

LStein: A new approach to visualizing sparse 2.5D data

SWIN
BUR
NE



Lukas Steinwender

Swinburne University of Technology,
Australia

lukassteinwender.com

github.com/TheRedElement

Supervisors:

Dr. Anais Möller

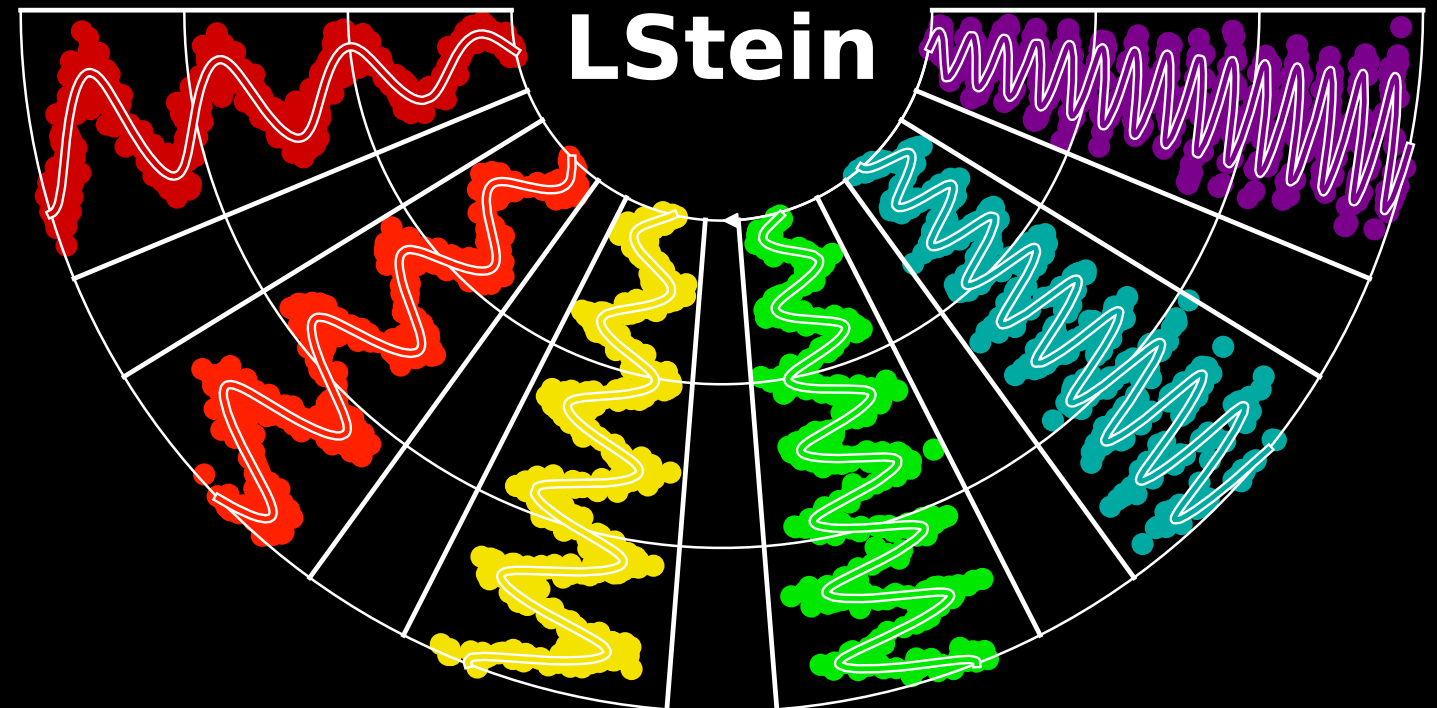
Prof. Christopher Fluke

Fink@World

Orsay, France

2026-06-11

Linking Series to envision information neatly



The Vera C. Rubin Observatoy

huge opportunity with new challenges



- Legacy Survey of Space and Time (LSST, Ivezić et al., 2019)
 - Southern night-sky
 - For 10 years
 - Once every 3 days
 - 6 colors
- 10 million alerts per night
- Largest digital camera ever built



(NSF-DOE Vera C. Rubin Observatory/NOIRLab/SLAC/AURA)

Astronomical observations

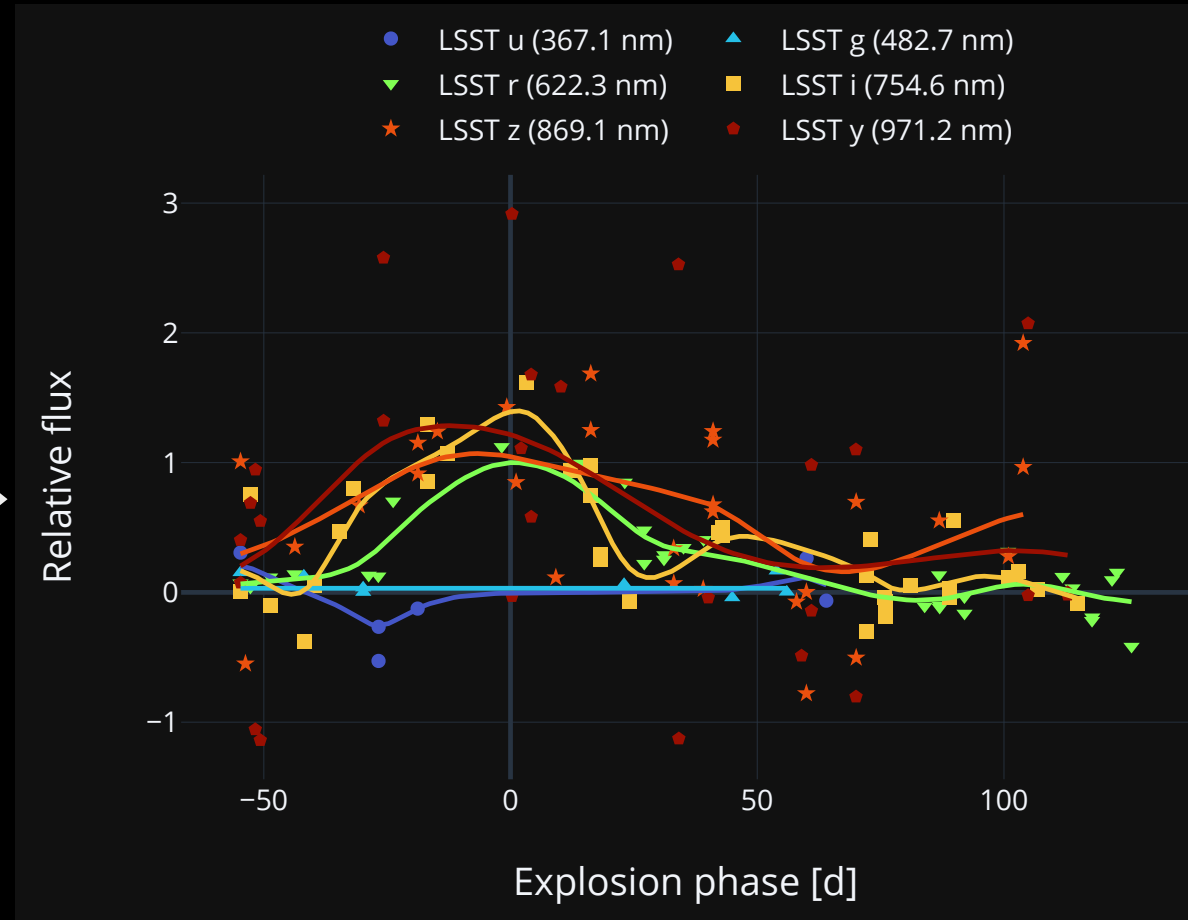
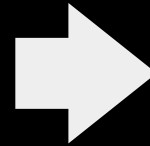


Spectrophotometry using a Filter-Wheel

Lukas Steinwender

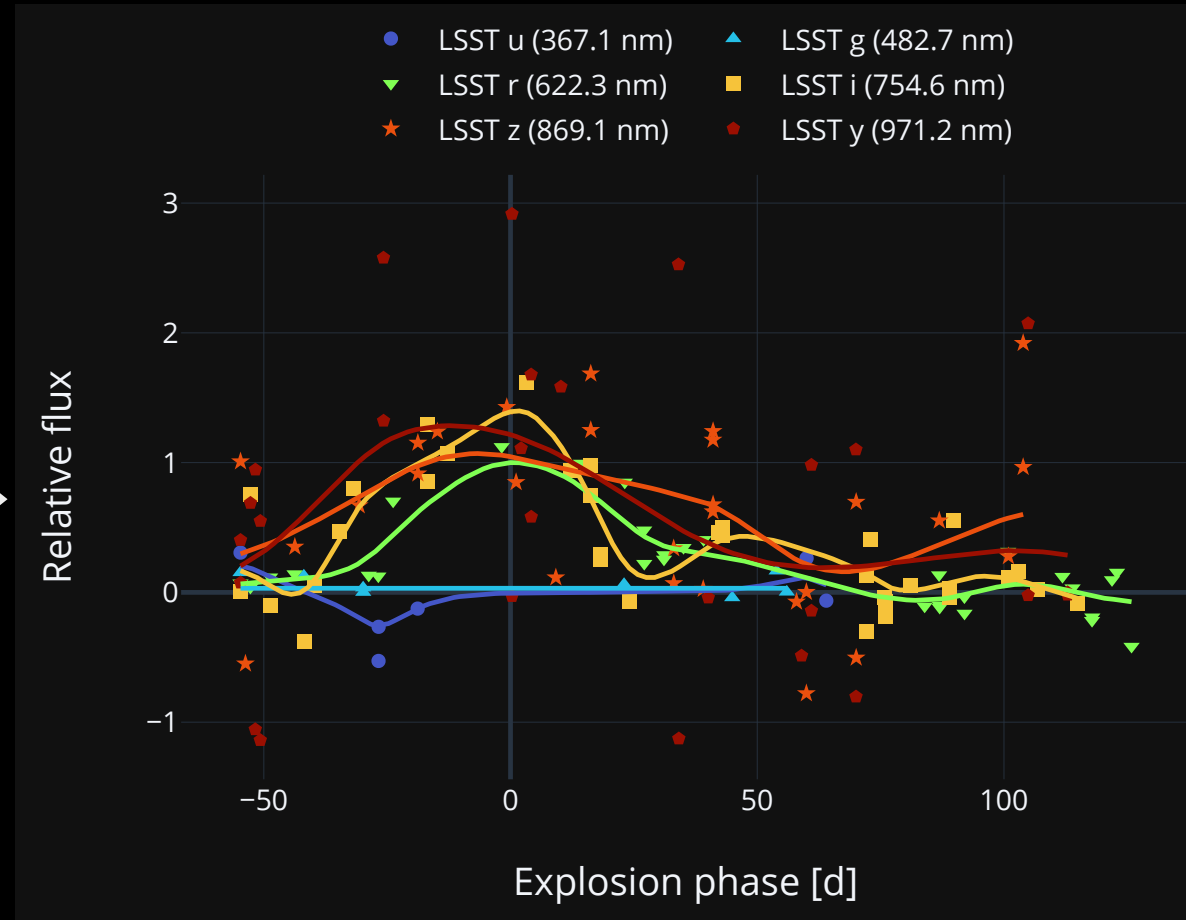
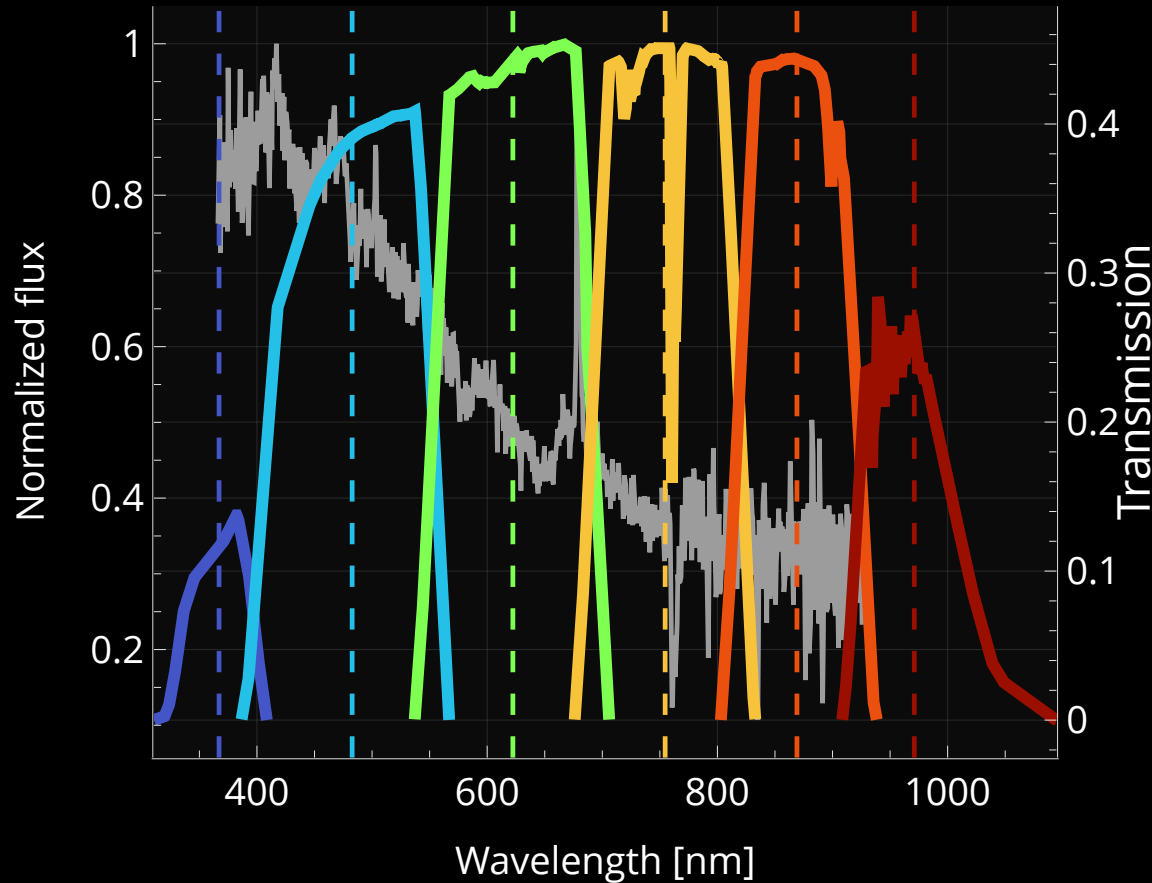


Watch on



Passband photometry. (Lukas Steinwender)

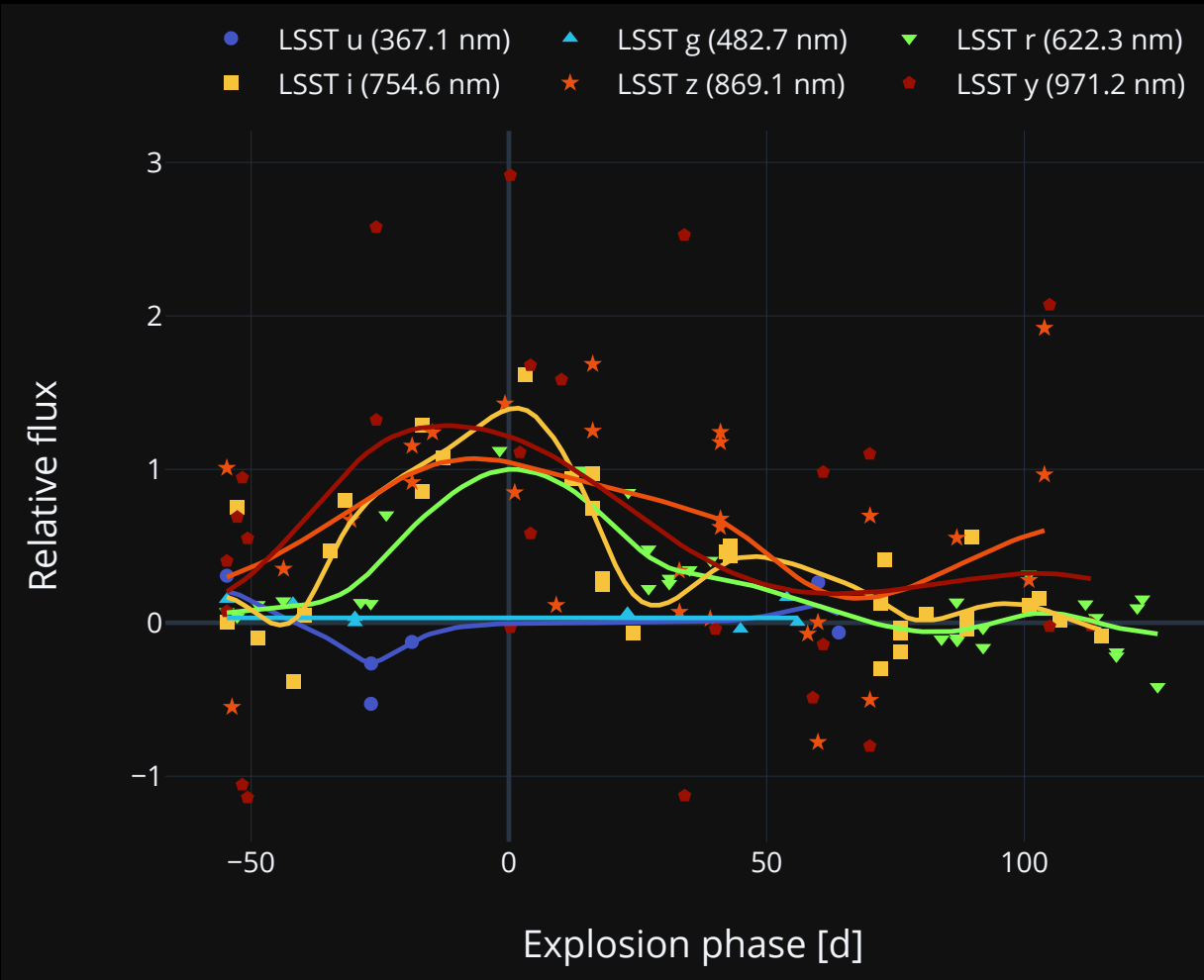
Astronomical observations



Simulated Rubin lightcurve.

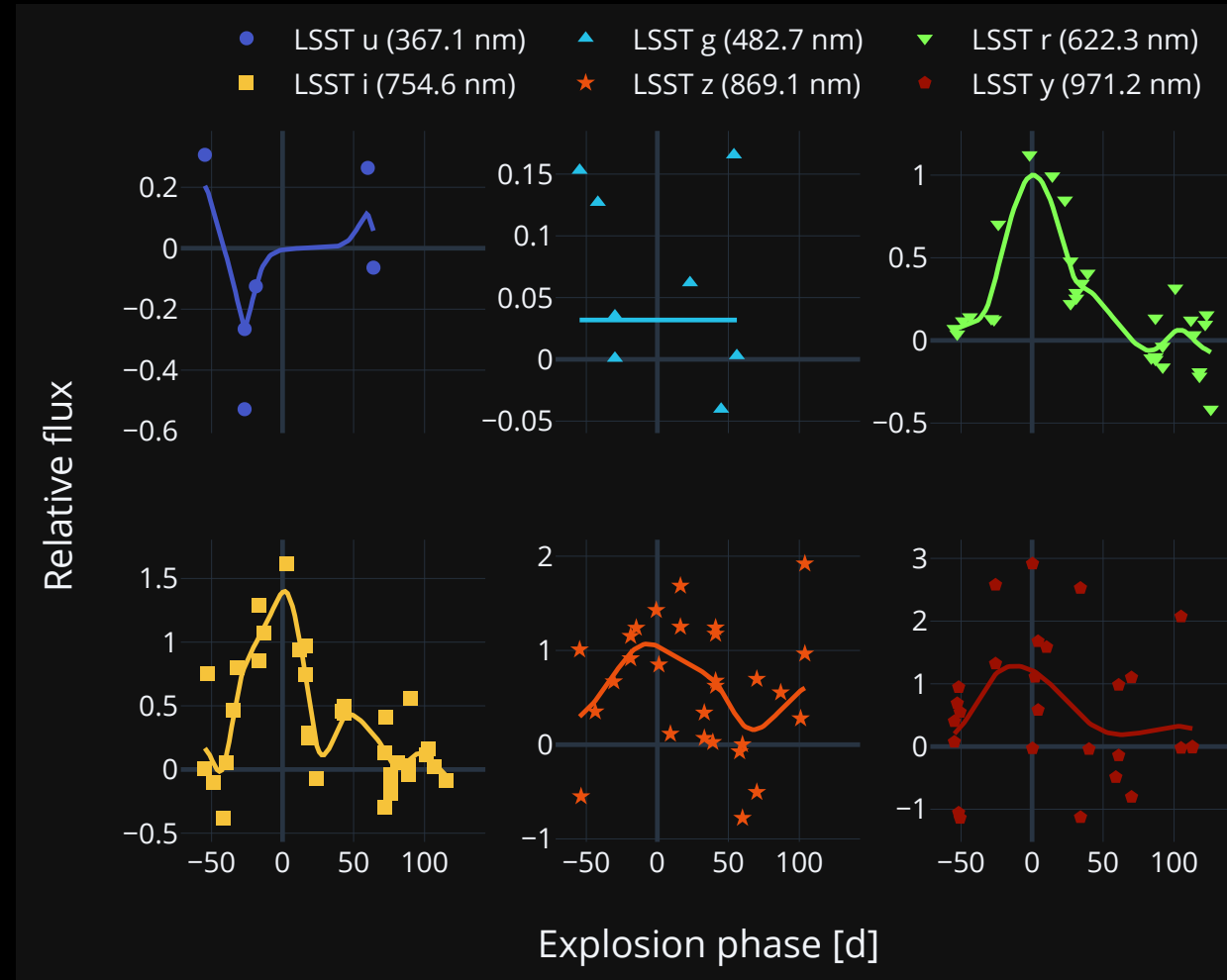
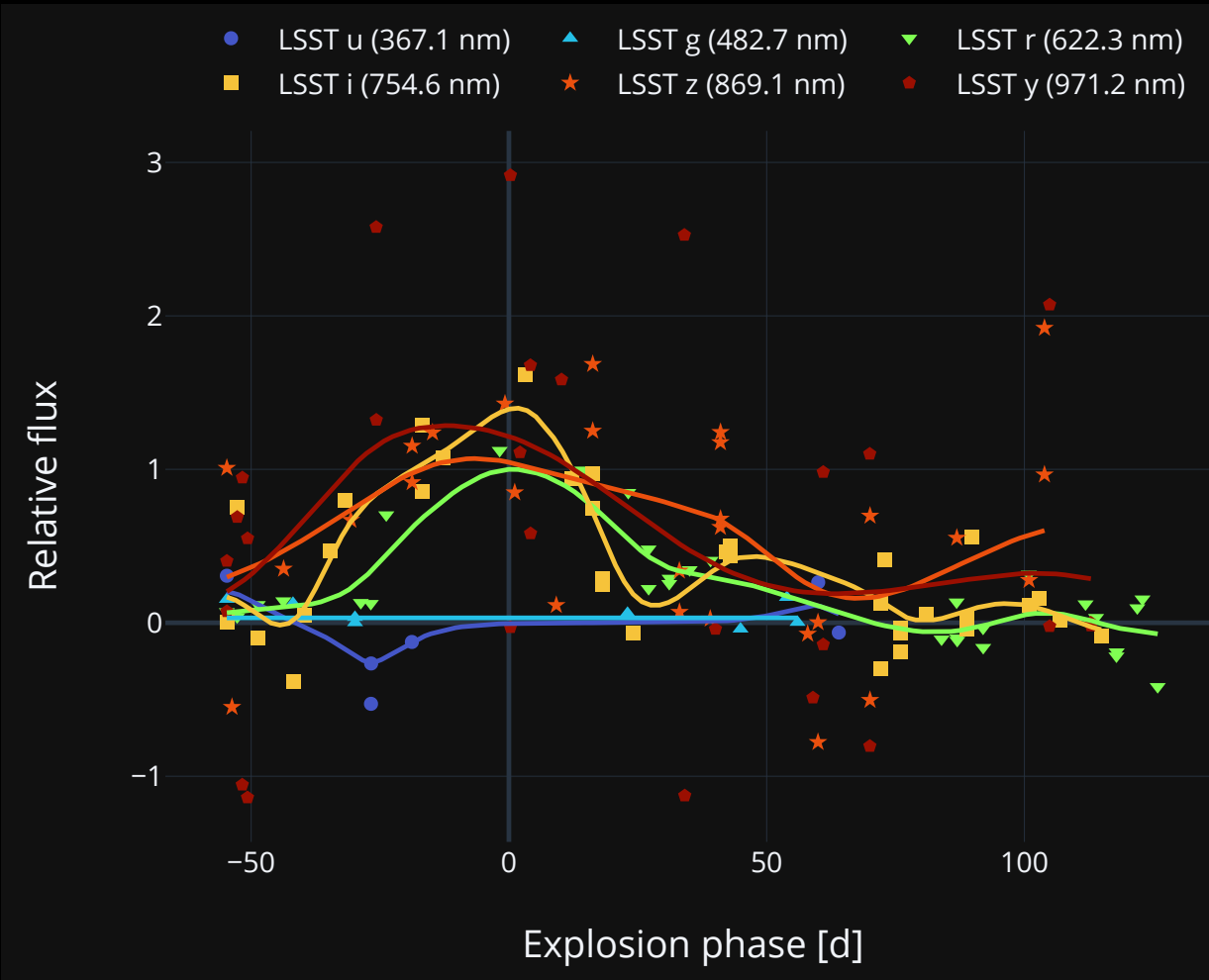
Passband application.

Visualization is challenging!



Single-panel approach.

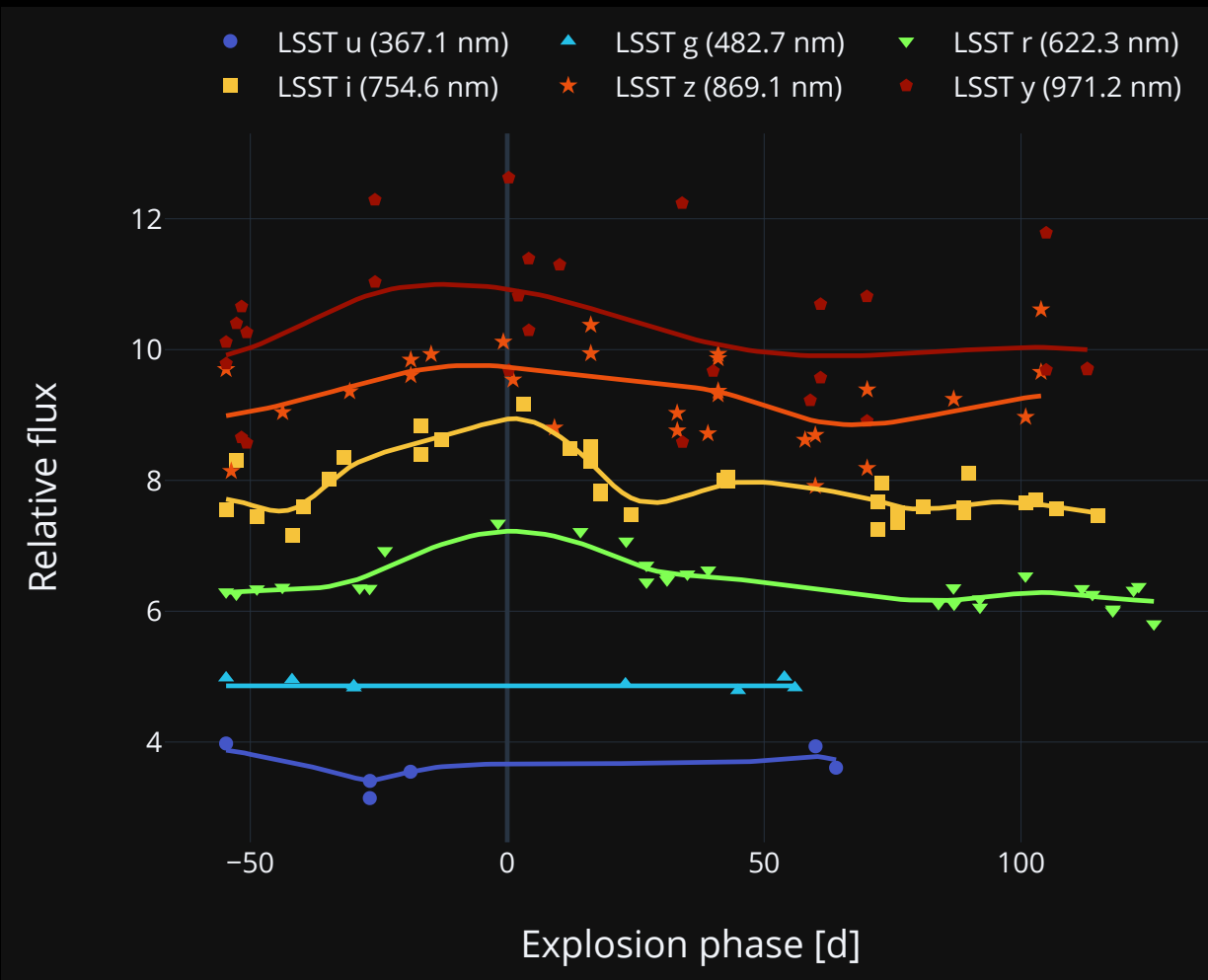
Visualization is challenging!



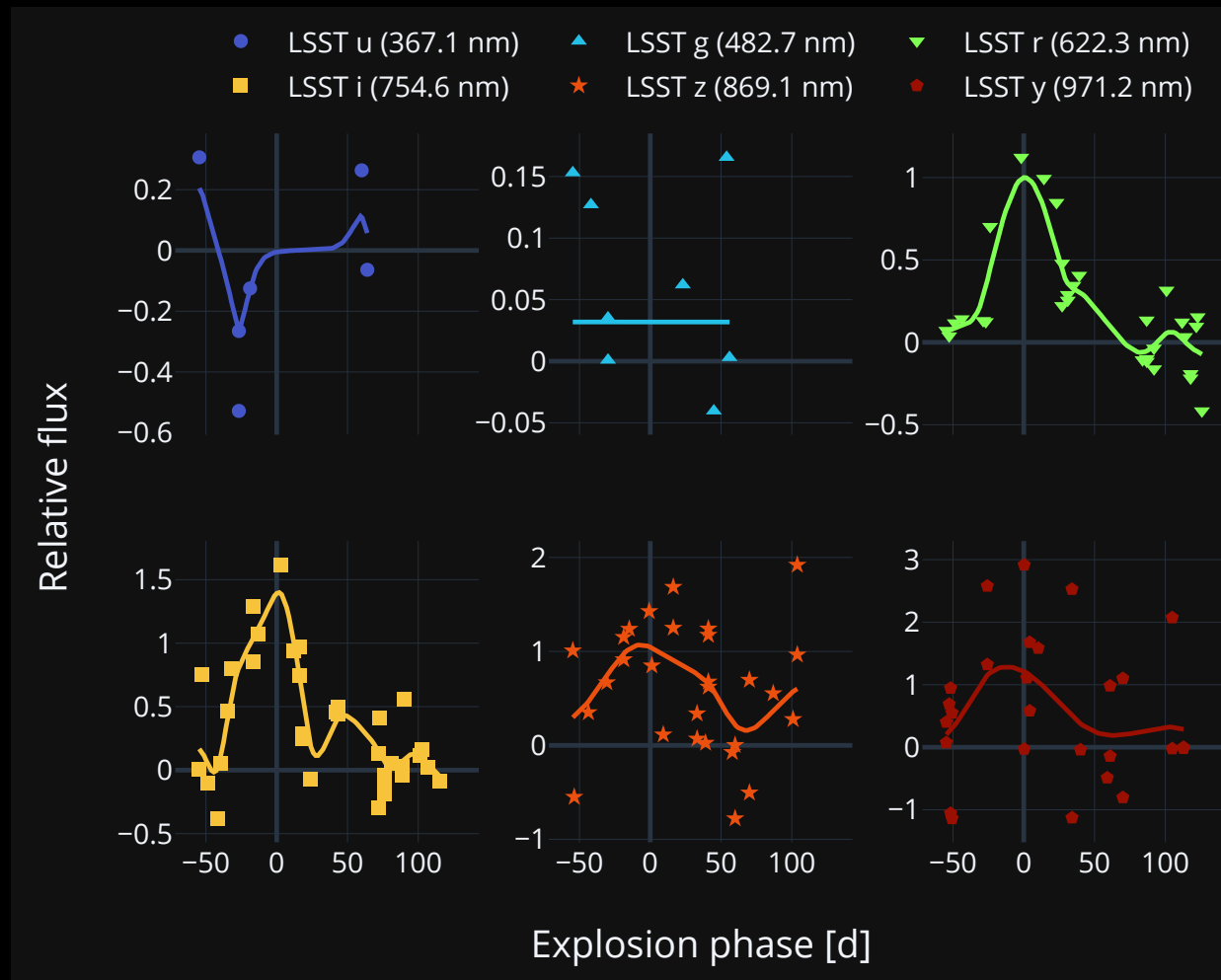
Single-panel approach.

Multi-panel approach.

Visualization is challenging!

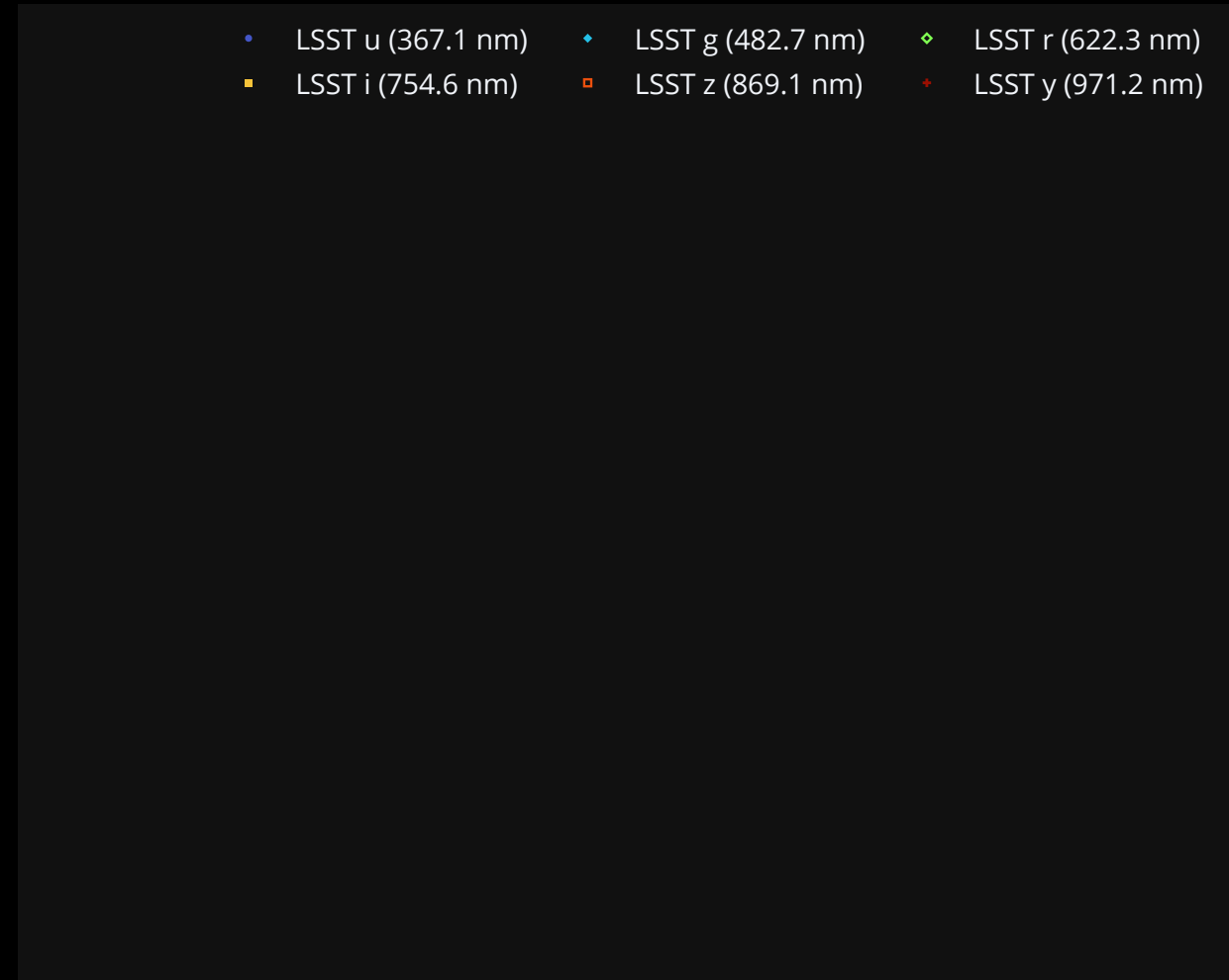
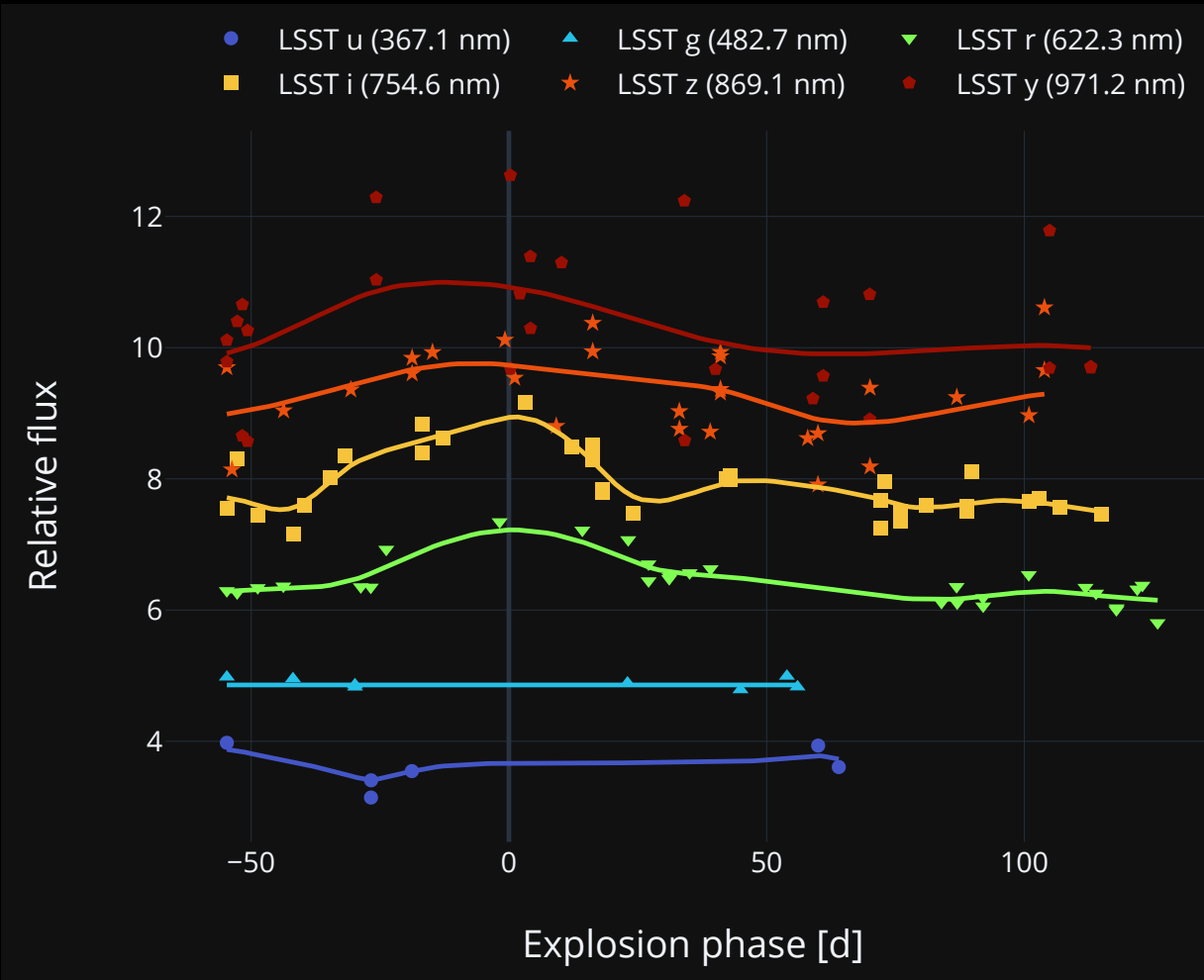


Single-panel with offset approach.



Multi-panel approach.

Visualization is challenging!



Single-panel with offset approach.

3D approach.

What I want...

Display in 2D medium	⇒	Projection
Keep all the information	⇒	Projection
Minimize projection effects	⇒	Specialized projection
Easy comparison	⇒	Linked information
Link across axes	⇒	Smart layout
Reduced clutter	⇒	Smart layout
Easy to use	⇒	Popular APIs
Open source	⇒	GitHub

What I provide...

Display in 2D medium



Keep all the information



Minimize projection effects



Easy comparison



Link across axes



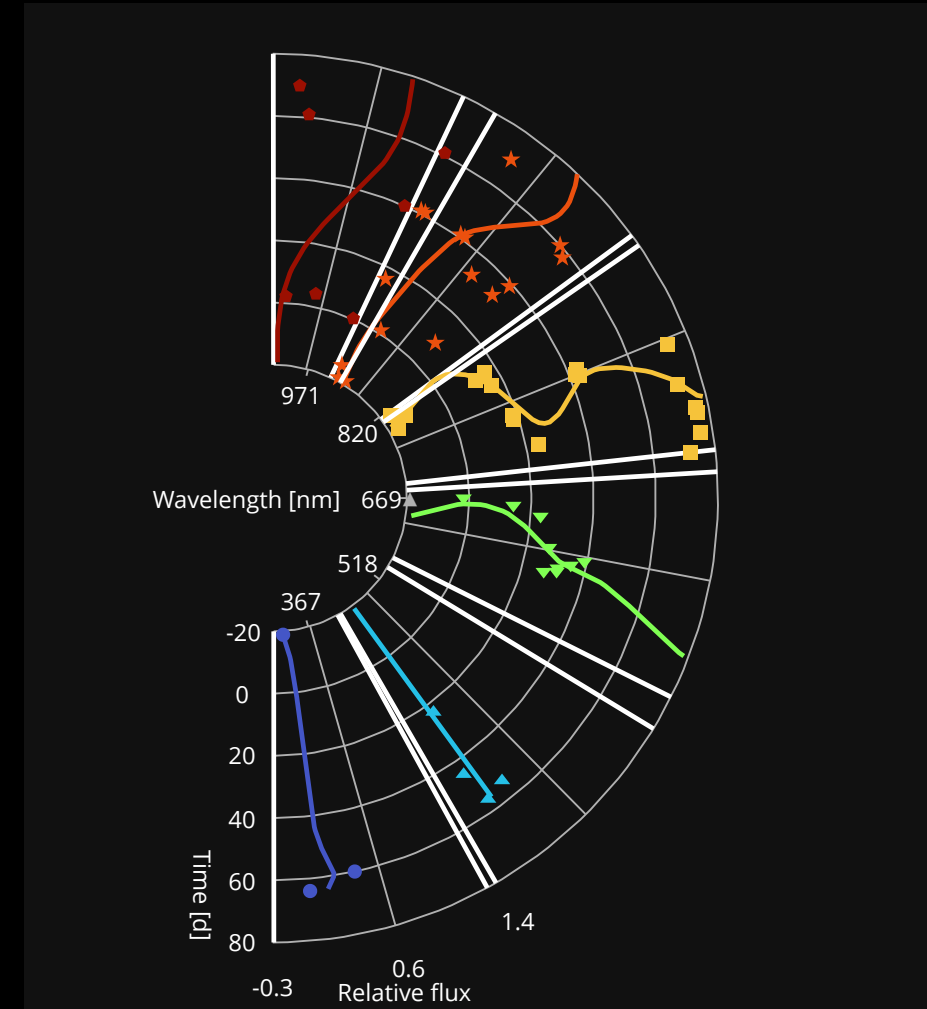
Reduced clutter



Easy to use

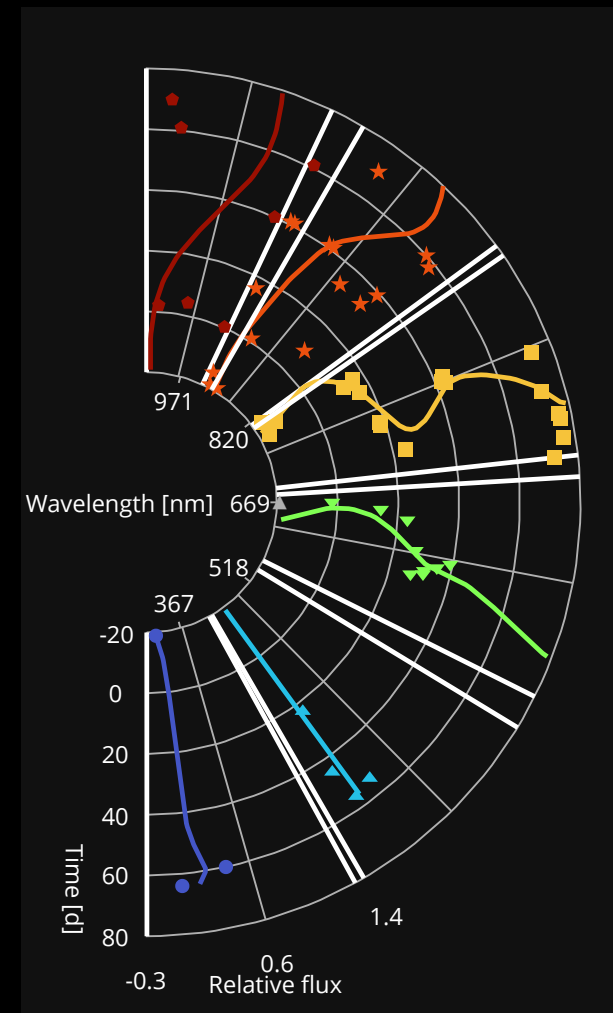


Open source



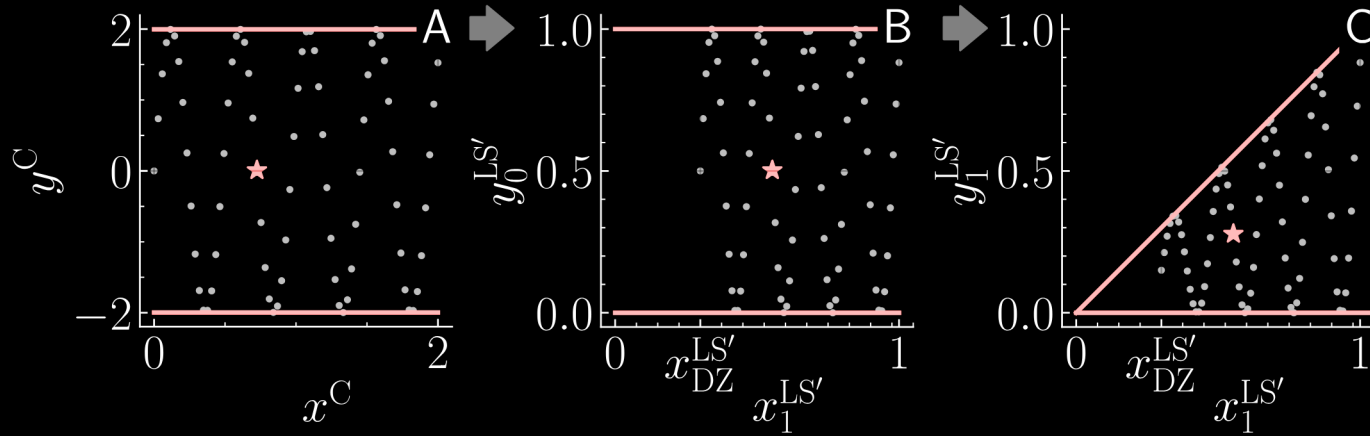
LStein. (Steinwender et al., 2026)

But how?

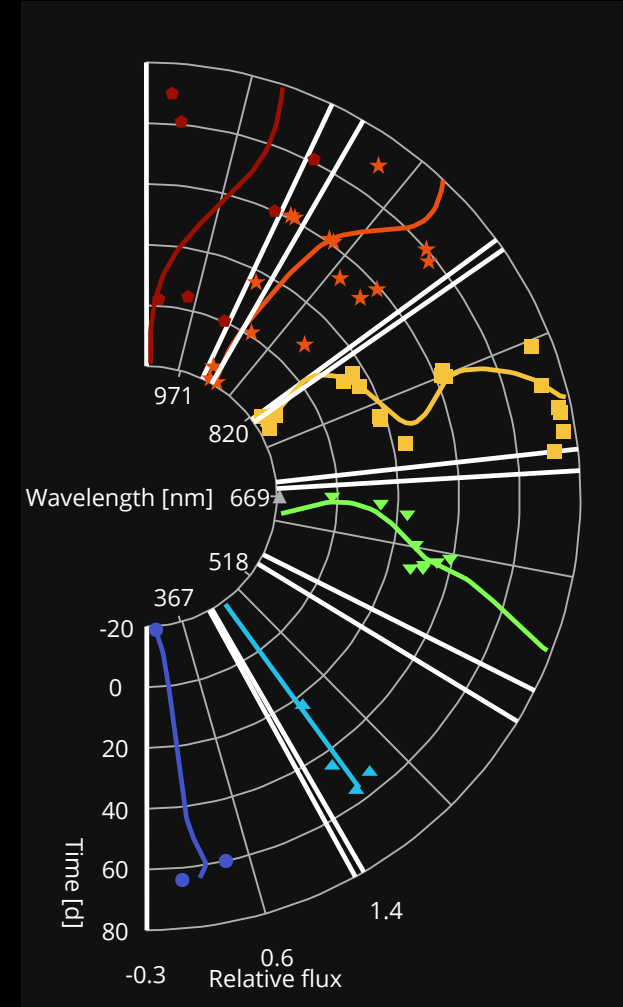


LStein. (Steinwender et al., 2026)

But how?

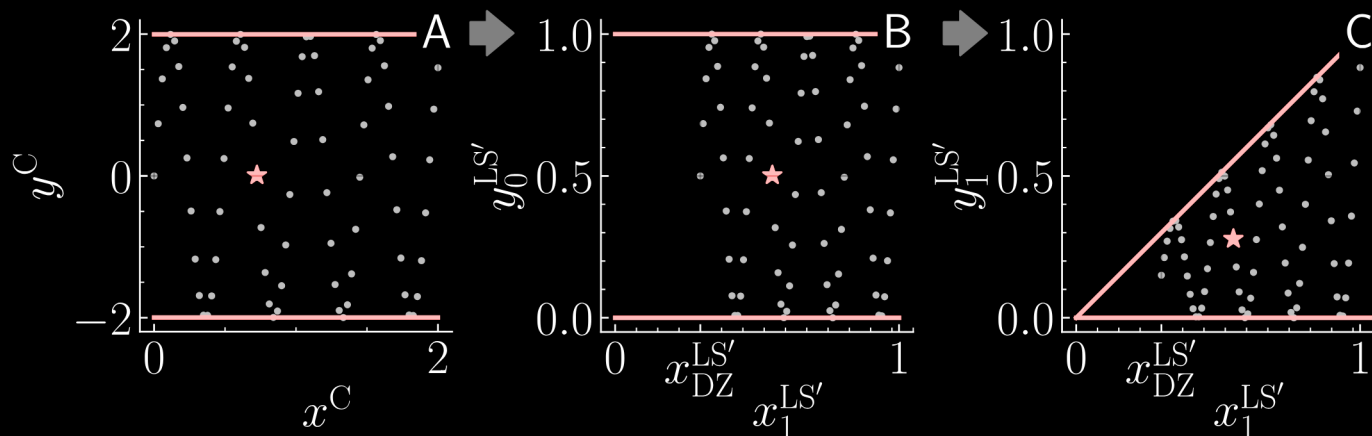


Preprocessing step for LStein projection (Steinwender et al., 2026).

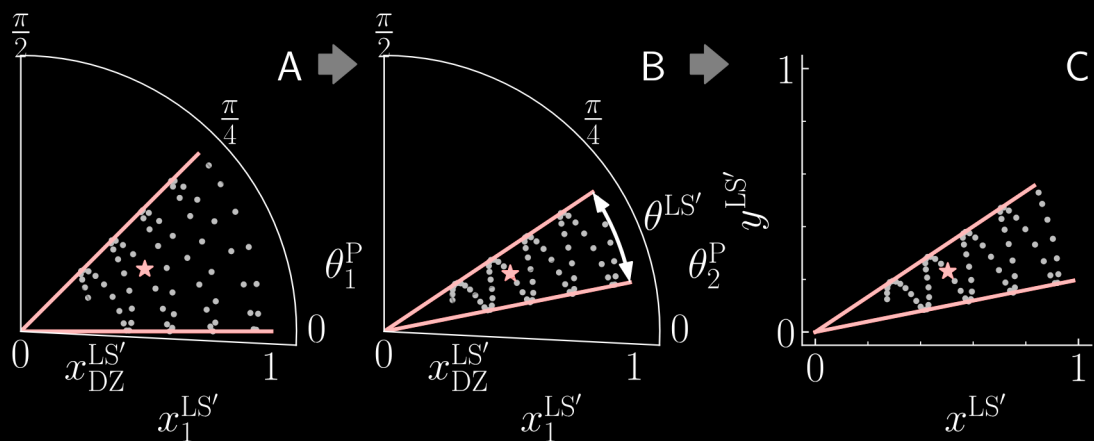


LStein. (Steinwender et al., 2026)

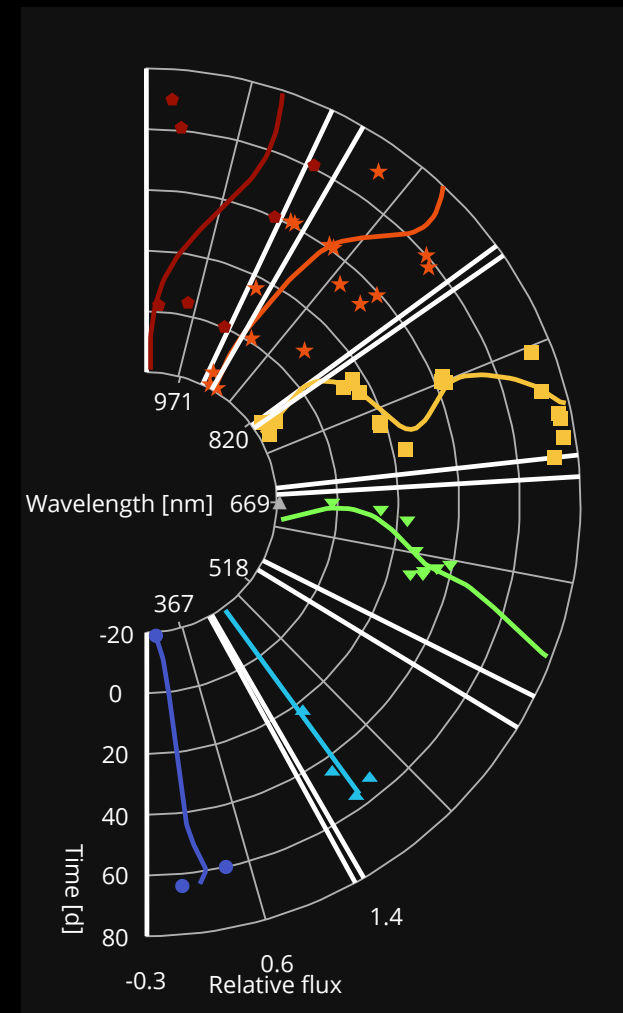
But how?



Preprocessing step for LStein projection (Steinwender et al., 2026).

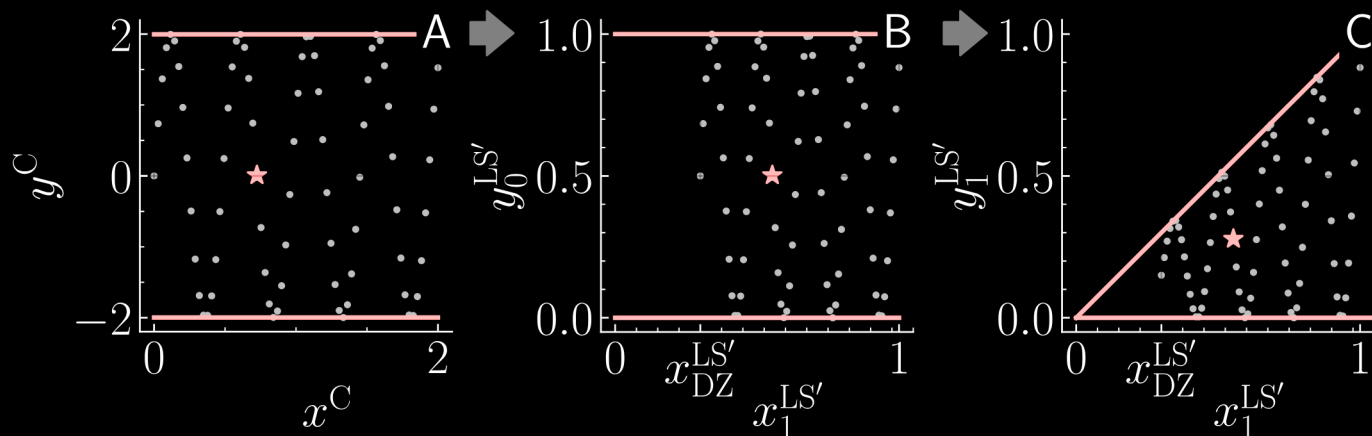


Projection step for LStein θ -projection (Steinwender et al., 2026).

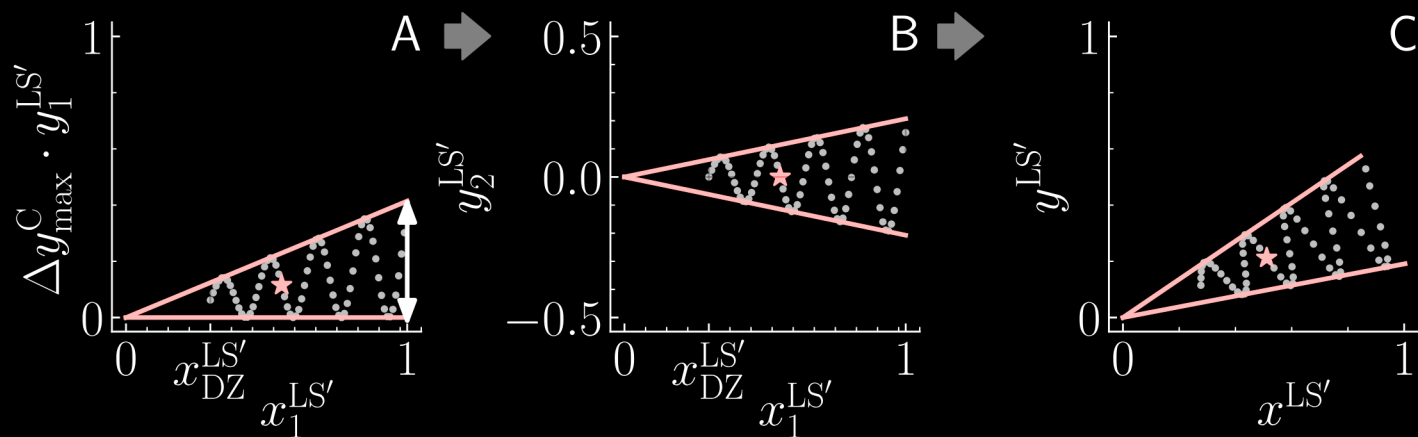


LStein. (Steinwender et al., 2026)

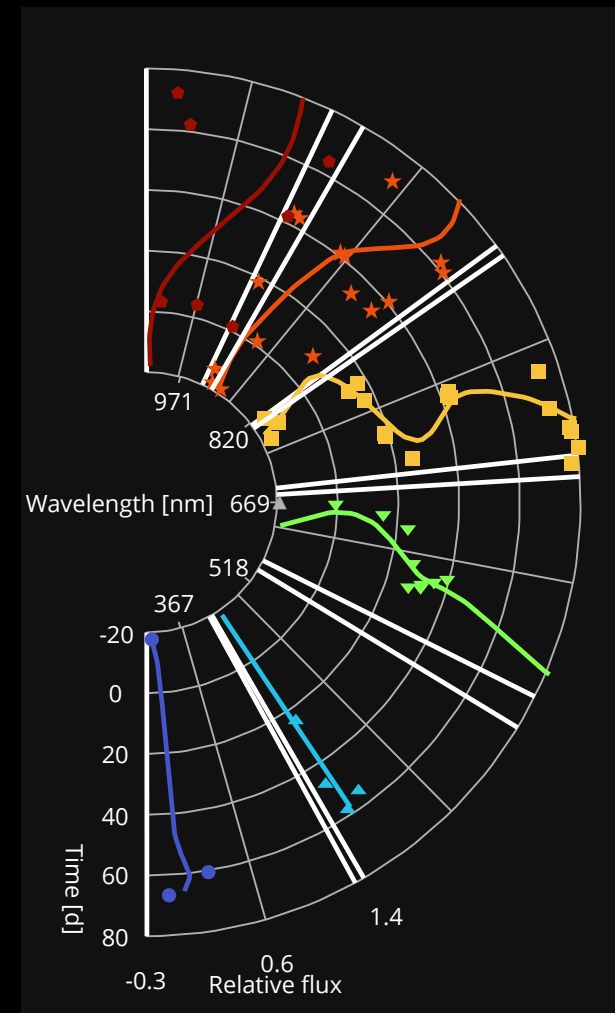
But how?



Preprocessing step for LStein projection (Steinwender et al., 2026).



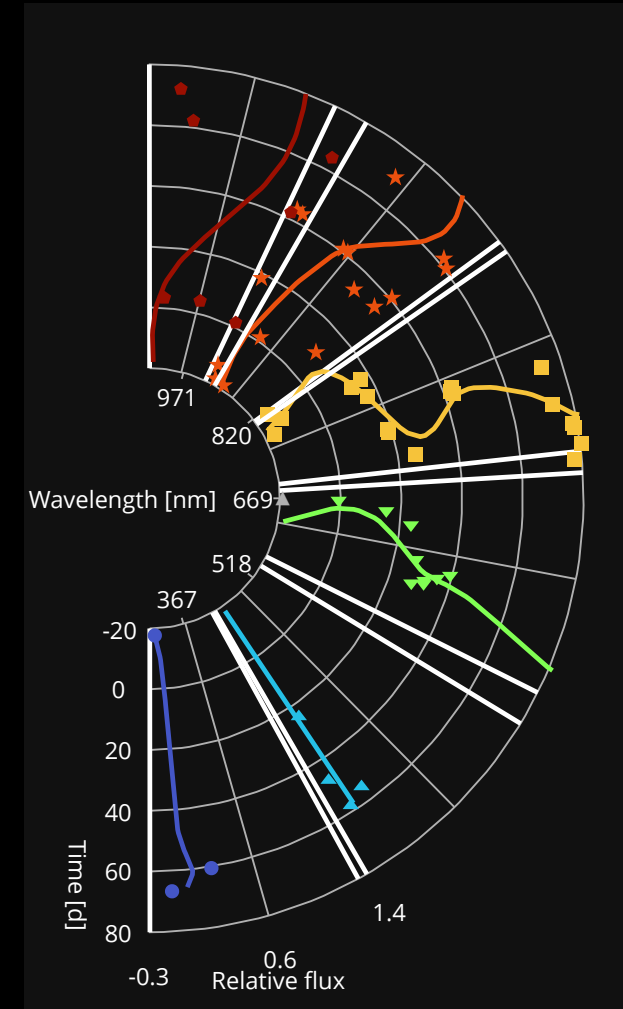
Projection step for LStein y -projection (Steinwender et al., 2026).



LStein. (Steinwender et al., 2026)

Advantages

- + Visualize 2.5D data in 2D medium
- + Only small projection effects
- + Linked information
- + Preservation of the sparse dimension
- + Available on PyPI

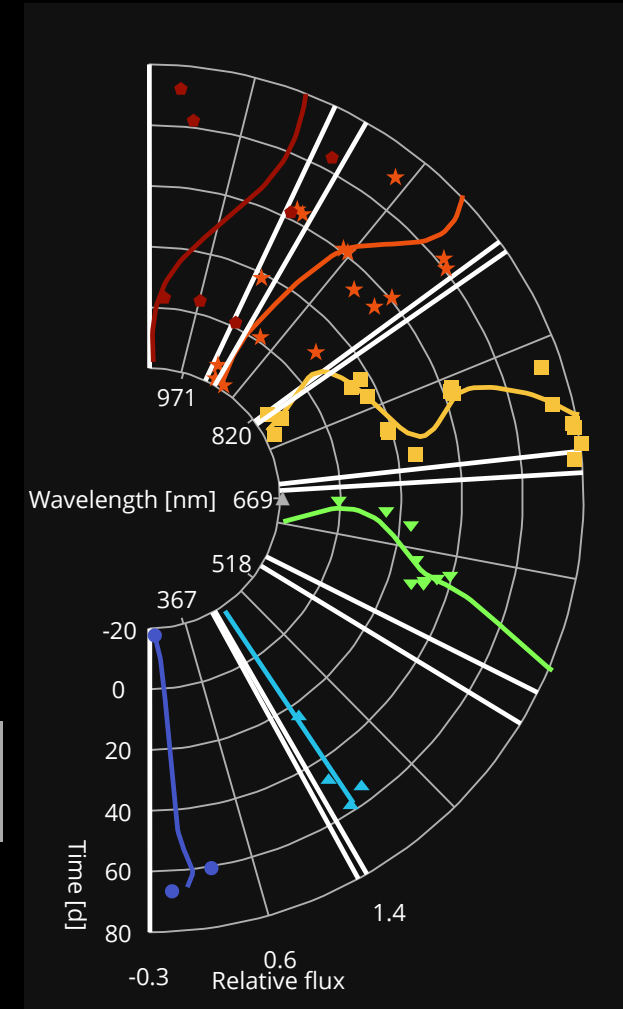


LStein. (Steinwender et al., 2026)

Advantages

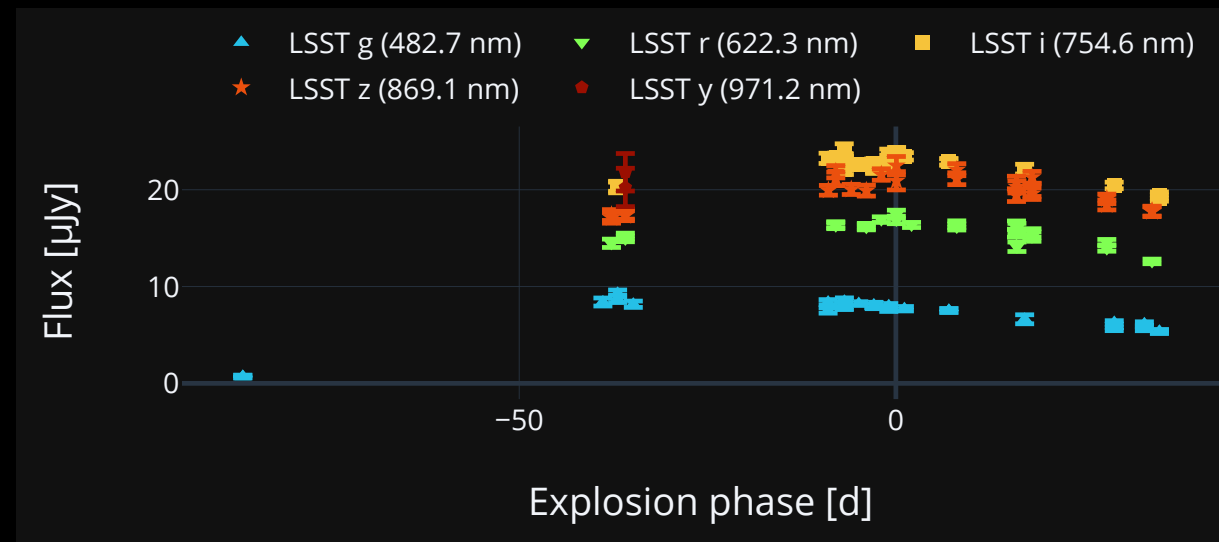
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astronomers like fancy looking plots



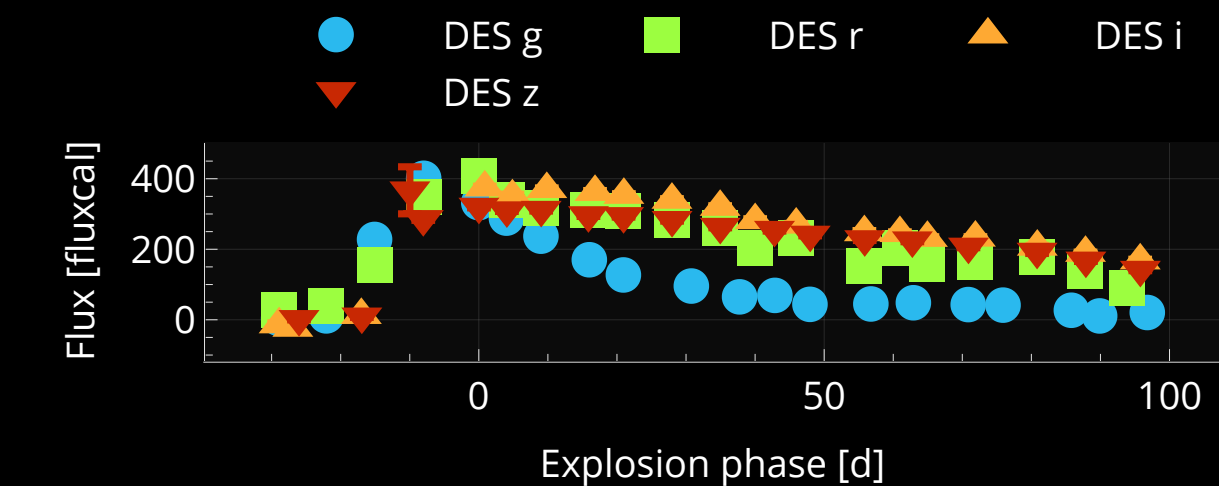
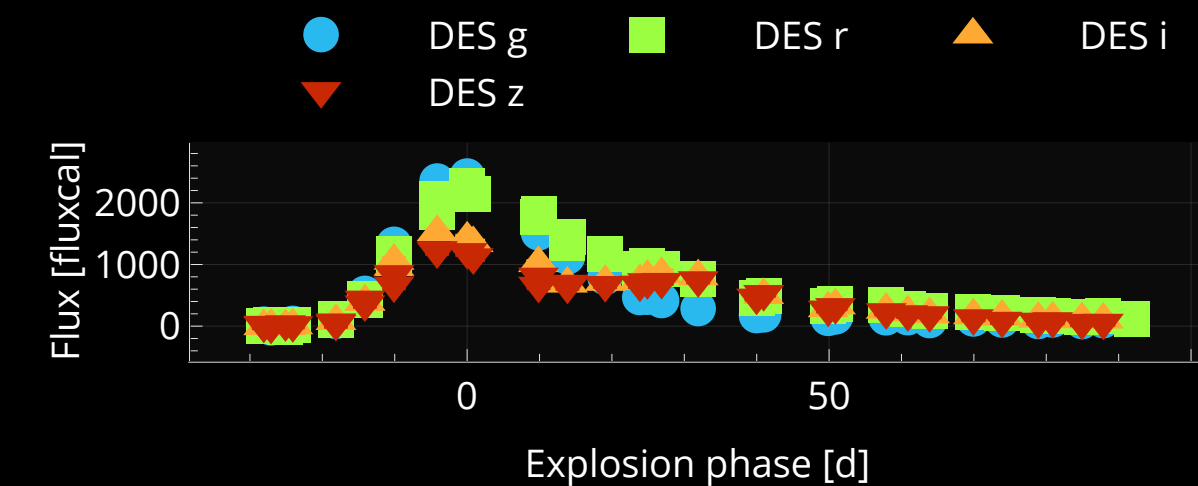
LStein. (Steinwender et al., 2026)

Applied to real observations



Rubin SN Ic lightcurve.

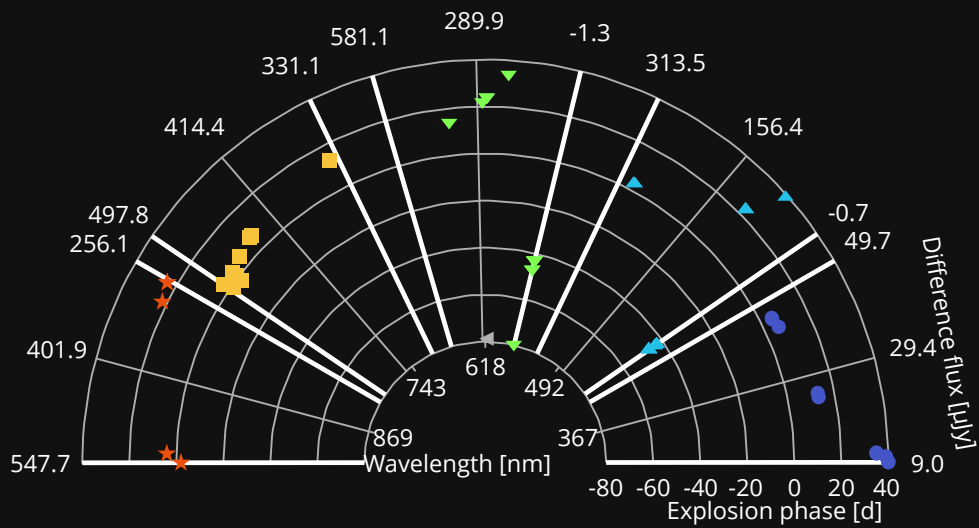
Rubin SN II lightcurve.



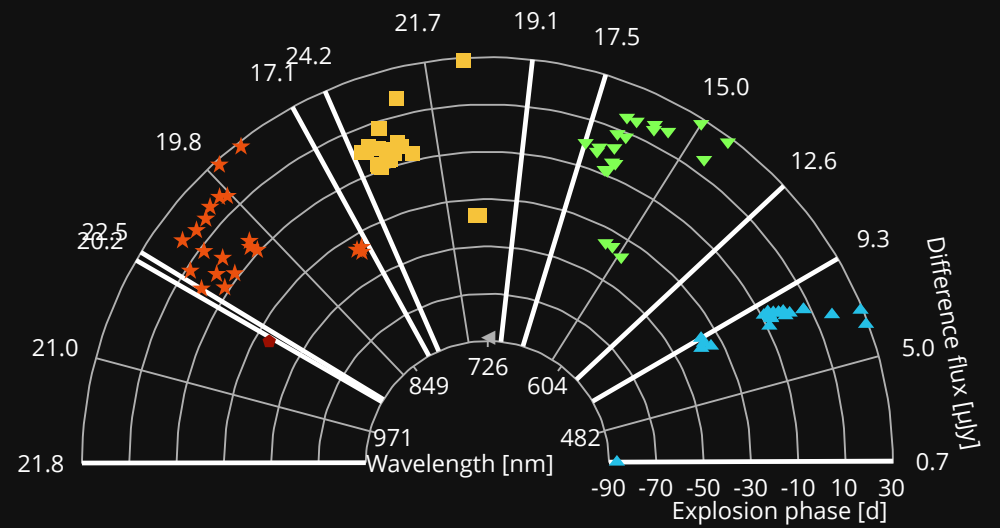
DES SN Ia lightcurve.

DES SN II lightcurve.

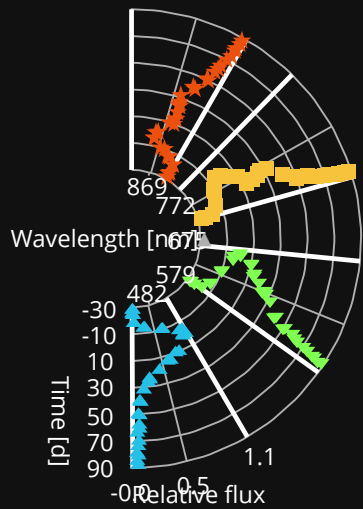
Applied to real observations



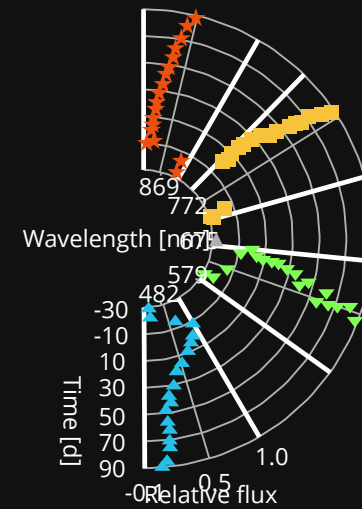
Rubin SN Ic lightcurve.



Rubin SN II lightcurve.

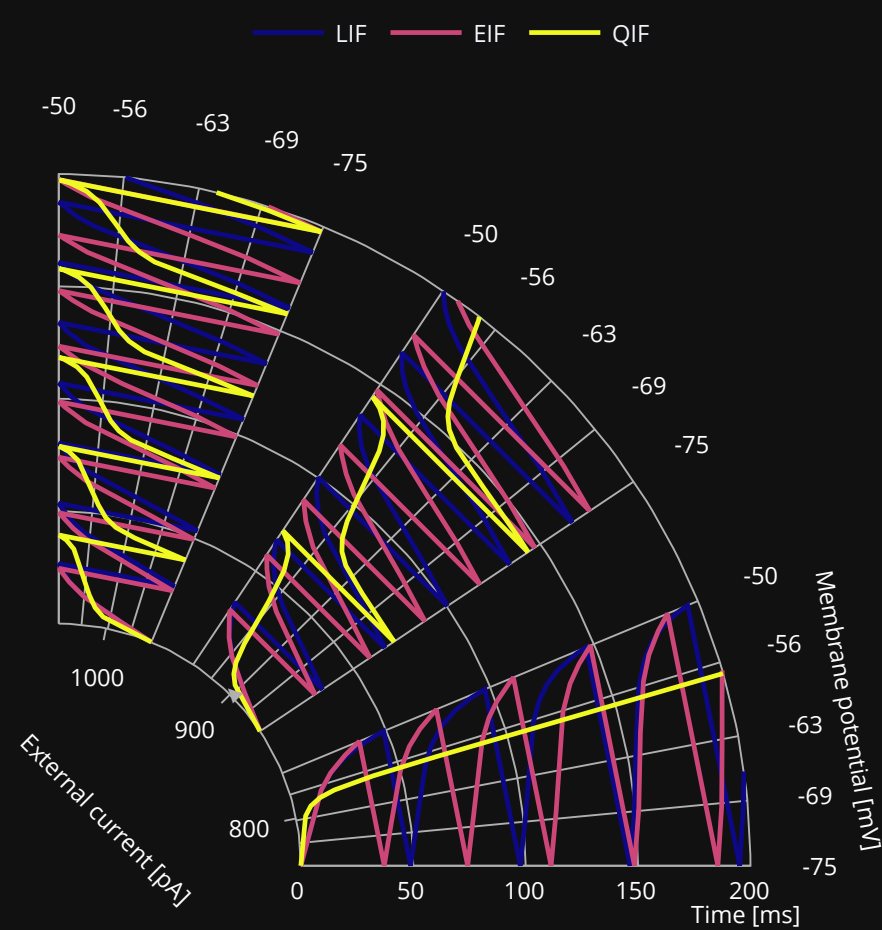
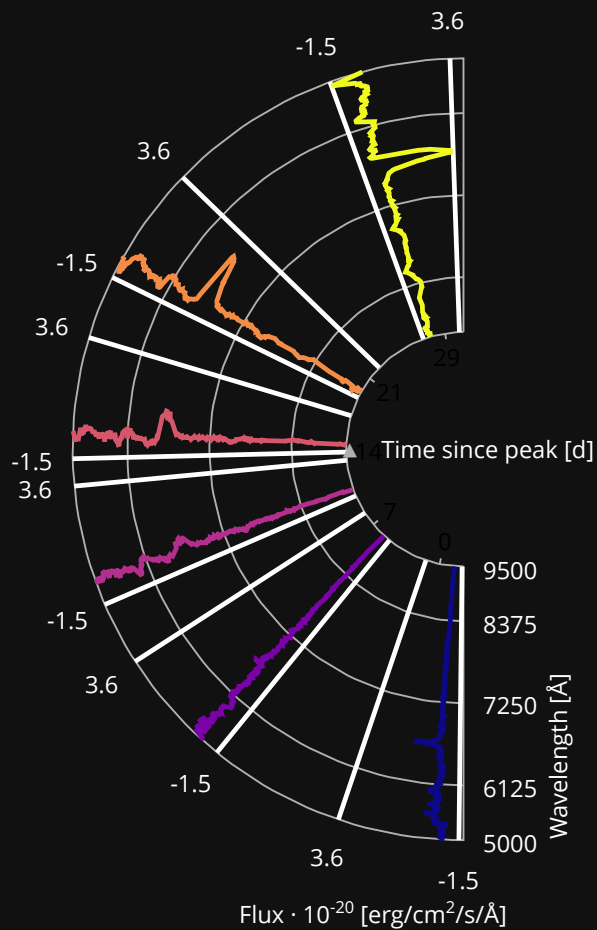
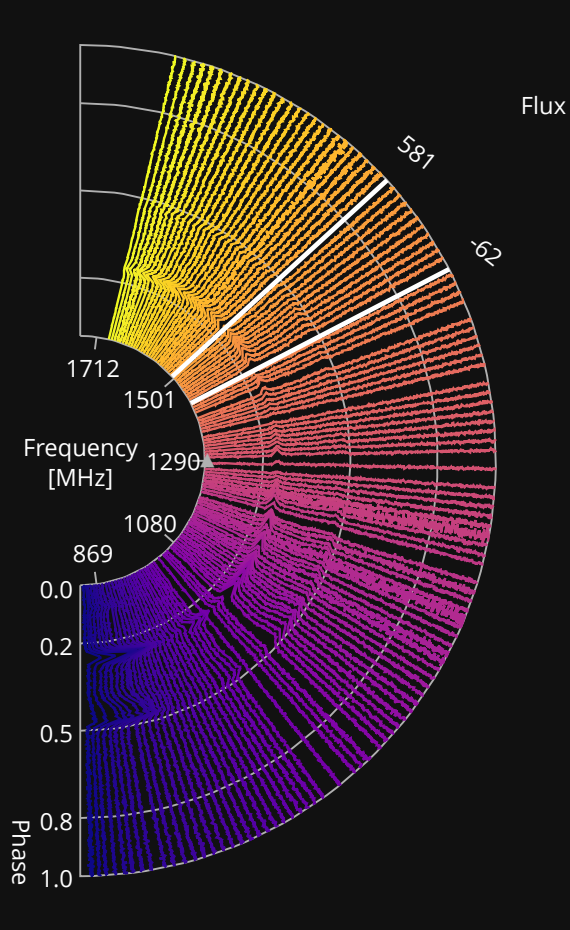


DES SN Ia lightcurve.



DES SN II lightcurve.

Try it in your field!



Radio pulsar. (Steinwender et al., 2026)

SN Ia spectrum. (Steinwender et al., 2026)

Spiking Neural Network. (Steinwender et al., 2026)

Try it today!

visualizing sparse, 3D data in 2D is hard

LStein is a first attempt to solve this challenge

LStein can be used in many domains



Documentation.



Paper.

Linking Series to envision information neatly

