LSST Solar System Science Collaboration Update

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@megschwamb

LSST SSSC Co-Chairs

Image Credits: AURA/Gemini/NSF

Expected LSST Yield

	Currently Known	LSST Discoveries	Median number of observations	Observational arc length
Near Earth Objects (NEOs)	~14,500	100,000	(D>250m) 60	6.0 years
Main Belt Asteroids (MBAs)	~650,000	5,500,000	(D>500m) 200	8.5 years
Jupiter Trojans	~6,000	280,000	(D>2km) 300	8.7 years
TransNeptunian + Scattered Disk Objects (TNOs + SDOS)	~2,000	40,000	(D>200km) 450	8.5 years
Interstellar Objects (ISOs)	1	10	?	?

Slide Credit: LSST Science book/Lynne Jones

It’s Really Coming!
Science Operations Start in 2022!

Slide Credit: LSST/AURA/LSSTC

Revised Data Delivery Schedule

Data Production Milestone	Start Date
First calibration data from Auxiliary Telescope	November 2018
First on-sky and calibration images with ComCam	May 2020
Images from Camera re-verification at Summit Facility	July 2020
Sustained observing with ComCam	August 2020
First on-sky and calibration data from Camera+Telescope	February 2021
Sustained scheduler driven observing with Camera+Telescope	April 2021
Start Science Verification mini-Surveys	June 2021

Slide Credit: Chuck F Claver

LSST Solar System Science Collaboration (SSSC)


David Trilling & Meg Schwamb
SSSC Co-Chairs

Large Synoptic Survey Telescope
Solar System Science Collaboration

www.lsstsssc.org

Wes Fraser
LSST: UK Solar System POC

Active objects Working Group (Lead: Alan Fitzsimmons): broadly consisting of all categories of activity in the minor planet populations: short period comets, long period comets, main belt comets, impact- or rotationally-generated active asteroids,etc

Community software/infrastructure development Working Group (Lead: Henry Hsieh): broadly consisting of people interested in helping build databases, software packages, etc to be used by the Solar System community on LSST data

Inner Solar System Working Group (Lead: Cristina Thomas): broadly consisting of the main belt, Mars/Jupiter Trojans, and Jupiter irregular satellites

NEOs (Near Earth Objects) and Interstellar Objects Working Group (Lead: Steve Chesley): broadly consisting of objects on orbits inward of or diffusing inward from the main belt as well as interstellar objects temporarily residing in the Solar System


Outer Solar System Working Group (Lead: Darin Ragozzine and Matt Holman): broadly consisting of KBOs, Centaurs, Oort cloud, Saturn/Neptune/Uranus Trojans, and Saturn/Neptune/Uranus irregular satellites

LARGE SYNOPTIC SURVEY TELESCOPE SOLAR SYSTEM SCIENCE ROADMAP

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MATTHEW J. HOLMAN,[5] HENRY HSIEH,[6] DARIN RAGOZZINE,[7] CRISTINA A. THOMAS,[6,8] DAVID E. TRILLING,[8] AND
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ON BEHALF OF THE LSST SOLAR SYSTEM SCIENCE COLLABORATION

https://arxiv.org/abs/1802.01783

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(Published February 2, 2018 - Version 1.0)

ABSTRACT

The Large Synoptic Survey Telescope (LSST) is uniquely equipped to search for Solar System bodies due to its unprecedented combination of depth and wide field coverage. Over a ten-year period starting in 2022, LSST will generate the largest catalog of Solar System objects to date. The main goal of the LSST Solar System Science Collaboration (SSSC) is to facilitate the efforts of the planetary community to study the planets and small body populations residing within our Solar System using LSST data. To prepare for future survey cadence decisions and ensure that interesting and novel Solar System science is achievable with LSST, the SSSC has identified and prioritized key Solar System research areas for investigation with LSST in this roadmap. The ranked science priorities highlighted in this living document will inform LSST survey cadence decisions and aid in identifying software tools and pipelines needed to be developed by the planetary community as added value products and resources before the planned start of LSST science operations.

So we have a Science Road Map, what's next?

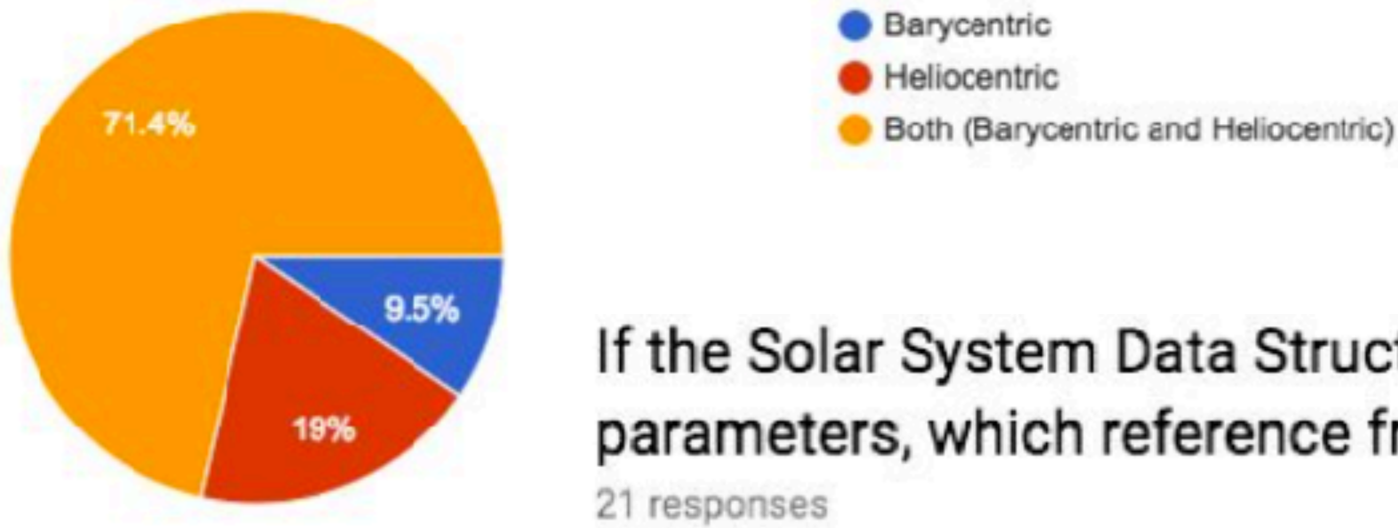
Coming up with quantitative measures that can be used to measure how successful a LSST proposed cadence achieves that science priority/goal

Working group leads are gathering your opinions, please give them feedback.

What should LSST provide?

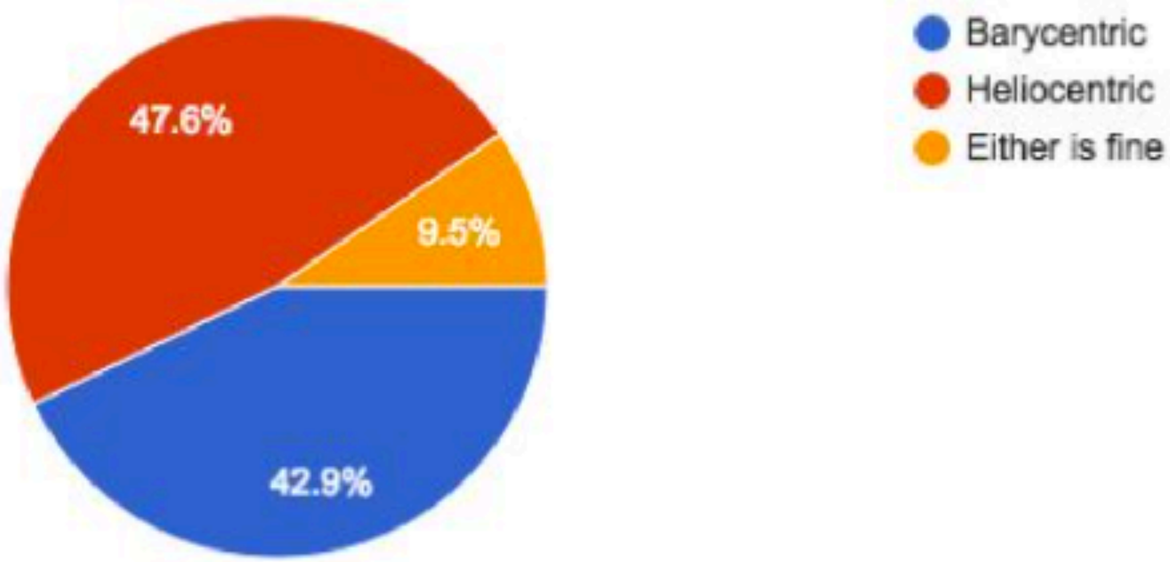
Which reference frame should the Solar System Data Structure store orbital parameters:

21 responses



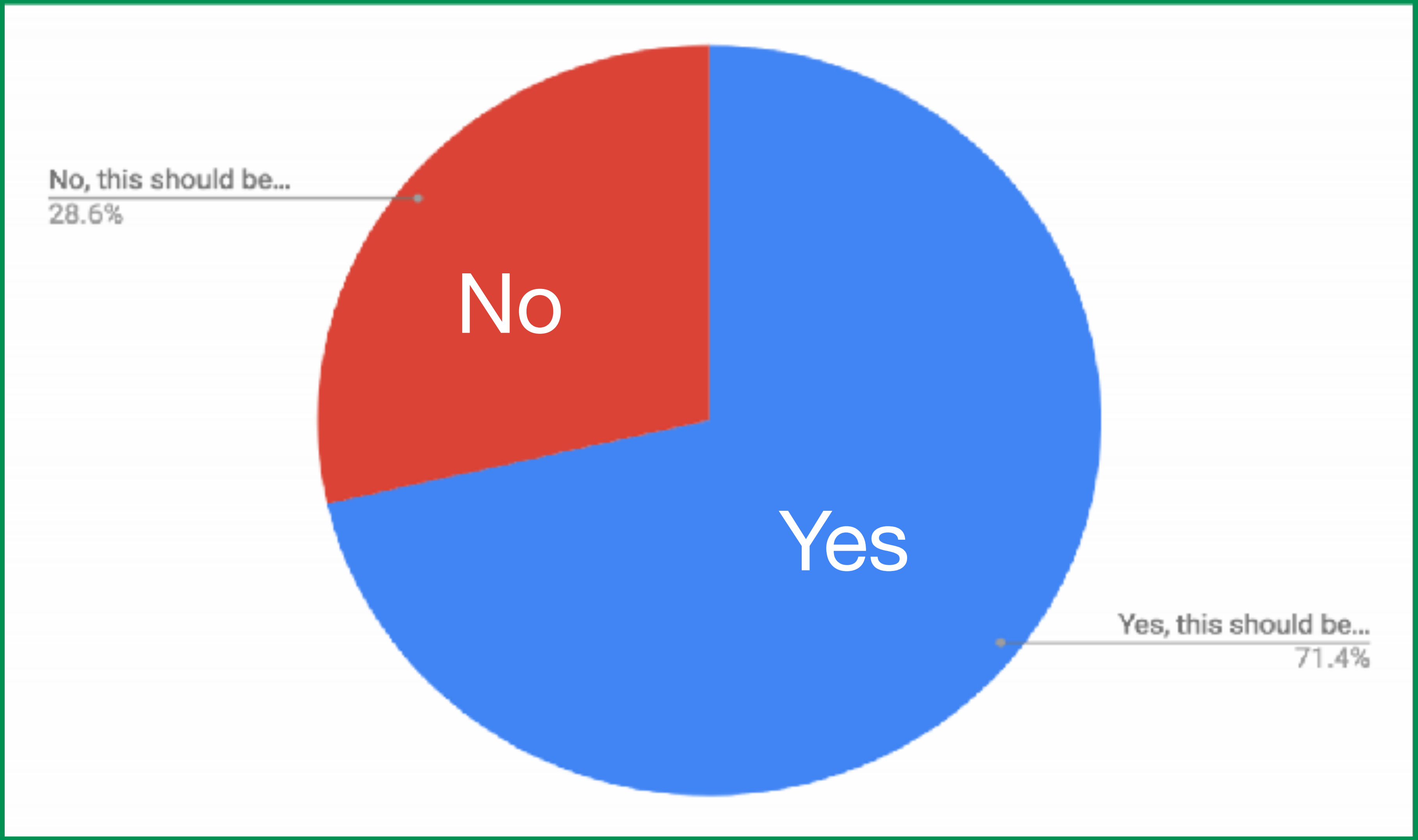
If the Solar System Data Structure can have only one set of orbital parameters, which reference frame do you prefer

21 responses

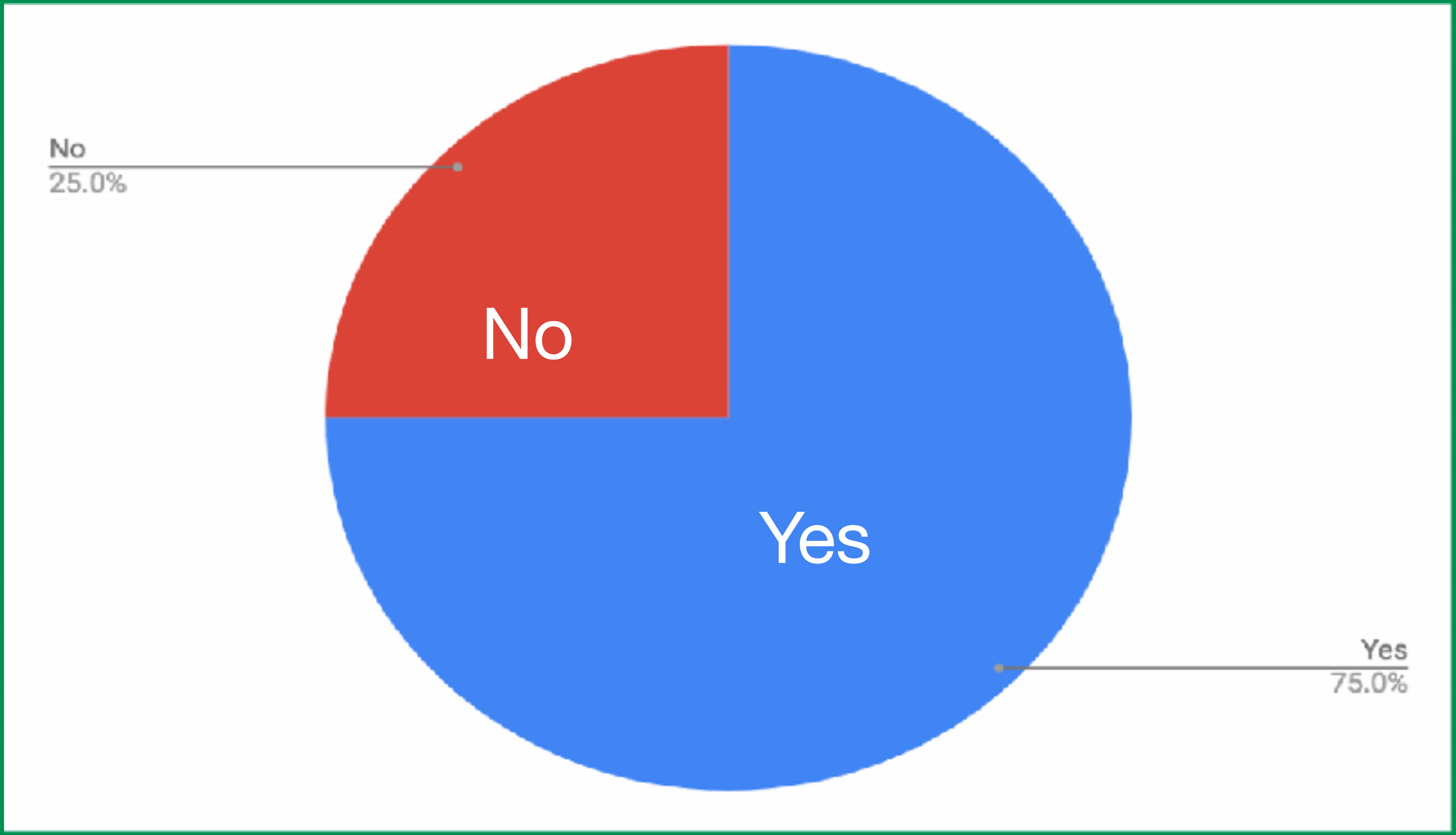


Heliocentric orbital parameters will be reported

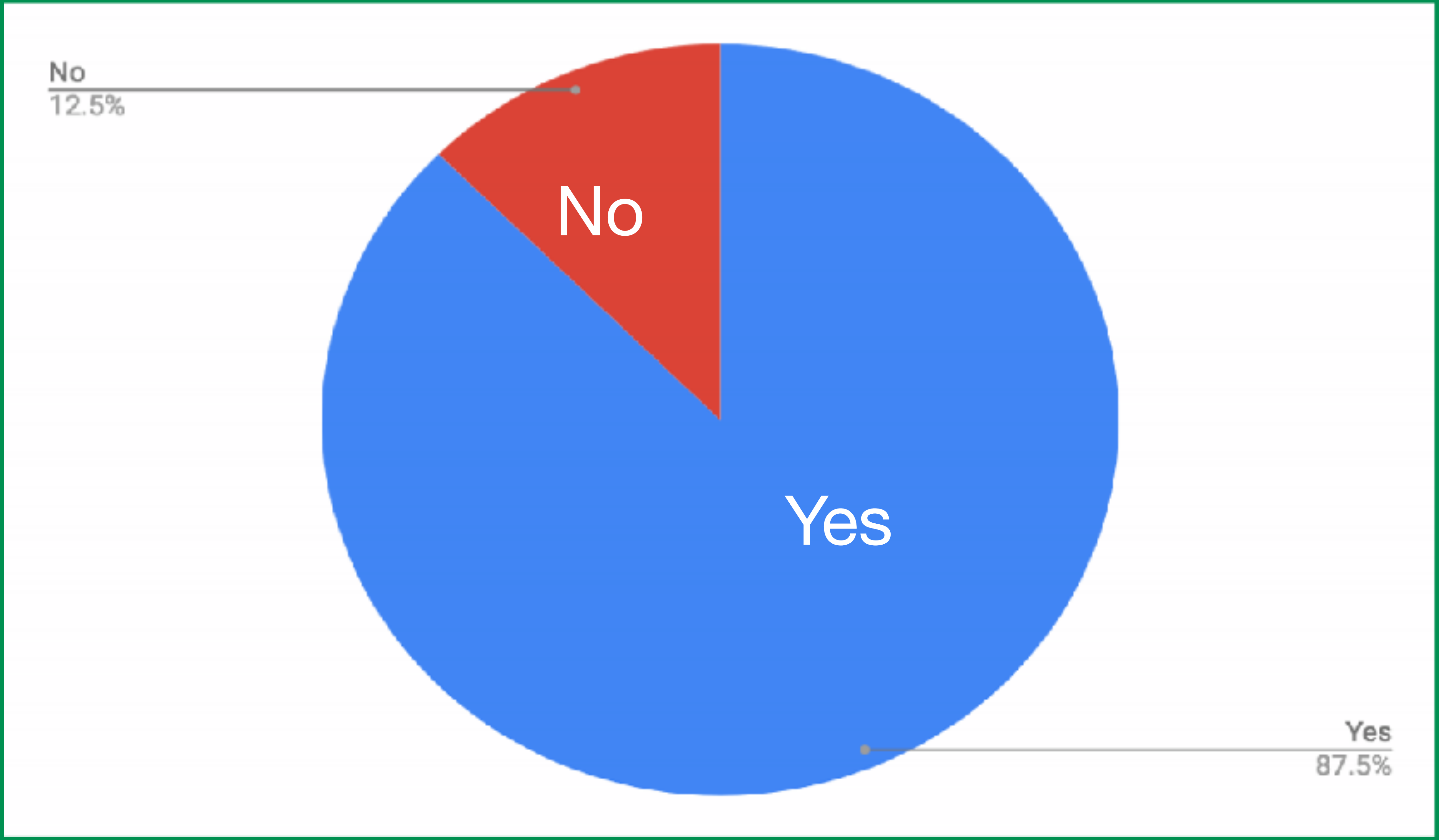
Our current proposal is for only Earth MOID (Minimum orbit intersection distance) to be recorded in the Solar System object database schema. Do you agree?



Should heliocentric distance for each detection of an identified object be reported in the Solar System object database schema?



Should the LSST alert stream and Solar System detections report aperture photometry from multiple photometric apertures of varying radii?



LSST Observing Strategy Is Not Set

Science-Driven Optimization of the LSST Observing Strategy

LSST Science Collaborations: Phil Marshall, Timo Anguita, Federica B. Bianco, Eric C. Bellm, Niel Brandt, Will Clarkson, Andy Connolly, Eric Gawiser, Zeljko Ivezic, Lynne Jones, Michelle Lochner, Michael B. Lund, Ashish Mahabal, David Nidever, Knut Olsen, Stephen Ridgway, Jason Rhodes, Ohad Shemmer, David Trilling, Kathy Vivas, Lucianne Walkowicz, Beth Willman, Peter Yoachim, Scott Anderson, Pierre Antilogus, Ruth Angus, Iair Arcavi, Humna Awan, Rahul Biswas, Keaton J. Bell, David Bennett, Chris Britt, Derek Buzasi, Dana I. Casetti-Dinescu, Laura Chomiuk, Chuck Claver, Kem Cook, James Davenport, Victor Debattista, Seth Digel, Zoheyr Doctor, R. E. Firth, Ryan Foley, Wen-fai Fong, Lluis Galbany, Mark Giampapa, John E. Gizis, Melissa L. Graham, Carl Grillmair, Phillipe Gris, Zoltan Haiman, Patrick Hartigan, et al. (52 additional authors not shown)

(Submitted on 14 Aug 2017)

The Large Synoptic Survey Telescope is designed to provide an unprecedented optical imaging dataset that will support investigations of our Solar System, Galaxy and Universe, across half the sky and over ten years of repeated observation. However, exactly how the LSST observations will be taken (the observing strategy or "cadence") is not yet finalized. In this dynamically-evolving community white paper, we explore how the detailed performance of the anticipated science investigations is expected to depend on small changes to the LSST observing strategy. Using realistic simulations of the LSST schedule and observation properties, we design and compute diagnostic metrics and Figures of Merit that provide quantitative evaluations of different observing strategies, analyzing their impact on a wide range of proposed science projects. This is work in progress: we are using this white paper to communicate to each other the relative merits of the observing strategy choices that could be made, in an effort to maximize the scientific value of the survey. The investigation of some science cases leads to suggestions for new strategies that could be simulated and potentially adopted. Notably, we find motivation for exploring departures from a spatially uniform annual tiling of the sky: focusing instead on different parts of the survey area in different years in a "rolling cadence" is likely to have significant benefits for a number of time domain and moving object astronomy projects. The communal assembly of a suite of quantified and homogeneously coded metrics is the vital first step towards an automated, systematic, science-based assessment of any given cadence simulation, that will enable the scheduling of the LSST to be as well-informed as possible.

https://arxiv.org/abs/1708.04058

Observing Strategy Optimization – Next Steps

1) *Develop tools* (running operations simulations at scale & improvements in the Metrics Analysis Framework) that will enable production and analysis of hundreds of simulated cadences

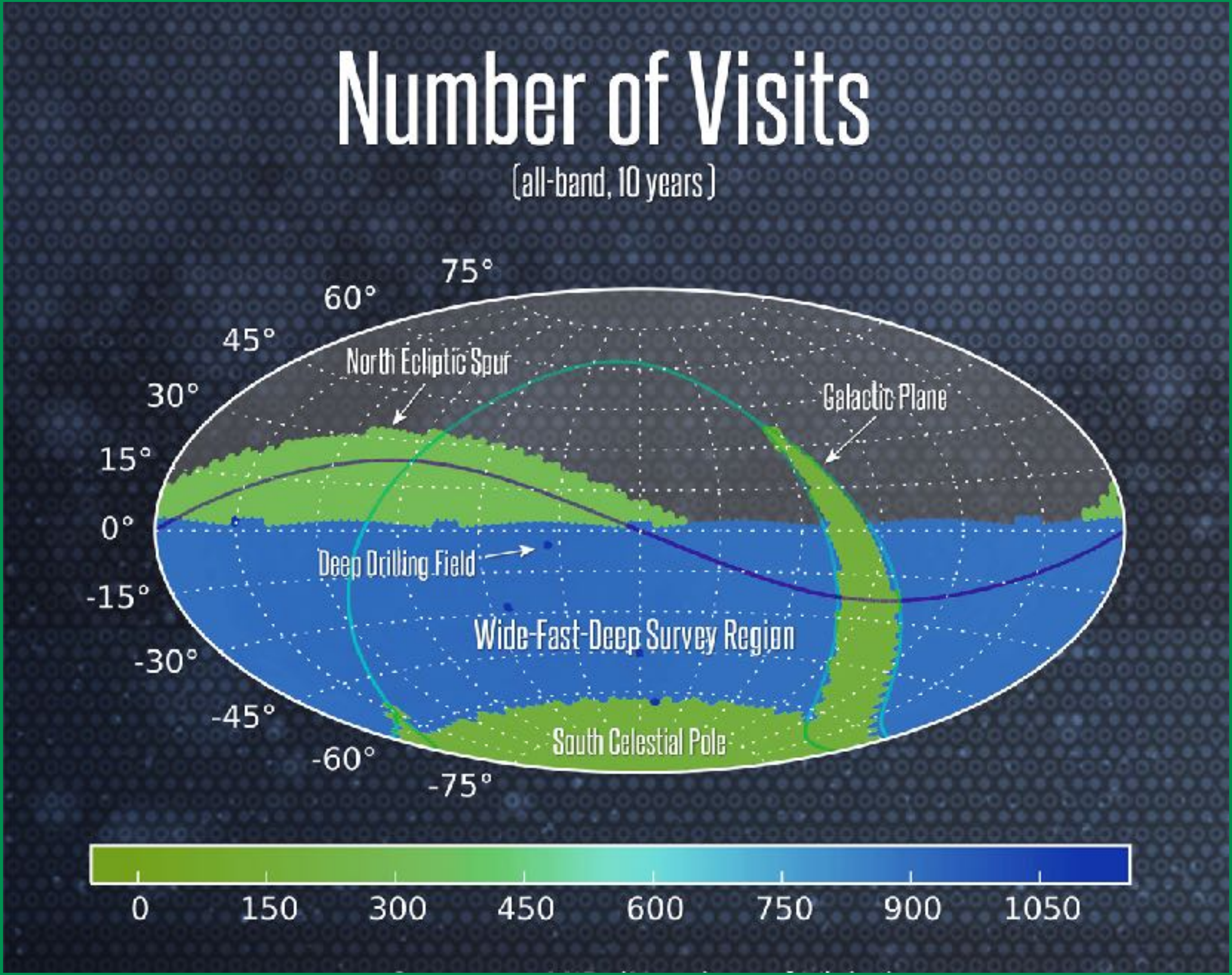
2) *Interact with the community* and stakeholders:

Call for mini-survey and Deep Drilling Field white papers - Summer 2018 (due late 2018)

3) *Produce, analyze and document a set of Observing Strategies* and present to the SAC for a final strategy recommendation (in 2020) to begin the survey.

Slide Credit Beth Wilman

Defending the Northern Ecliptic Spur



Slide Credit: LSST/AURA/LSSTC

Cadence Optimization White Paper Ideas

1. Deep Drilling Fields (Lead: David Trilling)
2. Northern Ecliptic Spur (Lead: Meg)
3. Defense of two obs per field per night (& in what filters)
4. Two snaps per obs (or 1 snap)
5. Rolling cadence?
6. ?