Cosmography of Laniakea from near-infrared type Ia supernovae light curves

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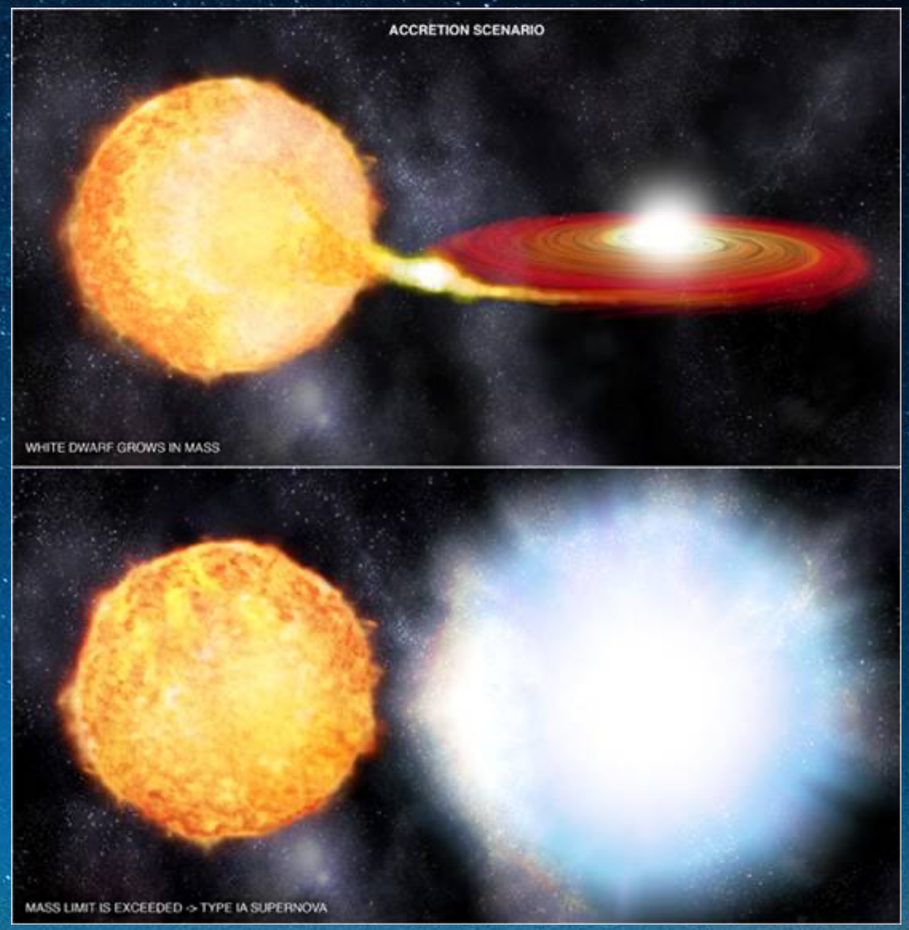
Type Ia supernovae

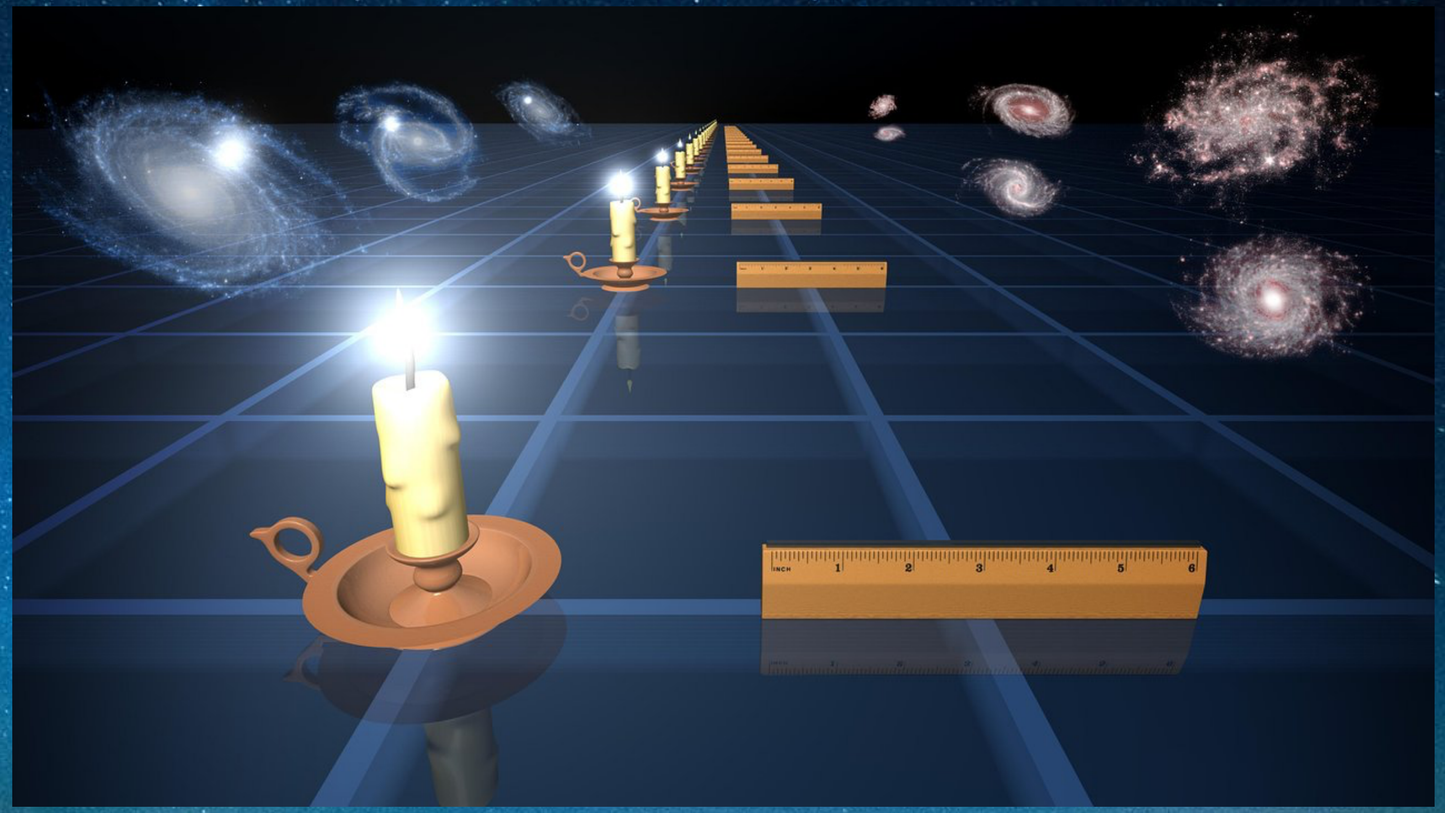
- Occurs in binary systems with one or two white dwarf stars
- If the white dwarf is able to accrete mass and exceed the Chandrasekhar limit ($1.4M_{\odot}$), the star gravitationally collapses and explodes
- Can be as bright as 10^{43} erg/s



www.schoolsobservatory.org

Type Ia supernovae

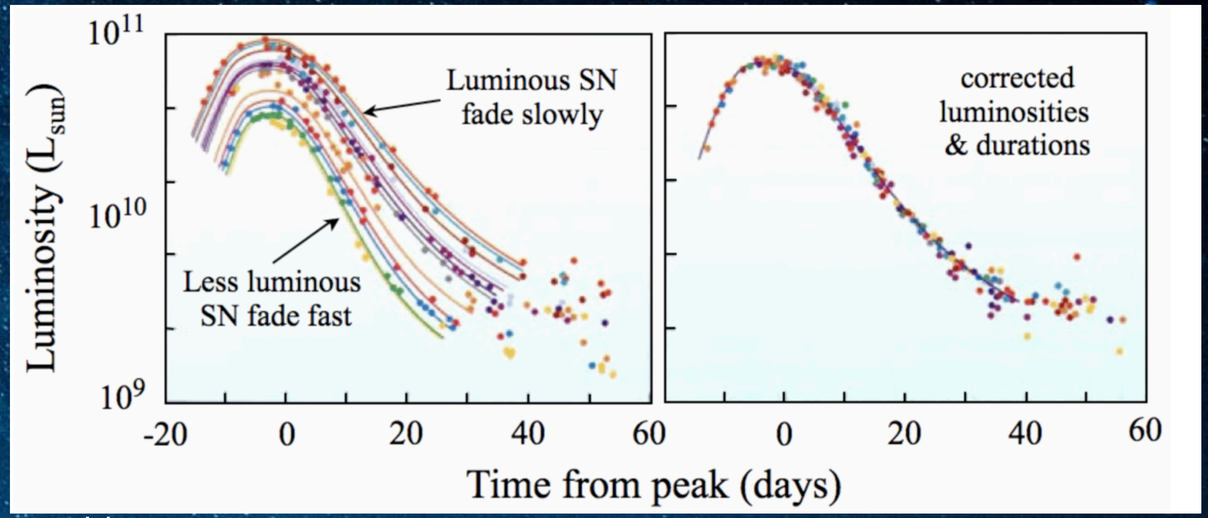
- Can be used as standard candles to accurately determine distances in the Universe



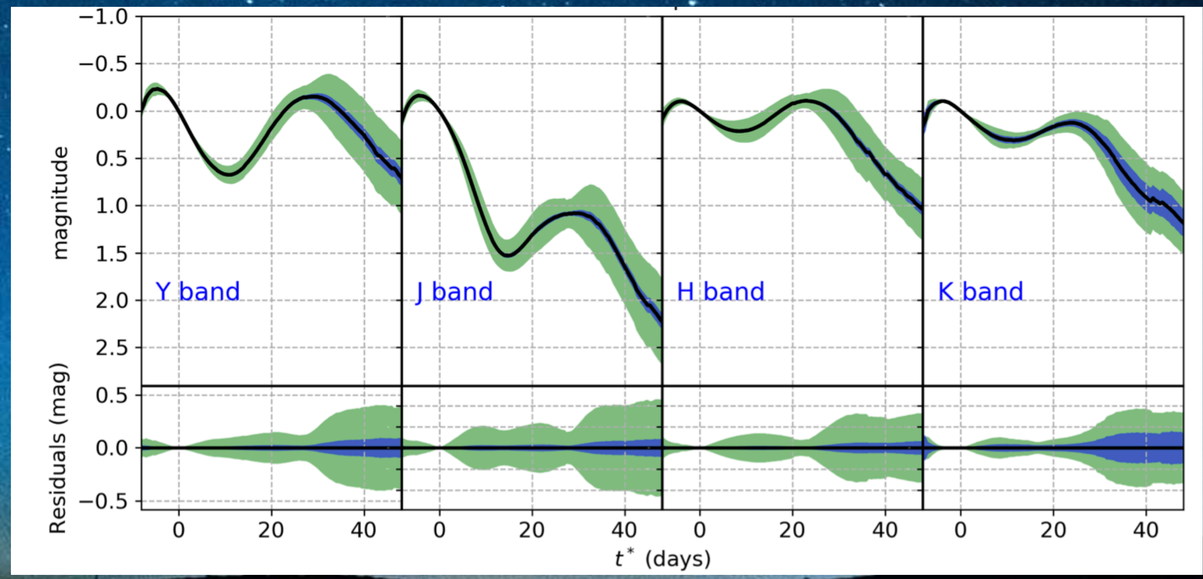
supernova.eso.org

Why use near-infrared?

- In optical, SNe Ia light curves show more variation before standardisation
- In near-infrared, light curves are more homogenous
- Little effect from dust



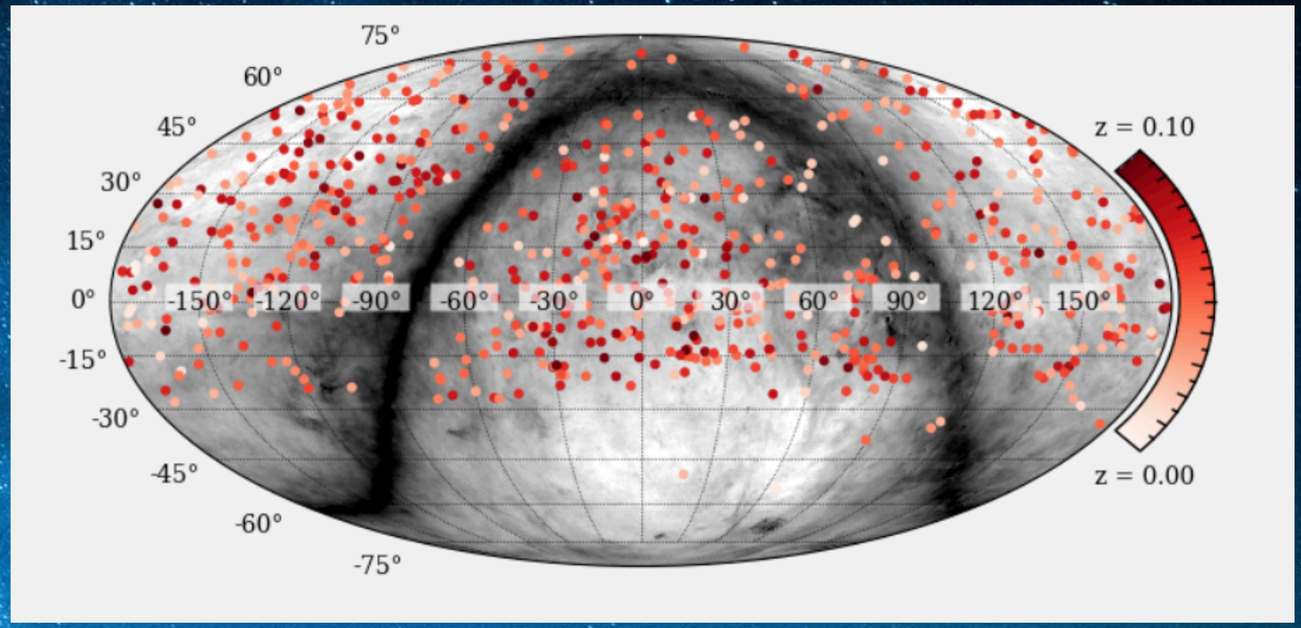
astrobites.org



Avelino et al. 2019

FLOWS project

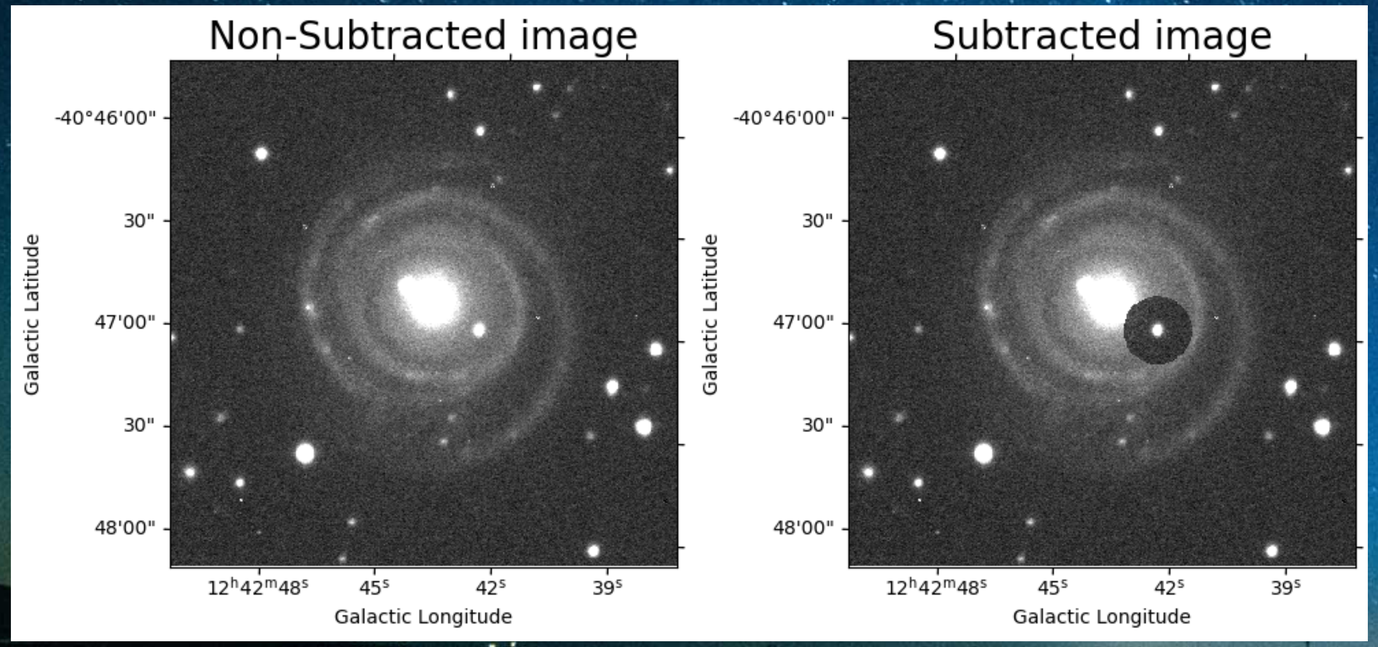
- Over 700 SNe at $z < 0.1$ with near-infrared observations from NOT, CAHA, VLT.
- Goal is to determine the Hubble constant to an accuracy of $3\,\%$ with minimal effort
- We will use publicly available optical data (ZTF+ATLAS) along with our NIR images
- Lastly determine σ_8 from peculiar motions

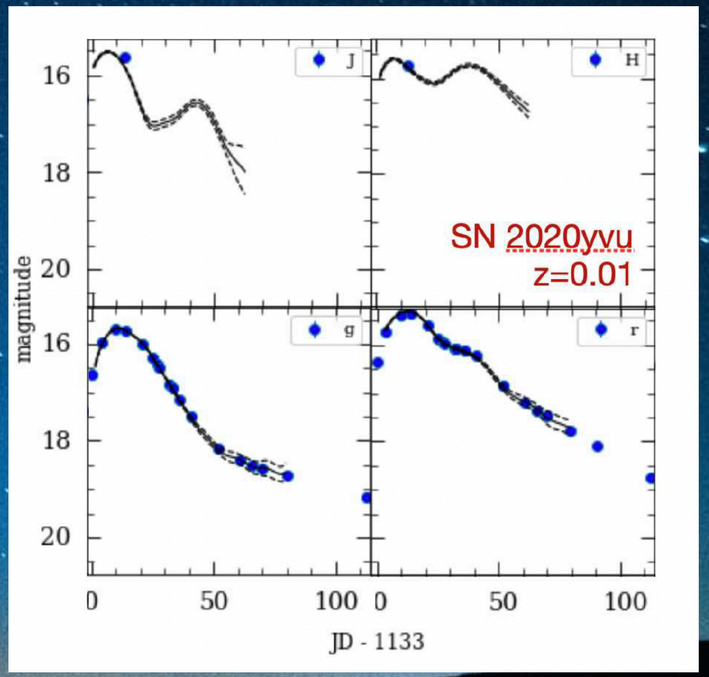


For more, check out https://flows.phys.au.dk/

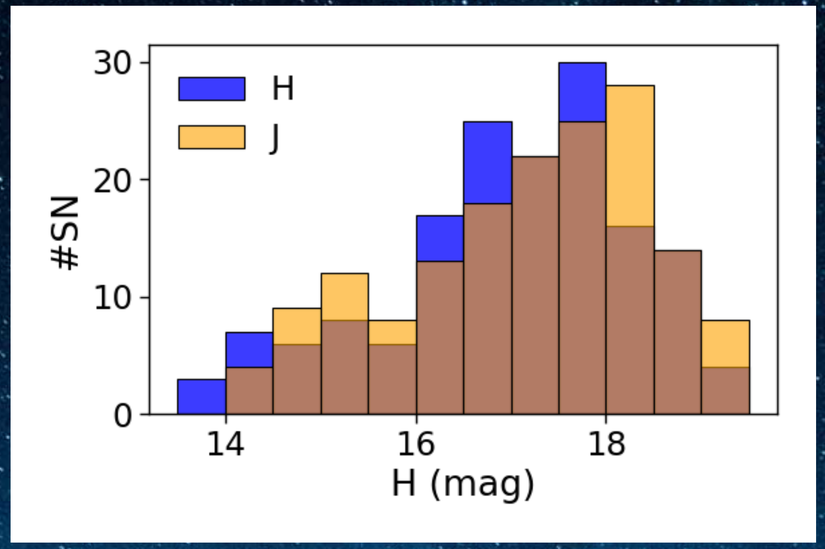
Our work

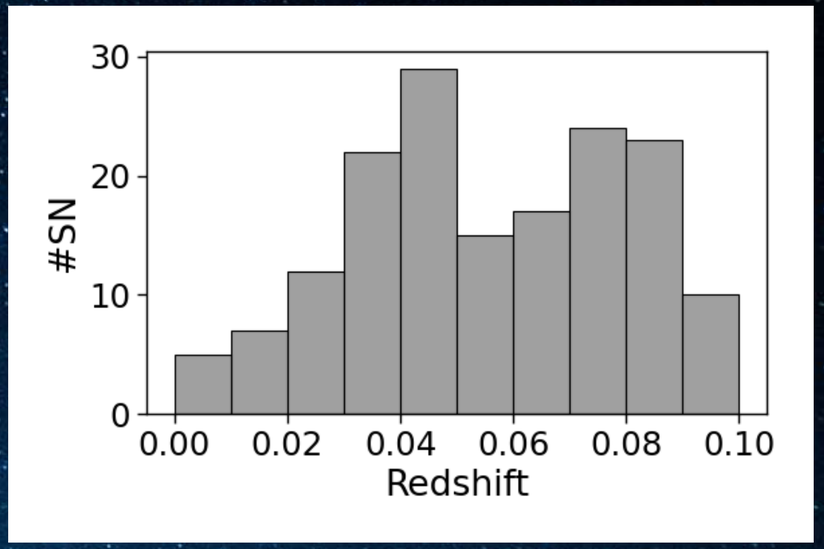
- Take two images; one with the supernova and one after the SN has faded
- If available, we use an archival image from UKIDSS/VISTA, where the SN is not present
- Use ImageMatch (https://github.com/obscode/imagematch) to remove the light around the SN
- Perform photometry and do light curve fitting in SNooPy (https://github.com/obscode/snpy)



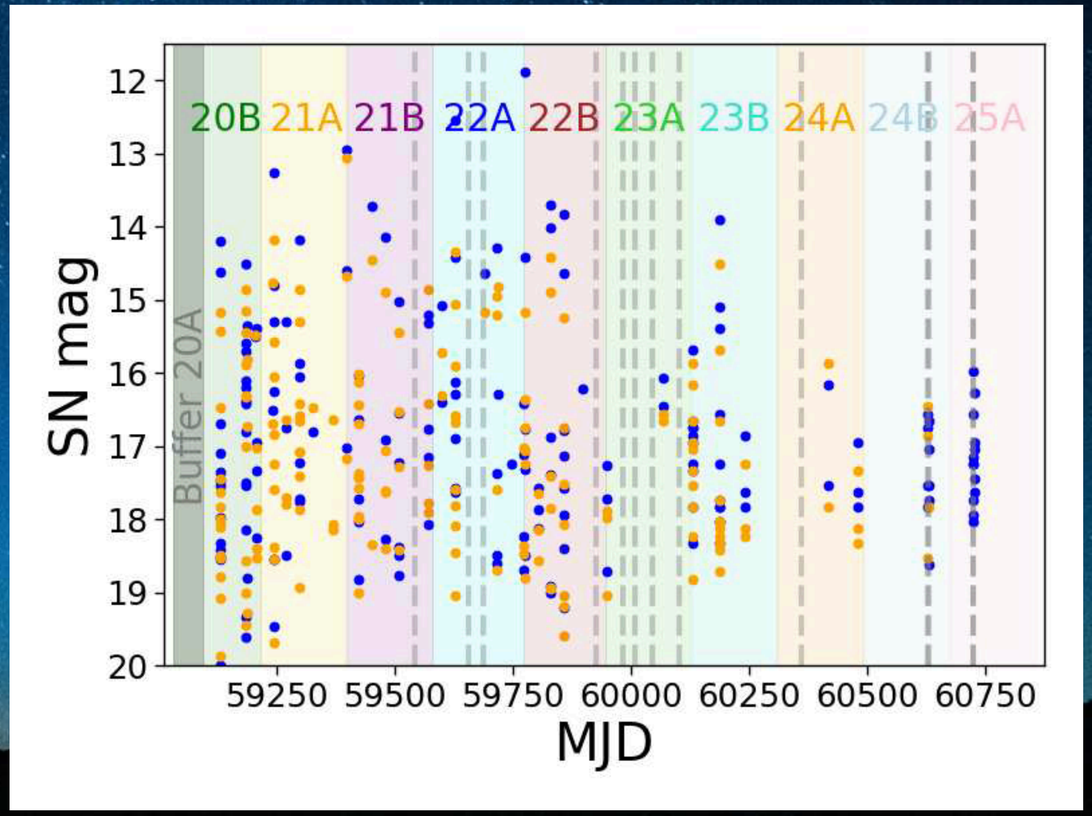


Project so far





- 181 SNe observed with Omega2000 (around 25 percent of the total FLOWS sample so far)



Why PANIC is useful

- Before we could only obtain a single epoch because Omega2000 was only mounted once per month
- PANIC gives more versatility to schedule FLOWS objects since it is always available
- With PANIC we can now do follow-up observations of SNe and construct full SNe Ia NIR light curves with 3-5 days cadence
- This allows us to better estimate JH peak magnitudes and determine distances to the SNe

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