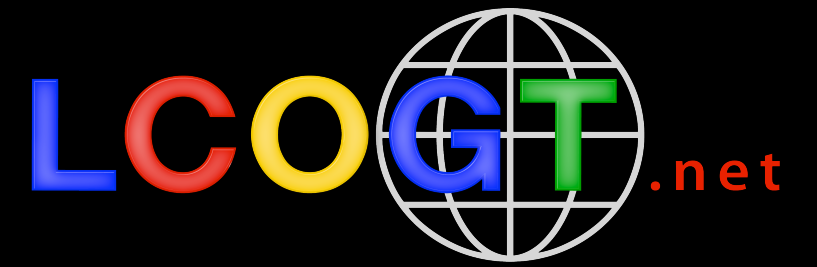


Las Cumbres Observatory Global Telescope Network

Andy Howell

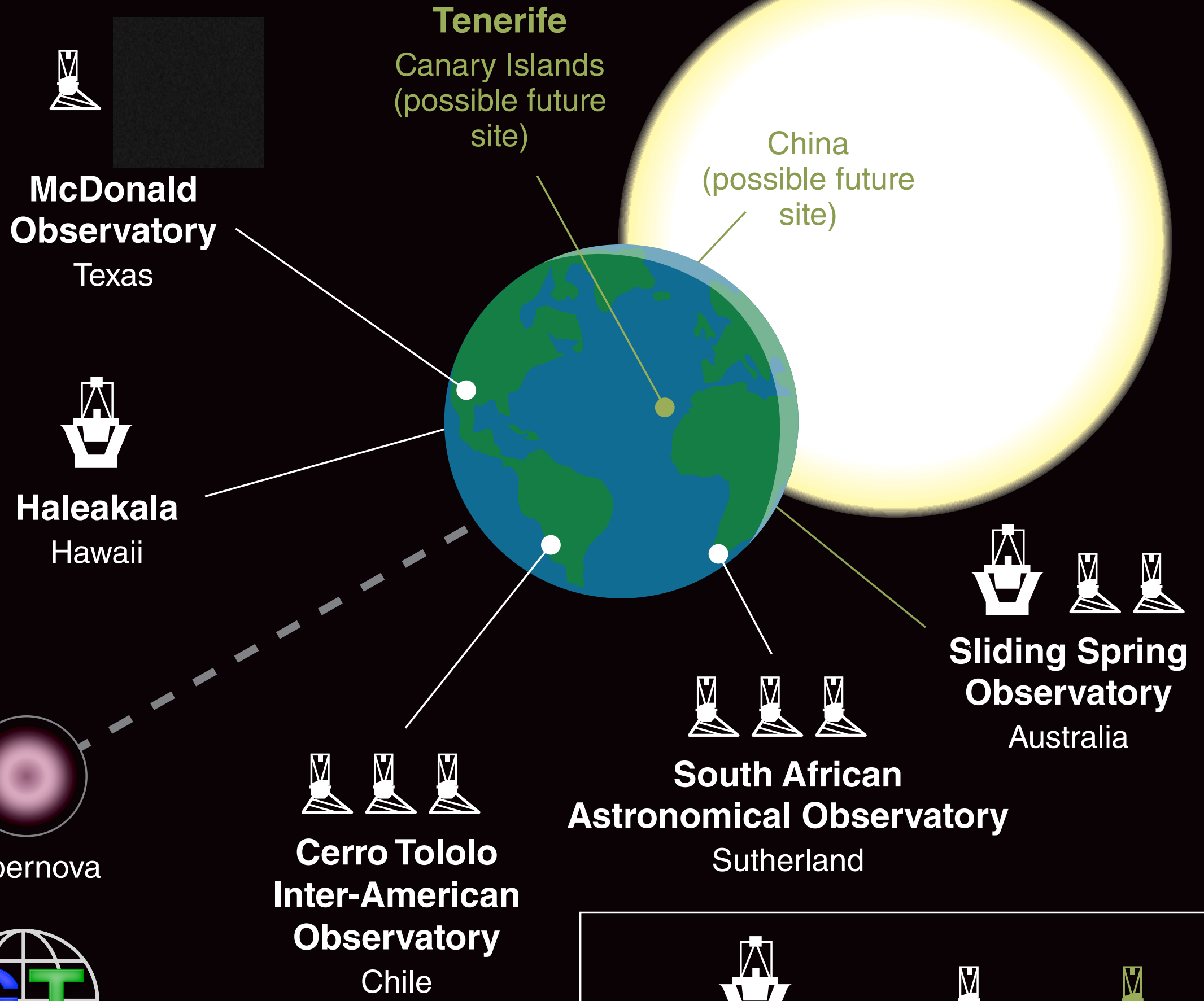


SAAO

@BrunoLetarte



supernova

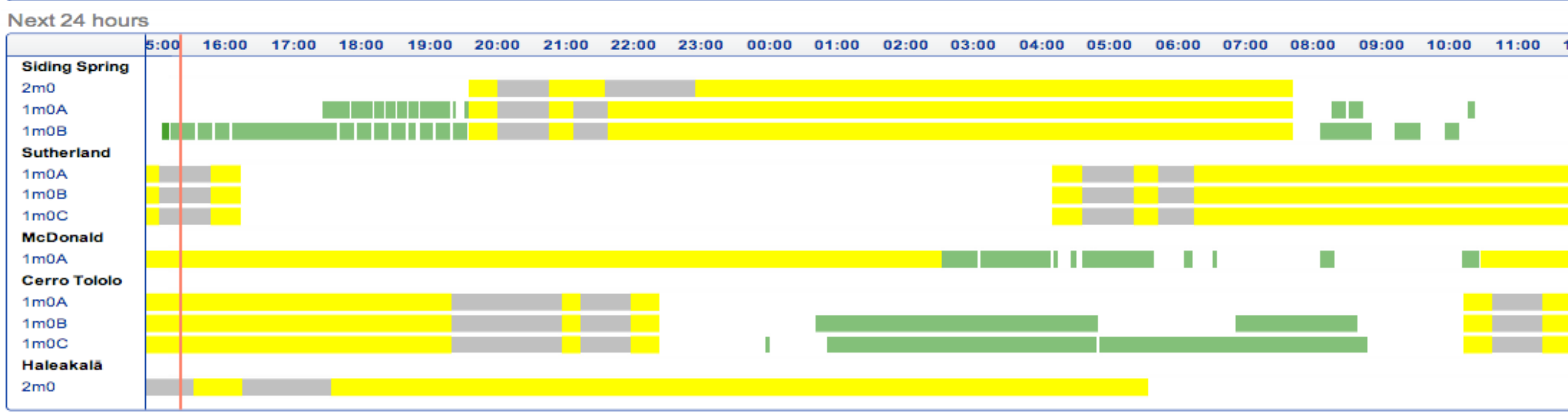
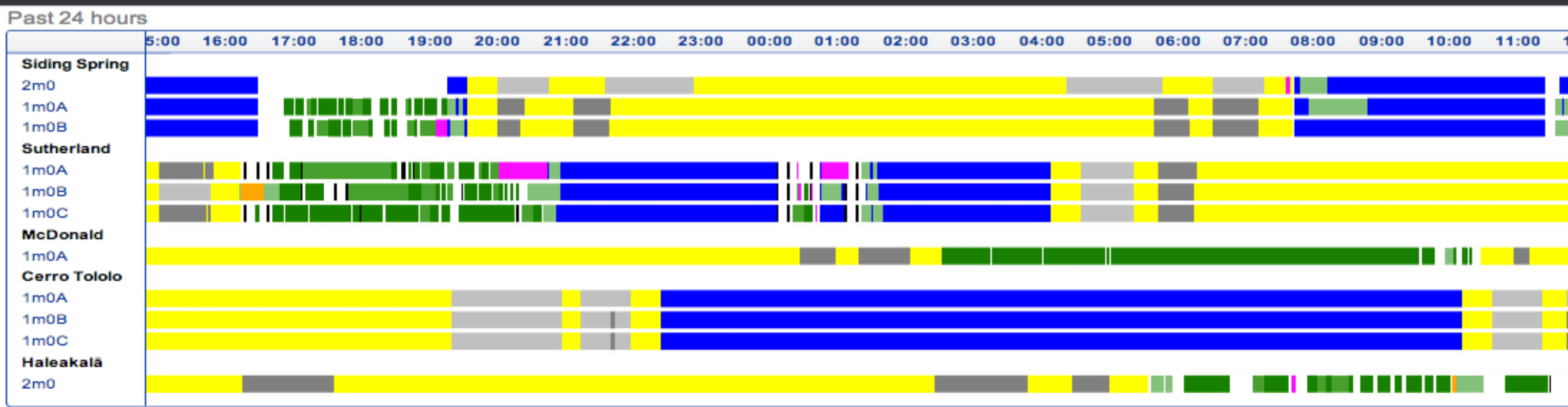


2 meter Faulkes	1 meter	proposed

Network Scheduler

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

Las Cumbres Observatory Global Telescope Network



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

LCOGT Science Archive Documentation Api LCOGT.net ahowell@lcogt.net Logout

2016-04-01 00:00
2016-09-30 23:59

Download 0

Proposal? KEY2014A-003

Include public data

Basename

Point? Lookup RA Dec

Object?

Obstype All

Reduction Level All

Site All

Telescope All

Instrument

<input type="checkbox"/>	Basename	Time	Proposal	Object	Filter	Type	Exp. Time	R.level
+ <input type="checkbox"/>	coj2m002-en05-20160520-0013-a00	2016-05-20 12:28:37	KEY2014A-003	SN2016X	air	ARC	80.000	Raw
+ <input type="checkbox"/>	coj2m002-en05-20160520-0012-w00	2016-05-20 12:14:08	KEY2014A-003	SN2016X	air	LAMPFLAT	20.000	Raw
+ <input type="checkbox"/>	coj2m002-en05-20160520-0011-a00	2016-05-20 12:12:00	KEY2014A-003	SN2016X	air	ARC	80.000	Raw
+ <input type="checkbox"/>	ogg2m001-en06-20160519-0027-w00	2016-05-20 12:07:07	KEY2014A-003	SN2016ccj	air	LAMPFLAT	20.000	Raw
+ <input type="checkbox"/>	ogg2m001-en06-20160519-0026-a00	2016-05-20 12:04:56	KEY2014A-003	SN2016ccj	air	ARC	80.000	Raw
+ <input type="checkbox"/>	coj2m002-en05-20160520-0010-w00	2016-05-20 11:59:54	KEY2014A-003	SN2016zb	air	LAMPFLAT	20.000	Raw
+ <input type="checkbox"/>	coj2m002-en05-20160520-0009-a00	2016-05-20 11:57:49	KEY2014A-003	SN2016zb	air	ARC	80.000	Raw
+ <input type="checkbox"/>	ogg2m001-en06-20160519-0025-e00	2016-05-20 11:32:56	KEY2014A-003	SN2016ccj	air	SPECTRUM	1800.000	Raw
+ <input type="checkbox"/>	coj2m002-en05-20160520-0007-w00	2016-05-20 11:26:00	KEY2014A-003	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 SNEEx

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

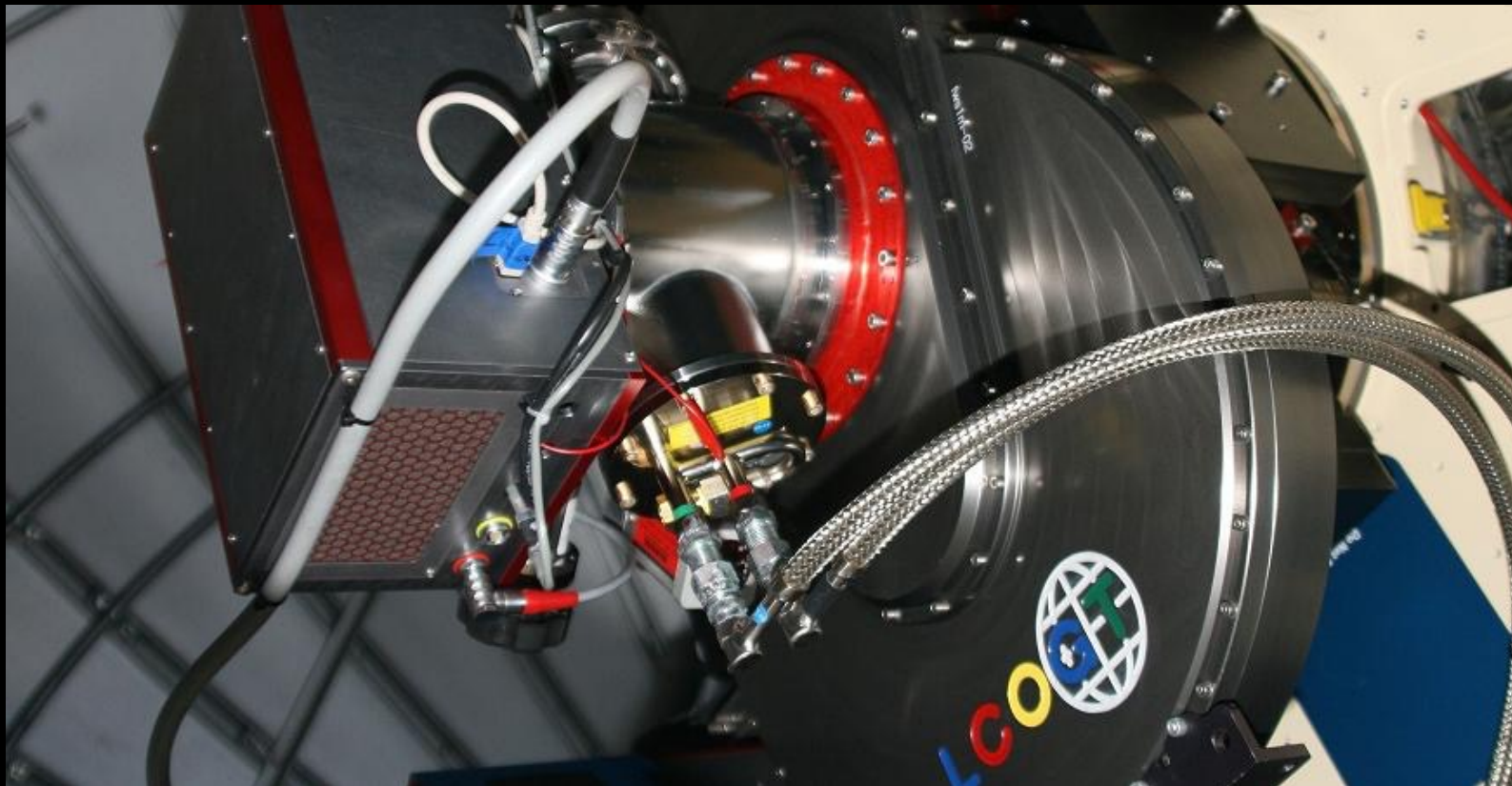


1m Imaging



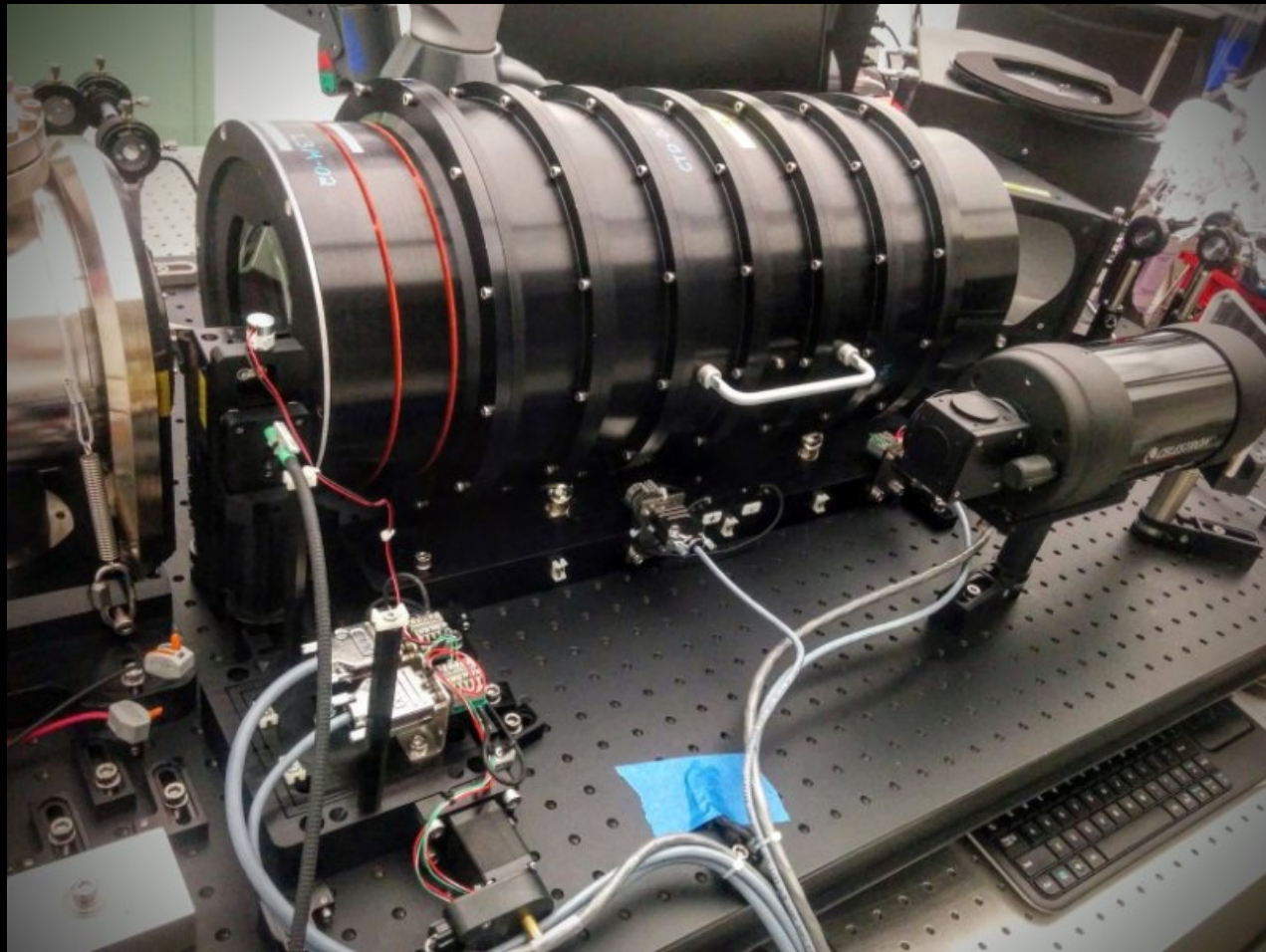
Sinistro: 26.4' x 26.4', 0.389"/pixel.
Fairchild CCD486, backside illuminated.
21 position filter wheel, photometric
shutter. 16 Mpix; 4 Mpix/s readout at
~10 e-/pix

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



SINISTRO
1st light

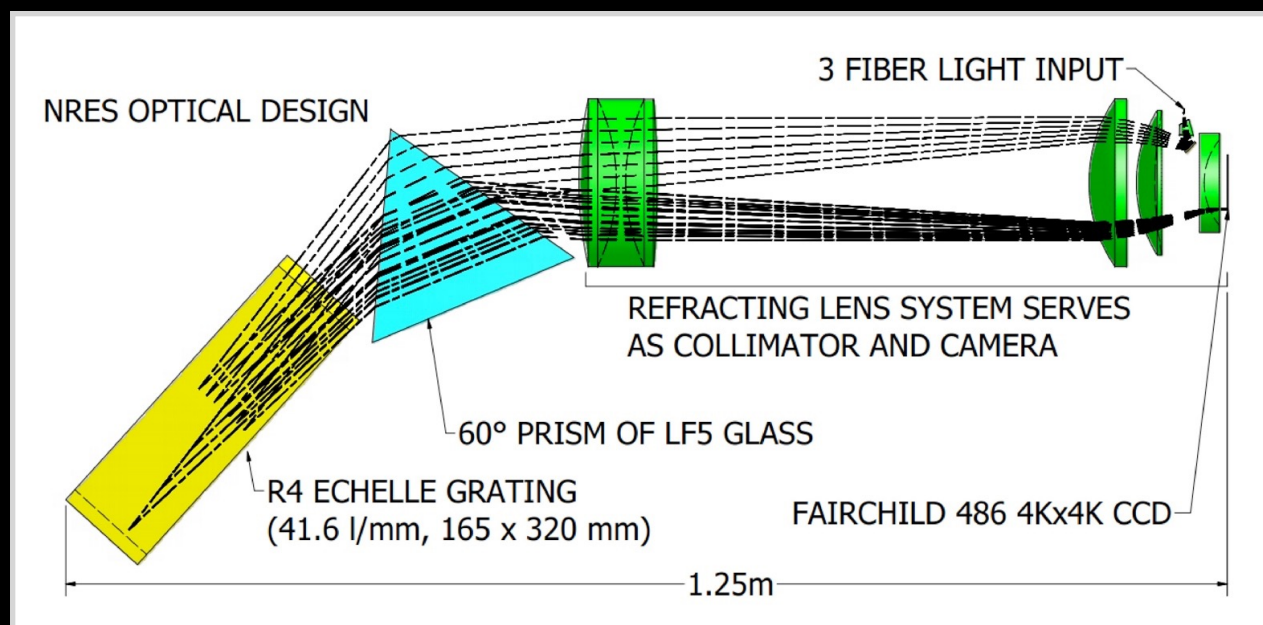
1m Spectroscopy



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

High-resolution ($R \sim 53,000$), 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 $V = 12$

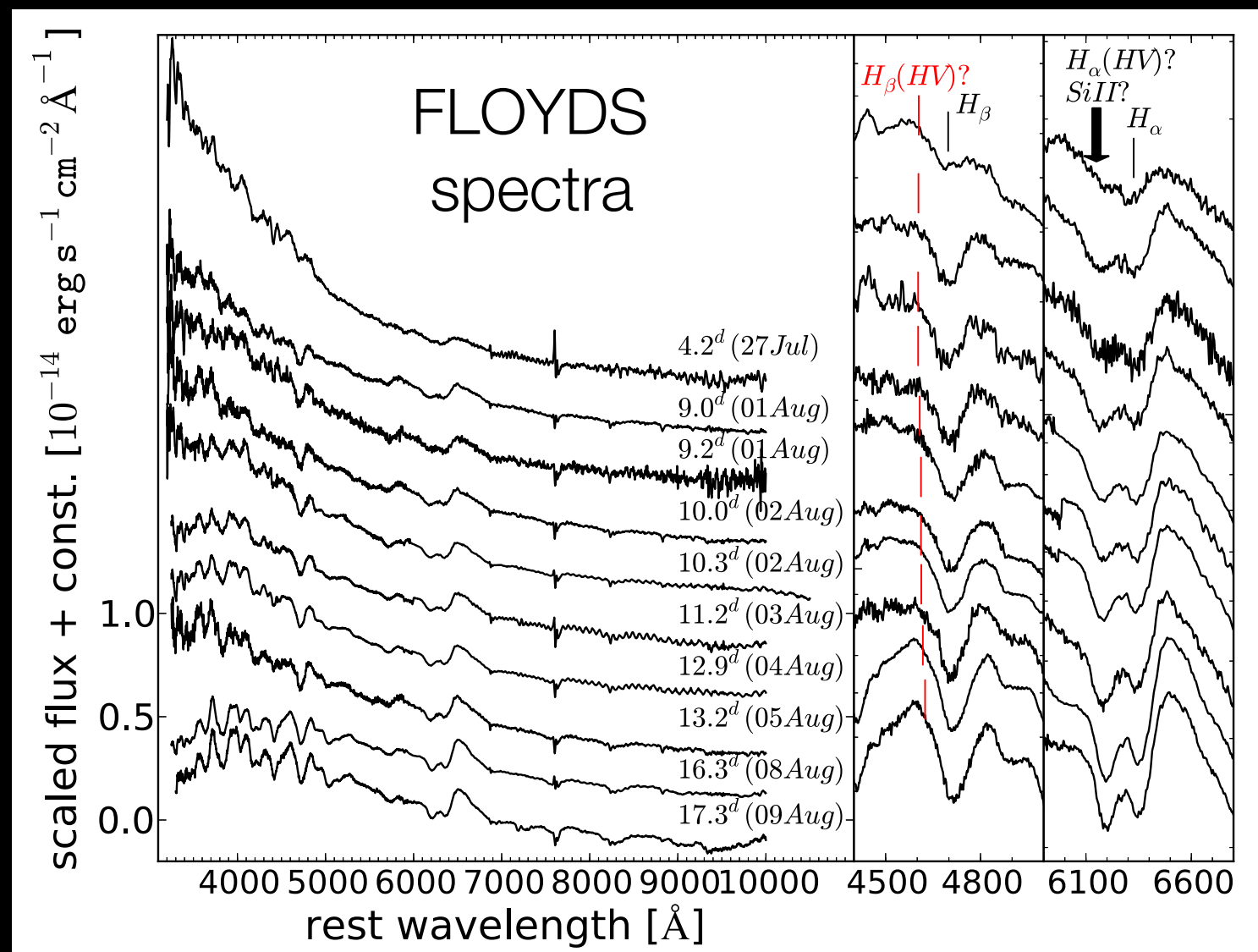
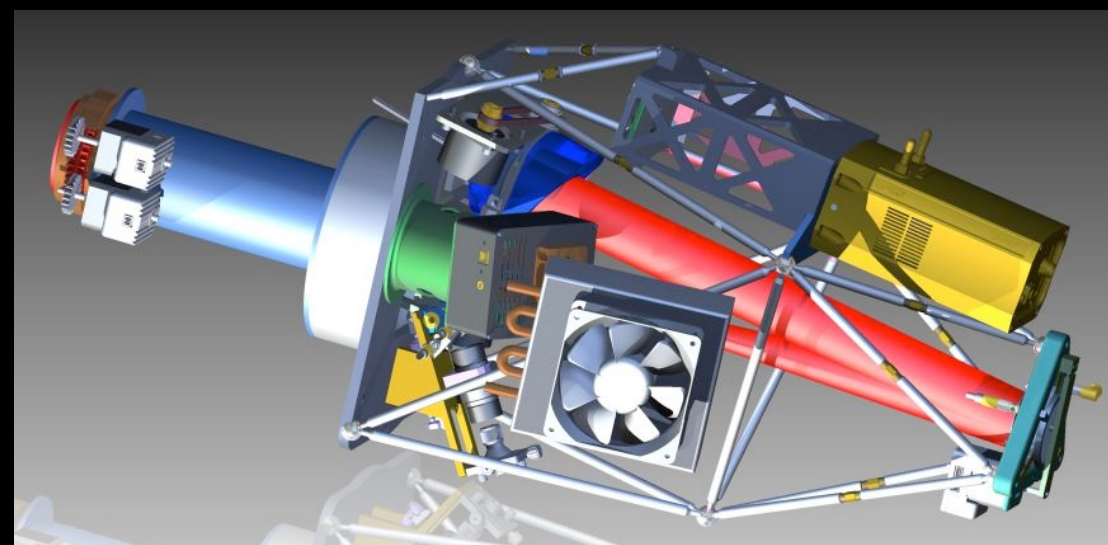
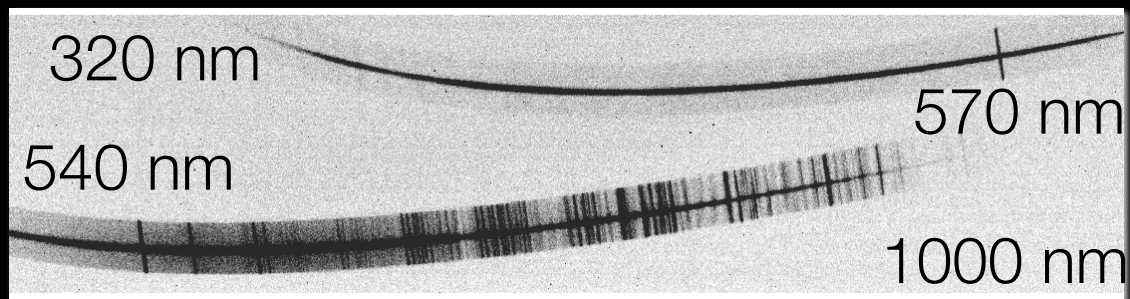
NSF funded. Prototype is on Sedgwick 0.8m

2m FLOYDS robotic low resolution spectrographs

Designed for supernovae

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

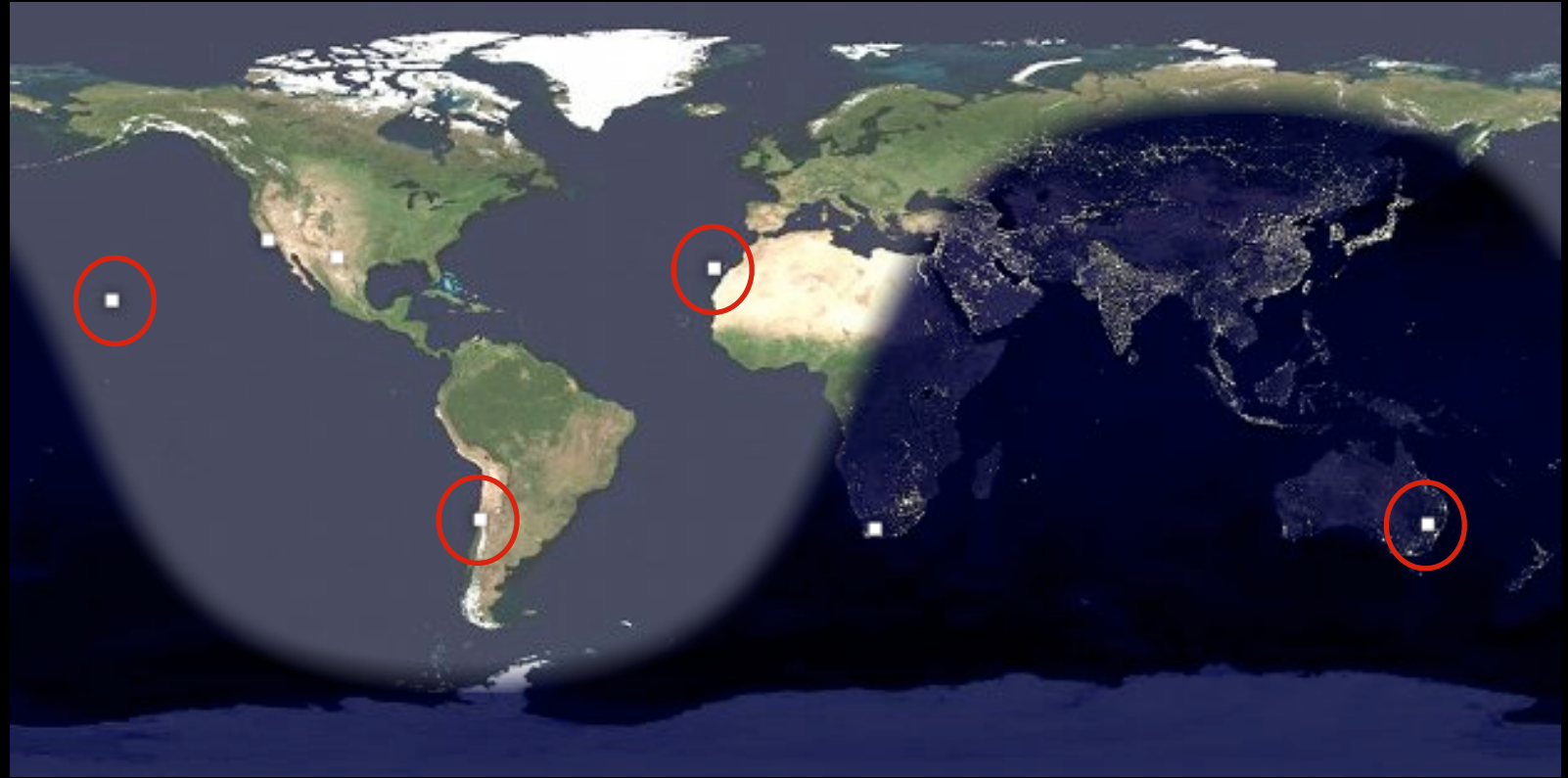
Can go down to V~18.5 mag with S/N=10 in 1 hour



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

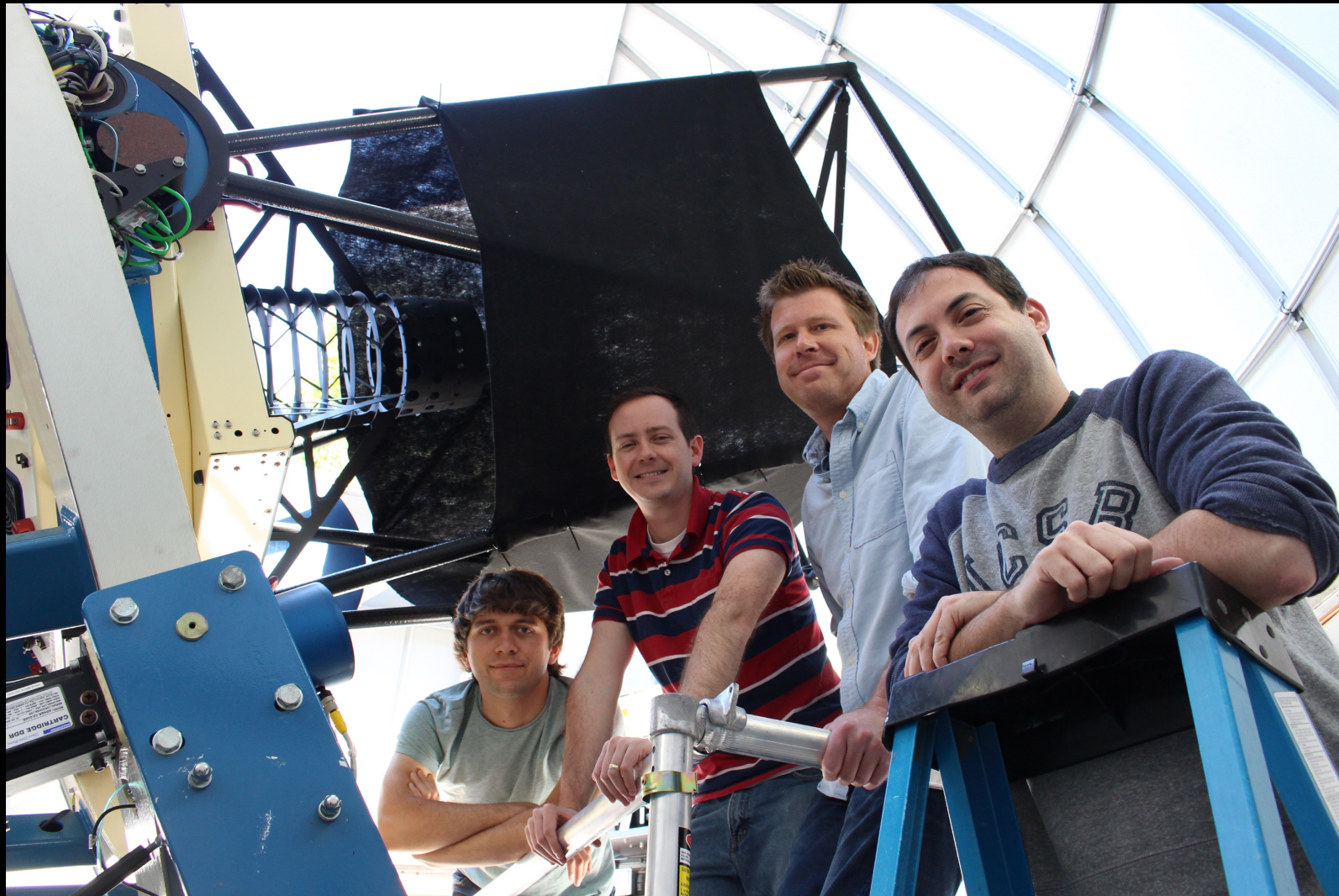
Haleakala

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

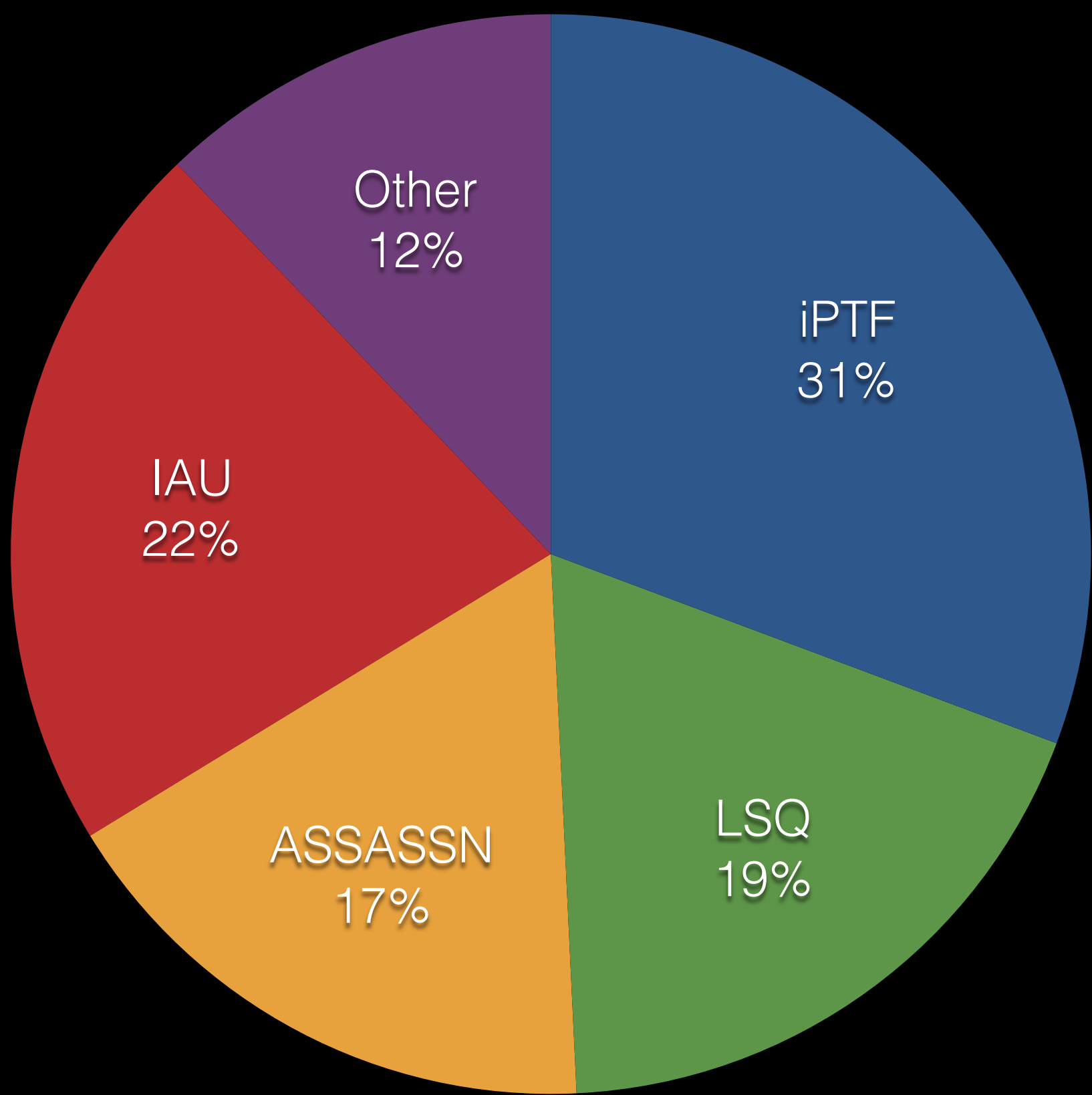
1160 spectra of 254 objects

Public surveys

- ASAS-SN
- Catalina Sky Survey
- MASTER
- OGLE
- KAIT
- ATLAS
- Gaia

Member surveys

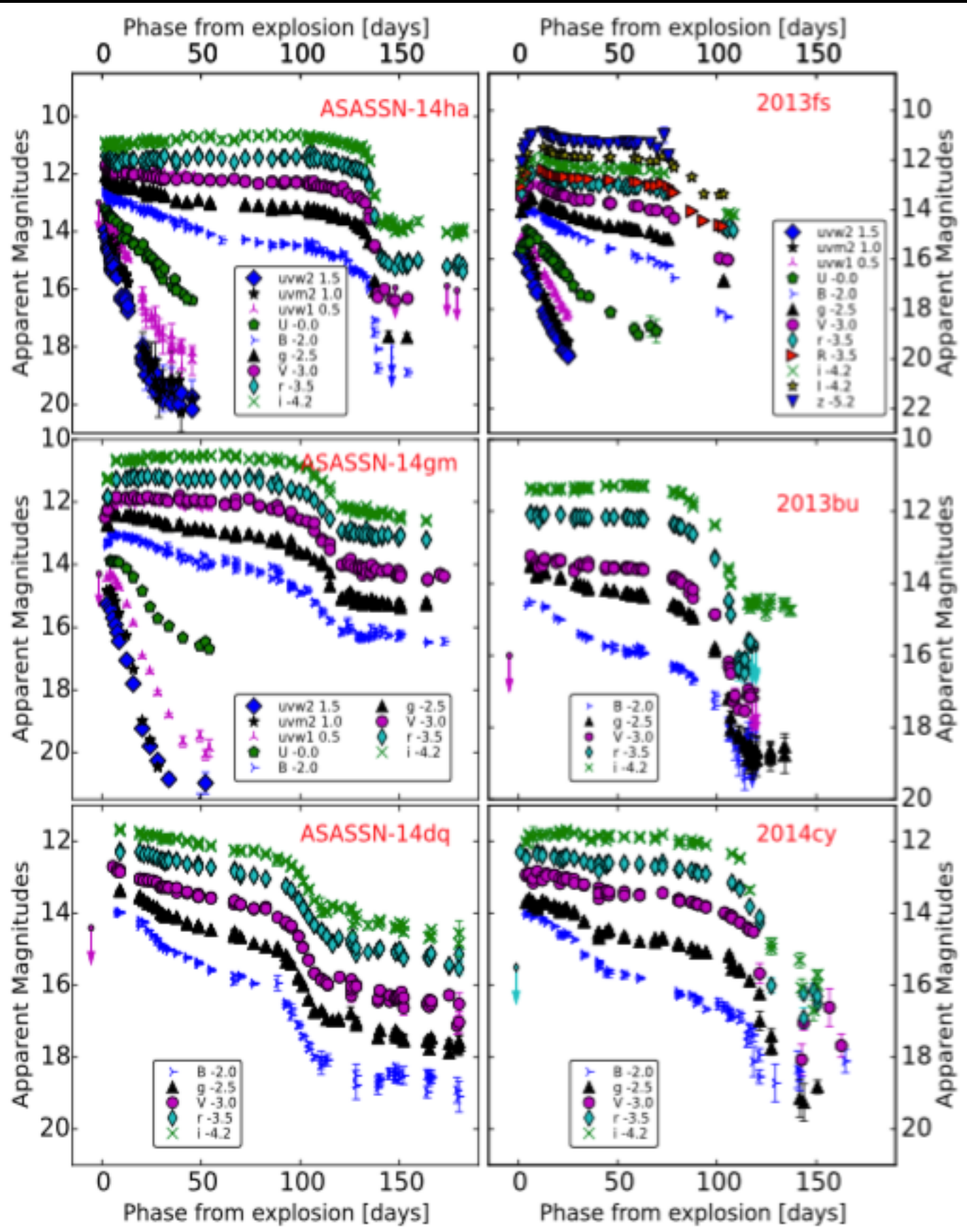
- iPTF
- PS1
- PESSTO
- La Silla-Quest
- KMTNet
- Sky mapper



~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 syncing with iPTF

LCOGT photometry and spectroscopy automatically appears.

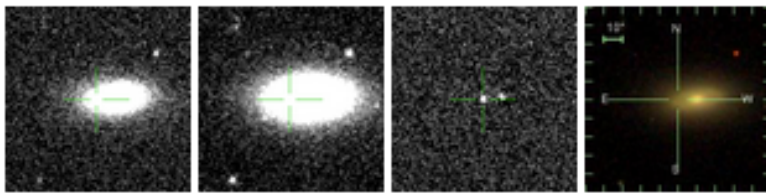
Link to SNEx

12:52:44.84 +26:28:13.0
193.186849 +26.470284
Note: 2.7" from 14tz

View another

OVERVIEW PHOTOMETRY SPECTROSCOPY FOLLOWUP OBSERVABILITY FINDING CHART EXAMINE PAGE

NEW REF SUB SDSS



16 18 20 22
125 100 75 50 25
-19 -17 -15 -13
4000 6000 8000 10000

$r = 18.7$ (50.7 d) | Upload New Photometry
 $z = 0.021405$ | Upload New Spectroscopy
DM (approximate) = 34.79

ADDITIONAL INFO

ED SNEx SIMBAD Vizier HEASARC SkyView PyMP MPChecker Extinction
IPAC DSS WISE Subaru VLT FIRST CRTS Variable Marshal (Search) ADS

FOLLOW UP

PROGRAMS

Date	Program	Priority	Type
2014 May 05	P60 Transient Vetting	3	phot
2014 May 05	Transients in the Local Universe	1	phot
2014 May 06	Core-collapse SN Photometry	4	all
2014 May 09	Transients in the Local Universe	5	all

GROUPS

Name	Cadence	Maximum Age
CC 2day Bgriz	2 days	30 days
gri single snapshot	1 day	10 days
group 1 day gri	1 day	150 days
r snapshot	1 day	5 days

ADD FOLLOWUP

Program: <--- Select Program --->
Observing Group: No Follow Up
Observation type: all Priority: 1 (1=low, 5=high)

ASSIGNMENTS

Date	Instrument	Priority	Comment	Status
2014-05-05	Lick 3-m+KAST	4.0	Classification I	pending

CROSS REFERENCES

ATel 6168: ASAS-SN Discoveries of a Probable Supernova in IC 0831 and a Possible Extreme (delta V > 6.6 mag) M-dwarf Flare T. W.-S. Holien et al., 2014 May 24

COMMENTS

2014 Aug 09 ycao [comment]: According to Dan, the absorption at 6630 is a weak telluric line.
2014 Aug 04 lair [type]: Transient
2014 Aug 04 lair [type]: Transient
2014 Aug 04 lair [type]: Transient
2014 Aug 04 lair [type]: Transient
2014 Jul 30 penugent [phase]: -2 days
2014 Jun 12 ycao [comment]: fine reduction
2014 Jun 12 ycao [comment]: fine reduction
2014 Jun 11 ycao [info]: Spectral comparison between 14atg and 91bg around max [view attachment]
2014 Jun 11 ycao [info]: Swift UVOT light curve [view attachment]
2014 May 16 joeljo [info]: Looks like a 91bg (but with shallower abs. features à la 91T) [view attachment]
2014 May 11 joeljo [classification]: SN Ia
2014 May 10 ftadd [info]: NOT triggered for spectroscopy
2014 May 09 avishay [comment]: Similar to the early spectrum of IPTF13ab, which we classified as SN Ic. Given host properties, may instead prompt reclassifying both objects (13ab and 14atg) as some sort of peculiar SN I from an old progenitor, akin to SNe Ia. [view attachment]
2014 May 06 ycao [info]: Swift triggered
2014 May 06 ftadd [redshift]: 0.021405
2014 May 05 isagiv [SDSS_specz]: 0.02129
2014 May 05 mansi [nearpgc]: PGC43708
2014 May 05 mansi [distmod]: 34.86
2014 May 05 isagiv [type]: Transient

Add a Comment:

Attach File:
Choose File NO FILE CHOSEN
info Save Comment

SEND AN ALERT

Soft Alert (email iptftransient)
Hard Alert (email + SMS)

Request immediate LCOGT photometry
Request immediate LCOGT spectroscopy

PERSONALIZE

Add to Favorites
Subscribe to this Target (daily digest)
Subscribe to this Target (immediate alerts)

welcome to

SNEx

the SupernovaExchange

AT 2016bse SN II $z = 0.0344$

09:20:34.30 +50:41:46.8
140.142917 +50.696333



iPTF14hls

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

1119 photometry points and counting

48 spectra

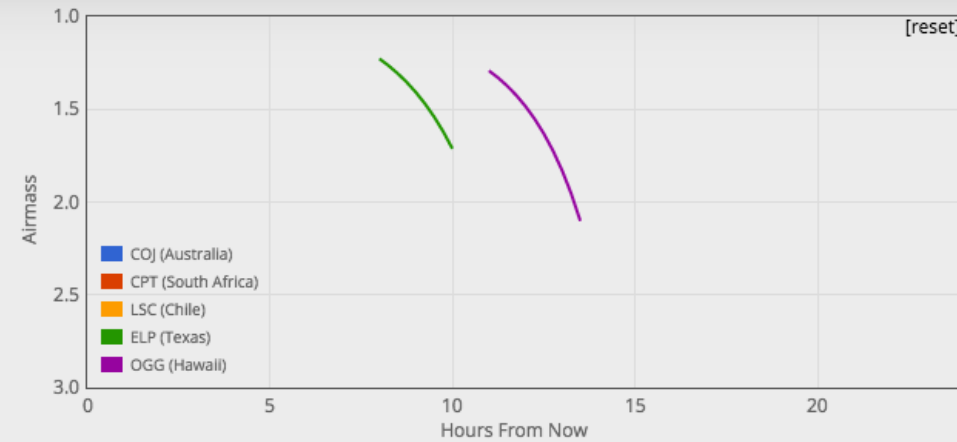
Known as:
CSS141118:092034+50414...
iPTF14hls
AT 2016bse

- Known to:**
- AMNH
 - ANU
 - ASASSN
 - Boulder
 - CfA
 - Chase
 - China
 - CSP
 - ex-LCOGT
 - Gaia
 - iPTF
 - KMTNet
 - LBNL
 - LCOGT
 - LSQ
 - OGLE
 - OKC
 - Padova
 - PESSTO
 - PS1
 - PTF
 - Public
 - QUB
 - SAAO
 - SDSU
 - Skymapper
 - TAU
 - UCB
 - UCB-Kasen
 - UT
- Grant to all sharing groups

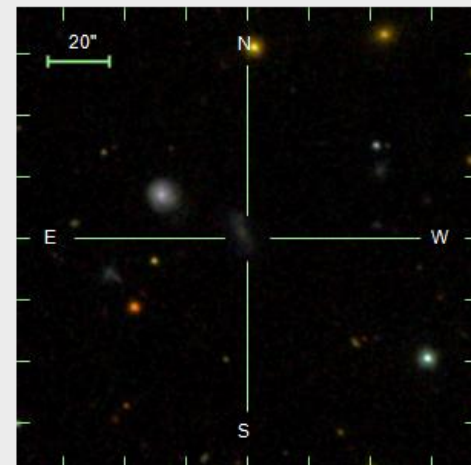
Object Comments

- lair** Found by Andrew, spectacularly interesting light curve in PTF
2015-02-03 20:41:59
 - Andy** It was ToO. I stopped that and started normal monitoring.
2015-03-26 00:31:30 *Delete this comment*
 - Stefano** soon we should increase the cadence to get the end of the plateau
2015-04-26 18:53:47
 - lair** This is a peculiar Type II, which has been going on for at least 220 days, it is not clear when or if a fall from plateau is expted
2015-05-04 04:25:14
 - lair** Now rising again, unbelievable..! Soon will need to split photometric sequence to two blocks due to deminishing observability
2015-05-16 23:32:11
 - Stefano** not visible any more
2015-07-04 15:05:07
 - lair** It's back! Latest PTF spectrum is still IIP with only slightly lower velocities
2015-09-20 19:50:02
 - lair** Rising again! On the way to peak number >=5.
2015-10-22 06:23:14
 - lair** Now declining fast. May need to increase exposure times soon.
2015-12-25 07:24:15
- Add a comment...

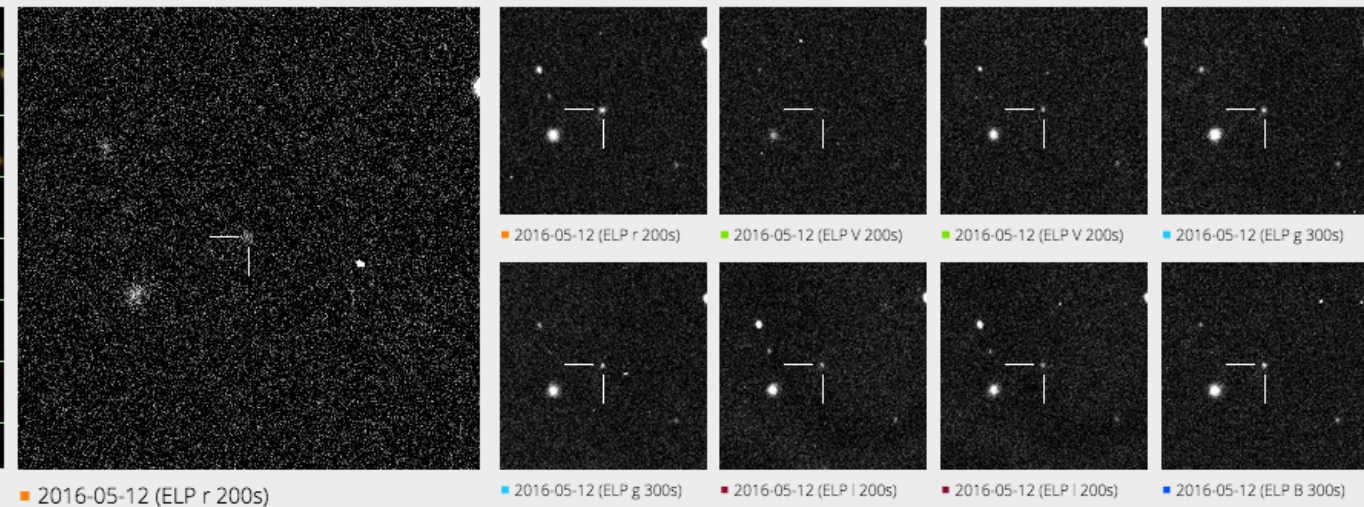
Current Visibility at LCOGT



SDSS



Latest LCOGT Images



Interested Persons:

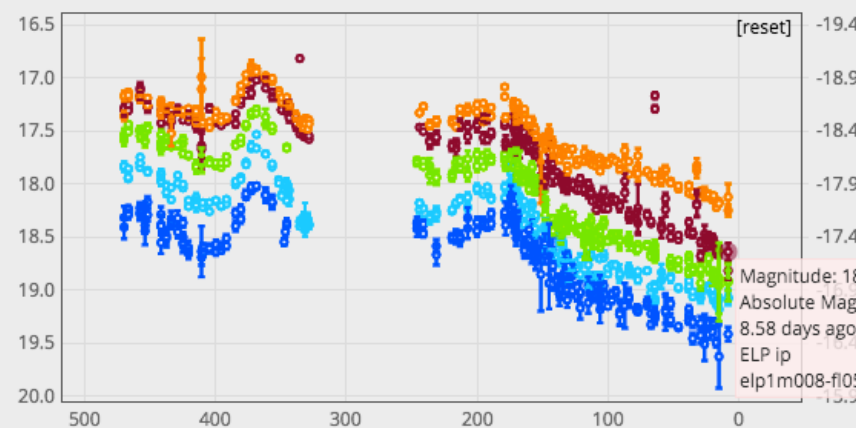
- Stefano Valenti
- Andy Howell
- lair Arcavi

I'm not interested in this object

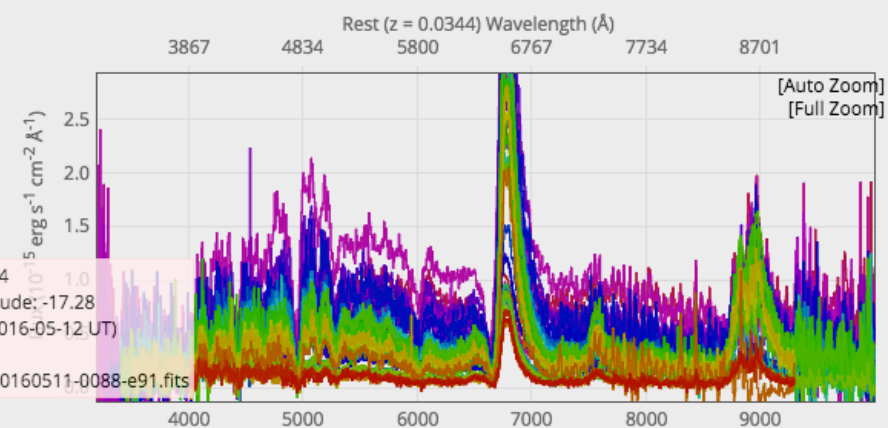
Science Interests:

- Peculiar SNE
- SN II Plateau Lengths

Photometry



Spectroscopy (binned)





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](#)

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 +

Comments

Repeating every days

Airmass Limit
 Camera
 Program
 Priority
 Reminder in days

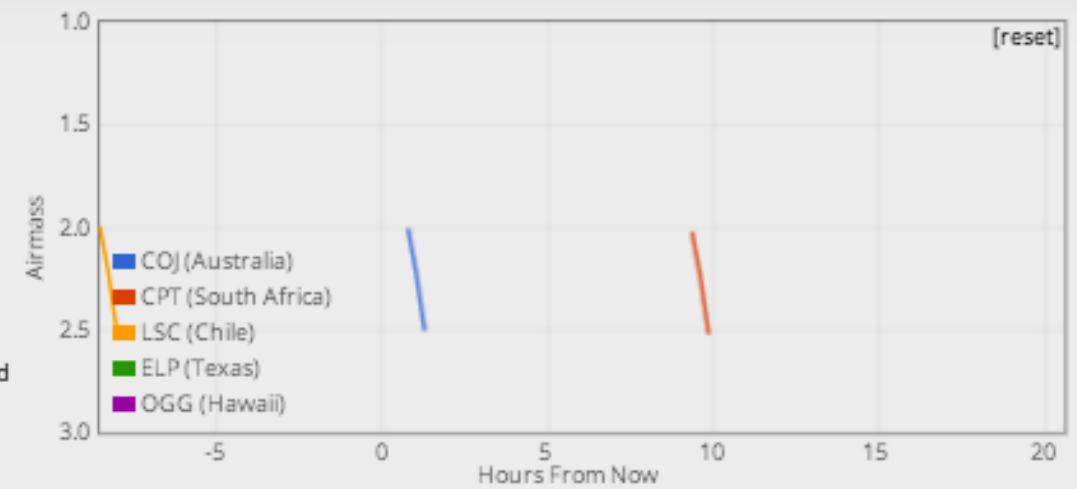
Data granted to

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

Pre-approved / urgent observations

Submit

Current Visibility at LCOGT



Add a Spectroscopic Sequence

Once in the next days

Exposure Time
 Airmass limit
 Site
 Program
 Priority
 Reminder in days

Science Tags
No tags selected +

Data granted to

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

Pre-approved / urgent observations

Comments

Submit

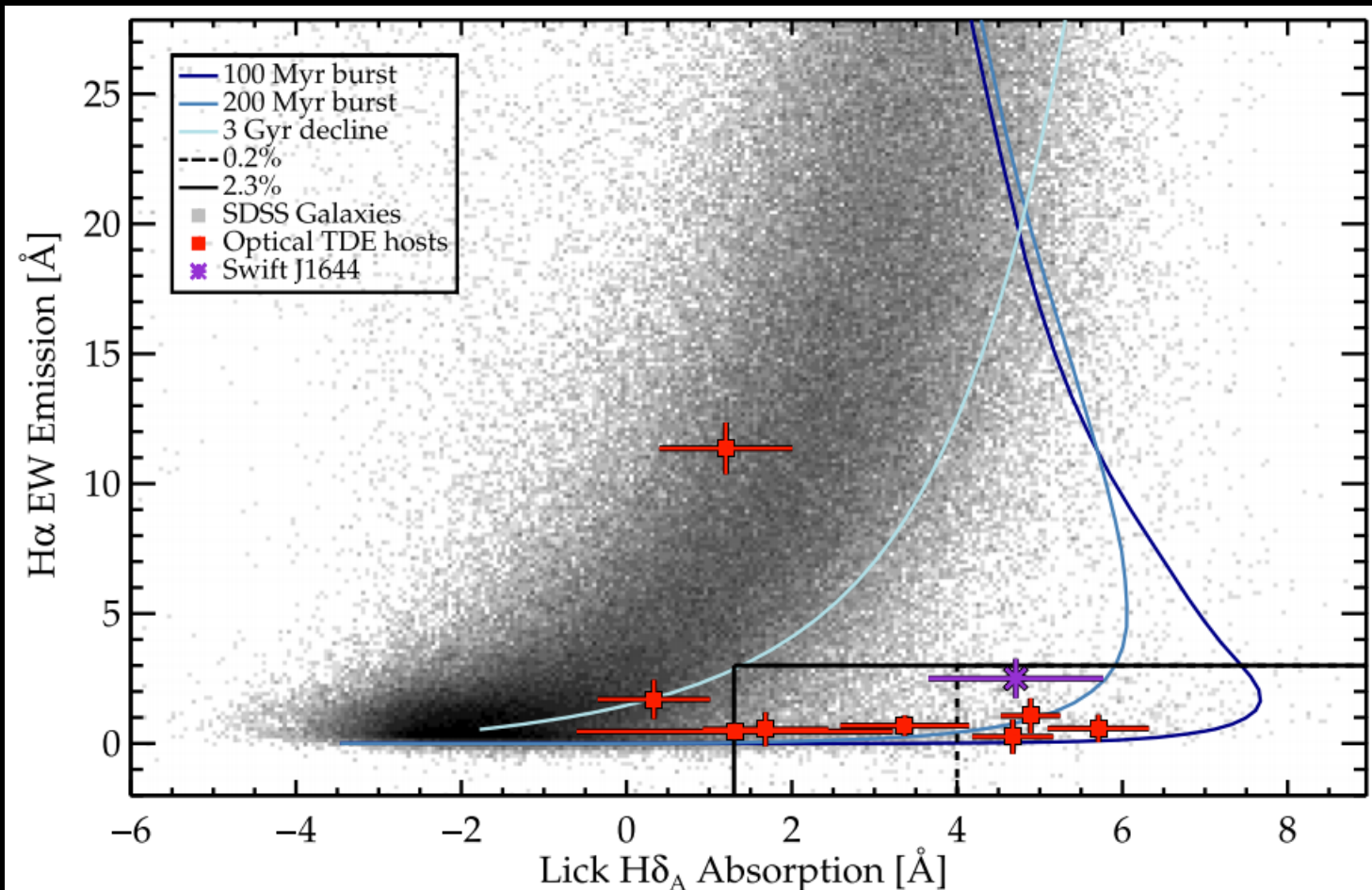
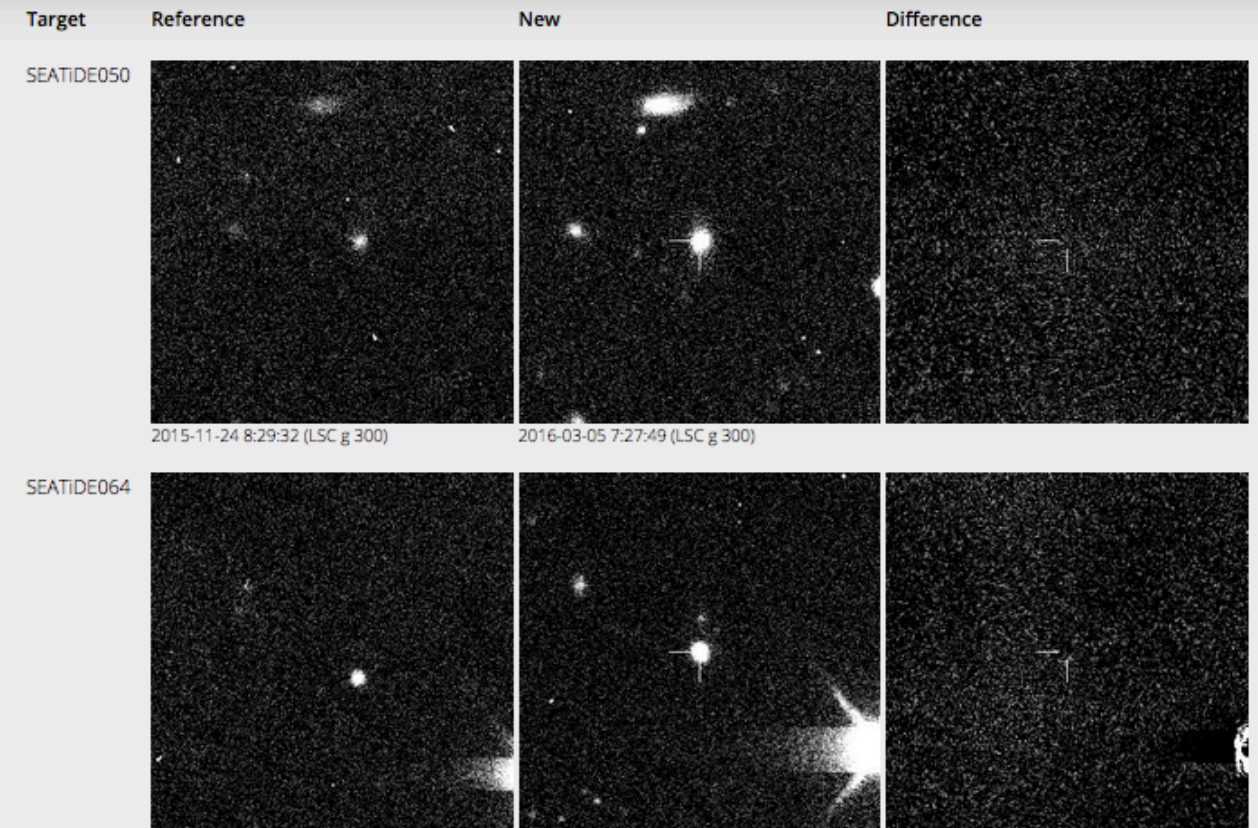
SEATiDE

Searching E+A galaxies for Tidal Disruption Events

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

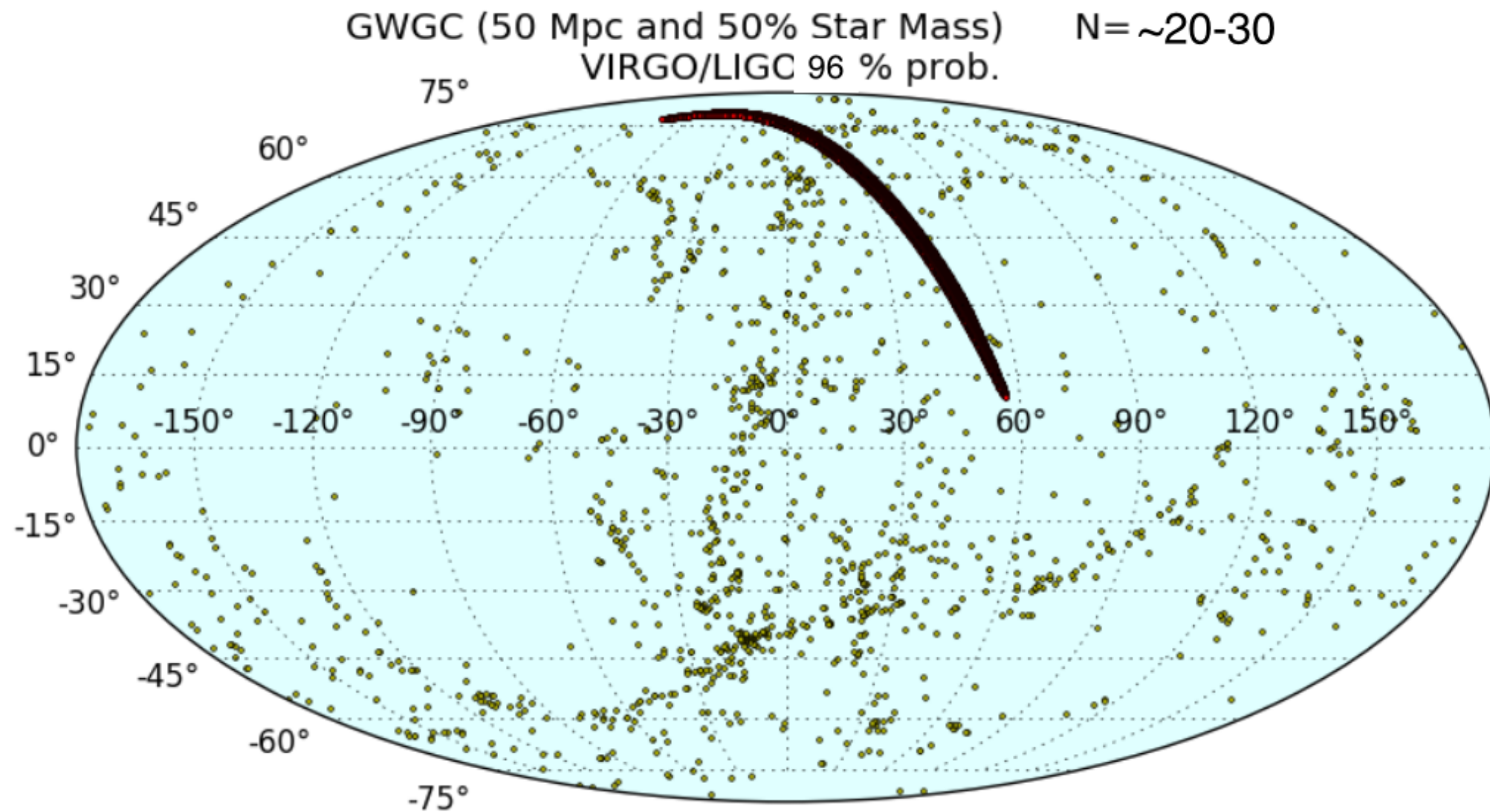
French, Arcavi, & Zabludoff 2016

SEATiDE



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

Soon will use KAIT to search 3000 galaxies per year.



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

14atg SN Ia +90.6d Note: 2.7" from 14hr

12:52:44.64 +26:28:13.0
193.186849 +26.470284

OVERVIEW PHOTOMETRY SPECTROSCOPY FOLLOWUP OBSERVABILITY FINDING CHART EXAMINE PAGE

NEW REF SUB SDSS

$r = 18.7$ (50.7 d) | Upload New Photometry

$z = 0.021405$ | Upload New Spectroscopy
DM (approximate) = 34.79

ADDITIONAL INFO

NEB SNE_x SIMBAD Vizier HEASARC SkyView PyMP MPChecker Extinction

IPAC DSS WISE Subaru VLT FIRST CRTS Variable Marshal (Search) ADS

FOLLOW UP

PROGRAMS

Date	Program	Priority	Type
2014 May 05	P80 Transient Vetting	3	phot
2014 May 05	Transients in the Local Universe	1	phot
2014 May 06	Core-collapse SN Photometry	4	all
2014 May 09	Transients in the Local Universe	5	all

GROUPS

Name	Cadence	Maximum Age
CC 2day Bgriz	2 days	30 days
gri single snapshot	1 day	10 days
group 1 day gri	1 day	150 days
r snapshot	1 day	5 days

ADD FOLLOWUP

Program: [Select Program]

Observing Group: [No Follow Up]

Observation type: [all] Priority: [1] (1=low, 5=high)

ASSIGNMENTS

Date	Instrument	Priority	Comment	Status
2014-05-05	Lick 3-m+KAST	4.0	Classification I	pendin

Home | Favorites | View object: []

SN2014ad SN Ic-BL $z = 0.005$

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

Known as: PSN1157444, PSN1157, SN2014ad

Object Comments

- SV** blue continuum, strange features, in close galaxy, spectrum taken from M. Childress
- lair** No recent data, trying to split observations
- dah** We missed the peak. Should we still follow this?
- lair** Yes, Ic-BL's are super rare, continuing followup. We can collaborate for peak data.

Current Visibility at LCOGT

2014-08-07 (CPT r 200s), 2014-08-07 (CPT V 200s), 2014-08-07 (CPT V 200s), 2014-08-07 (CPT g 300s), 2014-08-07 (CPT g 300s), 2014-08-07 (CPT i 200s), 2014-08-07 (CPT i 200s), 2014-08-07 (CPT i 300s), 2014-08-07 (CPT B 300s)

Latest LCOGT Images

Calibrated Photometry

Science Interests: Well Sampled SNe Ic-BL

Spectroscopy

Rest ($z = 0.005$) Wavelength (Å): 3980, 4975, 5970, 6965, 7960, 8955, 9950, 10945

Flux ($10^{-15} \text{ erg s}^{-1} \text{ cm}^{-2} \text{ \AA}^{-1}$)

Observed Wavelength (Å): 4000, 5000, 6000, 7000, 8000, 9000, 10000, 11000