Las Cumbres Observatory Global Telescope Network

Andy Howell

Tenerife
Canary Islands
(possible future
site)

China
(possible future
site)

McDonald Observatory
Texas

Haleakala
Hawaii

Sliding Spring Observatory
Australia

South African Astronomical Observatory
Sutherland

Cerro Tololo Inter-American Observatory
Chile

supernova

LCOGT.net

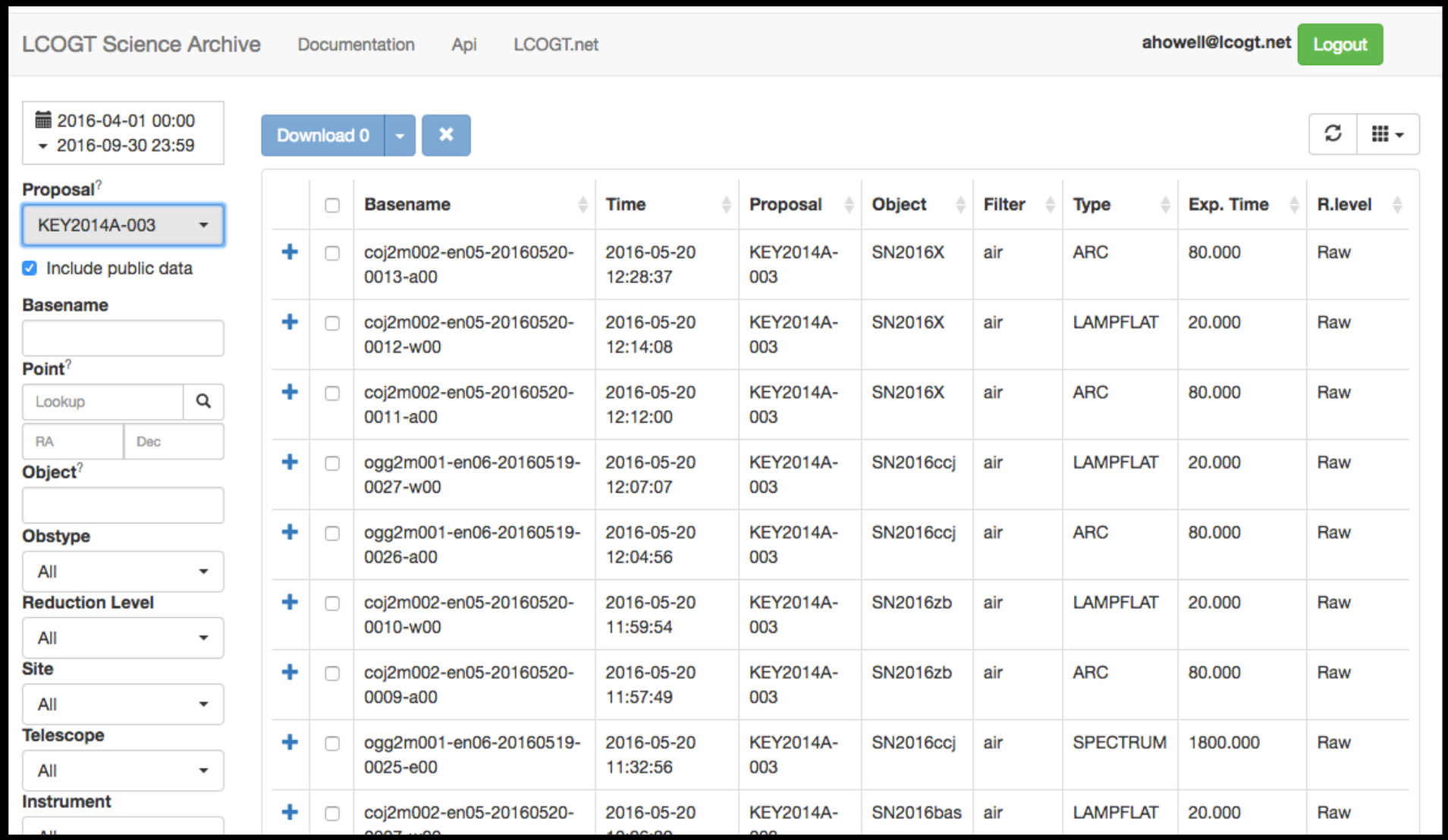
2 meter Faulkes | 1 meter | proposed

Network Scheduler

All telescopes scheduled by automated scheduler that solves an optimized whole-network schedule in minutes.

Molecule id:	50807369	**Type:**	EXPOSE	**Priority:**	3	**Block id:**	19984361	**Tag id:**	SCICOLLAB
User id:	andy.howell	**Proposal:**	KEY2014A-003	**Group:**	PSN103448	**Instrument:**	kb75	**Filters:**	ip
Exposure time:	300	**Exposure count:**	2	**Status:**	completed	**Tracking #:**	0000045952	**Request #:**	000011839
Block start:	2014-06-03T17:05:00	**Block end:**	2014-06-03T17:38:48	**Site:**	cpt	**Observatory:**	domc	**Telescope:**	1m0a
Airmass:	2	**Molecule start:**	2014-06-03T17:26:52	**Molecule end:**	2014-06-03T17:37:33				

New archive, pipeline, software



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+	coj2m002-en05-20160520-0013-a00	2016-05-20 12:28:37	KEY2014A-003	SN2016X	air	ARC	80.000	Raw
+	coj2m002-en05-20160520-0012-w00	2016-05-20 12:14:08	KEY2014A-003	SN2016X	air	LAMPFLAT	20.000	Raw
+	coj2m002-en05-20160520-0011-a00	2016-05-20 12:12:00	KEY2014A-003	SN2016X	air	ARC	80.000	Raw
+	ogg2m001-en06-20160519-0027-w00	2016-05-20 12:07:07	KEY2014A-003	SN2016ccj	air	LAMPFLAT	20.000	Raw
+	ogg2m001-en06-20160519-0026-a00	2016-05-20 12:04:56	KEY2014A-003	SN2016ccj	air	ARC	80.000	Raw
+	coj2m002-en05-20160520-0010-w00	2016-05-20 11:59:54	KEY2014A-003	SN2016zb	air	LAMPFLAT	20.000	Raw
+	coj2m002-en05-20160520-0009-a00	2016-05-20 11:57:49	KEY2014A-003	SN2016zb	air	ARC	80.000	Raw
+	ogg2m001-en06-20160519-0025-e00	2016-05-20 11:32:56	KEY2014A-003	SN2016ccj	air	SPECTRUM	1800.000	Raw
+	coj2m002-en05-20160520-	2016-05-20	KEY2014A-	SN2016bas	air	LAMPFLAT	20.000	Raw

Archive

Replaced IPAC Archive with in-house software.

Data stored in Amazon cloud

Can also get SN data via SNEx

Pipeline

Written by Curtis McCully

All in Python

Quick reduction in real time

Better reduction at end of night

Scheduling

Intraproposal priority being introduced.

Better tools for monitoring observations.

New partners

Major time sales:
PESSTO
TESS
Satellite tracking

Israel Wise Observatory. NRES spectrograph to be installed on existing 1m.

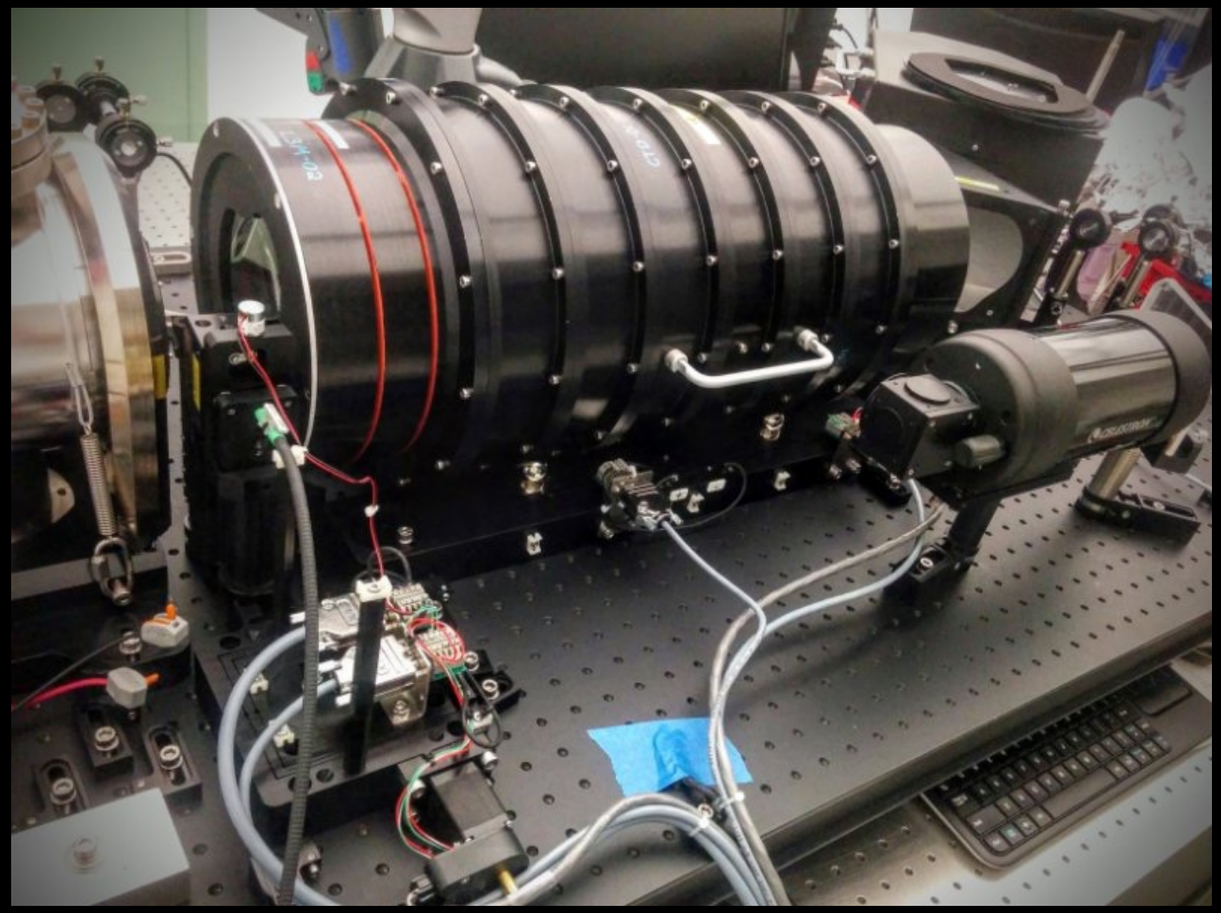
NAOC Ali Observatory, Tibet. Two LCOGT 1m telescopes in 2017

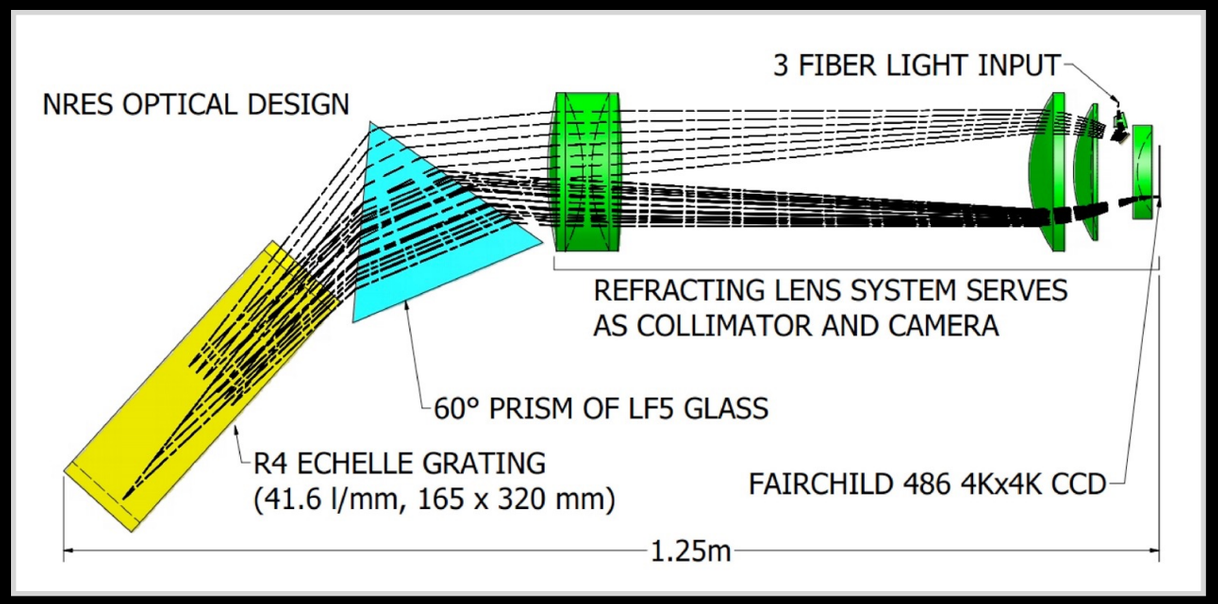
1m Imaging

Sinistro: 26.4’ x 26.4’, 0.389”/pixel. Fairchild CCD486, backside illuminated. 21 position filter wheel, photometric shutter. 16 Mpix; 4 Mpix/s readout at ~10 e-/pix

Camera distribution: 5/9 1m telescopes have Sinistro cameras. The rest have SBIGs. Hope to deploy the rest by end of 2016.

1m Spectroscopy





Coming later this year:
Network Robotic Echelle Spectrographs (NRES)

High-resolution (R~53,000), precise (≤ 3 m/s), optical (380-860 nm) echelle spectrographs.

One at each 1m site (6 total), can be fiber-fed (2.58" per fiber width) by two 1m telescopes and ThAr calibration source

Will double the radial velocity planet-vetting capacity in the US and achieve accuracy better than 3 m/s to V = 12

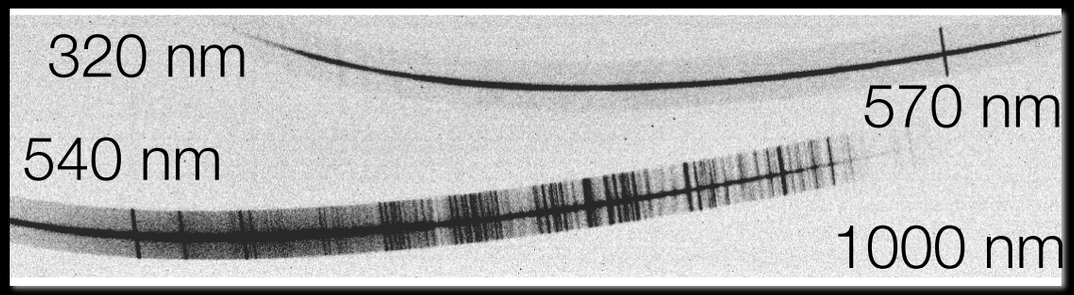
NSF funded. Prototype is on Sedgwick 0.8m

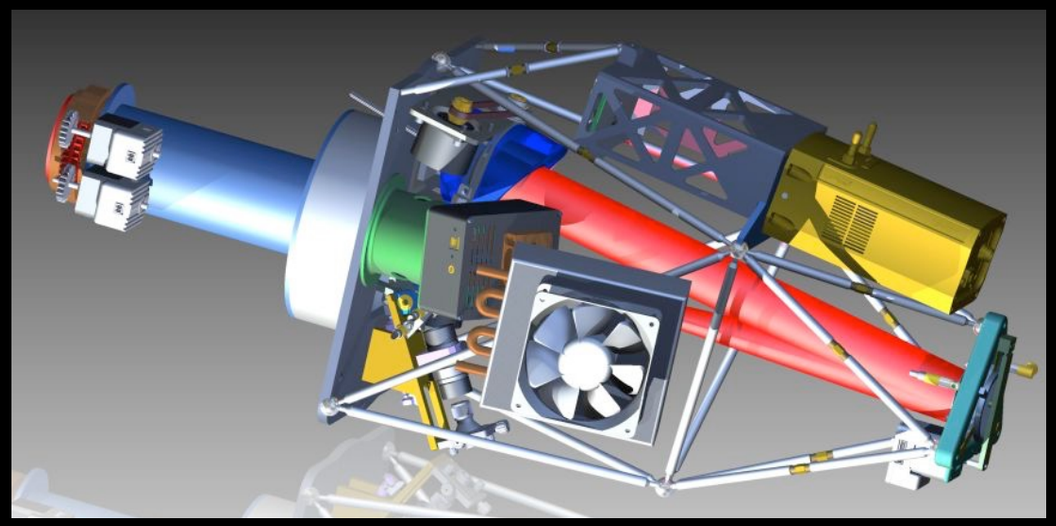
2m FLOYDS robotic low resolution spectrographs

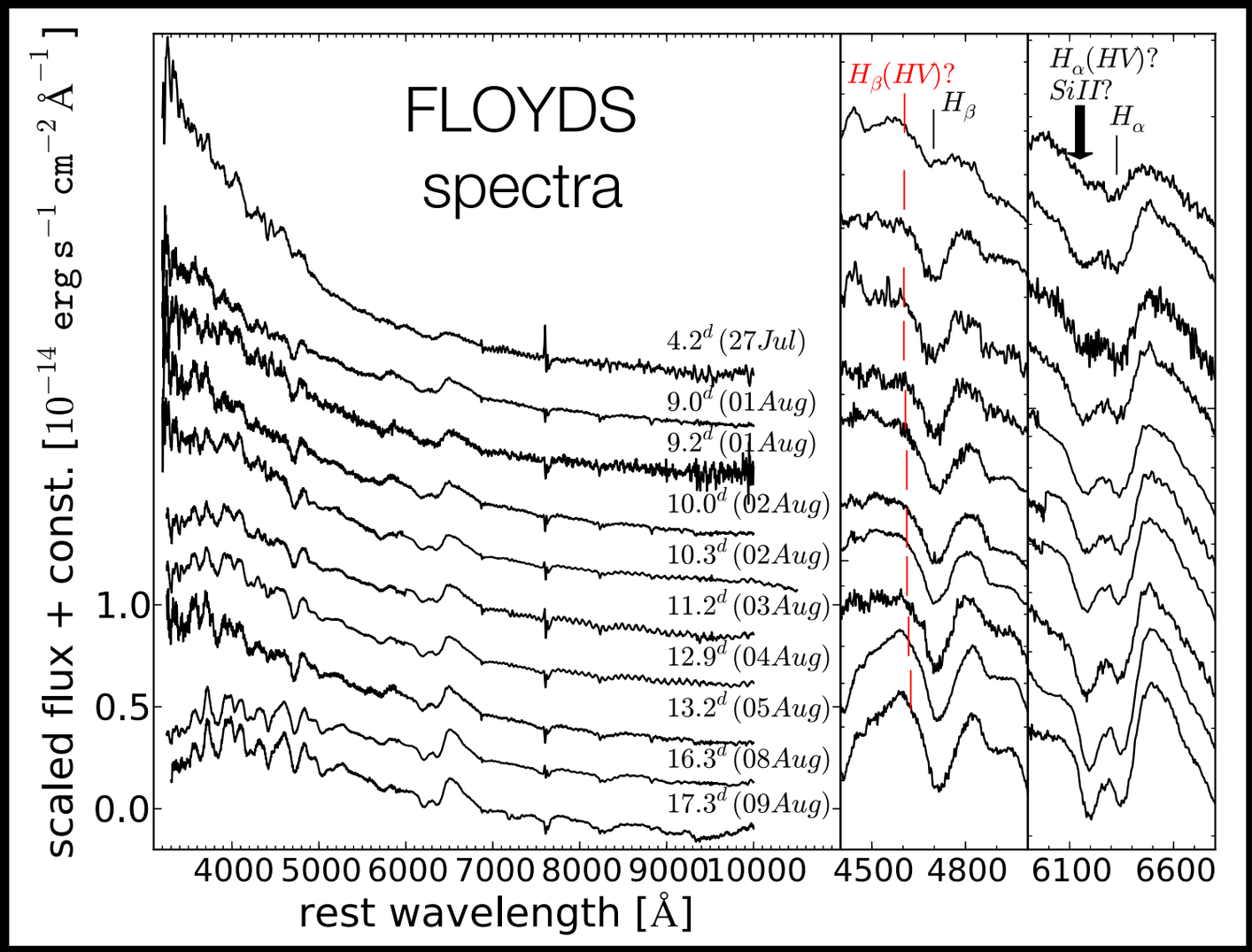
Designed for supernovae

R~400 covering 325nm -- 1000nm in one pointing (cross dispersed).

Can go down to V~18.5 mag with S/N=10 in 1 hour



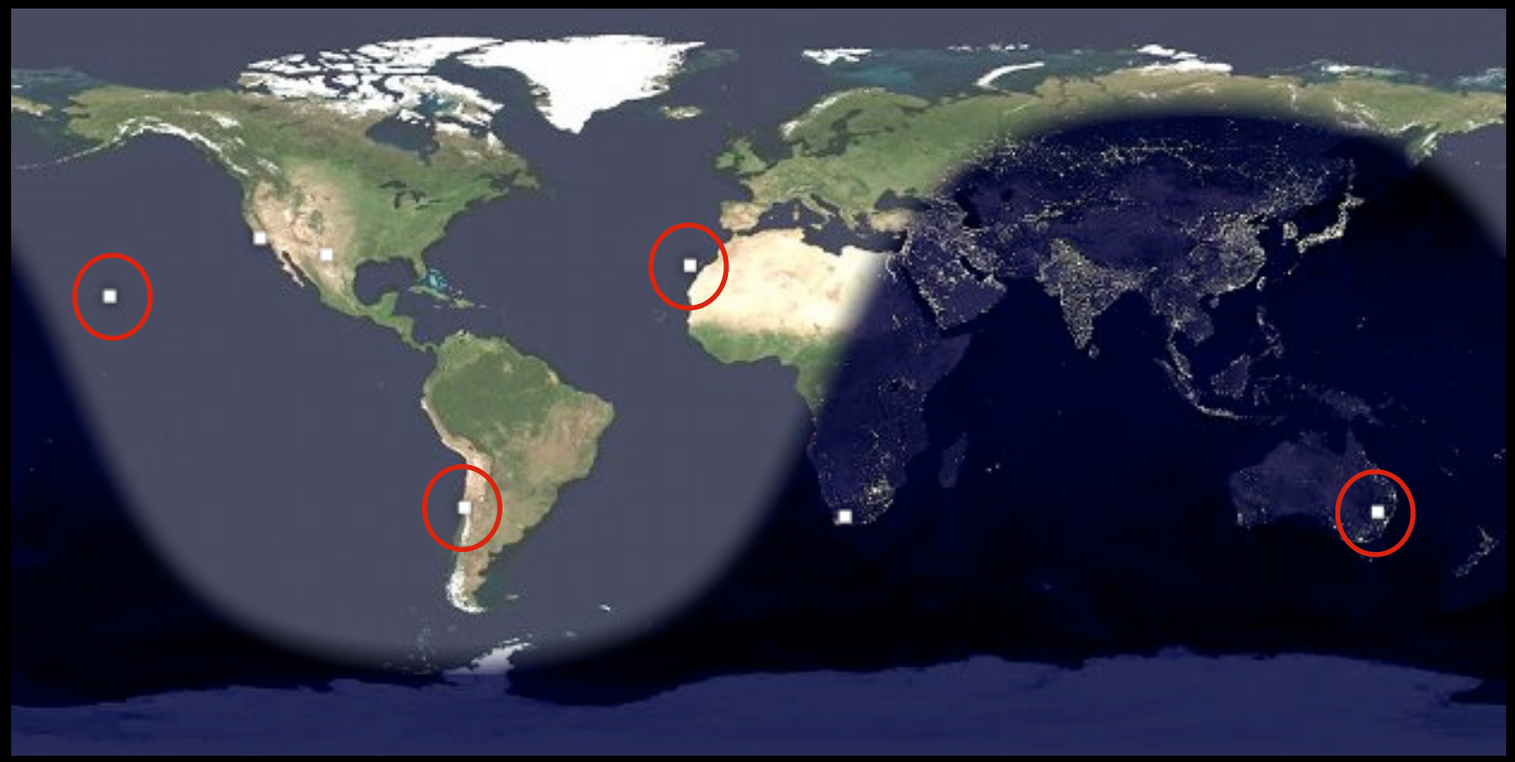




0.4m telescopes

For commercial satellite tracking, science, and educational use.

Up to 24 total, deployed in clusters of 2-4 at each site, contingent on funding

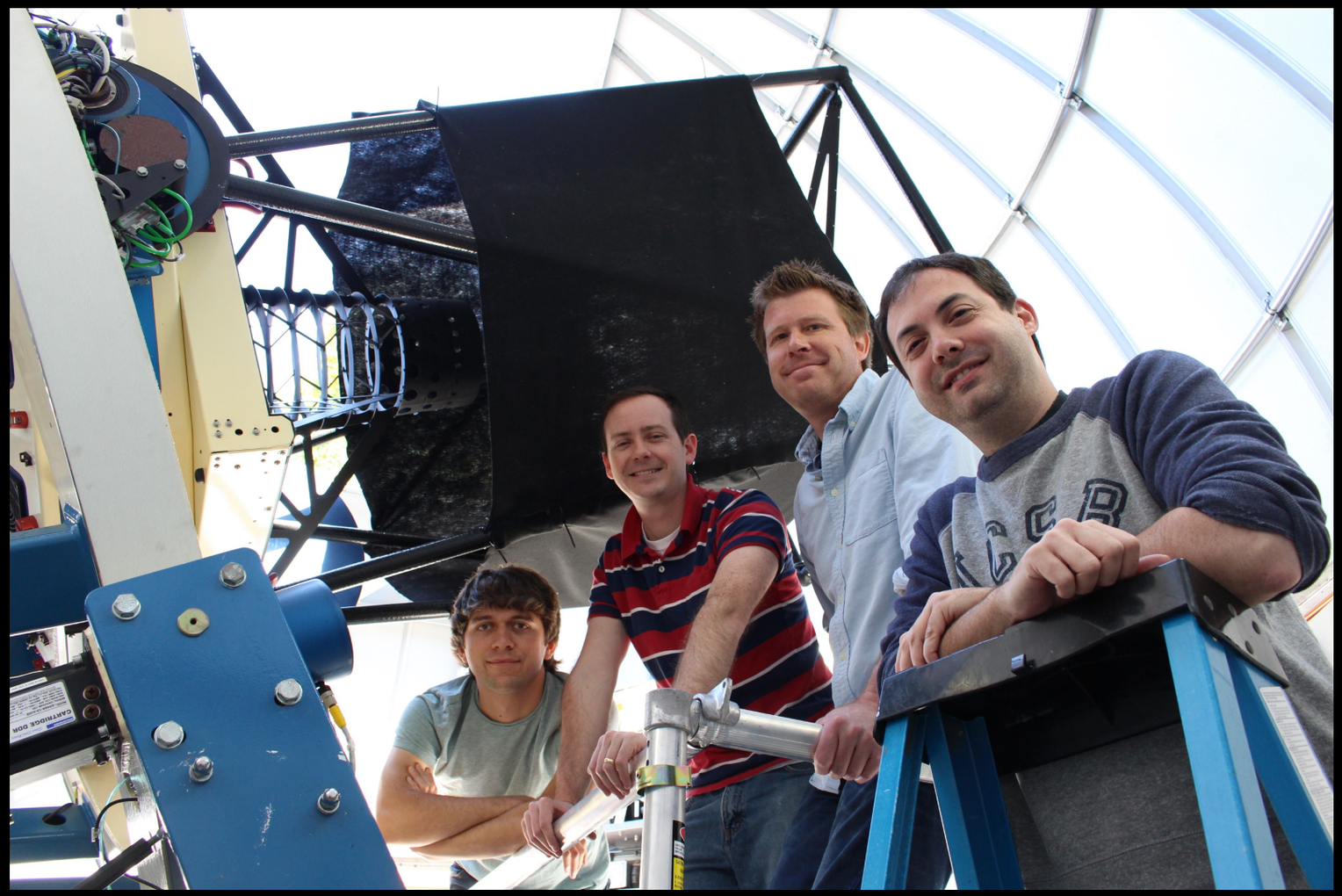


Currently 7 deployed
Tenerife
CTIO
Haleakala
Siding Spring

LCOGT Supernova Key Project

Allocation LCOGT time over 3 years:
1m time: 2200 hours / year
2m time: 700 hours / year

Goals Build a sample of 500 supernovae of all types.



Globally, more than 100 members

Africa: SAAO
Antartica: CSTAR
Asia: China (NAOC)
Australia: Australian National University
Europe: PESSTO
South America: Chile
North America: LCOGT, University of Texas, UC Davis, Texas Tech, UC Berkeley, iPTF

At LCOGT

Andy Howell
Iair Arcavi
Curtis McCully
Griffin Hosseinzadeh

First 2yrs

51,770 photometric points from 325 SNe

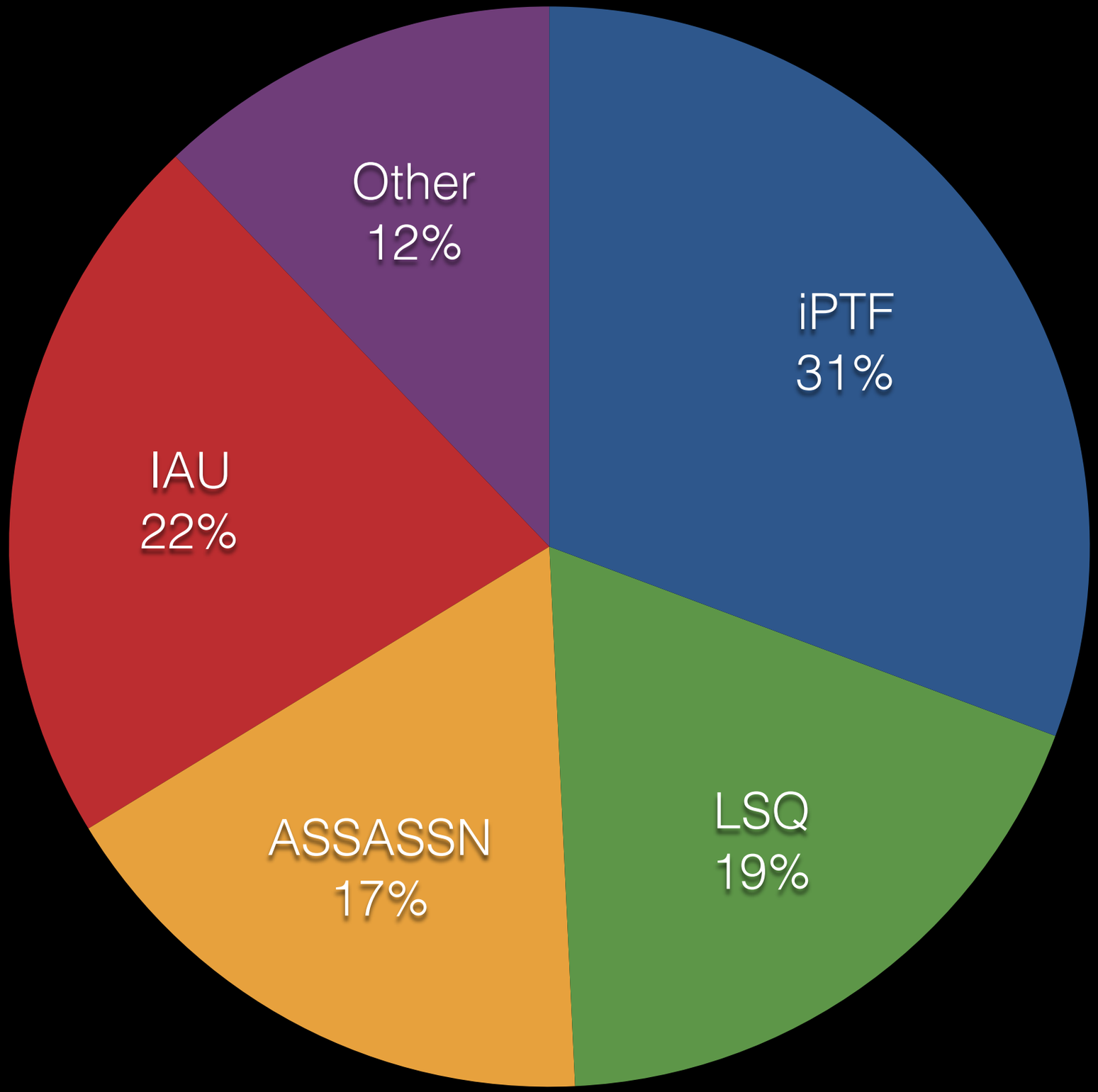
1160 spectra of 254 objects

Public surveys

ASAS-SN
Catalina Sky Survey
MASTER
OGLE
KAIT
ATLAS
Gaia

Member surveys

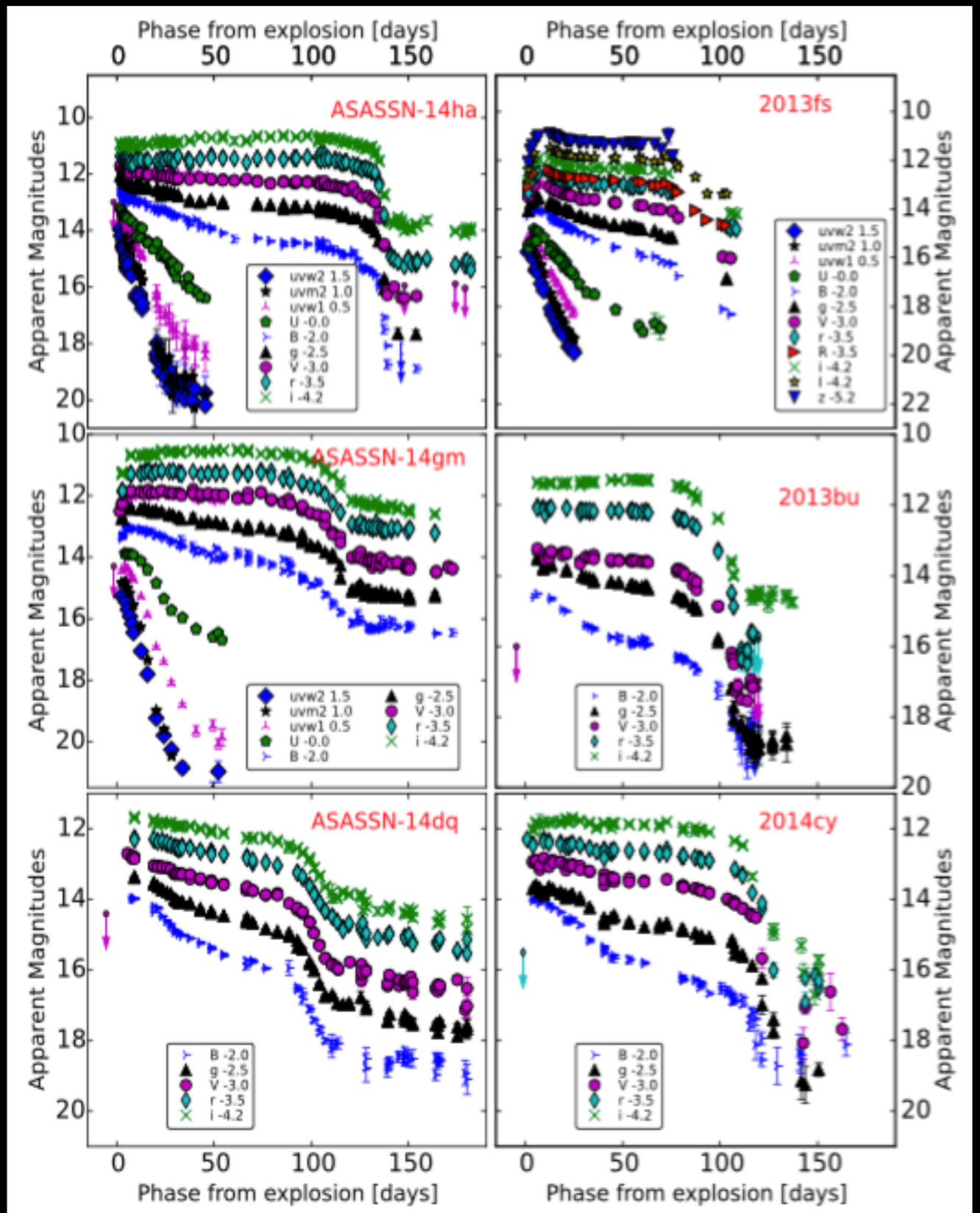
iPTF
PS1
PESSTO
La Silla-Quest
KMTNet
Sky mapper



~20 papers/yr from the Key Project

A sample of Type II SNe from LCOGT

Valenti et al. 2015b, Valenti et al. 2016



12 new SNe II with well-sampled UV +optical light curves compared to the literature

If you follow SNe IIL long enough, they also fall off a “plateau”

SNe IIL are on average more luminous than SNe IIP

However:

They don’t produce more ^{56}Ni.

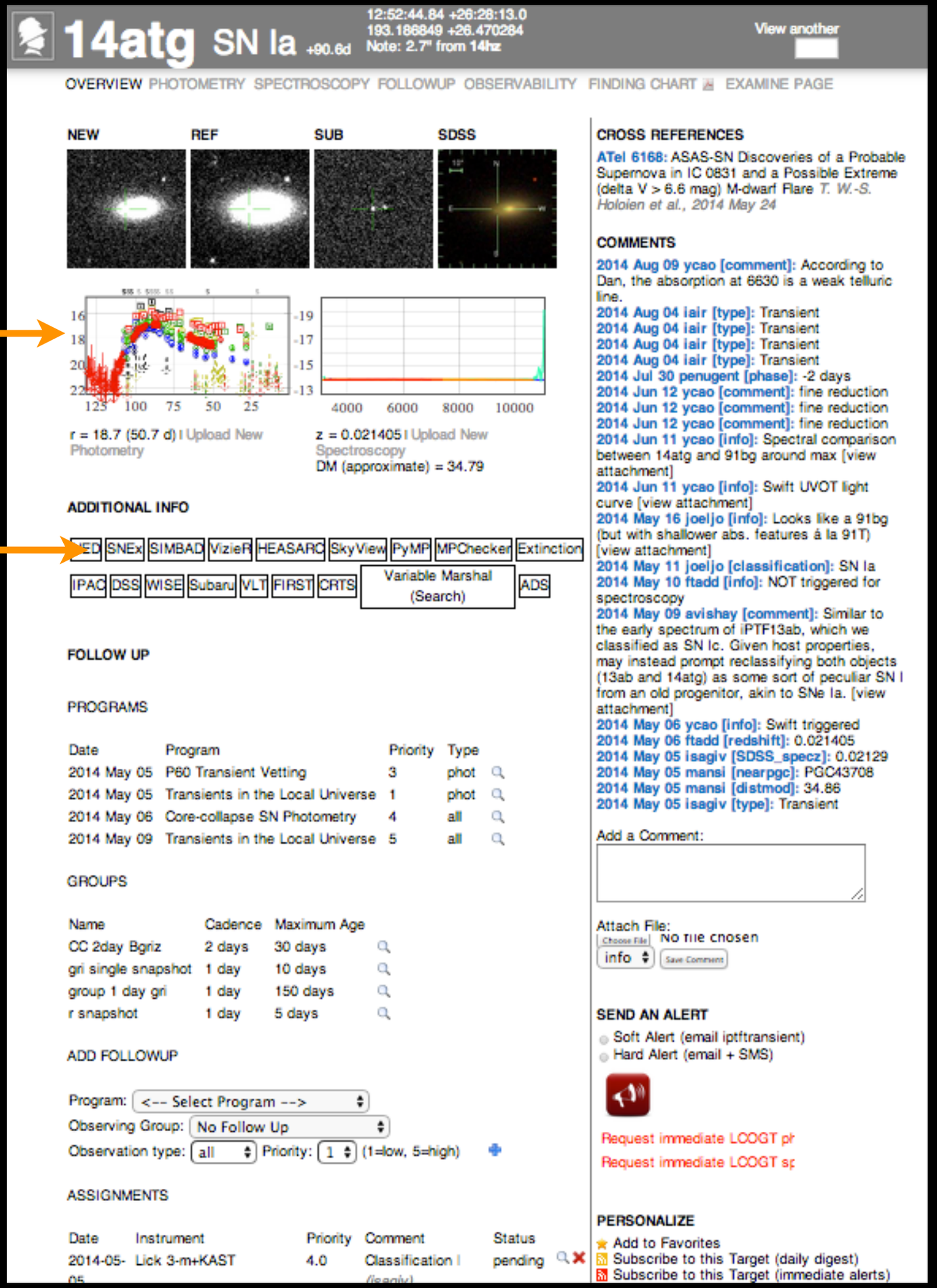
They don’t have more luminous progenitors.

Nebular spectra of SNe IIL are consistent with them having 12-16 $M_\odot$ progenitors.

Data synching with iPTF

LCOGT photometry and spectroscopy automatically appears.

Link to SNEx



welcome to

SNEx

the SupernovaExchange

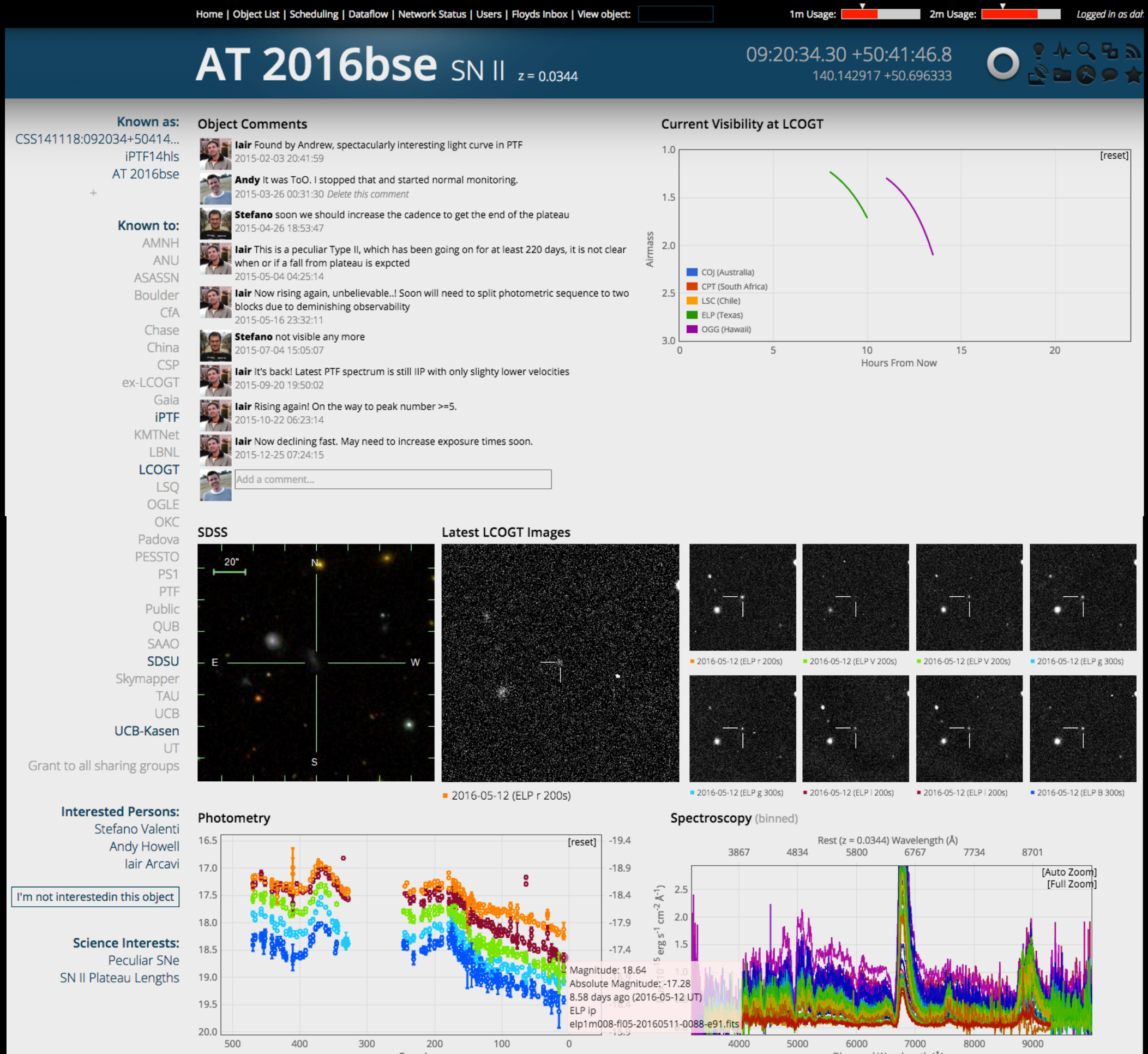
insert object name or coordinates

iPTF14hls

Monitoring every 2/4 days over ~500d, few gaps

1119 photometry points and counting

48 spectra



SN2014ad SN Ic-BL z = 0.005

11:57:44.44 -10:10:15.7
179.435167 -10.171028

Known as:
PSN1157444
PSN1157
SN2014ad

Known to:
ANU
ASASSN
Boulder
CfA
Chase
China
CSP
ex-LCOGT
iPTF
LBNL
LCOGT
LSQ
OKC
Padova
PESSTO
PS1
PTF
Public
QUB
SAAO
Skymapper
UCB
UT
Grant to all sharing groups

Science Interests:
Well Sampled SNe Ic-BL

Submitted Sequences

Photometry: 3-day cadence of B (2x200s), V (2x120s), g (2x200s), r (2x120s), i (2x120s) starting 2014-05-08, ending 2014-06-03, using Sbig
iair: Lowering cadence

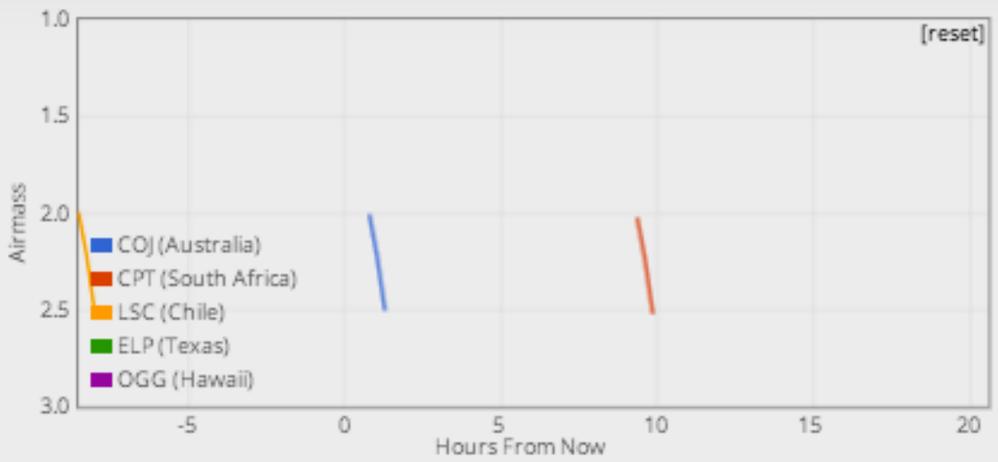
Spectroscopy: Single observation of 1800s starting 2014-05-08, ending 2014-05-09, using Floyds

Photometry: 7-day cadence of B (2x300s), V (2x200s), g (2x300s), r (2x200s), i (2x200s) starting 2014-06-03, ending 2014-08-05, using Sbig
SV: change airmass from 2 to 3

Spectroscopy: 7-day cadence of 3600s starting 2014-07-16 using Floyds (Tags: Well Sampled SNe Ic-BL)
Stop this sequence

Photometry: 7-day cadence of B (2x300s), V (2x200s), g (2x300s), r (2x200s), i (2x200s) starting 2014-08-05 using Sbig (Tags: Well Sampled SNe Ic-BL)
Stop this sequence

Current Visibility at LCOGT



Add a Photometric Sequence

	Exposure Time	No. of Exposures	Block No.
U	0	2	1
B	200	2	1
V	120	2	1
R	0	2	1
I	0	2	1
u	0	2	1
g	200	2	1
r	120	2	1
i	120	2	1
z	0	2	1

Science Tags
No tags selected +

Repeating every 3 days

Airmass Limit 2
Camera SBIG (1m)
Program SN Key Project
Priority Normal
Reminder in 7 days

Data granted to

ANU	iPTF	PTF
ASASSN	LBNL	Public
Boulder	LCOGT	QUB
CfA	LSQ	SAAO
Chase	OKC	Skymapper
China	Padova	UCB
CSP	PESSTO	UT
ex-LCOGT	PS1	
Grant to all sharing groups		

Pre-approved / urgent observations

Comments

Submit

Add a Spectroscopic Sequence

Once in the next 1 days

Exposure Time 1800
Airmass limit 2
Site Any
Program SN Key Project
Priority Normal
Reminder in 2 days

Science Tags
No tags selected +

Data granted to

ANU	iPTF	PTF
ASASSN	LBNL	Public
Boulder	LCOGT	QUB
CfA	LSQ	SAAO
Chase	OKC	Skymapper
China	Padova	UCB
CSP	PESSTO	UT
ex-LCOGT	PS1	
Grant to all sharing groups		

Pre-approved / urgent observations

Comments

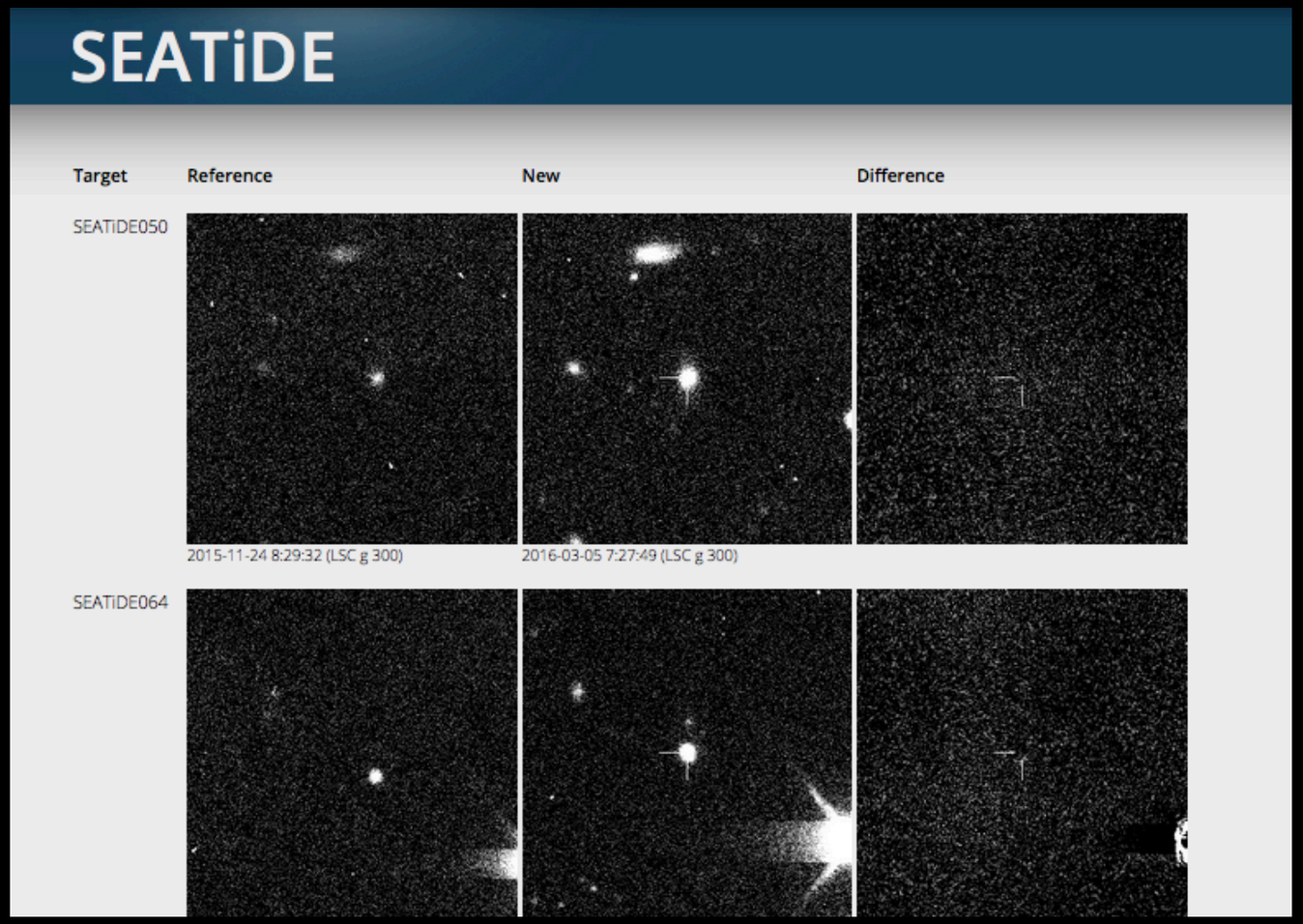
Submit

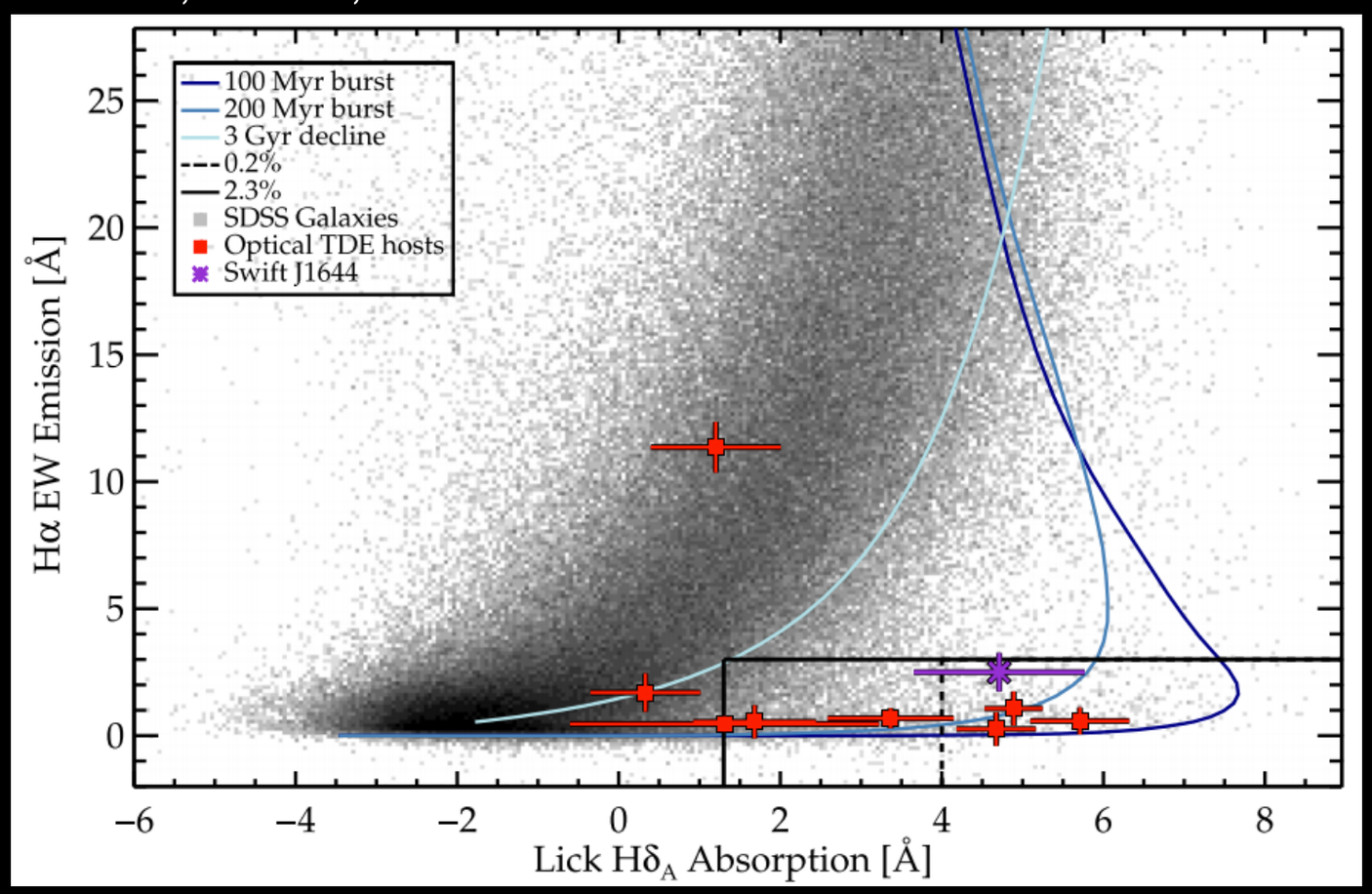
SEATiDE

Searching E+A galaxies for Tidal Disruption Events

TDEs enhanced by a factor of 200 in E+A galaxies)

French, Arcavi, & Zabludoff 2016

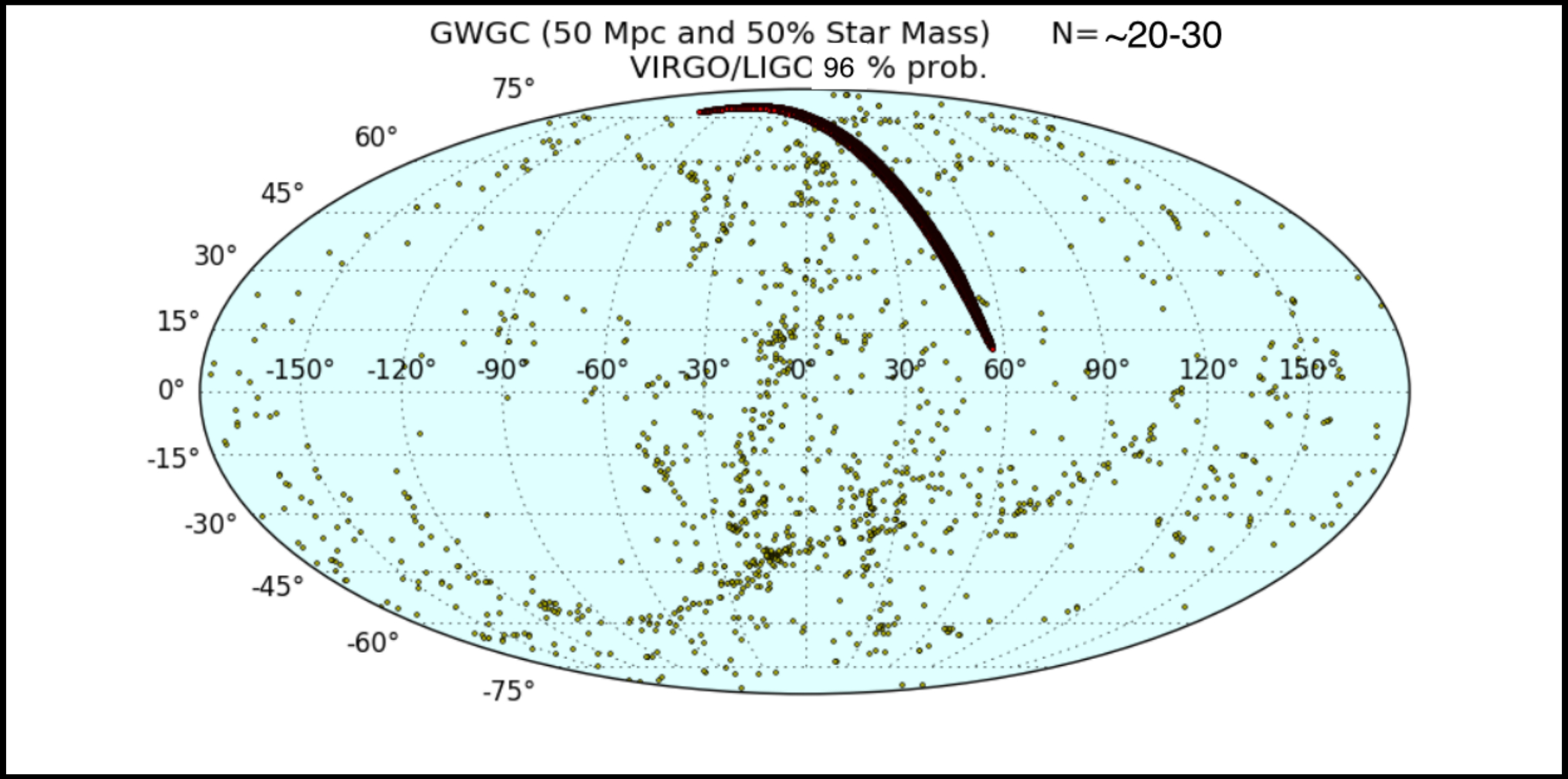




Using LCOGT: Searching 100 galaxies for a year. Expect 1ish TDEs

Soon will use KAIT to search 3000 galaxies per year.

LIGO



In collaboration with Leo Singer, Dovi Poznanski, Tsvi Piran, et al.

Find galaxies in LIGO error region, cut at 50% of mass.

Robotically observe 20-30 galaxies with 2m imagers for several days.

We are members of the LIGO/VIRGO electromagnetic follow-up collaboration, and have recently joined AMON.

Working on parsing VOEvents to trigger LCOGT without human intervention

Observatory	Contact	Letter of Collaboration	MoU in Review	MoU Signed
ANTARES	Juergen Brunner	✓	✓	✓ MOU
Auger	Miguel Mostafa	✓	✓	✓ MOU
FACT	Adrian Biland			✓ MOU
Fermi	Julie McEnery	✓		
HAWC	Ignacio Taboada	✓	✓	✓ MOU
IceCube	Doug Cowen	✓	✓	✓ MOU
Las Cumbres Observatory Global Telescope (LCOGT)	Todd Boroson	✓	✓	✓ MOU
LIGO	Gabriela Gonzalez	✓		
Large Millimeter Telescope	Alberto Carramiñana	✓	✓	✓
MASTER	Vladimir Lipunov			✓ MOU
Palomar Transient Factory	Tom Prince	✓		
Swift	Scott Barthelmy	✓	✓	✓
VERITAS	Abe Falcone	✓	✓	✓

For the future

Trigger LCOGT yourself — don't just send an email.

Make alerts more reliable (e.g. early colors, host galaxy priors, better asteroid screening, better machine learning) so we can trigger robotic follow-up without humans.

Browse SNEx — tons of SN data is sitting there waiting to be used.