federica b. bianco
she/her

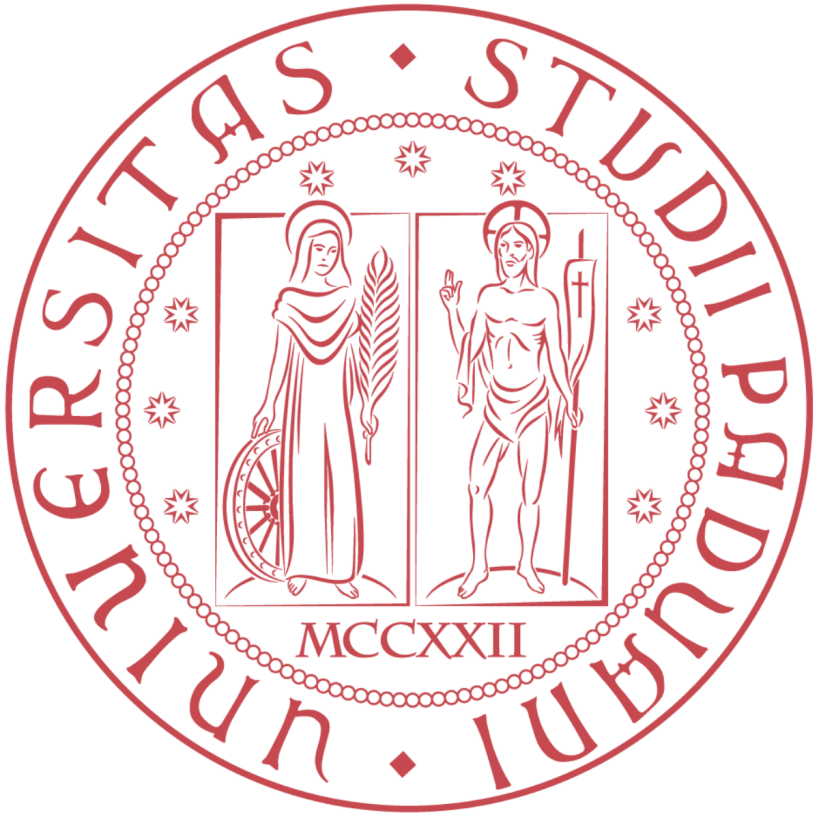
Rubin Legacy Survey of Space and Time
Deputy Project Scientist, Construction
Acting Head of Science, Operation

University of Delaware
Department of Physics and Astronomy
Biden School of Public Policy and Administration
Data Science Institute

Building a legacy:

the LSST transient sky


ALMA MATER STUDIORUM
UNIVERSITA
DI BOLOGNA
LIBERTAS
A.D. 1088


UNIVERSITAS STUDII PADUANI
MCCXXII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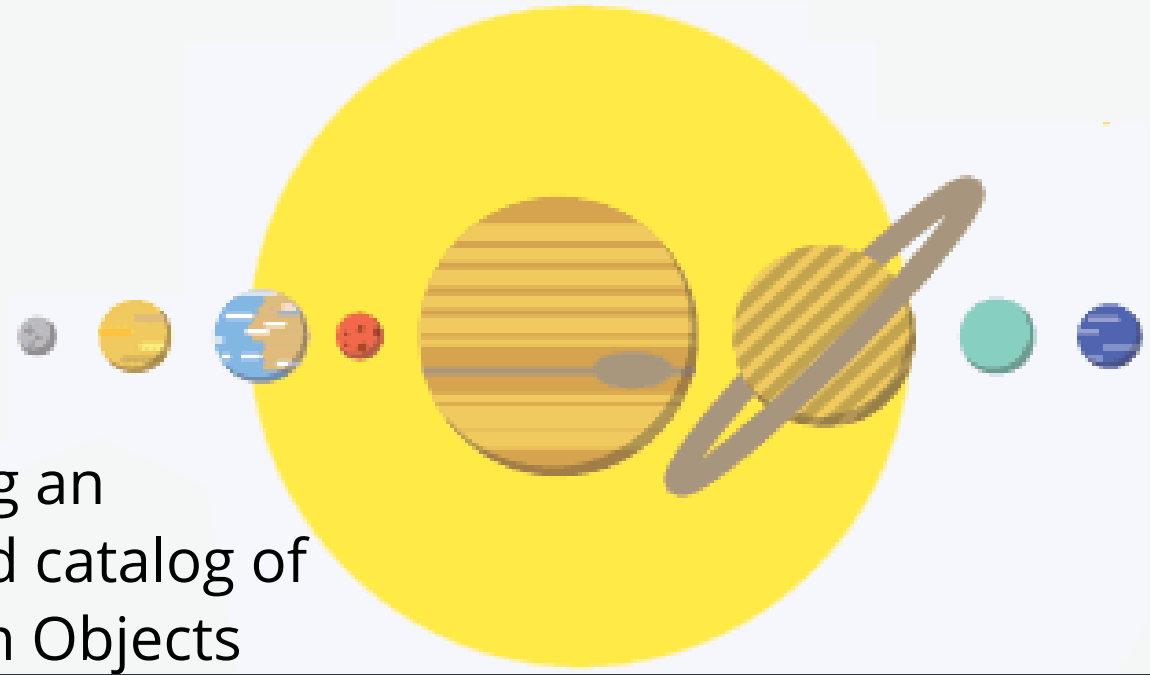
Rubin Observatory

Site: Cerro Pachon, Chile

Funding: US NSF + DOE

LSST Science Drivers



Building an
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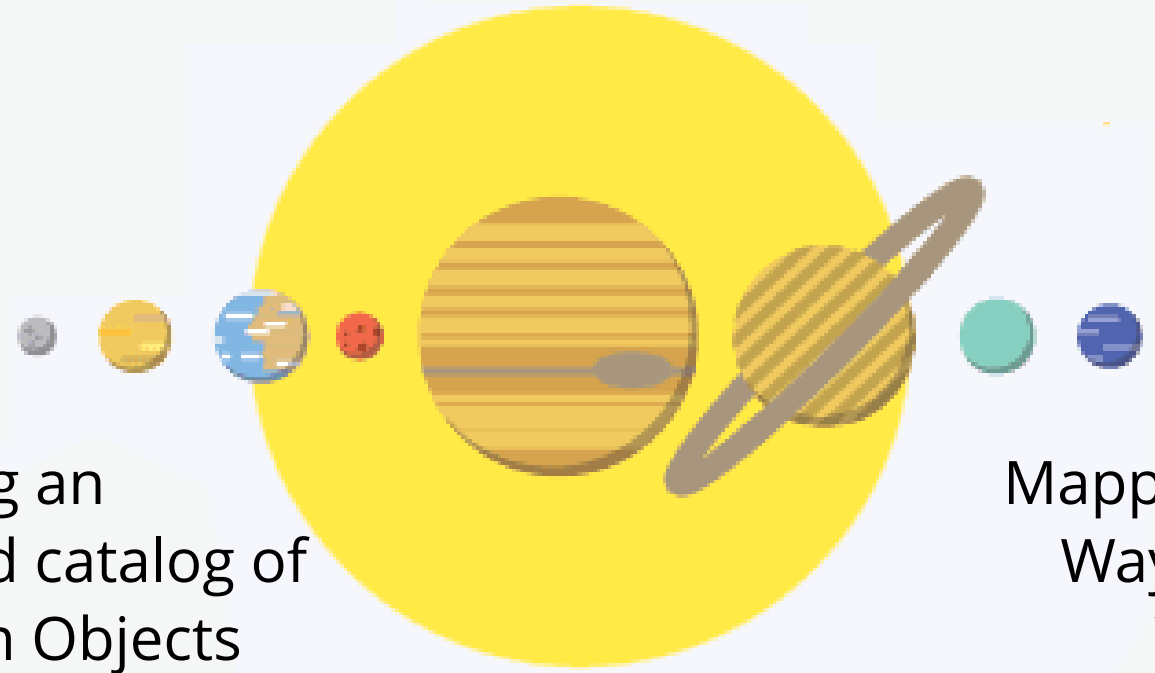
Solar System Objects

LSST Science Drivers



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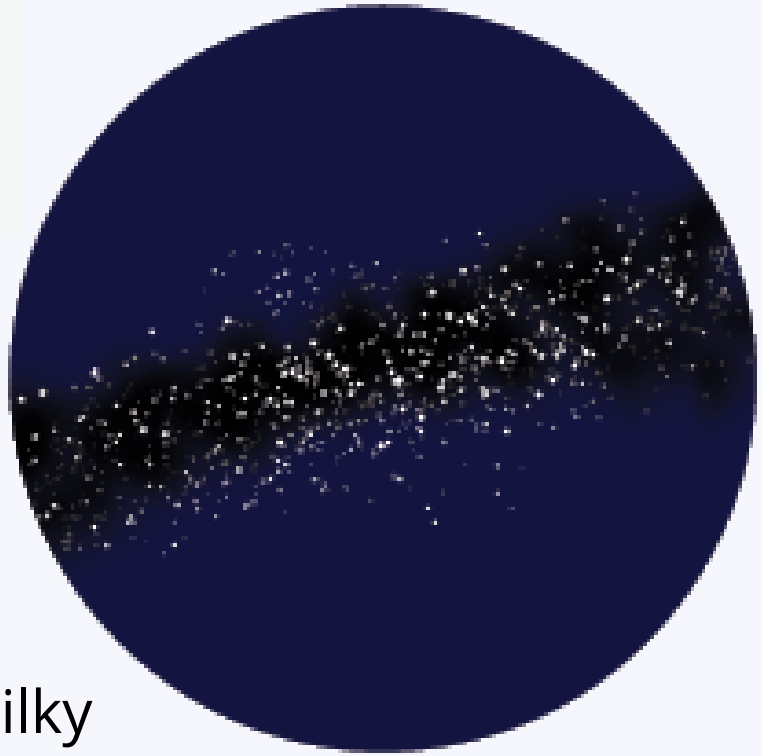
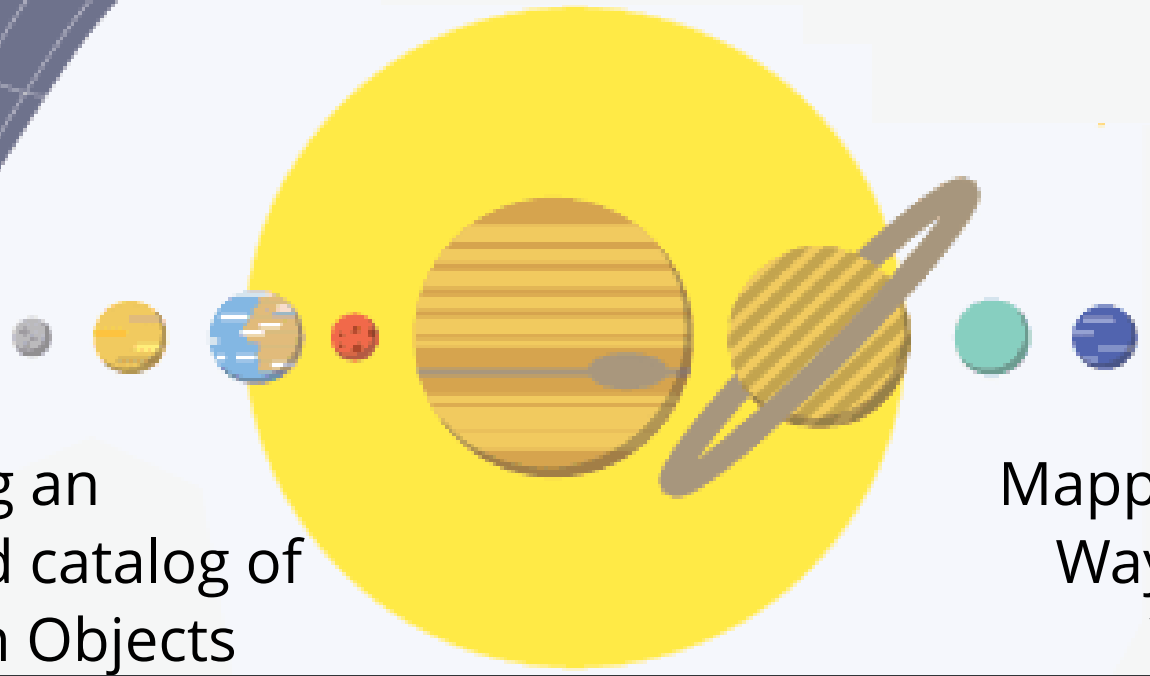


Mapping the Milky
Way and Local
Volume

LSST Science Drivers

Probing Dark Energy and Dark Matter



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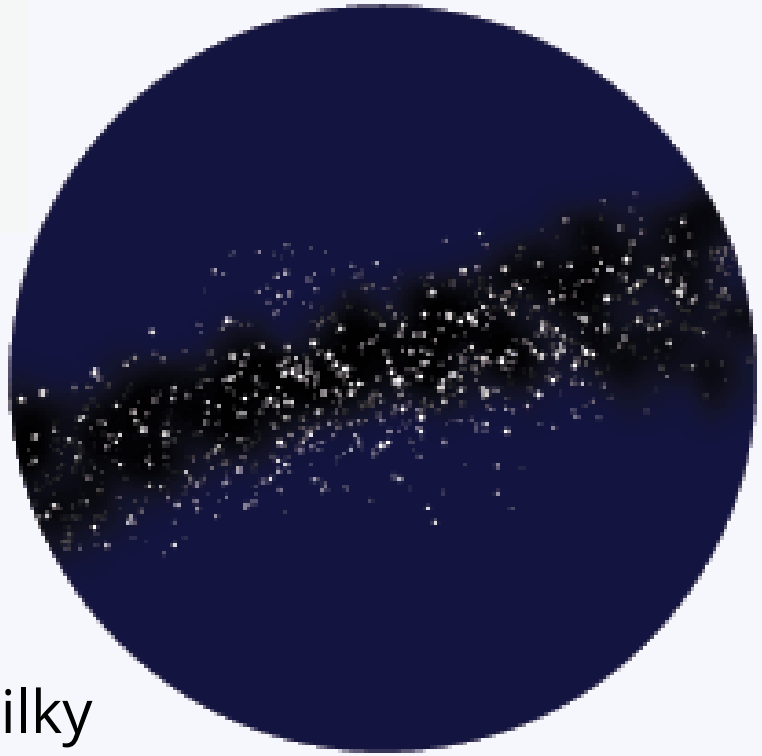
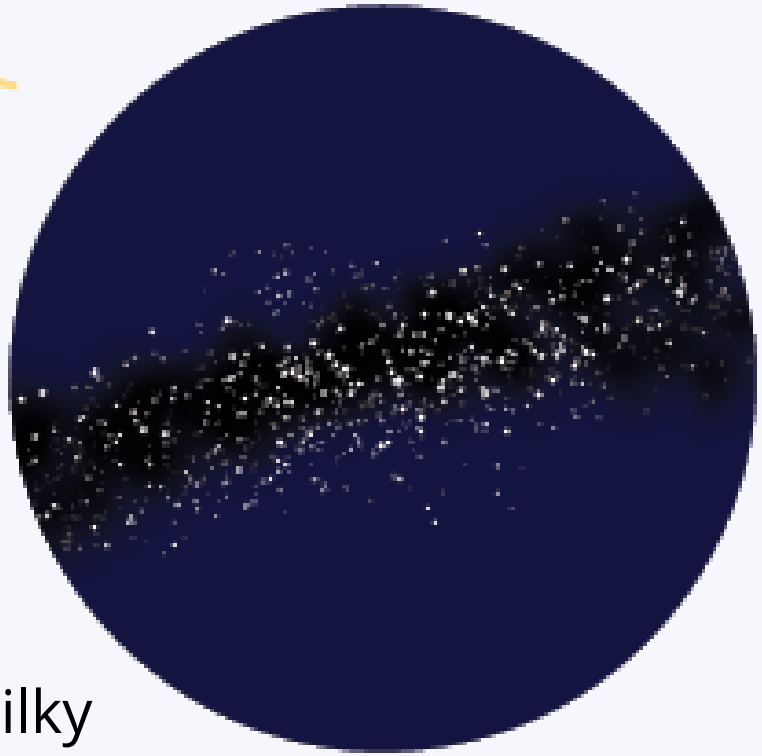


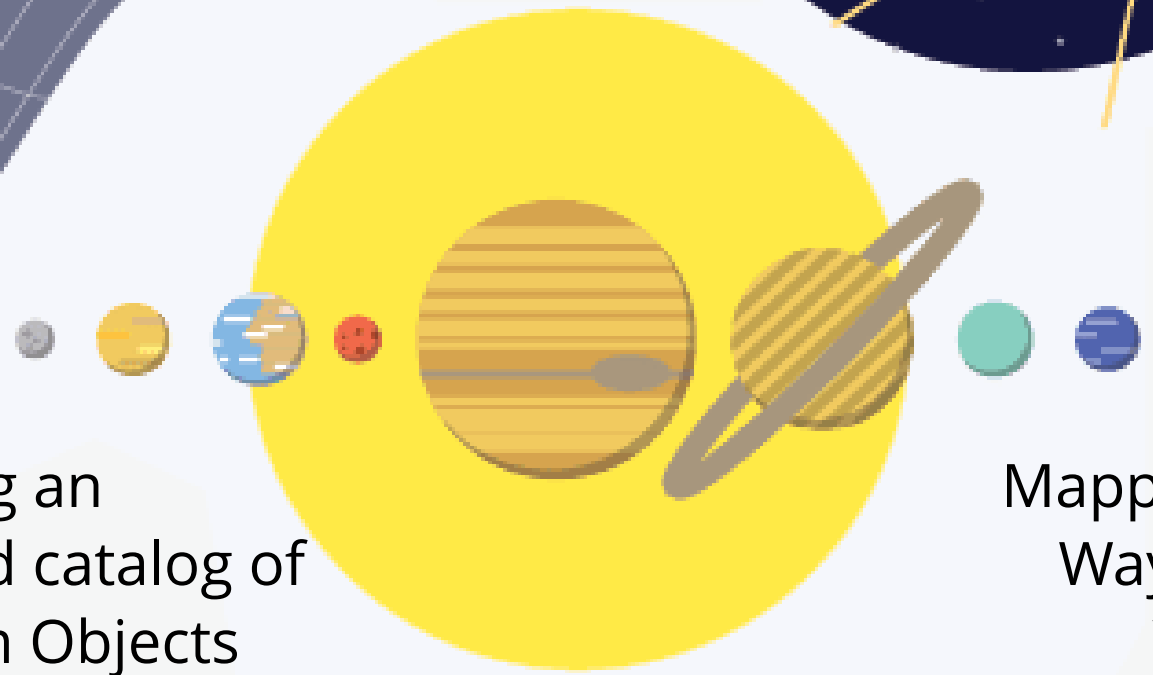
Mapping the Milky Way and Local Volume

LSST Science Drivers

Probing Dark Energy and Dark Matter

Exploring the Transient Optical Sky





Building an unprecedented catalog of Solar System Objects

Mapping the Milky Way and Local Volume

Objective: to provide a science-ready dataset to transform the 4 key science area

To accomplish this, we need:

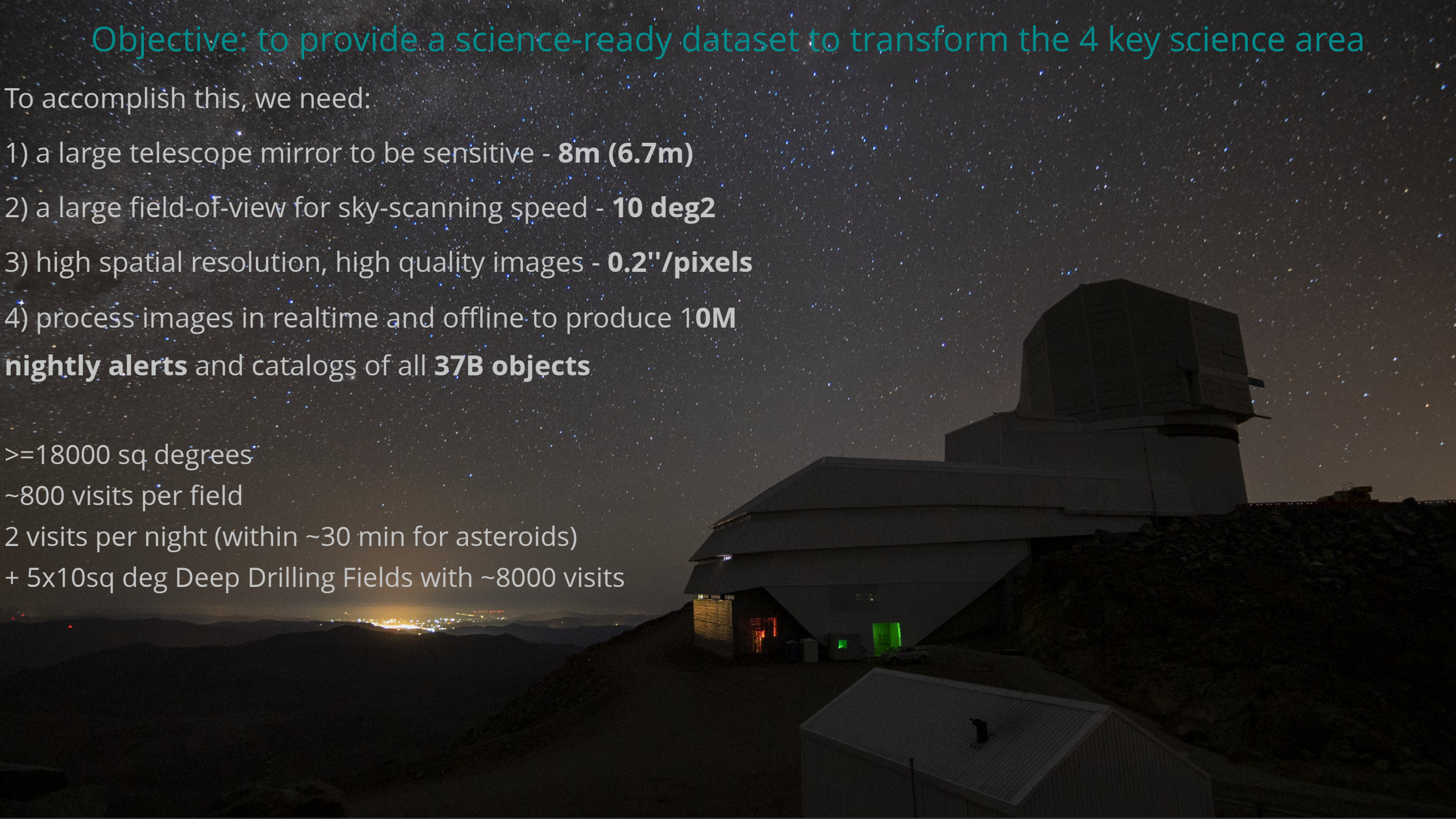
1) a large telescope mirror to be sensitive - **8m (6.7m)**

2) a large field-of-view for sky-scanning speed - **10 deg2**

3) high spatial resolution, high quality images - **0.2''/pixels**

4) process images in realtime and offline to produce 1**0M**

nightly alerts and catalogs of all **37B objects**



>=18000 sq degrees

~800 visits per field

2 visits per night (within ~30 min for asteroids)

+ 5x10sq deg Deep Drilling Fields with ~8000 visits

Are We There YET???!!!!

rubin_observatory and **2 others**
Original audio

rubin_observatory Lights, camera, action!🎥

The world's largest digital camera has officially been installed at NSF–DOE Vera C. Rubin Observatory! 📸 With this major milestone achieved, Rubin is now in its final phase of testing ahead of revealing long-awaited "First Look" imagery later this year — over a decade in the making!

The car-sized LSST Camera was the final major component to be installed on the telescope 🔭 Soon, Rubin will begin to #CaptureTheCosmos with the decade-long Legacy Survey of Space and Time, repeatedly scanning the southern night sky and generating the greatest cosmic movie of our Universe ever made 🌌

Once online later this year, Rubin will be jointly operated by @nsfgov @noirlabastro and @energy's @slac_lab.

Read more about this exciting milestone at the link in our Stories or the "Latest News" URL in our bio!

¡Luces, cámara, acción! 🎥

¡Ya es oficial! La cámara digital más grande del mundo ya está instalada en el Observatorio Vera C. Rubin de NSF-DOE. 📸 Con este importante hito alcanzado, Rubin se encuentra ahora en su fase final de pruebas antes de revelar las tan esperadas imágenes de la "Primera Luz", ¡un proyecto que ha tomado más de una década!

La Cámara LSST, del tamaño de un automóvil, fue el último componente principal que se instaló en el telescopio. Pronto, Rubin comenzará a #CapturarElCosmos con su Investigación del Espacio-Tiempo como Legado para la posteridad (LSST), que durará diez años, y escaneará repetidamente el cielo nocturno del hemisferio sur, generando la película cósmica más grande del Universo creada por la humanidad. 🌌

Una vez que esté en línea a finales de este año, Rubin será operado conjuntamente por @noirlabastro_es de @nsfgov de EE.UU. y @slac_lab de @energy de EE.UU.

Liked by **gauthamnarayan** and **975 others**
March 12

Add a comment... Post

artist (me) impression of the first image taken by ComCam

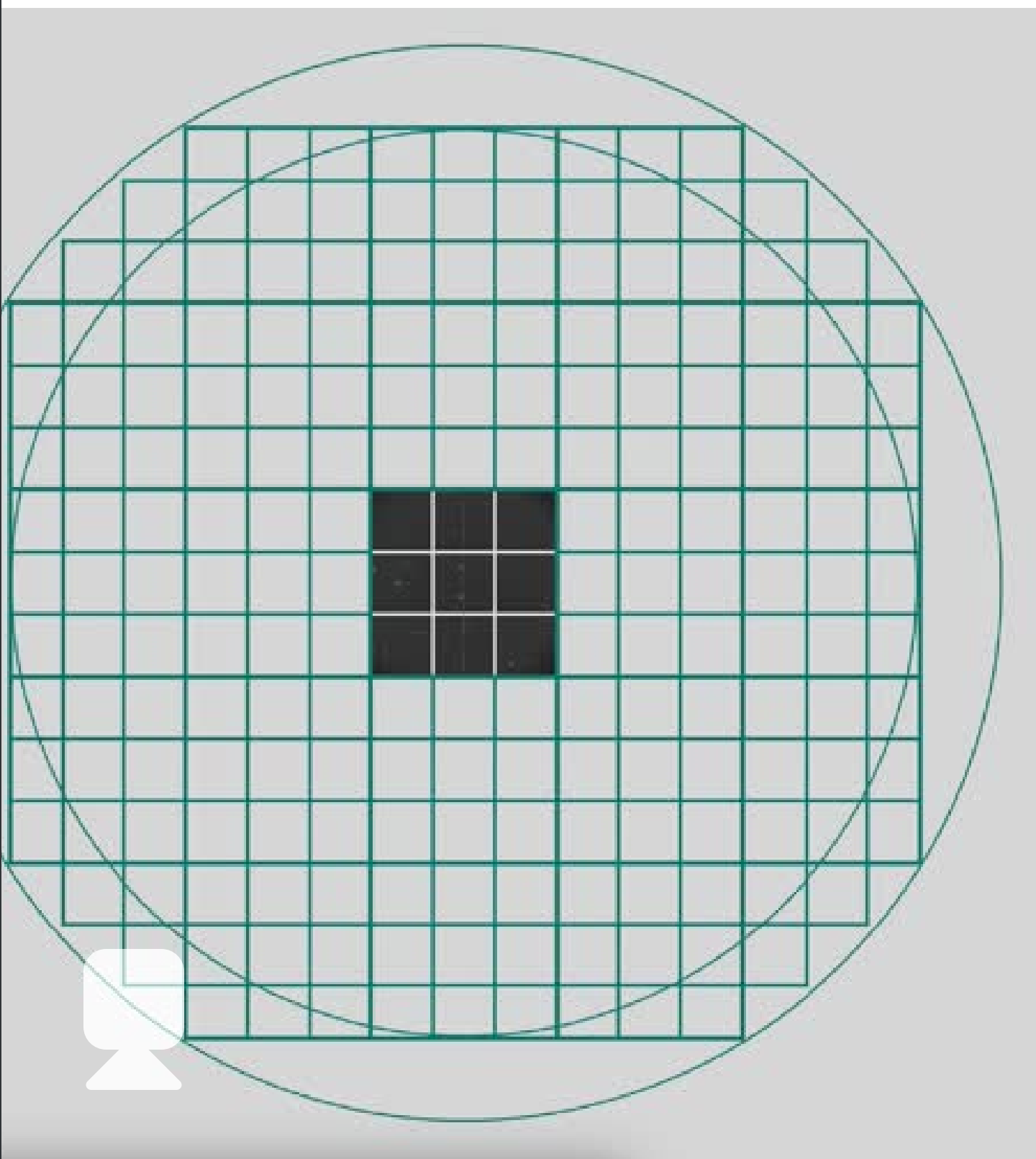
rgill Ranpal GIll LSST

Versión en Español más abajo

All,

What an incredible milestone we've reached together! Last night, on October 24, 2024, we passed our first end-to-end engineering test, marking a historic moment for all of us. Using the Commissioning Camera, we successfully captured and transferred our first on-sky data from Chile to the US Data Facility at SLAC. The excitement in the control rooms and online was electric, as decades of dedication and innovation came to life. Look out for the public announcement coming soon.

https://rubinobservatory.org/news/rubin-completes-comcam-tests



The DOE LSST Camera - 3.2 Gigapixel

3024 science raft amplifier channels

Camera and Cryostat integration completed at SLAC in May 2022,

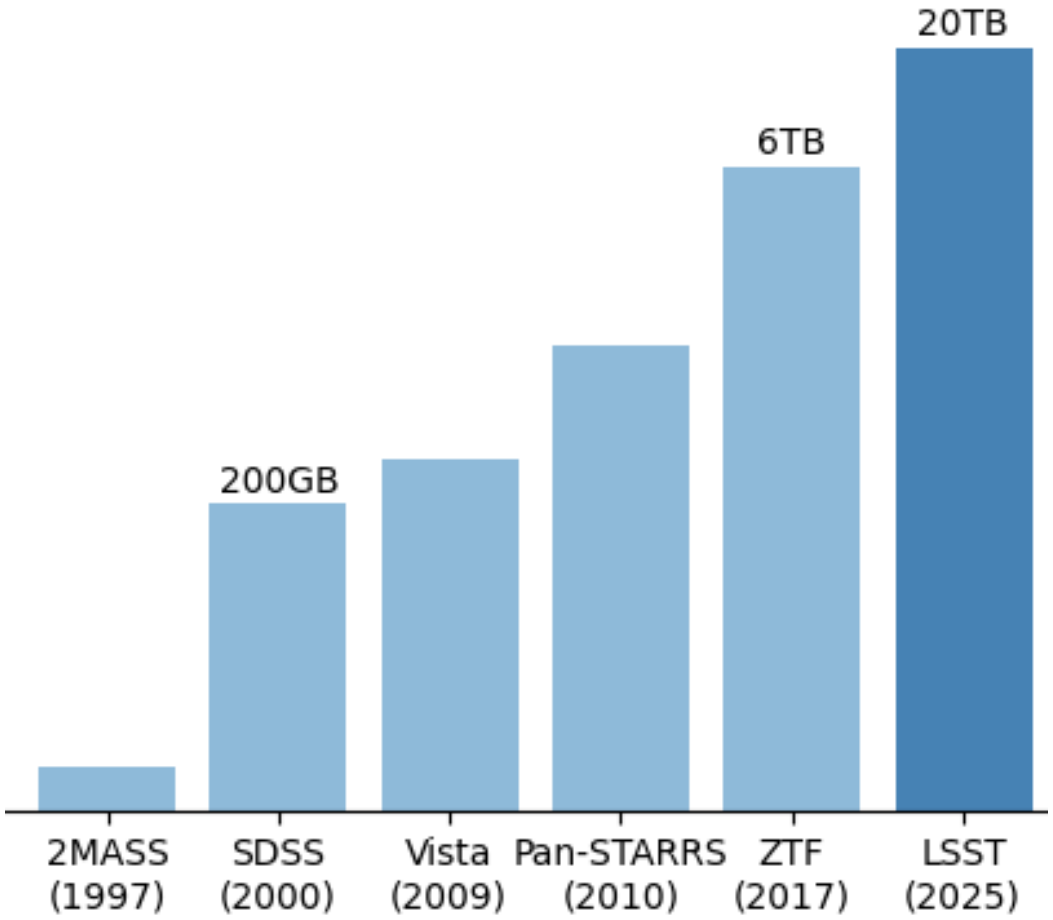
Shutter and filter auto-changer integrated into camera body

LSSTCam undergoing final stages of testing at SLAC


Sphere Entertainment
INSIDE
The Company behind the
$2.3 billion concert venue ...

Rubin LSST Transients by the numbers

17B stars (x10) Ivezic+19



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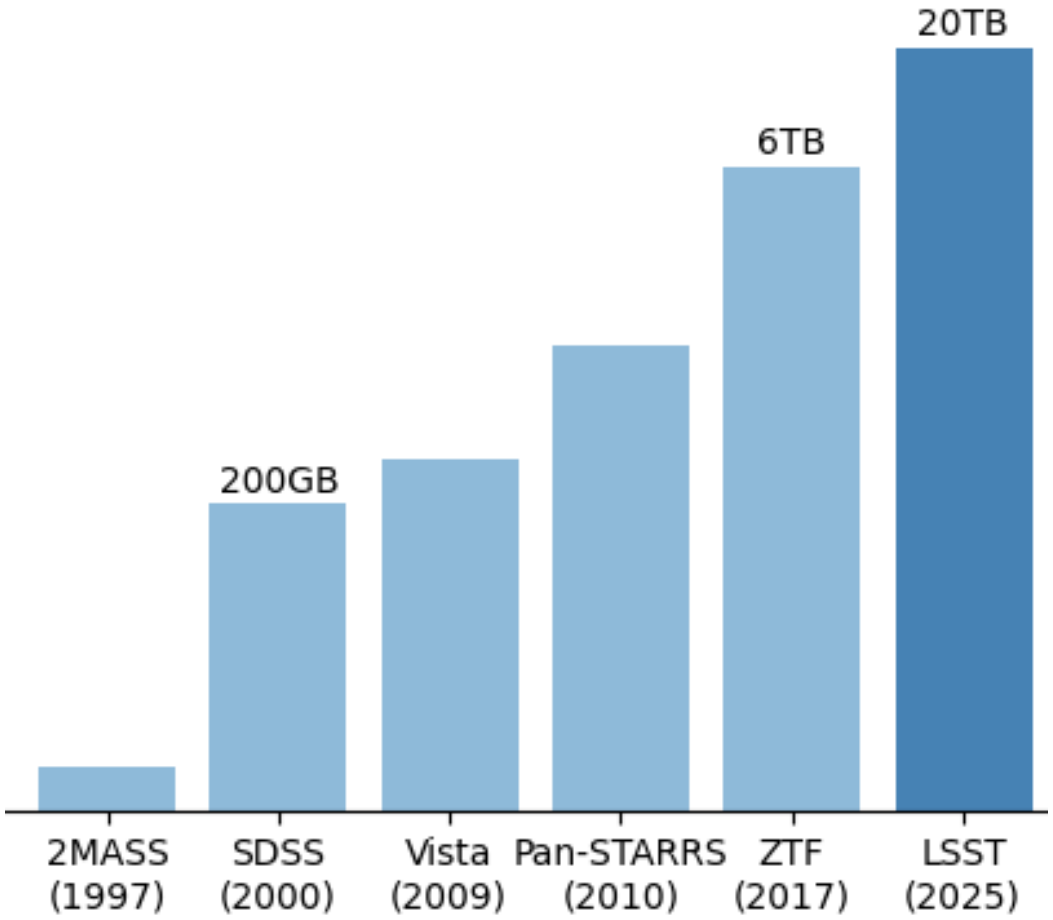
~10k SuperLuminous Supernovae (from ~200)Villar+ 2018



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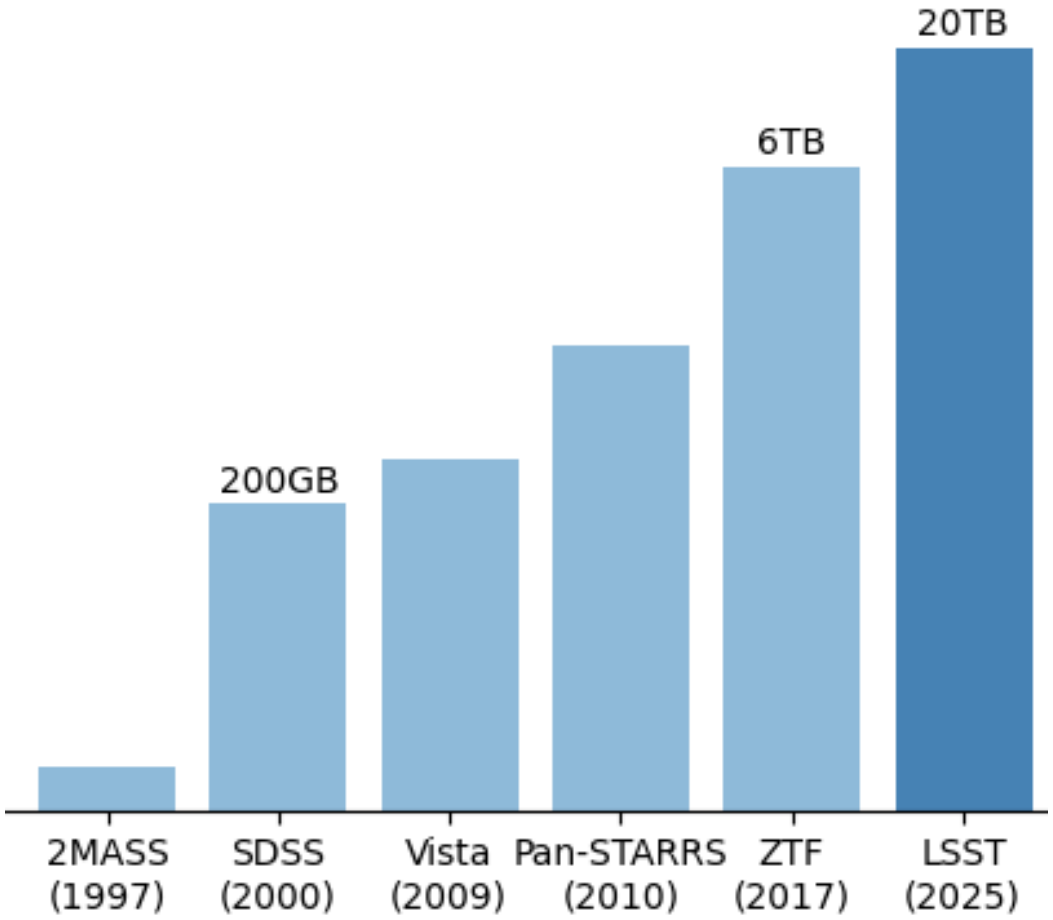

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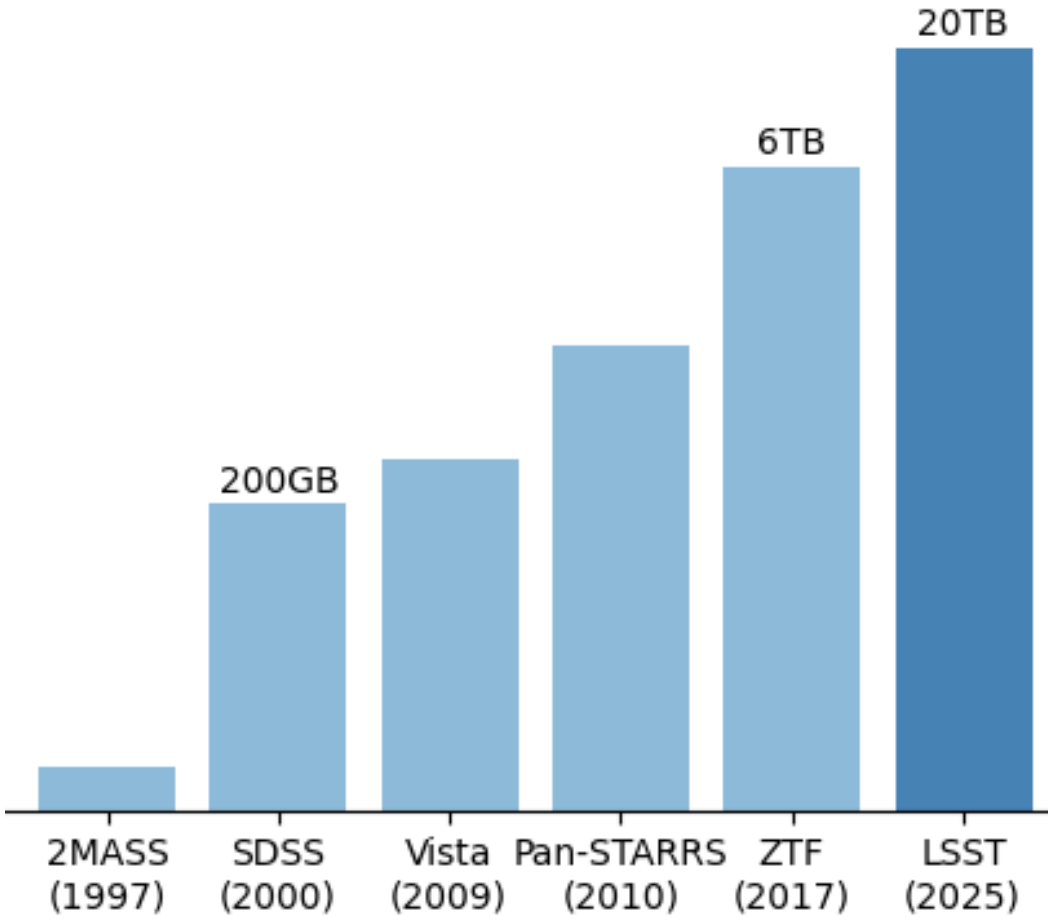

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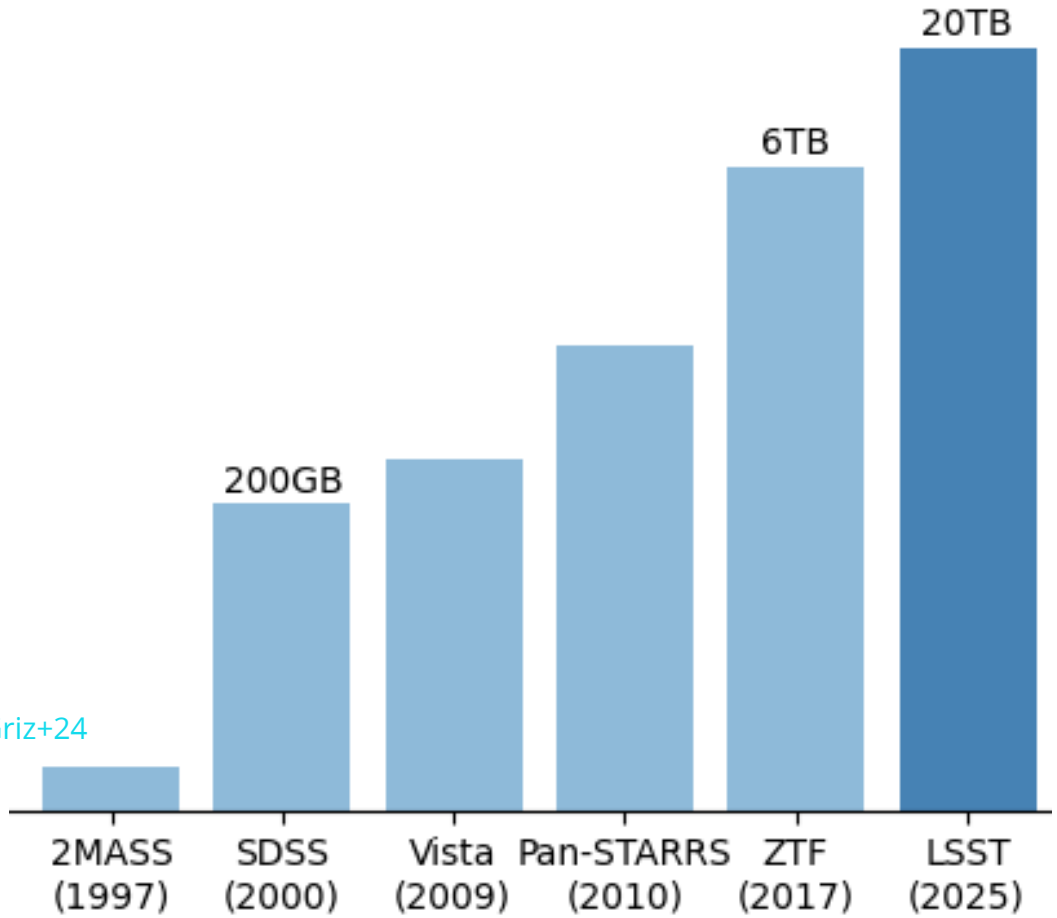

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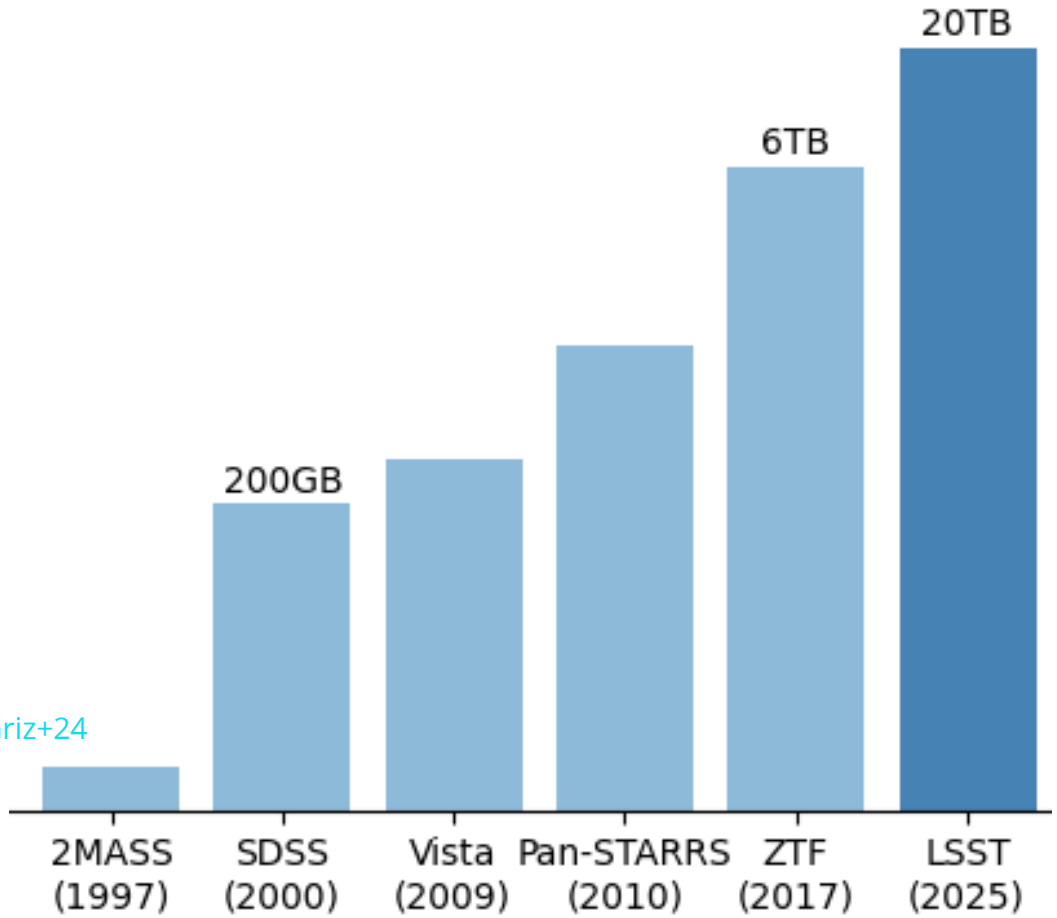
~50 kilonovae (from 2) Setzer+19, Andreoni+19 (+ ToO)



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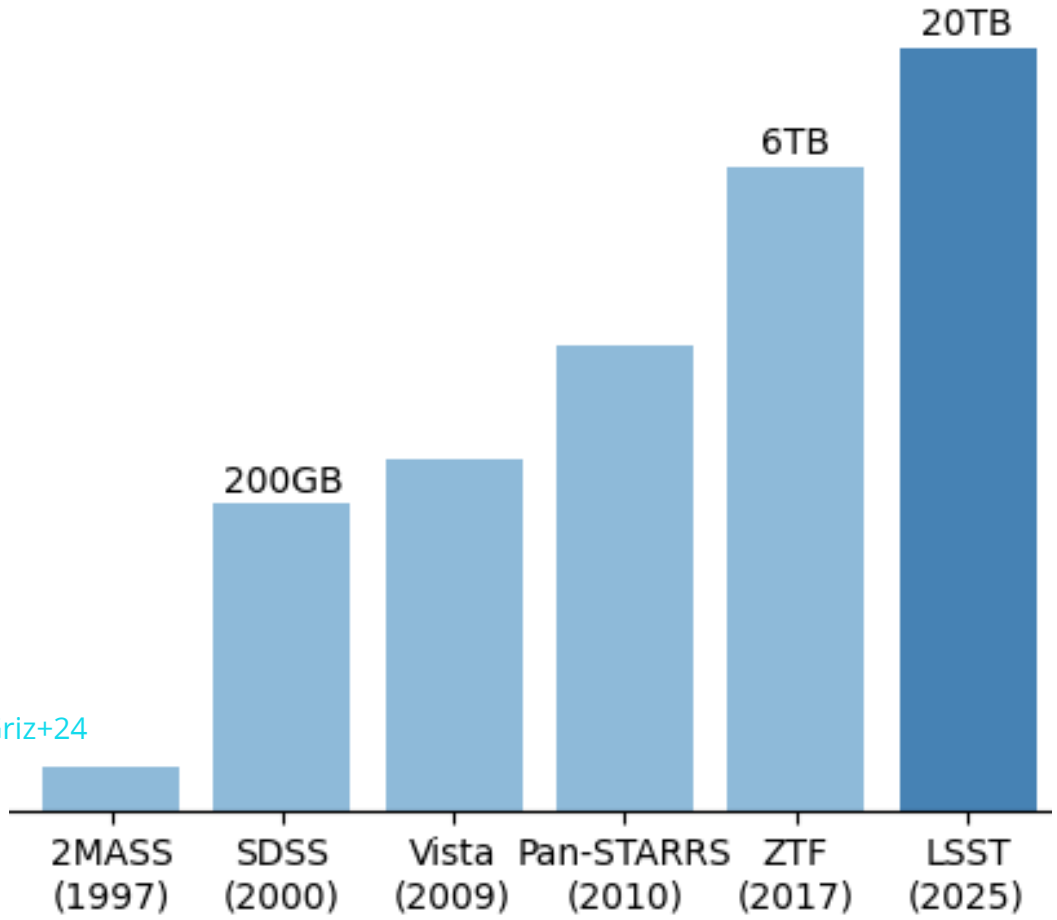
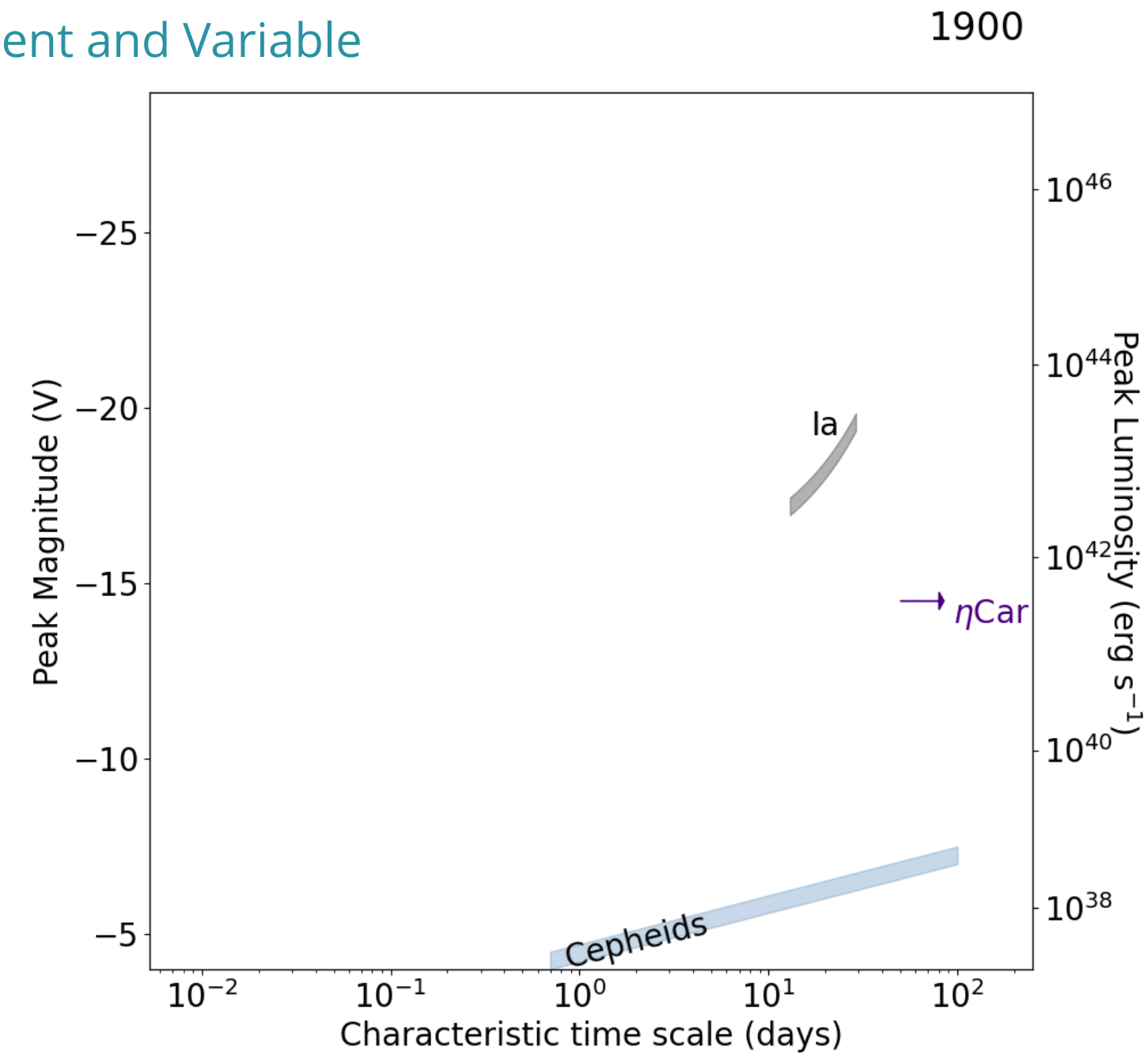
> 10 Interstellar Objects fom 2...👽?)

True Novelties!



Exploring the Transient and Variable Optical Sky



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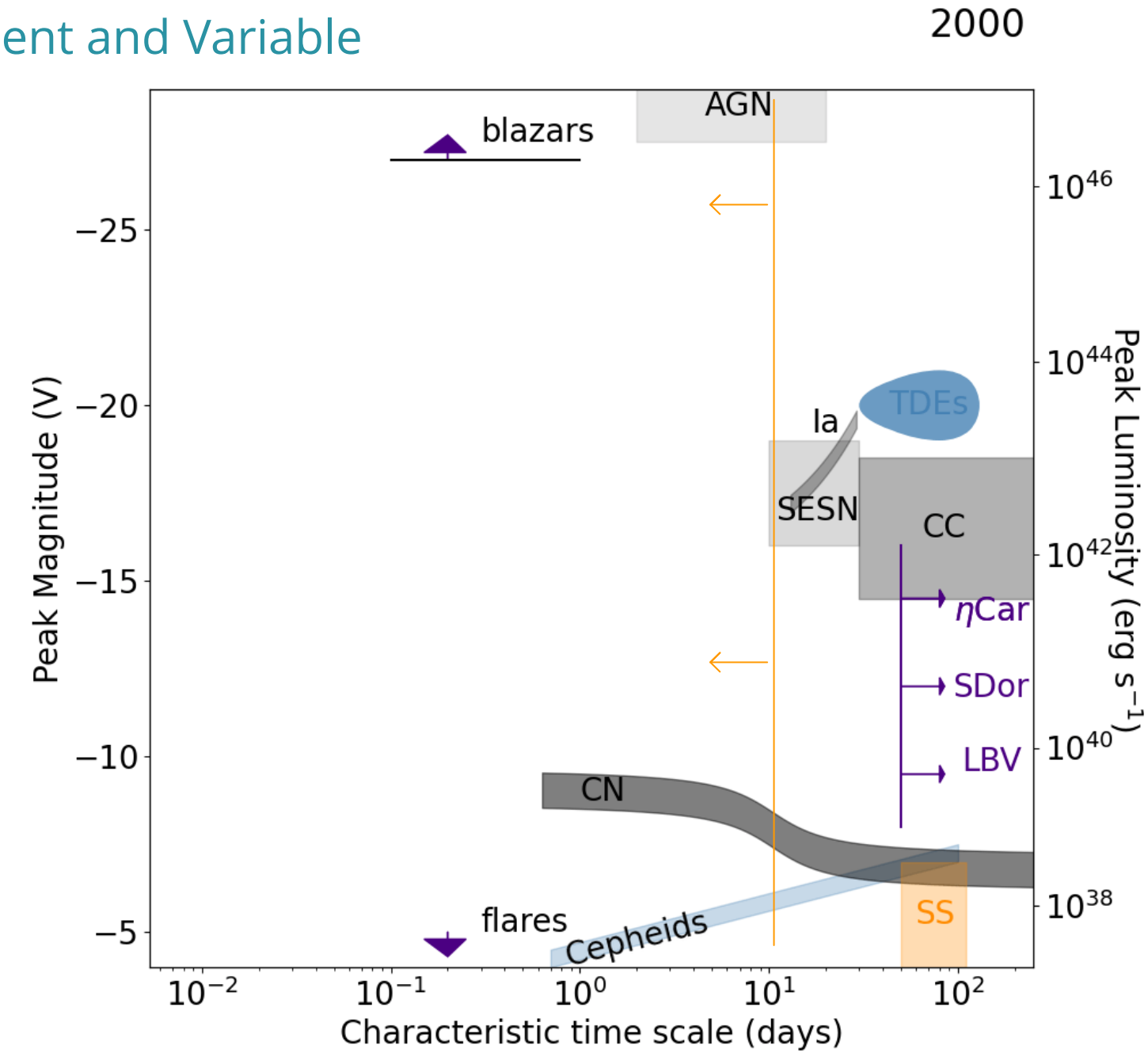
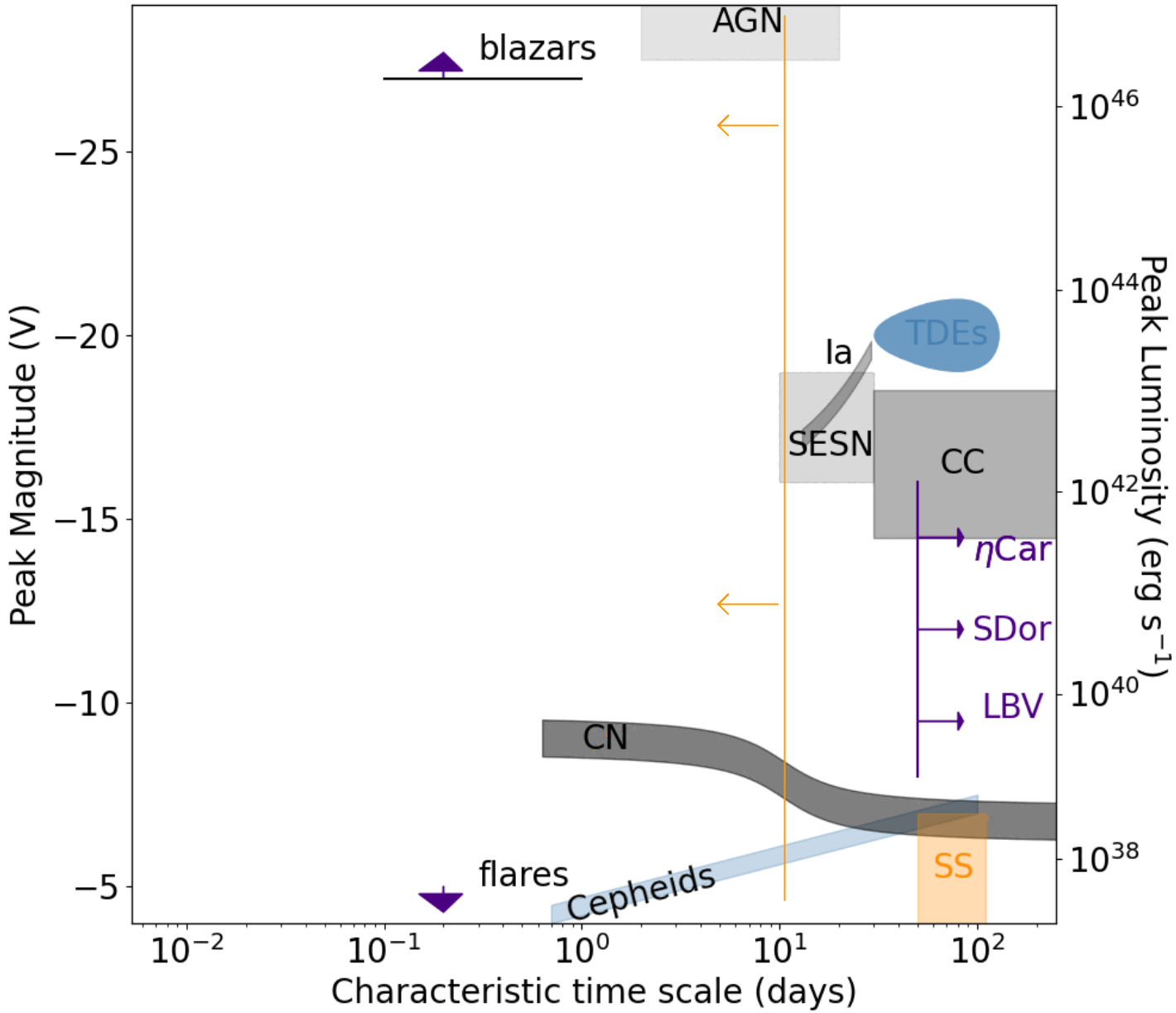


Exploring the Transient and Variable Optical Sky

2000



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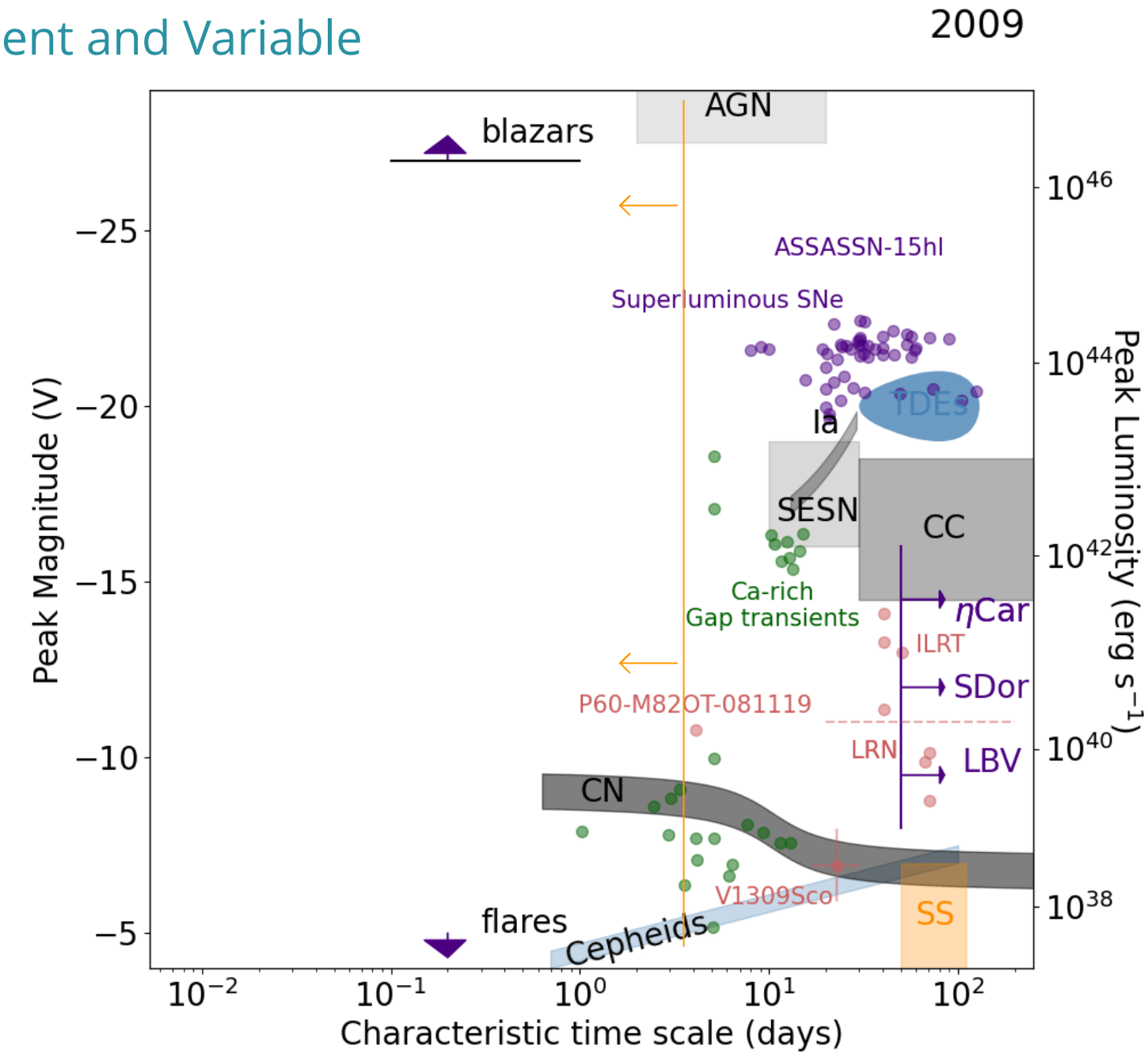

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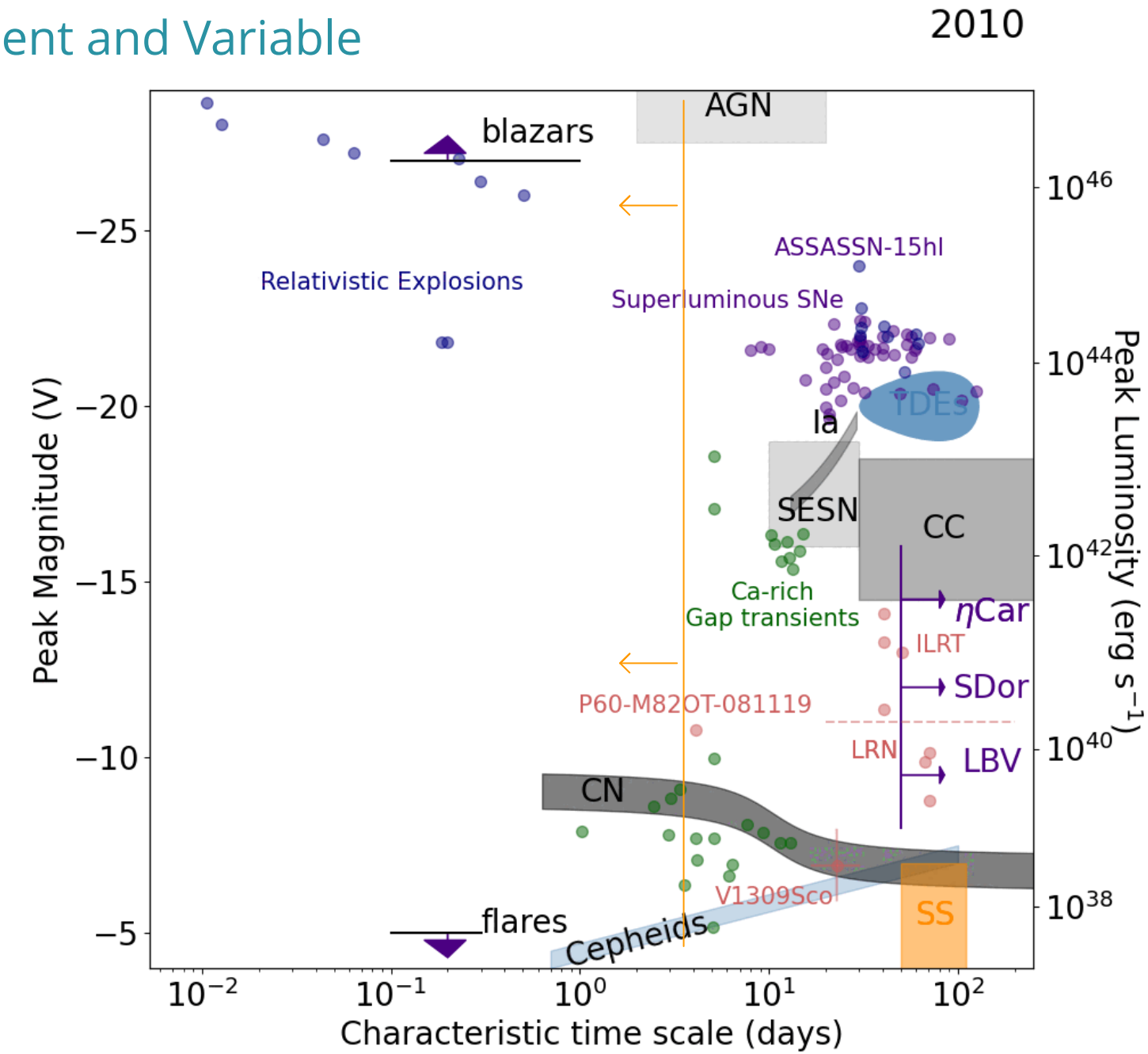
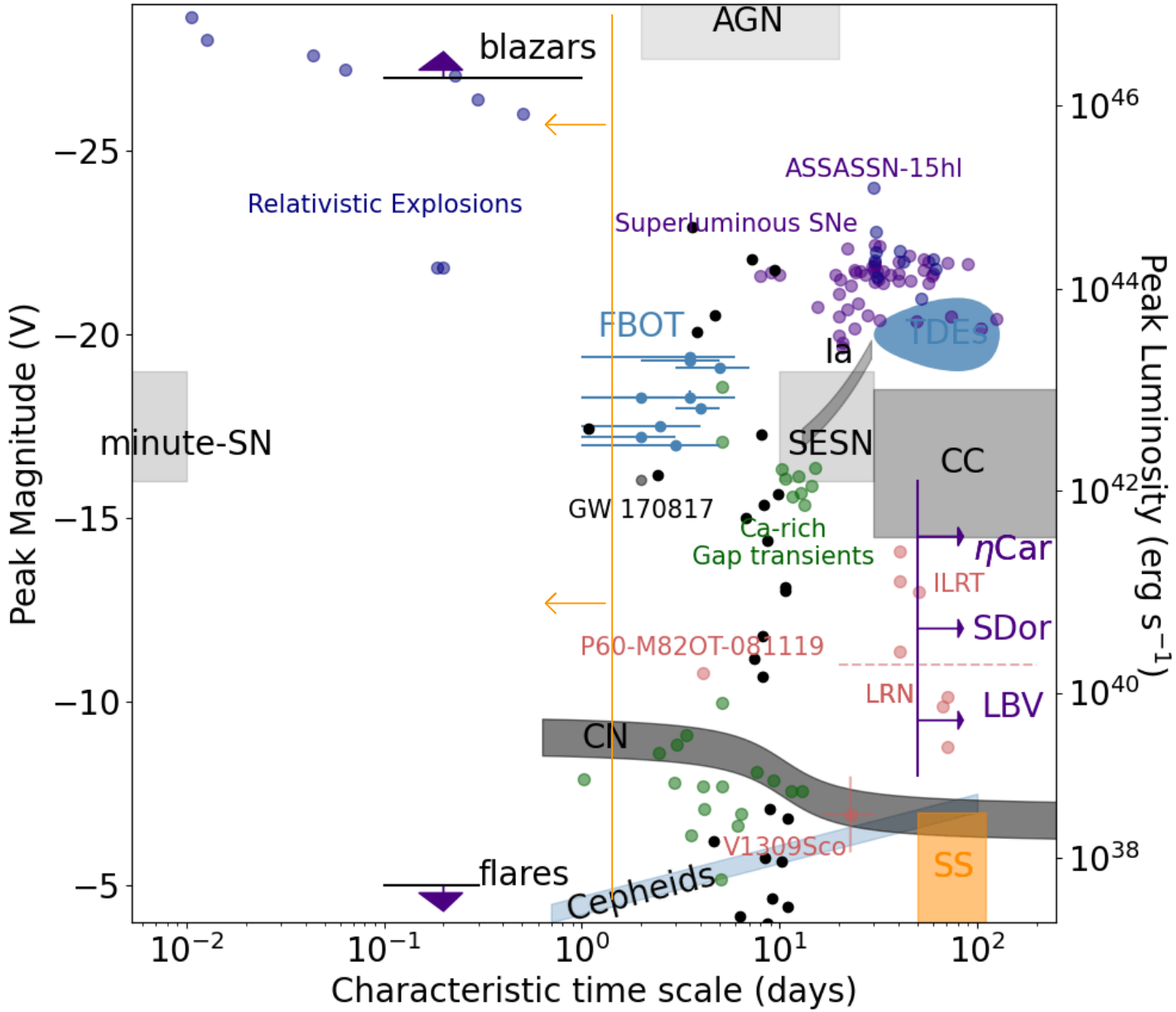
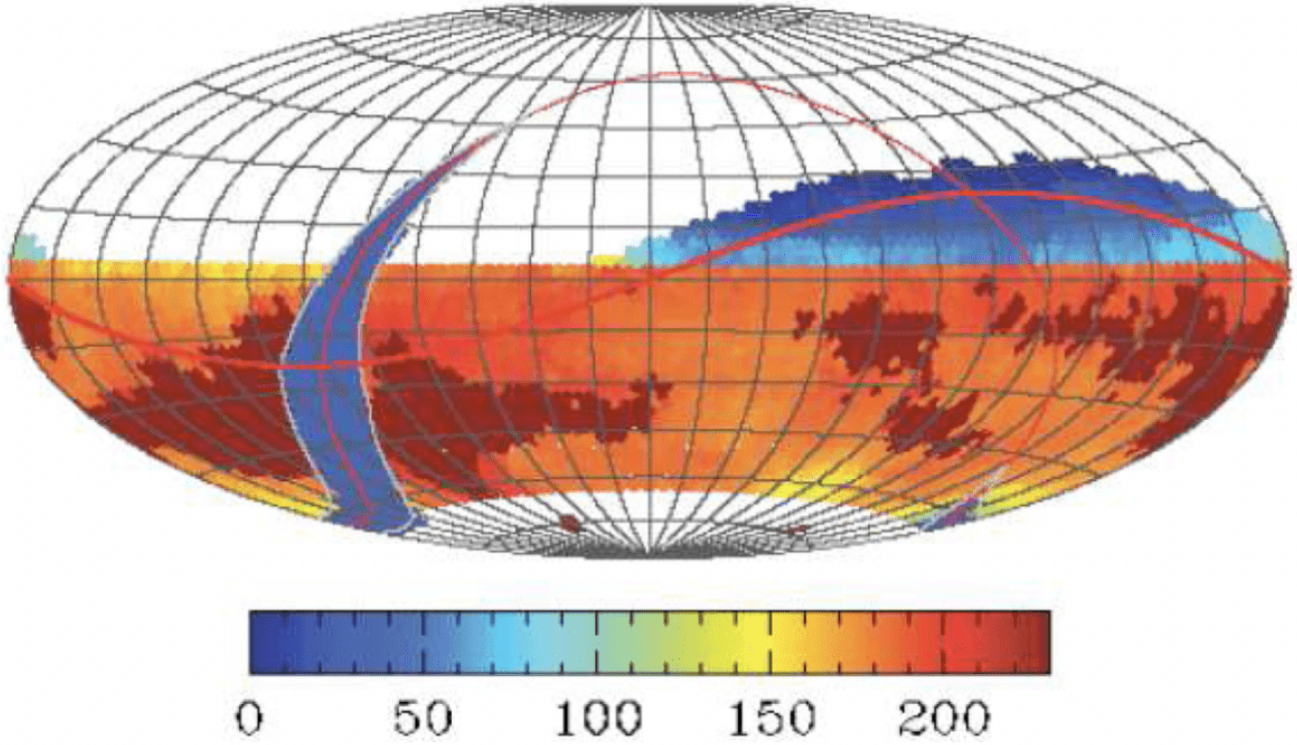


Exploring the Transient and Variable Optical Sky

2024



LSST survey strategy optimization



A vigorous and systematic research effort is underway to explore the enormously large parameter space of possible survey cadences, using the Operations Simulator tool described in § 3.1. The commissioning period will be used to test the usefulness of various observing modes and to explore alternative strategies. Proposals from the community and the Science Collaborations for specialized cadences (such as mini-surveys and micro-surveys) will also be considered.

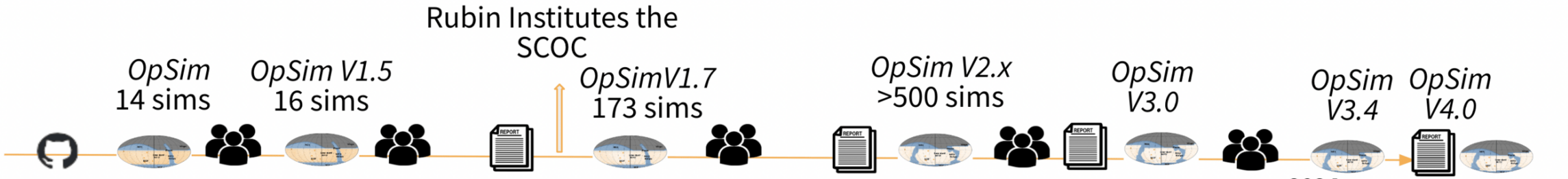
LSST Science Book (2009)

Rubin LSST survey design

Rubin has involved the community to an unprecedented level in survey design this is a uniquely "democratic" process!

Survey Cadence Optimization Committee

https://www.lsst.org/content/charge-survey-cadence-optimization-committee-scoc



2014 Opsim and MAF software (Jones + 2014)

2015-2017 COSEP *Marshall & The Science Collaborations* https://ui.adsabs.harvard.edu/abs/2017arXiv170804058L/abstract Initial science driven optimization of LSST

2018 Community contributions: **46 Community White Papers** https://www.lsst.org/submitted-white paper-2018

5/01/2019 SAC report **baseline v1.7**

2021 Community contributions: **39 Community Cadence Notes** https://www.lsst.org/content/survey-cadence-notes-2021

31/12/2021 Phase 1 report released pstn-053.lsst.io **baseline v2.0** *Major changes to the footprint*

31/12/2022 Phase 2 report released pstn-055.lsst.io **baseline v3.0**

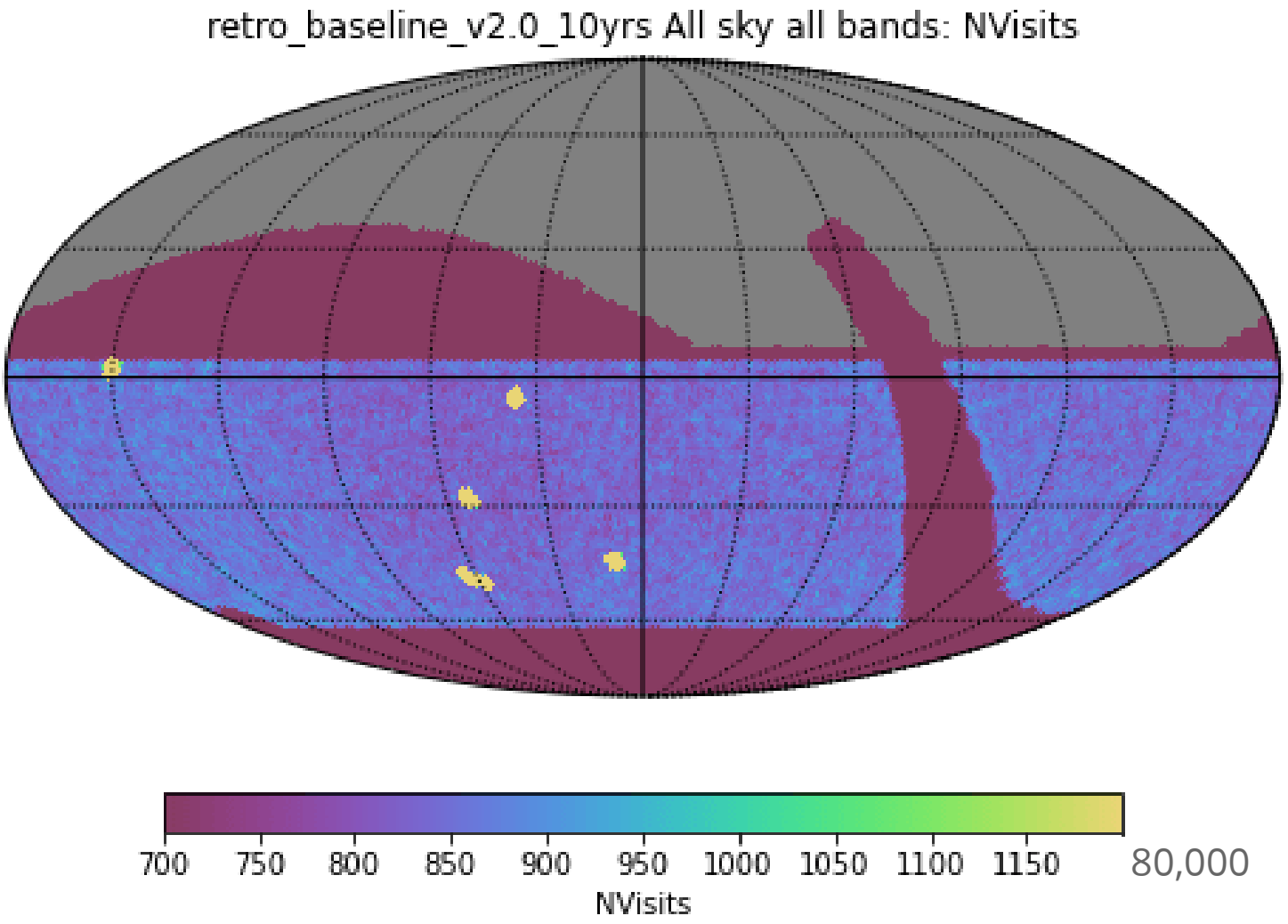
Selection of Euclid Deep Field South as 5th DDF, rolling, footprint, filter balance

2023 Community contributions form: Observing Strategy Desiderata 14 responses: AGN SC (1); DESC (3); GAL SC (1); SMWLV (5); SLSC (2); SSSC (1); TVS (5)

2024 Filter swap u-y, new throughput

2024 Phase 3 report released pstn-056.lsst.io **baseline v4.0**

Rubin LSST survey design



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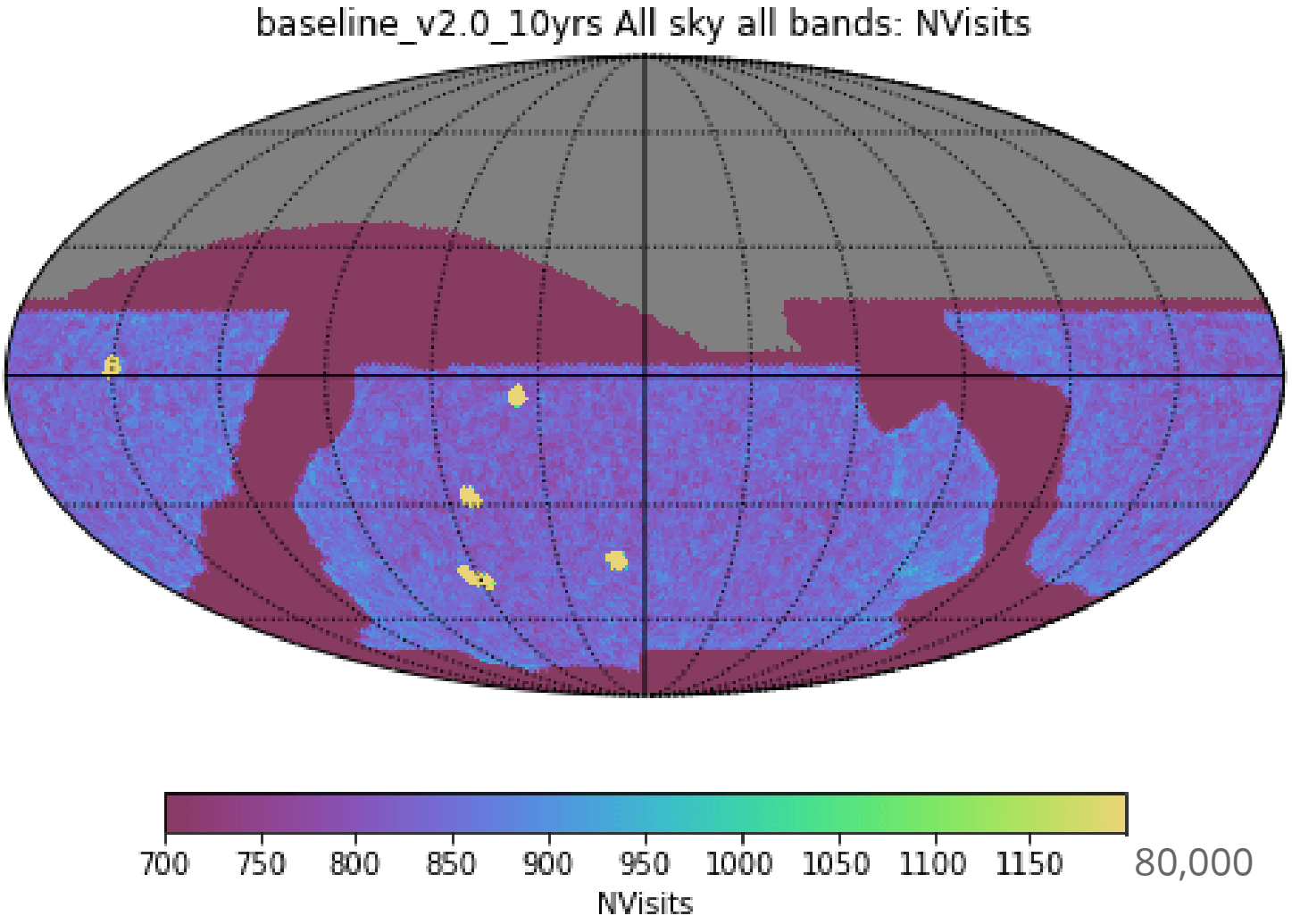

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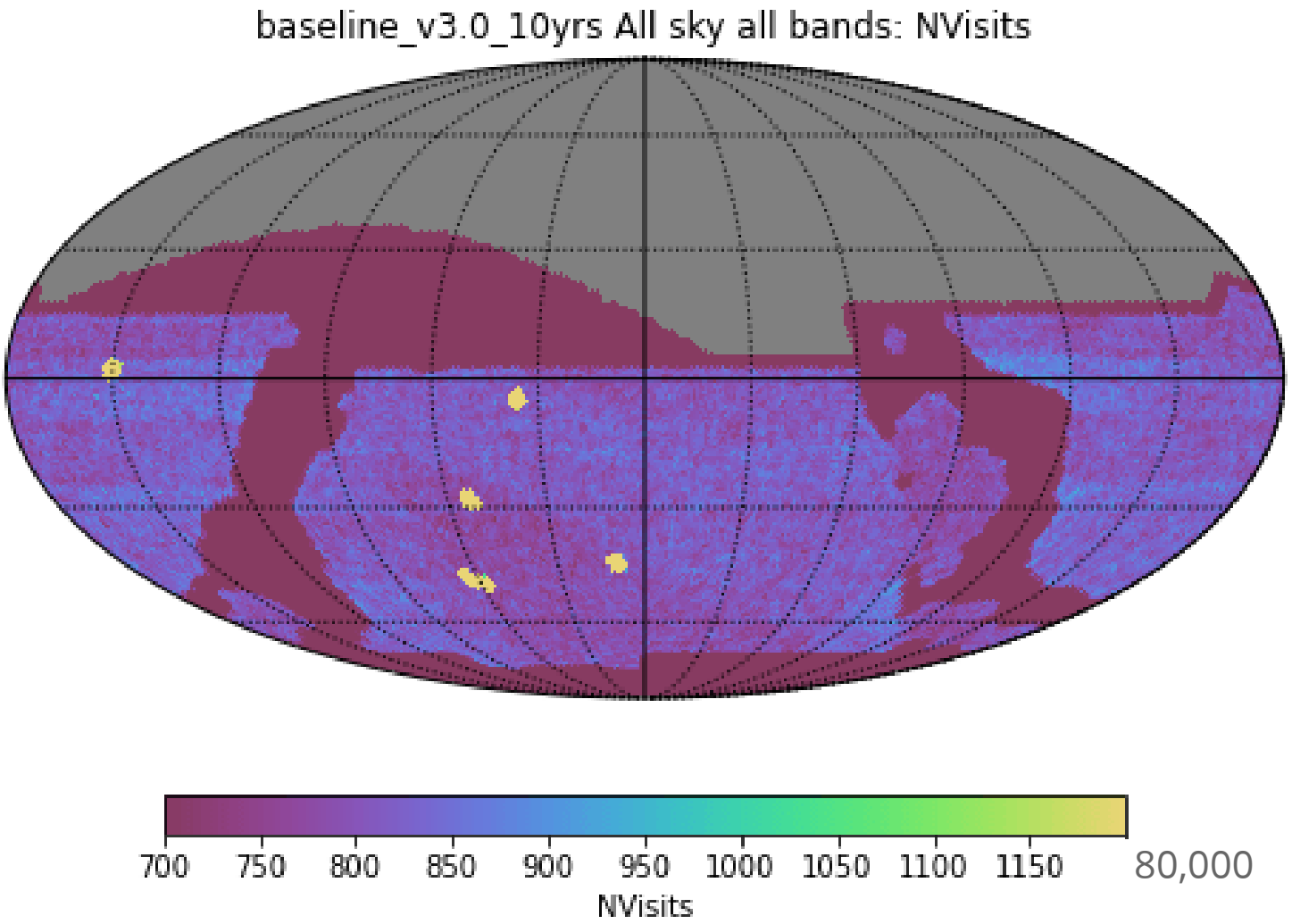

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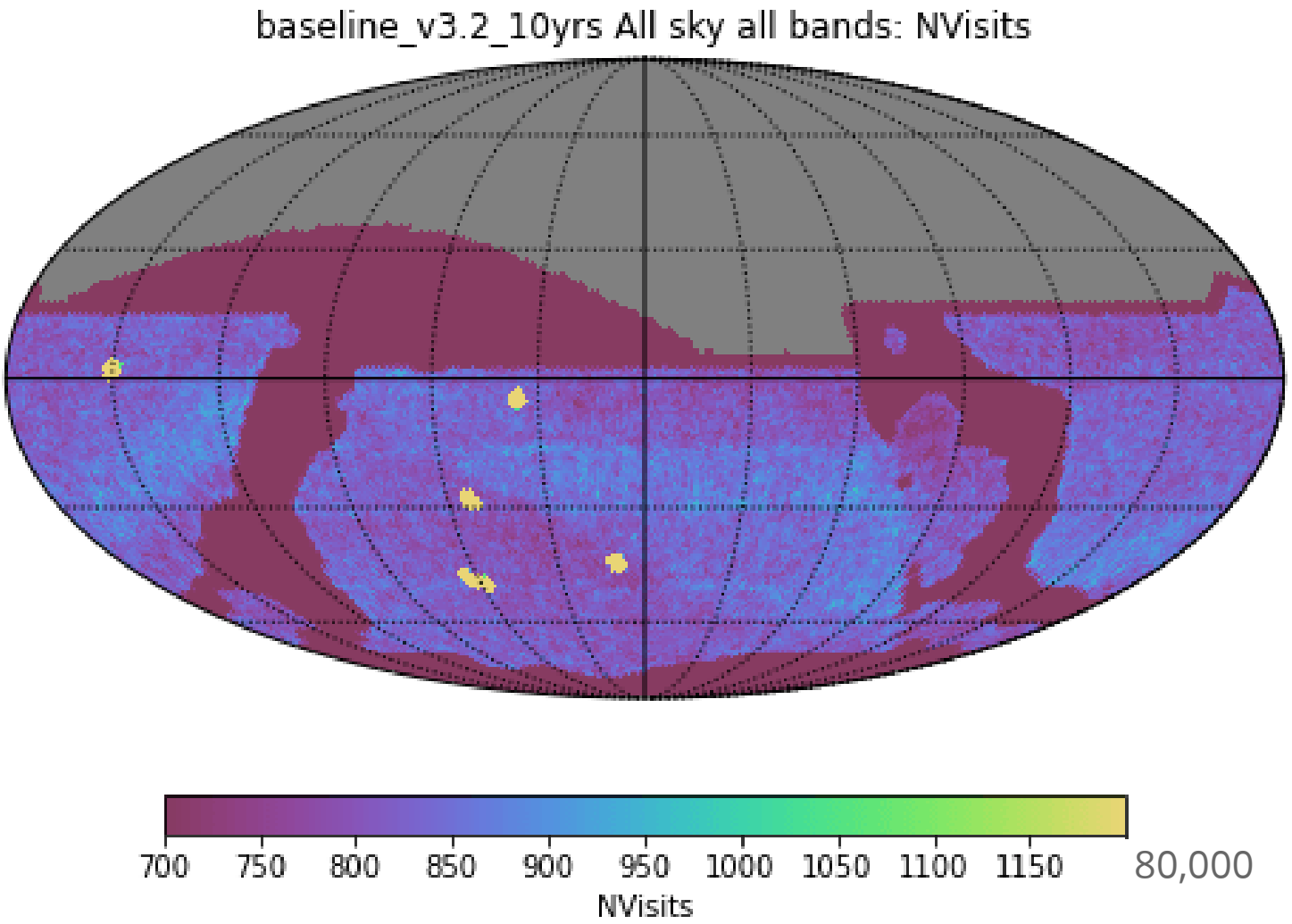

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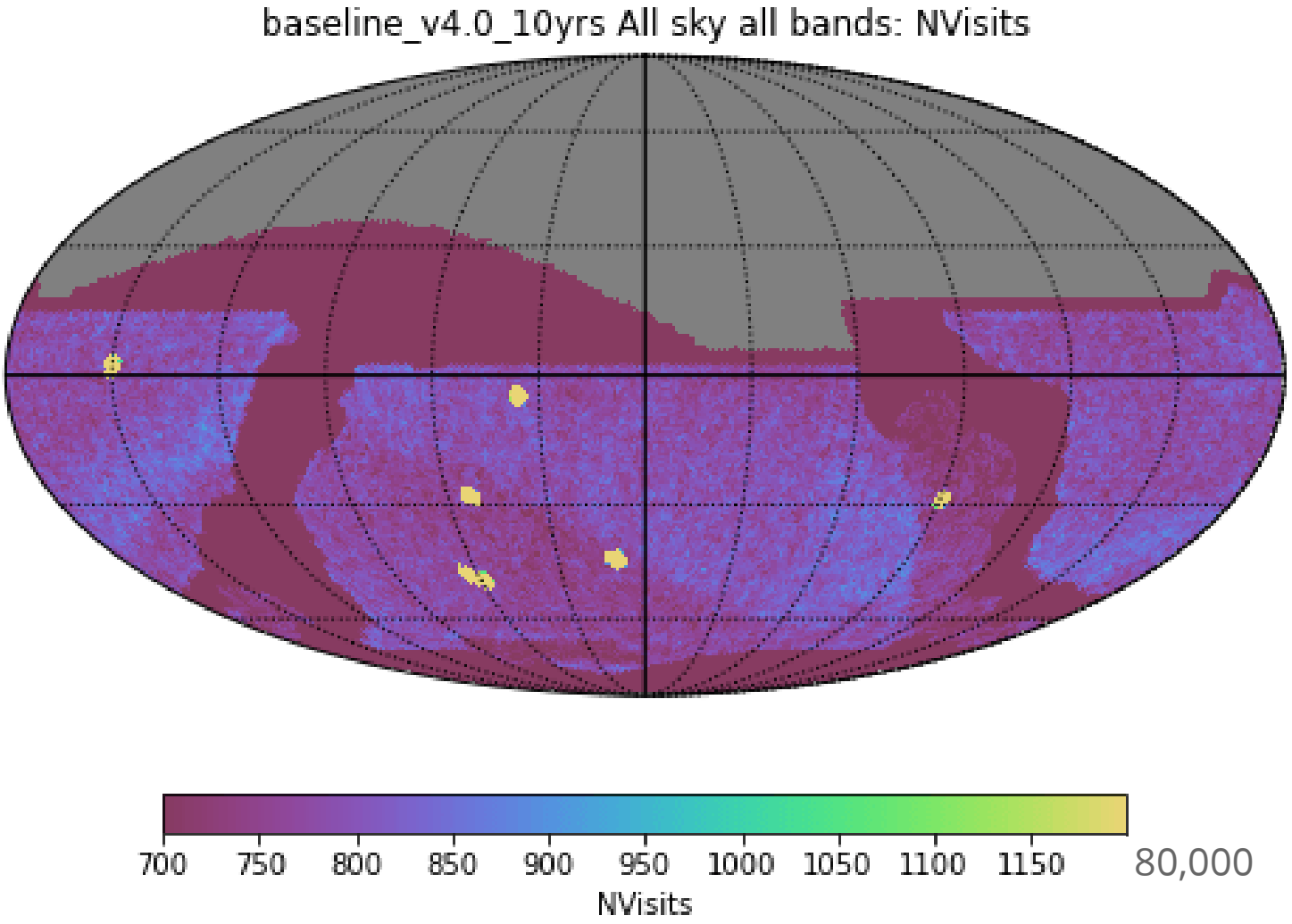
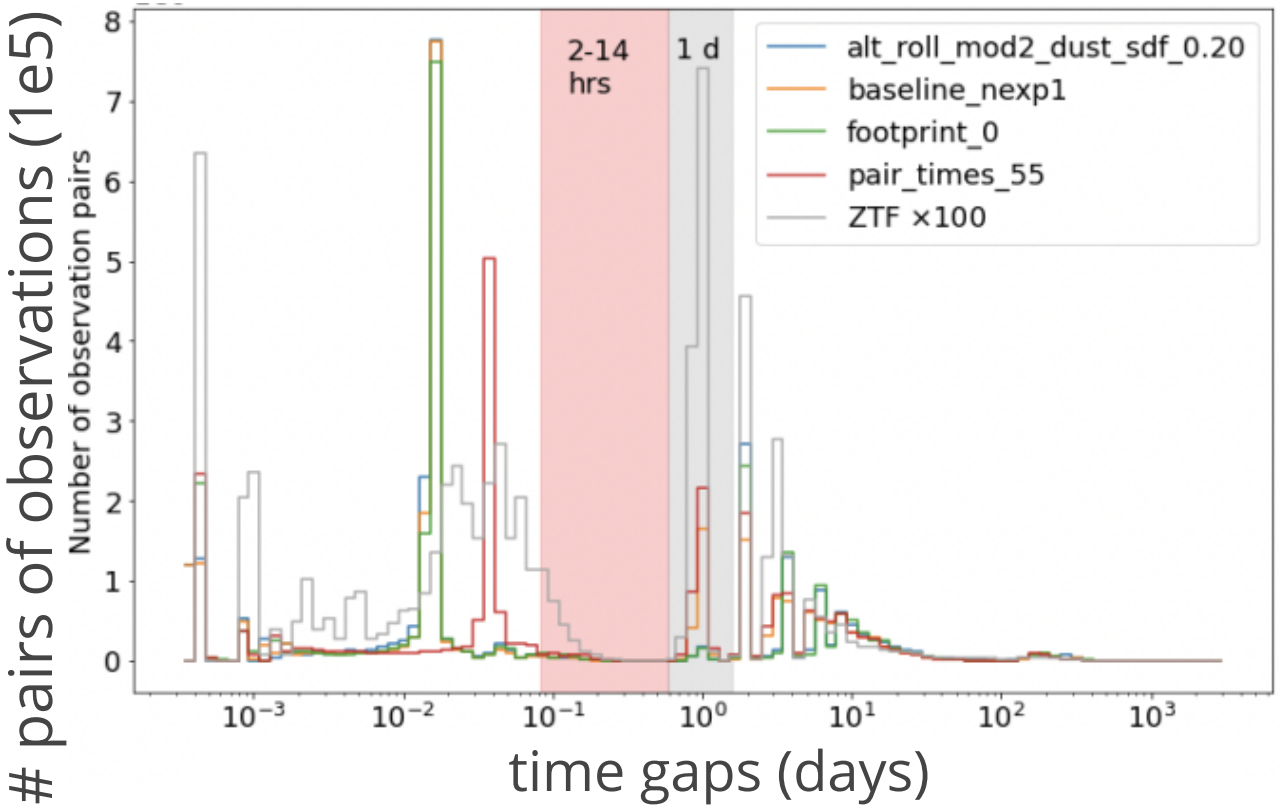
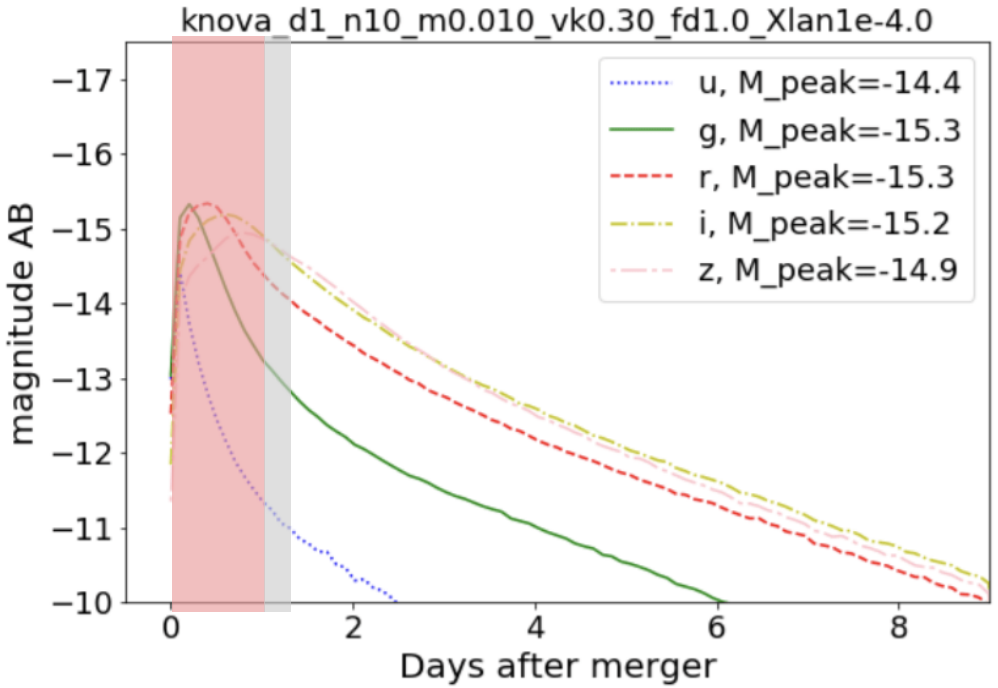


Rubin LSST survey design up to 2018



Eric C. Bellm *et al* 2022 *ApJS* **258** 13



Igor Andreoni *et al* 2022 *ApJS* **258** 5

Introducing Rolling Cadence

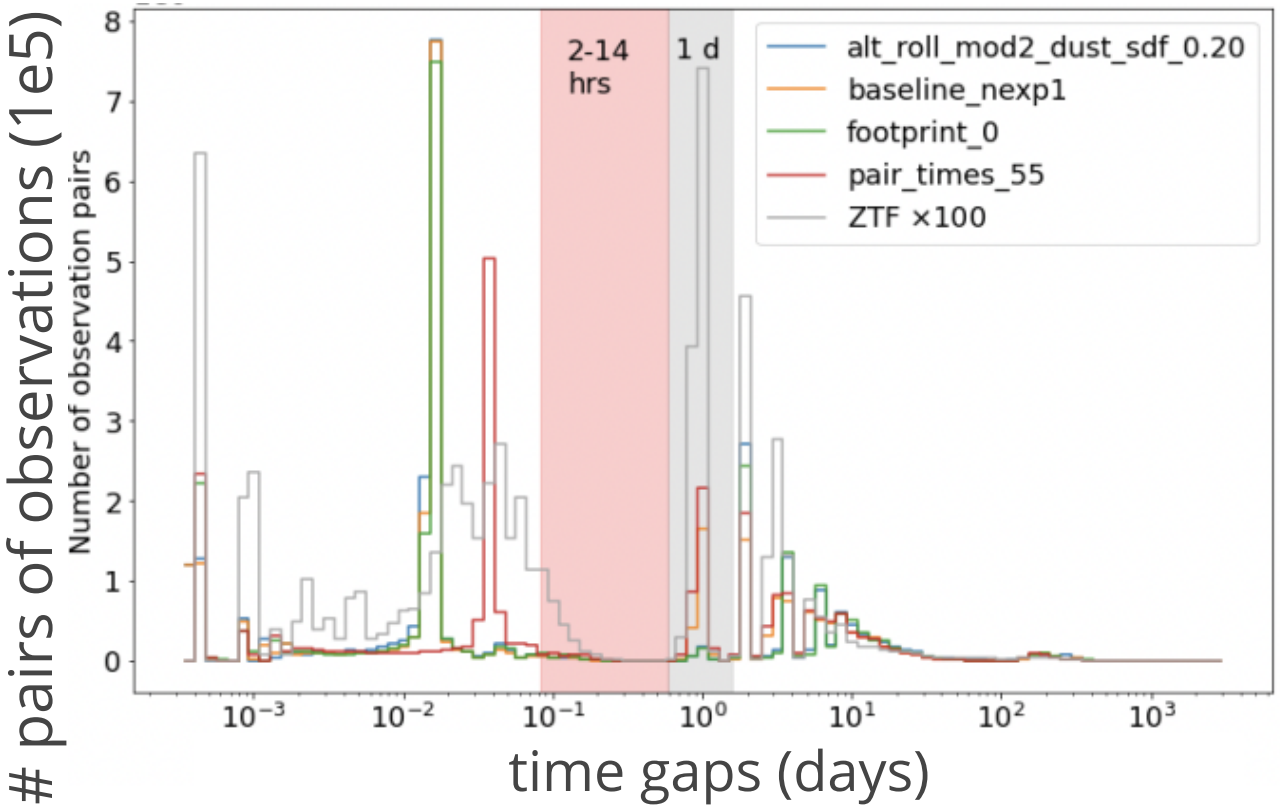
Current plan: rolling 8 out of the 10 years

Rubin LSST survey design up to 2018

Proposed 3 intranight obs

2 within 1 hour in different filters → Intranight color (near instantaneous)

1 at 4-8 hours separation w repeat filter → Intranight rate of change (~hour time scales)



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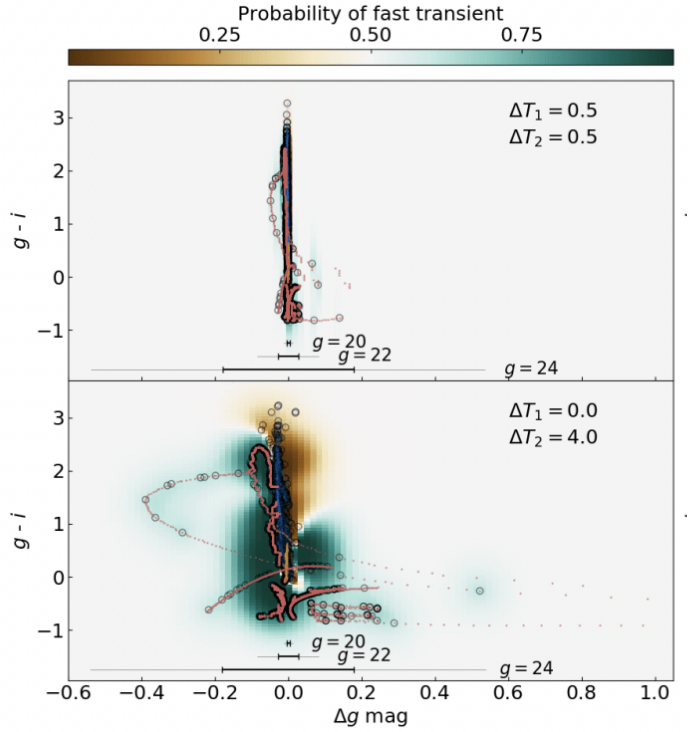
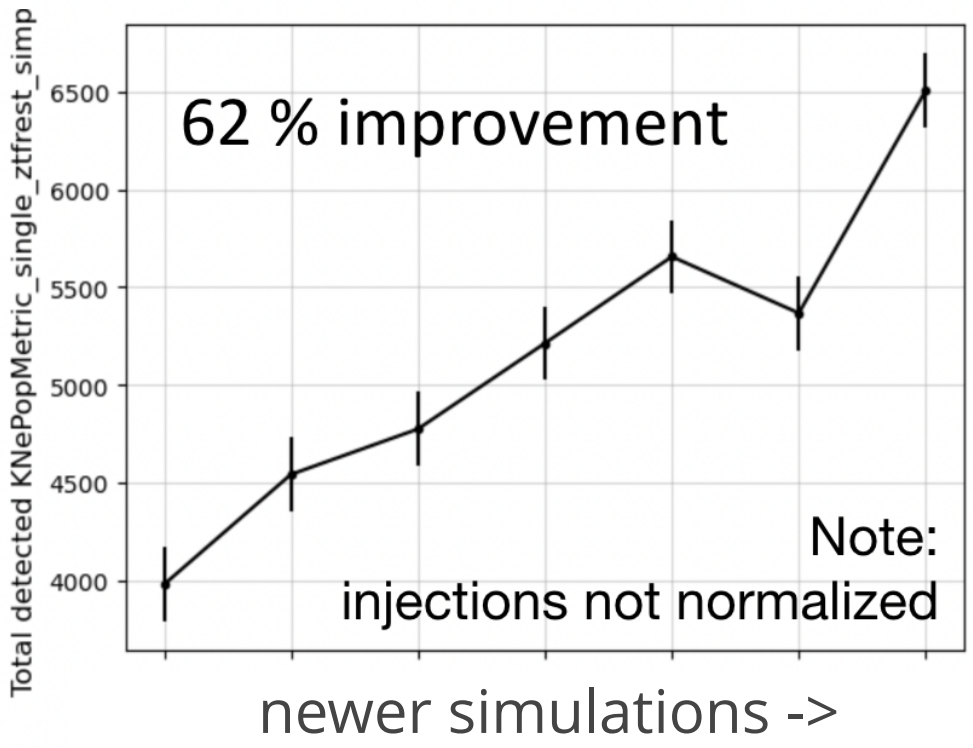
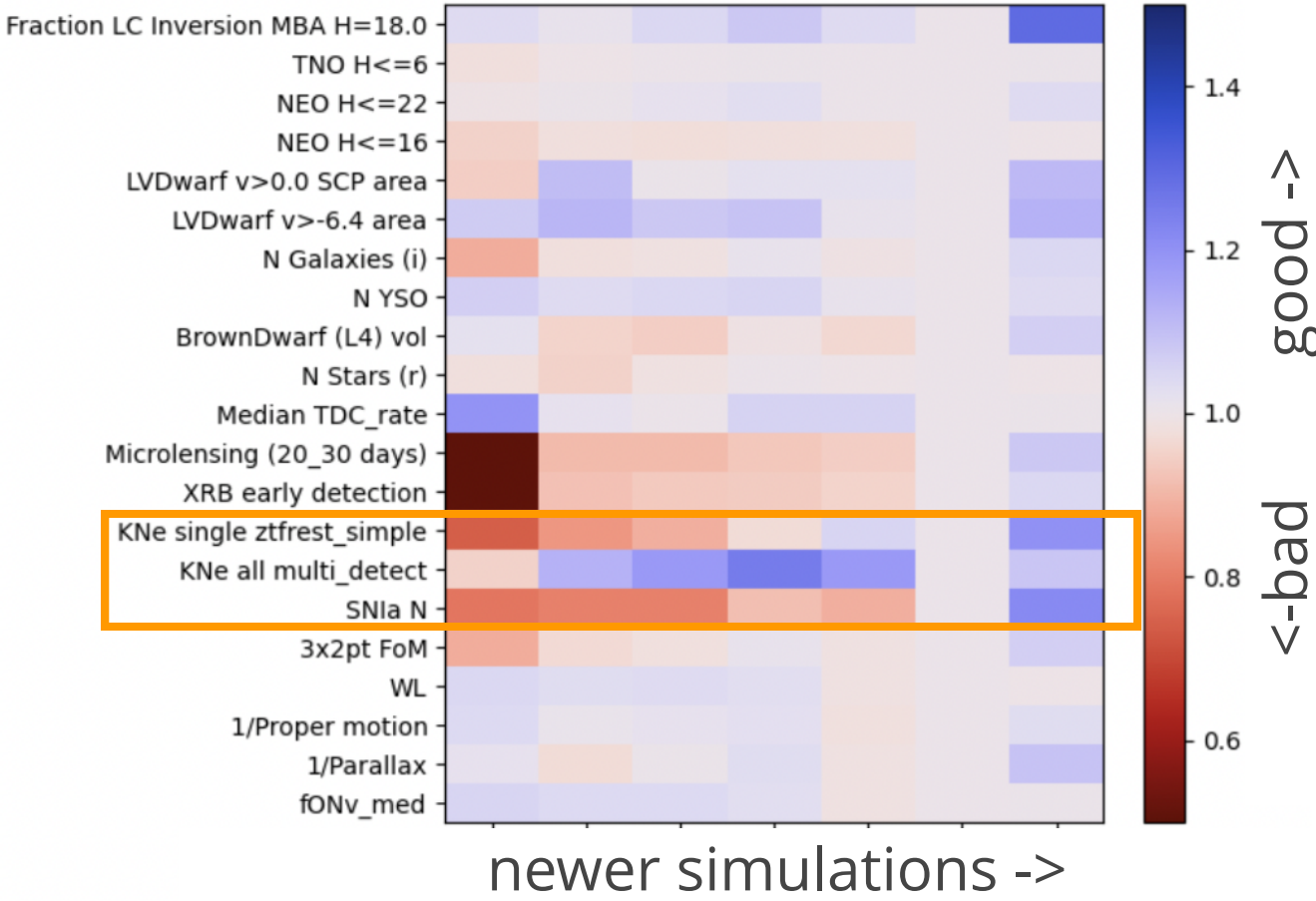


Presto-Color, Bianco+ 2019

Kilonovae in LSST Wide Fast Deep

Andreoni+ 2022a



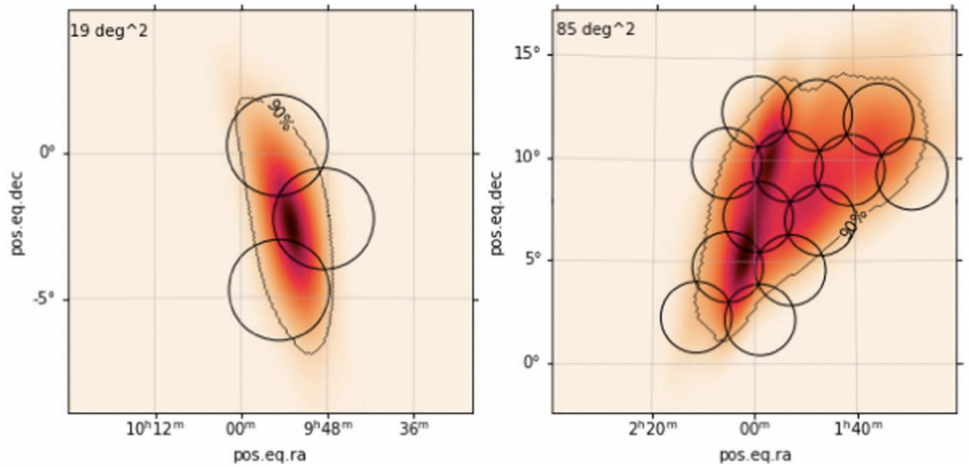


4 – 24 hour gaps between epochs will enable kilonova parameter estimation

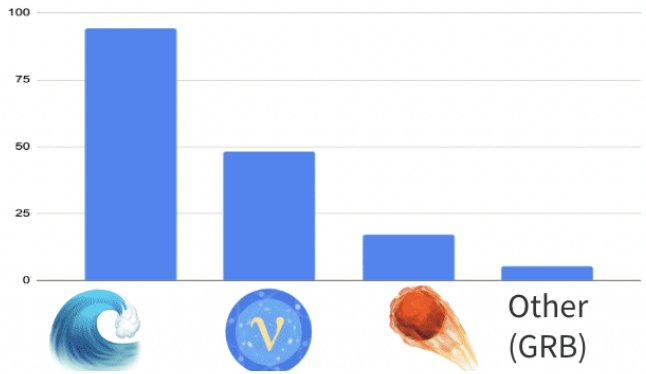
Rubin ToO program

https://lssttooworkshop.github.io/

114 signed up participants



SOC: Igor Andreoni, Federica Bianco, Anna Franckowiak, Tim Lister, Raffaella Margutti, Graham Smith
LOC: Raffaella Margutti, Josh Bloom, Ryan Chornock, Steve Kahn



Rubin ToO program

https://arxiv.org/pdf/2411.04793

Rubin ToO 2024:

Envisioning the Vera C. Rubin Observatory LSST Target of Opportunity program

Authors and Lead Editors: Igor Andreoni (1,2,3,4), Raffaella Margutti (5,6)

Authors and Section Editors: John Banovetz (7), Sarah Greenstreet (8,9), Claire-Alice Hébert (7), Tim Lister (10), Antonella Palmese (11), Silvia Piranomonte (12), S. J. Smartt (13,14), Graham P. Smith (15), Robert Stein (16)

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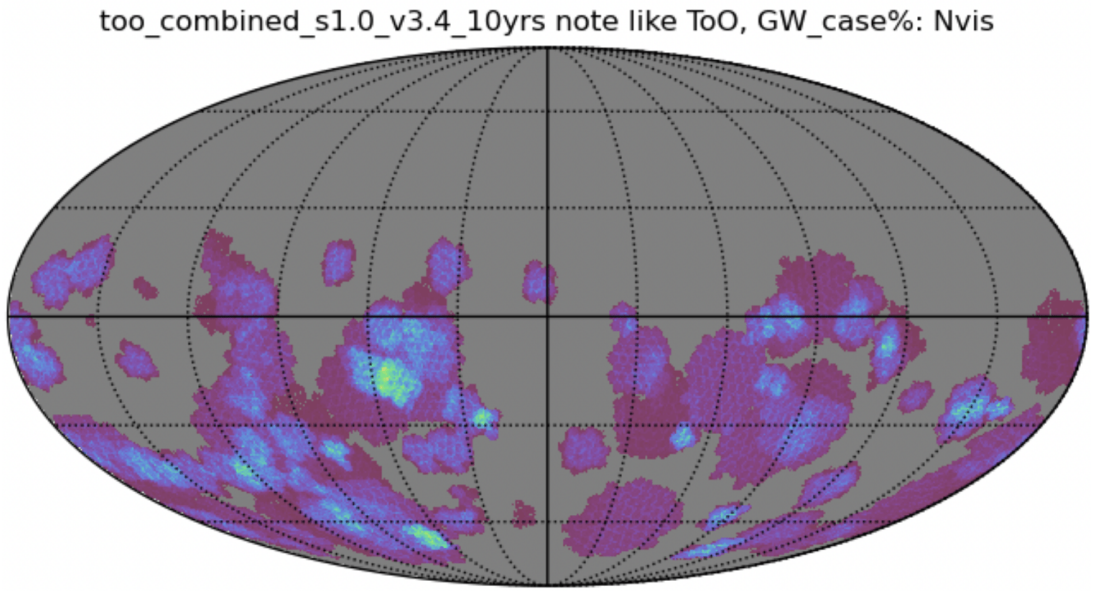
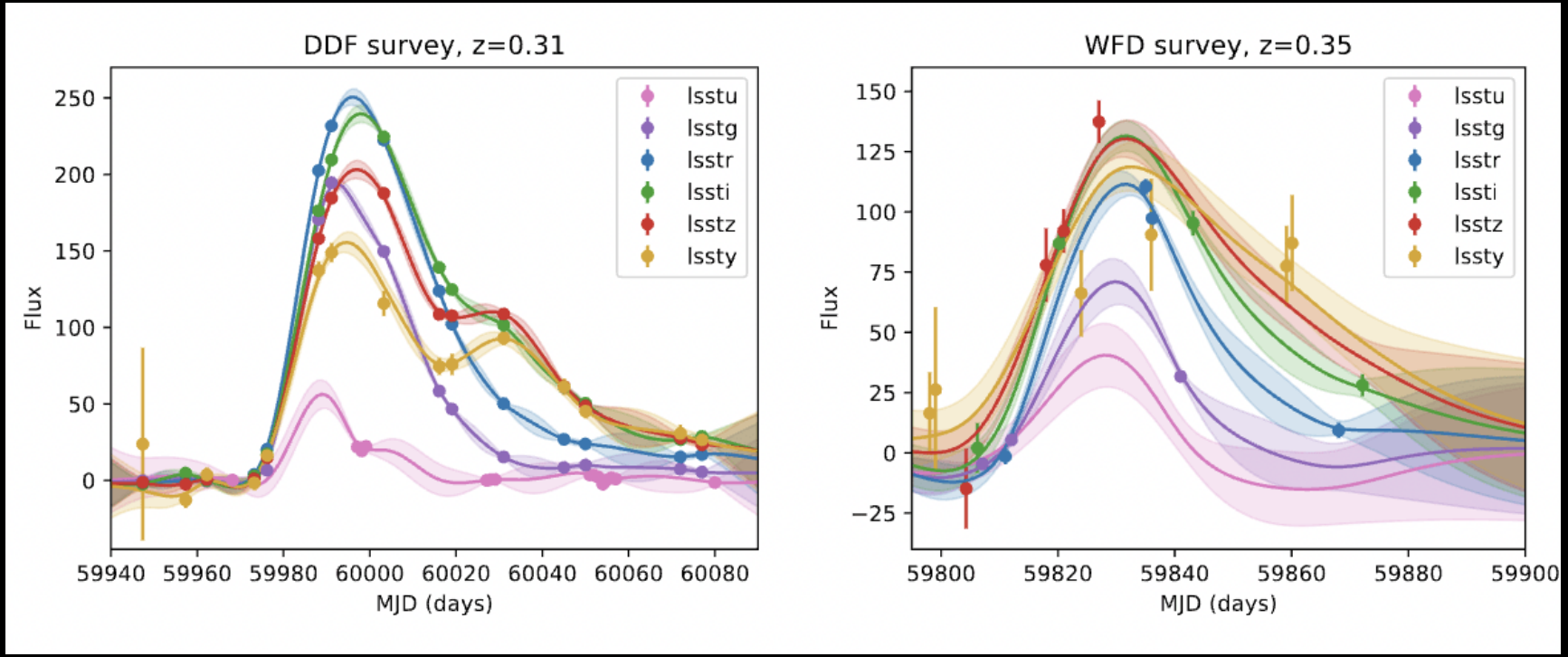


GW case	Total time (hrs) - O5
BNS/NS-BH	240
Lensed BNS	31
BBH	11
Unidentified GW	16
Grand total	**298**

Nu case	6-18 hours

PHA case	<30 hours

What can we do with LSST SN data??



7% of LSST data

The rest

Rubin will see ~1000 SN every night!

Credit: Alex Gagliano University of Illinois,
IAIFI fellow 2023

Photometric Classification

Featured Prediction Competition

PLAsTiCC Astronomical Classification

Can you help make sense of the Universe?

$25,000
Prize Money

LSST Project · 1,094 teams · 2 years ago

Overview | Data | Notebooks | Discussion | Leaderboard | Rules | Join Competition

Overview

- Description
- Evaluation
- Prizes
- Timeline
- PLAsTiCC's Team

Help some of the world's leading astronomers grasp the deepest properties of the universe.

The human eye has been the arbiter for the classification of astronomical sources in the night sky for hundreds of years. But a new facility -- the Large Synoptic Survey Telescope (LSST) -- is about to revolutionize the field, discovering 10 to 100 times more astronomical sources that vary in the night sky than we've ever known. Some of these sources will be completely unprecedented!

LSST DESC
Dark Energy Science Collaboration

TVSSC

LSST: Science Collaborations

LSST CORPORATION

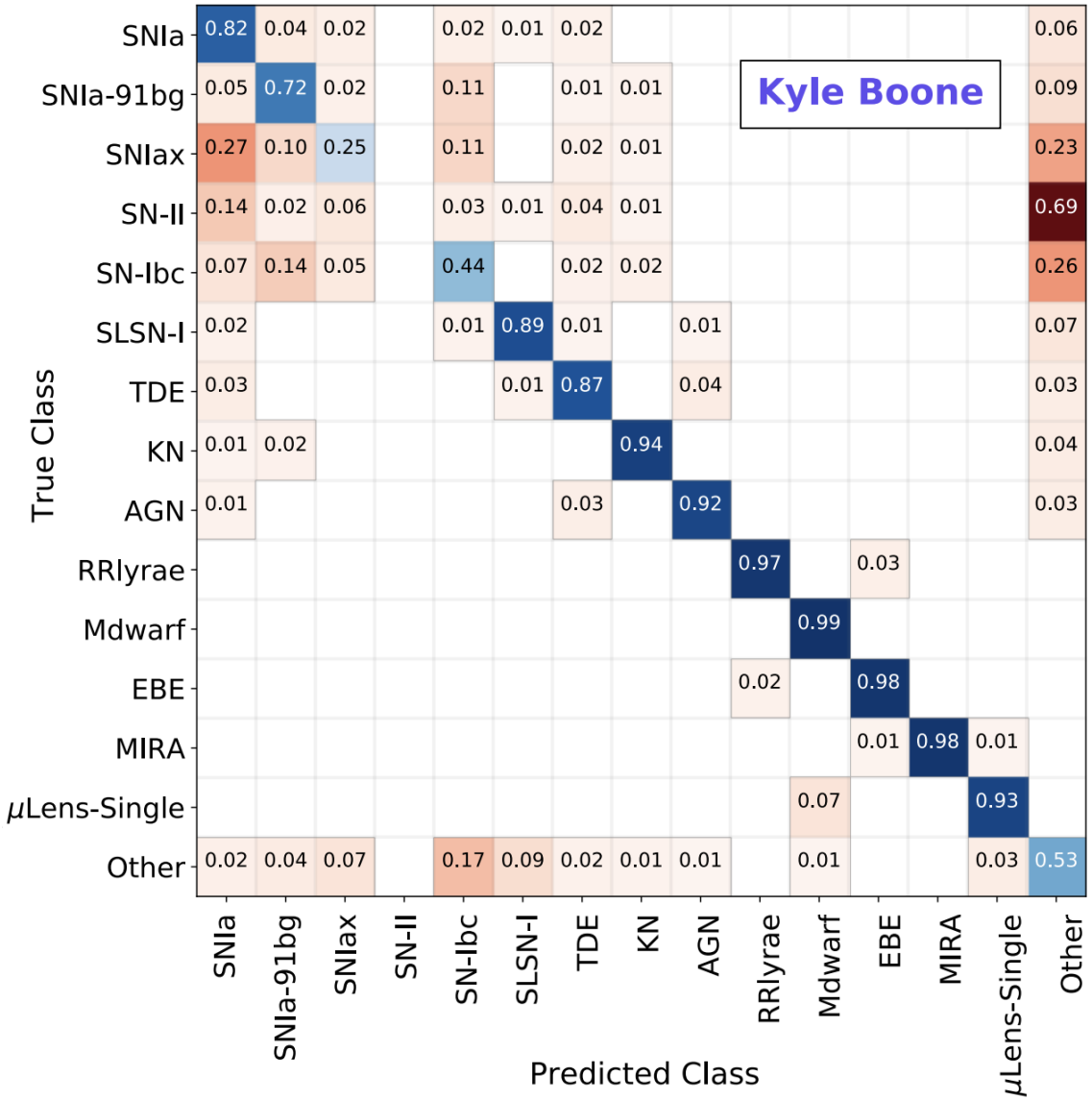
kaggle

highest participation of any astronomical Kaggle challenges

The PLAsTiCC challenge winner, Kyle Boone was a grad student at Berkeley, and did not use a Neural Network!

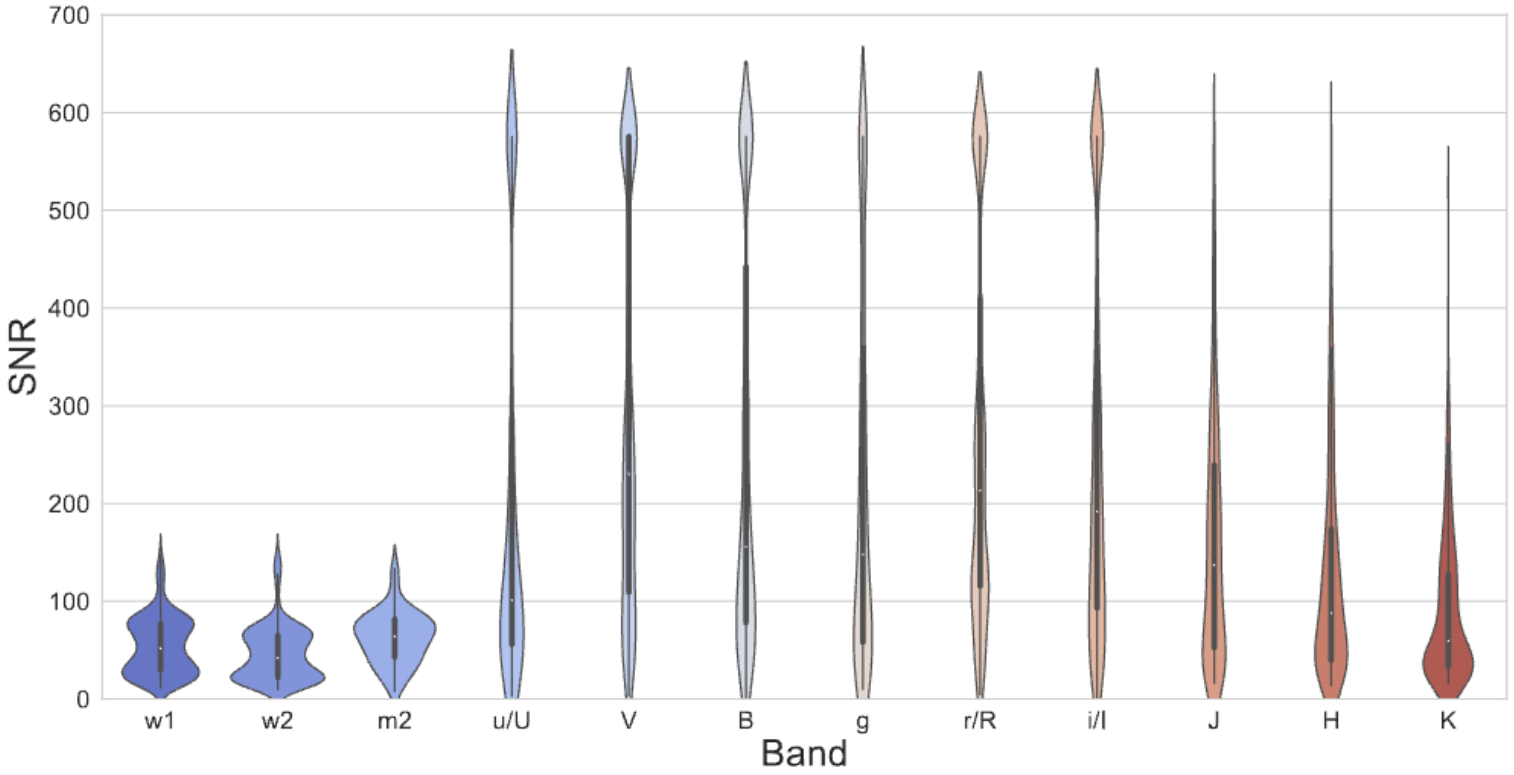
He won $2,000

https://arxiv.org/abs/1907.04690



Data-Driven Photometric Templates for stripped SESN

FASTlab Flash highlight



Multi-filter UV to NIR Data-driven Light Curve Templates for Stripped Envelope Supernovae

Somayeh Khakpash,[1,2,3] Federica B. Bianco,[2,4,3,5] Maryam Modjaz,[6] Willow F. Fortino,[2,3] Alexander Gagliano,[7,8,9] Conor Larison,[1] and Tyler A. Pritchard[10]

[1] *Rutgers University, Department of Physics & Astronomy, 136 Frelinghuysen Rd, Piscataway, NJ 08854, USA*
[2] *University of Delaware Department of Physics and Astronomy 217 Sharp Lab Newark, DE 19716 USA*
[3] *University of Delaware Data Science Institute*
[4] *University of Delaware Joseph R. Biden, Jr. School of Public Policy and Administration, 184 Academy St, Newark, DE 19716 USA*
[5] *Vera C. Rubin Observatory, Tucson, AZ 85719, USA*
[6] *University of Virginia, Department of Astronomy, 530 McCormick Road Charlottesville, VA 22904*
[7] *The NSF AI Institute for Artificial Intelligence and Fundamental Interactions*
[8] *Center for Astrophysics | Harvard & Smithsonian, 60 Garden Street, Cambridge, MA 02138-1516, USA*
[9] *MIT Laboratory For Nuclear Science, 77 Massachusetts Ave., Cambridge, MA 02139, US*
[10] *NASA's Goddard Space Flight Center, Greenbelt, MD 20771 USA*

Khakpash et al. 2024 ApJS
https://arxiv.org/pdf/2405.01672

Rare classes will become common, but how do we know what we are looking at and classify different objects for sample studies?

on the job market!

Dr. Somayeh Khakpash
LSSTC Catalyst Fellow, Rutgers

FASTlab Flash highlight

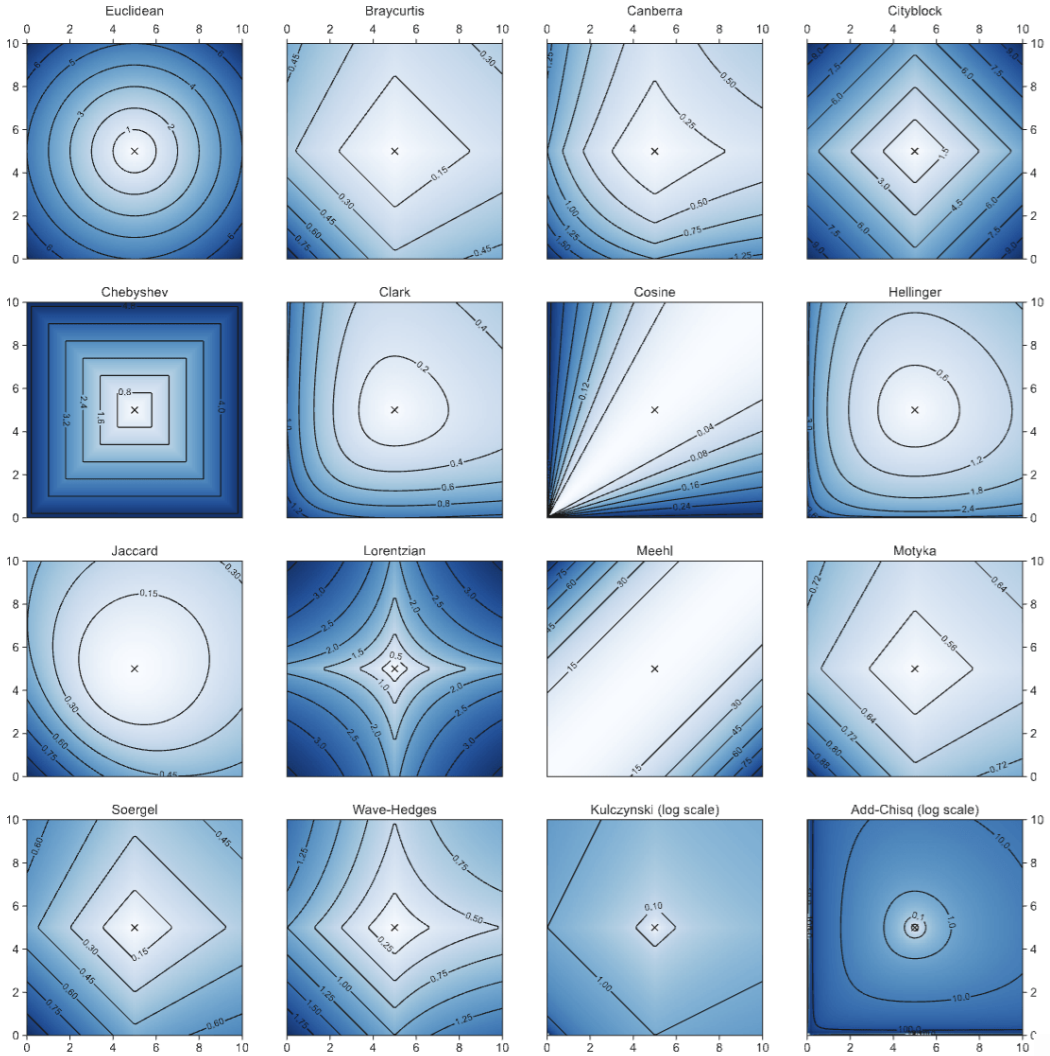


Figure 1: A visualization of 16 (of the 18) different distance metrics we used throughout this work. In each subplot, we look at the equidistant loci measurin distance from the central point of the coordinate space (5, 5). The color background denotes the distance values, while contours are labeled accordingly. Note the contours differ for each subplot, as the range of values the distance can take is different for each metric. To aid the readability of the plot, we use a log- representation for the last two metrics - Kulczynski and the Additive ChiSq because the high-power elements in the metric formula compress the distance scale. Correlation and Maryland Bridge metrics have not been visualized here as both require input data to be vectors, and not a 2-dimensional data point (see Appe A).

Most classifiers for variable stars use Random Forest (not distance based)

In distance based classification, optimal distances can be found for the class of interest: *flexible, customizable, efficient*

ELSEVIER

Astronomy and Computing
Volume 48, July 2024, 100850

Full length article

Light curve classification with DistClassiPy: A new distance-based classifier

S. Chaini [a b], A. Mahabal [c d], A. Kembhavi [e], F.B. Bianco [a f g h]

https://arxiv.org/pdf/2403.12120.pdf

Astronomy and computing

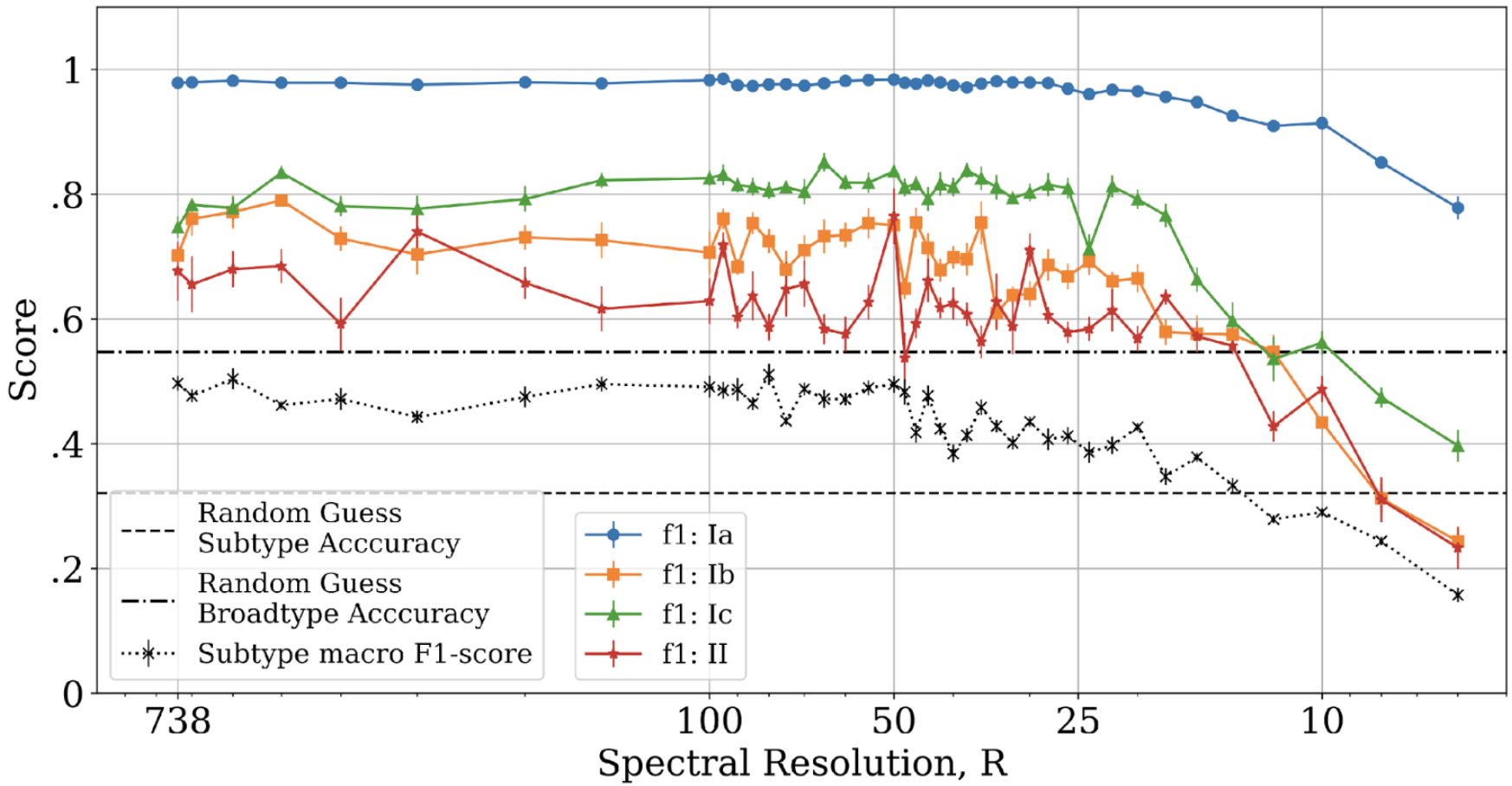
SCAN ME

DistClassiPy

Siddarth Chiaini, UDelaware

When they go high, we go low

FASTlab Flash highlight



Classification power vs spectral resolution for SNe subtypes

Neural Network classifier architectures:

- *transformers*
- *CNNs*

Willow Fox Fortino

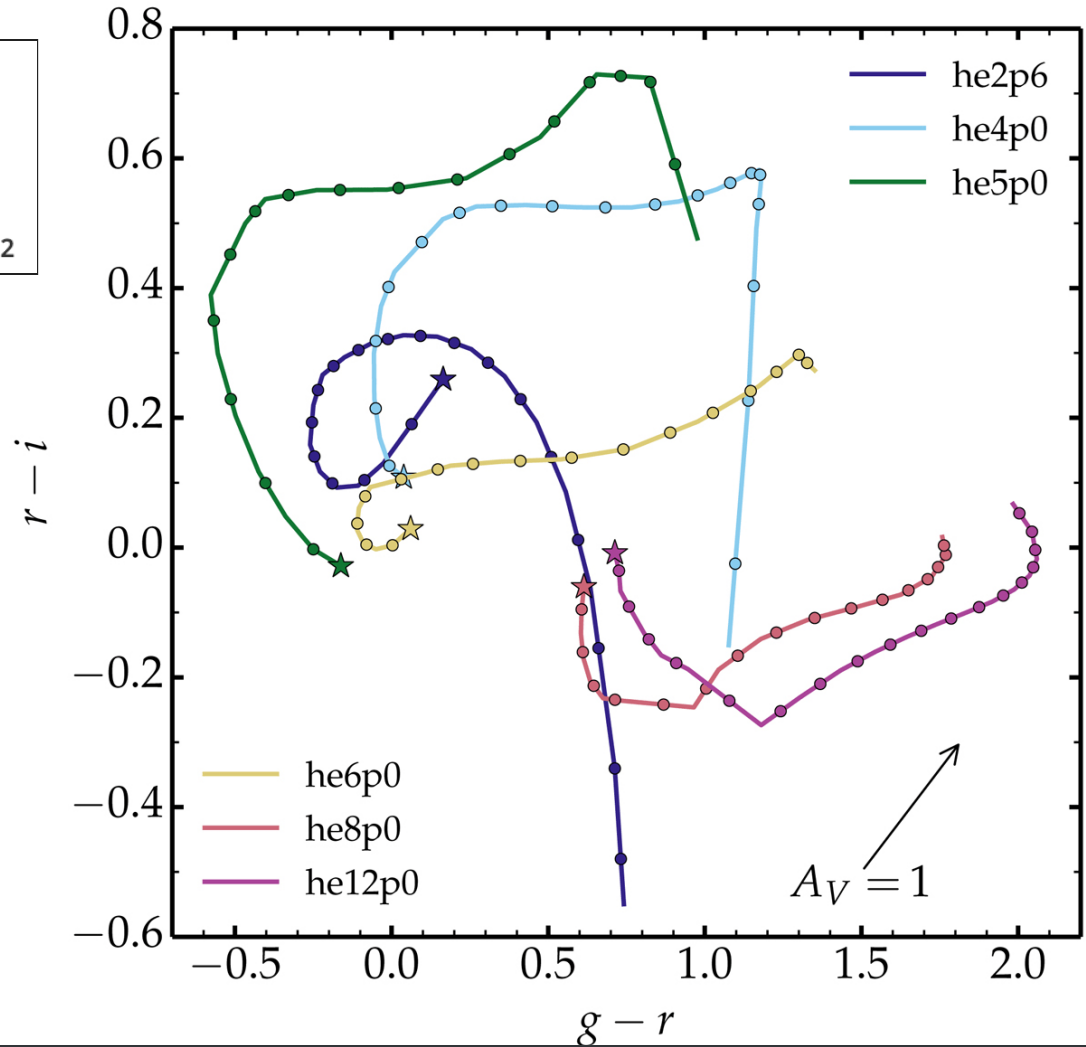
UDel grad student

Persistent Observations Give Extensive Time Lightcurves

Using LSST late-time photometry to constrain Type Ibc supernovae and their progenitors

Luc Dessart[1], Jose L. Prieto[2,3], D. John Hillier[4], Hanindyo Kuncarayakti[5,6] and Emilio D. Hueichapan[2]

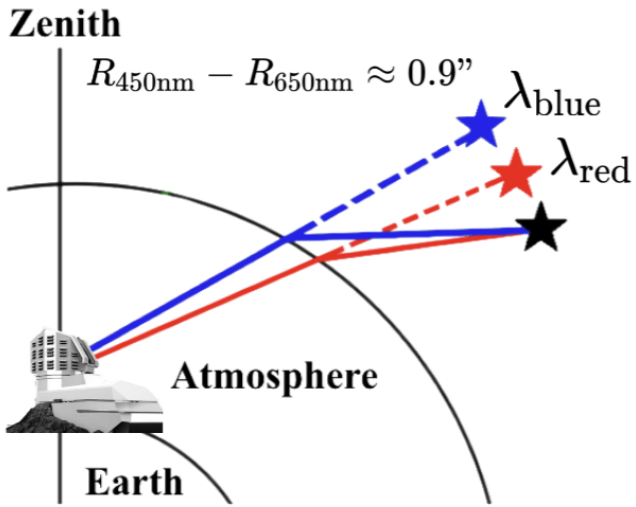
LSST color-color magnitude diagram for the Type Ibc simulations from 100 to about 450 d after explosion. We show the color curves $r - i$ vs. $g - r$ for our He-star explosion models from 100 d (indicated by a star symbol) until the end of the simulation at around 450 d. Dots are equally spaced in time every 20 d. The arrow corresponds to the color shift caused by AV = 1 mag.

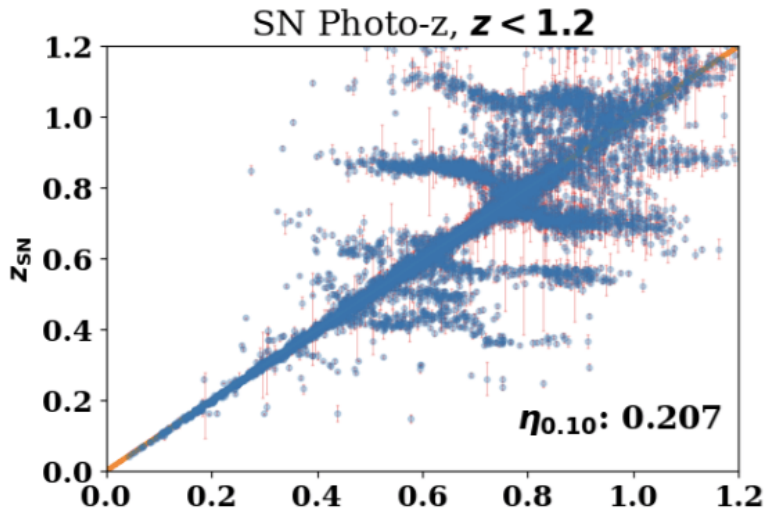


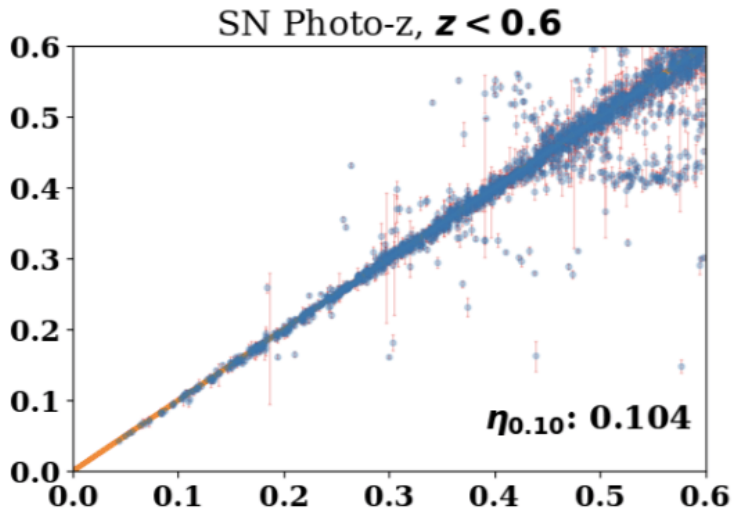
Leveraging image quality

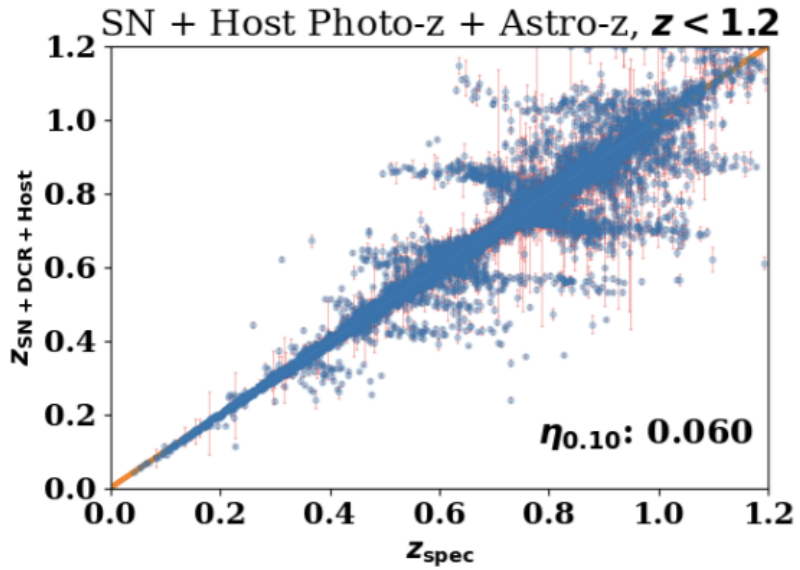
Astrometric Redshifts of Supernovae

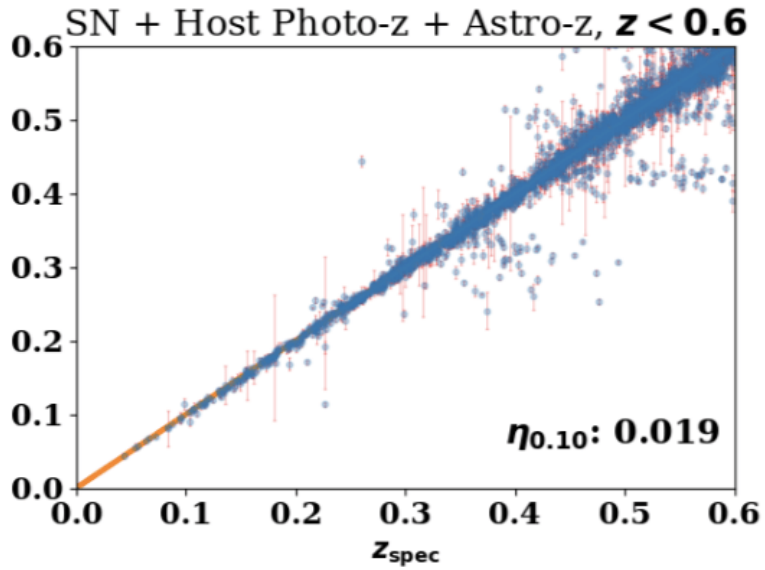
Jaemyoung (Jason) Lee [1,*] Masao Sako [1] Richard Kessler [2] Alex I. Malz [3] and The LSST Dark Energy Science Collaboration





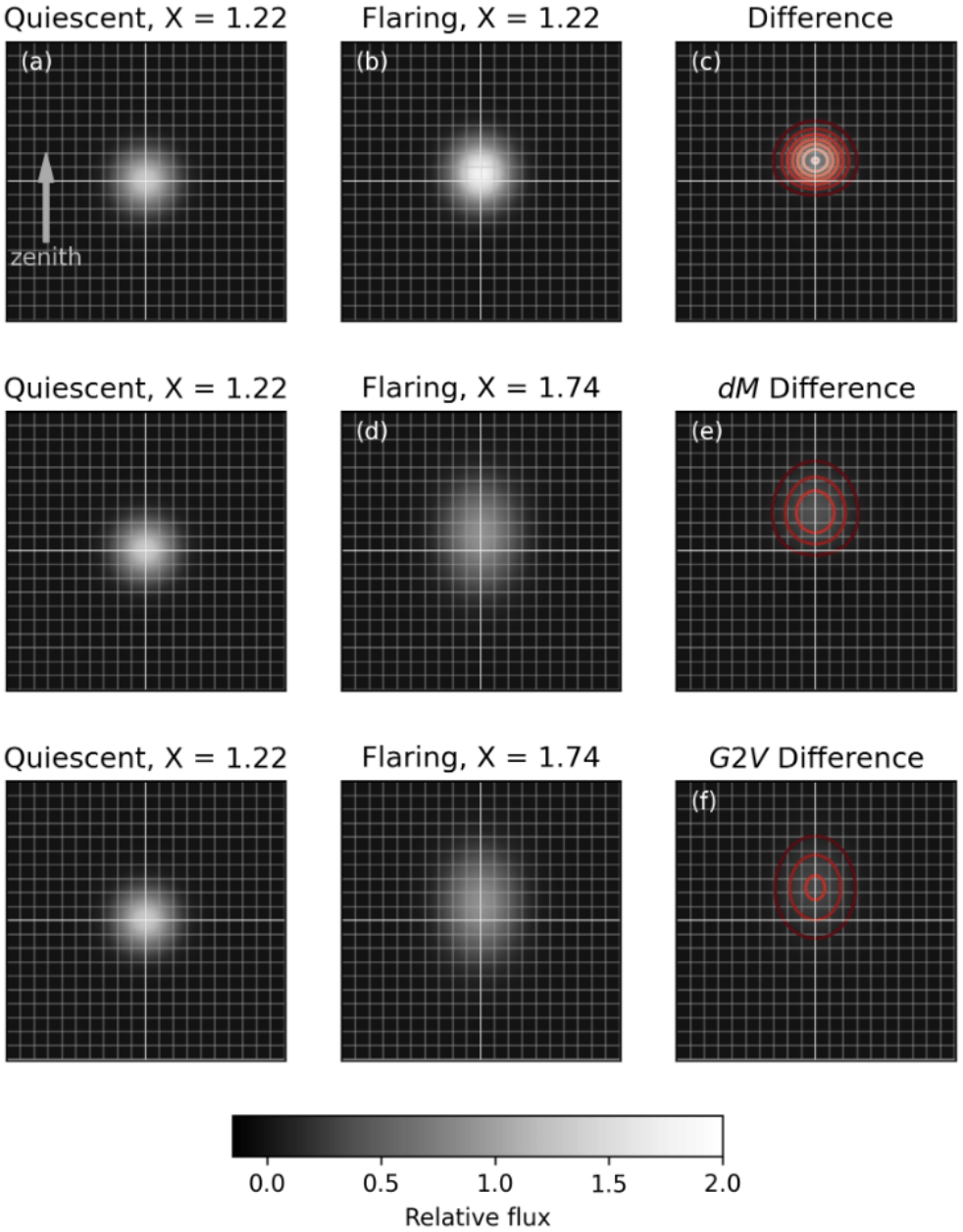






Stars that flare ΔDCR

FASTlab Flash highlight



OPEN ACCESS

Every Data Point Counts: Stellar Flares as a Case Study of Atmosphere-aided Studies of Transients in the LSST Era

Riley W. Clarke, James R. A. Davenport, John Gizis, Melissa L. Graham, Xiaolong Li, Willow Fortino, Easton J. Honaker, Ian Sullivan, Yusra Alsayyad, James Bosch ▾ Show full author list

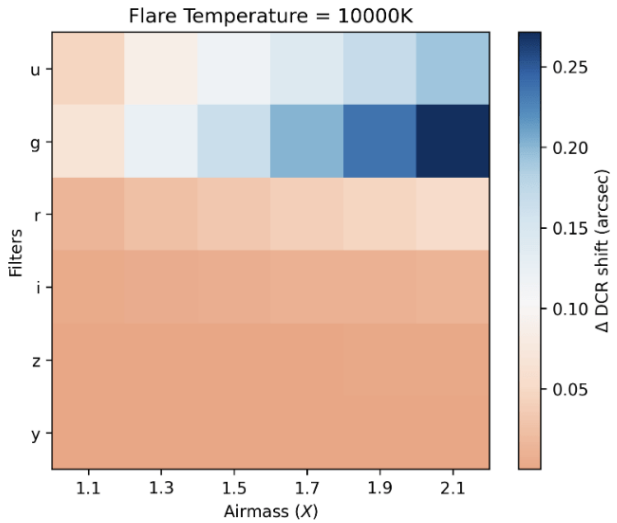
Published 2024 June 10 • © 2024. The Author(s). Published by the American Astronomical Society.

The Astrophysical Journal Supplement Series, Volume 272, Number 2

Rubin LSST Survey Strategy Optimization

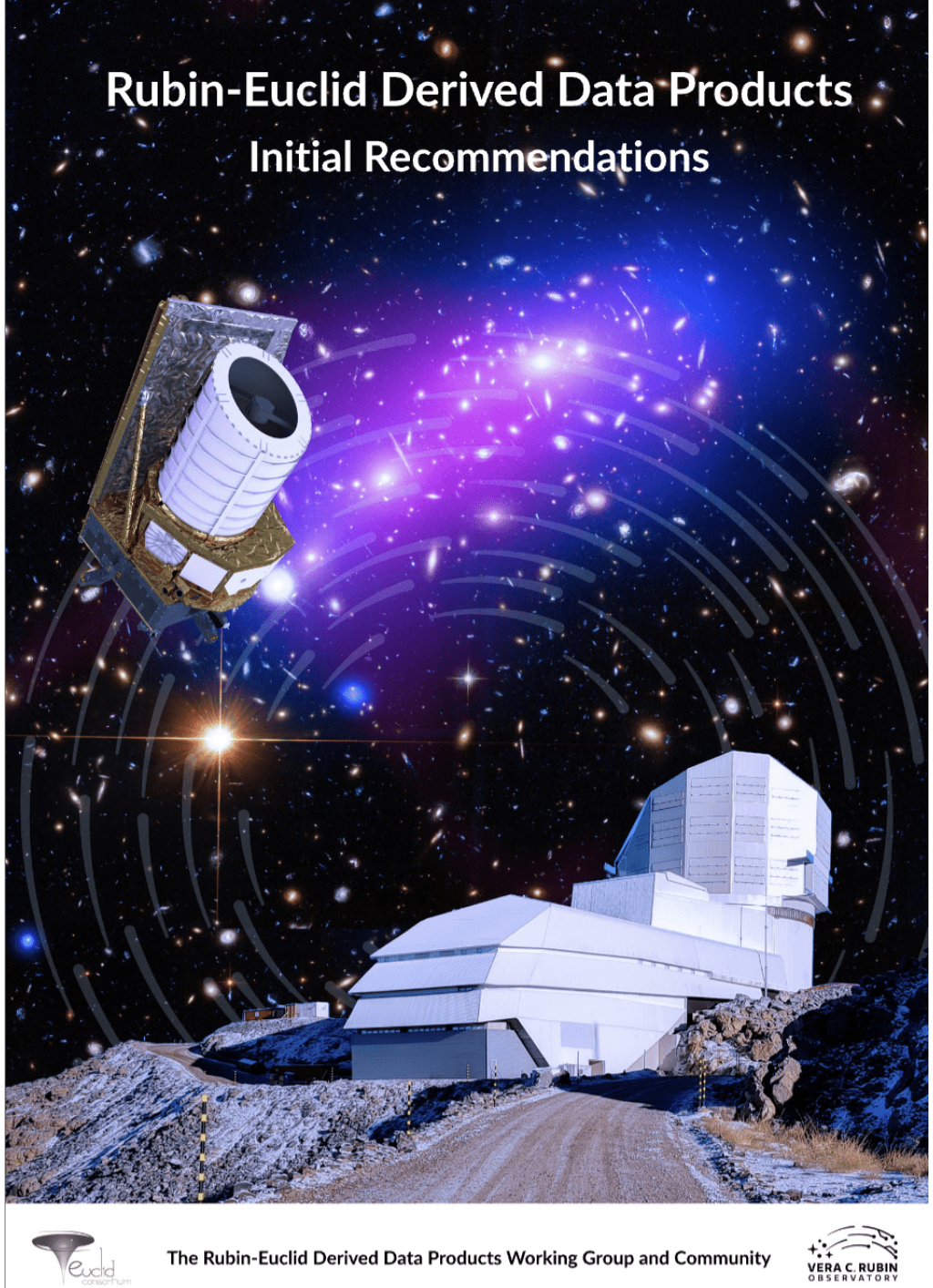
Citation Riley W. Clarke *et al* 2024 *ApJS* **272** 41

DOI 10.3847/1538-4365/ad4110



on the job market!

Riley Clarke, UDelware



JOURNAL ARTICLE

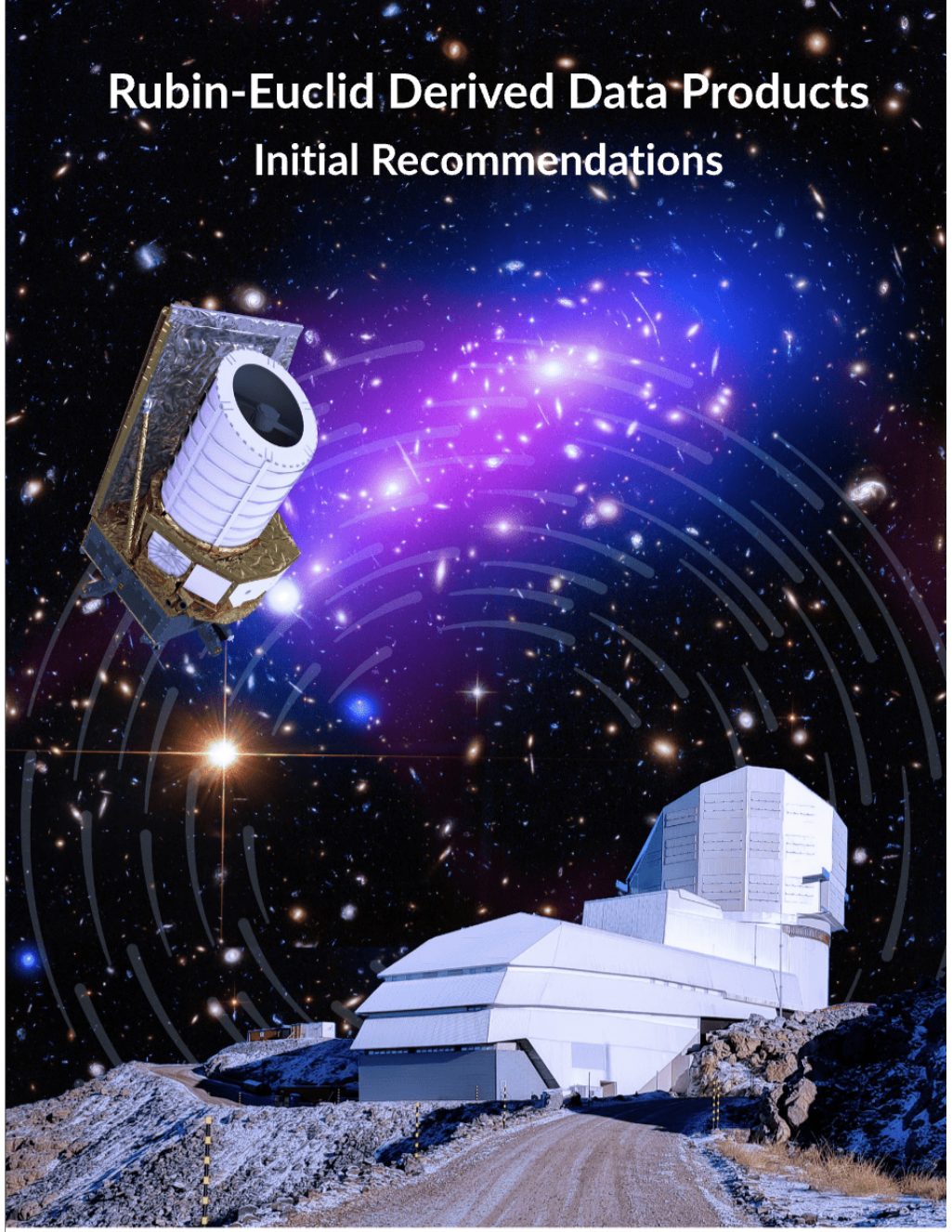
Type Ia supernova observations combining data from the *Euclid* mission and the Vera C. Rubin Observatory FREE

A C Bailey ✉, M Vincenzi, D Scolnic, J-C Cuillandre, J Rhodes, I Hook, E R Peterson, B Popovic

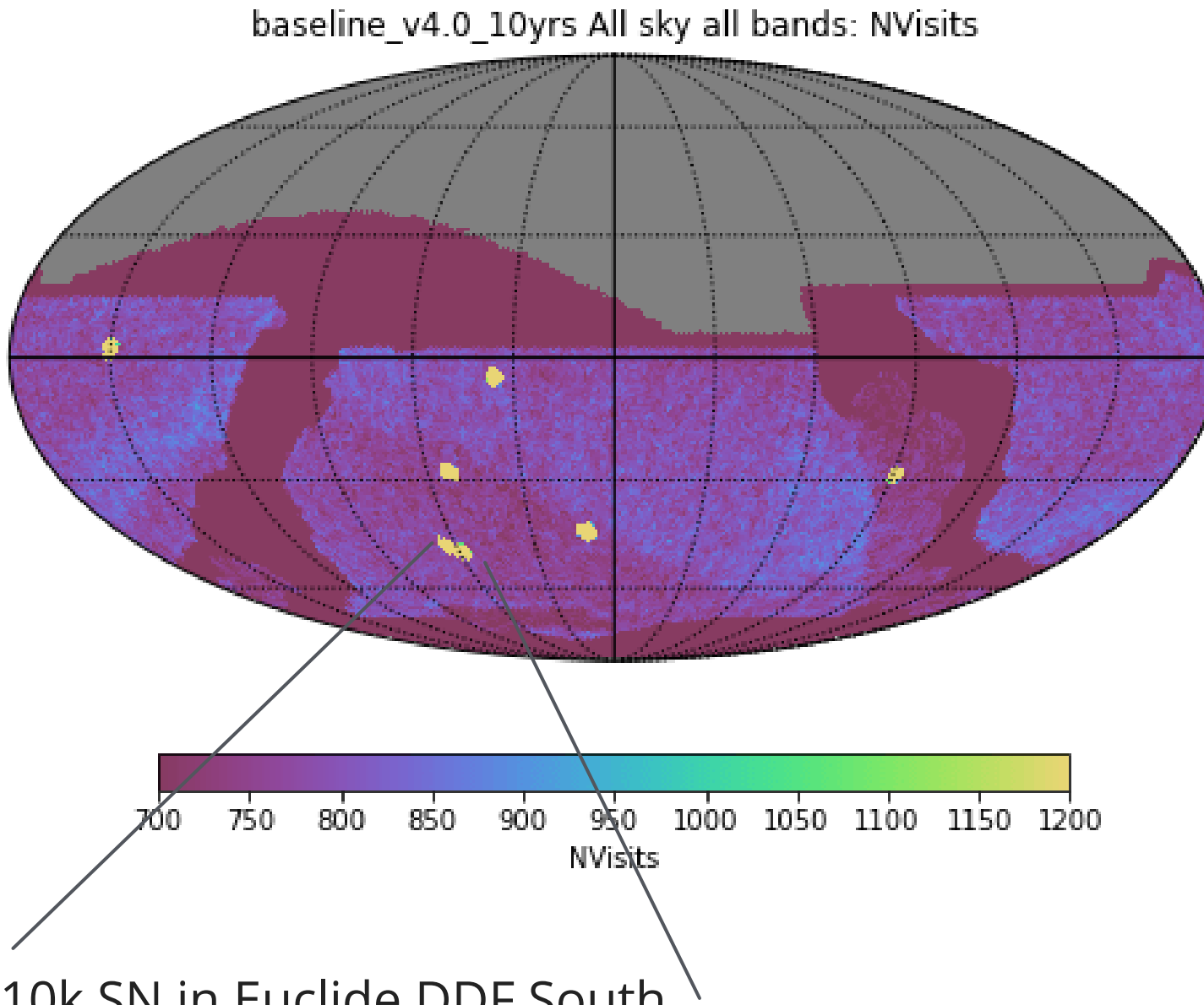
Over the five-year window considered in this analysis, we predict to have 18 000 SNe Ia with at least five LSST observations (in any filter) with SNR > 3 [...]However, we predict that approximately 3700 SNe will have at least five *Euclid* detections with SNR > 3, and 1900 SNe will have at least ten detections with SNR > 3 from *Euclid*.

Rubin-Euclid Derived Data Products

Initial Recommendations



The Rubin-Euclid Derived Data Products Working Group and Community



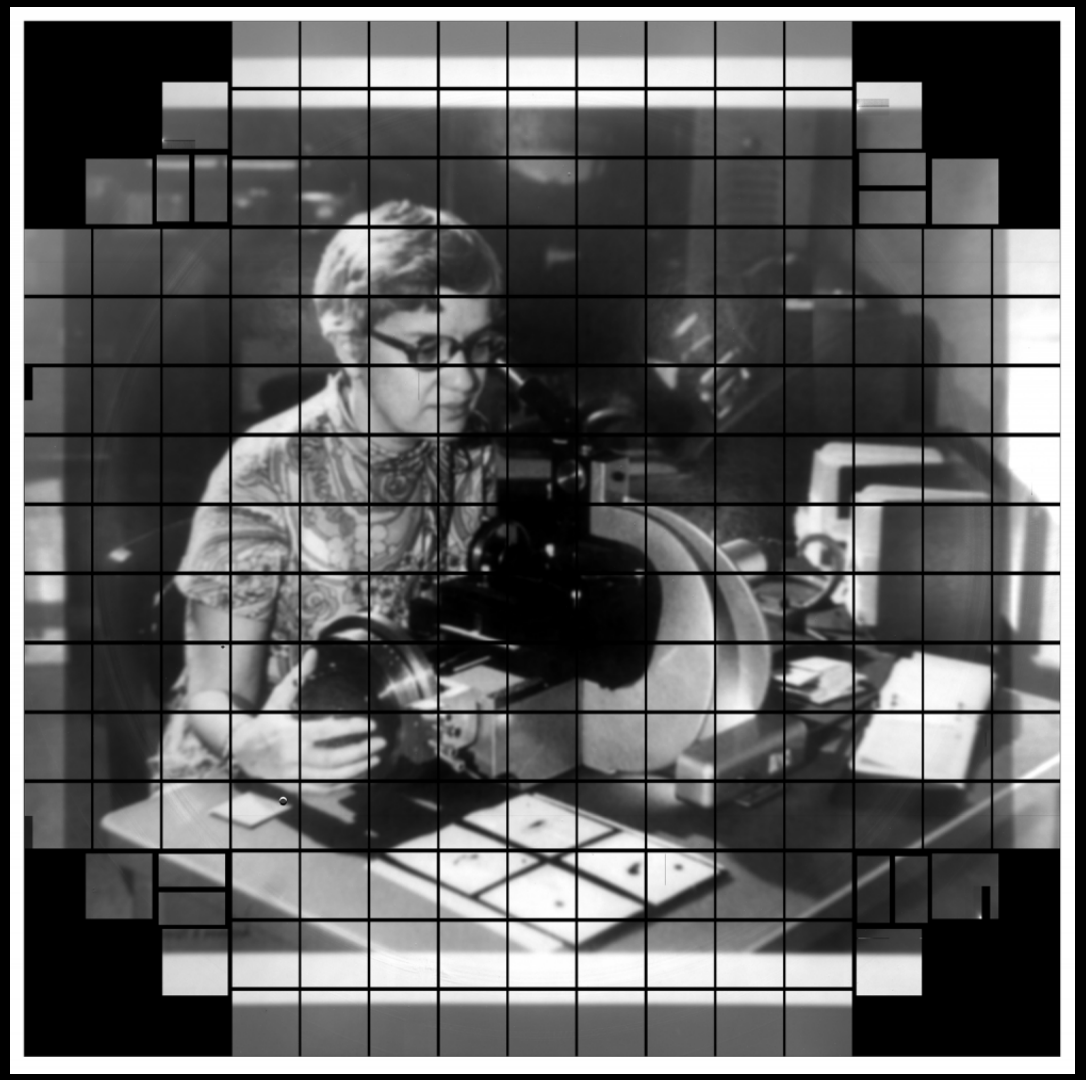
10k SN in Euclide DDF South

The LSST Science Collaborations

The LSST Science Collaborations

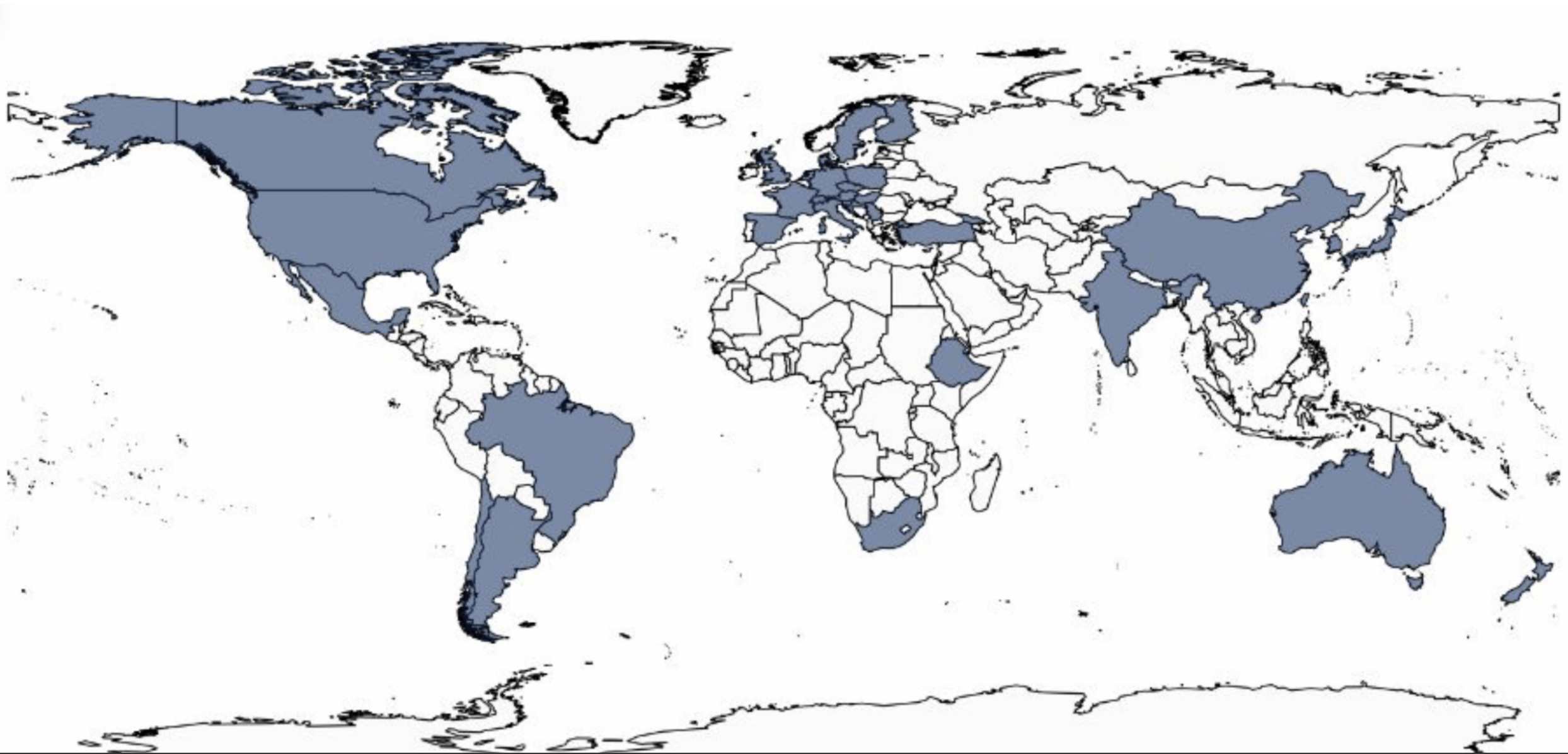
A community of practice funded on principles of Equity, Inclusivity, Cooperation

what's in a name?

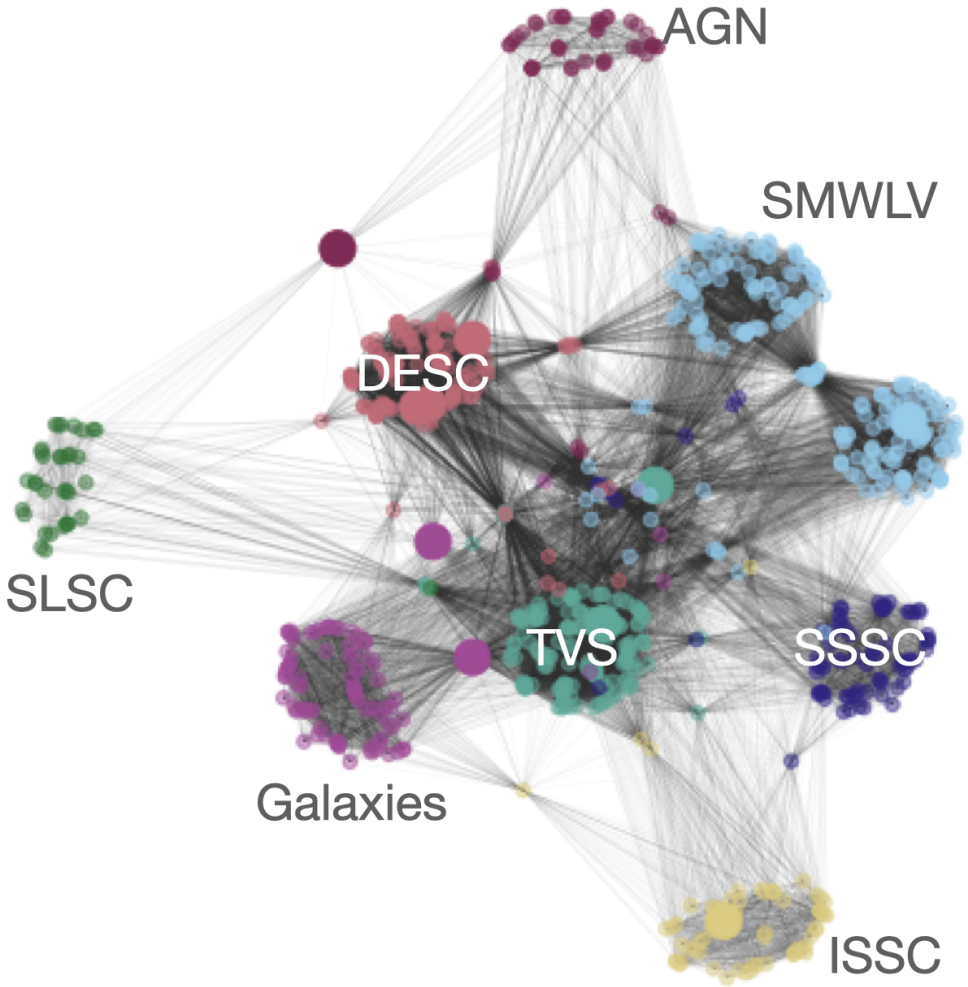


The first ground-based national US observatory named after a woman, Dr. Vera C. Rubin

An international community of practice built on principles of cooperation, equity, and solidarity



Rubin LSST Science Collaborations



8 teams

>2000 members

>2500 affiliations

5 continents

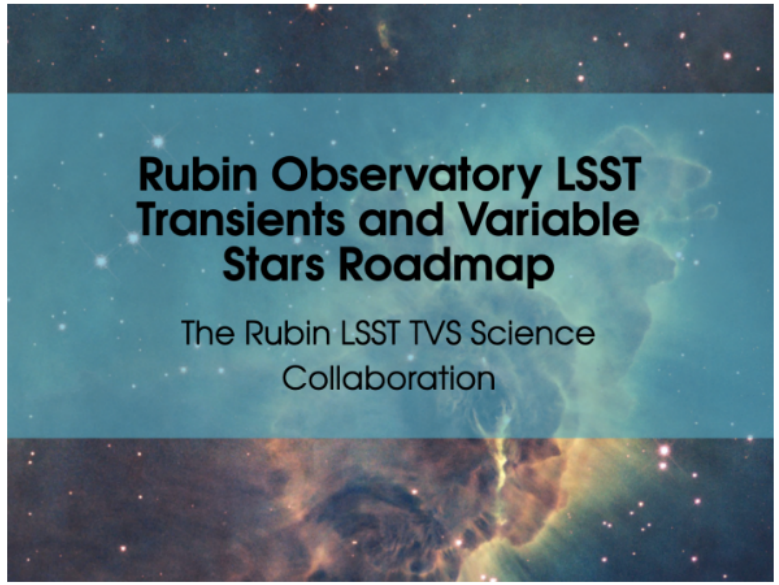
Rubin LSST Science Collaborations

MARCH 2023

TVS WELCOMES ITS NEW CO-CHAIRS
IGOR ANDREONI
AND SARA BONITO!!

TVS ROADMAP TO SCIENCE

https://arxiv.org/abs/2208.04499

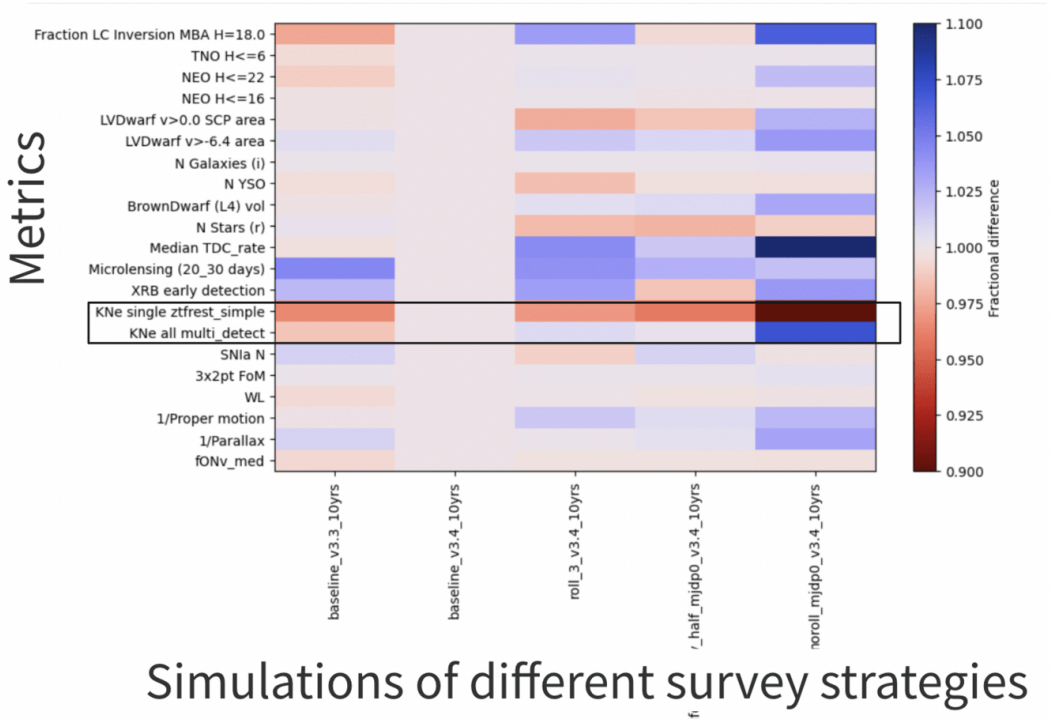


TVS Science Collaboration

Fast Transient Subgroup

join TVS! no fees no minimum req

Chair: Igor Andreoni



<= worse - better =>

The kilonova metric is used by the SCOC to track the science throughput on all fast and rare transients, not only KNe

Shar Daniels

NSF Graduate Student Fellow

University of Delaware

Rubin LSST Science Collaborations

LSST TVS workshop 2018

Large Synoptic Survey Telescope Corporation

Transients and Variable Stars workshop

Naples April 9-11, 2018

INAF – Osservatorio Astronomico di Capodimonte

Large Synoptic Survey Telescope

LSST - Large Synoptic Survey Telescope - Special Programs Workshop

8-10 October 2018
Palazzo dei Normanni
Palermo, Italy

https://lsstdiscoveryalliance.org/

15-Apr-2025

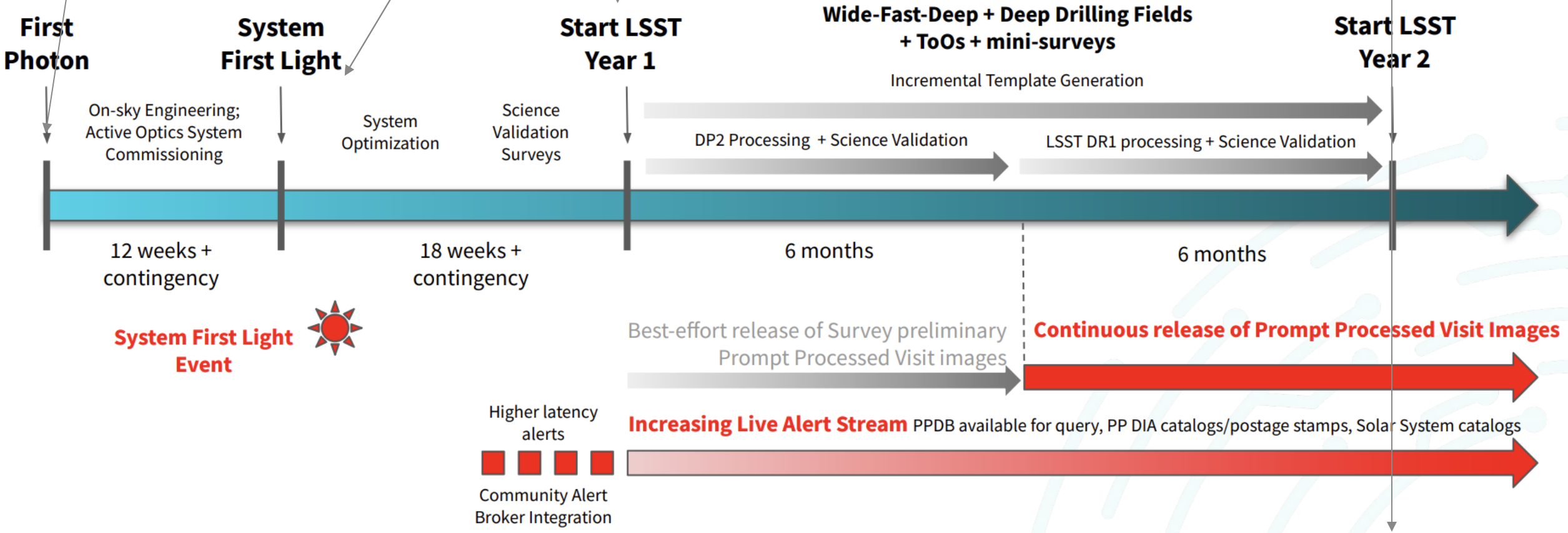
04-Jul-2025

~6-9 months

alerts build up

first data release ~1.5-2y from now

The First Look press conference is tentatively scheduled for June 17 2025



Data Preview 1
Subset of DRP processed visit images from System First Light to familiarize community with a small amount of on-sky data

All current-draft construction tech notes on science performance available

Data Preview 2
DRP coadd images, objects, DIA catalogs, forced sources; Commissioning science validation data
Science Performance Construction Papers Complete

LSST DR1
Data Release Processing from first 6 months of LSST

ls.st/dates

thank you!

federica bianco

Rubin Construction

Deputy Project Scientist

University of Delaware | Biden School of Public Policy and Administration

Department of Physics and Astronomy | Data Science Institute

fbianco@udel.edu

https://slides.com/federicabianco/padova25bianco

Rubin Observatory

Site: Cerro Pachon, Chile

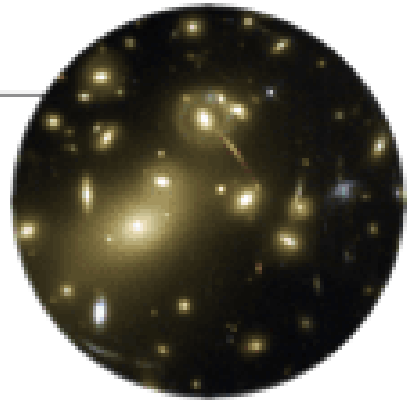
Funding: US NSF + DOE

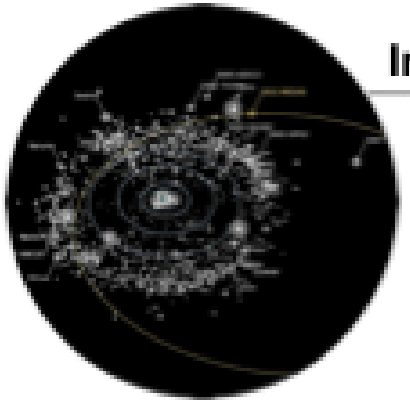
LSST Science Drivers

Four science programs as the key drivers of the science requirements

Probing Dark Matter & Dark Energy

- Strong & Weak Lensing
- Large Scale Structure
- Galaxy Clusters, Supernovae



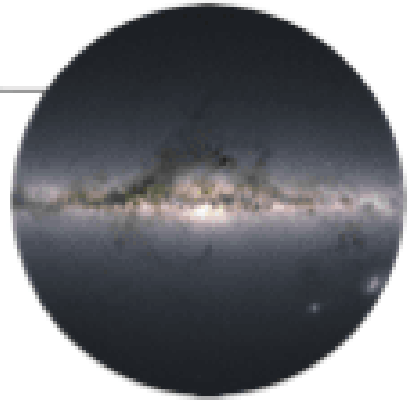


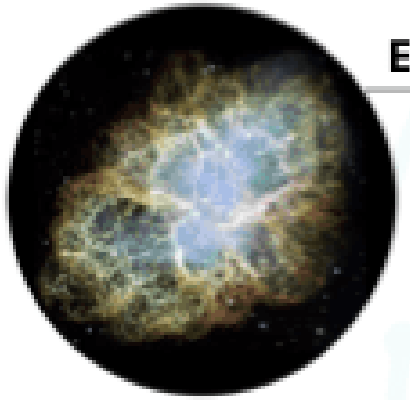
Inventory of the Solar System

- Comprehensive small body census
- Comets & ISOs
- Planetary defence

Mapping the Milky Way

- Structure and evolutionary history
- Spatial maps of stellar characteristics
- Reach well into the halo





Exploring the Transient Optical Sky

- Variable stars, Supernovae
- Fill in the variability phase-space
- Discovery of new classes of transients

Objective: provide a science-ready dataset to transform the 4 key science area

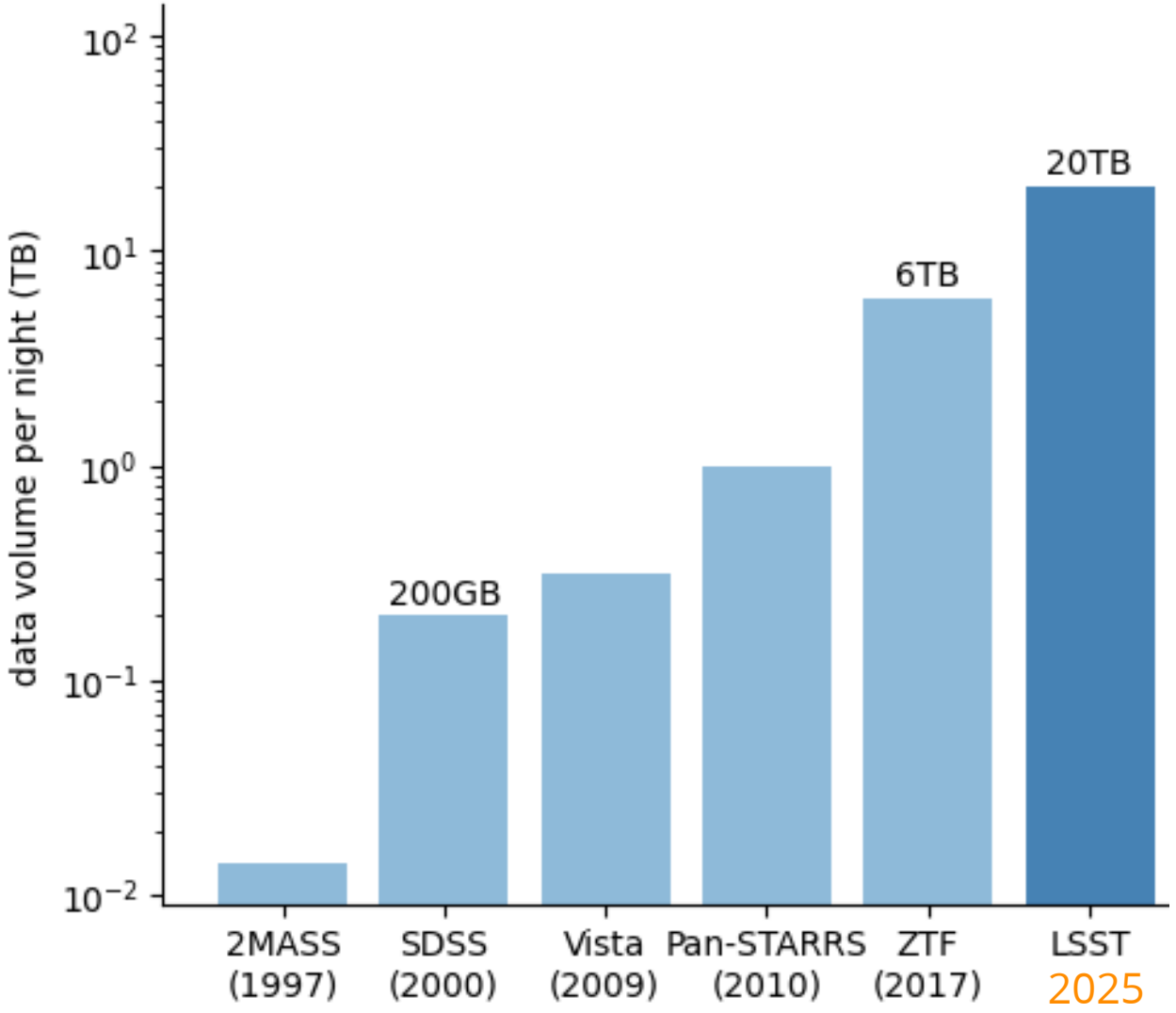
To accomplish this, we need:

1) a large telescope mirror to be sensitive - 8m (6.7m)

2) a large field-of-view for sky-scanning speed - 10 deg2

3) high spatial resolution, high quality images - 0.2''/pixels

4) process images in realtime and offline to produce live alerts and catalogs of all 37B objects



At this level of precision,everything is variable, everything is blended, everything is moving.

Field of View'	**9.6 sq deg**
Image resolution'	**0.2'' (seeing limited)**
DDFs'	5 DDF
Standard visit'	30 sec
Photometric precision'	5 mmag
Photometric accuracy'	10 mmag
Astrometric precision'	10 mas
Astrometric accuracy'	50 mas

' requirement: ls.st/srd

*simulation pstn-054.lsst.io

LSST-like HSC composite

At this level of precision,everything is variable, everything is blended, everything is moving.

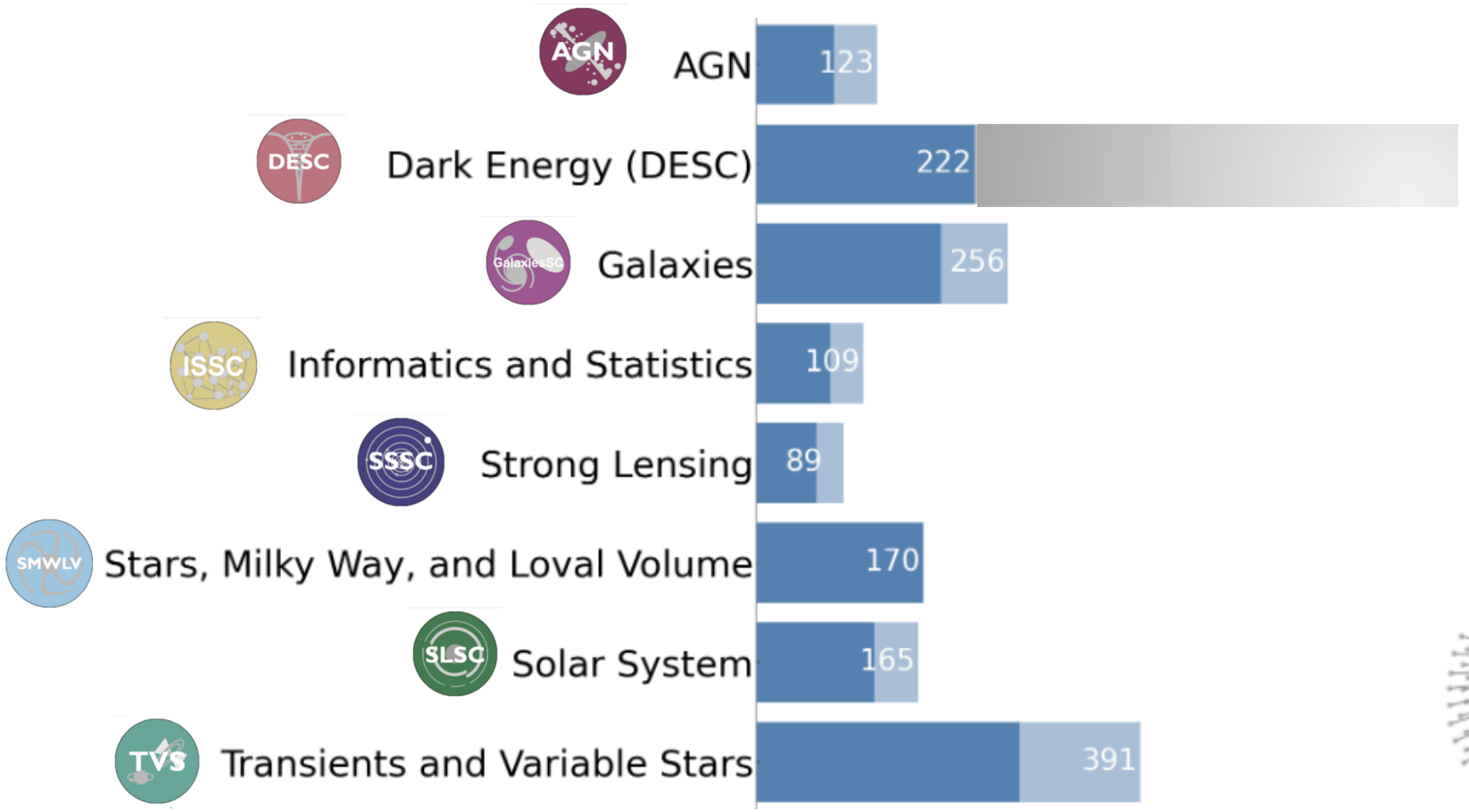
	u,g,r,i,z,y
Photometric filters'	**u, g, r, i, z, y**
saturation limit'	~15, 16, 16, 16, 15, 14
# visits*	53, 70, 185, 192, 168, 165
mag single image*	**23.34, 23.2, 24.05, 23.55 22.03**
mag coadd*	25.4, 26.9, 27.0, 26.5, 25.8, 24.9
Nominal cadence	**2-3 visits per night**

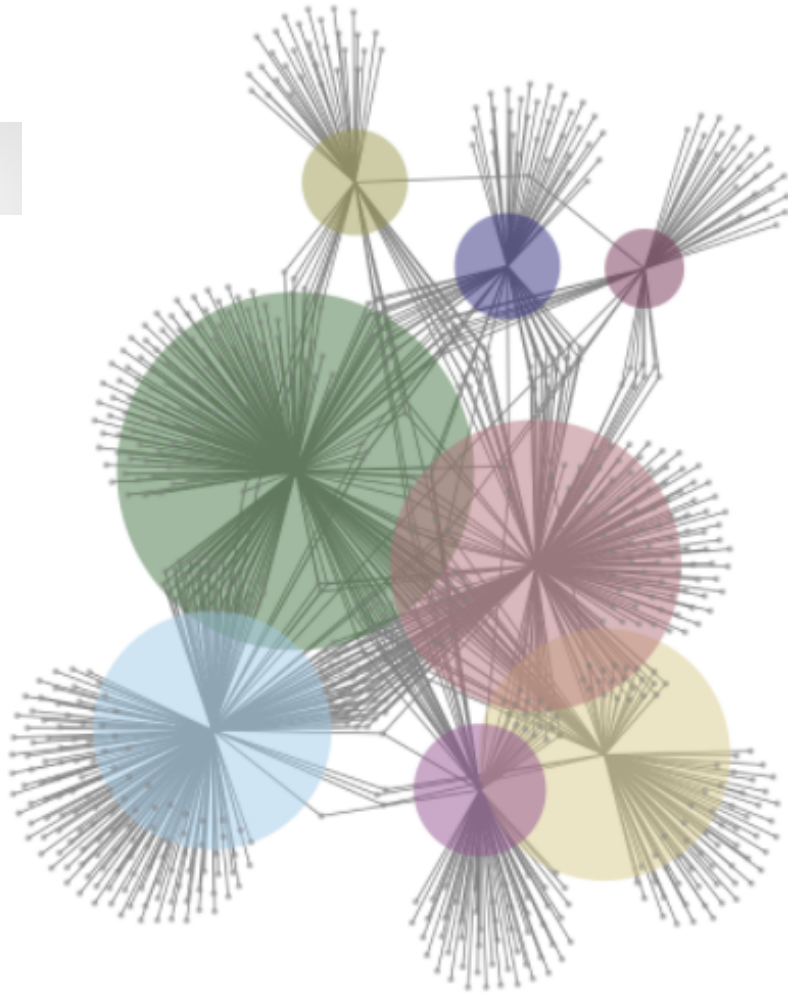
MYSUC (Gawiser 2014) 1 mag shallower than LSST coadds

' requirement: ls.st/srd

*simulation pstn-054.lsst.io

Rubin LSST Science Collaborations





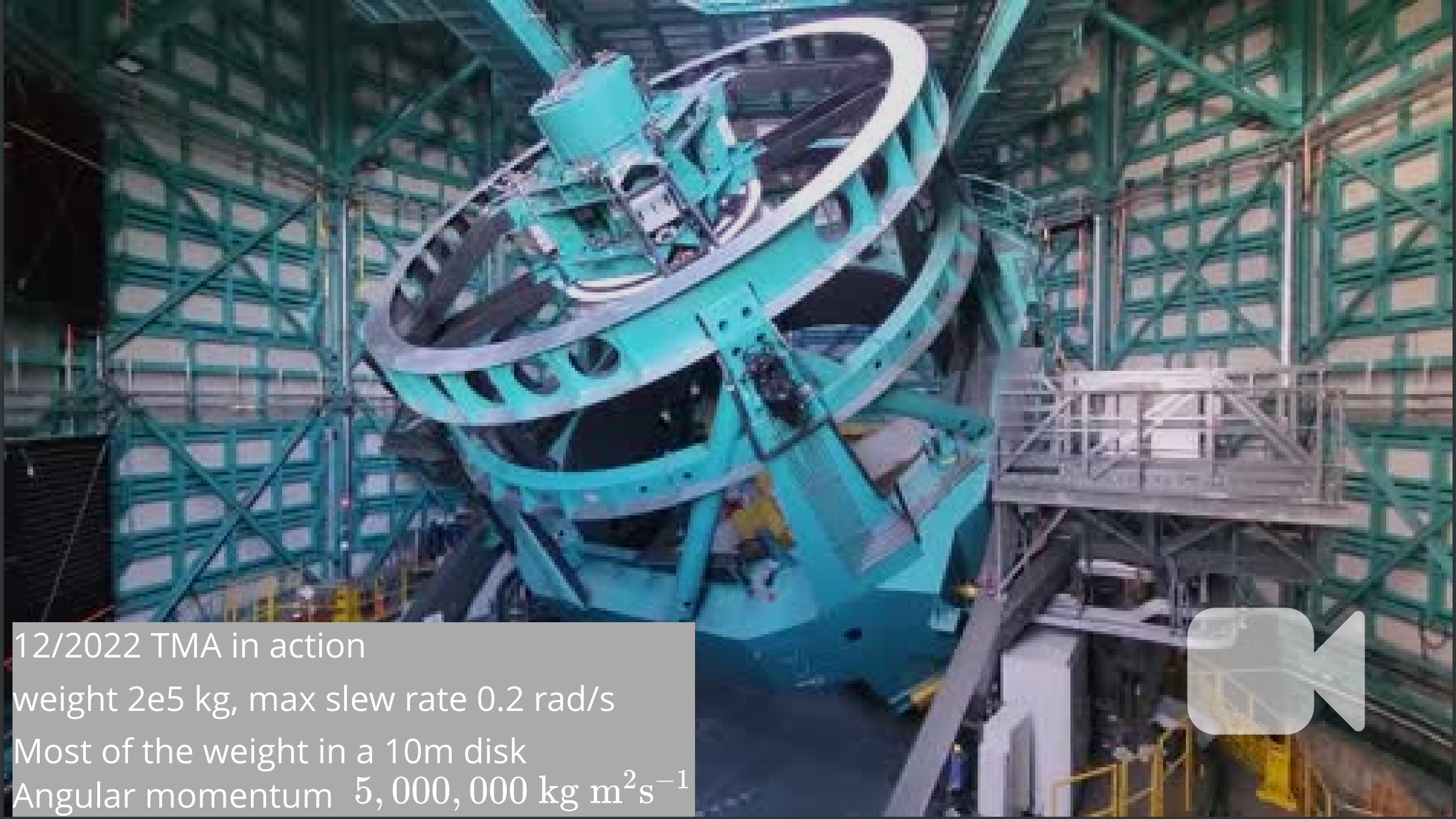
number are quite a bit larger now! this plot is from ~2022

on the right is a connectivity network for the SCs

Rubin Observatory Status


5 / 2019

May 2022 - Telescope Mount Assembly



12/2022 TMA in action

weight 2e5 kg, max slew rate 0.2 rad/s

Most of the weight in a 10m disk

Angular momentum $5,000,000\ \mathrm{kg\ m^2 s^{-1}}$

The DOE LSST Camera - 3.2 Gigapixel

3024 science raft amplifier channels

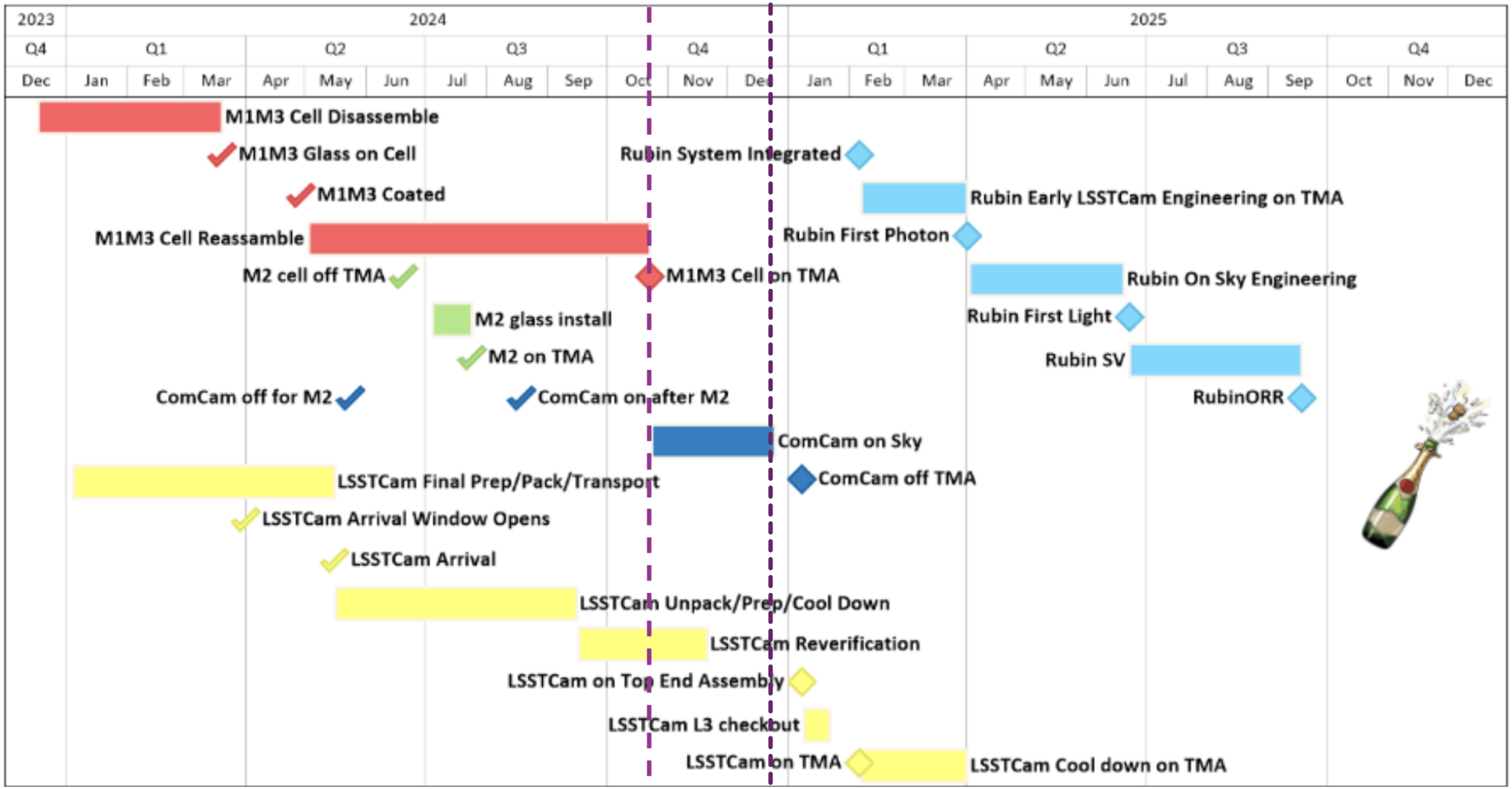
Camera and Cryostat integration completed at SLAC in May 2022,

Shutter and filter auto-changer integrated into camera body

LSSTCam undergoing final stages of testing at SLAC


Sphere Entertainment
INSIDE
The Company behind the
$2.3 billion concert venue ...

July 2024 ComCam installed on the telescope after M1M2 installation - Comcam is a 144Mpix version of LSSTCam


2023
2024
2025
Q4
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M1M3 Cell Disassemble
M1M3 Glass on Cell
M1M3 Coated
M1M3 Cell Reassamble
M2 cell off TMA
M1M3 Cell on TMA
M2 glass install
M2 on TMA
ComCam off for M2
ComCam on after M2
ComCam on Sky
LSSTCam Final Prep/Pack/Transport
ComCam off TMA
LSSTCam Arrival Window Opens
LSSTCam Arrival
LSSTCam Unpack/Prep/Cool Down
LSSTCam Reverification
LSSTCam on Top End Assembly
LSSTCam L3 checkout
LSSTCam on TMA
Rubin System Integrated
Rubin Early LSSTCam Engineering on TMA
Rubin First Photon
Rubin On Sky Engineering
Rubin First Light
Rubin SV
RubinORR
LSSTCam Cool down on TMA

artist (me) impression of the first image taken by ComCam

rgill Ranpal GIll LSST

Versión en Español más abajo

All,

What an incredible milestone we've reached together! Last night, on October 24, 2024, we passed our first end-to-end engineering test, marking a historic moment for all of us. Using the Commissioning Camera, we successfully captured and transferred our first on-sky data from Chile to the US Data Facility at SLAC. The excitement in the control rooms and online was electric, as decades of dedication and innovation came to life. Look out for the public announcement coming soon.

VERA C. RUBIN OBSERVATORY | Community forum

https://community.lsst.org/c/news/7

On-sky Commissioning Updates

News commissioning-update

bechtol Keith Bechtol LSST Nov 1

During the periods of on-sky commissioning using the Commissioning Camera (ComCam) and LSST Camera (LSSTCam), Rubin Observatory plans to share brief technical updates on the progress of on-sky commissioning activities with the Rubin science community on a roughly weekly cadence. These posts complement existing communications products.

Posts will appear on the LSST Community forum in the “News” category with the “commissioning-update” tag and on the LSSTC Slack workspace in the new #commissioning-updates channel.

telescope's optical alignment close to optimal and the system delivering an image quality of around 1.5 arcseconds.

The Data Management system effectively processed images, providing astrometric and photometric solutions.

2024-11-01 On-sky Commissioning Update

News commissioning-update

bechtol Keith Bechtol LSST Nov 1

As announced 3, on Thursday 24 October 2024, on-sky data taking began with the engineering test camera for commissioning (ComCam) installed on the Simonyi telescope 3. In a complicated system, many hardware and software systems must work all together. Decades of effort paid off: the telescope optical alignments were remarkably close to optimal before even looking at the sky, with the ComCam focal plane within about 1mm of being in-focus, and the initial model for gravity-induced distortions of the mirror, which are compensated by the active optics system (AOS), was enabled and used to refine the focus and alignment. The system was soon delivering a total image quality around 1.5 arcsec, even with most of the optical adjustments and environmental controls not yet fully in place. The Data Management system has successfully processed a subset of in-focus images through single-frame measurement to provide initial astrometric and photometric solutions for individual visit images within minutes of acquiring the exposures.

We have many months of effort and challenges ahead, but the experience during the first week of ComCam on-sky commissioning bodes well. The highest-priority activity of the coming weeks is to commission the AOS so that it runs automatically and reliably in this real environment.

AOS commissioning successfully running the system in a closed-loop configuration.

Continuous improvements in image quality were observed, achieving sub-arcsecond PSF FWHM

2024-11-08 On-sky Commissioning Update

News commissioning-update

bechtol Keith Bechtol LSST 25d

Progress continued during the second week of on-sky commissioning with ComCam. Per plan, the main emphasis in this period is on Active Optics System (AOS) commissioning. Early in the week, the end-to-end system was successfully run in a closed loop configuration (triplets of intra-focal, extra-focal, and in-focus images; wavefront analysis; apply recommended updates to telescope parameters; iterate) for rigid body as well as a subset of mirror figure bending mode degrees of freedom. This marks an important achievement by the team. Significant time was also spent verifying the wavefront response to applying various optical degrees of freedom. Over time, the delivered image quality continued to improve, demonstrating the capability to deliver sub-arcsecond PSF FWHM, even with many of the optical adjustments and environmental controls not yet fully in place.

As the delivered image quality becomes more stable, the team is beginning to take sets of repeated visits of a given field with focal-plane-scale dithers around a pointing center for science pipelines commissioning. The data management system has begun testing the internal astrometric solution and image coaddition with the on-sky ComCam data.

Most of the earlier data taking was in r-band, and now other bands (g and i) are also in the rotation.

In the coming weeks, the emphasis will continue to be on AOS commissioning and making the whole system run more efficiently. The current plan is to continue on-sky ComCam data taking through mid-December.

2024-11-15 On-sky Commissioning Update

News commissioning-update

bechtol Keith Bechtol LSST 18d

Active Optics System (AOS) commissioning continues as a main area of emphasis in the third week of the on-sky commissioning campaign with ComCam. The AOS system for the Simonyi Telescope includes two control loops. An open control loop uses a look-up table to make predictable adjustments for the optical degrees of freedom based on telescope elevation, temperature, and potentially other variables. A closed control loop uses wavefront sensing from out-of-focus “donut” images to make additional refinements between successive exposures. This week, closed-loop control using bending mode degrees of freedom for both the primary-tertiary (M1M3) and secondary mirror (M2) optical surfaces simultaneously was demonstrated. Using iterations of wavefront estimation and application of the computed corrections, the team observed steady convergence towards improved delivered image quality. PSF FWHM at the level of 0.7" was achieved on multiple nights. As noted in previous updates, environmental controls are not yet fully in place, and the current tests are using a subset of the AOS degrees of freedom.

Observations for Science Pipelines commissioning continued in parallel, interleaved with AOS commissioning. The ComCam filter exchanger holds three filters at a time. Over the course of the past week, the g filter was exchanged for u, and then u and for z as the moon approached full. An initial set of roughly 20-30 visits were acquired for each of the ugriz bands within an area of approximately 1 square degree located within the LSST Deep Drilling Field Extended Chandra Deep Field-South. Early tests of difference image analysis were carried out using observations in the same field in the same band across multiple nights. This dataset has also enabled early tests of the internal photometric calibration, showing encouraging results, even without a full set of calibration data products.

The telescope motion has also increased this week as testing and analysis demonstrates control of the inertial forces experienced by the mirrors during slews from one telescope position to another. Looking ahead, the team plans to test the AOS across a broader range of telescope elevation and azimuth angles to verify the open control loop and examine the closed loop performance across a wider range of conditions. This increased observing efficiency would also allow Science Pipelines commissioning observations to consider targeting a small set of fields in a preliminary survey mode.

achieving PSF FWHM of 0.7" on several nights.

Observations for science pipeline commissioning continued, including filter exchanges and initial tests of difference image analysis and photometric calibration.

2024-11-22 On-sky Commissioning Update

News commissioning-update

bechtol Keith Bechtol LSST 11d

It is the fourth week of on-sky commissioning with ComCam, and we are now about halfway through the planned duration of the campaign.

Active Optics System (AOS) commissioning continues to test both the closed loop and open loop systems. The AOS closed loop is now running with more than 90% of the optical degrees of freedom enabled, including the camera and secondary mirror (M2) hexapods that control the rigid-body relative positioning of the optics, and all of the lower order bending modes for the primary-tertiary mirror (M1M3) and M2 optical surfaces. Tests have been performed to evaluate the closed-loop convergence, for example, using shorter exposure times, adjusting the gain of the control loop to converge quickly while avoiding overfitting with noisy measurements, using various approaches to optimize image quality while avoiding movement along degenerate degrees of freedom, and using an alternative wavefront estimation algorithm that requires observations on only one side of focus. The team has begun scans in telescope elevation to verify the open loop look-up tables. Collectively, these tests are gradually making the AOS more efficient and reliable across a range of conditions.

Science Pipelines commissioning observations are continuing as opportunities allow between the AOS tests. Filter exchanges for ComCam are occurring roughly once per week, coinciding with routine mirror cleaning. This week, the z filter was exchanged for y, providing the first opportunity to obtain full-color six-band ugrizy coverage of a field, the Extended Chandra Deep Field South (ECDFS) LSST Deep Drilling Field. Flux measurements of stars in this field from observations across multiple nights and a range of airmass from 1.0 to 1.4 are repeatable at the 1% level for the u band, and 0.5% level for griz, before using the full set of planned calibration systems. The repeated observations of ECDFS have also been used to build prototype templates for difference imaging tests. The Data Management System demonstrated, for the first time with ComCam data, Prompt Processing with Difference Image Analysis (DIA) running to completion and producing candidate DIA sources and associated Alerts for the purpose of internal pipeline verification and validation. Observation within a second LSST Deep Drilling Field, the Euclid Deep Field South, began this past week, and there is currently rizy band coverage. The team currently plans to exchange the y filter for g during the upcoming c time around the new moon.

One continued area of emphasis is increasing the overall efficiency and reliability during nighttime operat The shutter open efficiency time has gradually improved during the first weeks of the campaign. The teles

AOS closed loop was operating with over 90% of the optical degrees of freedom enabled.

Full-color six-band (ugrizy) coverage of the Extended Chandra Deep Field South (ECDFS) LSST Deep Drilling Field.

Flux measurements demonstrated high repeatability across multiple nights and varying airmass.

The Data Management System successfully processed data with Difference Image Analysis, producing candidate sources and alerts.

Efforts were focused on increasing operational efficiency, including shutter open efficiency and telescope motion speed.

One continued area of emphasis is increasing the overall efficiency and reliability during nighttime operations. The shutter open efficiency time has gradually improved during the first weeks of the campaign. The telescope commanded speed also continues to increase gradually, reaching up to 10% of maximum motion during the past week, while testing and analysis of the inertial forces on the mirrors continues. The slew-and-settle time will be optimized as the telescope motion increases. As telescope motion increases, tests to verify the telescope pointing model over the full range of elevation and azimuth angles will also become more efficient.

To maximize the utility of observations for Science Pipelines commissioning during the late stages of the ComCam on-sky campaign, repeated visits distributed across multiple bands will be collected for the same fields across many nights. The team has identified a set of target fields that are visible over the next weeks, and plans to concentrate the available time for preliminary survey-mode observations on these fields. Details will be described in more detail in the Rubin Observatory Plans for an Early Science Program document (RTN-011 8).

Repeated imaging in r and i bands allowed to build templates for six target fields.
First association of Solar System Object detections
A new single-night record of 99 in-focus visits taken with the automated scheduler.

2024-11-29 On-sky Commissioning Update

News commissioning-update

bechtol Keith Bechtol LSST 4d

We are now in the fifth week of on-sky commissioning with ComCam. Observations with ComCam are continuing throughout the Thanksgiving holiday week.

Earlier in the week, the pointing model for the Simonyi telescope was verified for elevation angles above 45 degrees and over the full range of azimuth angles. In parallel, the Active Optics System (AOS) commissioning effort has continued testing the open loop look-up tables, including scans of telescope elevation angles and camera physical rotator angles, along with continued testing of multiple wavefront estimation algorithms and optimization of the AOS closed loop system. Together with the increased telescope motion described in the previous update, progress along these fronts has enabled observations of more fields across the sky. Sufficient imaging in both the r and i bands to build templates for difference image analysis testing has now been acquired for six target fields spanning a range of stellar densities, and including a target field near to the ecliptic plane. This week marked the first association of Solar System Object detections across multiple individual visits in Prompt Processing. The team set a new single-night record of 99 in-focus visits taken with Feature Based Scheduler (with the remaining time during the night being used for other engineering activities, including AOS commissioning). The currently loaded filter set is gri as we enter dark time. Recall that ComCam has space for three onboard filters, compared with five for the LSSTCam.

Locations of Target Fields Observed during On-sky Commissioning Campaign with ComCam

News commissioning-update

bechtol Keith Bechtol LSST 3d

Rubin Observatory is sharing the central pointing coordinates for six target fields observed during the on-sky commissioning campaign using the Commissioning Camera (ComCam). The intent is that this information will help the science community to prepare for the Early Science Program (RTN-011 8) and will enable near-contemporaneous observations with other facilities.

The on-sky commissioning campaign with ComCam began on 24 Oct 2024 and is currently planned to conclude in mid December. Technical updates on the progress of the campaign are shared on the LSST Community Forum with the #commissioning-update 3 tag and on the LSSTC Slack on the #commissioning-updates channel.

ICRS coordinates are shared in units of decimal degrees below.

Extended Chandra Deep Field South (ECDFS)
(ra, dec) = (53.13, -28.10)

Euclid Deep Field South (EDFS)
(ra, dec) = (59.10, -48.73)

Low Ecliptic Latitude Field (Rubin SV 38 7)
(ra, dec) = (37.86, 6.98)

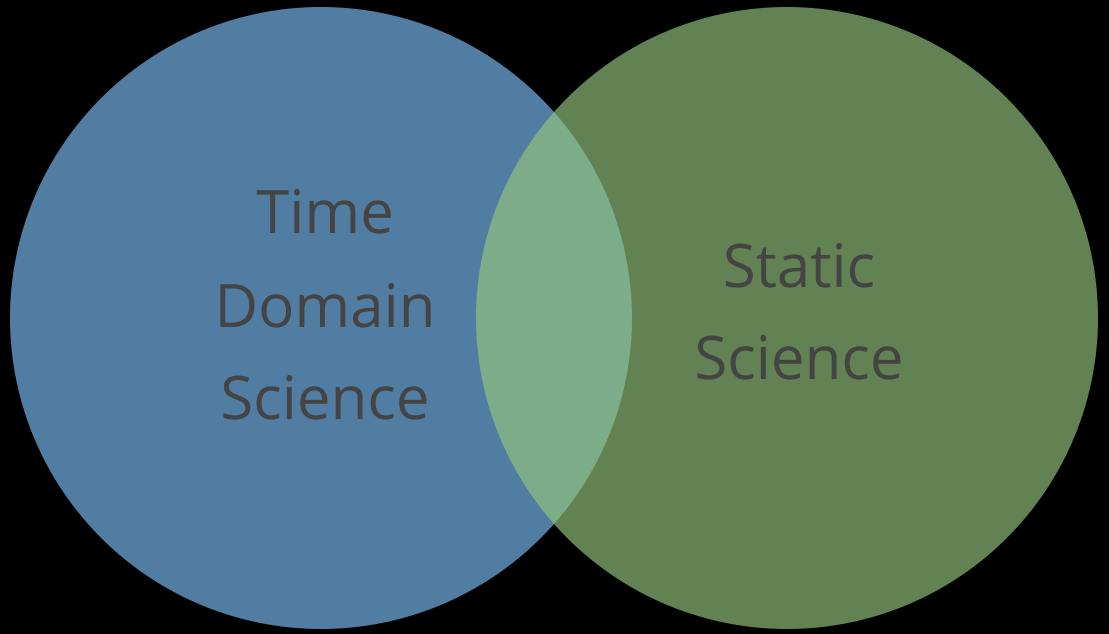
Low Galactic Latitude Field (Rubin SV 95 -25)
(ra, dec) = (95.00, -25.00)

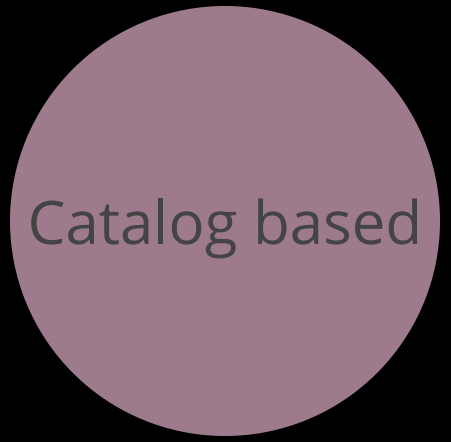
47 Tuc Globular Cluster (47 Tuc)
(ra, dec) = (6.02, -72.08)

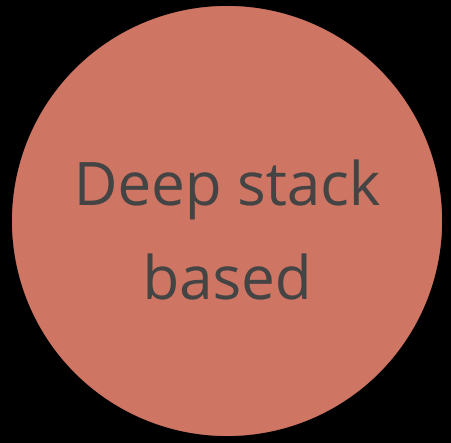
Fornax Dwarf Spheroidal Galaxy (Fornax dSph)
(ra, dec) = (40.00, -34.45)

LSST

data products





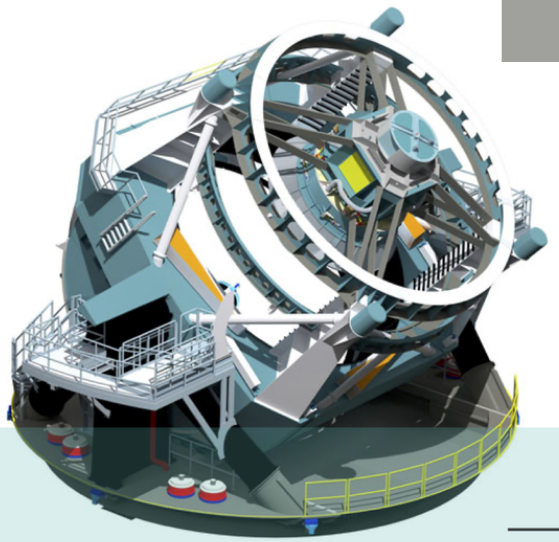


federica bianco - fbianco@udel.edu

Data Products

Raw Data: 20TB/night

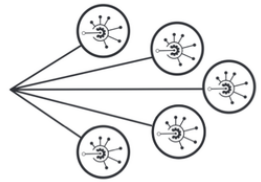
Sequential 30s images covering the entire visible sky every few days



Prompt Data Products

Alerts: up to 10 million per night

60s via nightly alert streams



Community Brokers

Raw & Processed Visit Images, Difference Images, Templates

Transient and variable sources from Difference Image Analysis

Solar System Objects: ~ 6 million

24h via Prompt Products DB

Data Release Data Products

Final 10yr Data Release:

- Images: 5.5 million x 3.2 Gpixels
- Catalog: 15PB, 37 billion objects

via Data Releases

Rubin Data Access Centres (DACs)

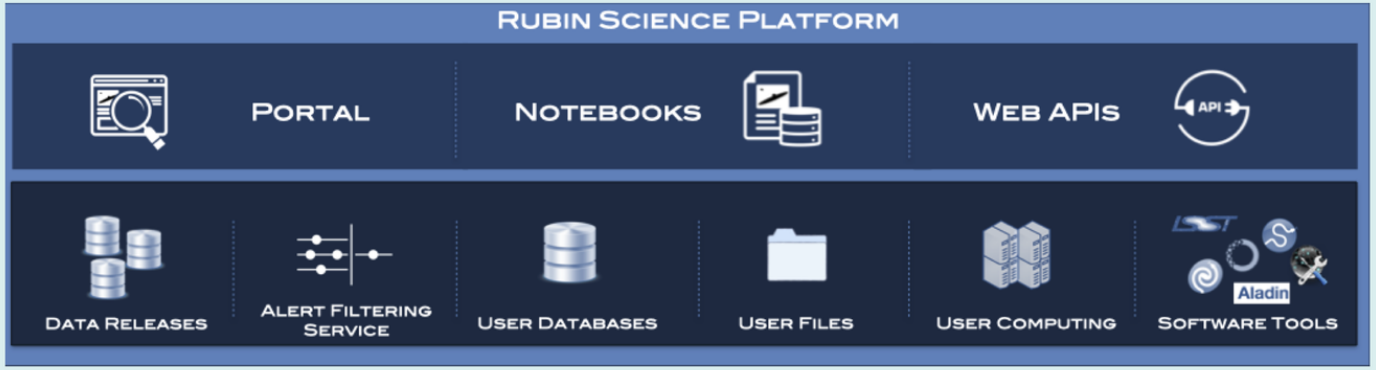
USA (USDF)
Chile (CLDF)
France (FRDF)
Uniter Kingdom (UKDF)

Independent Data Access Centers (IDACs)

Access to proprietary data and the Science Platform require Rubin data rights

LSST Science Platform

Provides access to LSST Data Products and services for all science users and project staff



redit: Leanne Guy

data right holders only

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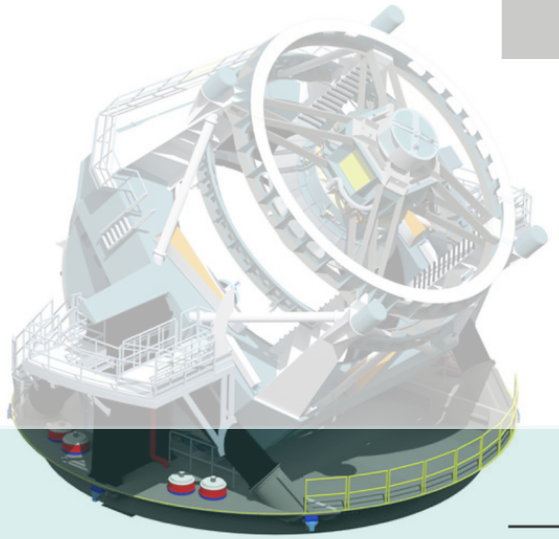

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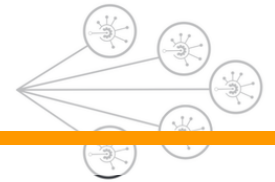

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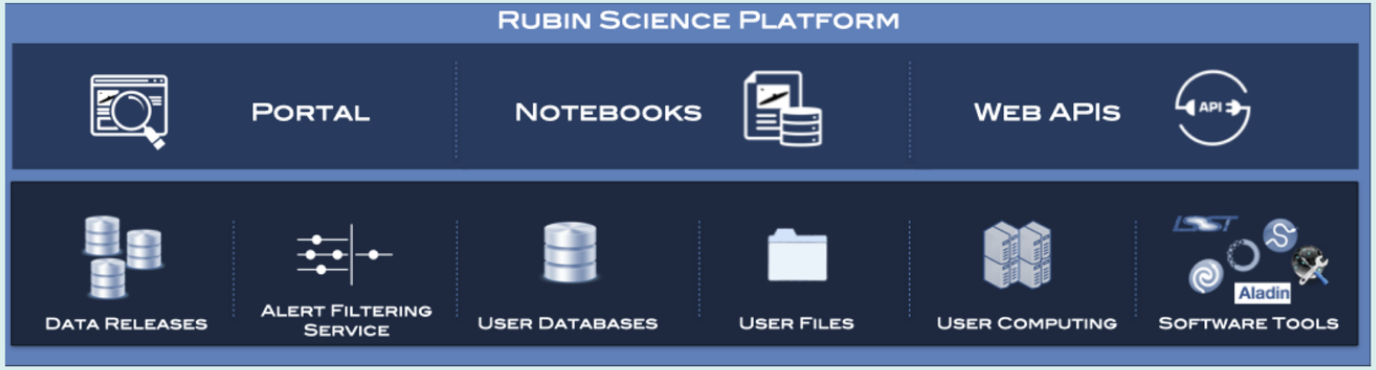


redit: Leanne Guy

Rubin In-Kind Contribution Program

https://www.lsst.org/scientists/in-kind-program

Contribution

LSST-DESC, the mexican contribution

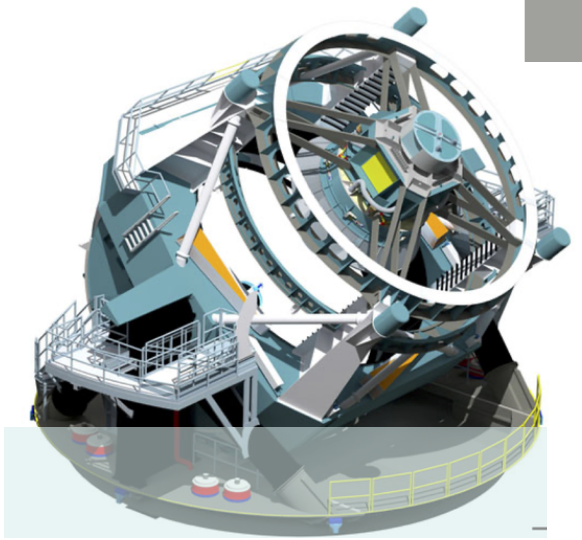
Speakers	Primary authors
Dr. Josué DE SANTIAGO	Dr. Josué DE SANTIAGO (Cinve...

Content

In the following months, the Vera Rubin Observatory will start collecting data from the cosmos. The Dark Energy Science Collaboration (DESC) will study the cosmological implications of the new data focusing in the nature of the dark energy. In particular it will use five probes, namely supernovae, galaxy clusters, large-scale structure, and weak and strong gravitational lensing. The Mexican team LSST-Mexico has gained data rights thanks to an in-kind contribution program, allowing several Mexican scientists to work with the different science collaborations in LSST. Two teams are currently working at different subjects in DESC. I will give an overview of the expected science that will be obtained from this new data.

Raw Data: 20TB/night

Sequential 30s images covering the entire visible sky every few days



Prompt Data Products

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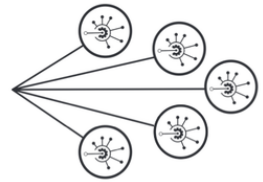
Transient and variable sources from Difference Image Analysis

Solar System Objects: ~ 6 million

← **world public!**

60s via nightly alert streams



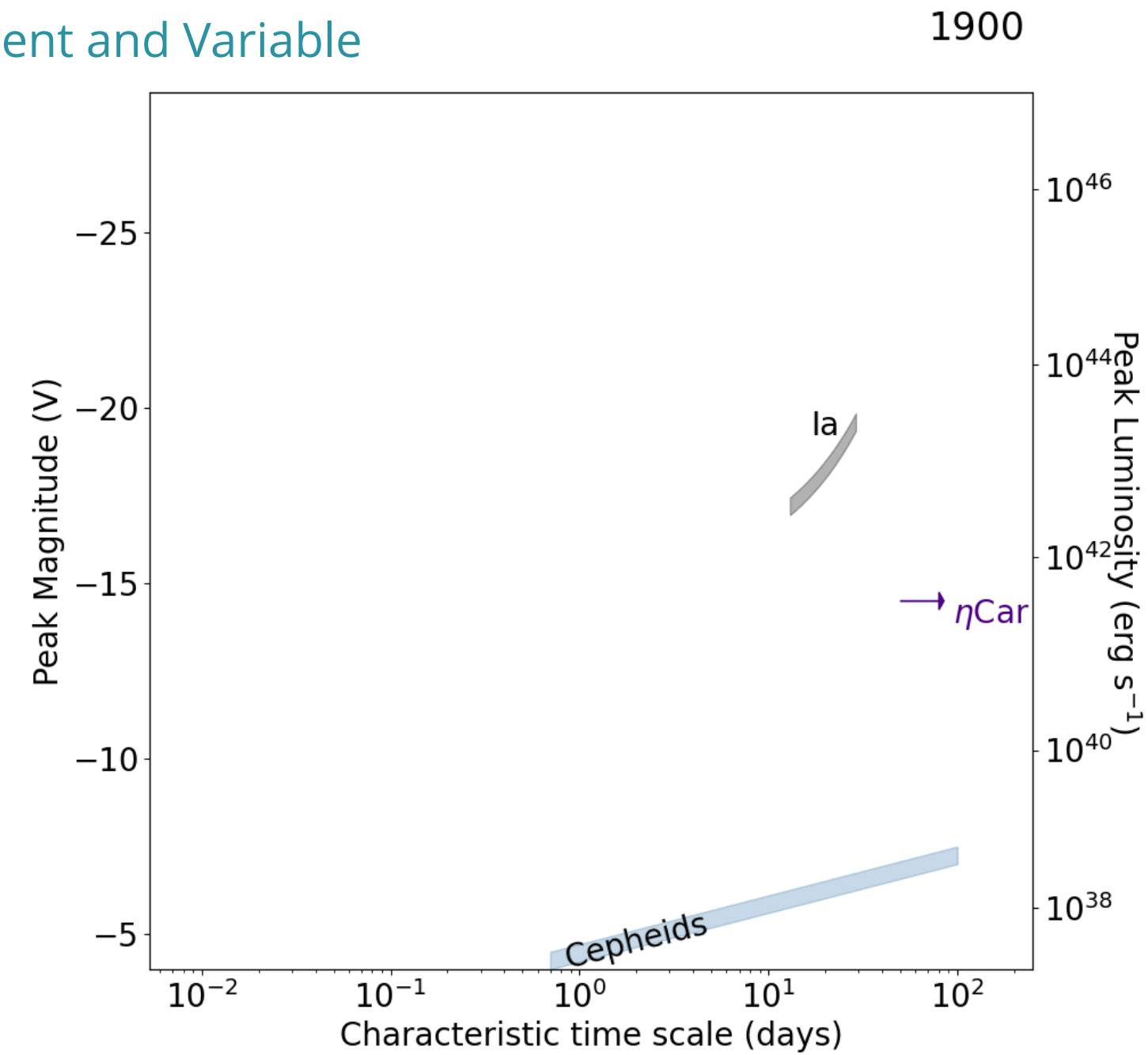
Community Brokers

10Million alerts per night!

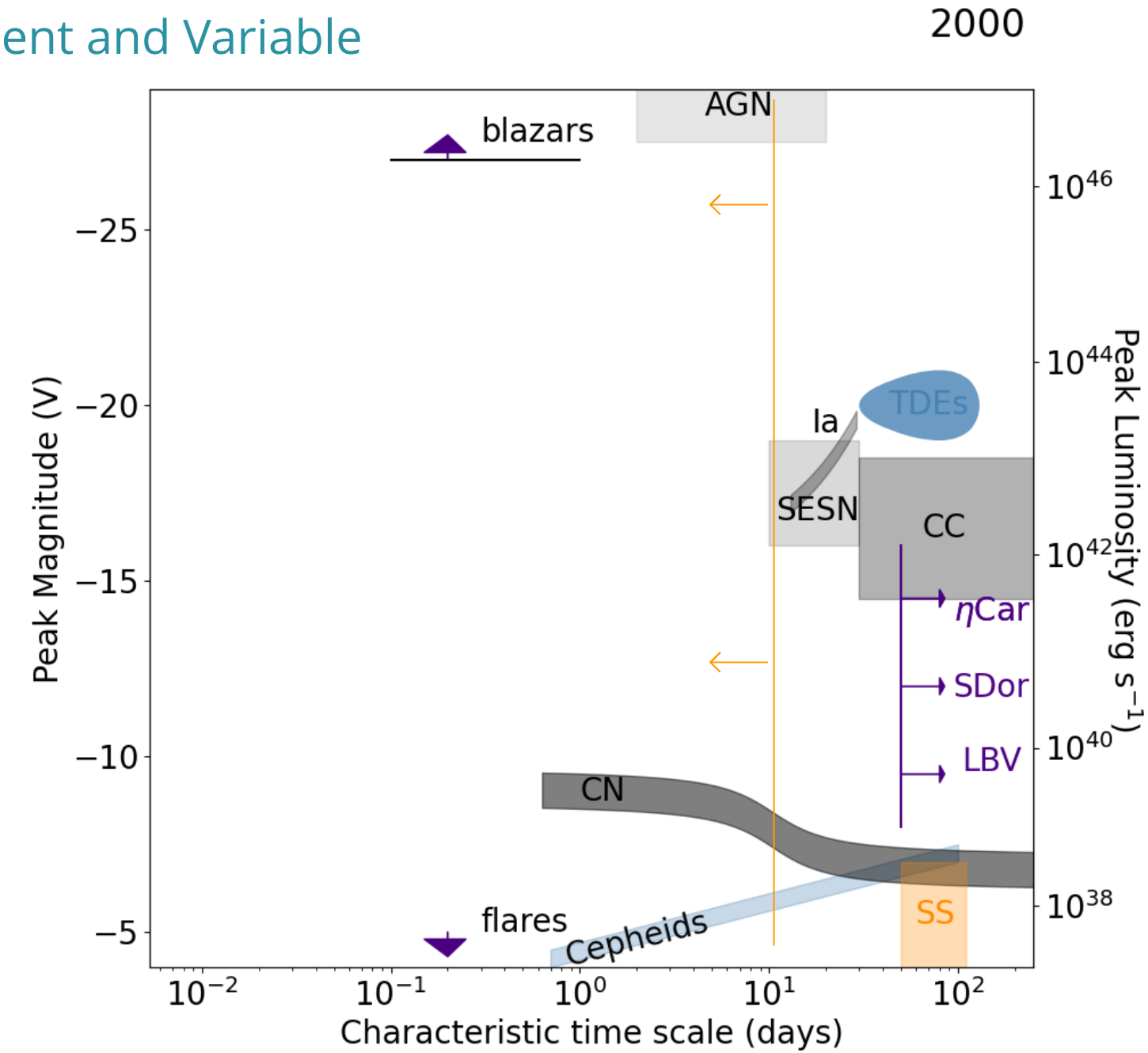
federica bianco - fbianco@udel.edu

LSST survey strategy optimization

Exploring the Transient and Variable Optical Sky



Exploring the Transient and Variable Optical Sky



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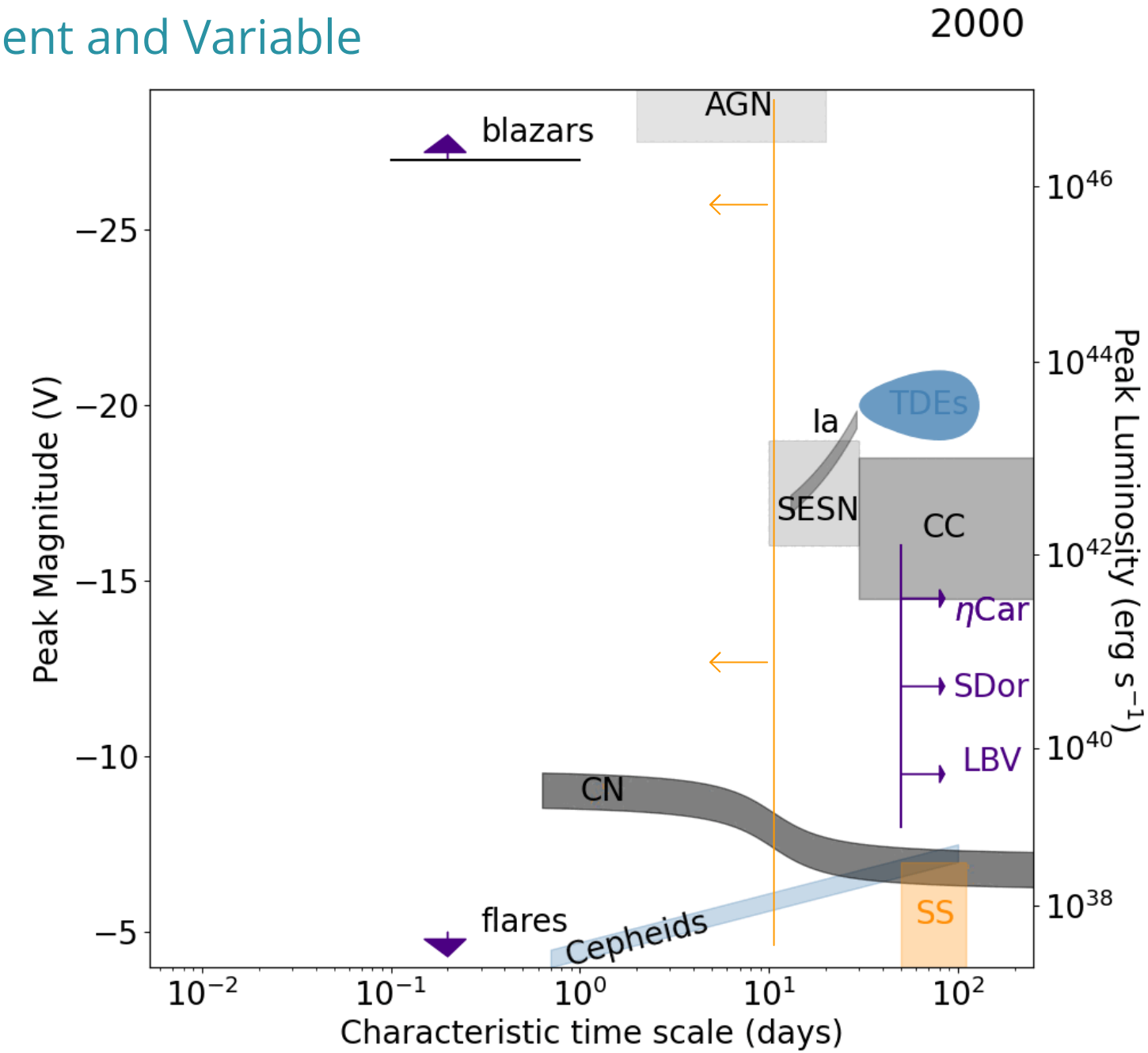

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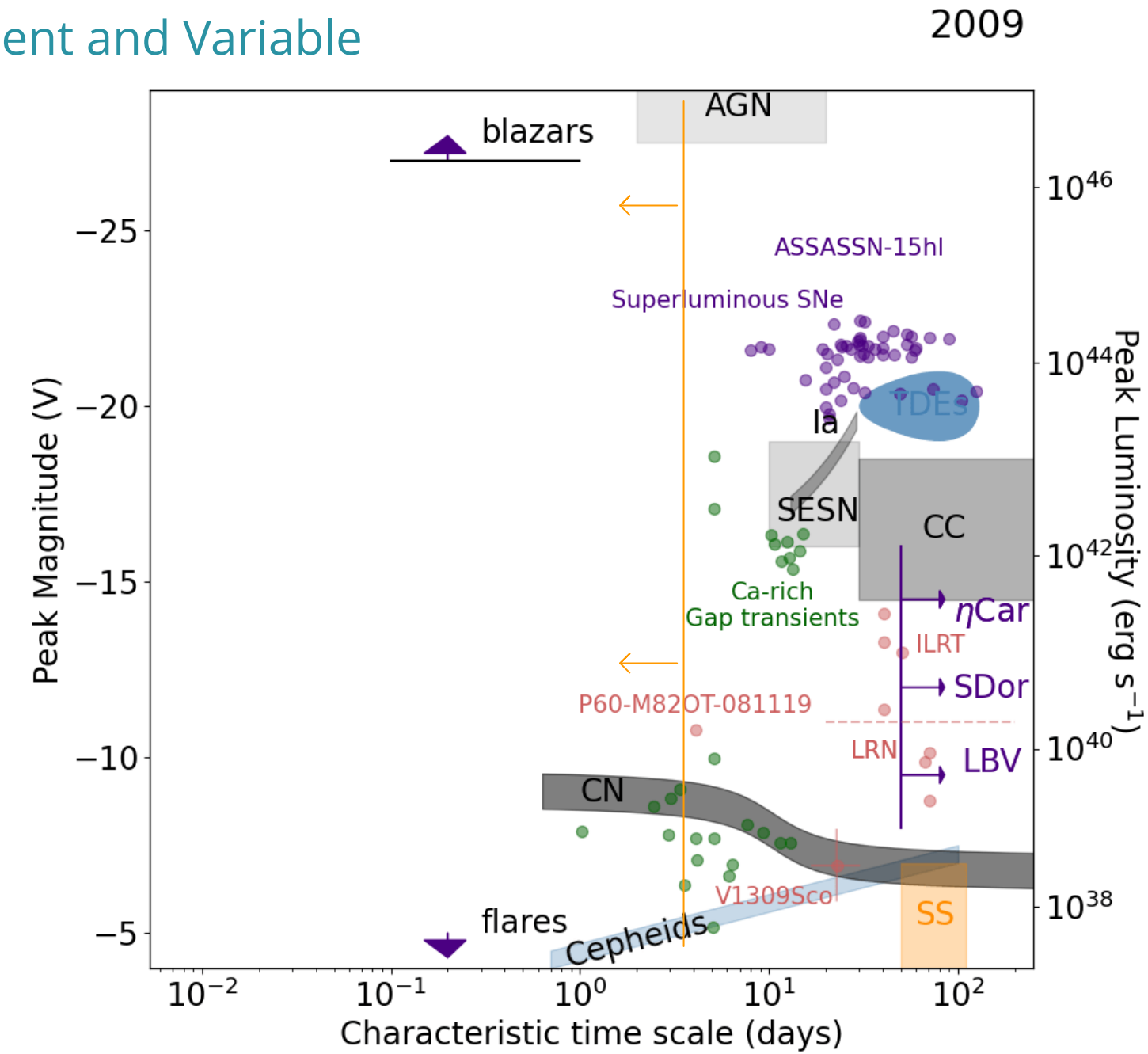

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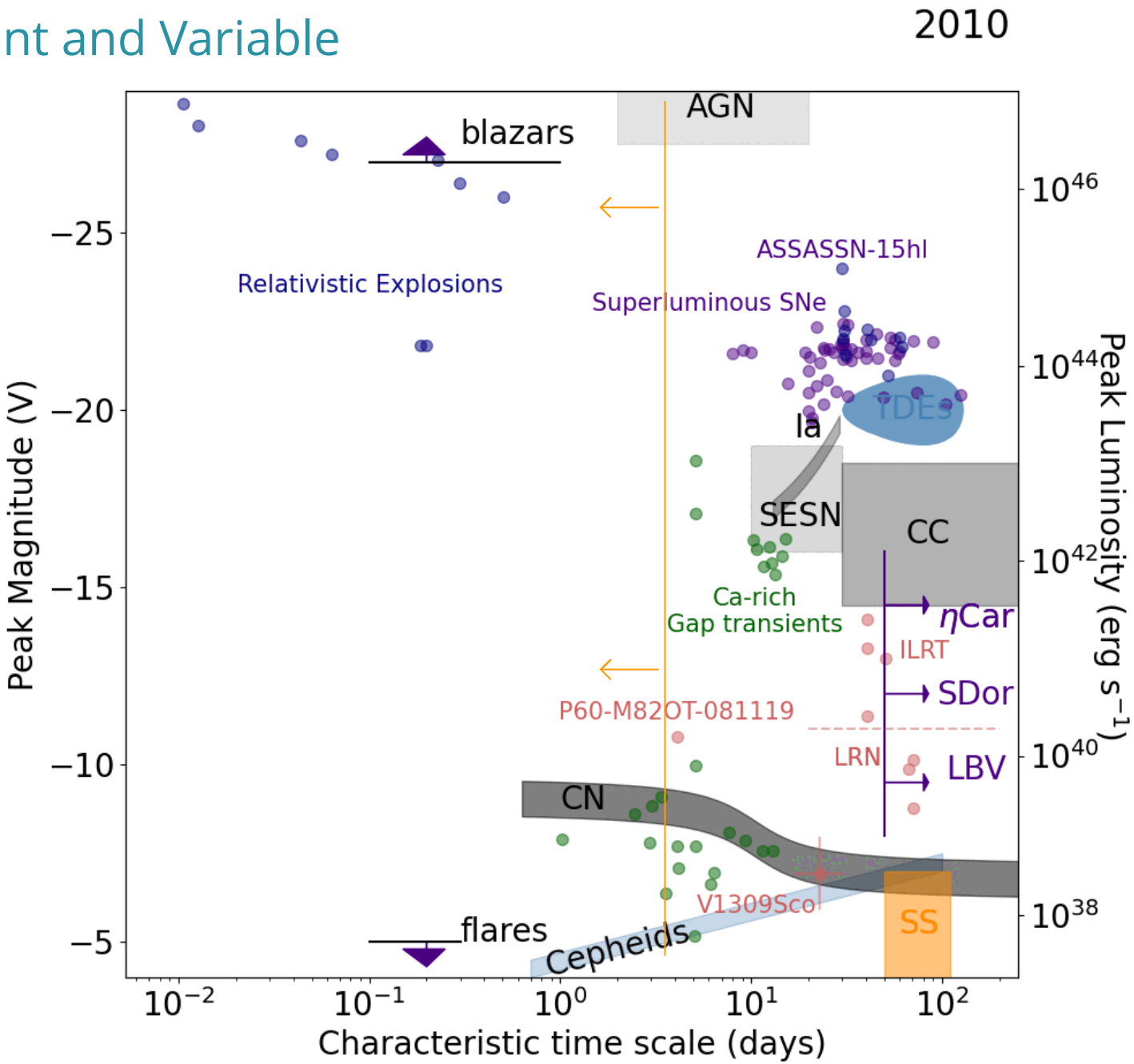

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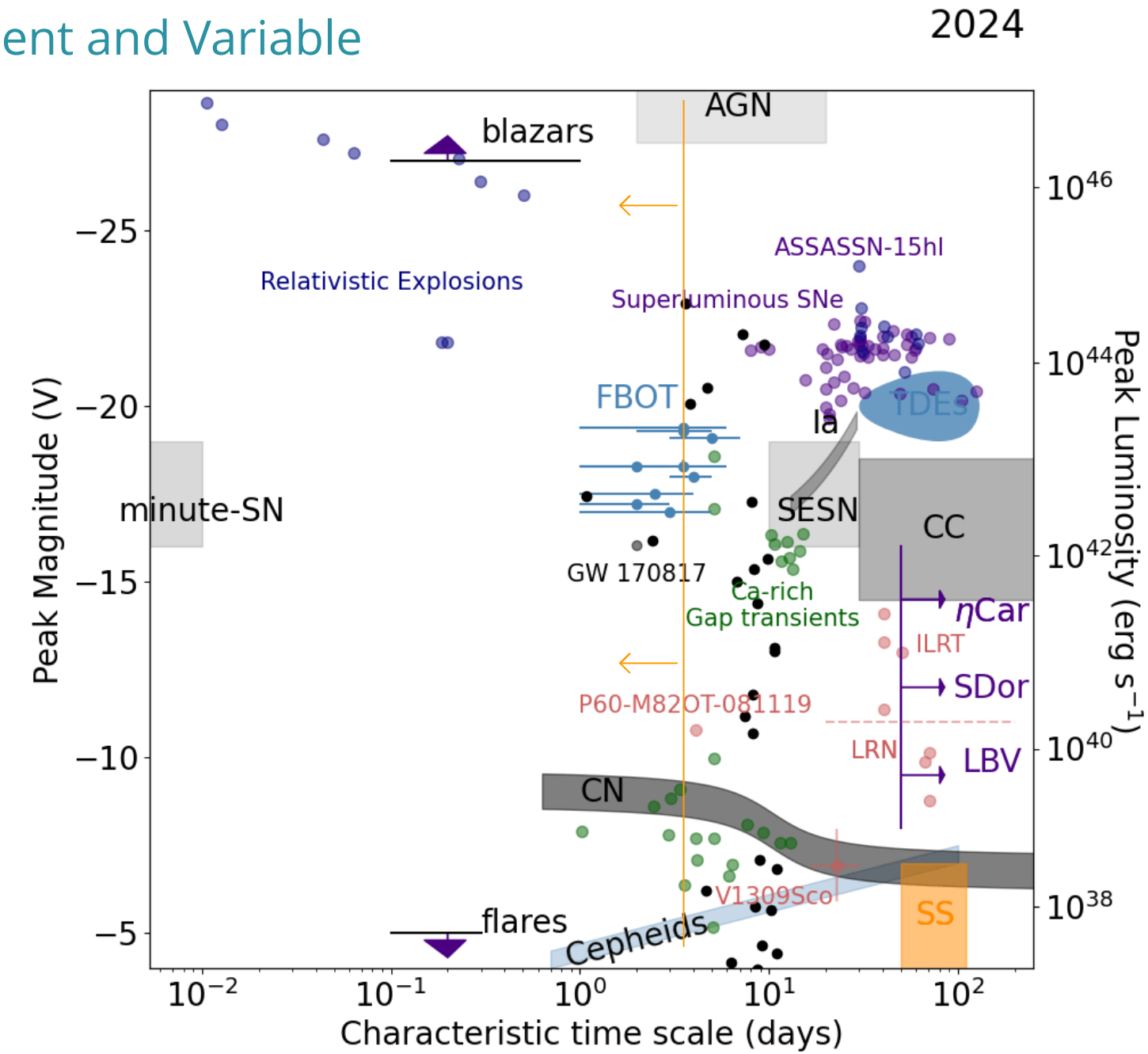

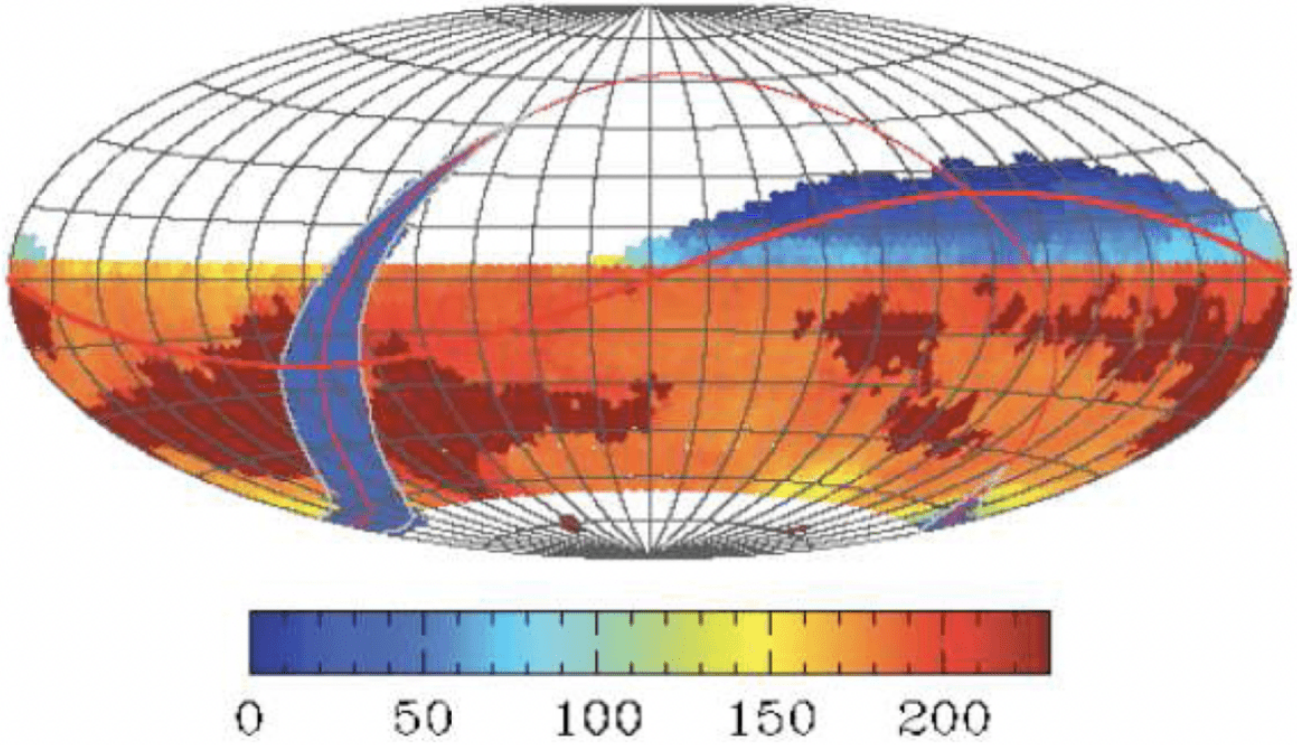

A vigorous and systematic research effort is underway to explore the enormously large parameter space of possible survey cadences, using the Operations Simulator tool described in § 3.1. The commissioning period will be used to test the usefulness of various observing modes and to explore alternative strategies. Proposals from the community and the Science Collaborations for specialized cadences (such as mini-surveys and micro-surveys) will also be considered.

LSST Science Book (2009)

Rubin LSST survey design

Operation Simulator (OpSim)

simulates the catalog of LSST observations
+ observation properties

https://www.youtube.com/embed/lihiuTTinYg?enablejsapi=1

Metric Analysi Framwork (MAF)

Python API to interact with OpSims specifying science performance on a science case with a metric

```
class KN_lc(object):
    """Read in some KNe lightcurves

    Parameters
    ----------
    file_list : list of str (None)
        List of file paths to load. If None, loads up all the files
        from data/bns/
    """

    def __init__(self, file_list=None):
        if file_list is None:
            datadir = get_data_dir()
            # Get files, model grid developed by M. Bulla
            file_list = glob.glob(os.path.join(datadir, "maf", "bns", "*.dat"))

        filts = ["u", "g", "r", "i", "z", "y"]
        magidxs = [1, 2, 3, 4, 5, 6]

        # Let's organize the data in to a list of dicts for easy lookup
        self.data = []
        for filename in file_list:
            mag_ds = np.loadtxt(filename)
            t = mag_ds[:, 0]
            new_dict = {}
            for ii, (filt, magidx) in enumerate(zip(filts, magidxs)):
                new_dict[filt] = {"ph": t, "mag": mag_ds[:, magidx]}
            self.data.append(new_dict)
```

Rubin LSST survey design

Rubin has involved the community to an unprecedented level in survey design this is a uniquely "democratic" process!

OpSim
14 sims

2014 Opsim and MAF software (Jones + 2014)

Rubin LSST survey design

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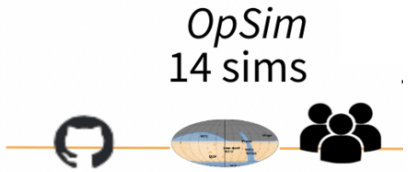


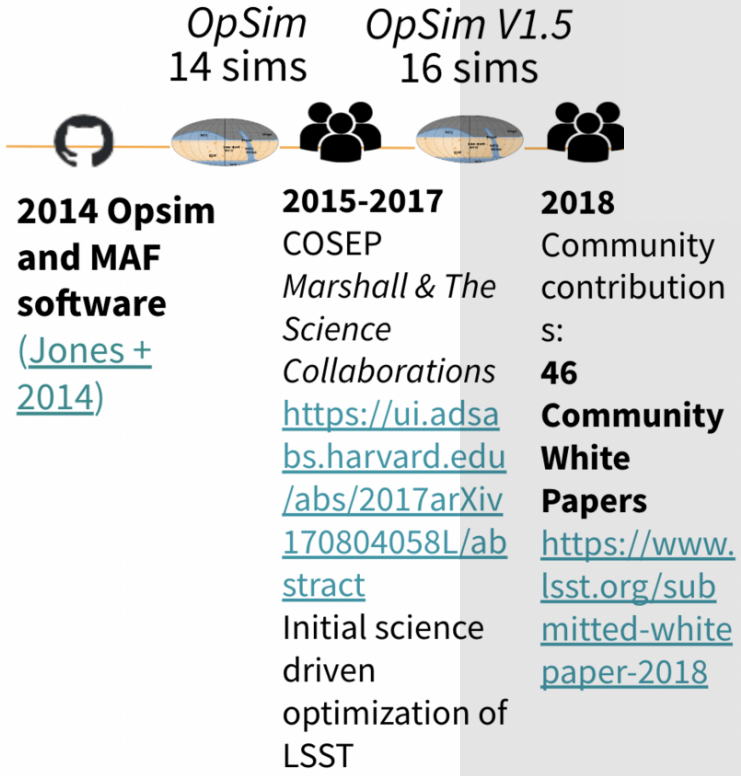
2014 Opsim and MAF software (Jones + 2014)

2015-2017 COSEP *Marshall & The Science Collaborations* https://ui.adsabs.harvard.edu/abs/2017arXiv170804058L/abstract Initial science driven optimization of LSST

Rubin LSST survey design

Rubin has involved the community to an unprecedented level in survey design this is a uniquely "democratic" process!

https://observablehq.com/embed/@f7f7156e50925896/rubin-lsst-science-collaborations-cells=chart



85% submissins led by SC members

Rubin LSST survey design

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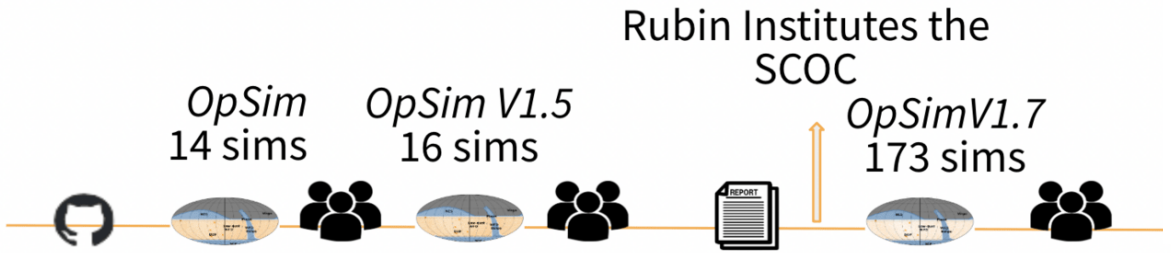
Survey Cadence Optimization Committee

https://www.lsst.org/content/charge-survey-cadence-optimization-committee-scoc



2014 Opsim and MAF software (Jones + 2014)

2015-2017 COSEP *Marshall & The Science Collaborations* https://ui.adsabs.harvard.edu/abs/2017arXiv170804058L/abstract Initial science driven optimization of LSST

2018 Community contributions: **46 Community White Papers** https://www.lsst.org/submitted-white paper-2018

5/01/2019 SAC report **baseline v1.7**

2021 Community contributions: **39 Community Cadence Notes** https://www.lsst.org/content/survey-cadence-notes-2021

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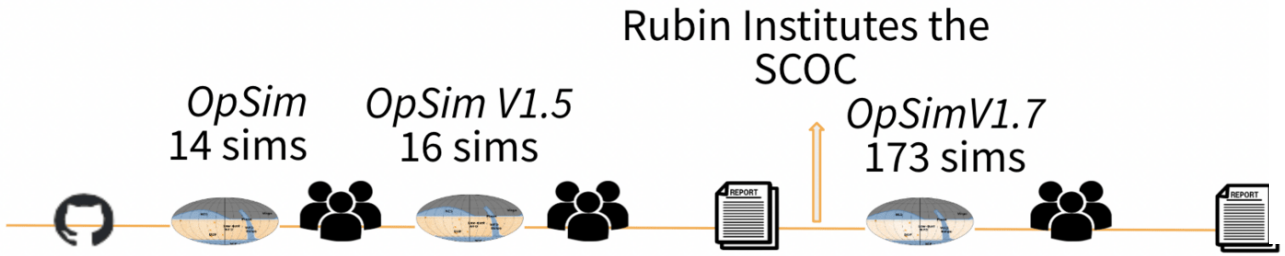

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31/12/2021 Phase 1 report released pstn-053.lsst.io **baseline v2.0** *Major changes to the footprint*

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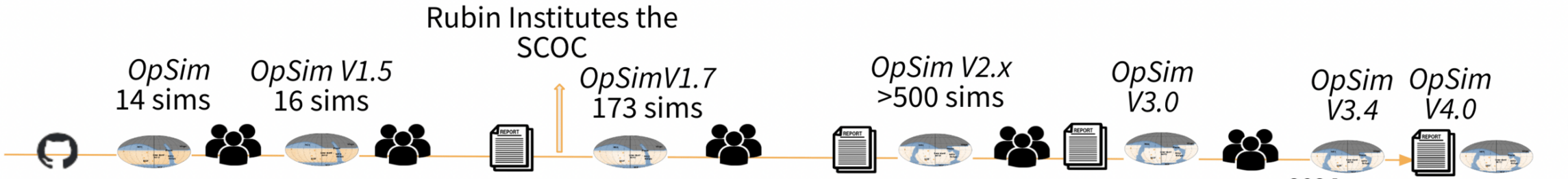

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5/01/2019 SAC report **baseline v1.7**

2021 Community contributions: **39 Community Cadence Notes** https://www.lsst.org/content/survey-cadence-notes-2021

31/12/2021 Phase 1 report released pstn-053.lsst.io **baseline v2.0** *Major changes to the footprint*

31/12/2022 Phase 2 report released pstn-055.lsst.io **baseline v3.0**

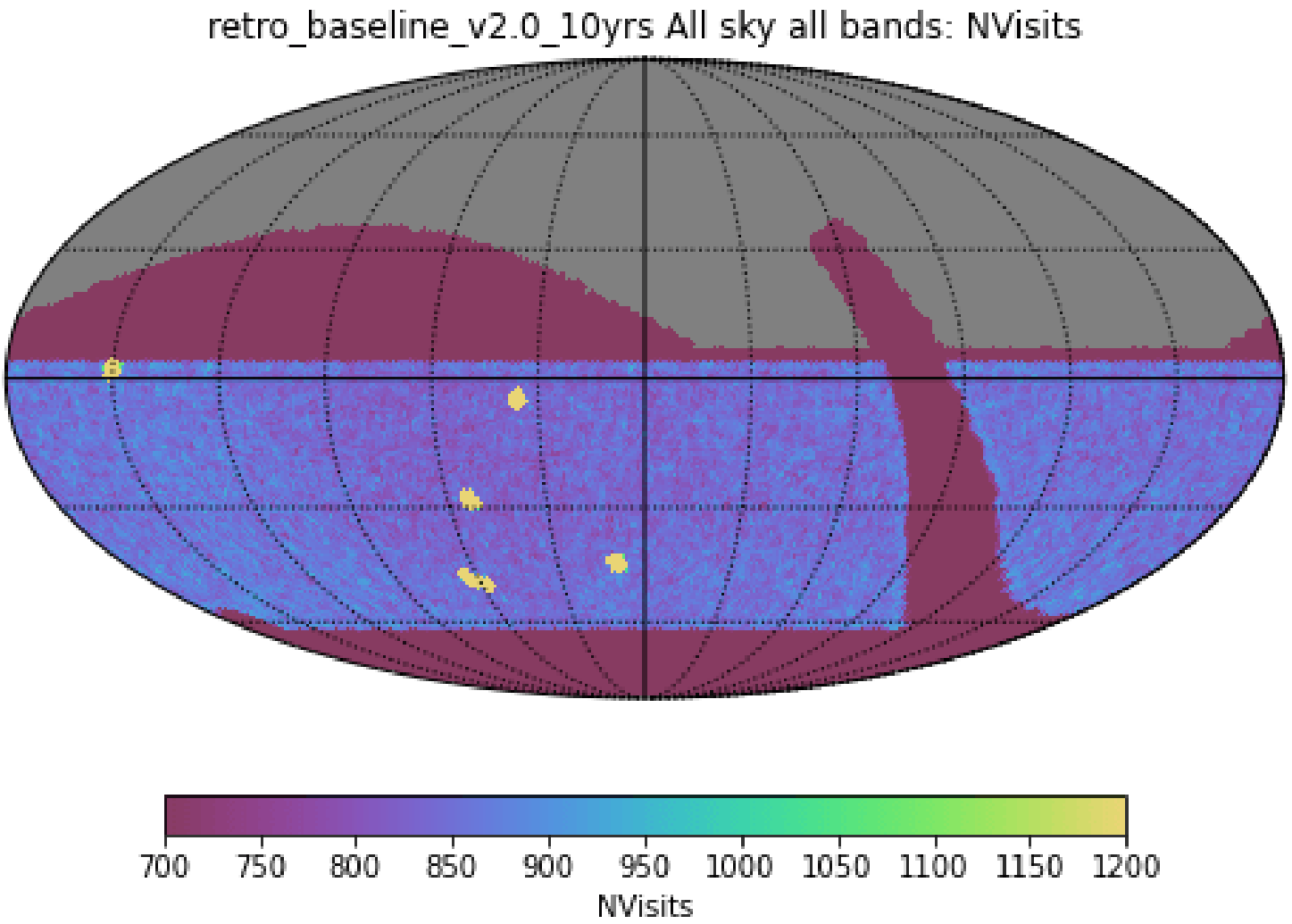
Selection of Euclid Deep Field South as 5th DDF, rolling, footprint, filter balance

2023 Community contributions form: Observing Strategy Desiderata 14 responses: AGN SC (1); DESC (3); GAL SC (1); SMWLV (5); SLSC (2); SSSC (1); TVS (5)

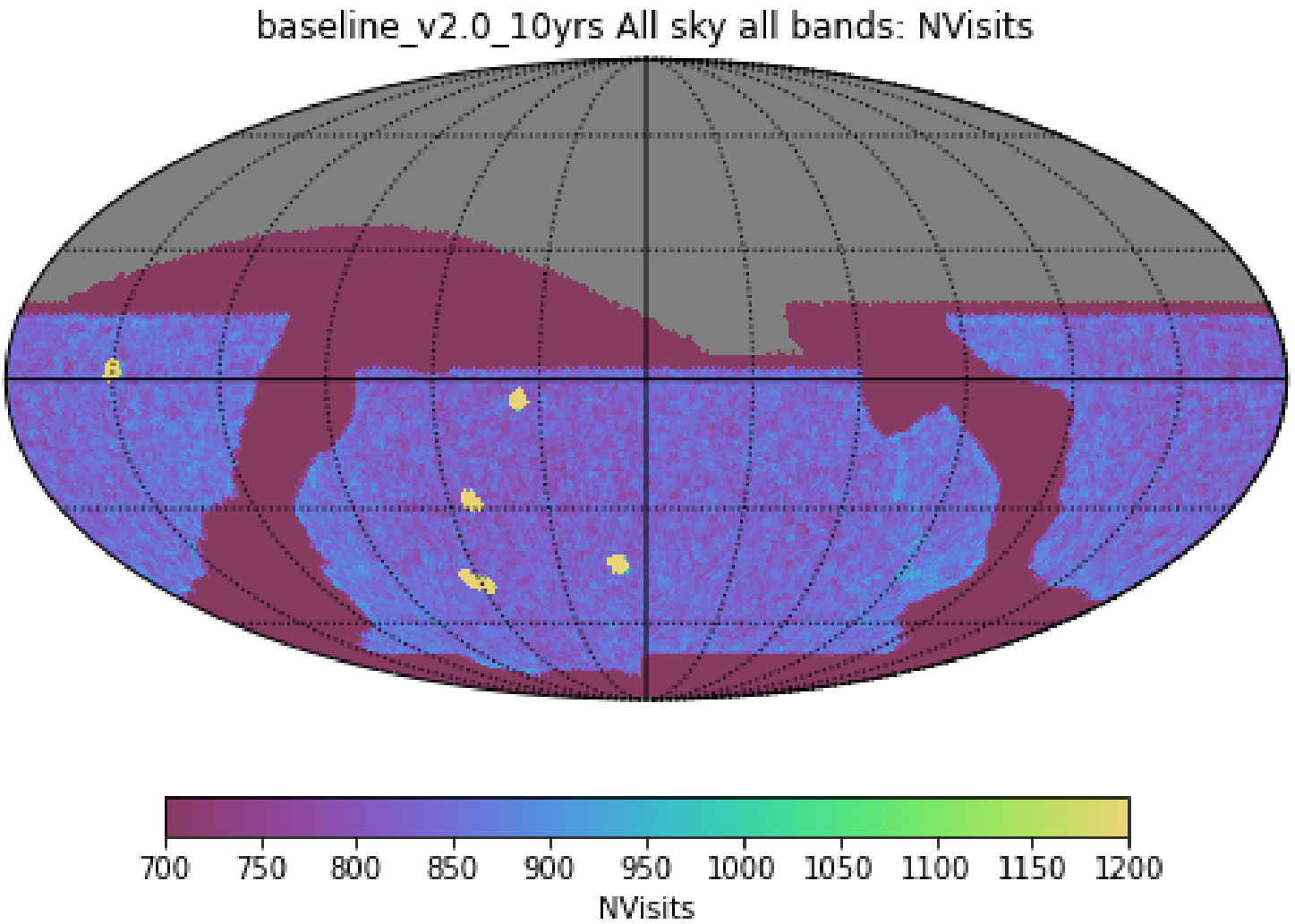
2024 Filter swap u-y, new throughput

2024 Phase 3 report released pstn-056.lsst.io **baseline v4.0**

Rubin LSST survey design



Rubin LSST survey design



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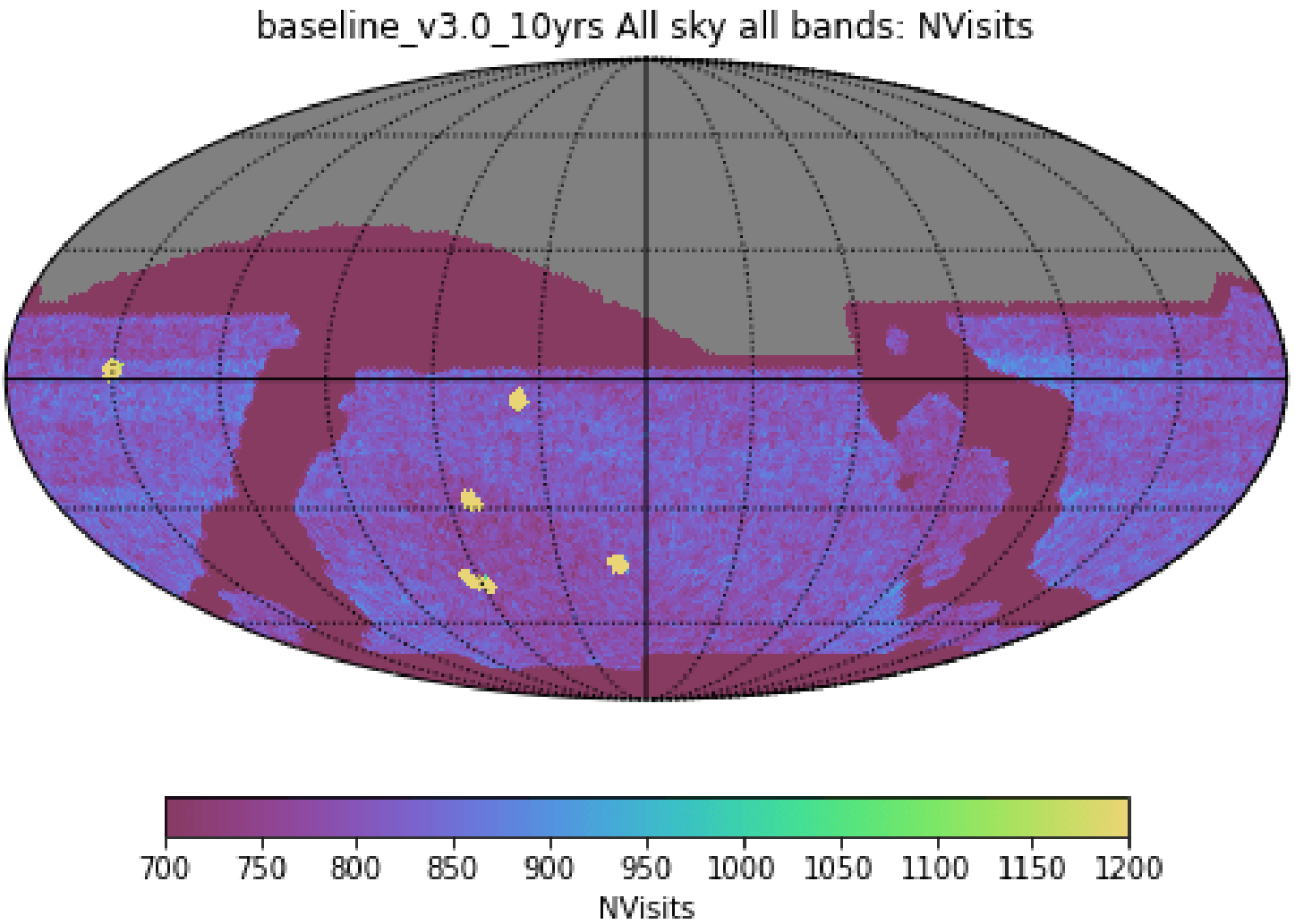
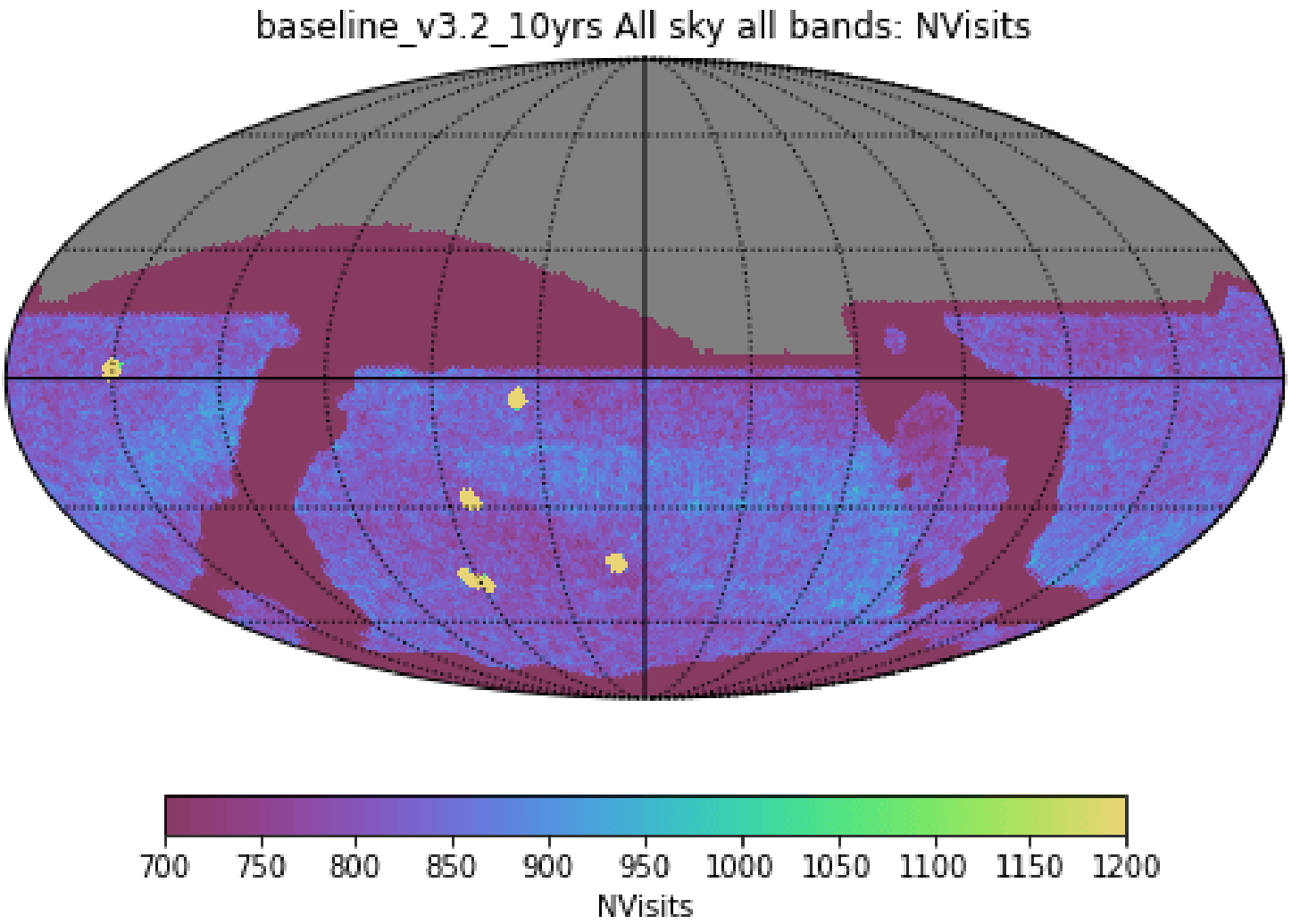
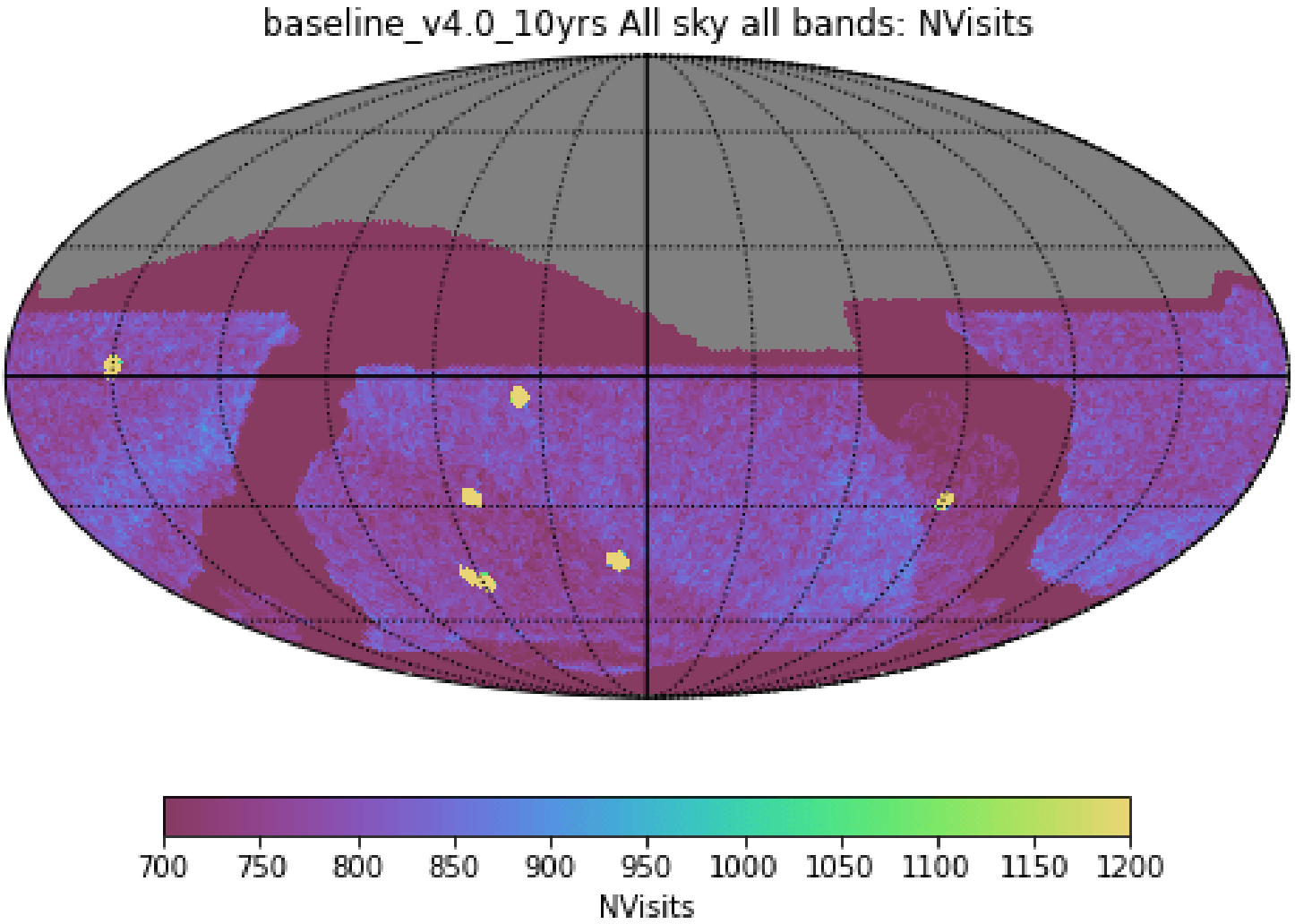


Rubin LSST survey design

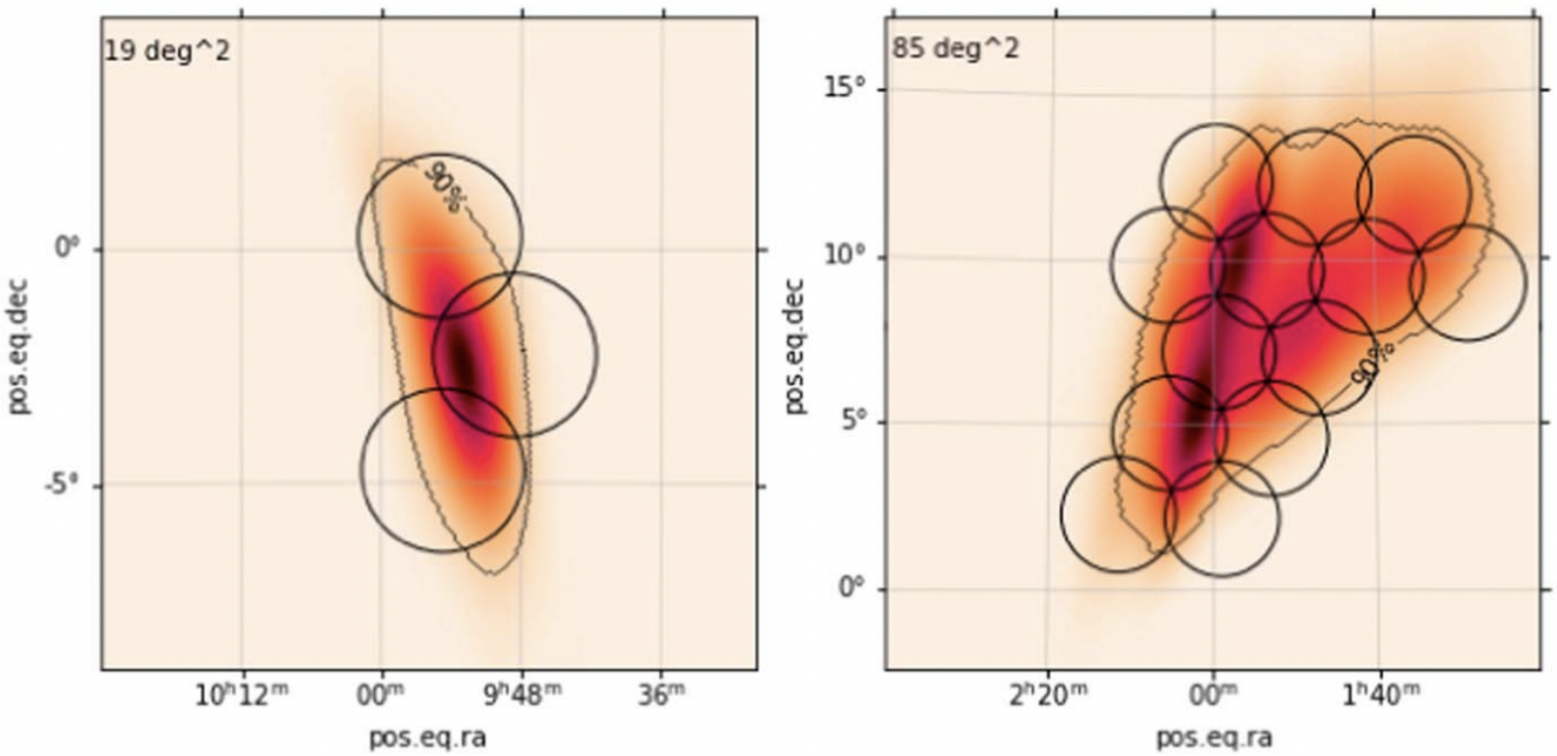


Rubin LSST survey design



LSST ToO program

Rubin ToO program



OPEN ACCESS

Target-of-opportunity Observations of Gravitational-wave Events with Vera C. Rubin Observatory

Igor Andreoni[50,1,2,3], Raffaella Margutti[4], Om Sharan Salafia[5,6], B. Parazin[7], V. Ashley Villar[8,9,10], Michael W. Coughlin[11], Peter Yoachim[12], Kris Mortensen[13], Daniel Brethauer[4], S. J. Smartt[14] + Show full author list

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The Astrophysical Journal Supplement Series, Volume 260, Number 1

Rubin LSST Survey Strategy Optimization

Citation Igor Andreoni *et al* 2022 *ApJS* **260** 18

Target of Opportunity Observations of Gravitational Wave Events with LSST

The TVS Multiwavelength Characterization/GW Counterparts subgroup,

Raffaella Margutti (chair, Northwestern),

+80 authors!

The main Rubin assets are the 10 sqdeg FoV + rapid slew + depth

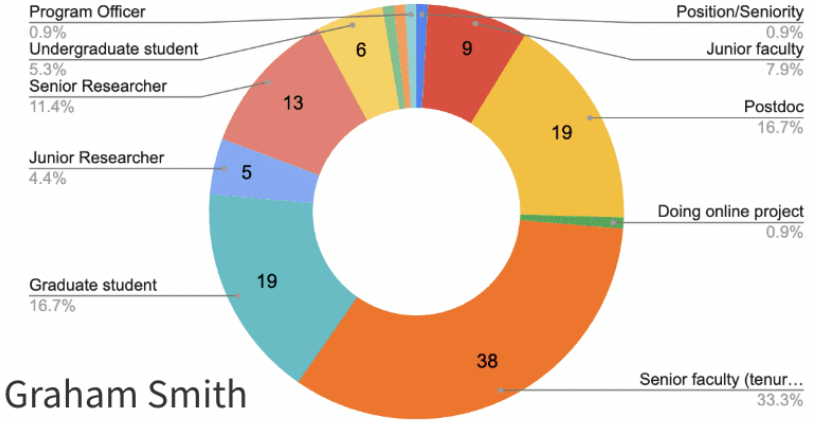
PSTN-055 (2022): The SCOC recommends a ToO program be enabled to respond to Gravitational Waves and MMA triggers with a fraction of ≤ 3% of dedicated survey time, with the possibility of extending it to additional types of targets in the future.

federica bianco - fbianco@udel.edu

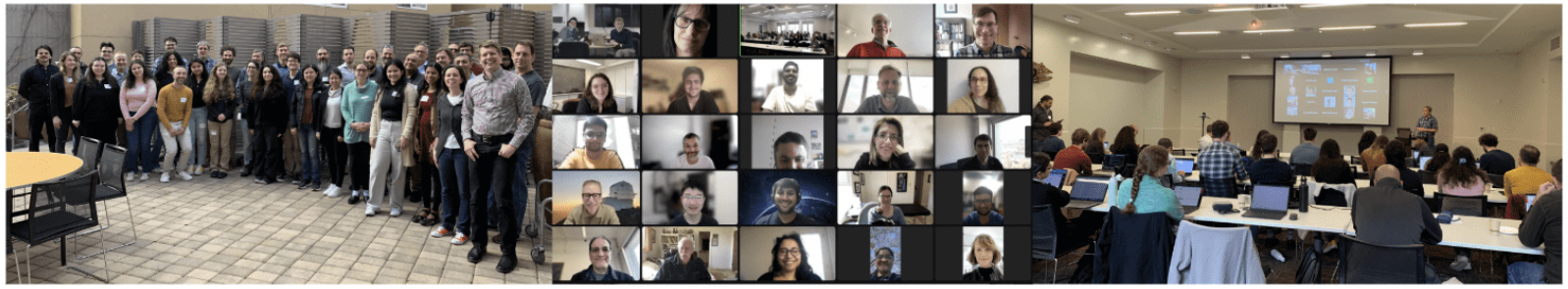
Rubin ToO program

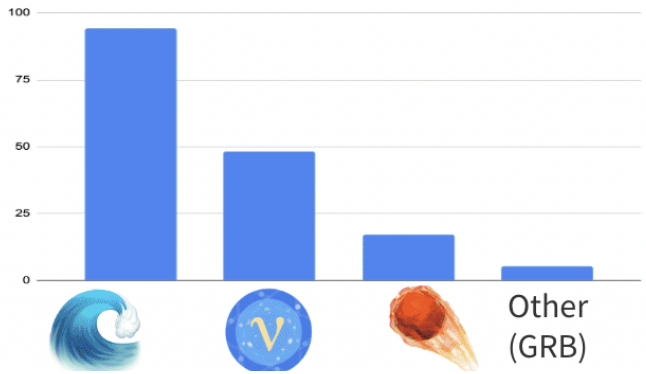
https://lssttooworkshop.github.io/

114 signed up participants
42% in person



SOC: Igor Andreoni, Federica Bianco, Anna Franckowiak, Tim Lister, Raffaella Margutti, Graham Smith
LOC: Raffaella Margutti, Josh Bloom, Ryan Chornock, Steve Kahn





Rubin ToO program

https://arxiv.org/pdf/2411.04793

Rubin ToO 2024:

Envisioning the Vera C. Rubin Observatory LSST Target of Opportunity program

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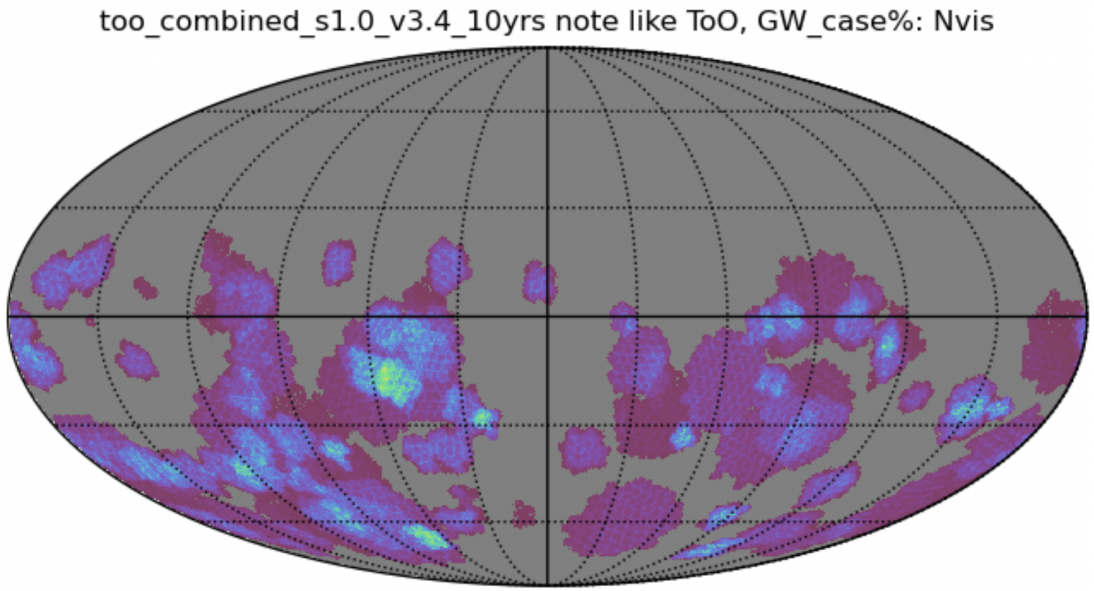
Authors and endorsers: Tomas Ahumada (17), Shreya Anand (18,19,20), Katie Auchettl (21,22), Michele T. Bannister (23), Eric C. Bellm (9), Joshua S. Bloom (5,24), Bryce T. Bolin (25), Clecio R. Bom (26,27), Daniel Brethauer (5), Melissa J. Brucker (28), David A.H. Buckley (29,30,31), Poonam Chandra (32), Ryan Chornock (5), Eric Christensen (8), Jeff Cooke (33,34), Alessandra Corsi (35), Michael W. Coughlin (36), Bolivia Cuevas-Otahola (37), D'Ammando Filippo (38), Biwei Dai (6,24), S. Dhawan (39), Alexei V. Filippenko (5), Ryan J. Foley (22), Anna Franckowiak (40), Andreja Gomboc (41), Benjamin P. Gompertz (15,42), Leanne P. Guy (8), Nandini Hazra (43,44,45), Christopher Hernandez (46), Griffin Hosseinzadeh (47), Maryam Hussaini (48), Dina Ibrahimzade (5), Luca Izzo (49,50), R. Lynne Jones (8), Yijung Kang (19,20), Mansi M. Kasliwal (16), Matthew Knight (51), Keerthi Kunnumkai (11), Gavin P Lamb (52), Natalie LeBaron (5), Cassandra Lejoly (28), Andrew J. Levan (53,54), Sean MacBride (55), Franco Mallia (56), Alex I. Malz (57), Adam A. Miller (58,59), John Carlos Mora (J. C. Mora) (60,61,62), Gautham Narayan (63,64), Nayana A.J. (5), Matt Nicholl (65), Tiffany Nichols (66,67,68), S. R. Oates (69), Akshay Panayada (70), Fabio Ragosta (71,72), Tiago Ribeiro (8), Dan Ryczanowski (73,15), Nikhil Sarin (74,75), Megan E. Schwamb (76), Huei Sears (77), Darryl Z. Seligman (78,79), Ritwik Sharma (80), Manisha Shrestha (81), Simran Kaur (82), Michael C. Stroh (59), Giacomo Terreran (10), Aishwarya Linesh Thakur (83), Aum Trivedi (84), J. Anthony Tyson (85), Yousuke Utsumi (86), Aprajita Verma (87), V. Ashley Villar (48,88), Kathryn Volk (89), Meet J. Vyas (84), Amanda R. Wasserman (63,64), J. Craig Wheeler (90), Peter Yoachim (9), Angela Zegarelli (40)

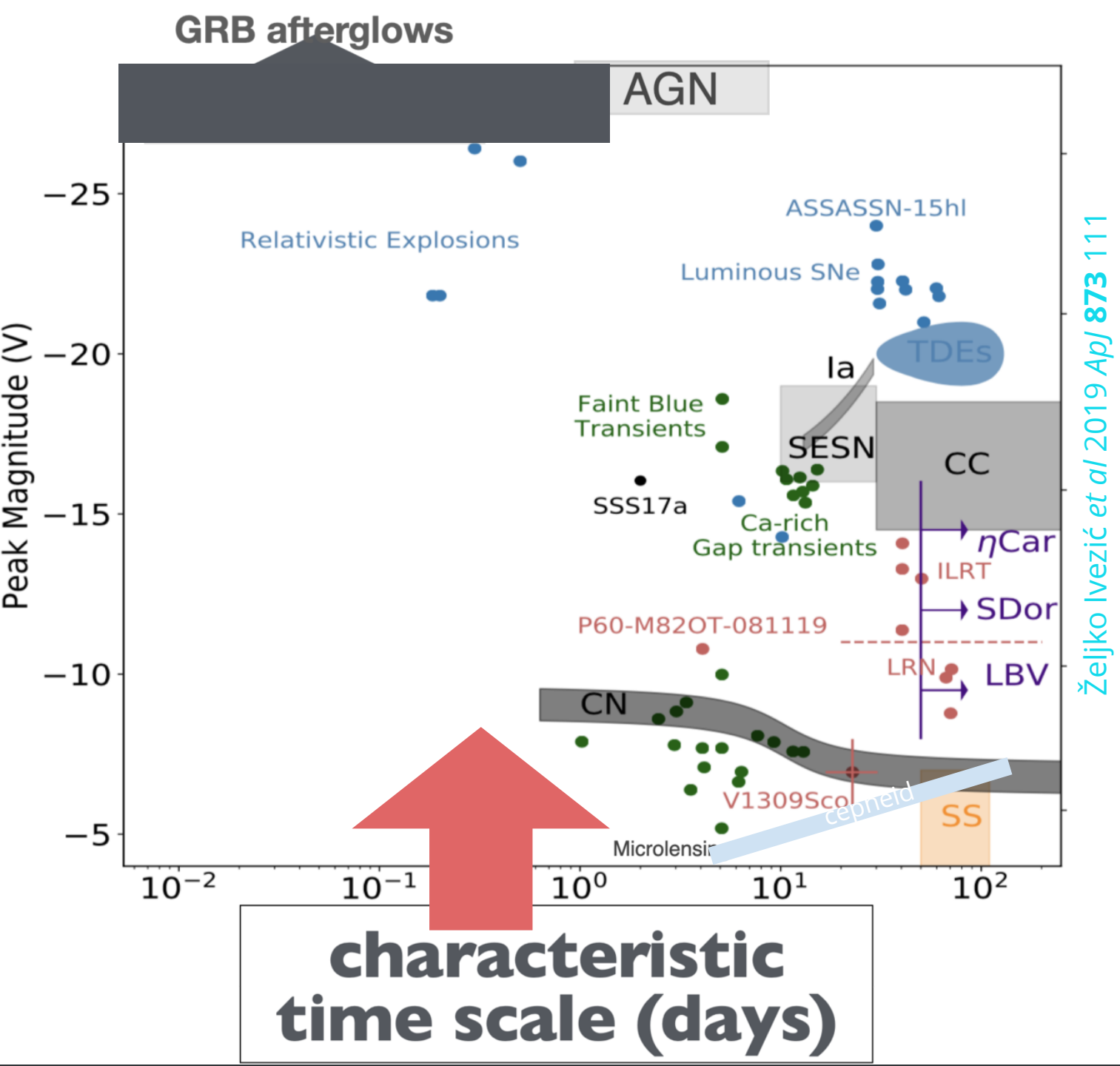


GW case	Total time (hrs) - O5
BNS/NS-BH	240
Lensed BNS	31
BBH	11
Unidentified GW	16
Grand total	**298**

Nu case	6-18 hours

PHA case	<30 hours

What about fast transients in the main survey?



The minutes-second-subsecond Universe

- **GRB afterglow**
- **Off-axis GRB**
- **Kilonovae**
- **SN-GRB breakout**
- **SN-GRB pop studies**
- **Fast Radio Bursts**
- **relativistic TDEs**
- X-ray binary stars
- cataclysmic variable stars
- blazars
- stellar flares
- solar system occultations
- technosignatures

Fast transients in LSST Wide Fast Deep

PAPER

Presto-Color: A Photometric Survey Cadence for Explosive Physics and Fast Transients

Federica B. Bianco[1,2,3,4], Maria R. Drout[5,6], Melissa L. Graham[7], Tyler A. Pritchard[8], Rahul Biswas[9], Gautham Narayan[10], Igor Andreoni[11], Philip S. Cowperthwaite[6], Tiago Ribeiro[12], and (With the Support of the LSST Transient and Variable Stars Collaboration)

Published 2019 April 25 • © 2019. The Astronomical Society of the Pacific. All r

Publications of the Astronomical Society of the Pacific, Volume 131, Number 10

Focus on Tools and Techniques for Time-domain Astronomy

Citation Federica B. Bianco *et al* 2019 *PASP* **131** 068002

DOI 10.1088/1538-3873/ab121a

Science-Driven Optimization of the LSST Observing Strategy (Chapter 6)

Most recent commit: fe3d2ad

(Mon, 14 Aug 2017 02:08:33 -0700)

Marshall et al. 2017

OPEN ACCESS

Give Me a Few Hours: Exploring Short Timescales in Rubin Observatory Cadence Simulations

Eric C. Bellm[1], Colin J. Burke[2], Michael W. Coughlin[3], Igor Andreoni[4,5,6,7], Claudia M. Raiteri[8], and Rosaria Bonito[9]

Published 2022 January 10 • © 2022. The Author(s). Published by the American Astronomical Society.

The Astrophysical Journal Supplement Series, Volume 258, Number 1

Rubin LSST Survey Strategy Optimization

Citation Eric C. Bellm *et al* 2022 *ApJS* **258** 13

DOI 10.3847/1538-4365/ac4602

OPEN ACCESS

Optimizing Cadences with Realistic Light-curve Filtering for Serendipitous Kilonova Discovery with Vera Rubin Observatory

Igor Andreoni[1], Michael W. Coughlin[2], Mouza Almualla[3], Eric C. Bellm[4], Federica B. Bianco[5,6,7], Mattia Bulla[8], Antonino Cucchiara[9], Tim Dietrich[10,11], Ariel Goobar[12], Erik C. Kool[8] + Show full author list

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The Astrophysical Journal Supplement Series, Volume 258, Number 1

Rubin LSST Survey Strategy Optimization

Citation Igor Andreoni *et al* 2022 *ApJS* **258** 5

Discovering gravitationally lensed gravitational waves: predicted rates, candidate selection, and localization with the Vera Rubin Observatory

Graham P Smith ✉, Andrew Robertson, Guillaume Mahler, Matt Nicholl, Dan Ryczanowski, Matteo Bianconi, Keren Sharon, Richard Massey, Johan Richard, Mathilde Jauzac

Smith +2019

RNAAS RESEARCH NOTES OF THE AAS

Is an LSST ToO Mode Necessary for Kilonova Discovery?

Kris Mortensen[1], Adam A. Miller[1,2], Raffaella Margutti[1], and Chris Pankow[1]

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Mortersen et al. 2019

Kilonova parameters estimation with LSST at Vera C. Rubin Observatory

Fabio Ragosta,[1,2] Tomás Ahumada,[3,4,5,*] Silvia Piranomonte,[1] Igor Andreoni,[6,3,4,†] Andrea Melandri,[1] Alberto Colombo,[7,8,9] and Michael W. Coughlin[10]

Ragosta+ et al. 2023

Rubin LSST survey design

The original survey plan didn't lead to good time domain astronomy (TDA) outcomes:

2 intranight obs in same filer +

2 intranight obs in another filter ~5 day later

~800 per field

10 seasons, with each 6 months

2 visits per night (within ~30 min for Solar System Science)

revisit time => 4.5 nights

This will scatter significantly (weather, moon, ...)

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GRB =>

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10 seasons, with each 6 months

2 visits per night (within ~30 min for Solar System Science)

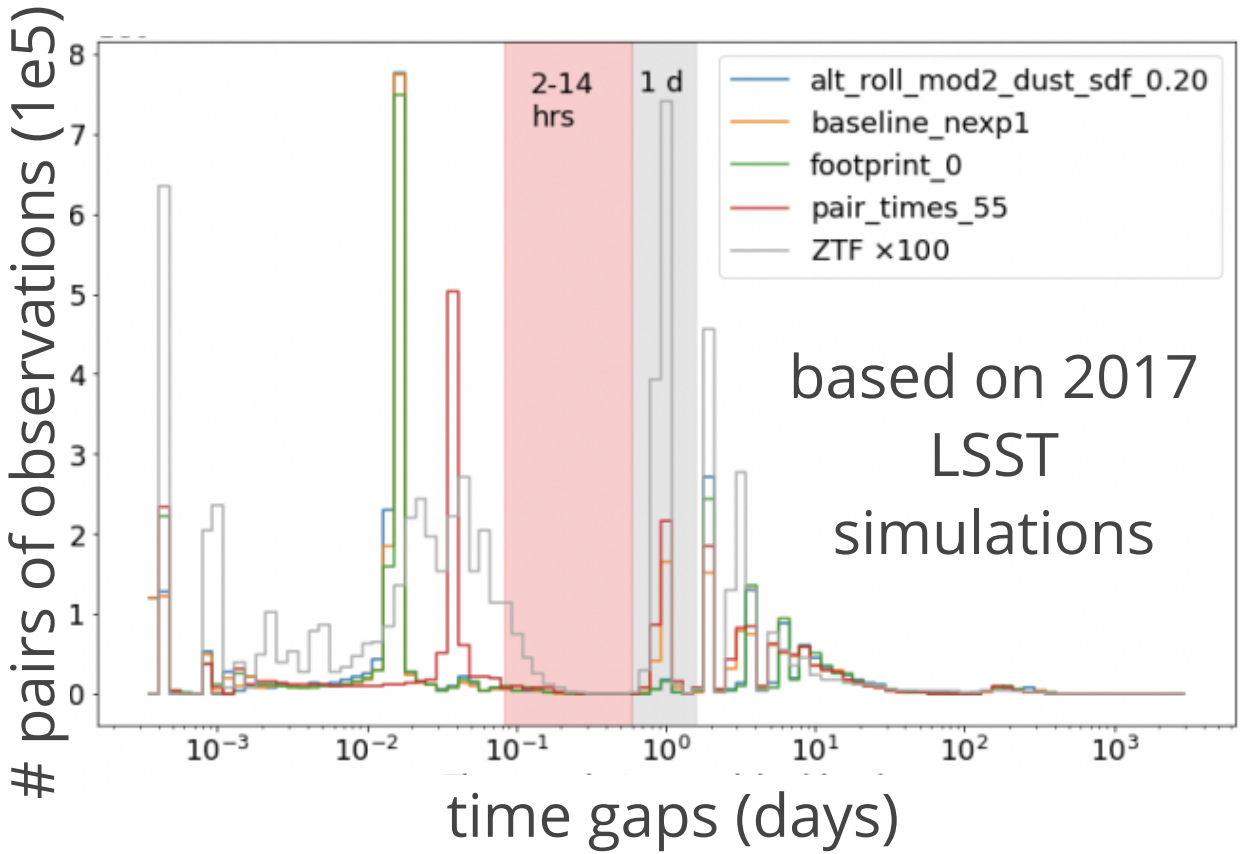
revisit time => 4.5 nights

This will scatter significantly (weather, moon, ...)

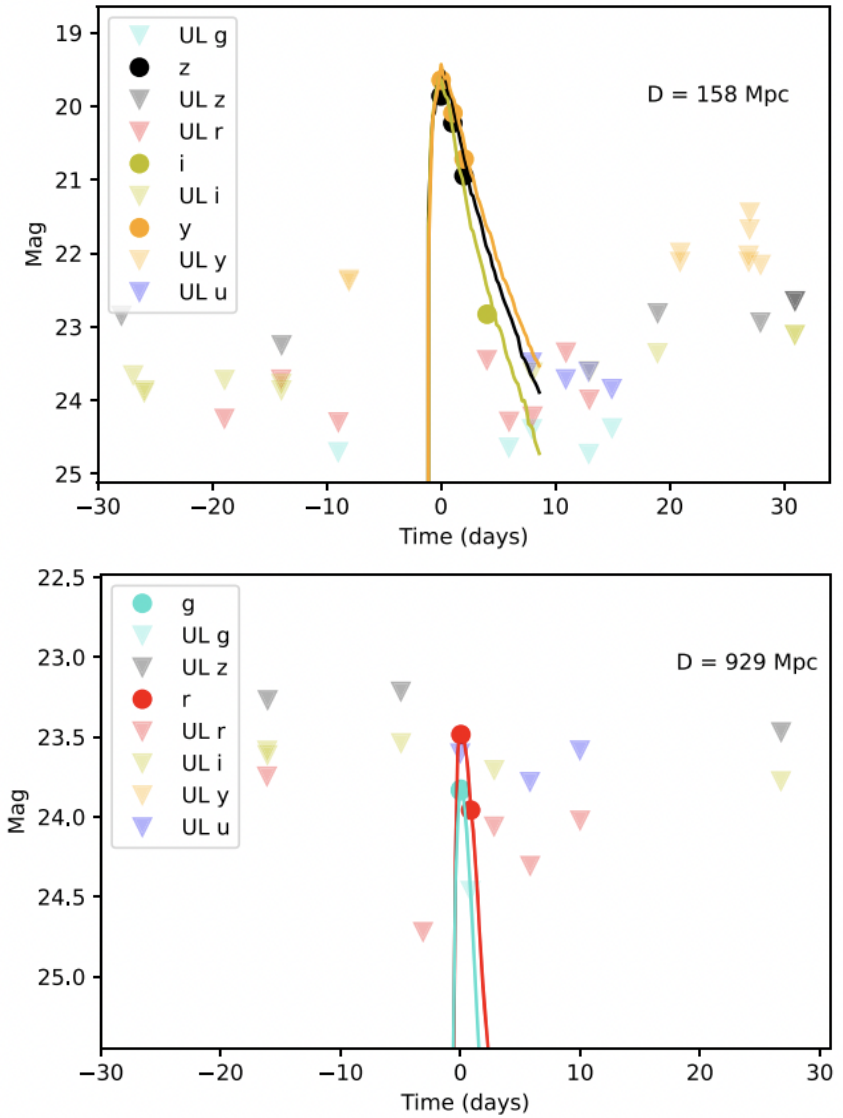
Introducing Rolling Cadence

Current plan: rolling 8 out of the 10 years

Rubin LSST survey design up to 2018



Eric C. Bellm *et al* 2022 *ApJS* **258** 13



Igor Andreoni *et al* 2022 *ApJS* **258** 5

2017 simulations: between 3 and 32 KN can be identified (~300 detected)

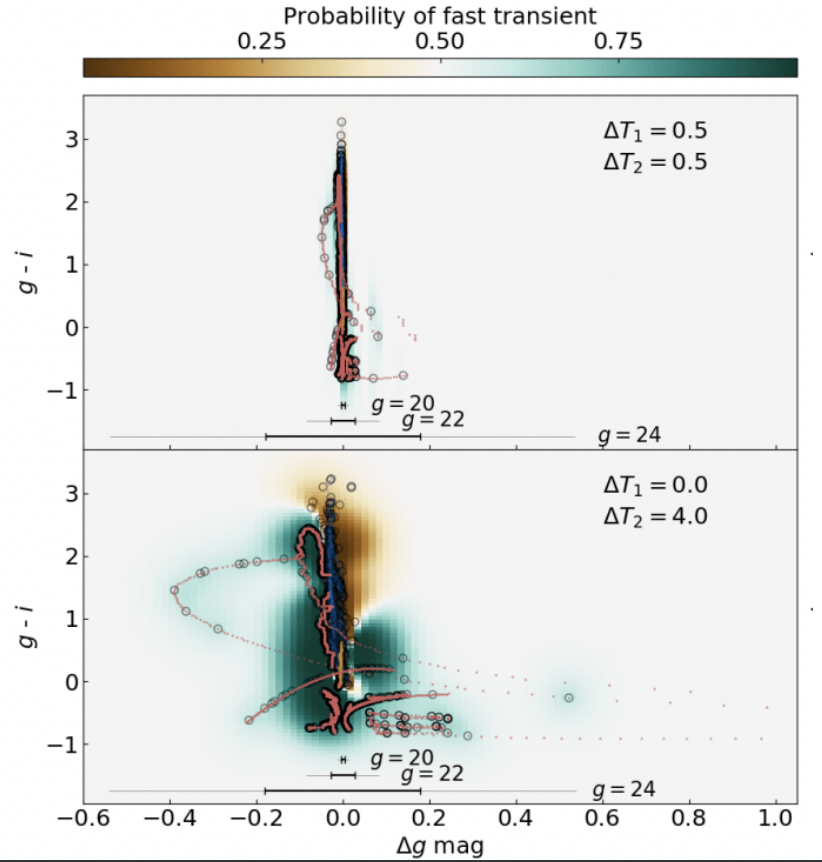
Intorducing Triplets

Current plan: rolling 8 out of the 10 years

Proposed 3 intranight obs

2 within 1 hour in different filters → Intranight color (near instantaneous)

1 at 4-8 hours separation w repeat filter → Intranight rate of change (~hour time scales)



Presto-Color, Bianco+ 2019

Intorducing Triplets

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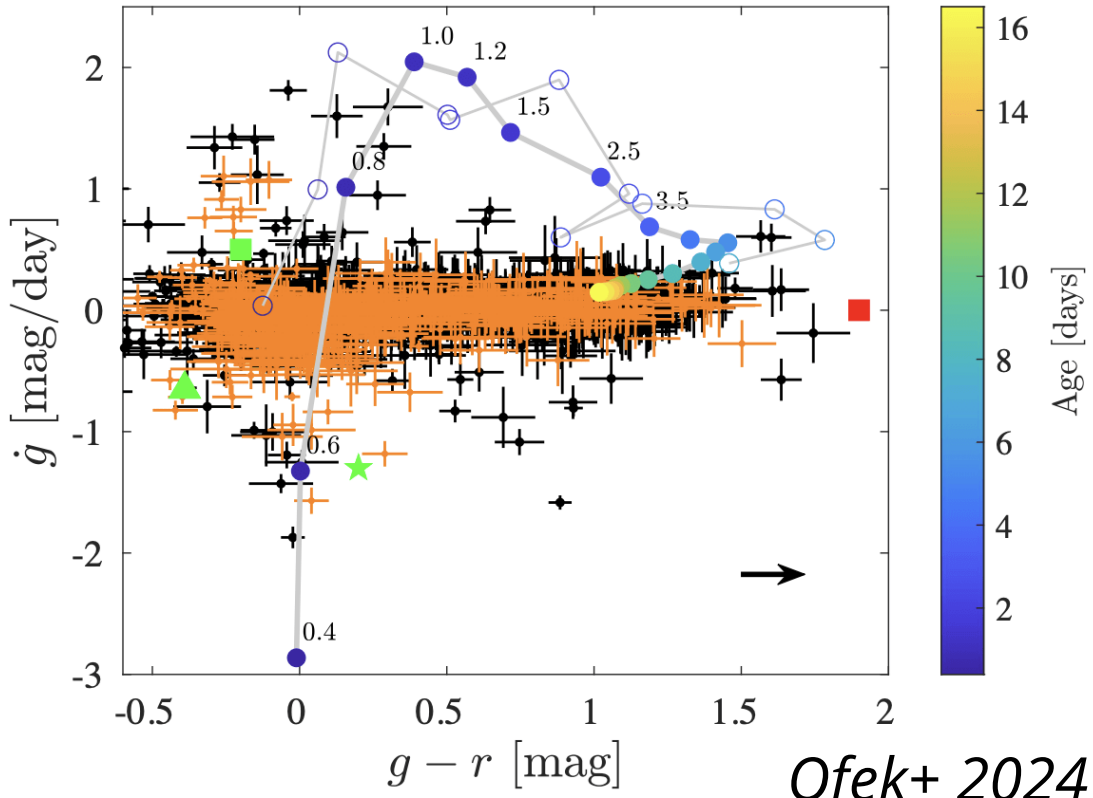


Ofek+ 2024

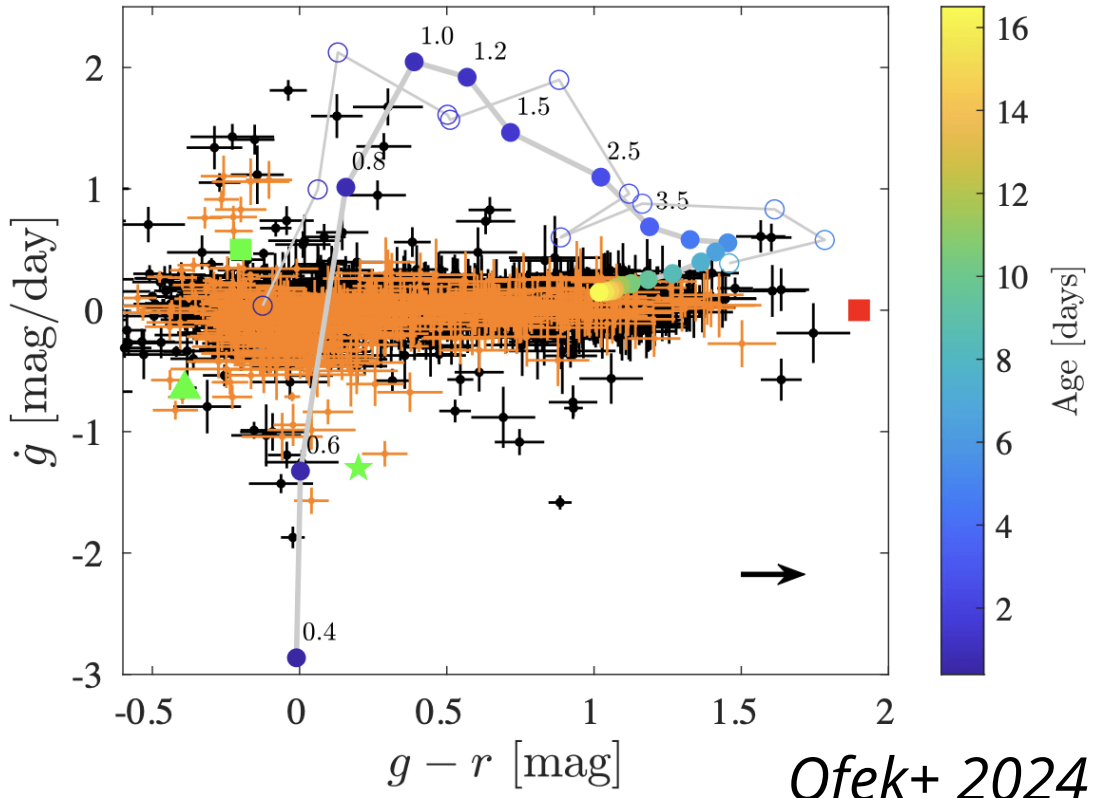
Intorducing Triplets

Current plan: 4% of the survey is currently conducted in triplets

Proposed 3 intranight obs

2 within 1 hour in different filters → Intranight color (near instantaneous)

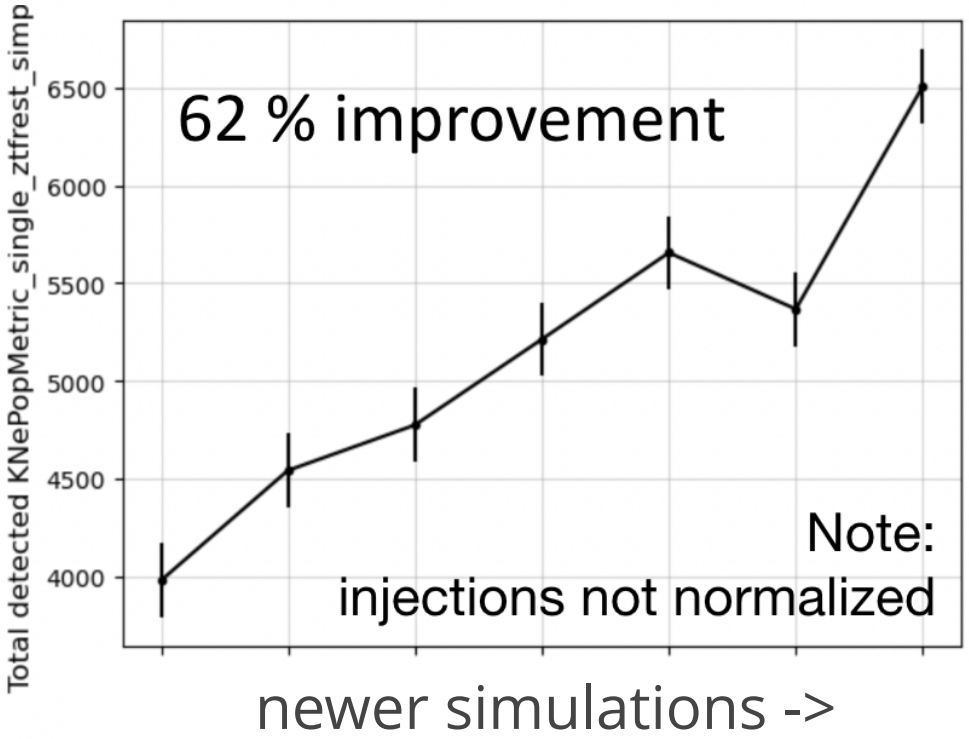
1 at 4-8 hours separation w repeat filter → Intranight rate of change (~hour time scales)

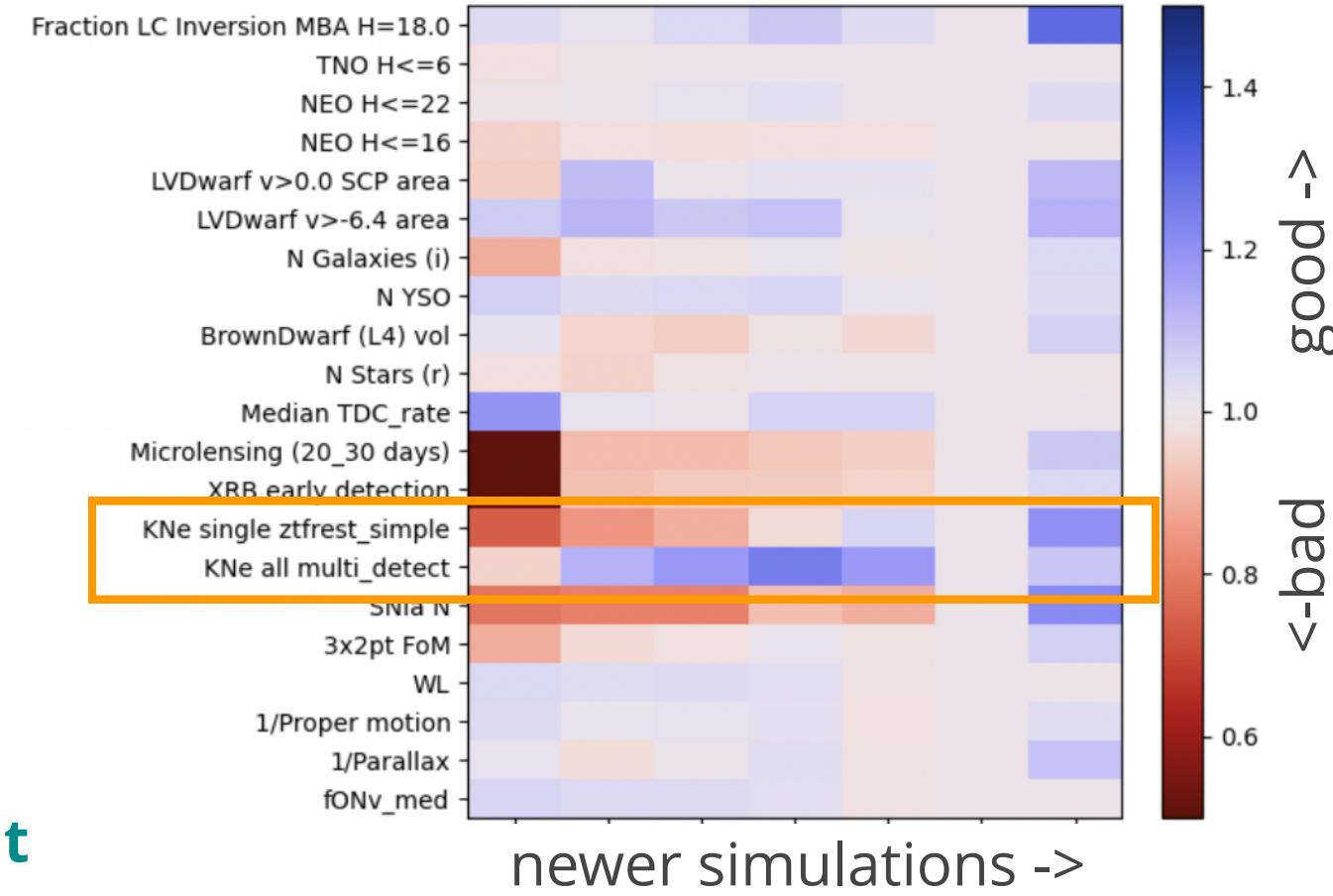


Ofek+ 2024

Kilonovae in LSST Wide Fast Deep

Andreoni+ 2022a



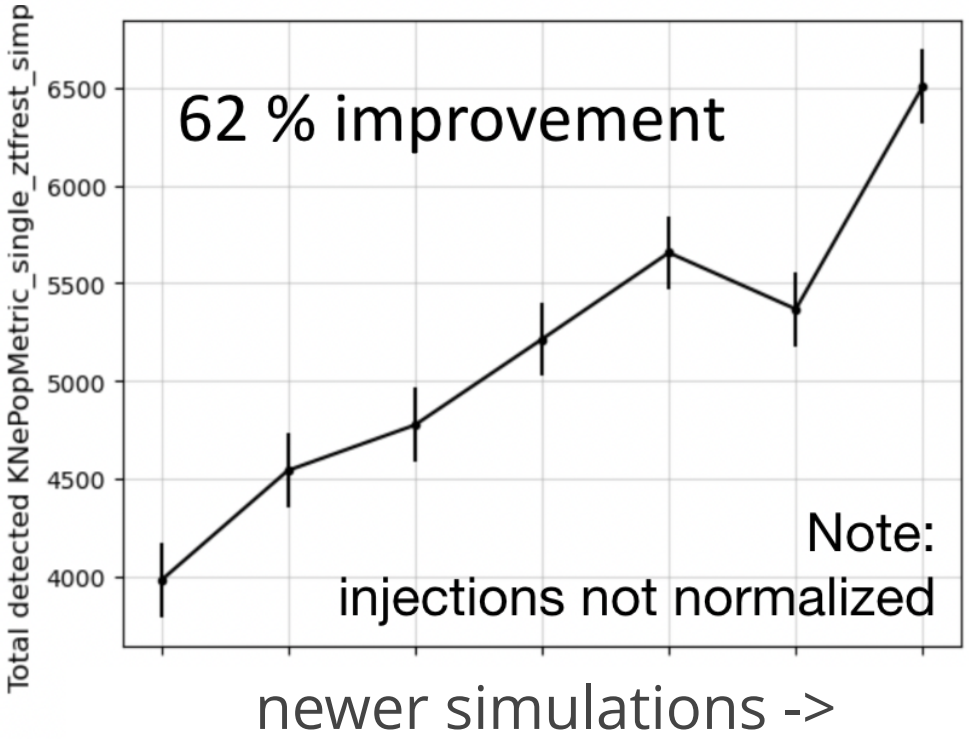


2023 simulations: 62% improvement

4 – 24 hour gaps between epochs will enable kilonova parameter estimation

Kilonovae in LSST Wide Fast Deep

Andreoni+ 2022a



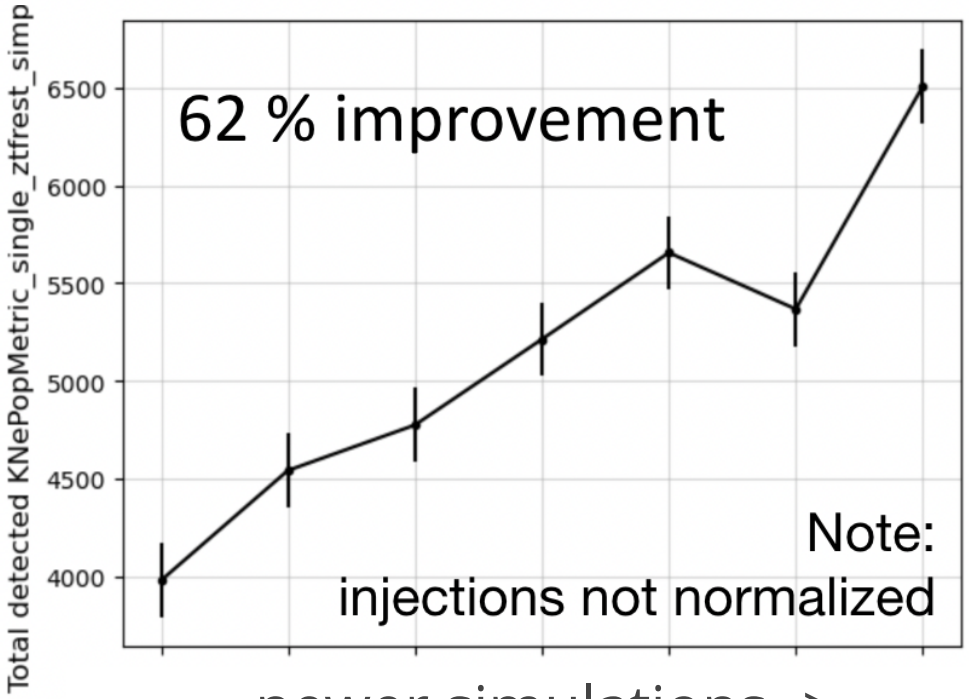
GRB =>

2023 simulations: 62% improvement

4 – 24 hour gaps between epochs will enable kilonova parameter estimation

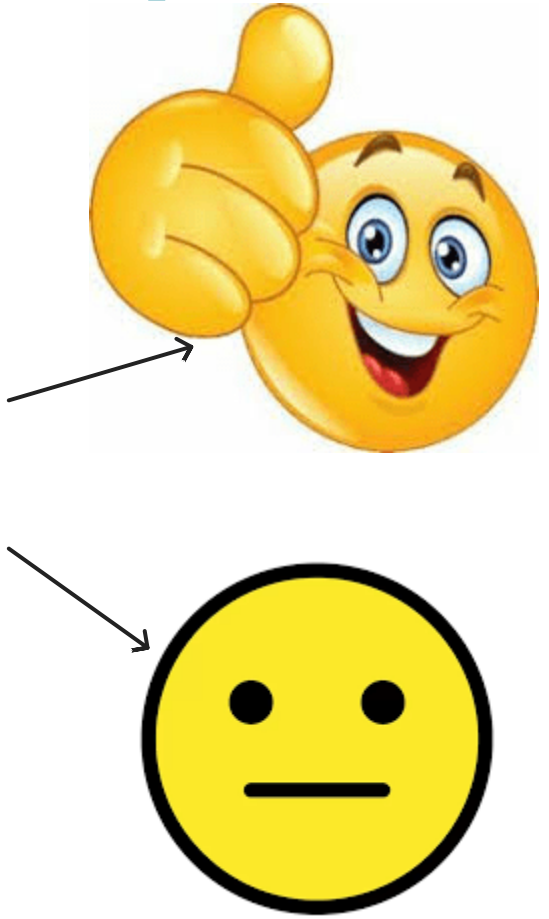
Kilonovae in LSST Wide Fast Deep

Andreoni+ 2022a



newer simulations ->

GRB =>



2023 simulations: 62% improvement

4 – 24 hour gaps between epochs will enable kilonova parameter estimation

Vera C. Rubin Observatory
Project Science Team

Survey Cadence Optimization Committee's Phase 3 Recommendations

The Rubin Observatory Survey Cadence Optimization Committee

PSTN-056

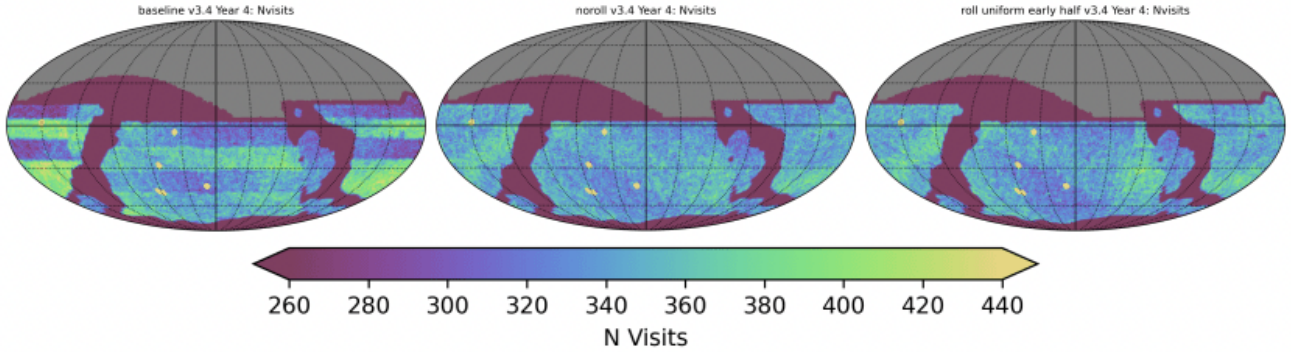
Latest Revision: 2024-10-01

https://pstn-056.lsst.io/

Abstract

We present the final planned comprehensive recommendation for Rubin Observatory the Legacy Survey of Space and Time (LSST) survey strategy ahead of the start of LSST. This recommendation is the product of a many-years-long iterative process where community recommendations to maximize the scientific impact of LSST across domains of astrophysics were reviewed, synthesized, aggregated, and merged to define the overall plan for 10 years of LSST observations. The current recommendation builds on Phase 1 (PSTN-053) and Phase 2 recommendations (PSTN-055) and, together, they define a 10-year plan for observing. Here we answer questions left open in PSTN-055, refine additional survey details, and describe the scope of future activities of the SCOC.

Proposed reduction to 6 rolling years (3 2-year cycles) to improve intrasurvey uniformity



Rubin cadence

00:00 / 11:55

NotebookLM EXPERIMENTAL

VERA C. RUBIN OBSERVATORY

Vera C. Rubin Observatory
Project Science Team

Survey Cadence Optimization Committee's Phase 3 Recommendations

The Rubin Observatory Survey Cadence Optimization Committee

PSTN-056

Latest Revision: 2024-10-01

https://pstn-056.lsst.io/

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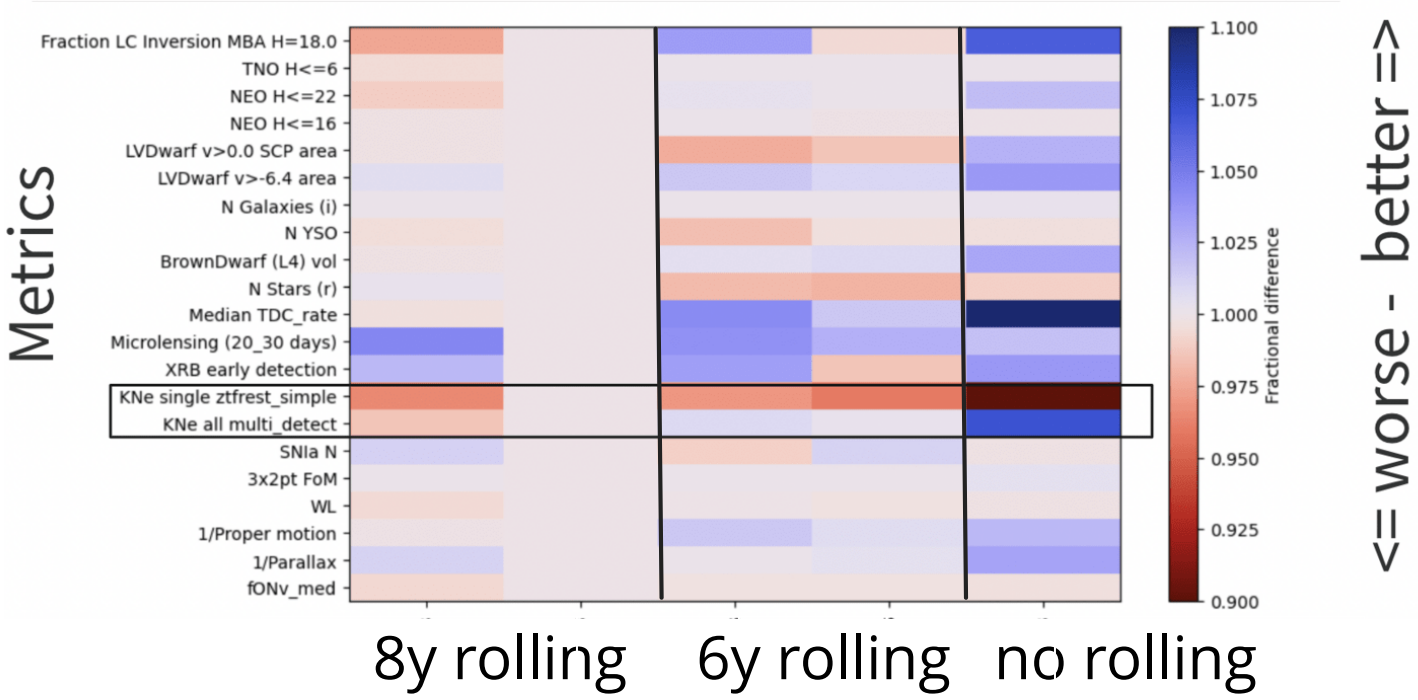

~7% loss in KN characterization

Vera C. Rubin Observatory
Project Science Team

Survey Cadence Optimization Committee's Phase 3 Recommendations

The Rubin Observatory Survey Cadence Optimization Committee

PSTN-056

Latest Revision: 2024-10-01

Abstract

We present the final planned comprehensive recommendation for Rubin Observatory the Legacy Survey of Space and Time (LSST) survey strategy ahead of the start of LSST. This recommendation is the product of a many-years-long iterative process where community recommendations to maximize the scientific impact of LSST across domains of astrophysics were reviewed, synthesized, aggregated, and merged to define the overall plan for 10 years of LSST observations. The current recommendation builds on Phase 1 (PSTN-053) and Phase 2 recommendations (PSTN-055) and, together, they define a 10-year plan for observing. Here we answer questions left open in PSTN-055, refine additional survey details, and describe the scope of future activities of the SCOC.

iii. ROLLING: The SCOC confirms the recommendation for rolling in two sky areas at 0.9 strength on the WFD low-dust footprint (PSTN-055 §2.5). We are adopting the Uniform Rolling strategy designed by the Uniformity Task Force in `baseline_v3.6` simulations, which implements three cycles of rolling, but, because rolling will not begin before the start of Y2 with any of the implementations under consideration, we will continue to investigate three- and four-cycles implementations of rolling until our Y1 recommendation. The SCOC recommends that the time domain community, particularly those interested in phenomena that have evolutionary time scales of hours-to-days, urgently quantify the impact of the proposed uniform rolling compared to rolling in four cycles.

TVS Science Collaboration

Fast Transient Subgroup

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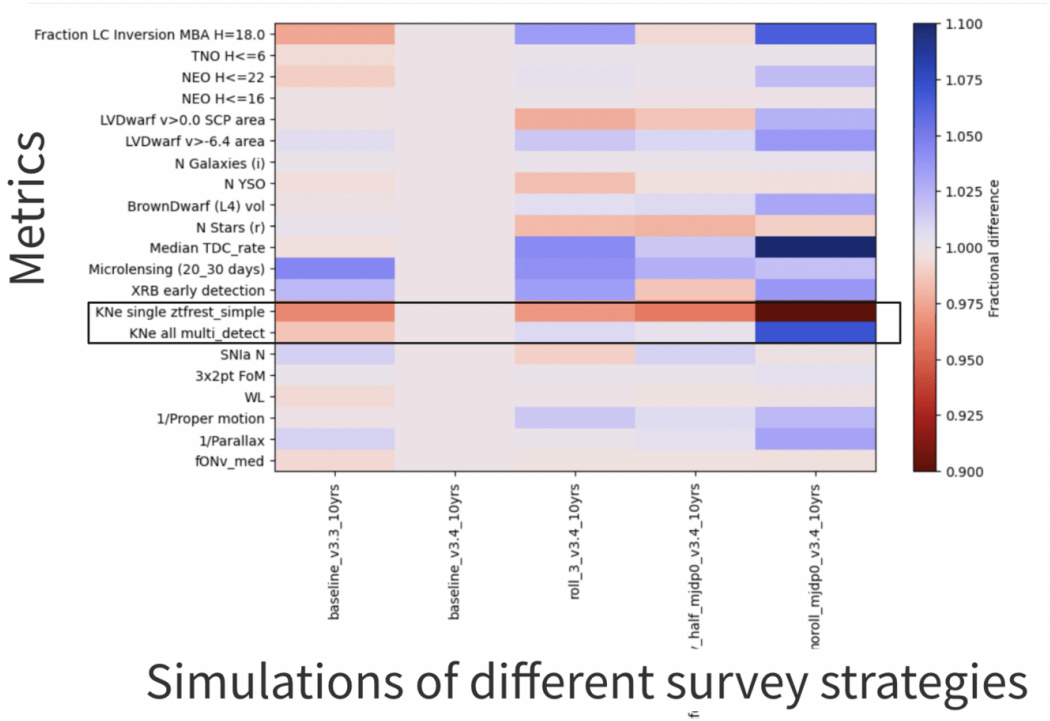
Chair: Igor Andreoni



<= worse - better =>

The kilonova metric is used by the SCOC to track the science throughput on all fast and rare transients, not only KNe

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This is urgent! results must come through in the next ~ 2 months or the strategy may be set for year 1

Let's work together!

join the overleaf paper ↓

Fast Transients MetricsCOordinations and White Paper

Transient LSST Metric Info

TVS Science Collaboration

September 2024

	u	g	r	i	z	y
Range of possible rise rates (mag/day)						
Range of possible fade rates (mag/day)						
Peak magnitude range (absolute magnitudes)						
Duration at peak (days)