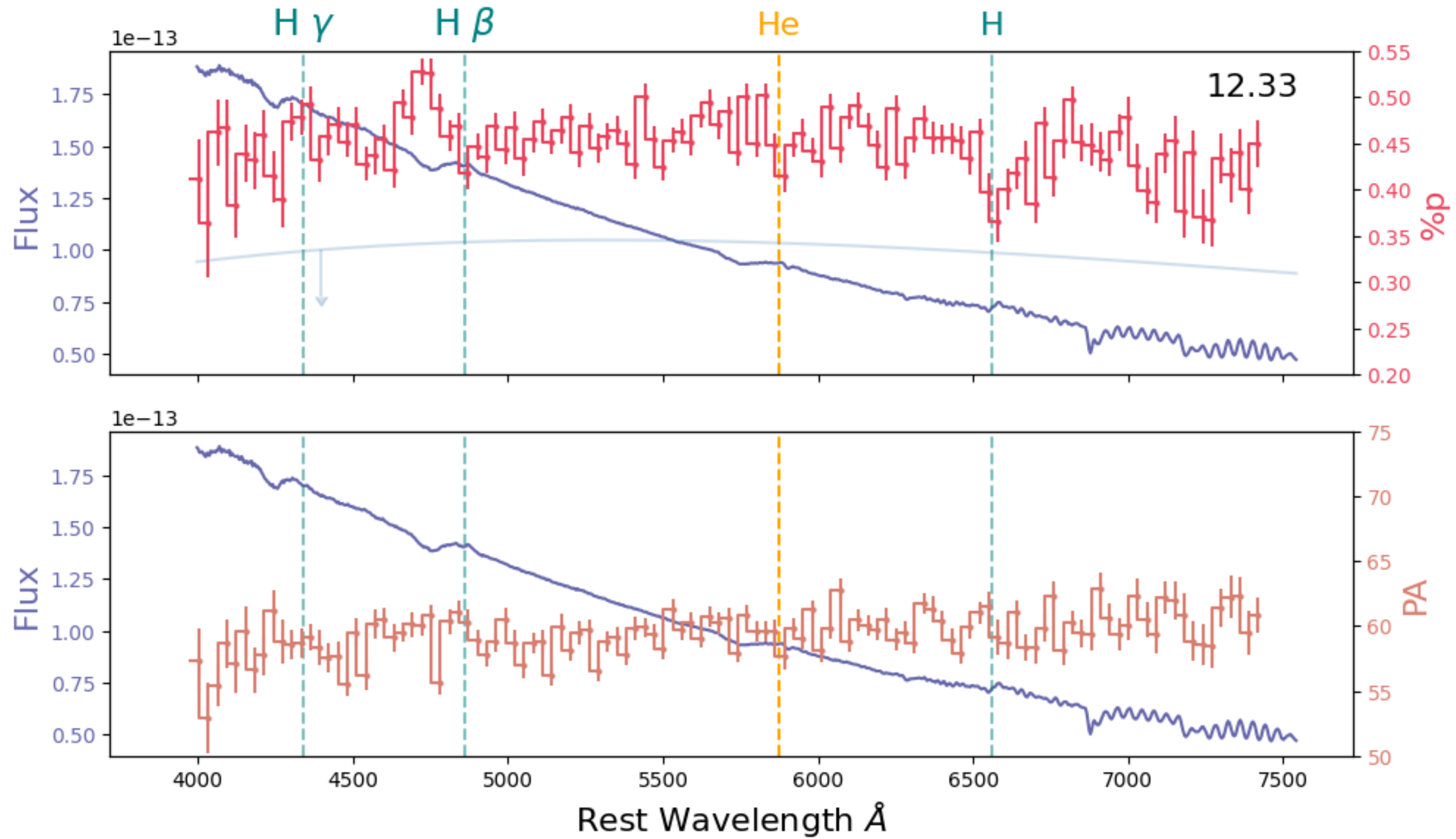
Shrestha et al. in prep

SN 2023ixf: significant polarization



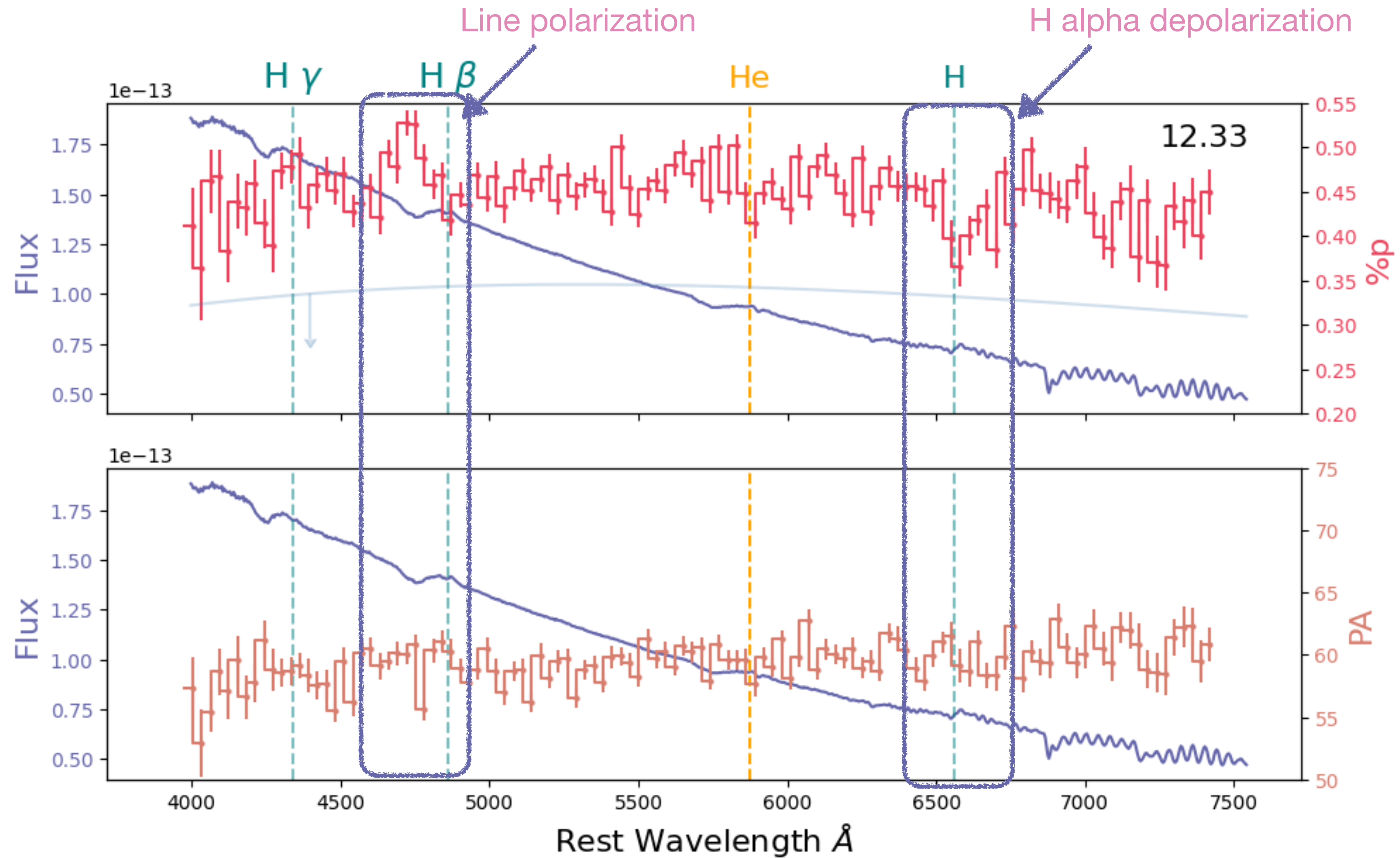
Shrestha et al. in prep

SN 2023ixf: line (de)polarization



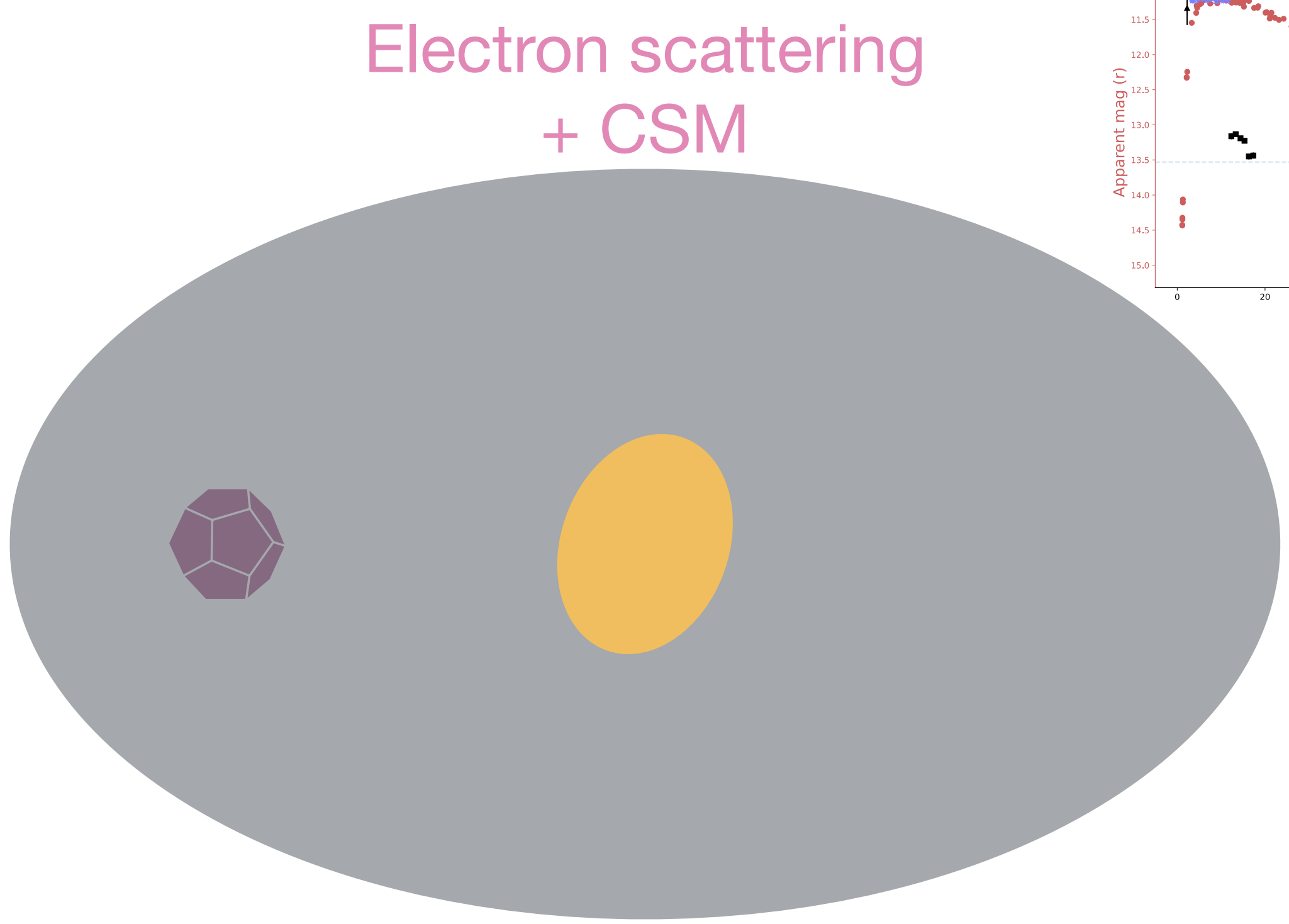
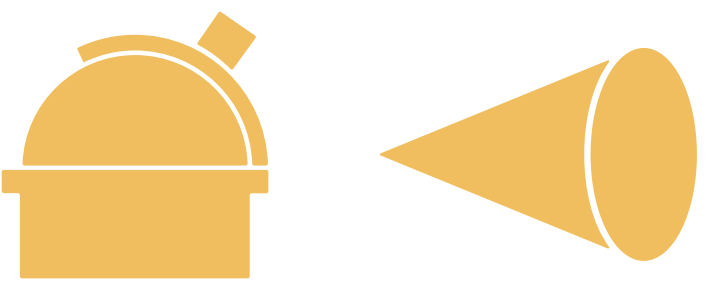
Shrestha et al. in prep

SN 2023ixf: line (de)polarization



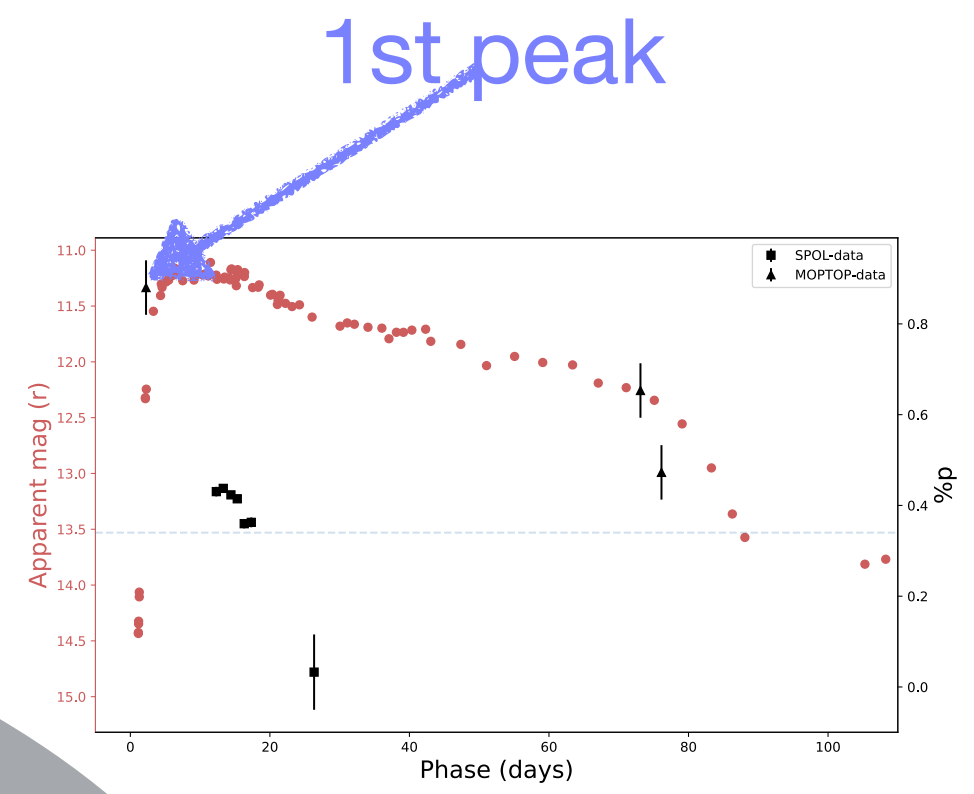
Shrestha et al. in prep

SN 2023ixf: significant polarization

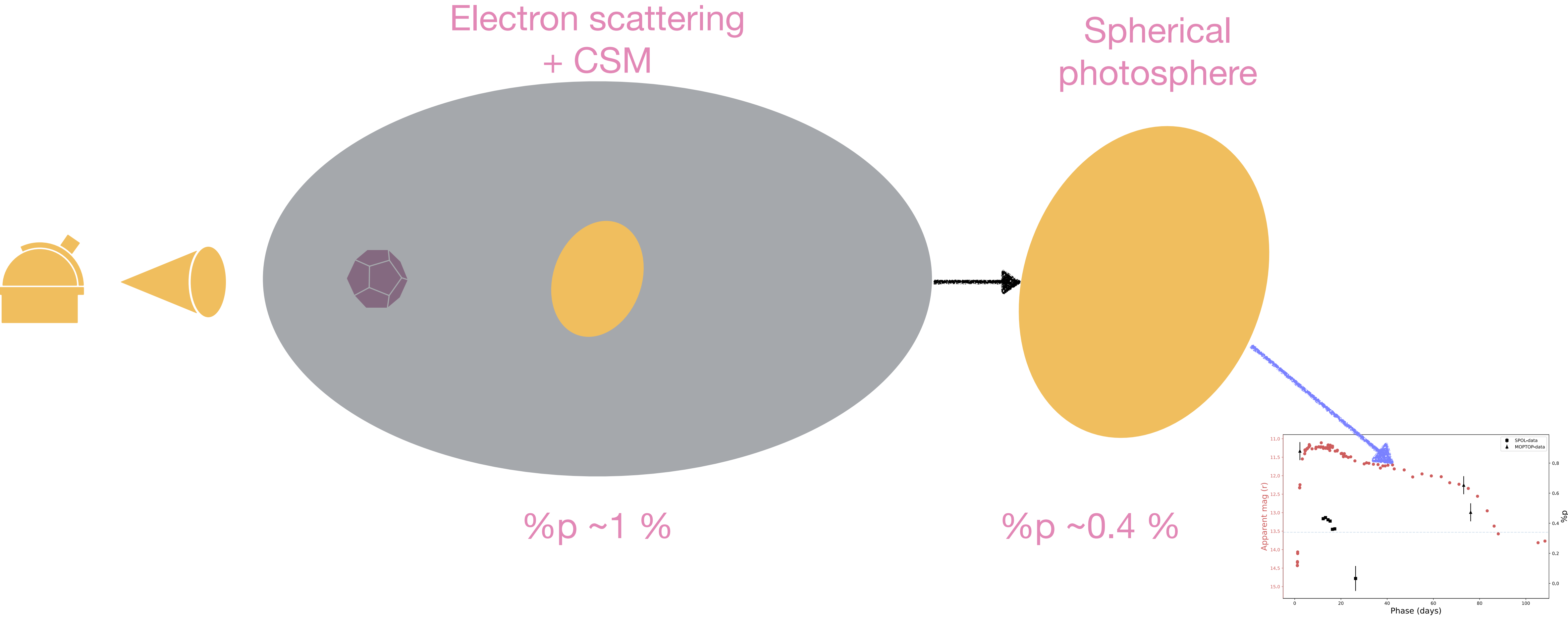


Electron scattering
+ CSM

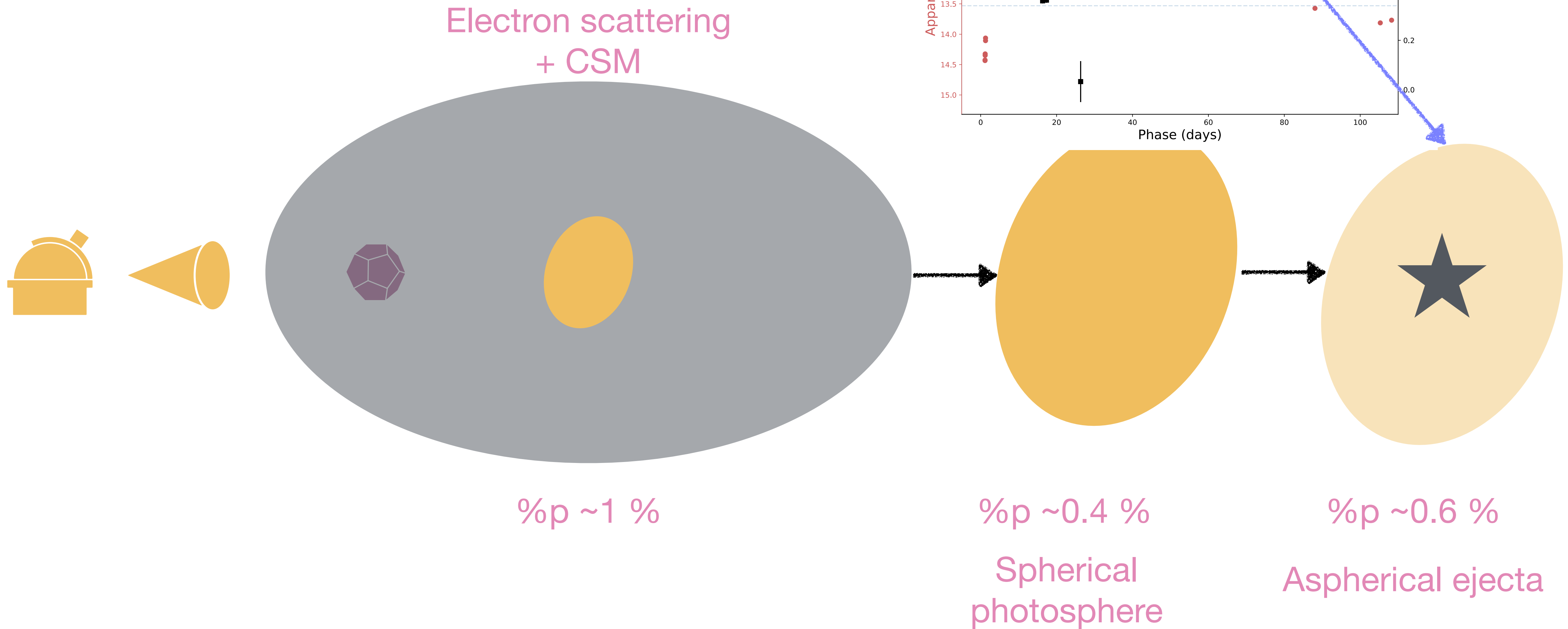
%p ~1 %
Flash features



SN 2023ixf: significant polarization



SN 2023ixf: significant polarization



Polarization signature shows an elevated and asymmetric mass loss and explosion

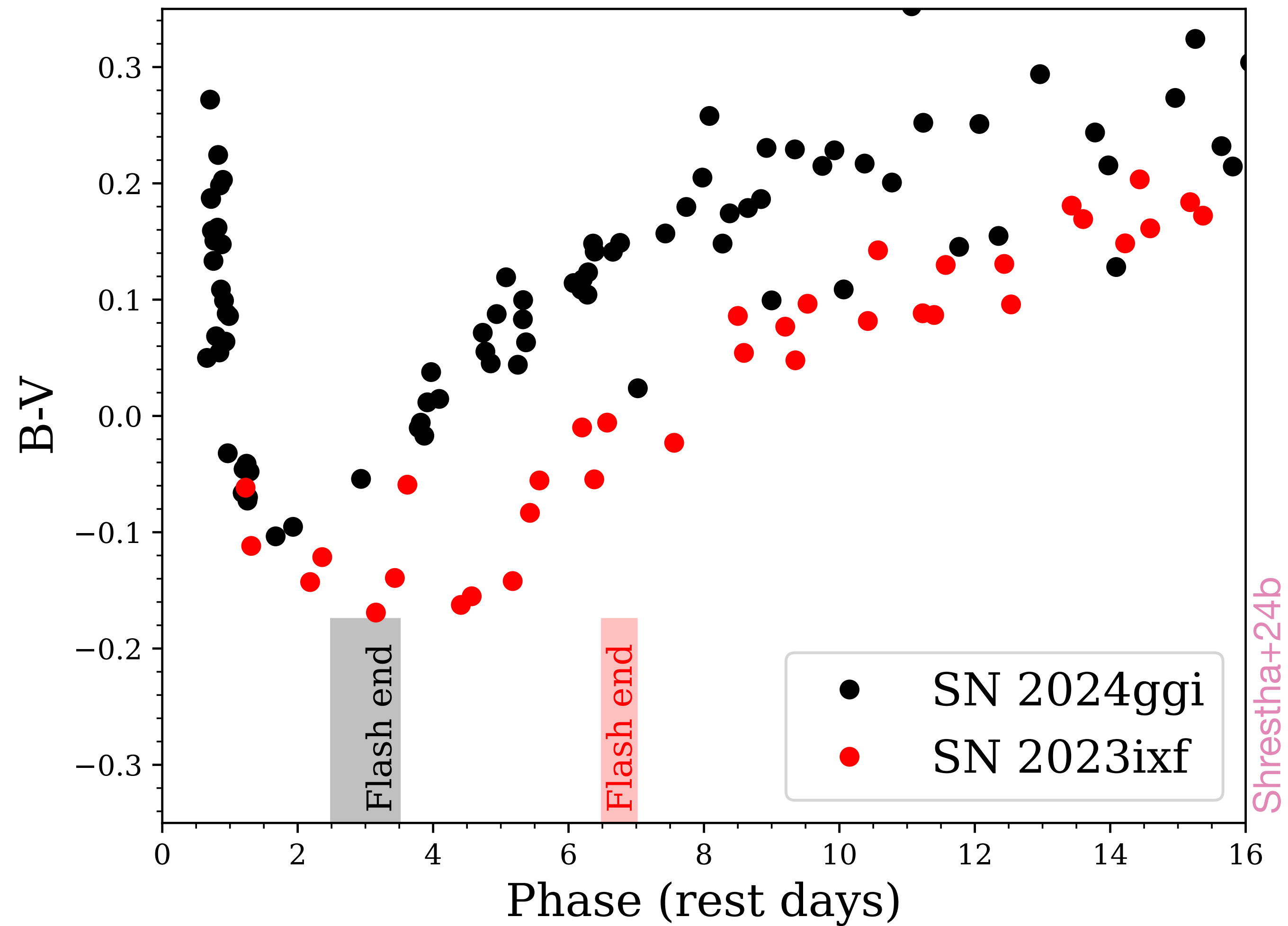
CSM interaction in SN 2024ggi

- Nearby type II SN (~ 7 Mpc)
- Similar distance to SN2023ixf
- Was discovered promptly
- Shows flash features

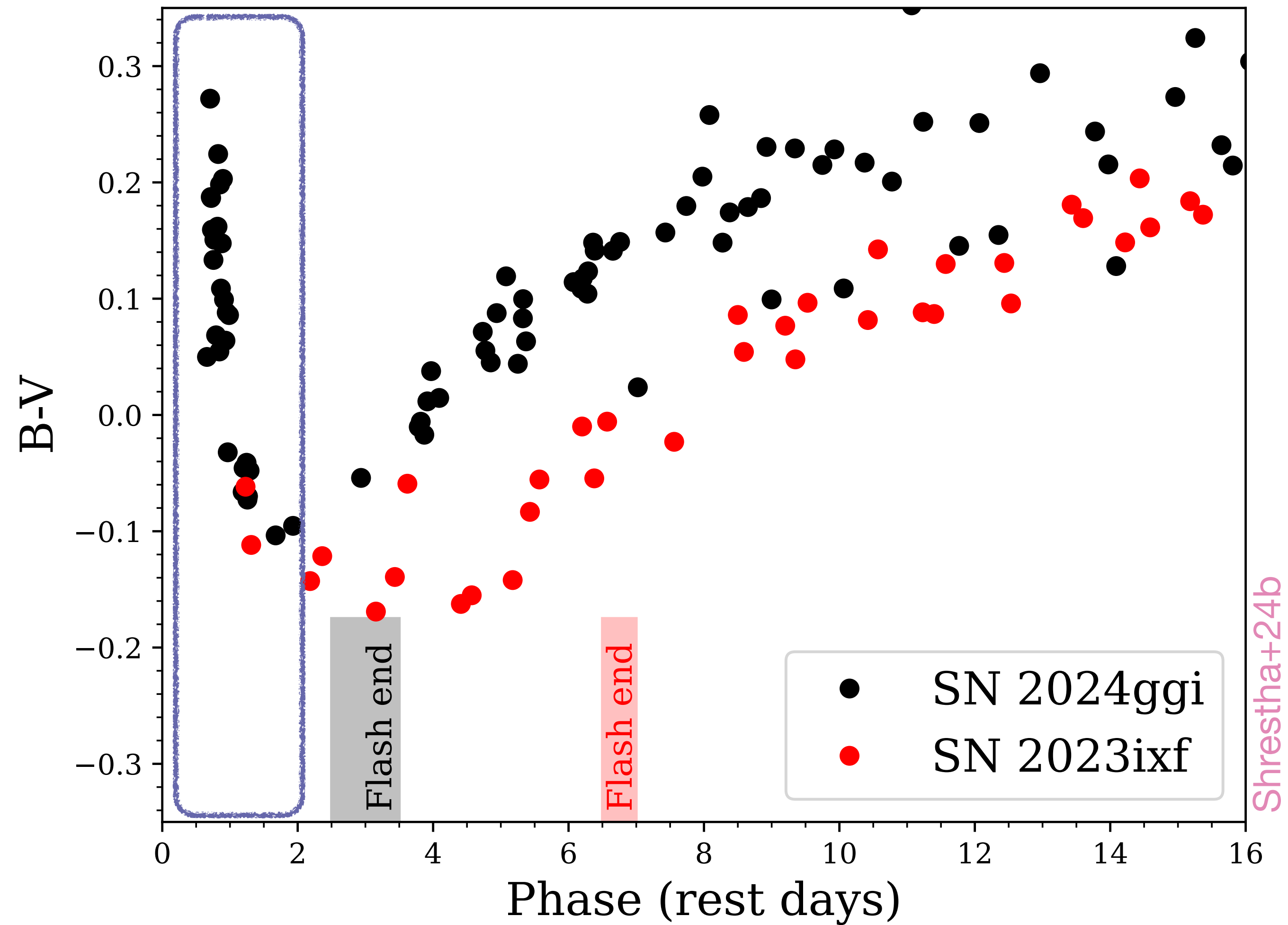
Image credit: Jeniveve Pearson

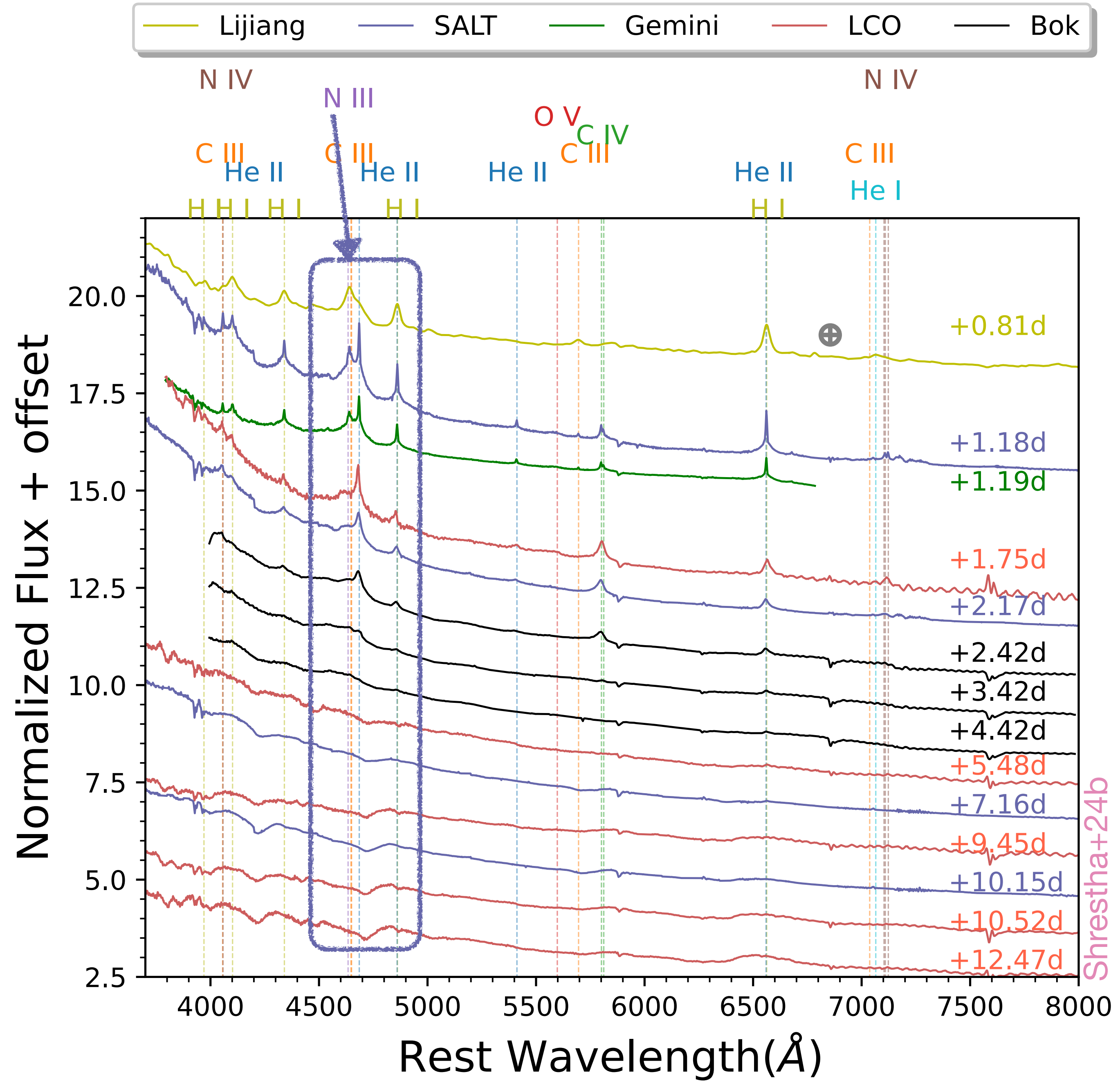


Color evolution of SN 2024ggi



Color evolution of SN 2024ggi





We are discovering more normal type II SNe with flash features ==> presence of elevated mass loss