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CSP/POISE State of Affairs

Pasadena Group Meeting, July 2022

It’s been a while

We were last here in 2019

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Say Hello To...

Doctor Melissa Shahbendeh

Professor Christopher Ashall

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Publications since last time

- *Optical and Near-Infrared Observations of Nearby SN Ia 2017cbv*, Wang et al. 2020
- *The Early Discovery of SN2017ahn: Signatures of Persistent Interaction in a Fast-declining Type II SN.* Tartaglia et al. 2020
- *SN2013ai: A link between Hydrogen-rich and Hydrogen-poor Core-collapse SNe.* Davis et al. 2021
- *Strong Near-infrared Carbon Absorption in the Transitional Type Ia SN2015bp.* Wyatt et al. 2021
- *ASASSN-15hy: An Underluminous, Red 03fg-like Type Ia SN*, Lu et al. 2021
- *Carnegie Supernova Project-II: The First Homogeneous Sample of Super-Chandrasekhar-mass/2003fg-like Type Ia SNe*, Ashall et al. 2021
- *Carnegie Supernova Project-II: Near-infrared Spectroscopy of Stripped-envelope Core-collapse SNe.* Shahbandeh et al. 2021
- *Carnegie Supernova Project: Kinki i-band Light Curves of Type Ia SNe*, Pessi et al. 2022
- *Type II SNe from the Carnegie Supernova Project-I. I, II, III.* Martinez et al. 2022
- *A Tale of Two SNe Ia: The Fast-Declining Siblings SNe 2015bo and 1997cn*, Hoogendam et al 2022

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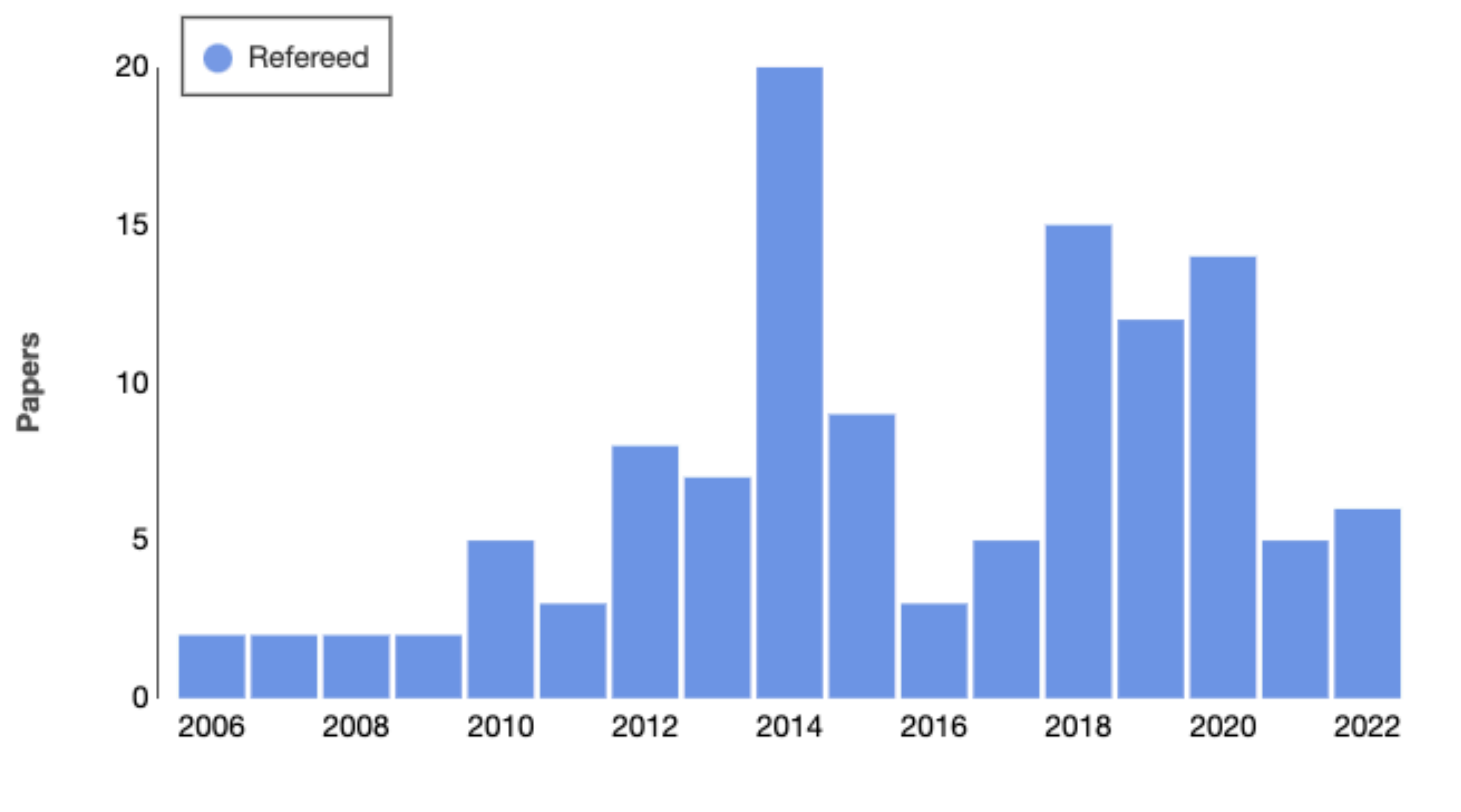

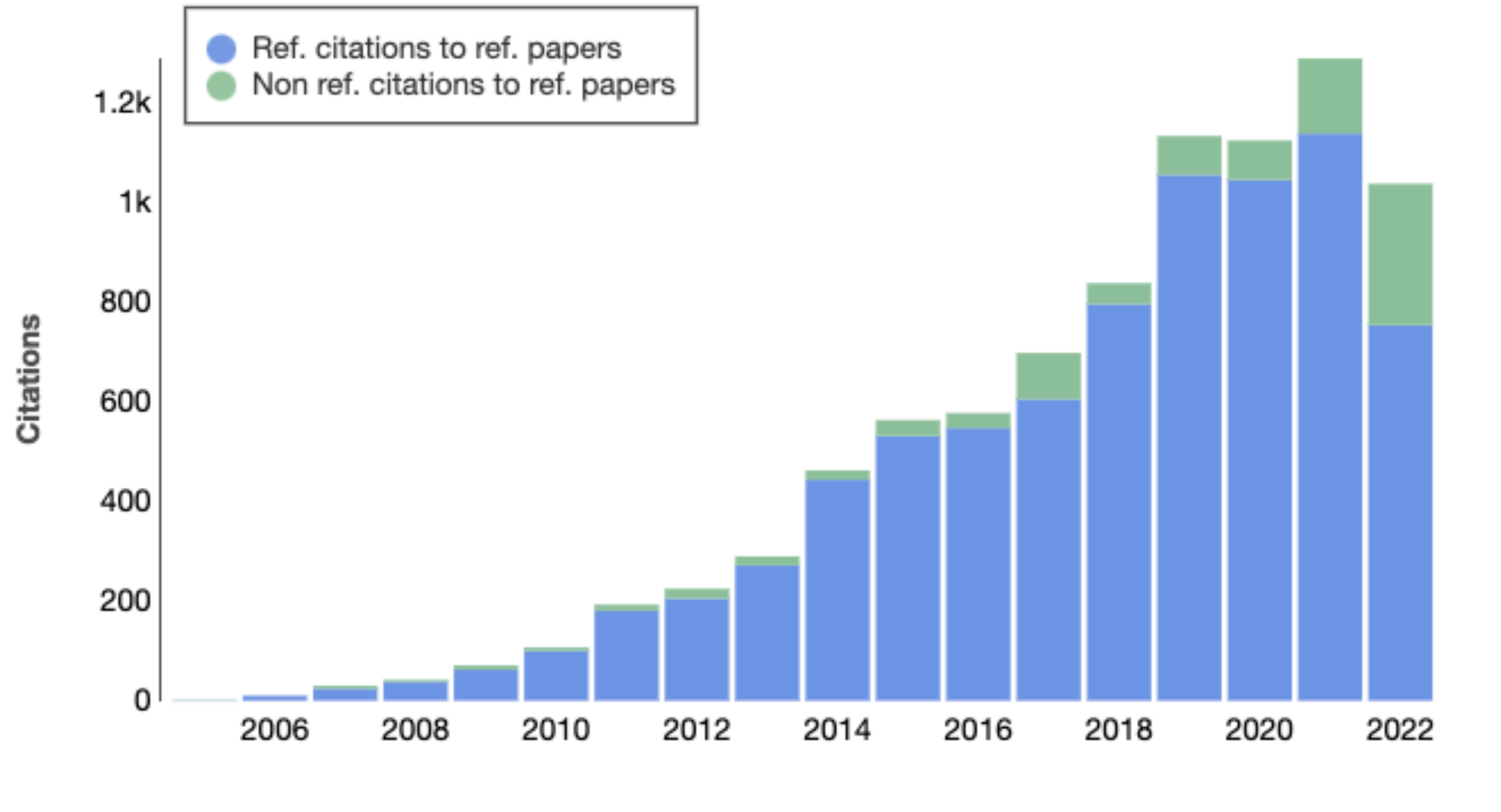

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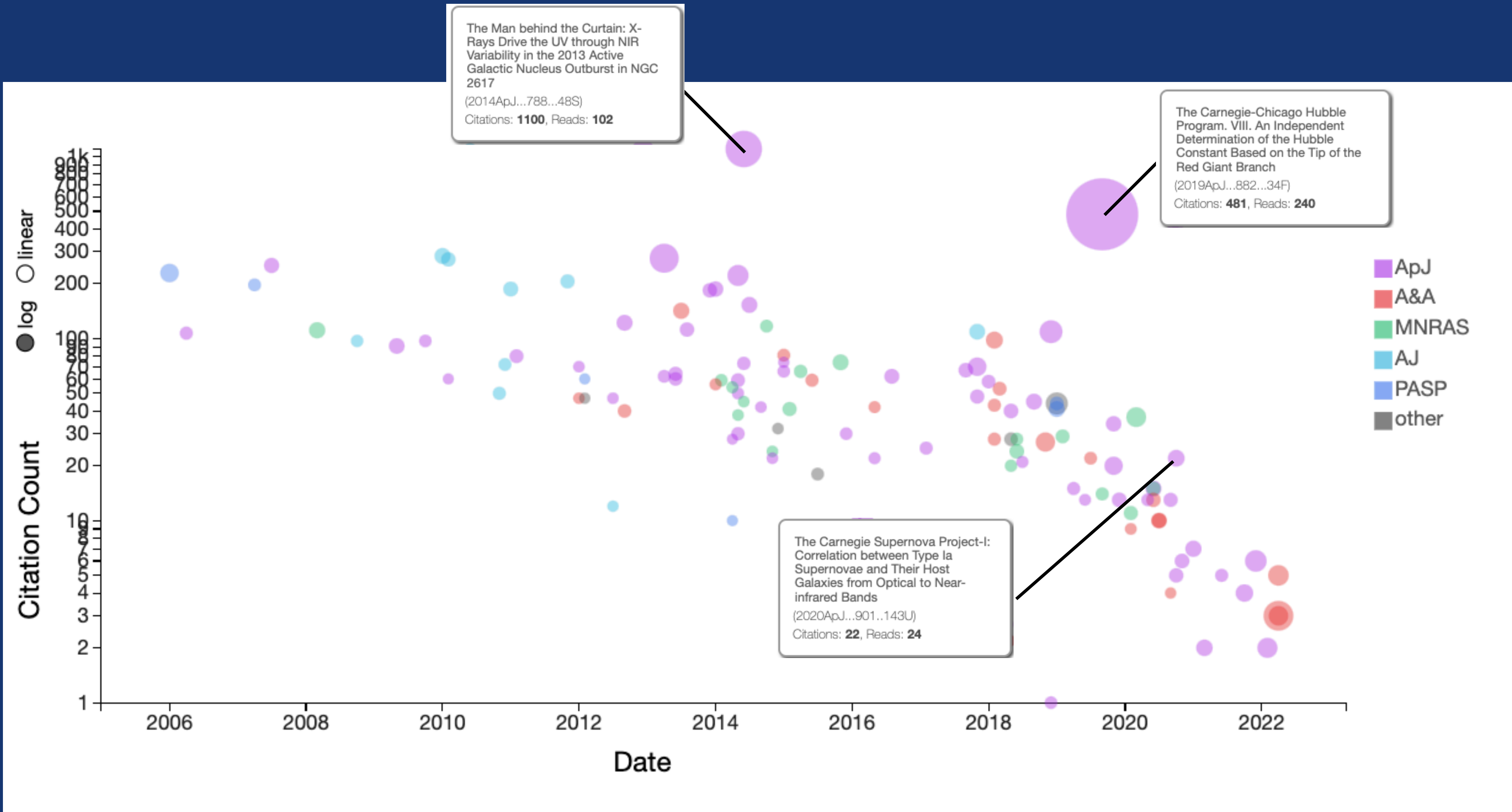

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Things that are Almost There

- Hubble Constant Paper is finally (we think!) ready for publication. The primary goal of the CSP-II.
- Type Ia NIR spectral templates with PCA. The final "promise" from the CSP-II project.
- Mark's Two papers on 91T-like Objects
- CSP-II Photometric data release paper. It would be great if this were submitted before our project is officially over
- CSP-II Spectroscopy data release paper?

How are we doing?

4. Objectives of the Current Proposal

The objectives of the current proposal may be summarized as follows:

- ***Complete the reductions of the optical and NIR imaging obtained by the CSP-II to produce final light curves.*** Between the cosmology and spectroscopic samples, 226 SNe Ia with five or more epochs of optical imaging were observed by the CSP-II, with at least two epochs of NIR imaging obtained for 80% of these. To reduce these data requires calibrating local standard stars in each field using images taken under photometric conditions, subtracting a host galaxy template in each filter obtained after the SN fades below the detection level, and measuring the brightness of the SN with respect to the local standard stars. We have developed all the tools to carry out these steps maintaining the highest possible precision, but each step is time consuming. Typically, a full day is required to produce final optical and NIR light curves of a single SN. We are currently obtaining the imaging required to finish the photometric calibrations of the local standards, and to carry out subtractions of the host galaxy light. We expect to have all the necessary data in hand by the end of 2016.
- ***Complete the reductions of the NIR spectra.*** Quick-look reductions of the NIR spectra of SNe Ia obtained during the CSP-II were typically performed at the telescope to ensure desired signal-to-noise ratio is reached. Full reductions are completed via automated pipeline by the following day. However, the telluric absorption corrections in the NIR are particularly time consuming and currently require human input. The reduction effort will be focused on completing these telluric corrections, and developing advanced empirical methods of telluric corrections using the ~1000 telluric star observations we have obtained.
- ***Produce new SN Ia spectral templates in both the optical and NIR.*** Spectral templates enable K-corrections to be computed as a function of temporal phase for any given bandpass. The current state-of-the art optical spectral templates for SNe Ia were made available to the community by CSP team member Eric Hsiao [31], and these were later updated to include the NIR (http://csp2.lco.cl/hsiao/hsiao_template.tar.gz). The Hsiao templates consist of a single average template covering the wavelength range 0.1-2.5 μm for each epoch spanning from -20 to +90 days with respect to t_{Bmax}. However, it is well known that the strengths of certain spectral features, both in the optical and the NIR, are dependent on light curve decline rate [5, 31, 65]. We will use the large number of optical spectra that have been published since 2005 along with the NIR spectra that we have obtained in collaboration with Kirshner, Marion, and Sands to produce new template spectra as a function of light curve decline rate.

How are we doing?

- ***Analyze the host galaxy properties.*** In recent years, SNe Ia luminosities have been found to depend on the global characteristics of th[illegible] host galaxies, with events of the same light-curve decline rate being, on average, 0.04-0[illegible] mag brighter in massive host galaxies and galaxies with low specific star formation rate[illegible], 38, 48, 91]. However, Kim et al. [40] find no evidence for this effect using a principal comp[illegible]nts analysis of the shapes and colors of SNe Ia light curves that they suggest may do a better job of capturing features of SN Ia diversity arising from progenitor stellar evolution. In the NIR, we would expect the effects of progenitor metallicity to be smaller, and the CSP-I and CSP-II data sets offer the opportunity to test this.
- ***Produce Hubble diagrams.*** Putting together final Hubble diagrams will require fitting all the light curves with SNooPy (incorporating the imp[illegible]ed K-corrections) and deriving individual host dust reddenings. We will look for residuals as [illegible]unction of host galaxy properties and examine the results for SNe in similar enviro[illegible]ent[illegible].g., see [39]). We will also investigate suggestions that systematic differences can be re[illegible] by comparing SN pairs that are photometric and spectroscopic "twins".
- ***Compare Theory with Observation.*** The CSP data set offers an exceptional opportunity to test theory with observation. For ten SNe Ia i[illegible]e CSP-II sample, our photometric observations began 12 days or more before t_{Bmax}. We will e[illegible]ine the distribution of ^{56}Ni in the SN ejecta for these objects, and also look for evide[illegible]e [illegible]teraction with a non-degenerate companion or circumstellar material. Using our NIR spectra, [illegible]ill probe the explosion physics as a function of luminosity and light curve decline rate.
- ***Publish the light curves and spectra.*** [illegible]m the beginning of the CSP in 2004, our highest priority has been to publish the data. We are [illegible]ently preparing the third and final data release paper for the SNe Ia observed by the CS[illegible], [illegible] we plan similar data releases for the CSP-II light curves. We will also publish the CSP-II optic[illegible]d NIR spectroscopic data in a timely fashion, as we have done for the CSP-I.

POISE

Precision Observations of Infant Supernova Explosions

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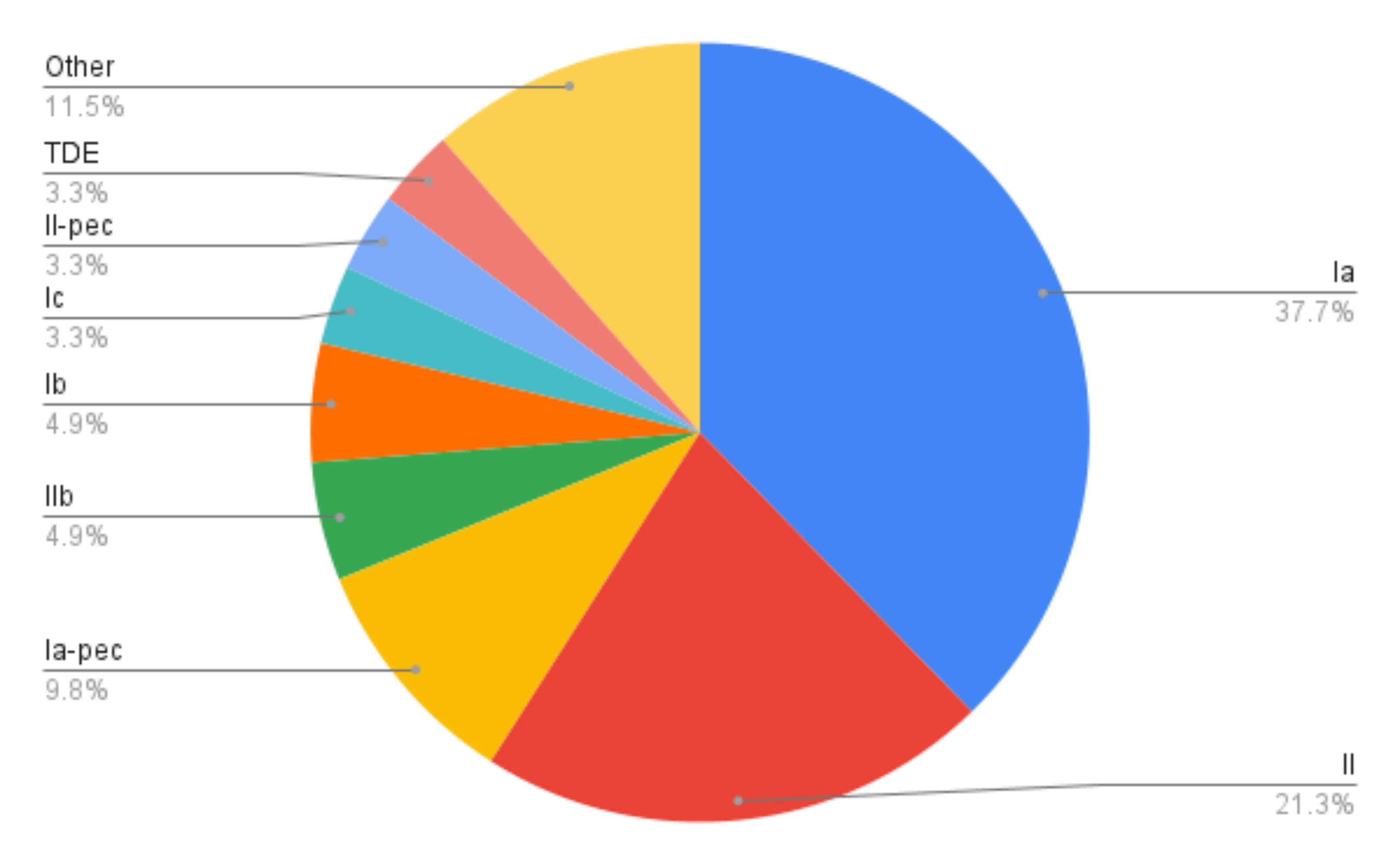
Observations

- 3 Successful semesters: 2021A - 2022A
  2022B coming up
- 61 SNe "of interest" (still have QSWO = 1)
- 24 Ia, 14 II, 6 Ia-pec, 3 Ib, 3 IIb, 2 II-pec, 2 Ic, 2 TDE, 1 Ib-pec, 1 Ibc, 1 Ibn, 1 Ic-BL, 1 Icn, 1 LRN, 1 SLSN



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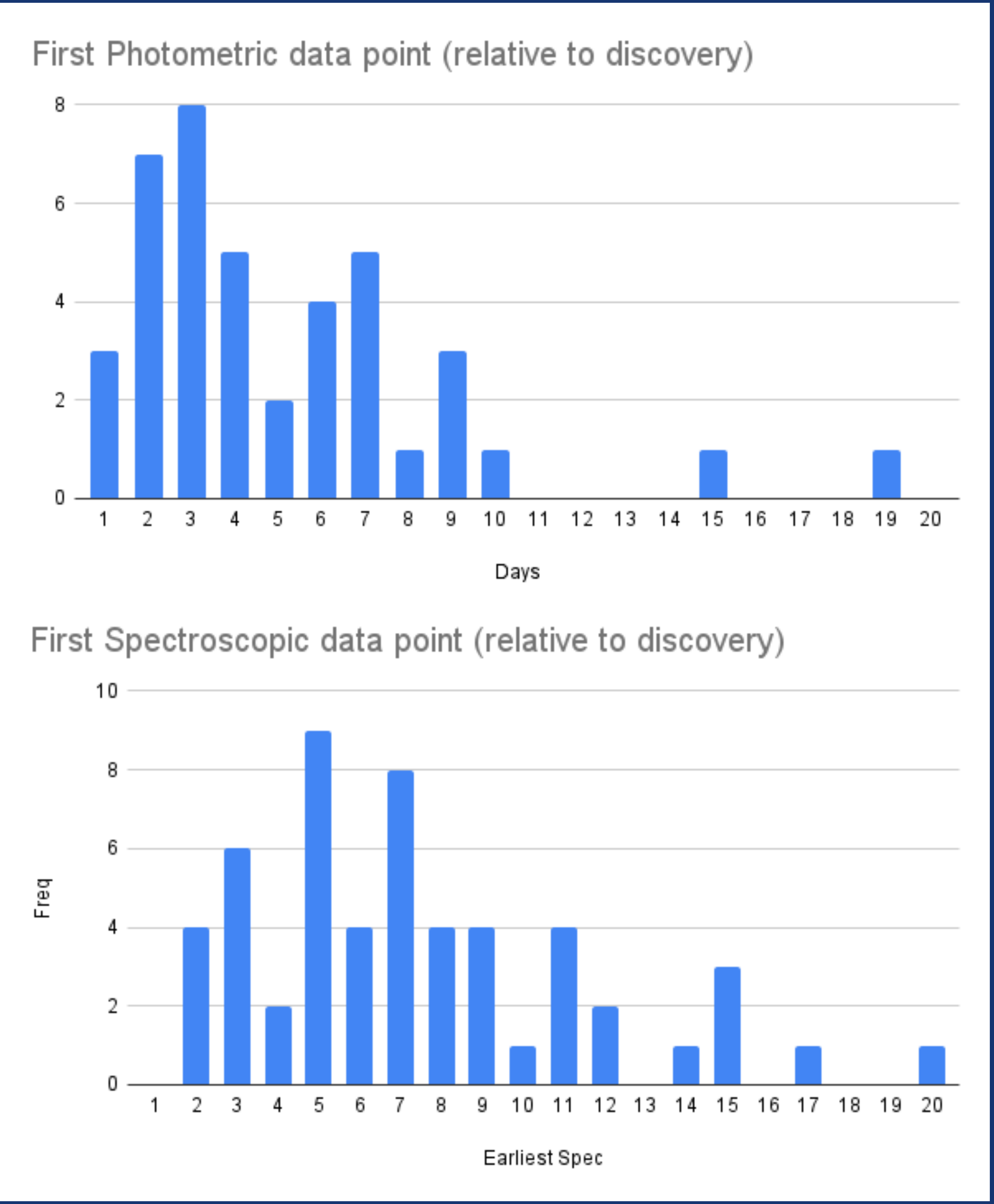
http://poise.obs.carnegiescience.edu/data/objects

POISE Objects

Object Name	Type		Campaign	z(hel)	Host	Dist. mod.	Time of first phot	Time of first spec.	# of spectra	Calibrations needed	templates	Priority	Comments
2021bmw	II	ATLAS21dks	2021A	0.0128	IC 4325	33.70	4.6	6	1			low	Photometry
2021bmx	Ia	ATLAS21dkt	2021A	0.0146	ESO 317- G 006	33.96	5.7	7	5			med	
2021bnb	Ia	ATLAS21dkv	2021A	0.042	AM 0516-364 NED02	36.27	5.8	7	2				
2021bwq	Ic	ZTF21aahdqrg	2021A	0.022	IC 2856	34.85	19.7	24	6			med	
2021bxu	IIb	ATLAS21dov	2021A	0.0178	ESO 478- G 006	34.33	6.7	8	8		iV	high	Chris A wor
2021can	II	ZTF21aaiaqhh	2021A	0.0207		34.72	2.8	5	4			med	
2021cgu	II	ZTF21aaipypa	2021A	0.0255	CGCG 038-099	35.17	2.4	5	3			low	
2021cgx	Ia	ATLAS21dxb	2021A	0.0347	MCG -06-29-016	35.85	2.6	5	1				
2021csp	Icn	ZTF21aakilyd	2021A	0.083		37.77	4.3	3	11				Morgan Fra
2021dae	Ia	ZTF21aakybgi	2021A	0.0367	MCG -02-12-055	35.97	3.9	9	1			high	
2021dbg	II	ATLAS21gfy	2021A	0.0205	MCG -01-24-014	34.70	4.7	9	9			high	
2021dch	Ia	ATLAS21ghj	2021A	0.0202	WISEA J130523.61+29	34.66	4.7	11	1			high	
2021dlb	Ia	ZTF21aamgcrv	2021A	0.0334	2MASX J14530723+03	35.77	2.0	14	1			med	
2021dov	Ia-pec	ZTF21aamokak	2021A	0.0121	CGCG 005-038	33.55	2.9	3	19			high	
2021dwg	Ic	ZTF21aannoix	2021A	0.025	IC 992	35.13	2.9	5	4			low	
2021efd	Ib	ZTF21aanvncv	2021A	0.0279	KUG 1121+239	35.37	5.8	6	5		griBV	low	
2021emc	Ia	ATLAS21hjl	2021A	0.0311	CGCG 075-074	35.61	1.7	41	1			low	
2021fxy	Ia	ZTF21aaprfqv	2021A	0.0094	NGC 5018	32.87	3.3	11	13			high	James Derl
2021gno	II	ZTF21aaqhhfu	2021A	0.0062	NGC 4165	32.98	2.7	11	12			high	Keila Ertini
2021hiz	Ia	ZTF21aaqytjr	2021A	0.0037	SDSS J122541.45+071	30.96	5.7	12	9			high	
2021abzd	Ia-pec	ATLAS21bkka	2021B	0.0181	NGC 0233	34.43	9.0	9	1	u(1)		low	
2021abze	II-pec	ATLAS21bkkb	2021B	0.0149	NGC 0234	34.00	10.0	8	5	u(2)		med	
2021aceo	Ia	ATLAS21bknt	2021B	0.048	Anon	36.60	4.0		0			low	
2021aclv	Ia	ZTF21acjeegy	2021B	0.0183	NGC 0327	34.45	8.0	8	6			high	All NIR Spe
2021acnt	Ia	ATLAS21bkno	2021B	0.0084	ESO 434-G 023	32.77	7.0	11	10			high	

How POISED are we?



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Published, arXiv'd, or Coming Soon

- *SN2021csp — The Explosion of a Stripped Envelope Star Within a H and He-Poor Circustellar Medium.*
  Fraser et al. 2022(?)

- A Speed Bump: SN2021aefx Shows that Doppler Shift Alone Can Explain Early Excess Blue Flux in Some Type Ia Supernovae.
  Ashall et al. 2022

- SN2021gno: a Calcium-rich transient with double-peaked light curves. Ertini et al. 2022 (talk Monday 8:00 AM)

- SN2021bxu. Desai et al. 2022 (talk Monday 11:50 AM)

Meeting Goals

- Listen to all the great science that's going on!
- Prioritize work on finalizing CSPII data releases.
- Contemplate the near/far future of POISE:
  - Is it time to take a break and work on science (we've published/are publishing only 4/61 objects)?
  - How do we look better to NSF?
- Work on stuff that's hard/impossible remotely.