LSST TVS collaboration

federica b. bianco, NYU
The Transient and Variable Stars LSST Collaborations

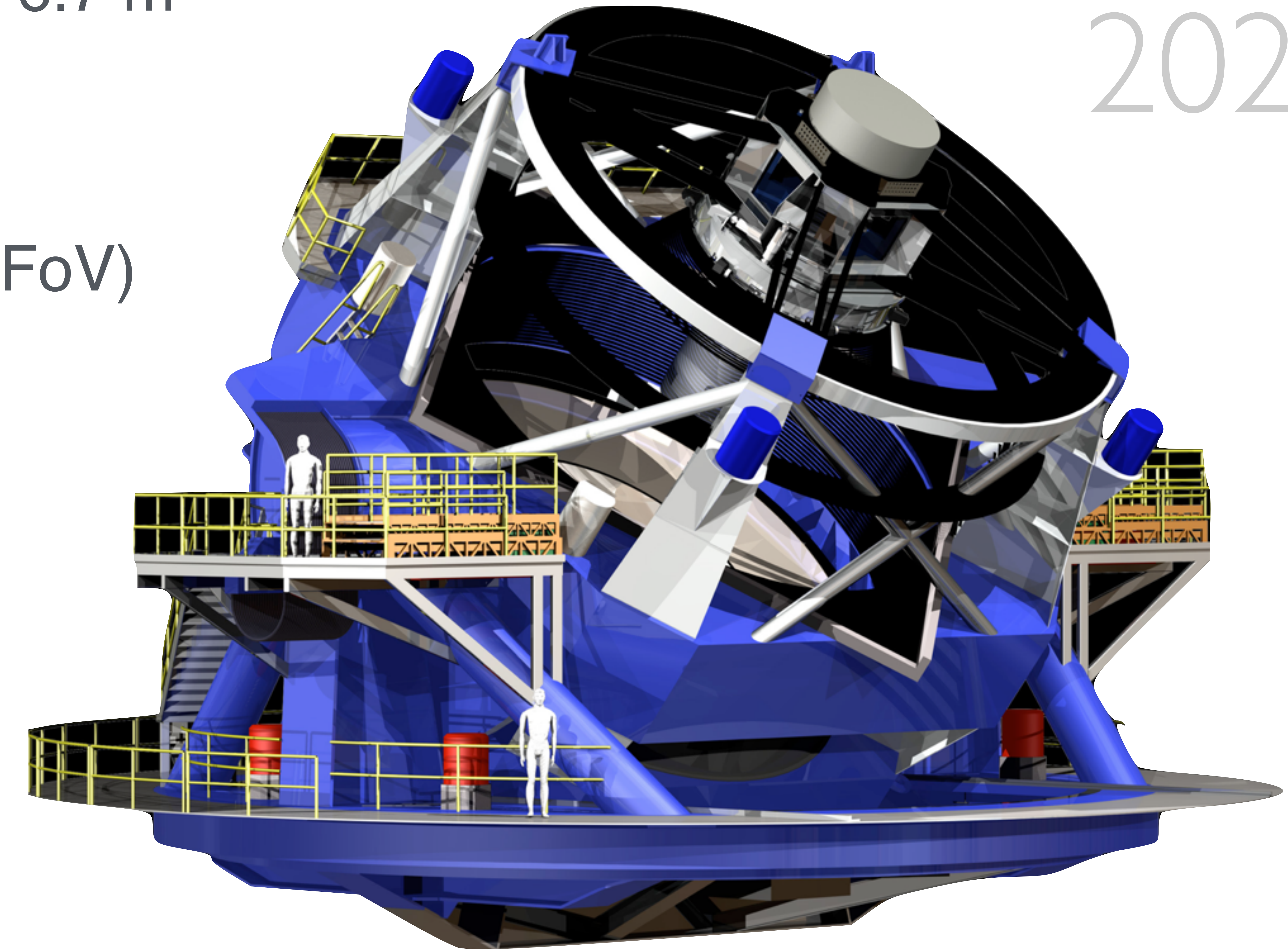
@fedhere

fedhere

Atacama Desert, Cerro Pachon

- effective aperture of 6.7 m
- FoV 9.6 deg^2
- large *etendue*
  (collecting area x FoV)

2022-2032



federica bianco NYU

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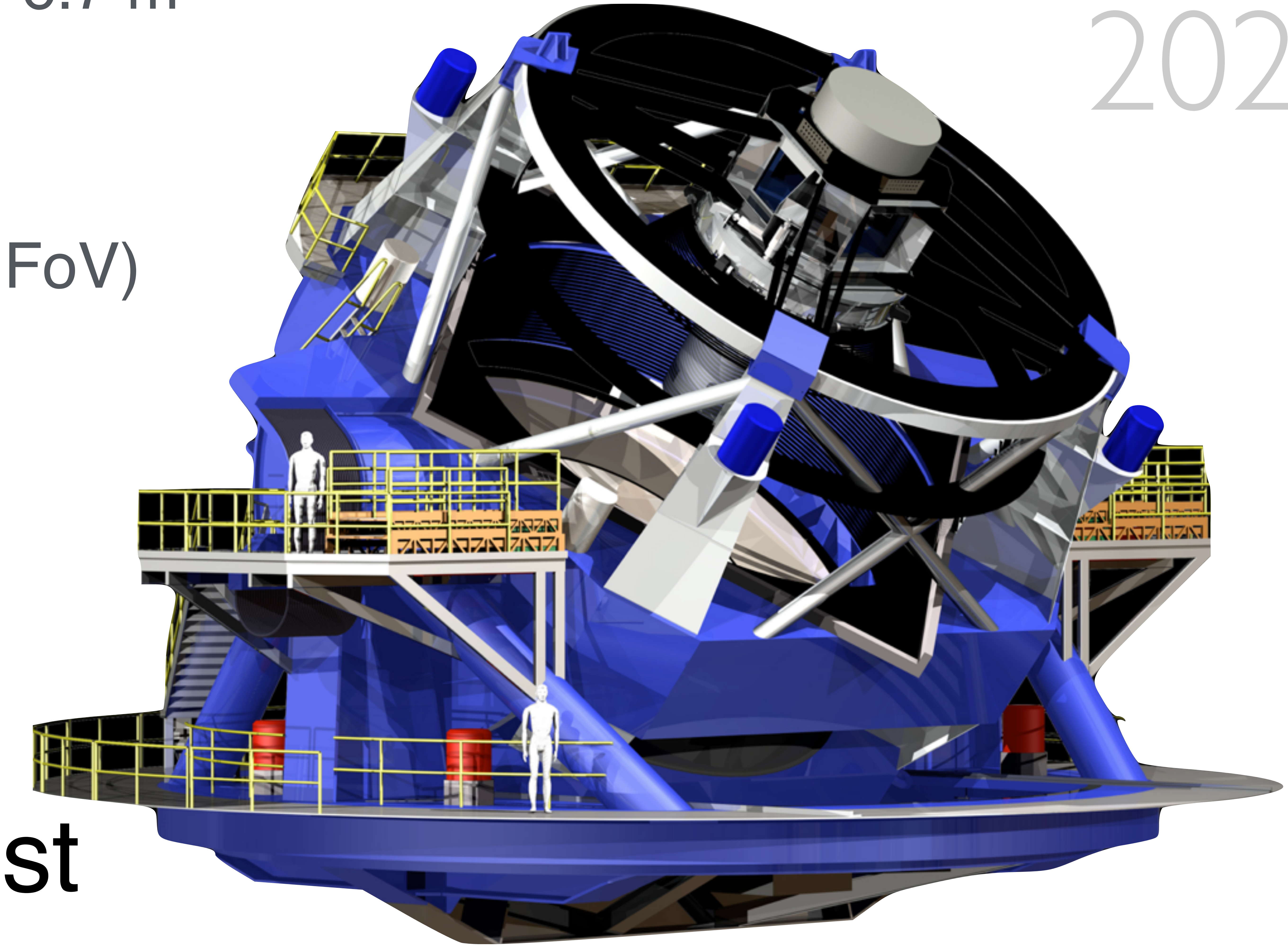
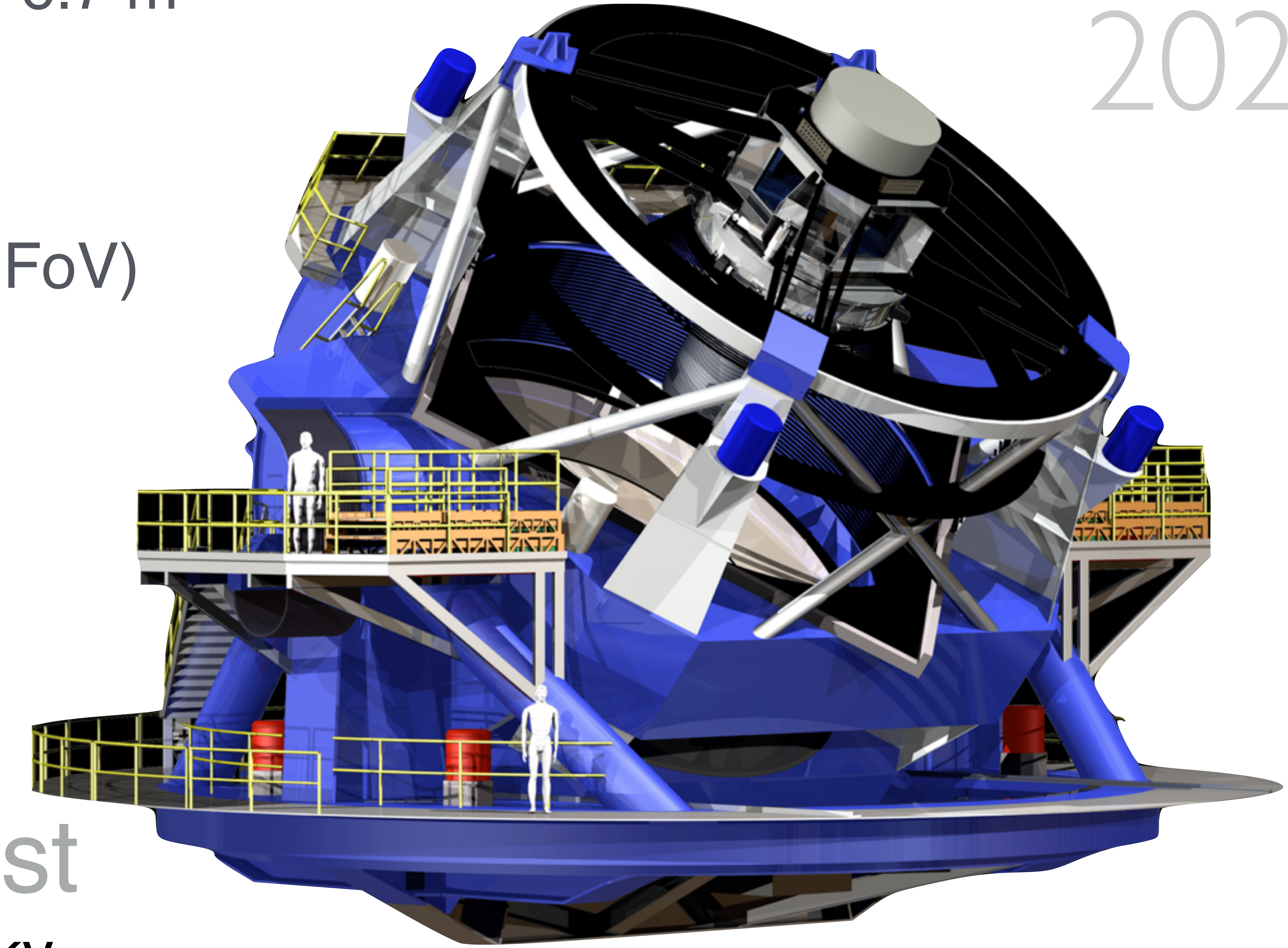


Wide-Deep-Fast

- effective aperture of 6.7 m
- FoV 9.6 deg^2
- large *etendue*
  (collecting area x FoV)

2022-2032



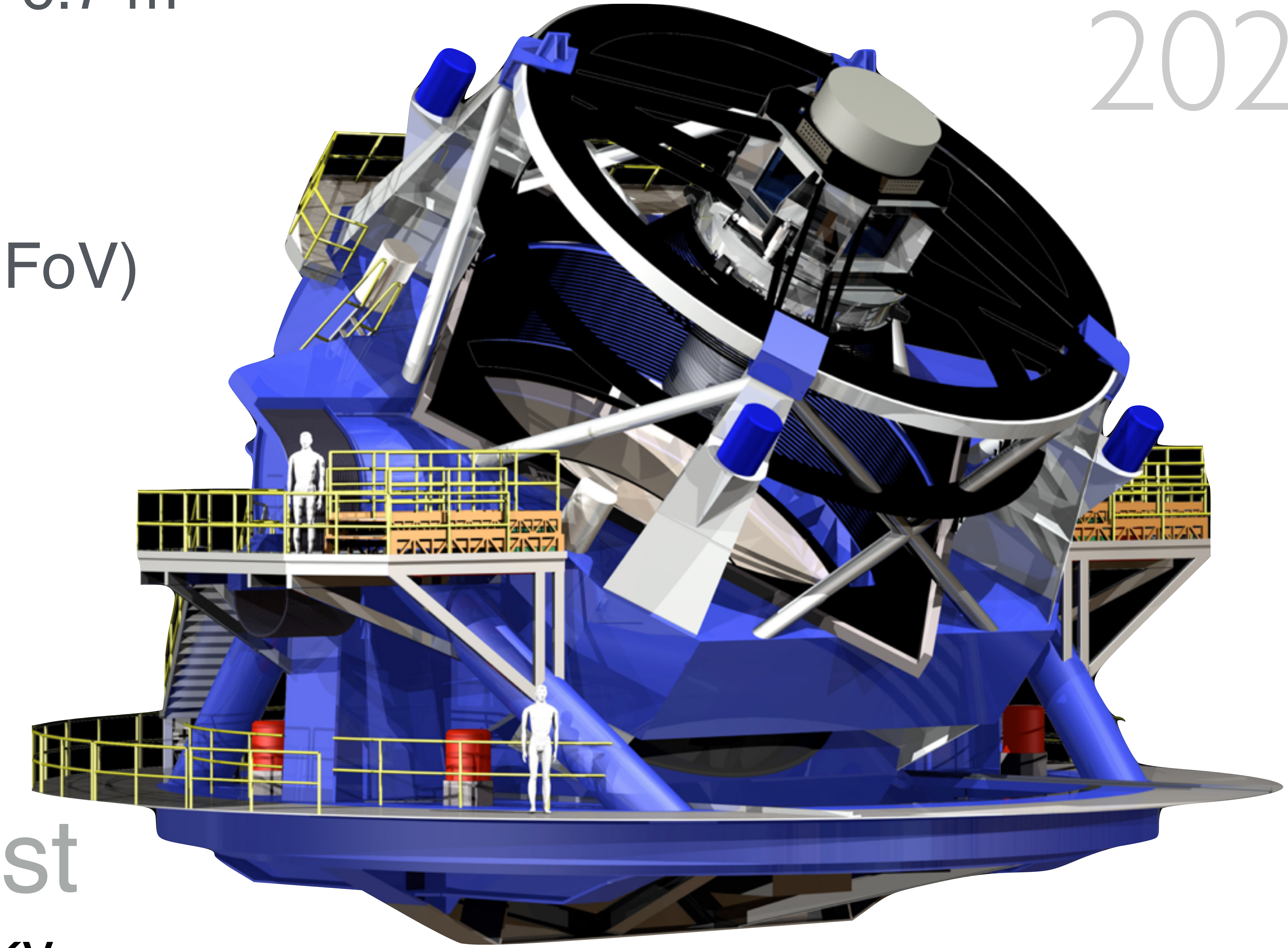
Wide-Deep-Fast

cover large swaths of sky

- effective aperture of 6.7 m
- FoV 9.6 deg^2
- large *etendue*

  (collecting area x FoV)

2022-2032

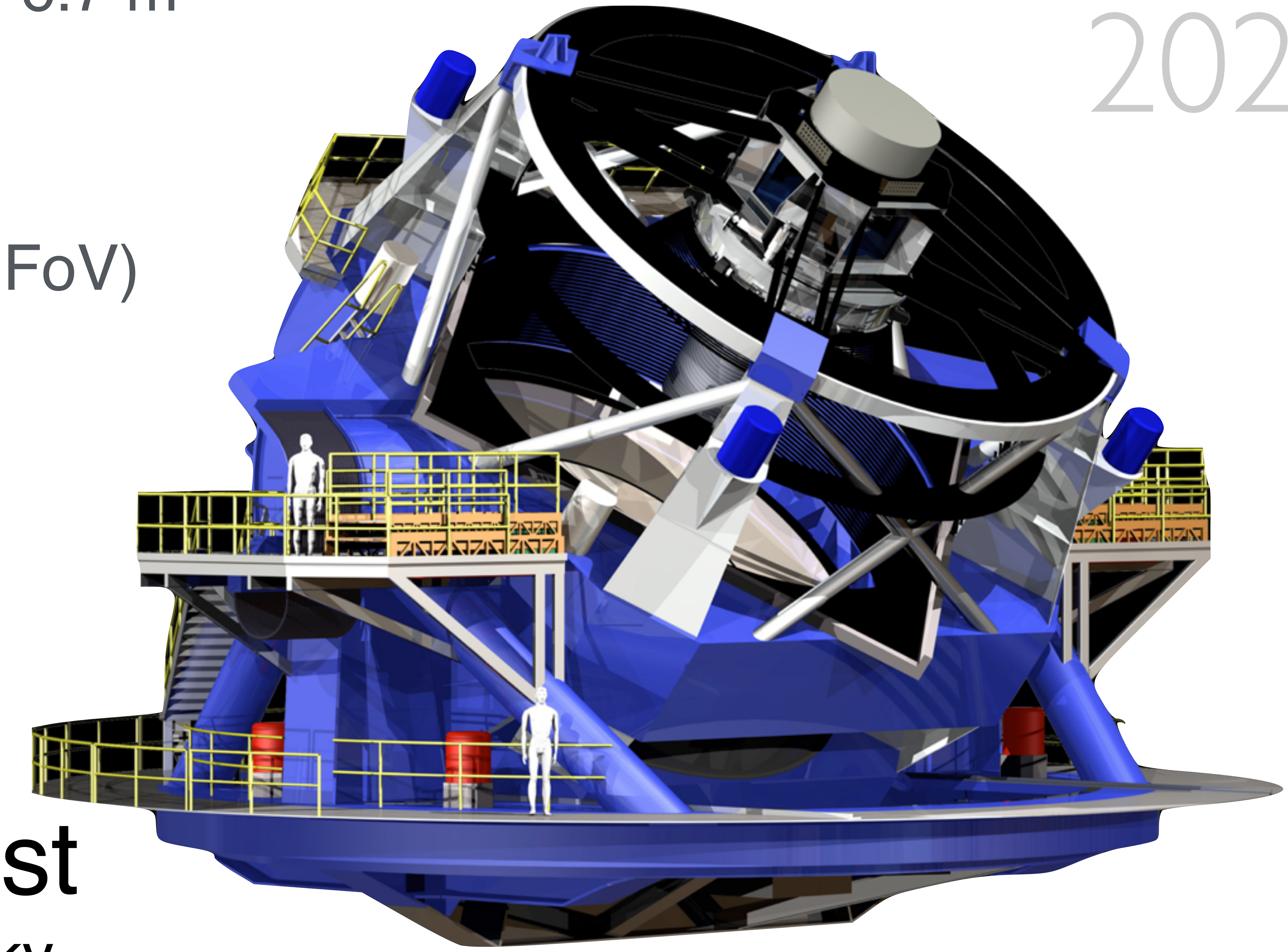


Wide-Deep-Fast

cover large swaths of sky

to faint magnitudes

- effective aperture of 6.7 m
- FoV 9.6 deg^2
- large *etendue*
  (collecting area x FoV)



2022-2032

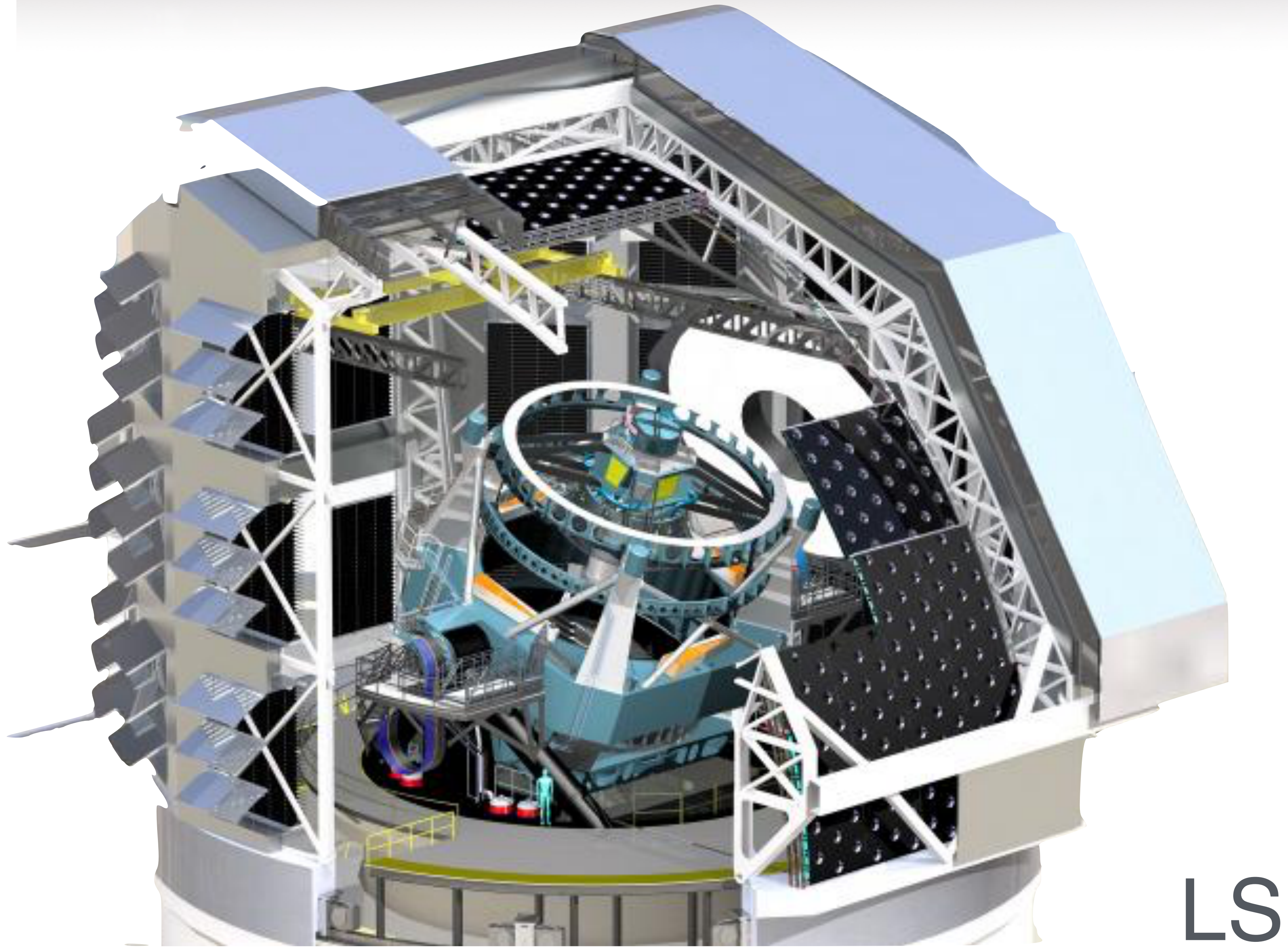
Wide-Deep-Fast

cover large swaths of sky

to faint magnitudes

in a short amount of time

Innovative Optical Design

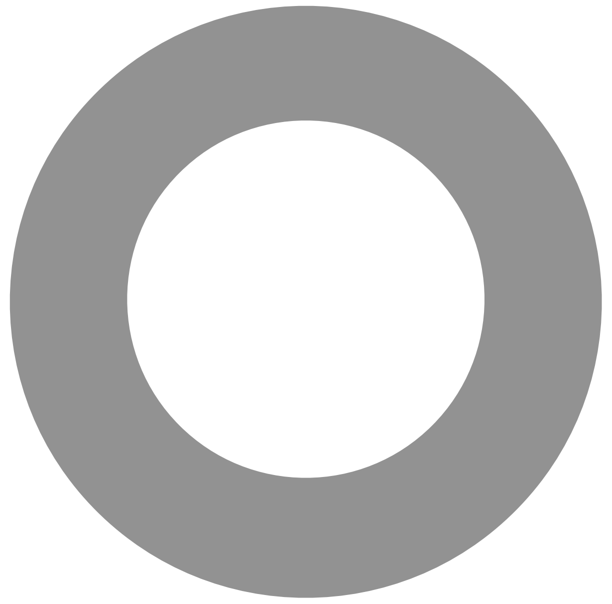


LSST

MIRROR:

8m diameter

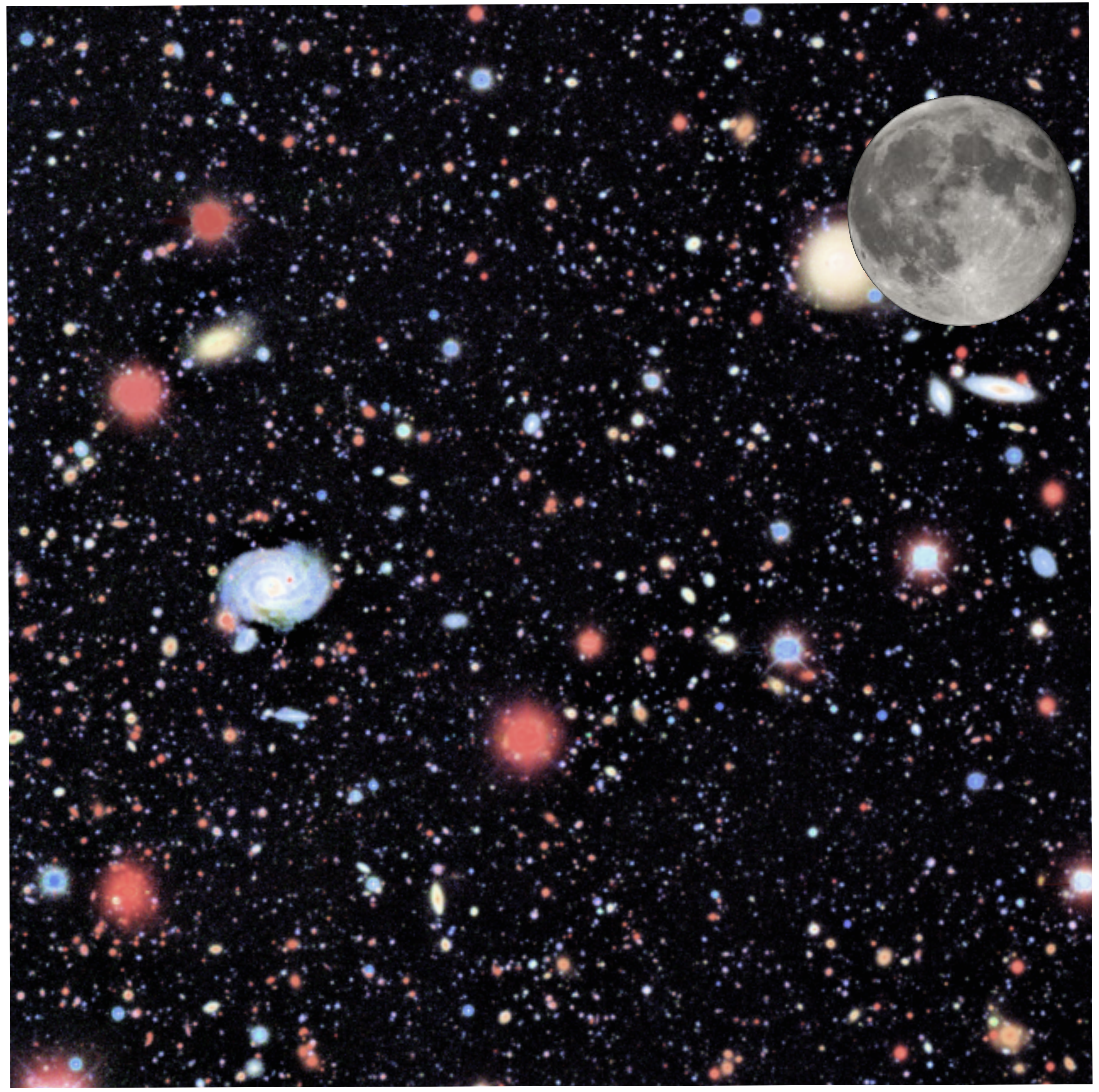
8.4m diameter

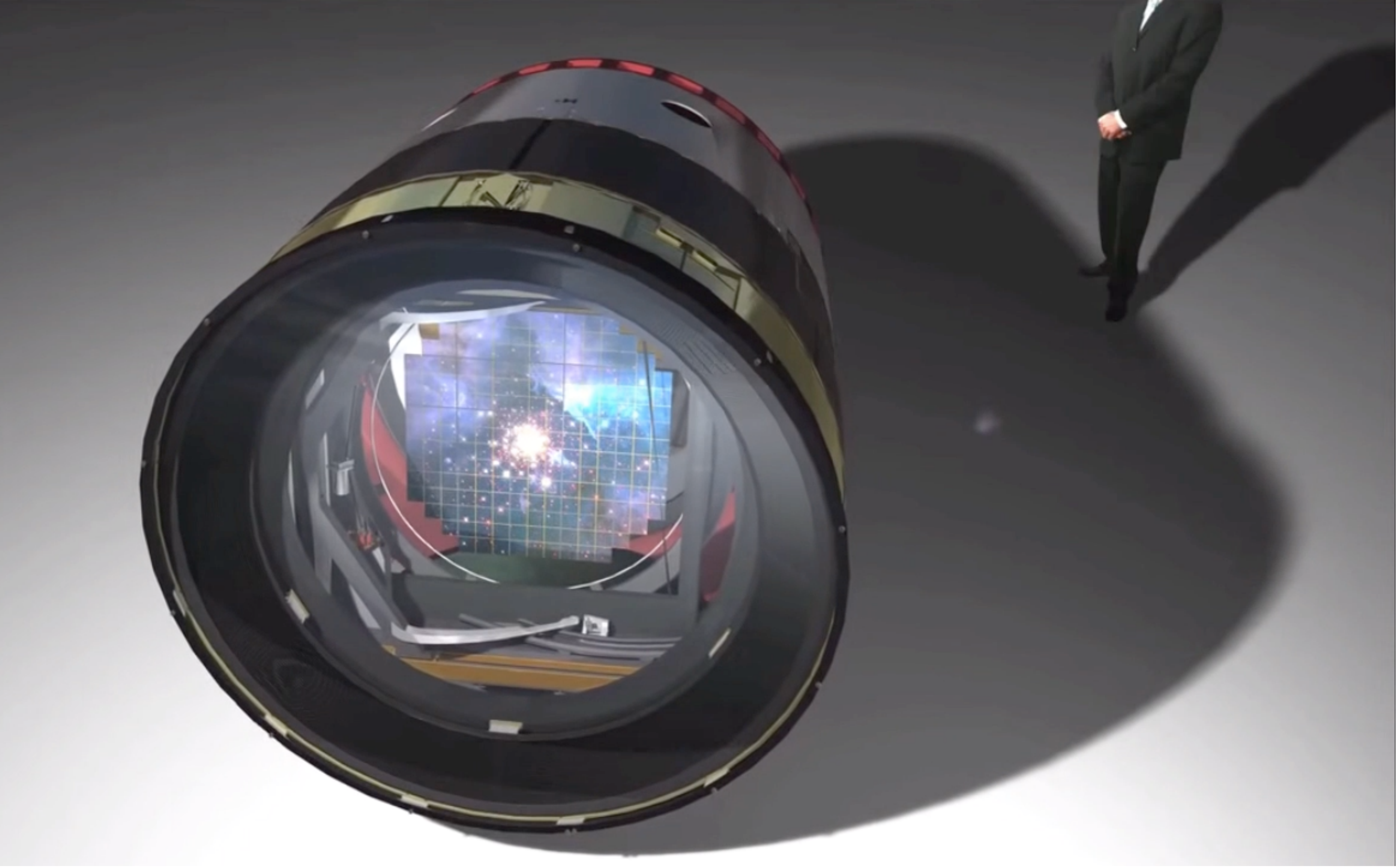


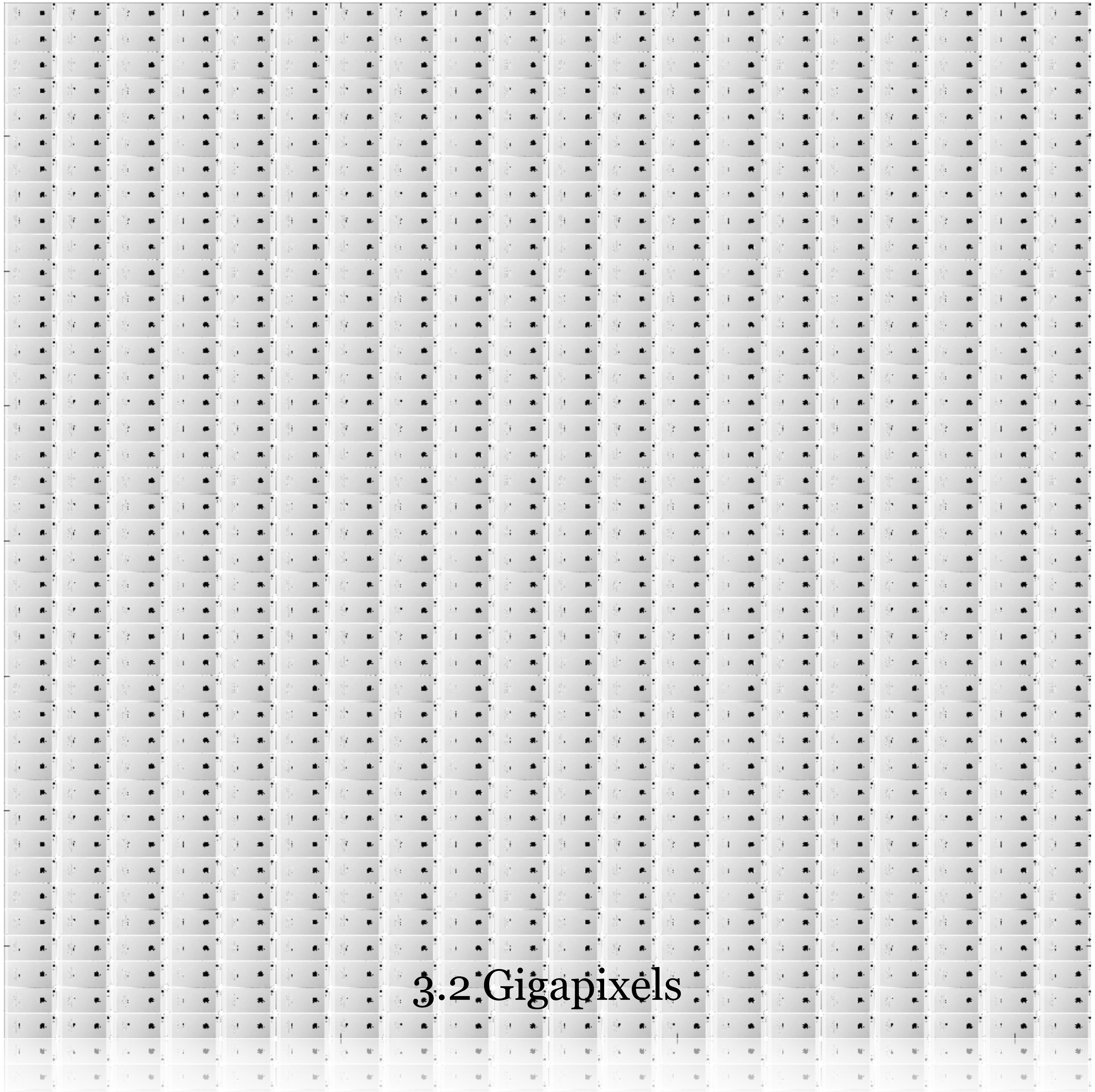
FIELD OF VIEW:

0.2 deg^2

9.6 deg^2







3.2 Gigapixels

federica bianco NYU

The LSST Data Stream

each night is 30TB data

- **30 Terabytes: 1,500,000 trees made into paper and printed;**

The LSST Data Stream

each night is 30TB data

- 30 Terabytes: 1,500,000 trees made into paper and printed;

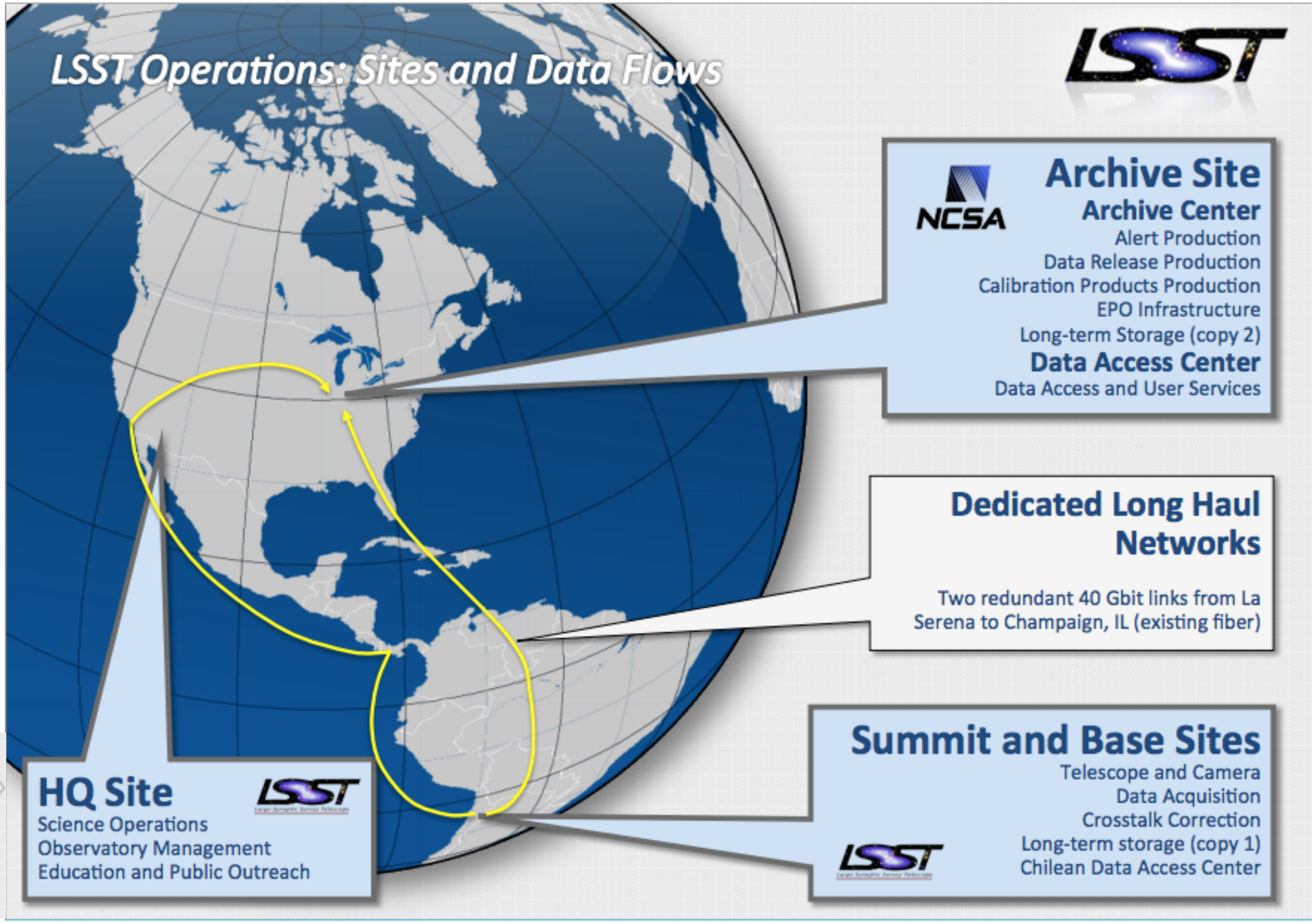
#OPENDATA #OPENSCIENCE

The LSST Data Stream

the LSST data

At 1Gbps, 30TB would take 67 hours to download

each night is 30TB data



LSST Operations: Sites and Data Flows

Archive Site

Archive Center
Alert Production
Data Release Production
Calibration Products Production
EPO Infrastructure
Long-term Storage (copy 2)
Data Access Center
Data Access and User Services

Dedicated Long Haul Networks

Two redundant 40 Gbit links from La Serena to Champaign, IL (existing fiber)

Summit and Base Sites

Telescope and Camera
Data Acquisition
Crosstalk Correction
Long-term storage (copy 1)
Chilean Data Access Center

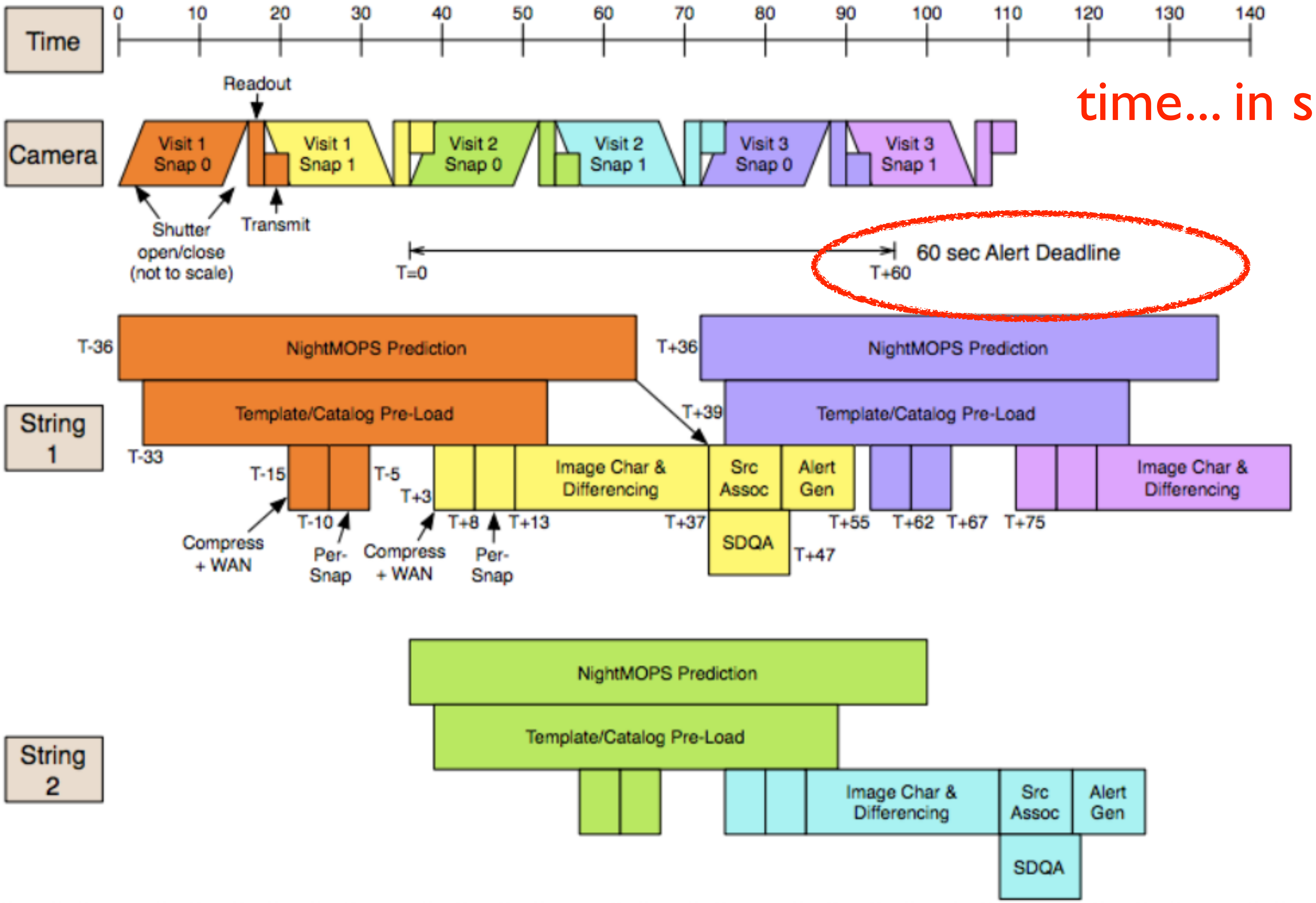
HQ Site

Science Operations
Observatory Management
Education and Public Outreach

Long Haul Networks to transport data from Chile to the U.S.

- *200 Gbps from Summit to La Serena (new fiber)*
- *2x40 Gbit (minimum) for La Serena to Champaign, IL (protected, existing fiber)*

Level 1 Processing: System Architecture



time... in seconds

https://www.youtube.com/watch?v=DfG

The LSST Science

- A stream of 1-10 million time-domain events per night, ***detected and transmitted** **within 60 seconds of observation.***

- A catalog of orbits for 6 million bodies in the Solar System.

- A catalog of 37 billion objects: 20B galaxies, 17B stars characterized in shape, color, and variability.

- High resolution deep stacks that will allow measure weak lensing.

Science Drivers

- Dark energy and dark matter (via measurements of strong and weak lensing, large-scale structure, clusters of galaxies, and supernovae)
- Exploring the transient and variable universe
- Studying the structure of the Milky Way galaxy and its neighbors via resolved stellar populations
- An inventory of the Solar System, including Near Earth Asteroids and Potential Hazardous Objects, Main Belt Asteroids, and Kuiper Belt Objects

Science Drivers

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Survey Strategy

WFD:

a pair of image per field, repeated twice/night. ~85% of the observing time

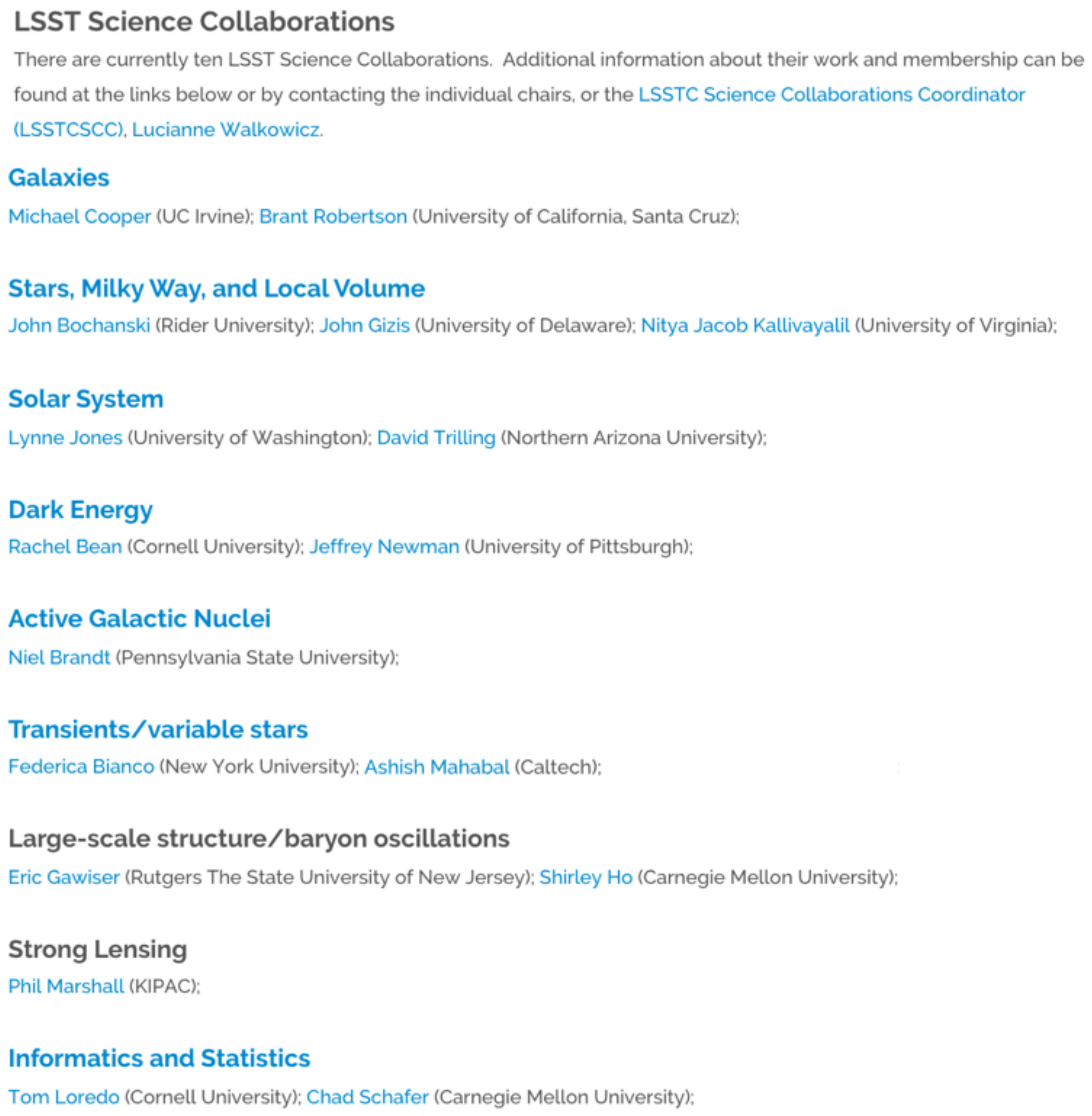
DeepDrilling fields:

a pair of image per field, repeated >twice/night   5-10 DD fields

Galactic plane survey

South Celestial Cap

Northern Ecliptic



LSST Science Collaborations

There are currently ten LSST Science Collaborations. Additional information about their work and membership can be found at the links below or by contacting the individual chairs, or the LSSTC Science Collaborations Coordinator (LSSTCSCC), Lucianne Walkowicz.

Galaxies

Michael Cooper (UC Irvine); Brant Robertson (University of California, Santa Cruz);

Stars, Milky Way, and Local Volume

John Bochanski (Rider University); John Gizis (University of Delaware); Nitya Jacob Kallivayalil (University of Virginia);

Solar System

Lynne Jones (University of Washington); David Trilling (Northern Arizona University);

Dark Energy

Rachel Bean (Cornell University); Jeffrey Newman (University of Pittsburgh);

Active Galactic Nuclei

Niel Brandt (Pennsylvania State University);

Transients/variable stars

Federica Bianco (New York University); Ashish Mahabal (Caltech);

Large-scale structure/baryon oscillations

Eric Gawiser (Rutgers The State University of New Jersey); Shirley Ho (Carnegie Mellon University);

Strong Lensing

Phil Marshall (KIPAC);

Informatics and Statistics

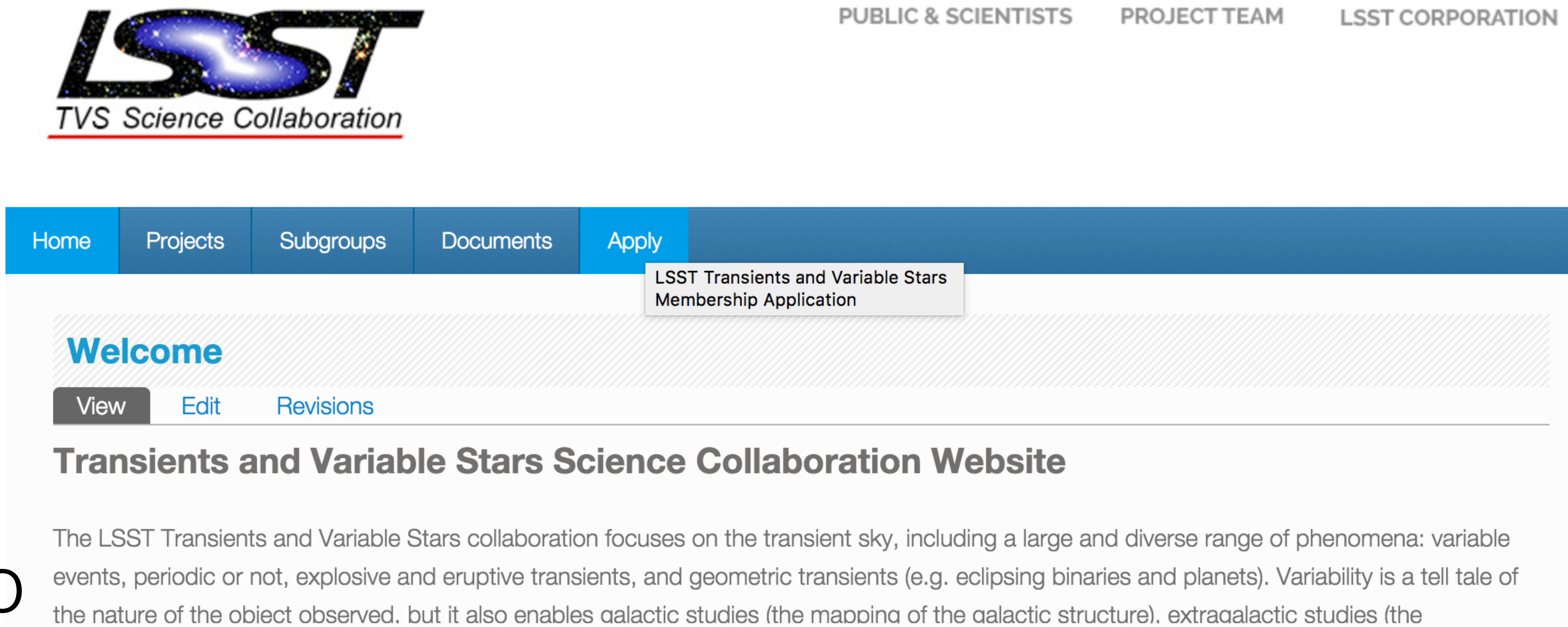
Tom Loredo (Cornell University); Chad Schafer (Carnegie Mellon University);

Transients & Variable Stars collaboration co-chairs

Ashish Mahabal

Federica Bianco

https://tvs.science.lsst.org/home



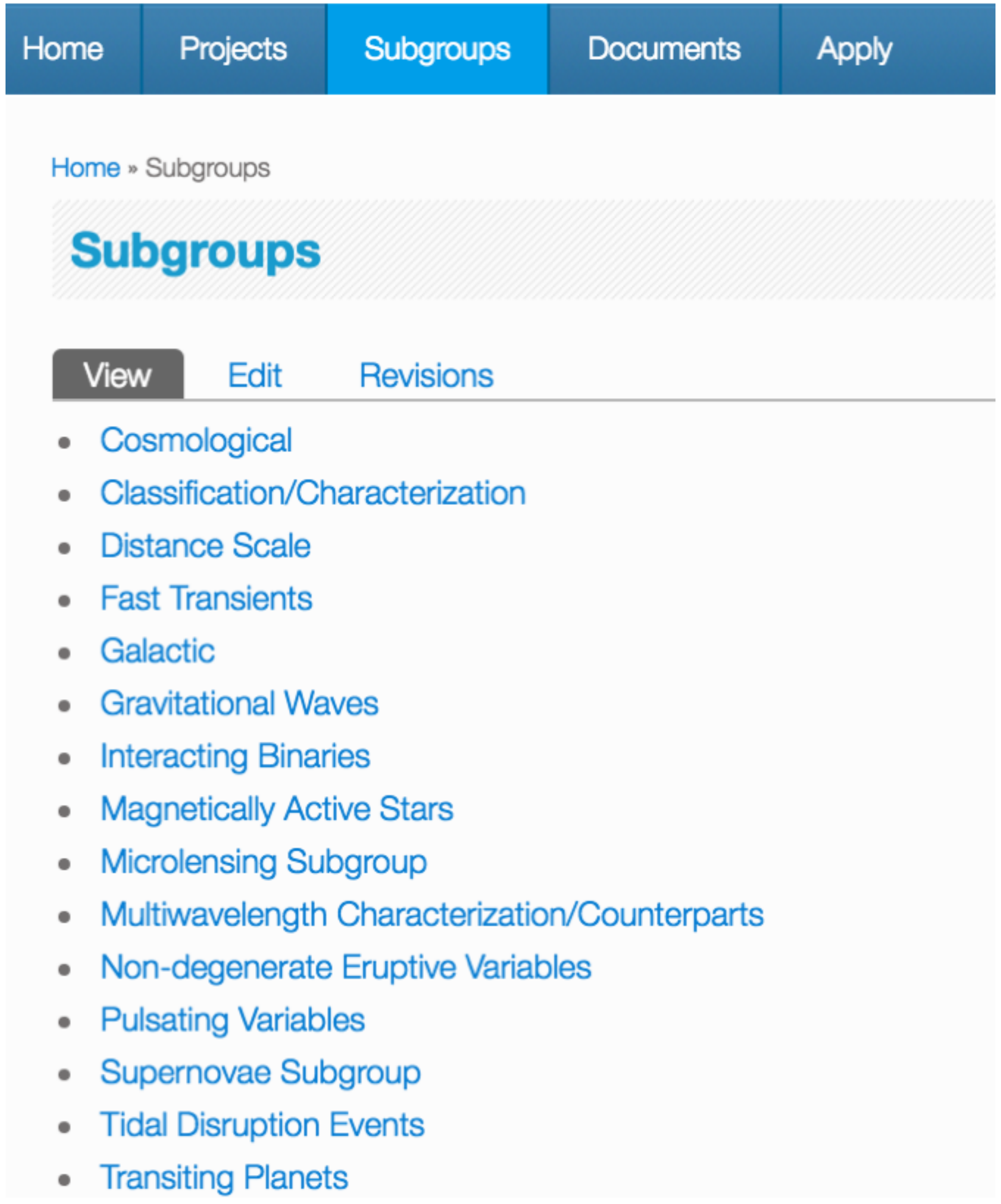
Transients and Variable Stars Science Collaboration Website

The LSST Transients and Variable Stars collaboration focuses on the transient sky, including a large and diverse range of phenomena: variable events, periodic or not, explosive and eruptive transients, and geometric transients (e.g. eclipsing binaries and planets). Variability is a tell tale of the nature of the object observed, but it also enables galactic studies (the mapping of the galactic structure), extragalactic studies (the

The LSST Transients and Variable Stars collaboration focuses on the transient sky, including a large and diverse range of phenomena: variable events, periodic or not, explosive and eruptive transients, and geometric transients (e.g. eclipsing binaries and planets). Variability is a tell tale of the nature of the object observed, but it also enables galactic studies (the mapping of the galactic structure), extragalactic studies (the characterization of the intracluster medium), and cosmological studies. Because of their physical and phenomenological diversity, the object we study span a wide range of timescales, and present themselves in a range of brightnesses, and colors. LSST also holds great potential for discovery of new transient phenomena, especially at the very short and very long time scales.

LSST

TVS Science Collaboration



Home » Subgroups

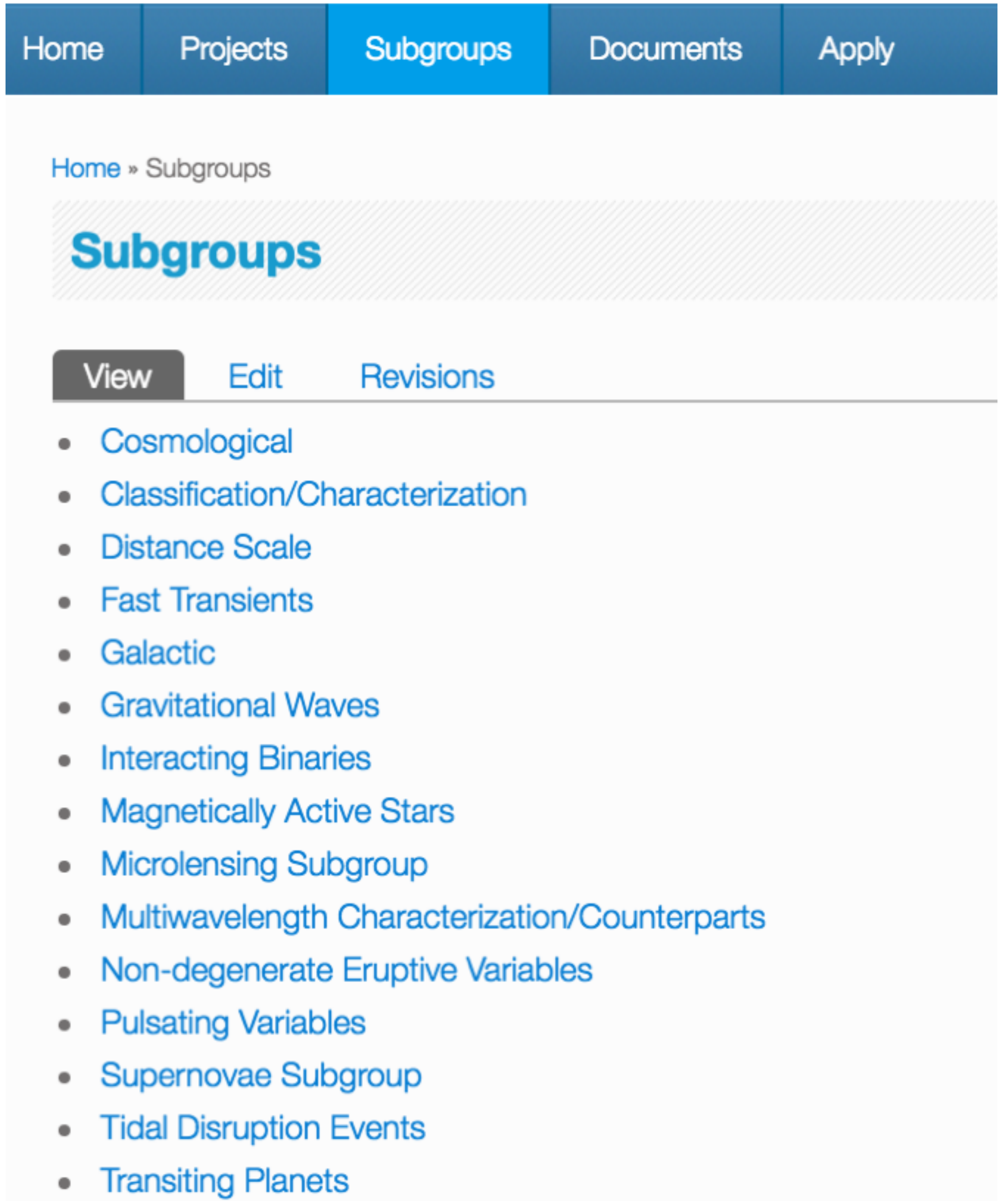
Subgroups

- Cosmological
- Classification/Characterization
- Distance Scale
- Fast Transients
- Galactic
- Gravitational Waves
- Interacting Binaries
- Magnetically Active Stars
- Microlensing Subgroup
- Multiwavelength Characterization/Counterparts
- Non-degenerate Eruptive Variables
- Pulsating Variables
- Supernovae Subgroup
- Tidal Disruption Events
- Transiting Planets

TVS Science Collaboration

Nearly 160 members!

Each member declares a *primary* affiliation and up to 3 *secondary* affiliations



Home » Subgroups

Subgroups

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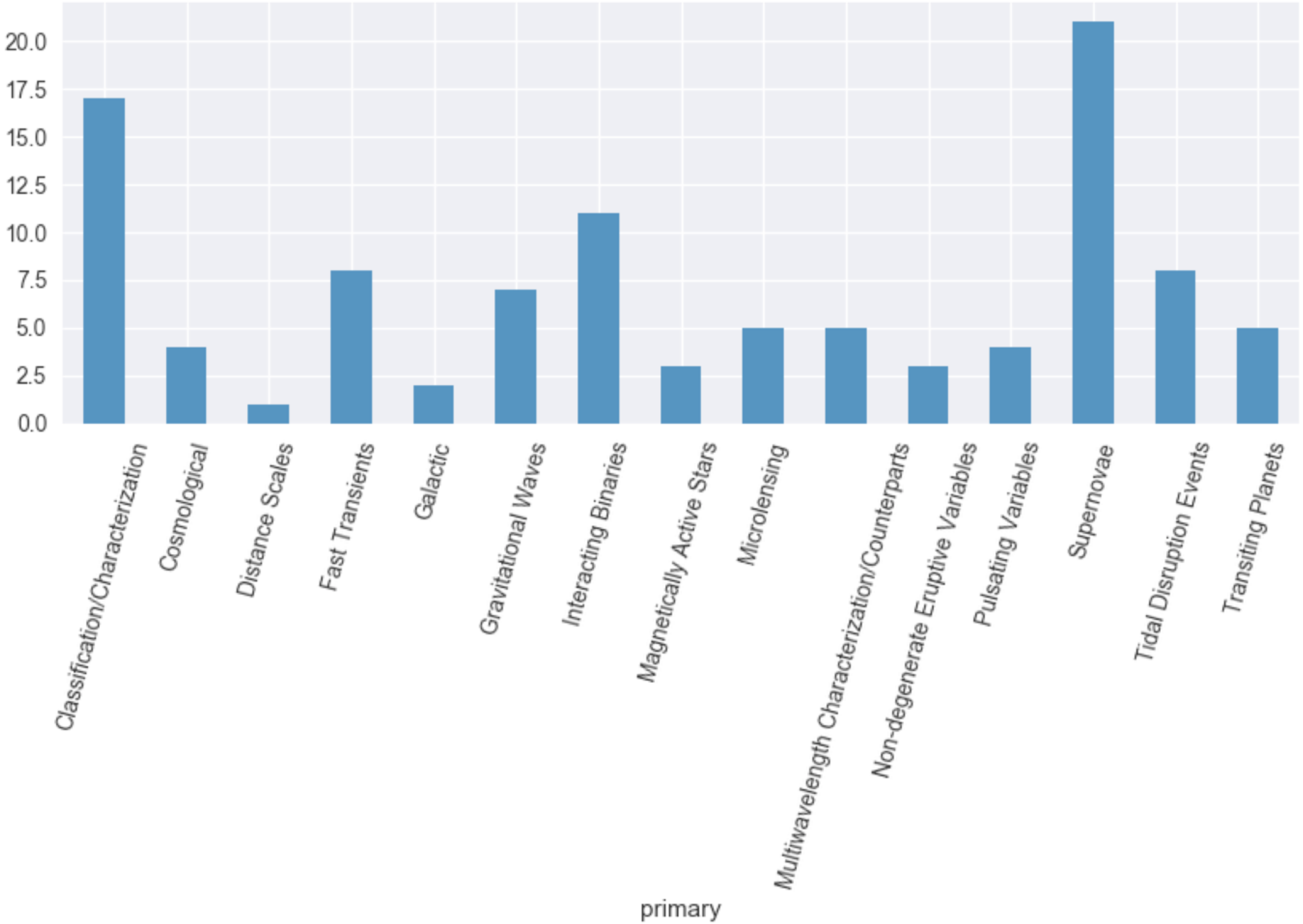


federica bianco NYU

Roadmapping LSST to success

different variable and transient phenomena benefit from different observing strategies
our group is working to reconcile the differences & understand the existing tensions & overlap

federica bianco NYU

The Time is Now!

we need a *science based evalution*
of the baseline LSST observing strategy and its variants

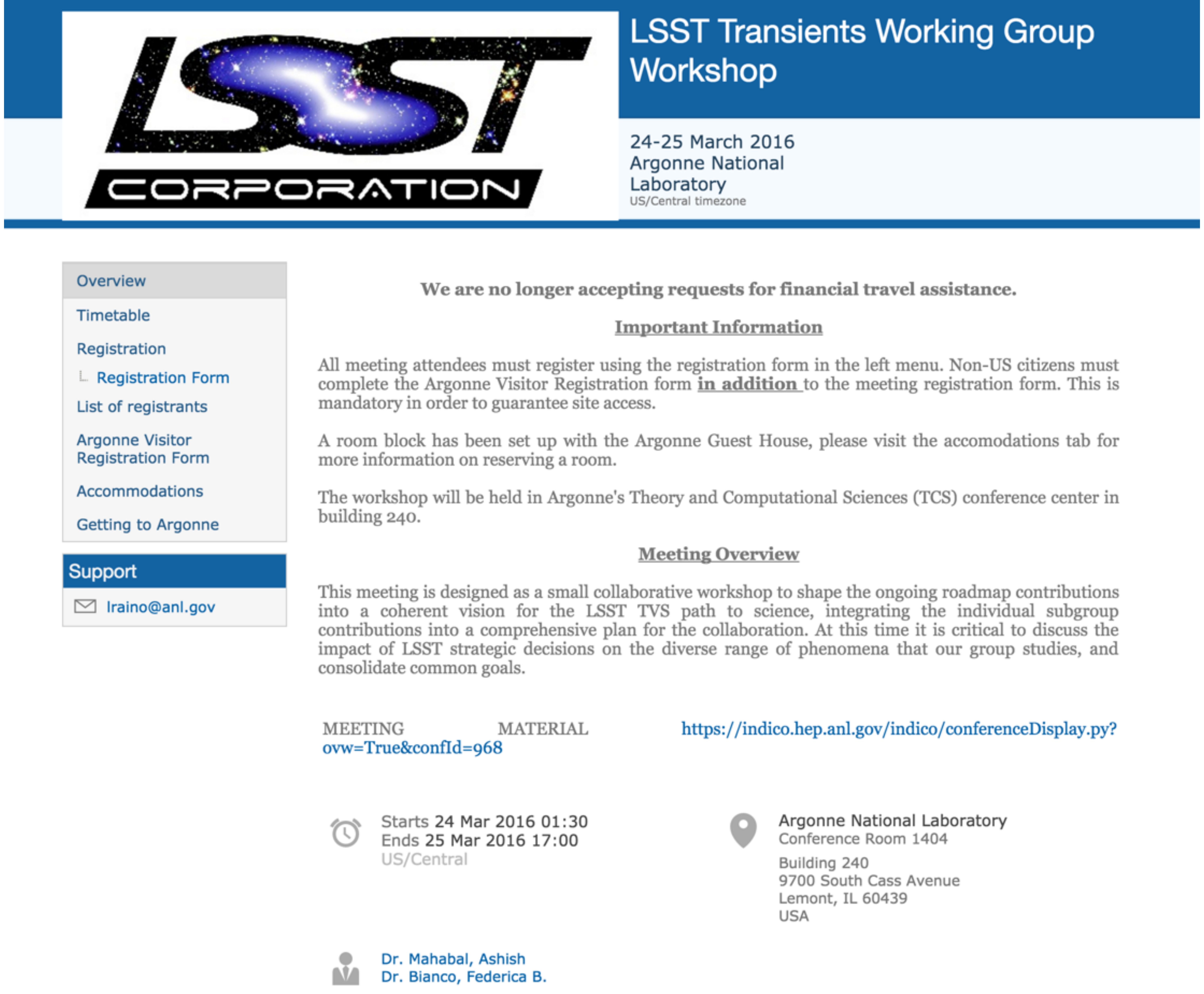
Observing Strategy White Paper Secion 1.2

Its a hell of a fight!

TRANSIENTS <=> CADENCE

VARIABLES <=> CADENCE

TVS ROADMAPPING MEETING



LSST Transients Working Group Workshop

24-25 March 2016
Argonne National Laboratory
US/Central timezone

We are no longer accepting requests for financial travel assistance.

Important Information

All meeting attendees must register using the registration form in the left menu. Non-US citizens must complete the Argonne Visitor Registration form **in addition** to the meeting registration form. This is mandatory in order to guarantee site access.

A room block has been set up with the Argonne Guest House, please visit the accomodations tab for more information on reserving a room.

The workshop will be held in Argonne's Theory and Computational Sciences (TCS) conference center in building 240.

Meeting Overview

This meeting is designed as a small collaborative workshop to shape the ongoing roadmap contributions into a coherent vision for the LSST TVS path to science, integrating the individual subgroup contributions into a comprehensive plan for the collaboration. At this time it is critical to discuss the impact of LSST strategic decisions on the diverse range of phenomena that our group studies, and consolidate common goals.

MEETING MATERIAL https://indico.hep.anl.gov/indico/conferenceDisplay.py?ovw=True&confId=968

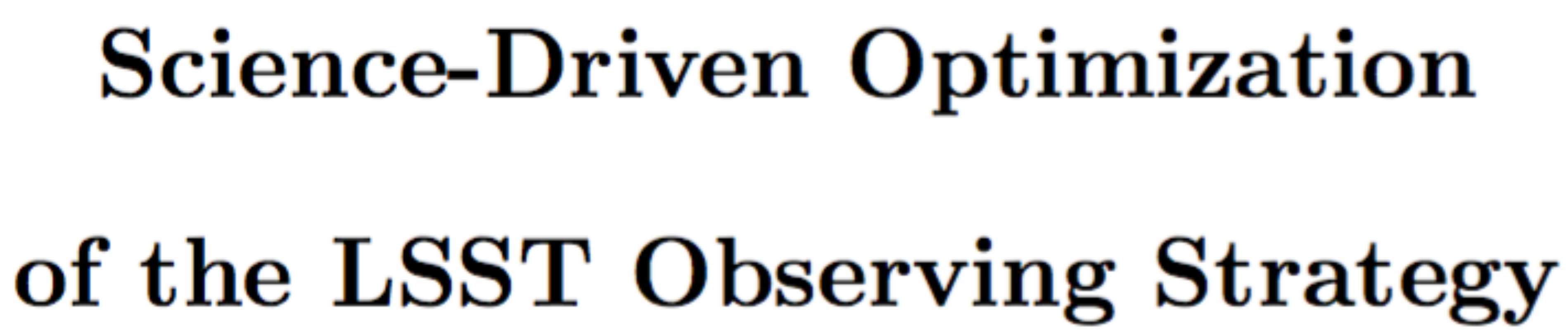
Starts 24 Mar 2016 01:30
Ends 25 Mar 2016 17:00
US/Central

Argonne National Laboratory
Conference Room 1404

Building 240
9700 South Cass Avenue
Lemont, IL 60439
USA

Dr. Mahabal, Ashish
Dr. Bianco, Federica B.

OBSERVING STRATEGY WHITE PAPER



Science-Driven Optimization

of the LSST Observing Strategy

Prepared by the LSST Science Collaborations,

with contributions from the LSST Project.

Contributing Authors

Phil Marshall,[1] Scott Anderson,[2] Timo Anguita,[3] Iair Arcavi,[4] Humna Awan,[5] Federica B. Bianco,[6] Rahul Biswas,[7] Keaton J. Bell,[8] Eric C. Bellm,[9] David Bennett,[10] Niel Brandt,[11] Chris Britt,[12] Dana I. Casetti-Dinescu,[13] Laura Chomiuk,[14] Will Clarkson,[15] Chuck Claver,[16] Andy Connolly,[17] Kem Cook,[18] Victor Debattista,[19] Seth Digel,[20] Zoheyr Doctor,[21] Wen-fai Fong,[22] Eric Gawiser,[23] John E. Gizis,[24] Carl Grillmair,[25] Zoltan Haiman,[26] Patrick Hartigan,[27] Željko Ivezić,[28] C. Johns-Krull,[29] Peter Kurczynski,[30] Lynne Jones,[31] Shashi Kanbur,[32] Vassiliki Kalogera,[33] Vishal Kasliwal,[34] Michael C. Liu,[35] Michelle Lochner,[36] Michael B. Lund,[37] Ashish Mahabal,[38] Raffaella Margutti,[39] Peregrine McGehee,[40] Tom Matheson,[41] Josh Meyers,[42] Dave Monet,[43] David Nidever,[44] Knut Olsen,[45] Eric Neilsen,[46] Matthew T. Penny,[47] Christina Peters,[48] Gordon Richards,[49] Stephen Ridgway,[50] Jeonghee Rho,[51] Jason Rhodes,[52] David Rubin,[53] Ohad Shemmer,[54] Avi Shporer,[55] Colin Slater,[56] Nathan Smith,[57] Marcelles Soares-Santos,[58] Jay Strader,[59] Michael Strauss,[60] Rachel Street,[61] Christopher Stubbs,[62] Paula Szkody,[63] David Trilling,[64] Virginia Trimble,[65] Miguel de Val-Borro,[66] Stefano Valenti,[67] Kathy Vivas,[68] Robert Wagoner,[69] Lucianne Walkowicz,[70] Beth Willman,[71] Peter Yoachim,[72] Bevin Ashley Zauderer,[73]

http://www.slac.stanford.edu/~digel/ObservingStrategy/whitepaper/LSST_Observing_Strategy_White_Paper.pdf

https://github.com/LSSTScienceCollaborations/ObservingStrategy

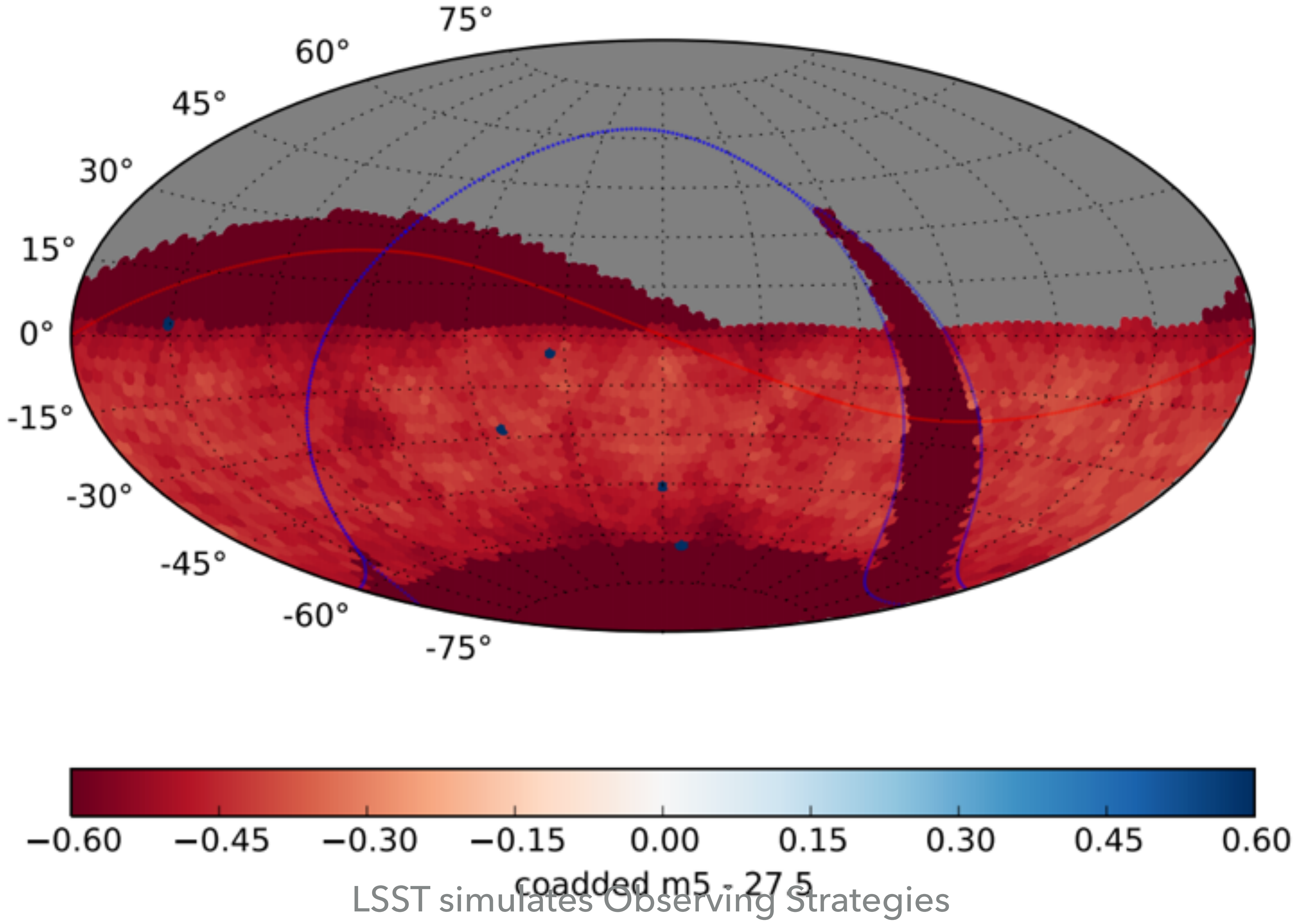
how to contribute

we need a *science based evalution*
of the baseline LSST observing strategy and its variants

Observing Strategy White Paper Secion 1.2

OpSim

LSST developed operation simulations
(A. Connoly)



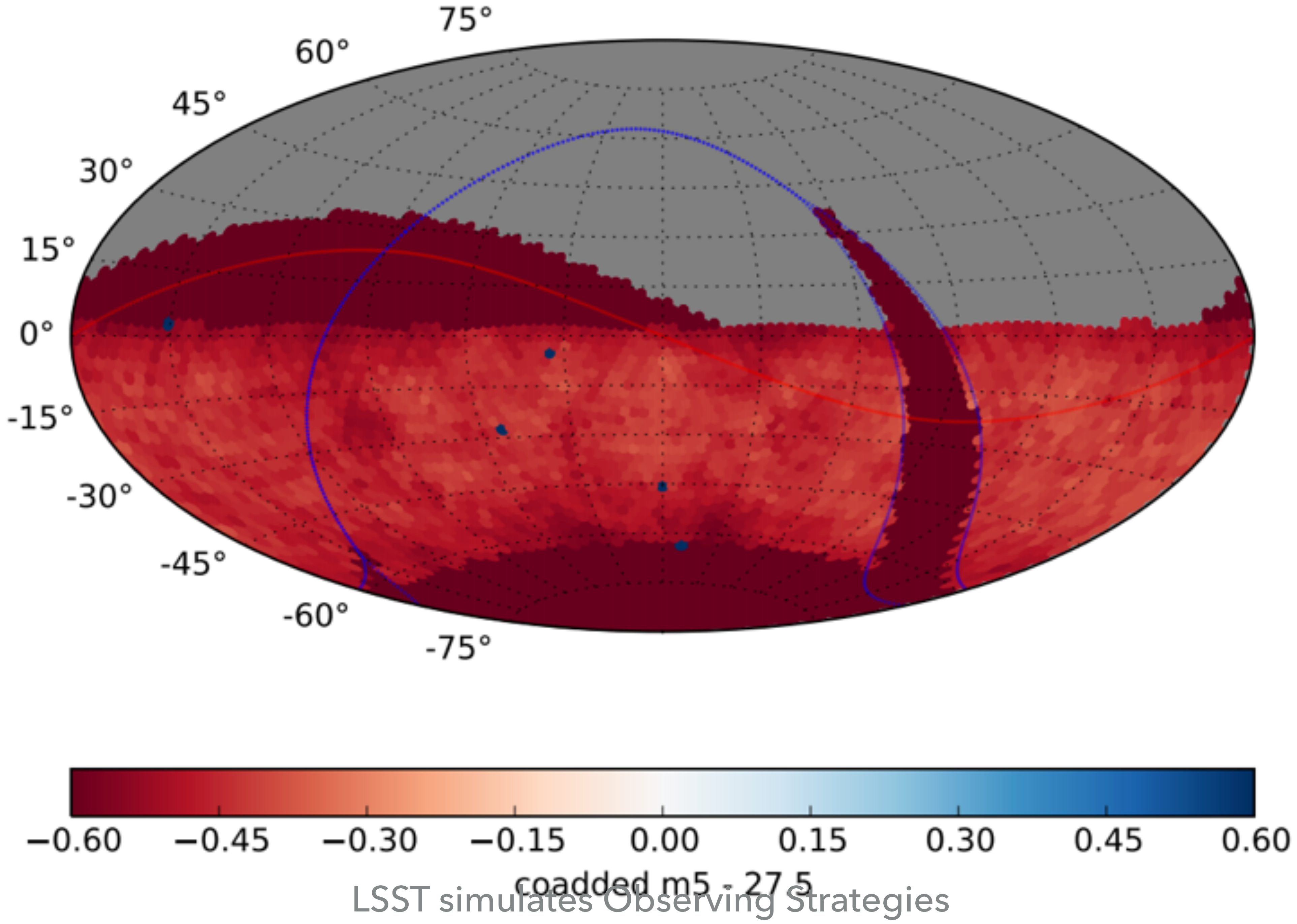
LSST simulates Observing Strategies

OpSim

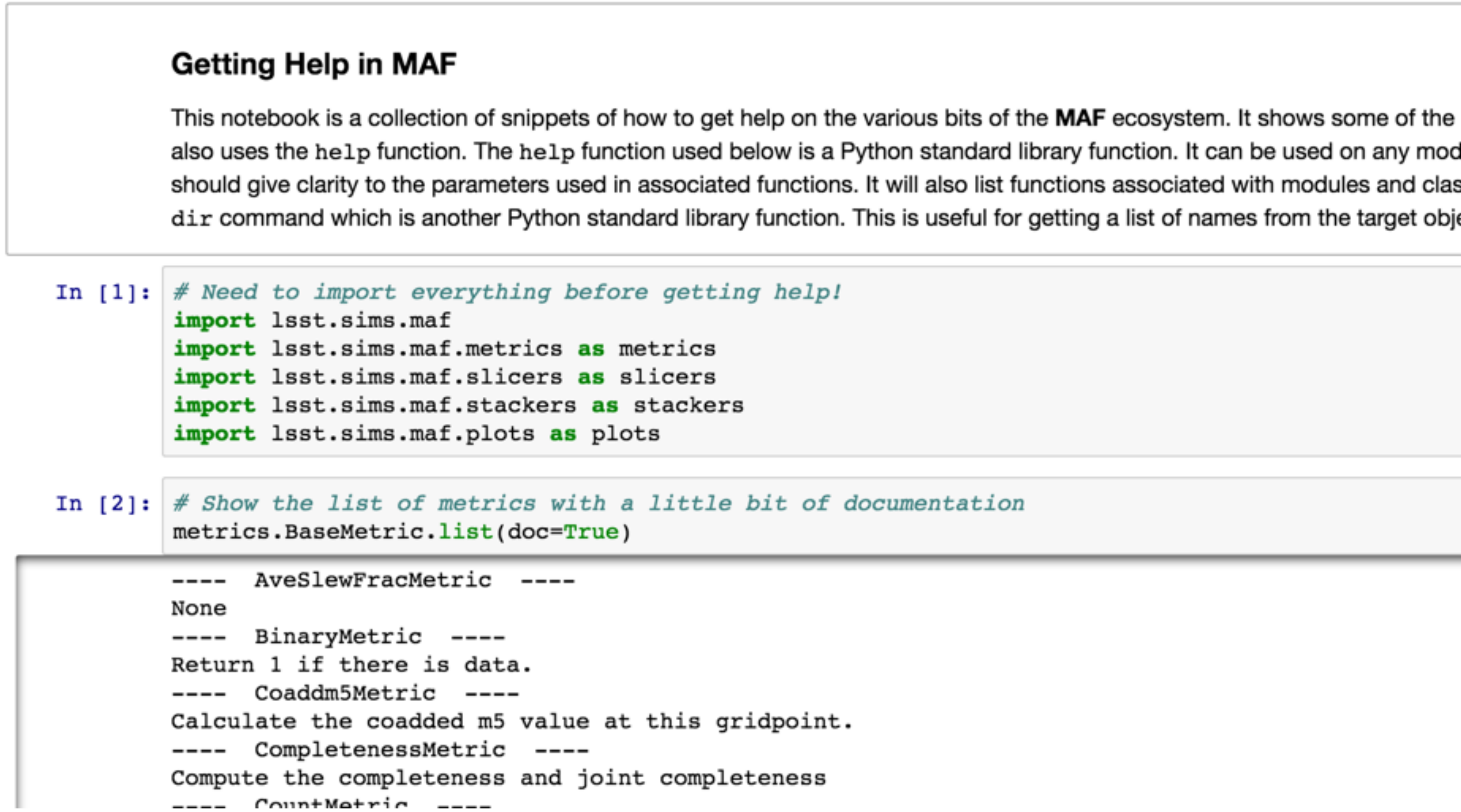
LSST developed operation simulations
(A. Connoly)

MAF API

Metric Analysis Framework
(Peter Yoachim, Lynne Jones)



LSST simulates Observing Strategies



Getting Help in MAF

This notebook is a collection of snippets of how to get help on the various bits of the **MAF** ecosystem. It shows some of the also uses the `help` function. The `help` function used below is a Python standard library function. It can be used on any mod should give clarity to the parameters used in associated functions. It will also list functions associated with modules and clas `dir` command which is another Python standard library function. This is useful for getting a list of names from the target obj

```
In [1]: # Need to import everything before getting help!
        import lsst.sims.maf
        import lsst.sims.maf.metrics as metrics
        import lsst.sims.maf.slicers as slicers
        import lsst.sims.maf.stackers as stackers
        import lsst.sims.maf.plots as plots
```

```
In [2]: # Show the list of metrics with a little bit of documentation
        metrics.BaseMetric.list(doc=True)
```

```
---- AveSlewFracMetric ----
None
---- BinaryMetric ----
Return 1 if there is data.
---- Coaddm5Metric ----
Calculate the coadded m5 value at this gridpoint.
---- CompletenessMetric ----
Compute the completeness and joint completeness
---- CountMetric ----
```

https://github.com/LSST-nonproject/

OpSim

LSST developed operation simulations
(A. Connoly)

MAF API

Metric Analysis Framework
(Peter Yoachim, Lynne Jones)

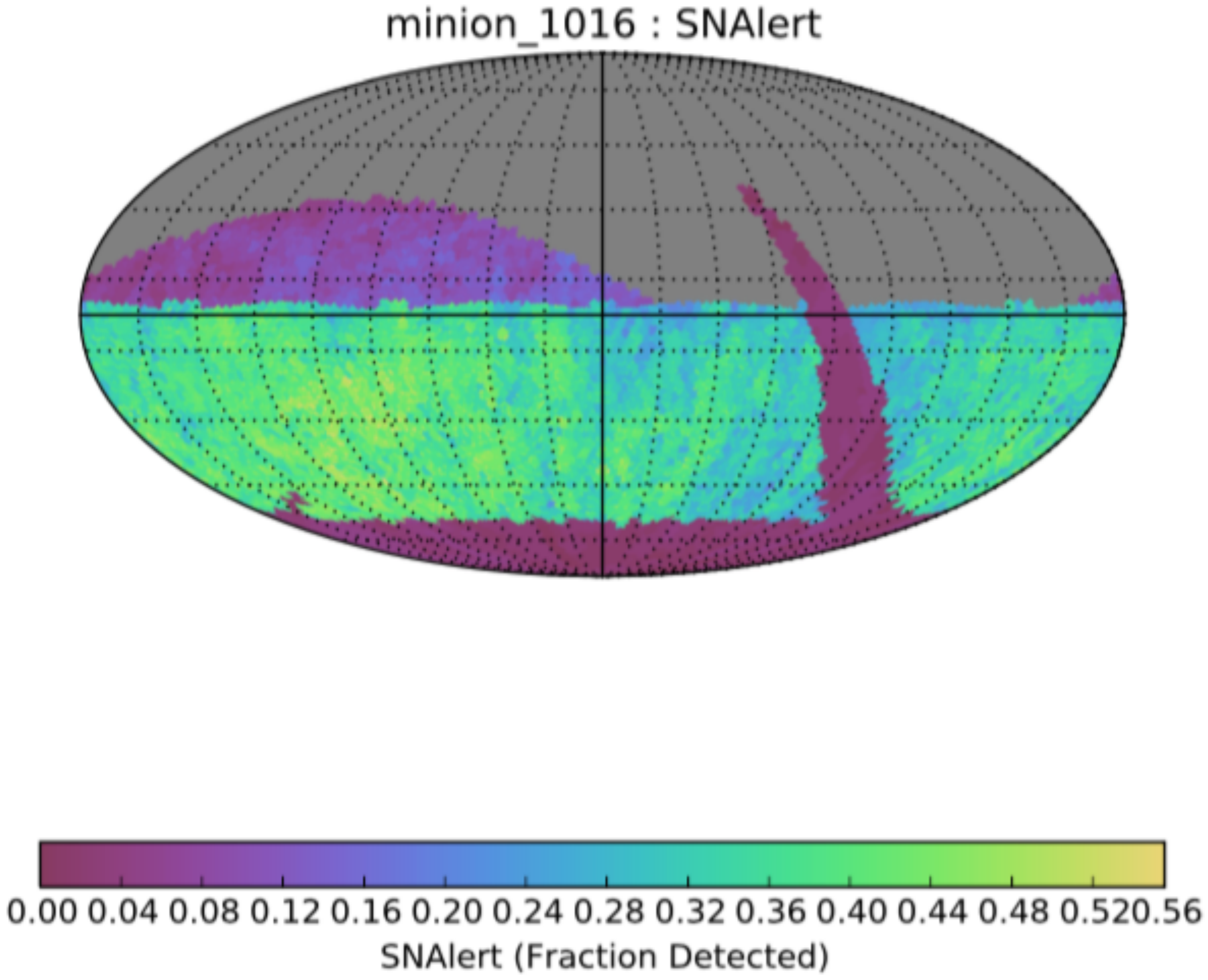
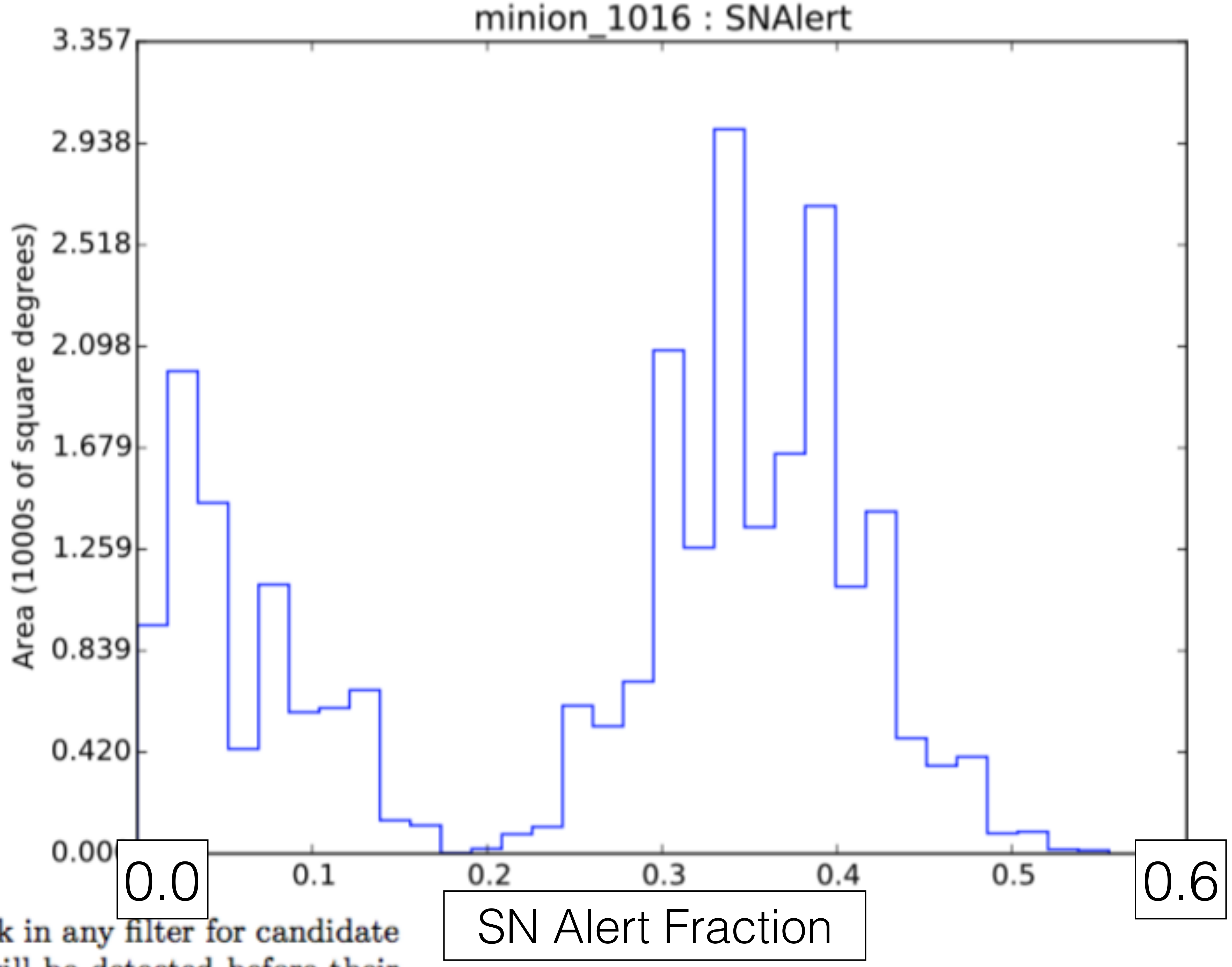


Figure 2.10: The fraction of simulated Type Ia SNe at a redshift of 0.5 detected pre-peak in any filter for candidate Baseline Cadence minion_1016. About 40% of all such SNe from the main survey will be detected before their maximum brightness.



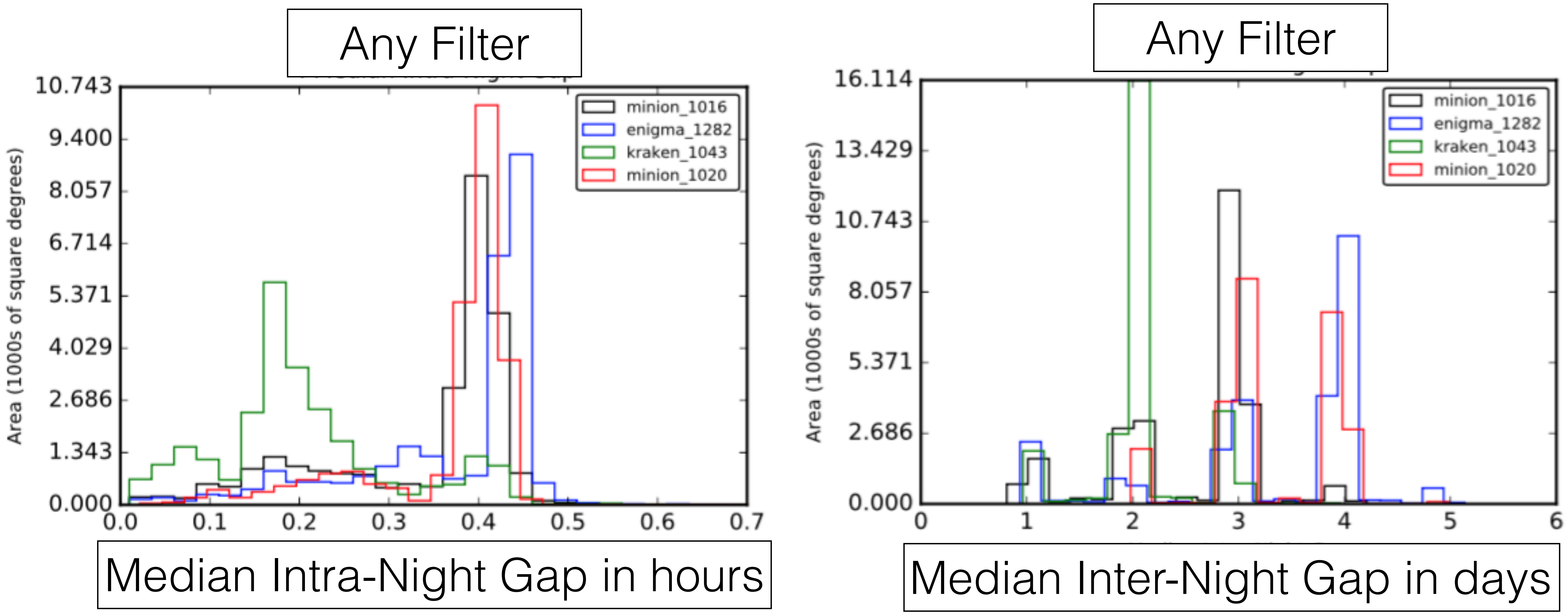


Figure 6.2: Histograms of median intra- (left) and inter- (right) night visit gaps for any band for several OpSim runs.

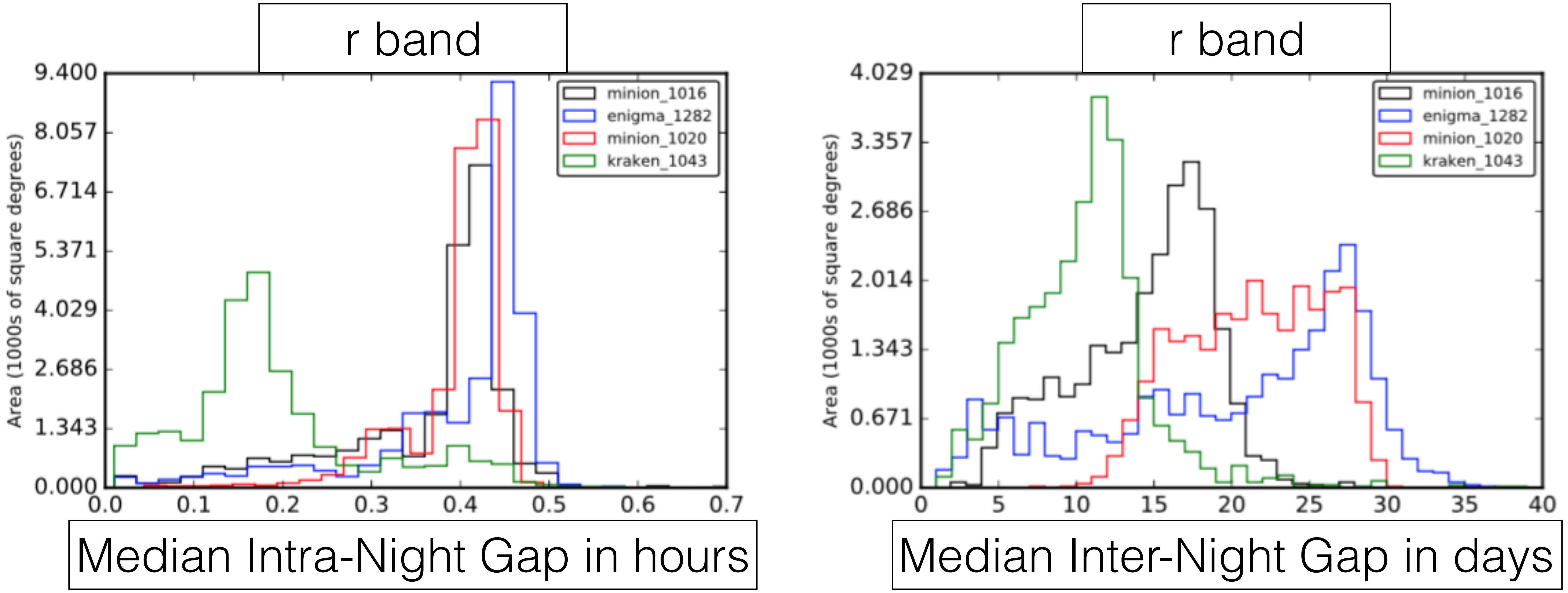


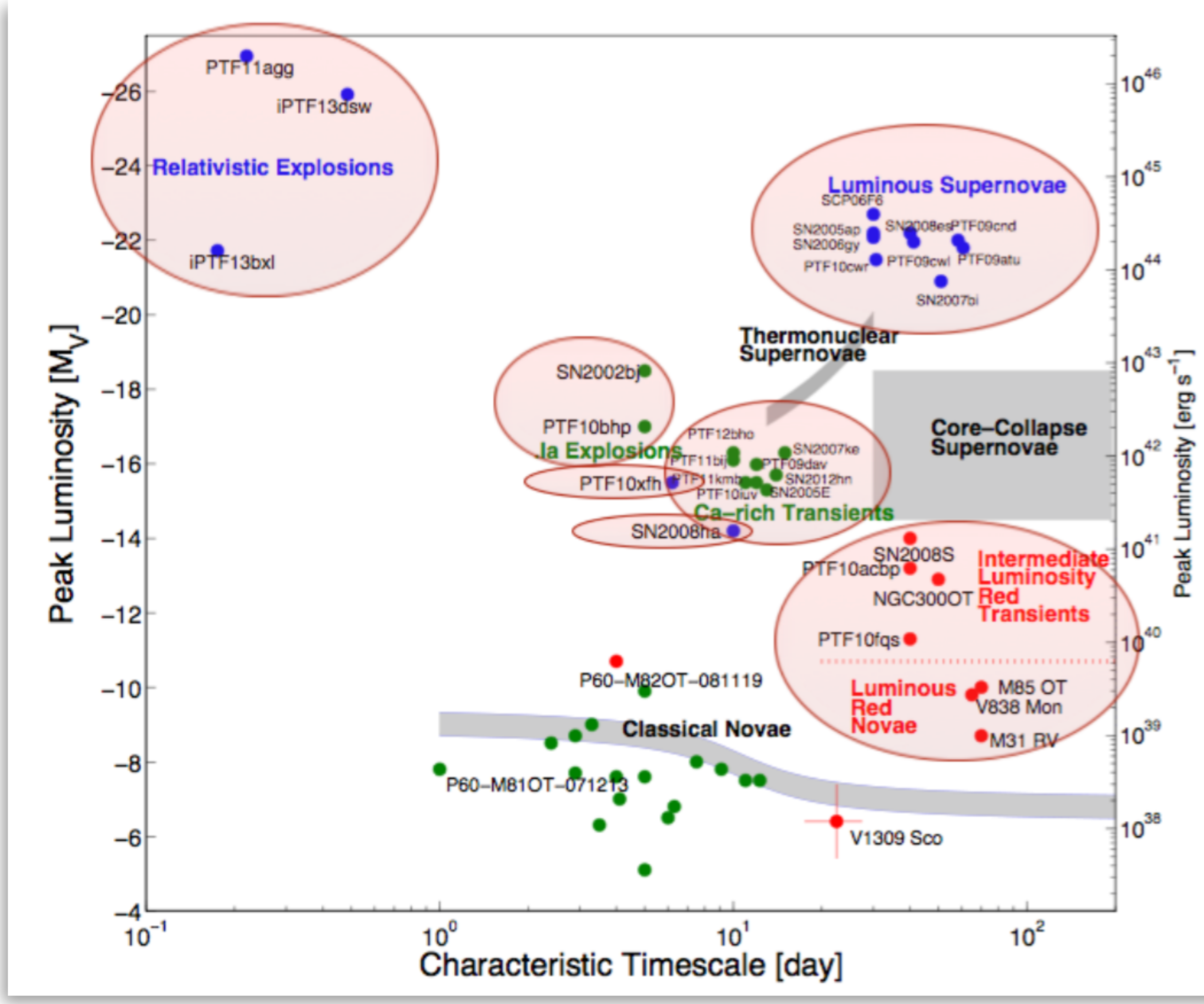
Figure 6.3: Histograms of median r-band intra- (left) and inter- (right) night visit gaps for several OpSim runs.

transients and variables

from the Observing Strategy White Paper

preliminary results

federica bianco NYU



Updated from Kasliwal 2011 (PhDT)

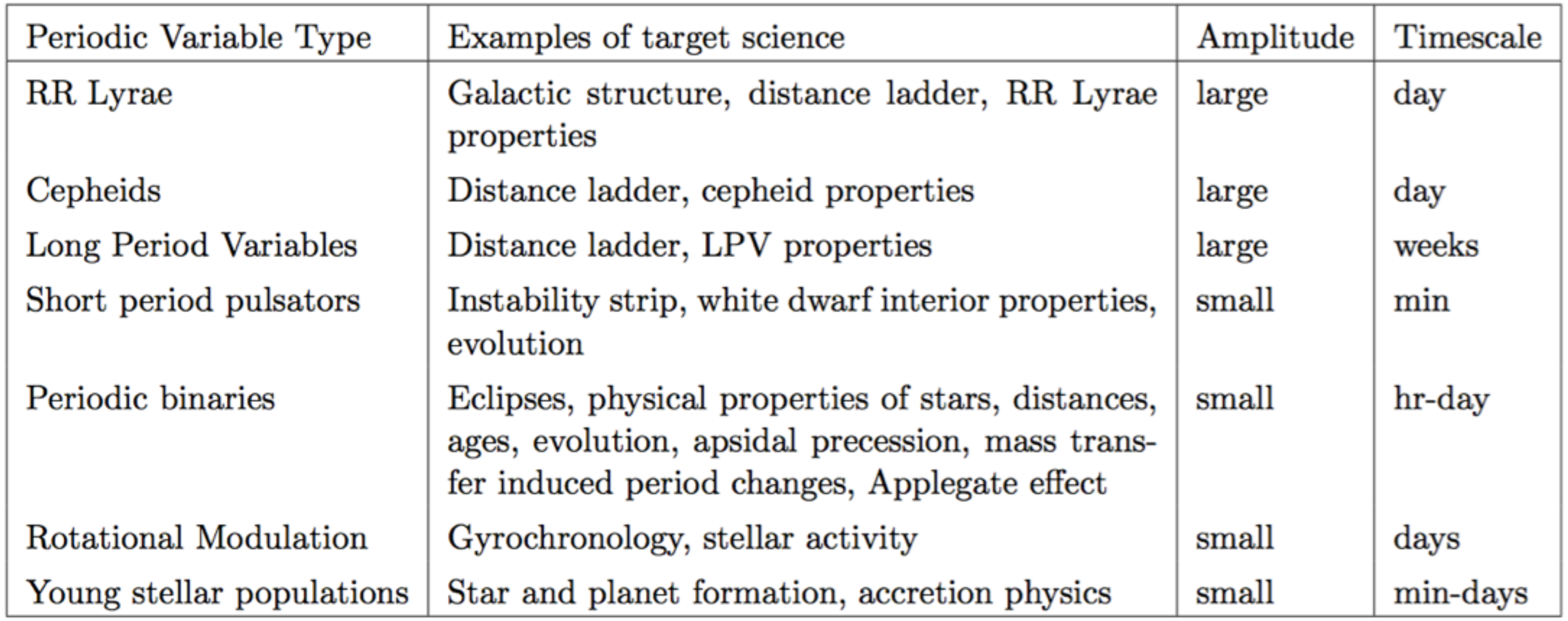
E. Bellm

different variable and transient phenomena benefit from different observing strategies

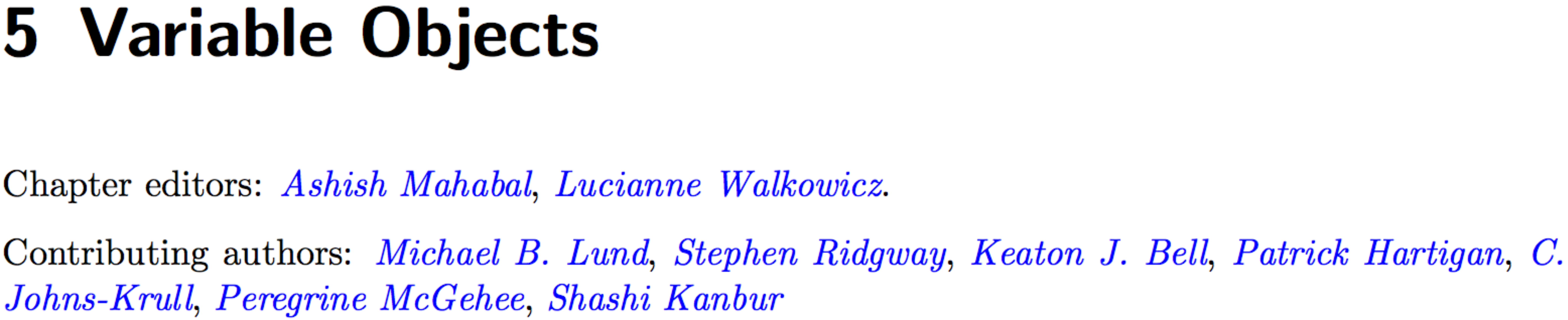
our group is working to reconcile the differences & understand the existing tensions & overlap

Tensions:

- color or sampling? (SN/GW vs GRB)
- dense sampling or duration? (SN vs TDE)
- Rolling cadence?
- ToO?



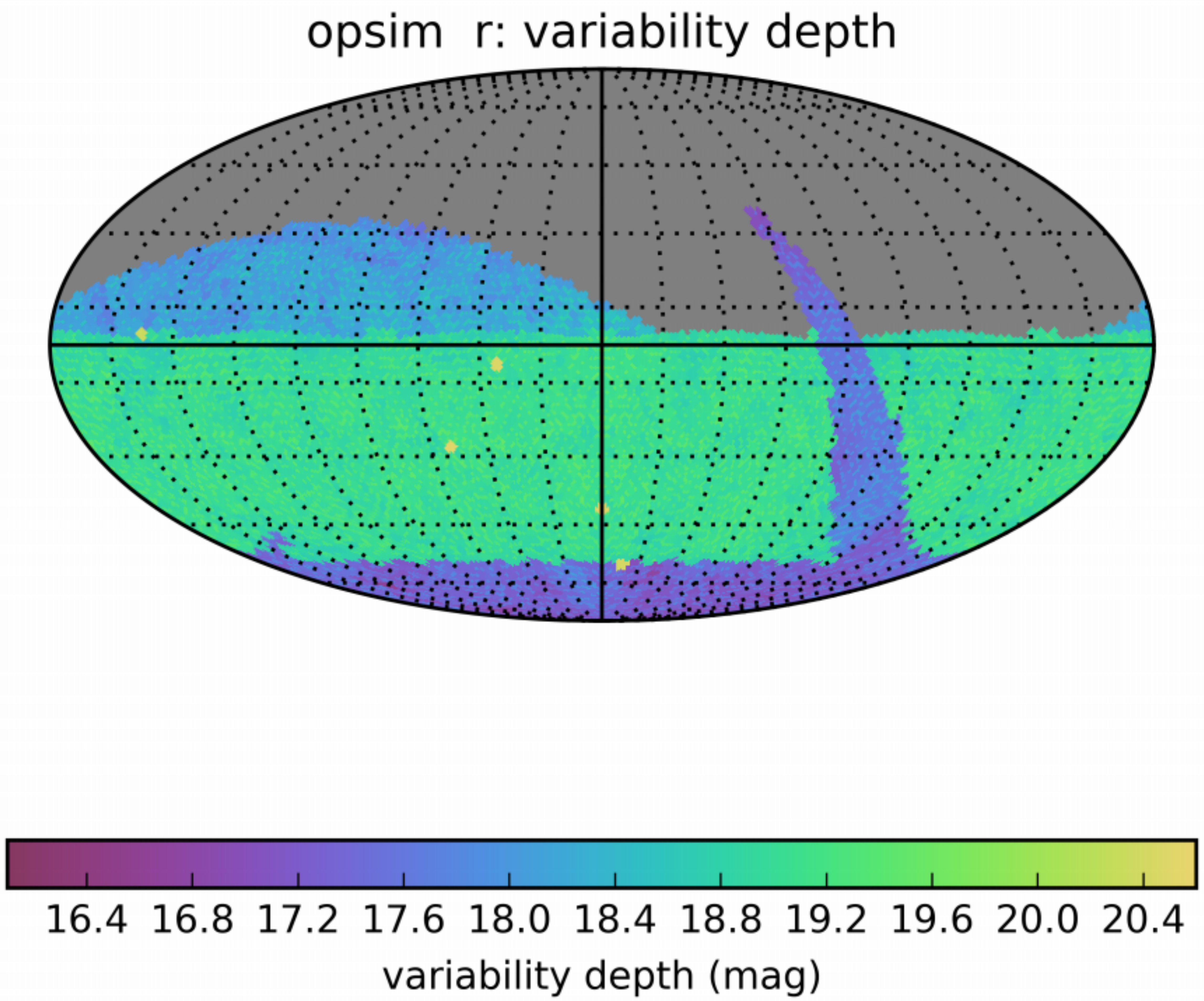
Periodic Variable Type	Examples of target science	Amplitude	Timescale
RR Lyrae	Galactic structure, distance ladder, RR Lyrae properties	large	day
Cepheids	Distance ladder, cepheid properties	large	day
Long Period Variables	Distance ladder, LPV properties	large	weeks
Short period pulsators	Instability strip, white dwarf interior properties, evolution	small	min
Periodic binaries	Eclipses, physical properties of stars, distances, ages, evolution, apsidal precession, mass transfer induced period changes, Applegate effect	small	hr-day
Rotational Modulation	Gyrochronology, stellar activity	small	days
Young stellar populations	Star and planet formation, accretion physics	small	min-days



5 Variable Objects

Chapter editors: *Ashish Mahabal*, *Lucianne Walkowicz*.

Contributing authors: *Michael B. Lund*, *Stephen Ridgway*, *Keaton J. Bell*, *Patrick Hartigan*, *C. Johns-Krull*, *Peregrine McGehee*, *Shashi Kanbur*

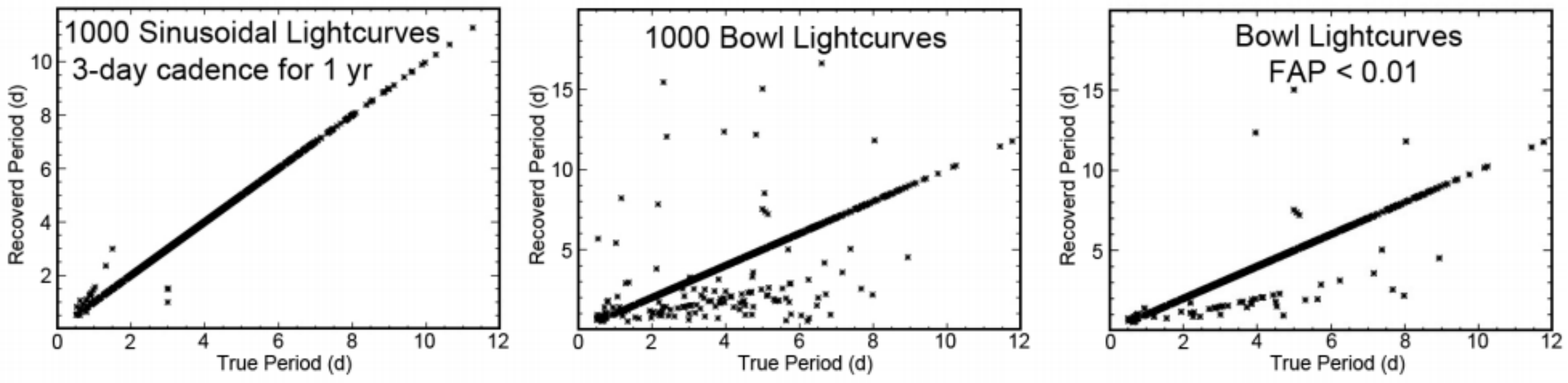

opsim r: variability depth
16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4
variability depth (mag)

Science-Driven Optimization
of the LSST Observing Strategy

5.5.2 Probing Planet Populations with LSST

Michael B. Lund, Avi Shporer, Keivan Stassun

This section describes the unique discovery space for extrasolar planets with LSST, namely, planets in relatively unexplored environments.

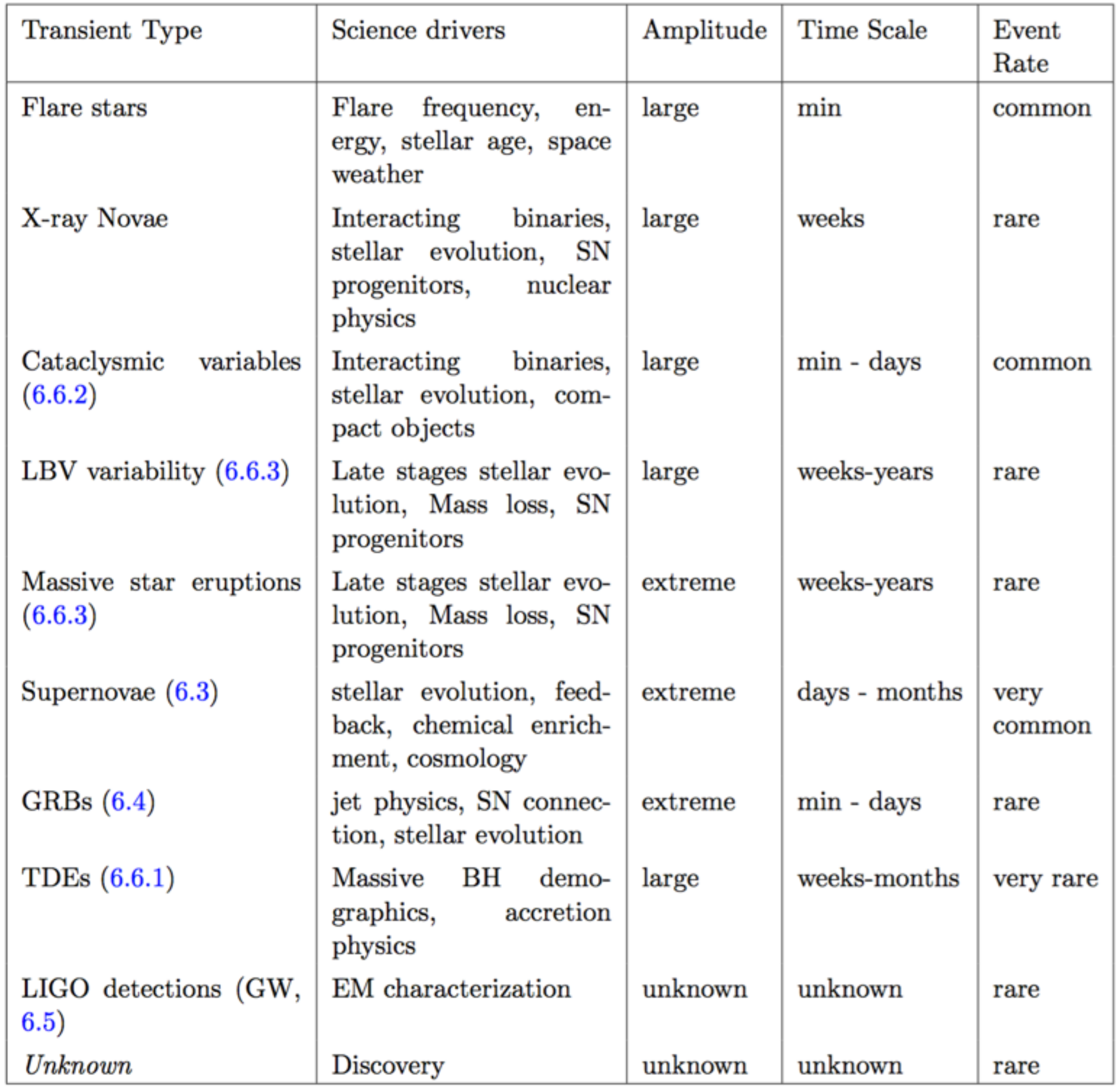


6 Eruptive and Explosive Transients

Chapter editors: *Eric C. Bellm*, *Federica B. Bianco*

Contributing Authors:

Iair Arcavi, *Laura Chomiuk*, *Zoheyr Doctor*, *Wen-fai Fong*, *Zoltan Haiman*, *Vassiliki Kalogera*, *Ashish Mahabal*, *Raffaella Margutti*, **??**, *Stephen Ridgway*, *Ohad Shemmer*, *Nathan Smith*, *Paula Szkody*, *Virginia Trimble*, *Stefano Valenti*, *Bevin Ashley Zauderer*

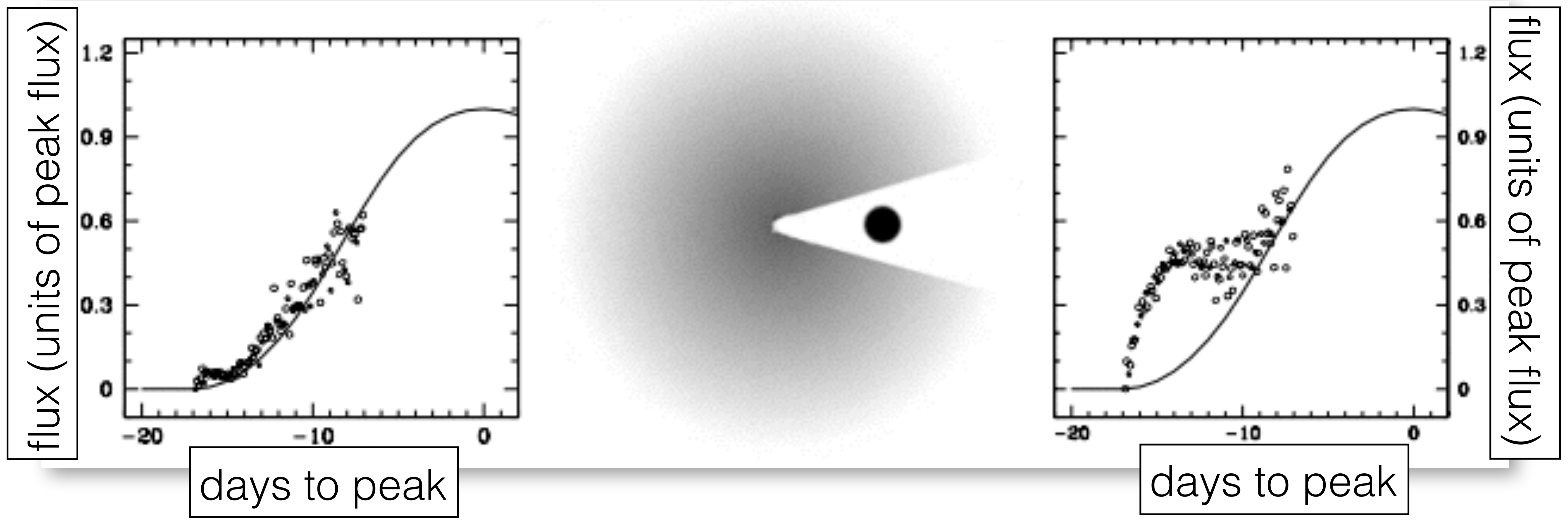


Transient Type	Science drivers	Amplitude	Time Scale	Event Rate
Flare stars	Flare frequency, energy, stellar age, space weather	large	min	common
X-ray Novae	Interacting binaries, stellar evolution, SN progenitors, nuclear physics	large	weeks	rare
Cataclysmic variables (6.6.2)	Interacting binaries, stellar evolution, compact objects	large	min - days	common
LBV variability (6.6.3)	Late stages stellar evolution, Mass loss, SN progenitors	large	weeks-years	rare
Massive star eruptions (6.6.3)	Late stages stellar evolution, Mass loss, SN progenitors	extreme	weeks-years	rare
Supernovae (6.3)	stellar evolution, feedback, chemical enrichment, cosmology	extreme	days - months	very common
GRBs (6.4)	jet physics, SN connection, stellar evolution	extreme	min - days	rare
TDEs (6.6.1)	Massive BH demographics, accretion physics	large	weeks-months	very rare
LIGO detections (GW, 6.5)	EM characterization	unknown	unknown	rare
Unknown	Discovery	unknown	unknown	rare

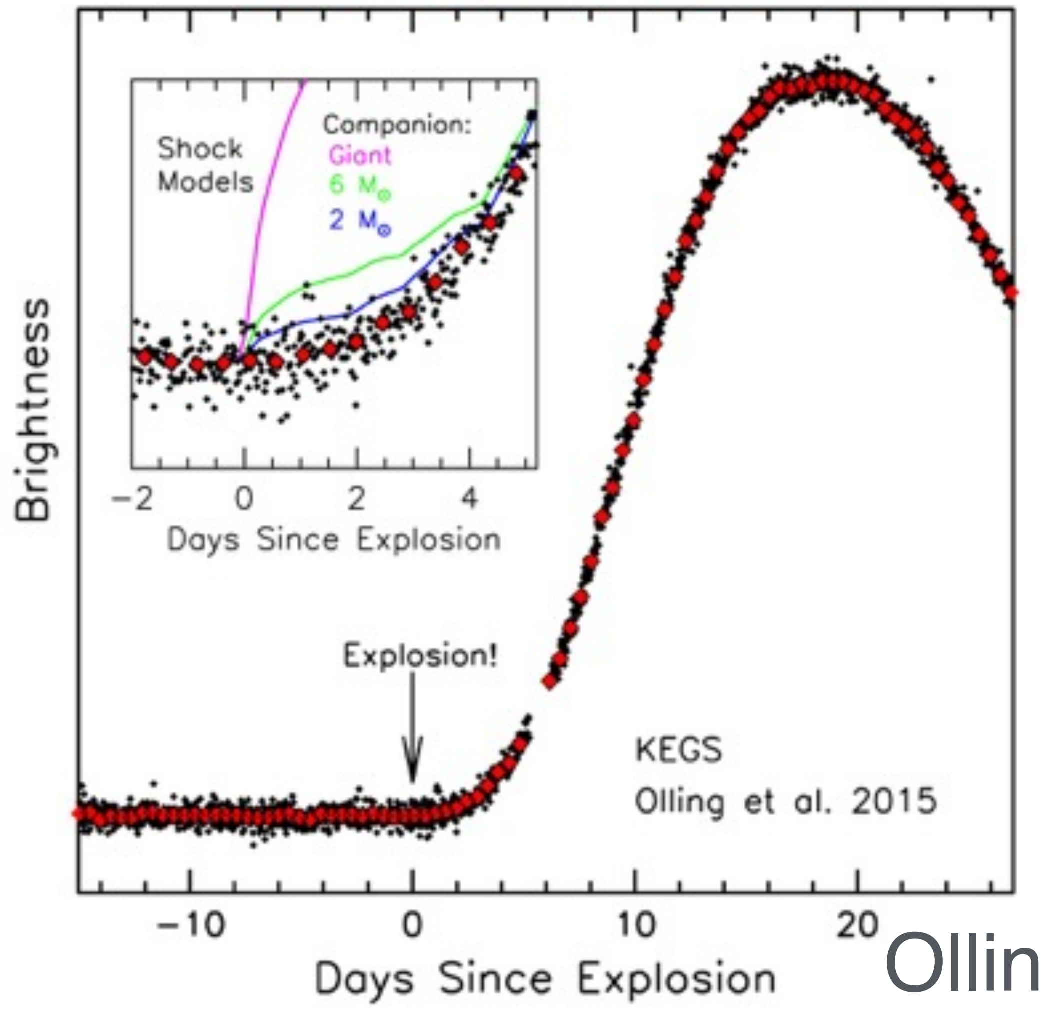
Non-Time-Critical

6.3 Supernovae as Transients

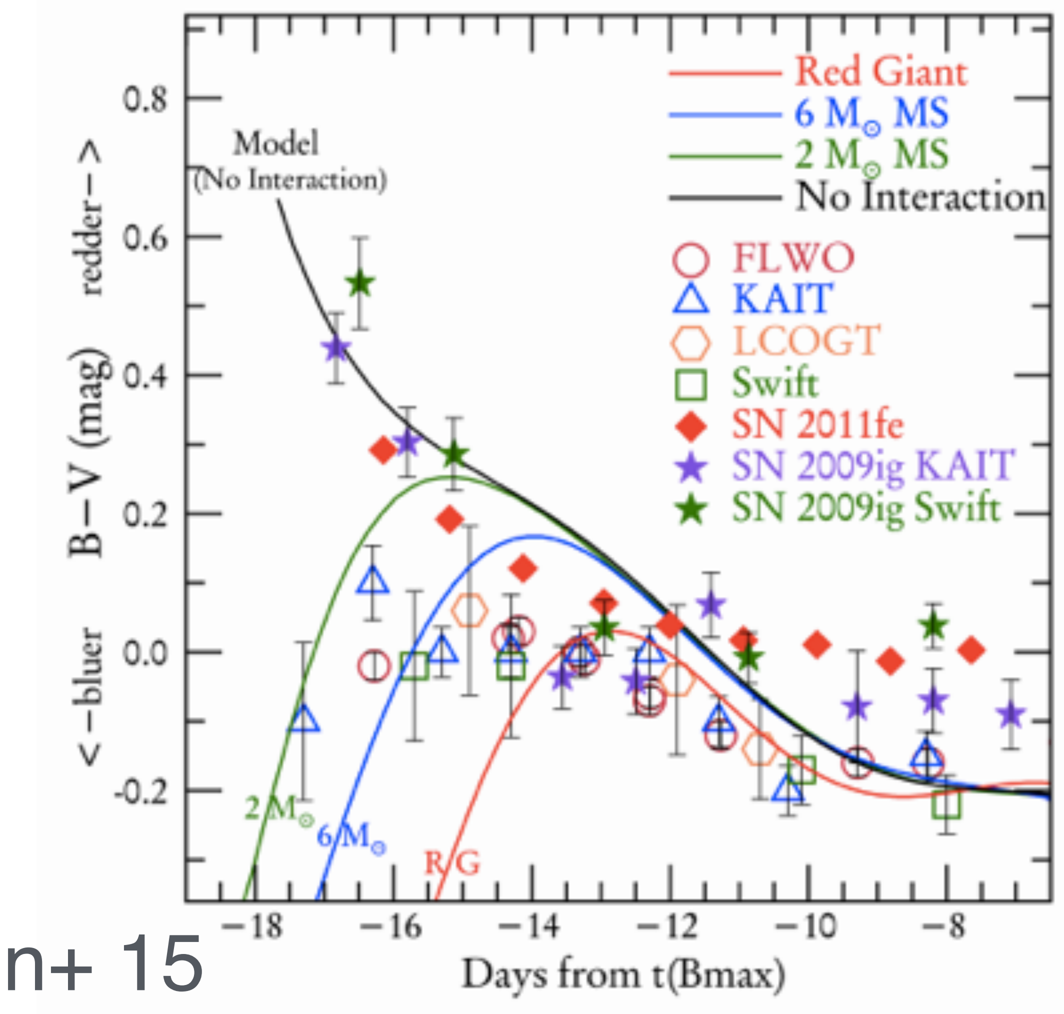
Federica B. Bianco



constraint RG progenitor systems to <20% (Bianco+ 2012, 3 year of SNLS data)
LSST 3 month -> 1%



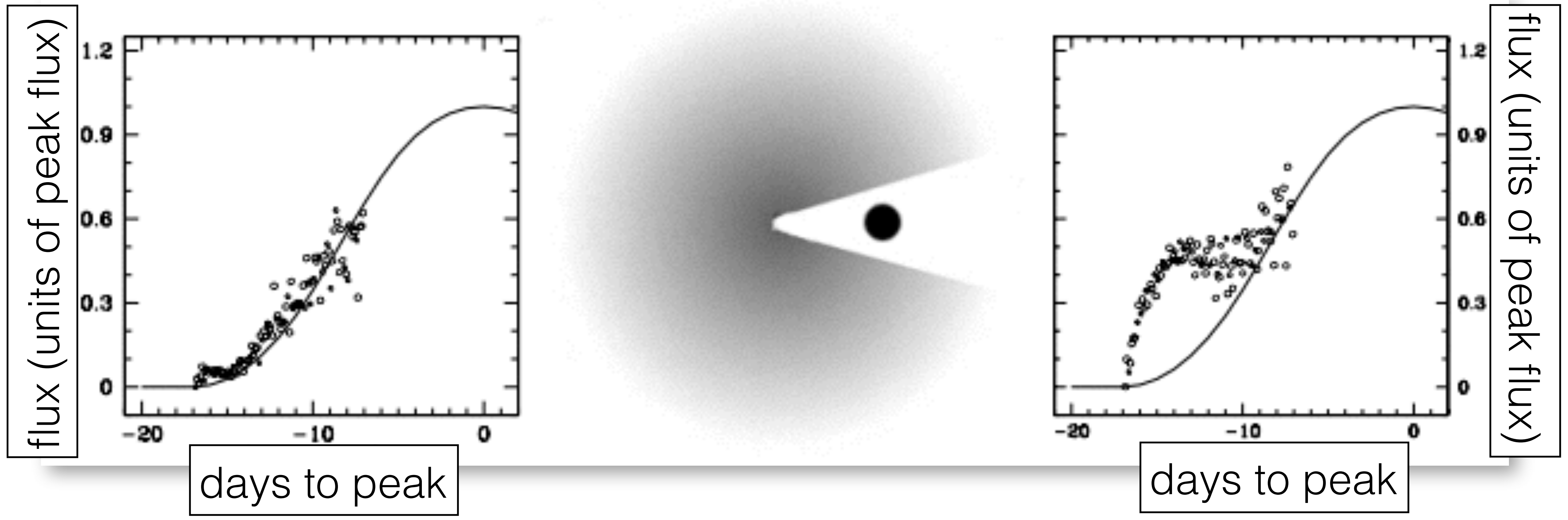
Olling+ 15



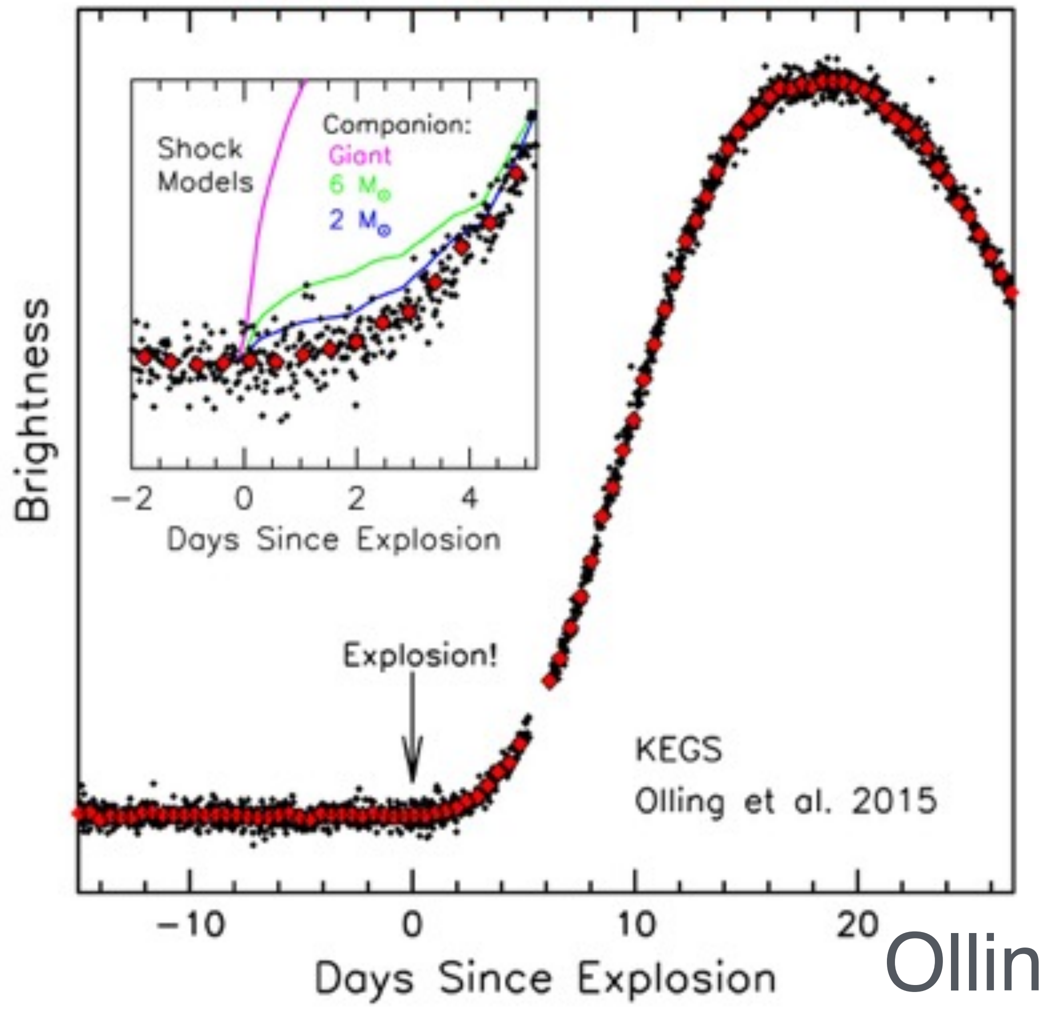
Marion+ 15

6.3 Supernovae as Transients

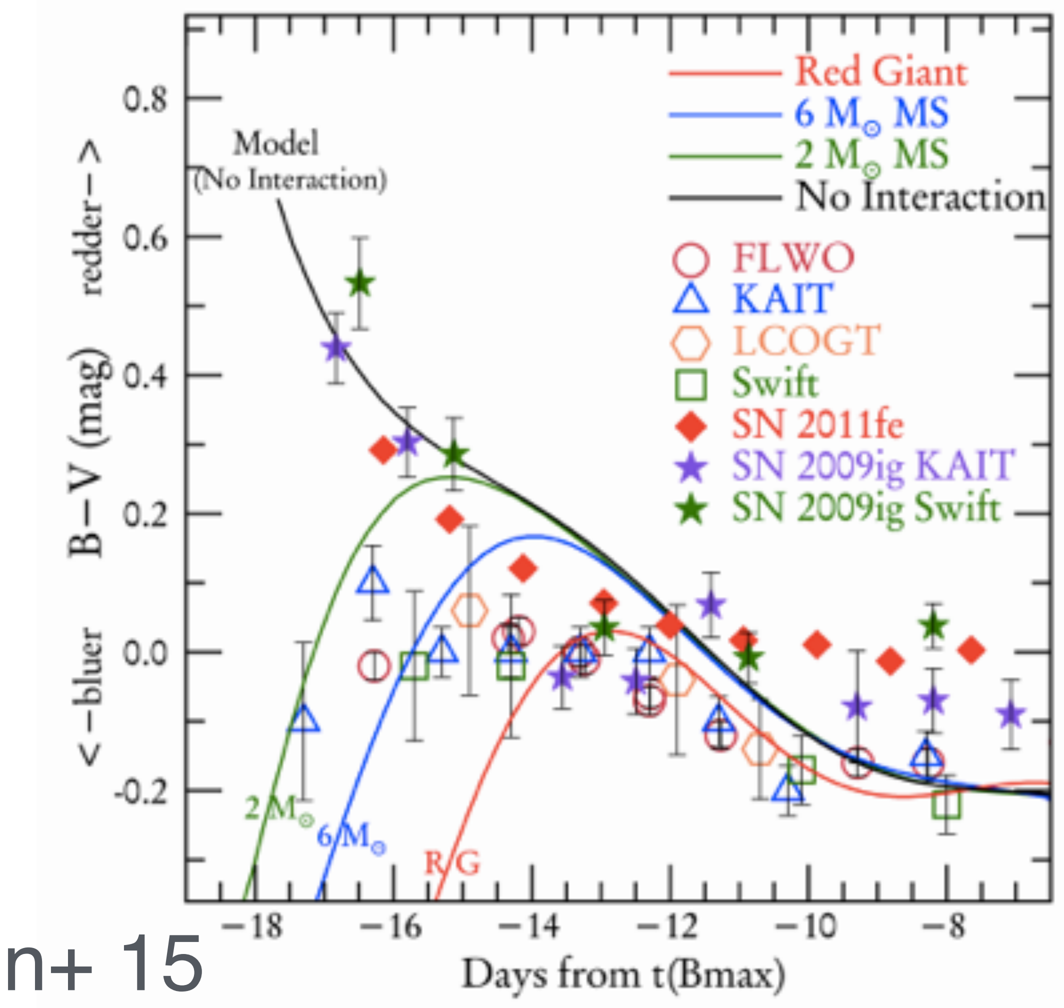
Federica B. Bianco



constraint RG progenitor
systems to <20%
(Bianco+ 2012,
3 year of SNLS data)
LSST 3 month -> 1%

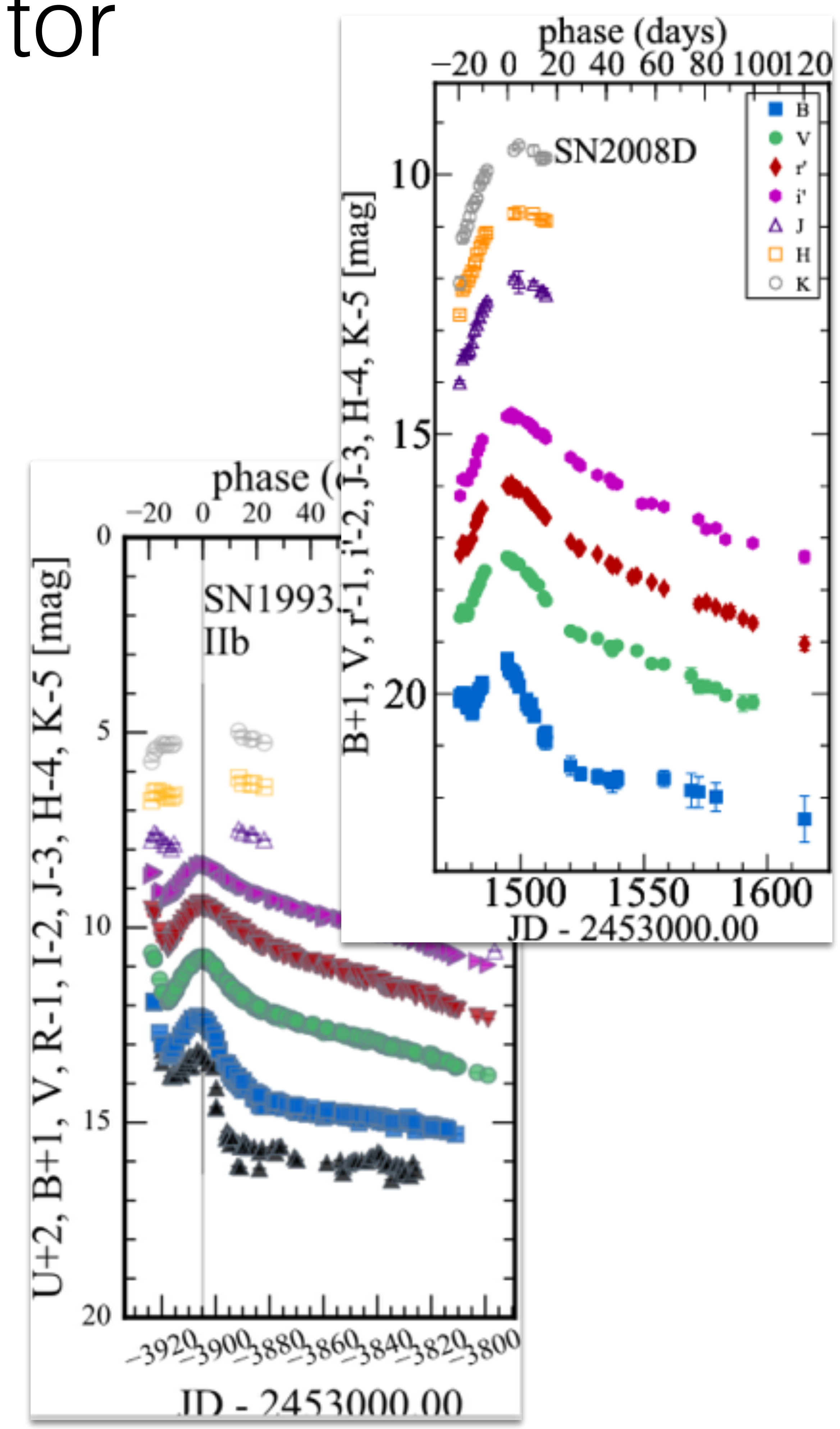


Olling+ 15



Marion+ 15

also:
shock breakout,
IIB double peaks



6.3 Supernovae as Transients

Federica B. Bianco

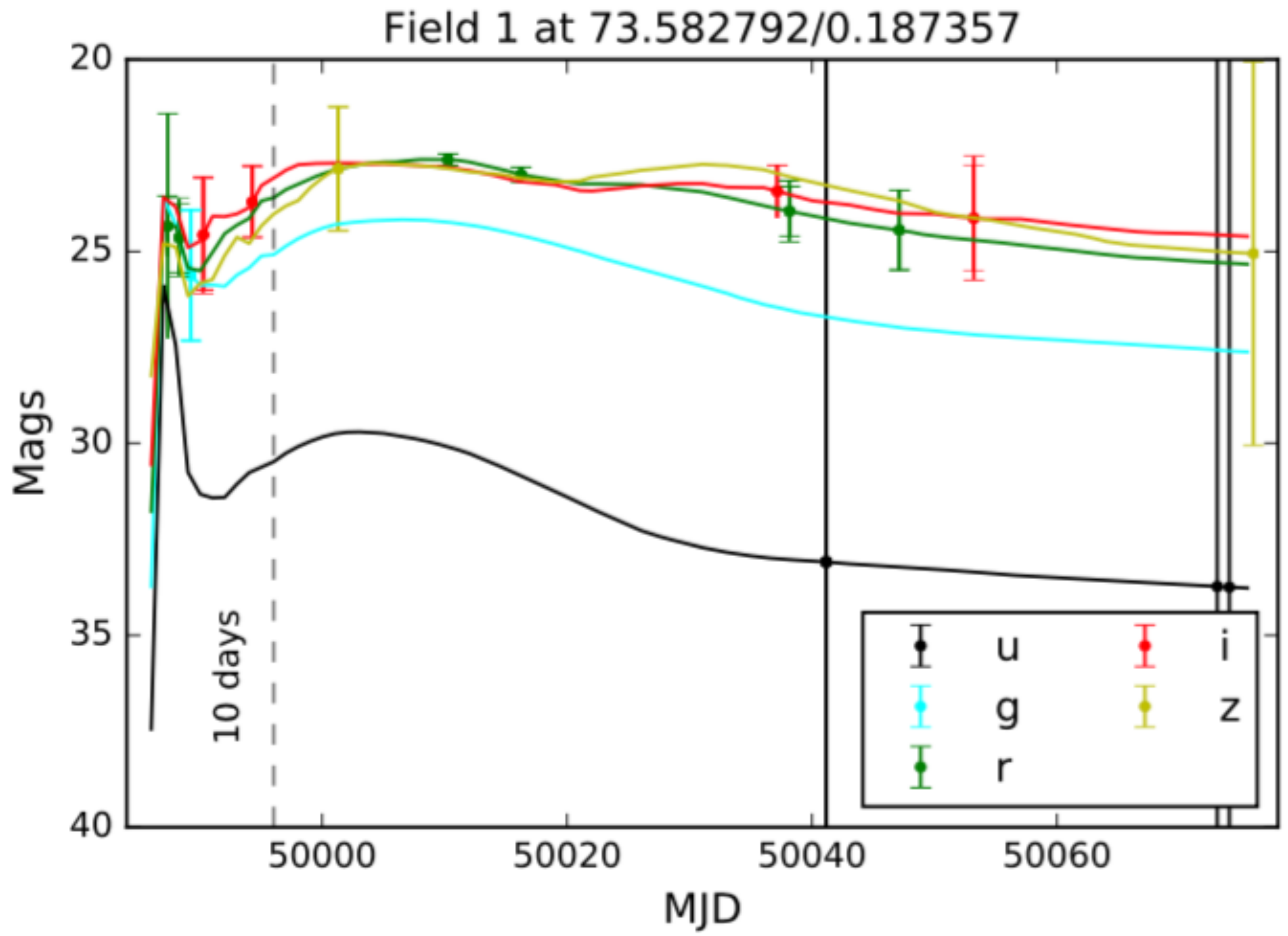


Figure 6.6: A normal SN Ia lightcure at z=0.5 showing interaction with a RG companion as seen from the most favorable viewing angle: the effect of interaction as simulated by Kasen (2010) is added on top of a lightcurve simulated from the Nugent et al. 2002 templates. The data points represent one possible set of LSST observations of this transient, obtained by running the `transientAsciiMetric`. This particular event is detected in g', r', and i' within the first 10 days.

6.3 Supernovae as Transients

Federica B. Bianco

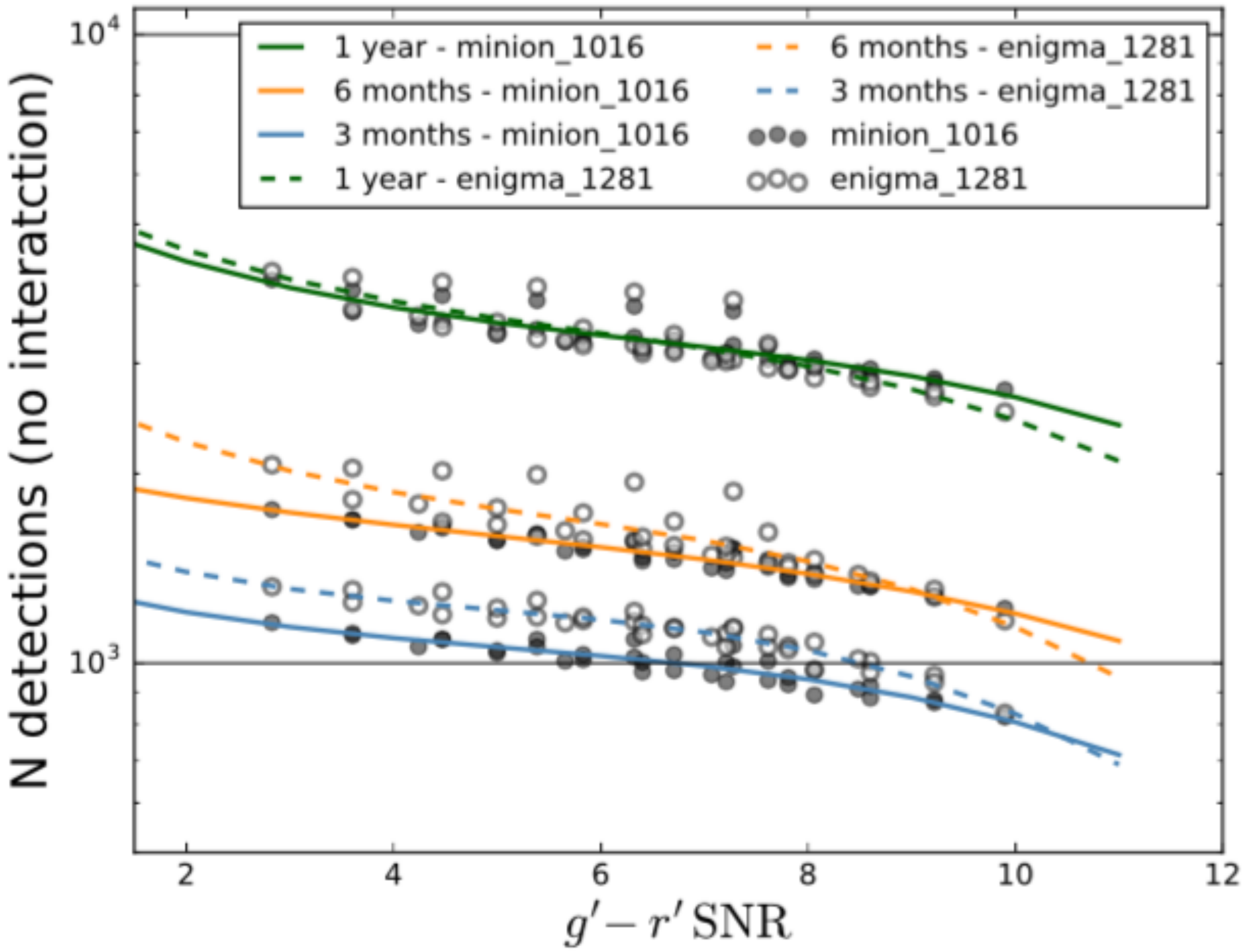


Figure 6.7: Normal SN Ia lightcure at z=0.5 detected by the `minion_1016` cadence in 3 months, 6 months, and 1 year, that provide color information useful to constrain the progenitor distribution. Line are third-degree polynomial fits.

Time-Critical:

CLASSIFICATION: young/old

FAST TRANSIENTS: GRB

GW: counterpart discovery

6.2 Realtime Identification of Young Transients

Stefano Valenti, *Federica B. Bianco*

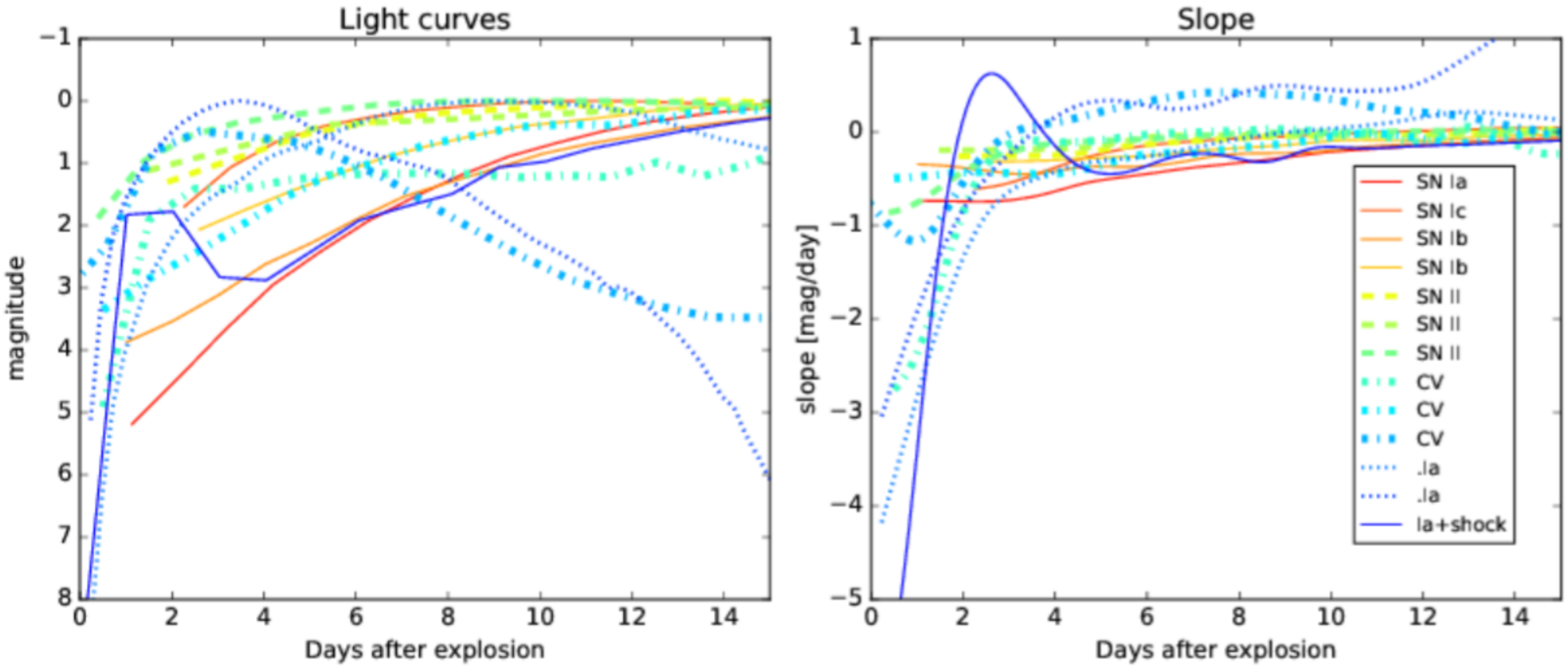
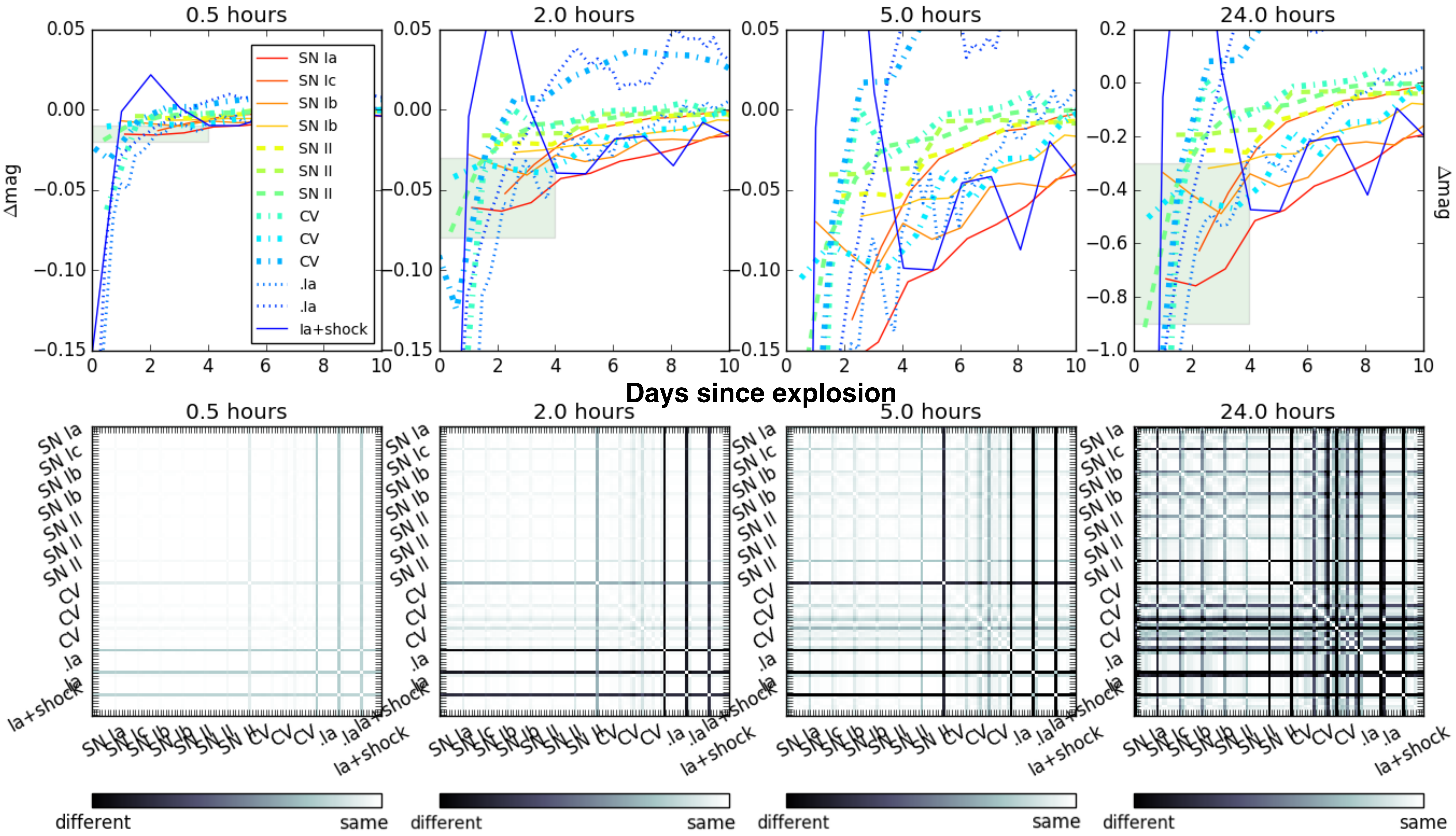
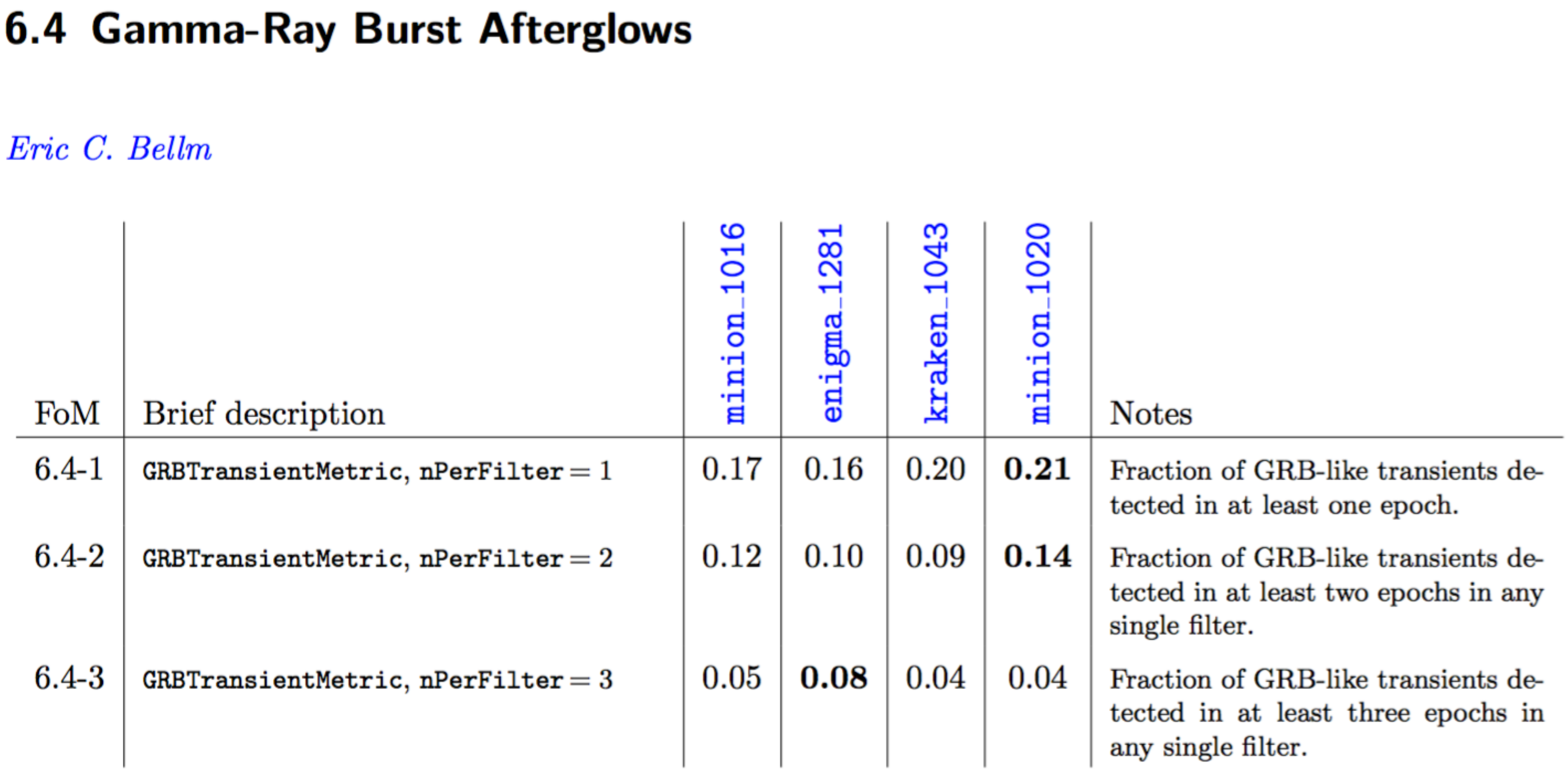


Figure 6.4: *Left*: r'-band light curve for representative transients as function of the phase from the beginning of the transient outburst/explosion for the first few days of the transient life. *Right*: slope of the transient evolution. Data from: SN Ia, Olling et al. (2015); SNII, Rubin et al. (2016); SN .Ia, Shen et al. (2010); SN Ib, Valenti et al. (2011), Cao et al. (2013); SN Ic, Mazzali et al. (2002); CV, Sokoloski et al. (2013), Finzell et al. (in prep), SN Ia+interaction (see Section 6.3)

Gap between observations





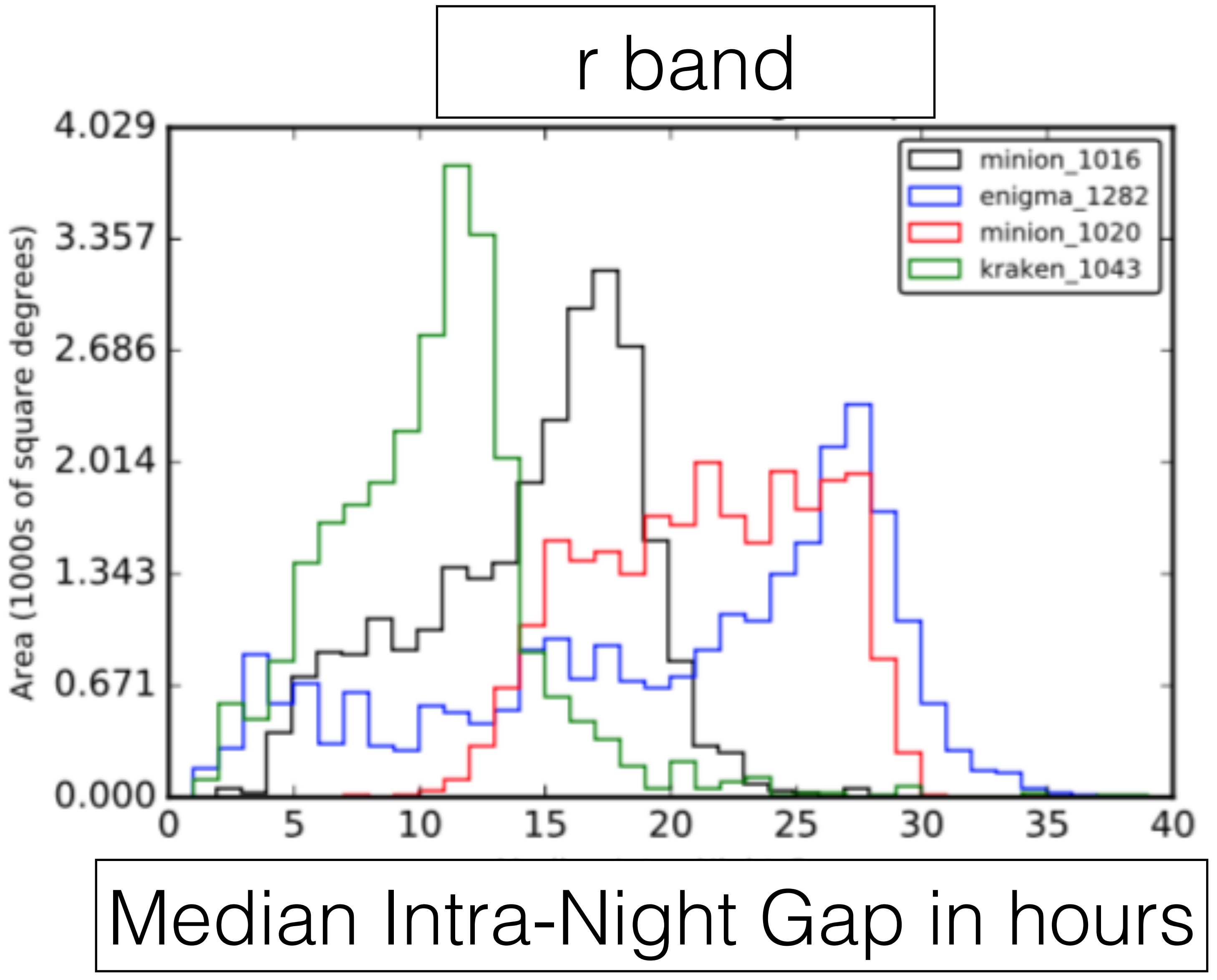
6.4 Gamma-Ray Burst Afterglows

Eric C. Bellm

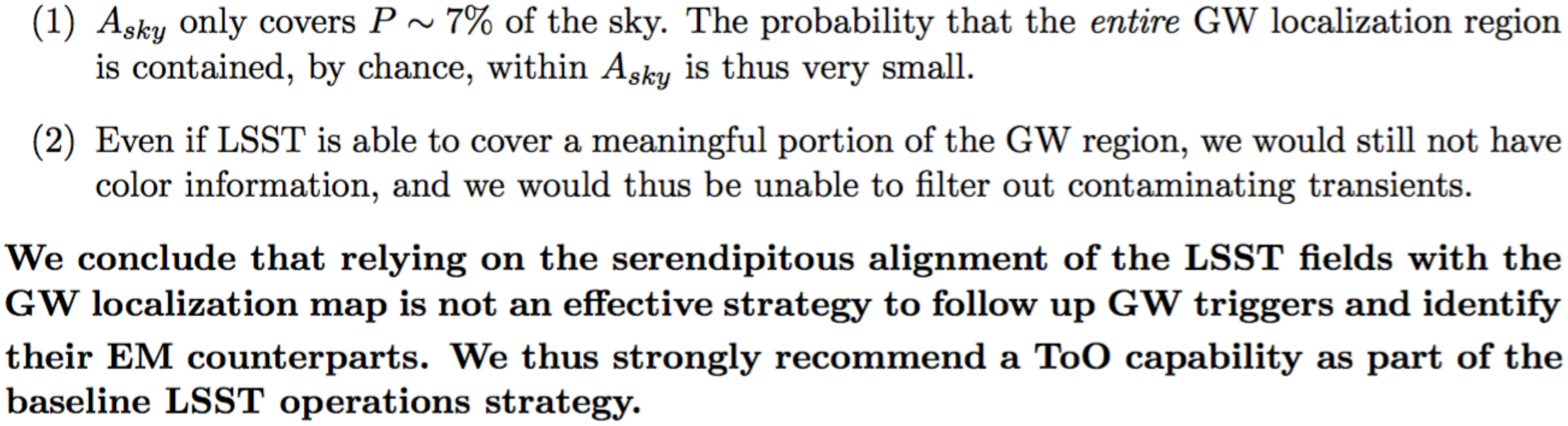
FoM	Brief description	minion_1016	enigma_1281	kraken_1043	minion_1020	Notes
6.4-1	`GRBTransientMetric`, `nPerFilter` = 1	0.17	0.16	0.20	**0.21**	Fraction of GRB-like transients detected in at least one epoch.
6.4-2	`GRBTransientMetric`, `nPerFilter` = 2	0.12	0.10	0.09	**0.14**	Fraction of GRB-like transients detected in at least two epochs in any single filter.
6.4-3	`GRBTransientMetric`, `nPerFilter` = 3	0.05	**0.08**	0.04	0.04	Fraction of GRB-like transients detected in at least three epochs in any single filter.

6.5 Gravitational Wave Sources

Raffaella Margutti, *Zoheyr Doctor*, *Wen-fai Fong*, *Zoltan Haiman*, *Vassiliki Kalogera*, *Virginia Trimble*, *Bevin Ashley Zauderer*



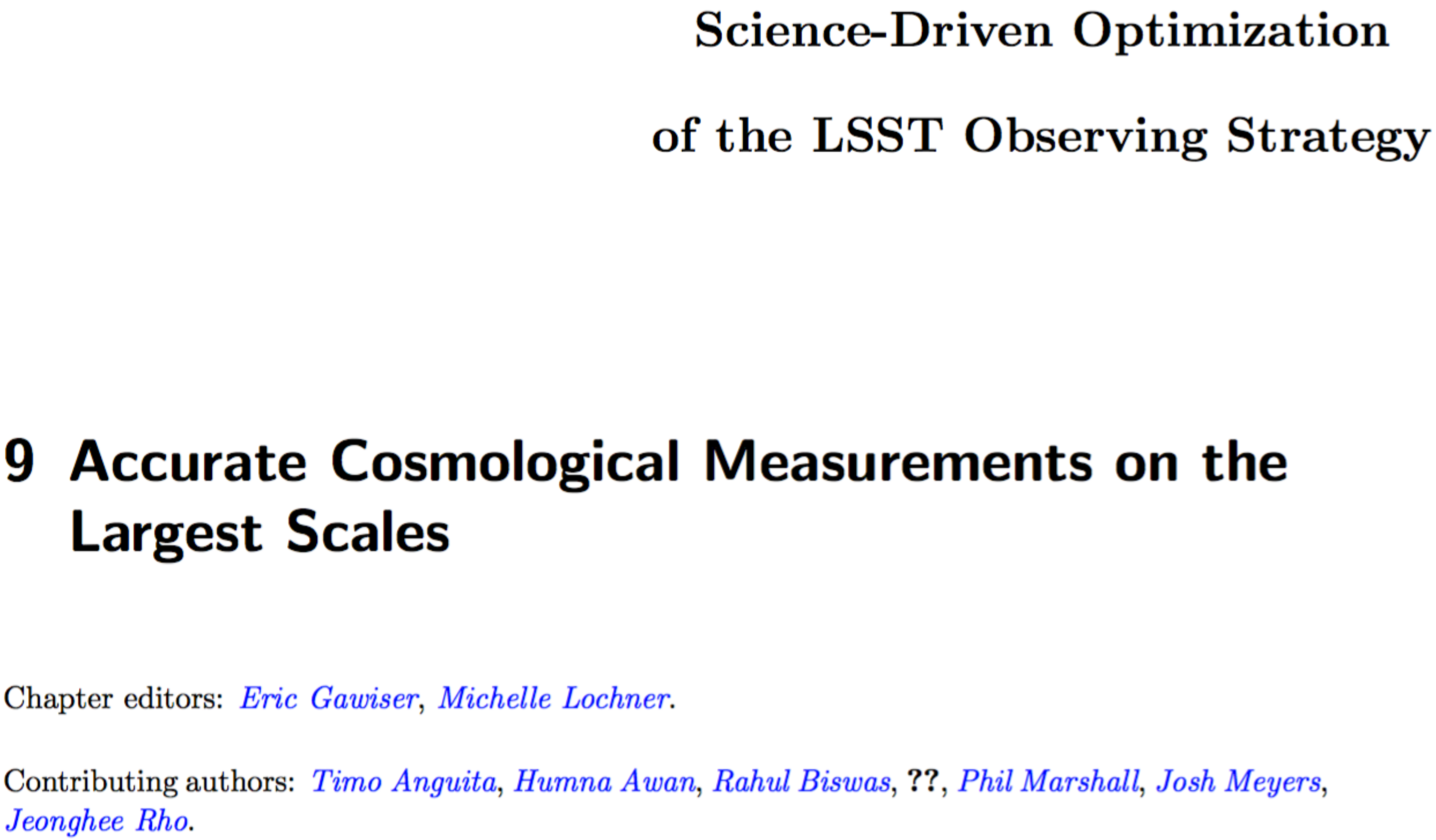
require 2 observations in 1 week after GW detection (Coperthwaite & Berger 2015)



(1) A_{sky} only covers $P \sim 7\%$ of the sky. The probability that the *entire* GW localization region is contained, by chance, within A_{sky} is thus very small.

(2) Even if LSST is able to cover a meaningful portion of the GW region, we would still not have color information, and we would thus be unable to filter out contaminating transients.

We conclude that relying on the serendipitous alignment of the LSST fields with the GW localization map is not an effective strategy to follow up GW triggers and identify their EM counterparts. We thus strongly recommend a ToO capability as part of the baseline LSST operations strategy.



Science-Driven Optimization of the LSST Observing Strategy

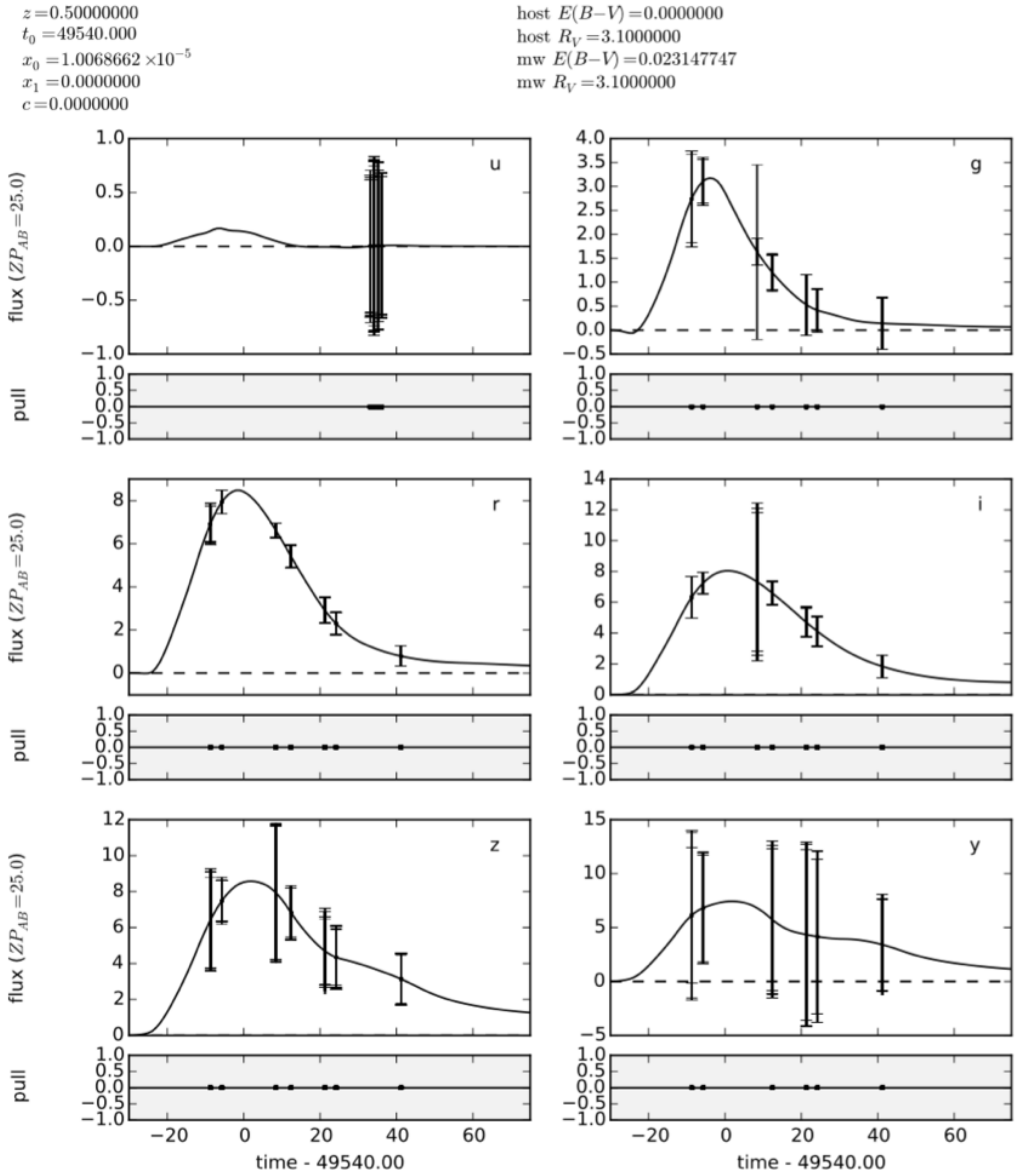
9 Accurate Cosmological Measurements on the Largest Scales

Chapter editors: *Eric Gawiser*, *Michelle Lochner*.

Contributing authors: *Timo Anguita*, *Humna Awan*, *Rahul Biswas*, ??, *Phil Marshall*, *Josh Meyers*, *Jeonghee Rho*.

9.5 Supernova Cosmology and Physics

Jeonghee Rho, *Michelle Lochner*, *Rahul Biswas*, *Seth Digel*.

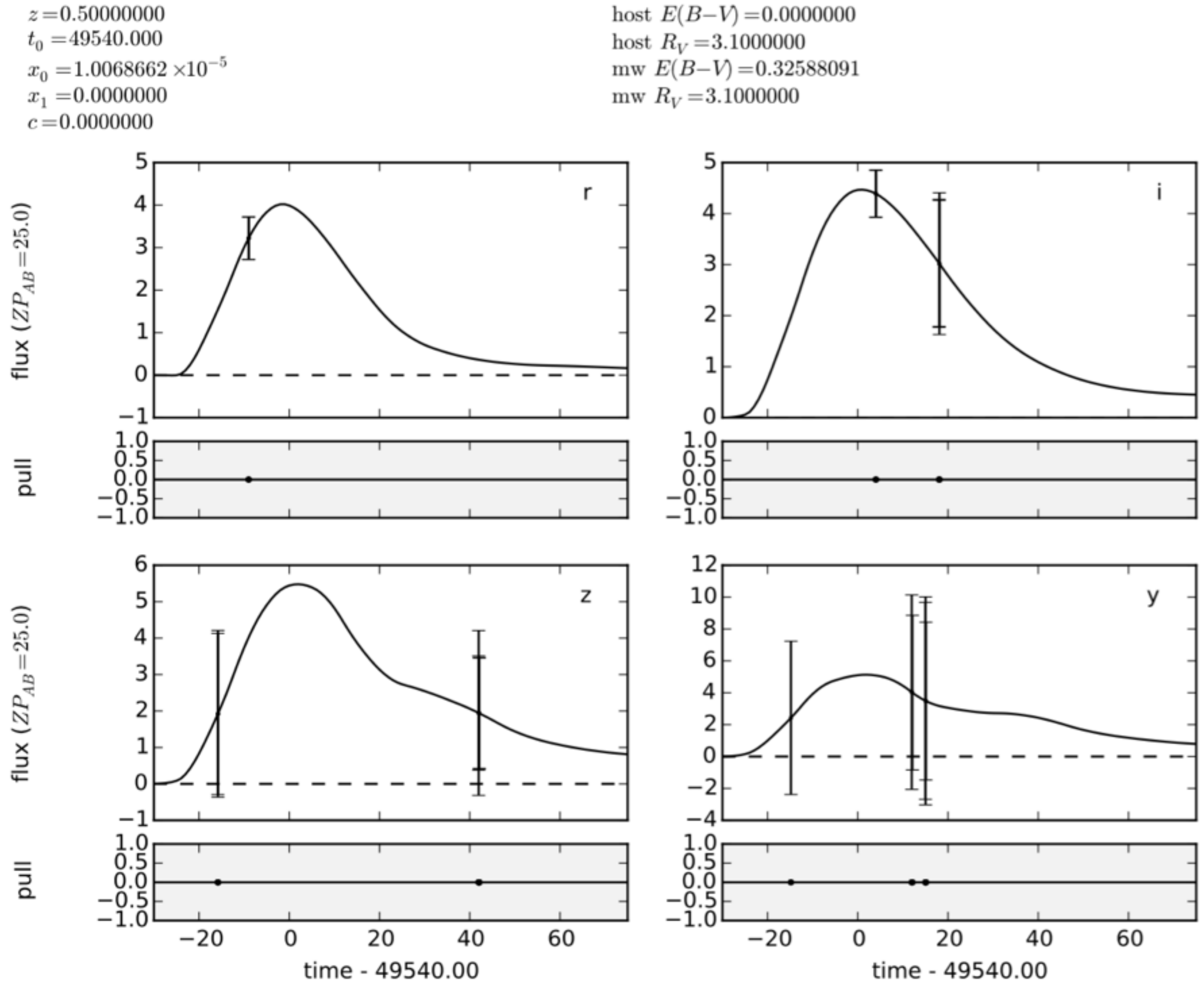


Deep Drilling Field

Figure 9.12: An example of a light curve, in six filter bands, of a SN Ia from a DDF in `enigma_1189`.

9.5 Supernova Cosmology and Physics

Jeonghee Rho, *Michelle Lochner*, *Rahul Biswas*, *Seth Digel*.



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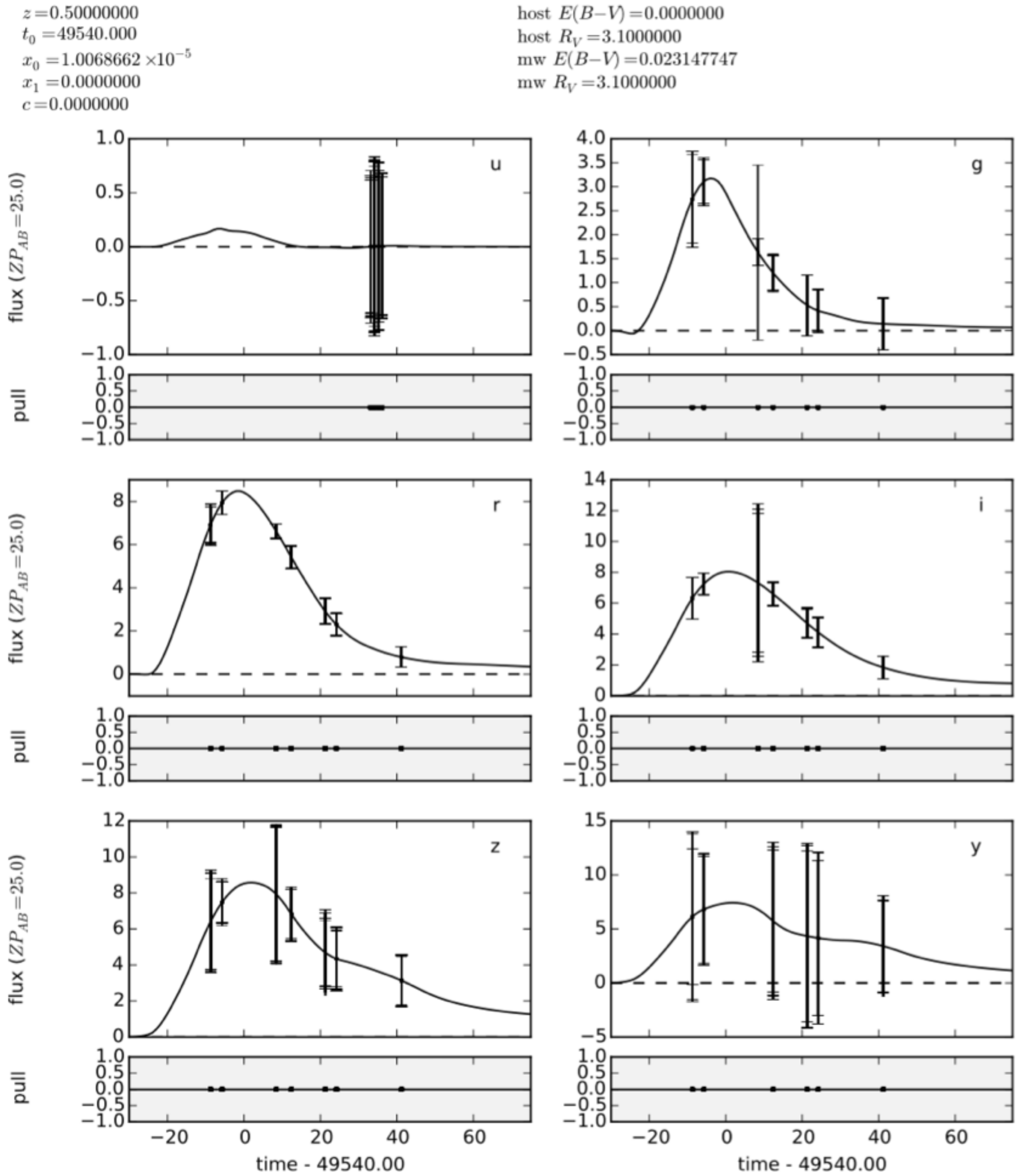
Wide Deep Fast

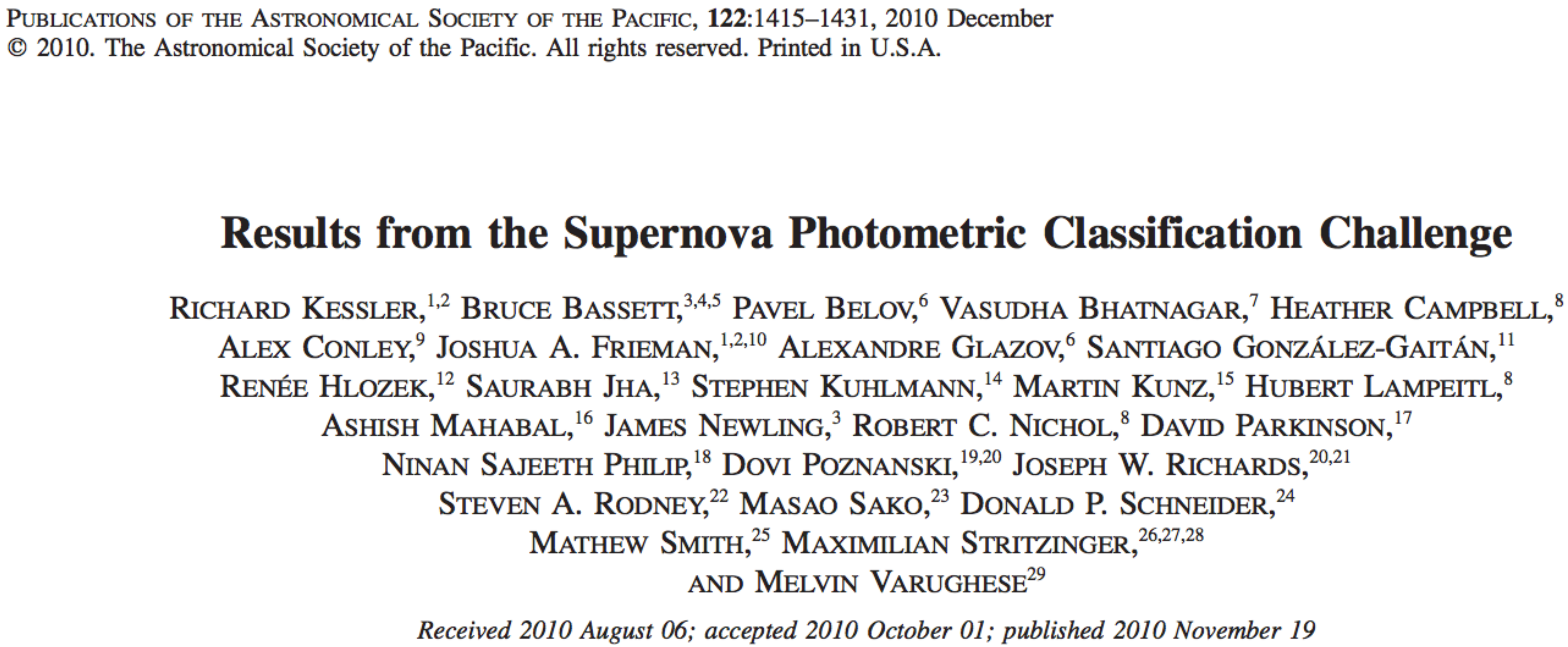
Figure 9.13: An example of a light curve, where only four filter bands are available, of a SN Ia from the WFD survey in **enigma_1189**.



Deep Drilling Field

Figure 9.12: An example of a light curve, in six filter bands, of a SN Ia from a DDF in **enigma_1189**.

Transients Classification challenge



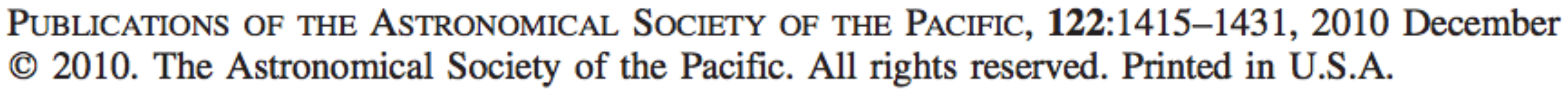
Publications of the Astronomical Society of the Pacific, **122**:1415–1431, 2010 December

Results from the Supernova Photometric Classification Challenge

Richard Kessler,[1,2] Bruce Bassett,[3,4,5] Pavel Belov,[6] Vasudha Bhatnagar,[7] Heather Campbell,[8]
Alex Conley,[9] Joshua A. Frieman,[1,2,10] Alexandre Glazov,[6] Santiago González-Gaitán,[11]
Renée Hlozek,[12] Saurabh Jha,[13] Stephen Kuhlmann,[14] Martin Kunz,[15] Hubert Lampeitl,[8]
Ashish Mahabal,[16] James Newling,[3] Robert C. Nichol,[8] David Parkinson,[17]
Ninan Sajeeth Philip,[18] Dovi Poznanski,[19,20] Joseph W. Richards,[20,21]
Steven A. Rodney,[22] Masao Sako,[23] Donald P. Schneider,[24]
Mathew Smith,[25] Maximilian Stritzinger,[26,27,28]
and Melvin Varughese[29]

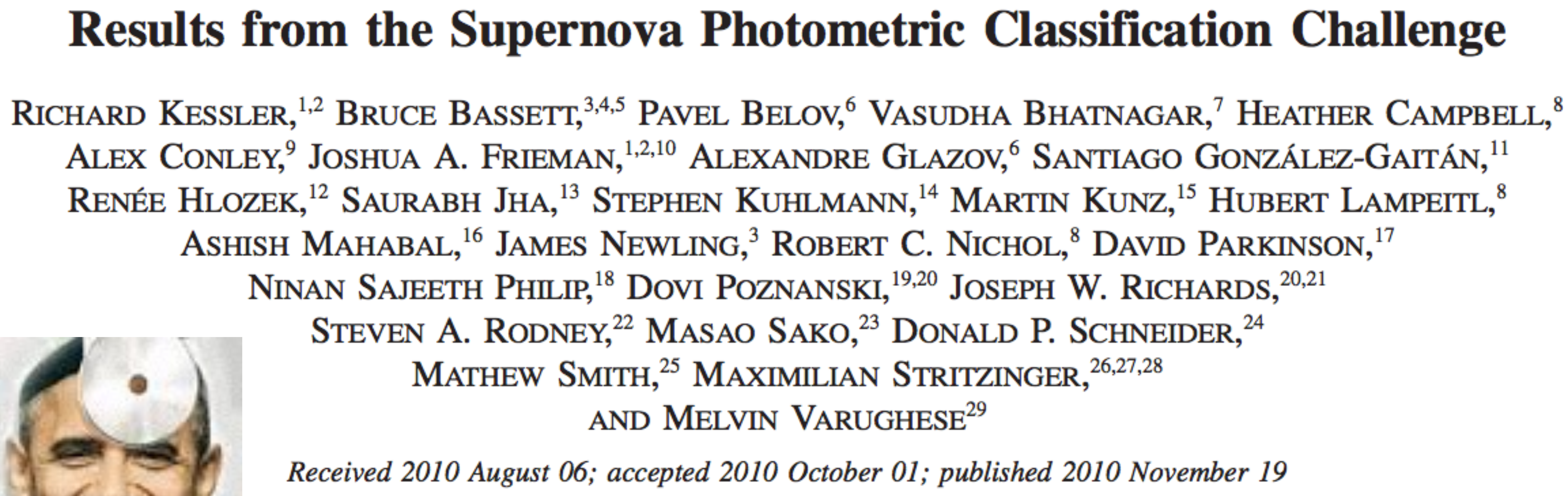
Received 2010 August 06; accepted 2010 October 01; published 2010 November 19

Transients Classification challenge



PUBLICATIONS OF THE ASTRONOMICAL SOCIETY OF THE PACIFIC, **122**:1415–1431, 2010 December

in 2009 Kessler+ issued s SN classification challenge.



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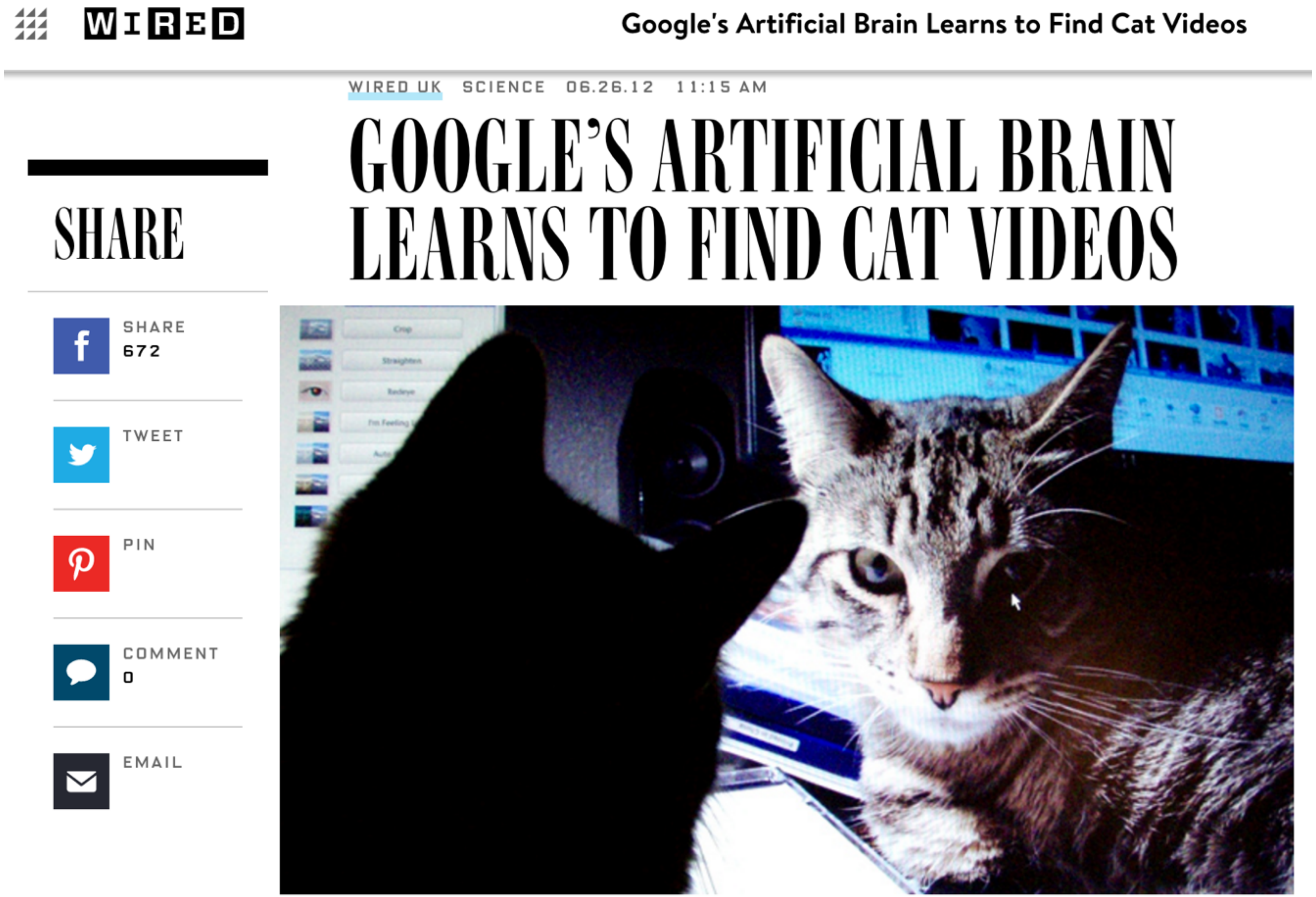

WIRED

Google's Artificial Brain Learns to Find Cat Videos

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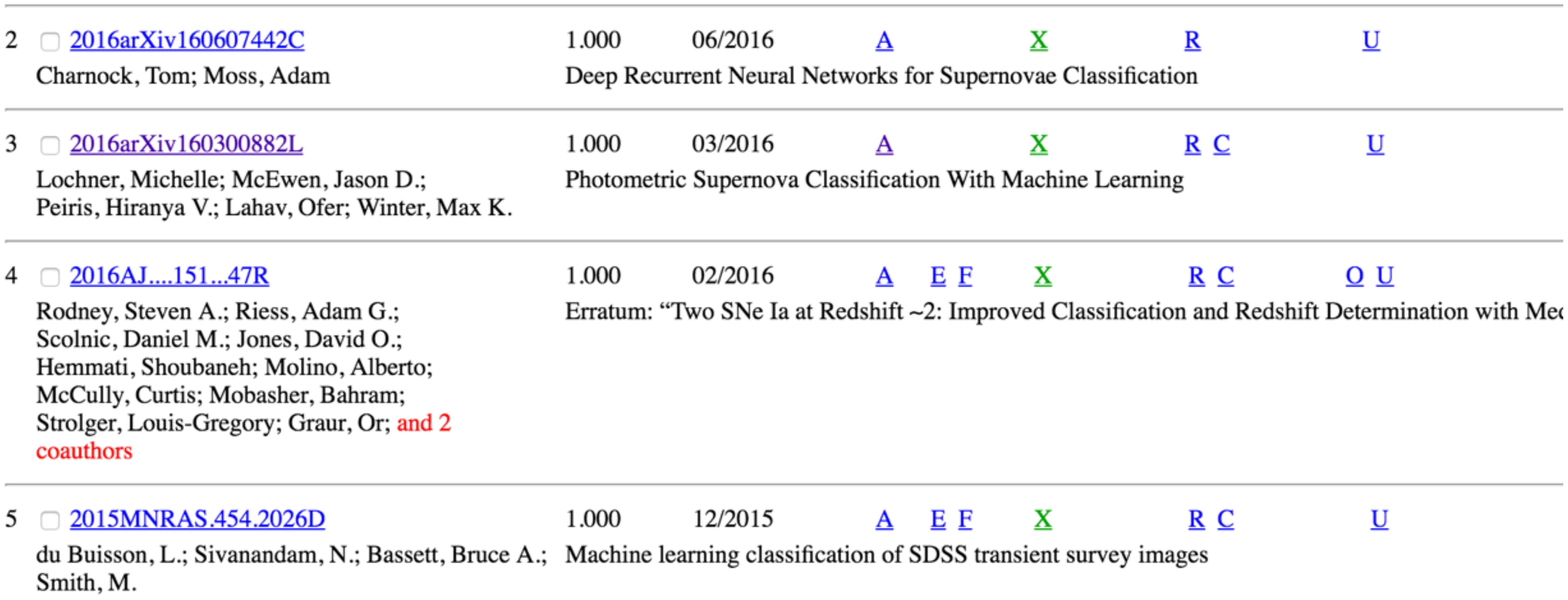
GOOGLE'S ARTIFICIAL BRAIN LEARNS TO FIND CAT VIDEOS

we have learned a lot since 2010!



2 ☐ 2016arXiv160607442C 1.000 06/2016 A X R U
Charnock, Tom; Moss, Adam
Deep Recurrent Neural Networks for Supernovae Classification

3 ☐ 2016arXiv160300882L 1.000 03/2016 A X R C U
Lochner, Michelle; McEwen, Jason D.; Peiris, Hiranya V.; Lahav, Ofer; Winter, Max K.
Photometric Supernova Classification With Machine Learning

4 ☐ 2016AJ....151...47R 1.000 02/2016 A E F X R C O U
Rodney, Steven A.; Riess, Adam G.; Scolnic, Daniel M.; Jones, David O.; Hemmati, Shoubaneh; Molino, Alberto; McCully, Curtis; Mobasher, Bahram; Strolger, Louis-Gregory; Graur, Or; and 2 coauthors
Erratum: “Two SNe Ia at Redshift ~2: Improved Classification and Redshift Determination with Me

5 ☐ 2015MNRAS.454.2026D 1.000 12/2015 A E F X R C U
du Buisson, L.; Sivanandam, N.; Bassett, Bruce A.; Smith, M.
Machine learning classification of SDSS transient survey images

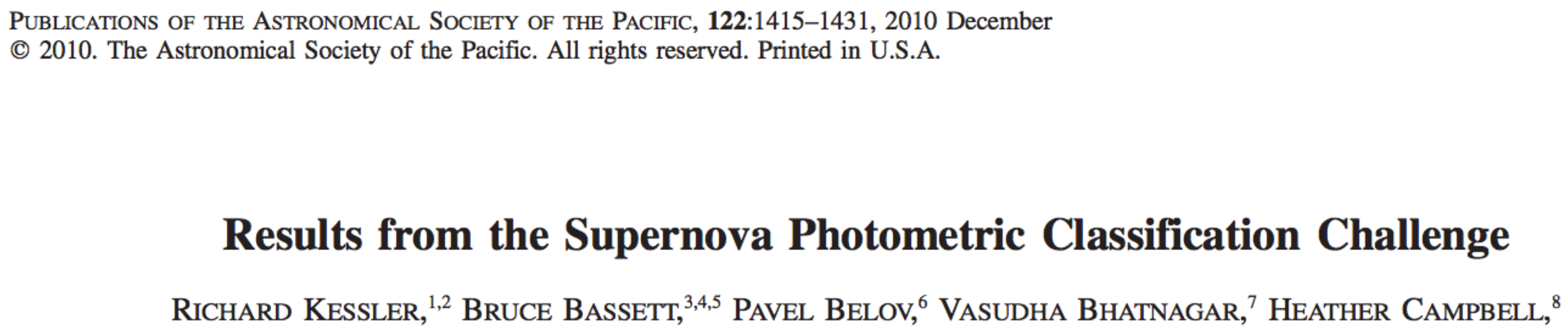
Michelle Lochner+ 2016

Anais Moller+ 2016

Gautham Narayan, Tom Matheson working on ***ANTARES***

Kevian Stussen @***Vanderbilt*** working on classifiers

Transients Classification challenge



PUBLICATIONS OF THE ASTRONOMICAL SOCIETY OF THE PACIFIC, **122**:1415–1431, 2010 December

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SNLS, SDSSII CSP

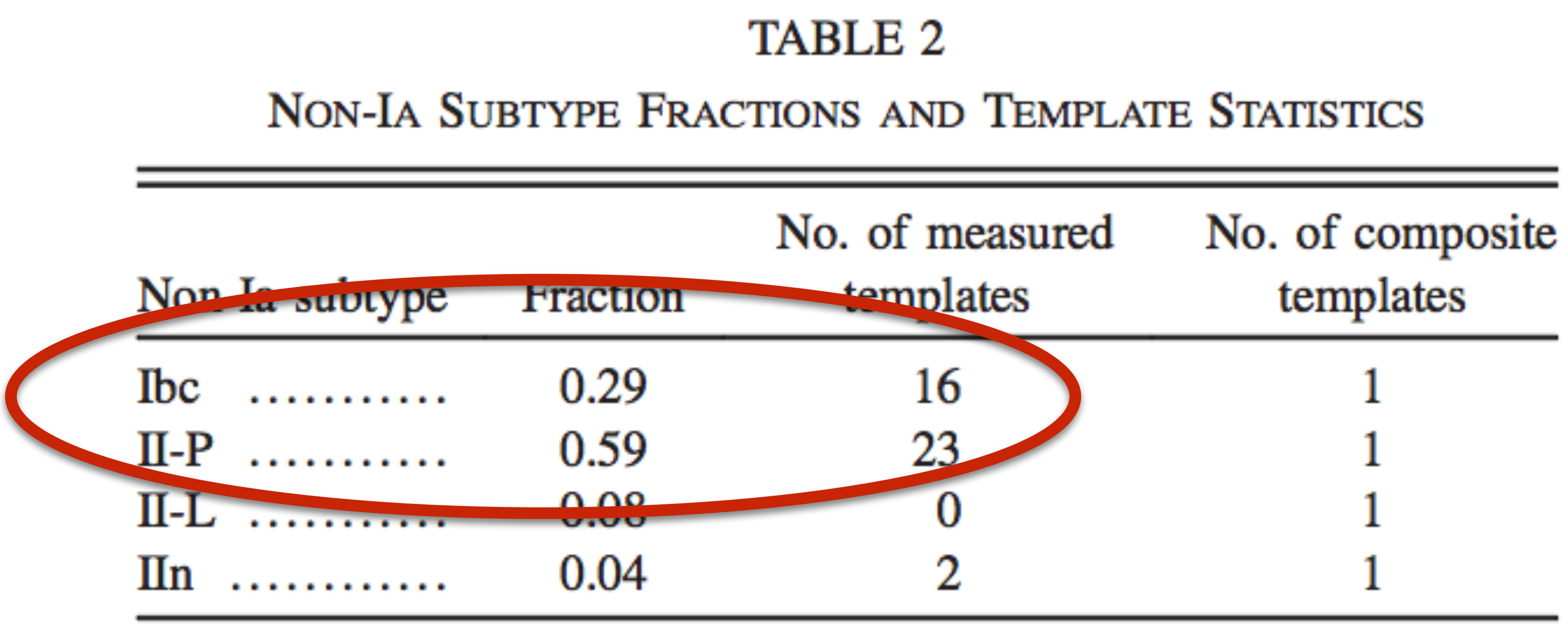
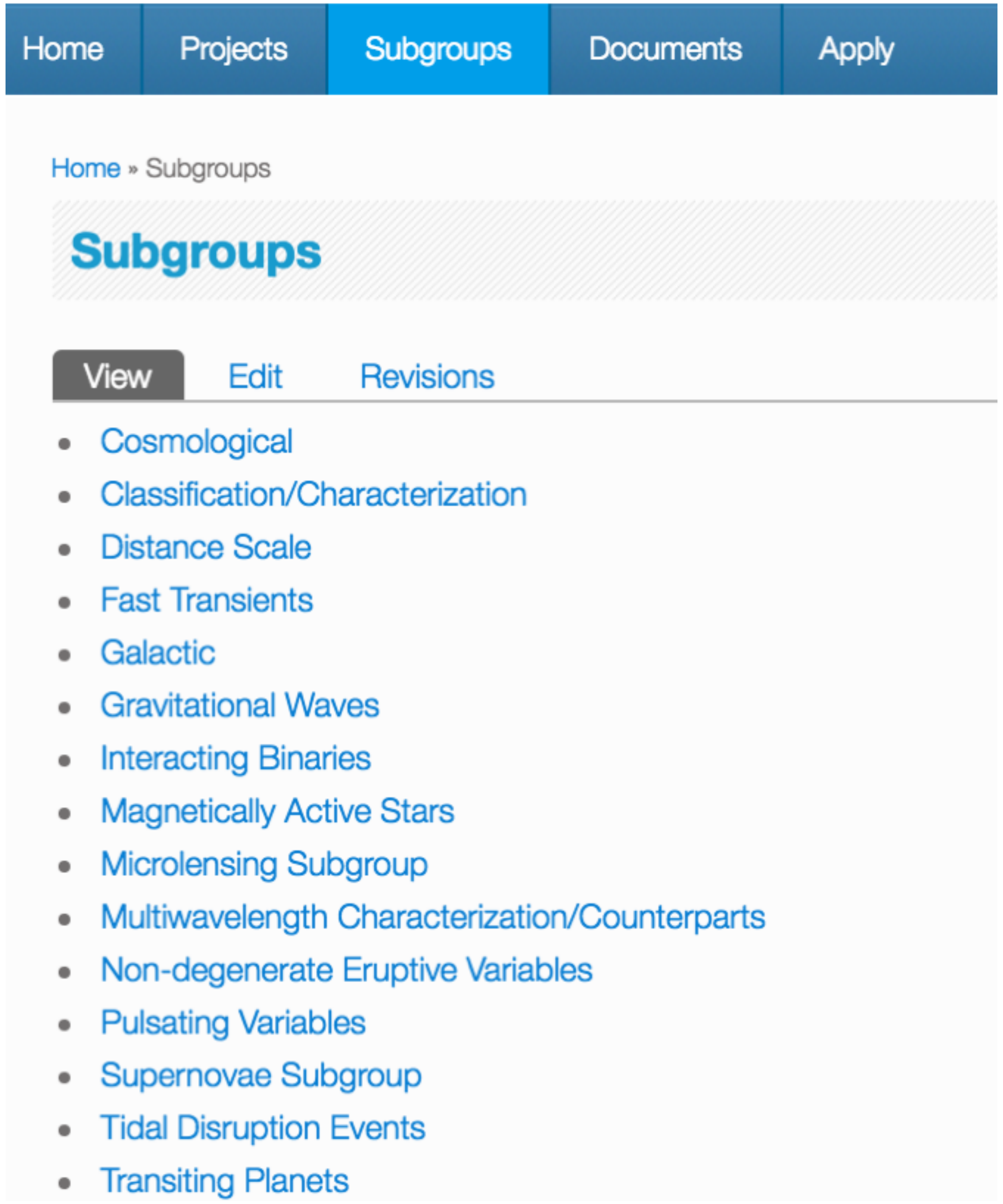


TABLE 2

NON-IA SUBTYPE FRACTIONS AND TEMPLATE STATISTICS

Non-Ia subtype	Fraction	No. of measured templates	No. of composite templates
Ibc	0.29	16	1
II-P	0.59	23	1
II-L	0.08	0	1
IIn	0.04	2	1

TVS Science Collaboration



Subgroups

- Cosmological
- Classification/Characterization
- Distance Scale
- Fast Transients
- Galactic
- Gravitational Waves
- Interacting Binaries
- Magnetically Active Stars
- Microlensing Subgroup
- Multiwavelength Characterization/Counterparts
- Non-degenerate Eruptive Variables
- Pulsating Variables
- Supernovae Subgroup
- Tidal Disruption Events
- Transiting Planets