

# LSST Solar System Science Collaboration Update

**Meg Schwamb & David Trilling**

(Gemini Observatory)

(Northern Arizona University)

@megschwamb

LSST SSSC Co-Chairs

@lsstsssc



# 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	?	?

ugrizy photometry

Slide Credit: LSST Science book/Lynne Jones



**It's Really Coming! Science Operations Start in 2022!**



Credit: Gianluca Lombardi



The LSST SSSC accepts applications from astronomers and planetary scientists who have data access rights to LSST data (example 1: a scientist based in countries with LSST data rights (US or Chile); example 2: a scientist who is part of an institution or organization that has data access for their members (like LSST: UK)).

[www.lsstsssc.org](http://www.lsstsssc.org)



LSST Science Advisory Committee provides a formal, and two-way, connection to the external science community served by LSST.

Solar System Representatives:  
Renu Malhotra & Amy Mainzer





# Revised Data Delivery Schedule



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

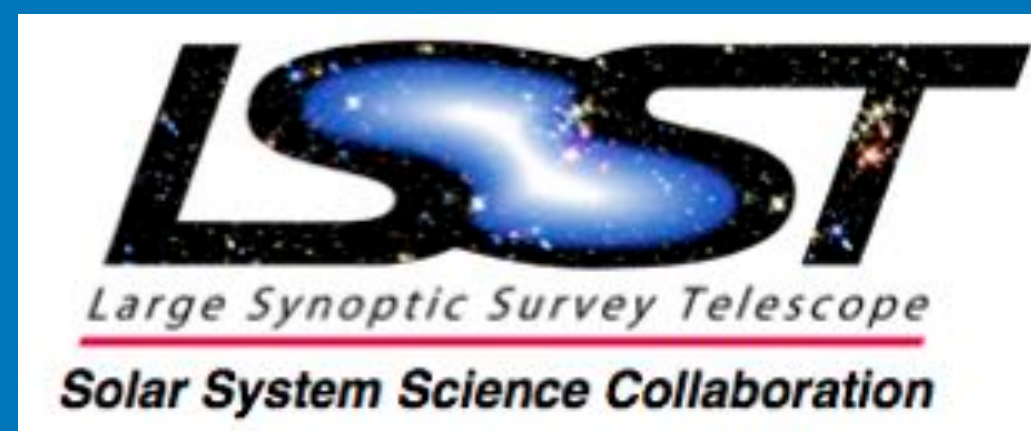
Slide Credit: Chuck F Claver



# LSST Solar System Science Collaboration (SSSC)



**David Trilling & Meg Schwamb**  
**SSSC Co-Chairs**



**[www.lsstsssc.org](http://www.lsstsssc.org)**



Wes Fraser  
**LSST: UK Solar System POC**



**Active objects Working Group (Lead: Mike Kelley):** 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

MEGAN E. SCHWAMB,<sup>1</sup> R. LYNNE JONES,<sup>2</sup> STEVEN R. CHESLEY,<sup>3</sup> ALAN FITZSIMMONS,<sup>4</sup> WESLEY C. FRASER,<sup>4</sup>  
MATTHEW J. HOLMAN,<sup>5</sup> HENRY HSIEH,<sup>6</sup> DARIN RAGOZZINE,<sup>7</sup> CRISTINA A. THOMAS,<sup>6,\*</sup> DAVID E. TRILLING,<sup>8</sup> AND  
MICHAEL E. BROWN<sup>9</sup>

ON BEHALF OF THE LSST SOLAR SYSTEM SCIENCE COLLABORATION

<https://arxiv.org/abs/1802.01783>

<sup>1</sup>*Gemini Observatory, Northern Operations Center, 670 North A'ohoku Place, Hilo, HI 96720, USA*

<sup>2</sup>*Department of Astronomy, University of Washington, 3910 15th Ave NE, Seattle, WA 98195, USA*

<sup>3</sup>*Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA, 91109, USA*

<sup>4</sup>*Astrophysics Research Centre, Queen's University Belfast, Belfast BT7 1NN, UK*

<sup>5</sup>*Harvard-Smithsonian Center for Astrophysics, 60 Garden St., MS 51, Cambridge, MA 02138, USA*

<sup>6</sup>*Planetary Science Institute, 1700 East Fort Lowell Road, Suite 106, Tucson, AZ 85719, USA*

<sup>7</sup>*Brigham Young University, Department of Physics and Astronomy, N283 ESC, Provo, UT 84602, USA*

<sup>8</sup>*Department of Physics and Astronomy, Northern Arizona University, P.O. Box 6010, Flagstaff, AZ 86011, USA*

<sup>9</sup>*Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125, USA*

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## 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.



# How do we achieve our LSST Solar System Science Roadmap? Leads to the LSST Solar System Software Roadmap Effort



**Draft expected by end of the month. Final version by end of 2018/early 2019**

Image credit: bahahamelly - flickr - <https://www.flickr.com/photos/bahahamelly/14900306241/>



# Collaboration Publication Policy

**Committee Formed to Draft and Brainstorm Policy Based on Past SSSC Feedback**



**Draft Policy expected by end of the month. Final version by end of 2018/early 2019**

Image credit: - flickr - <https://coffee-channel.com>



# First LSST Solar System Readiness Sprint

July 10-12, 2018

University of  
Washington, Seattle  
WA



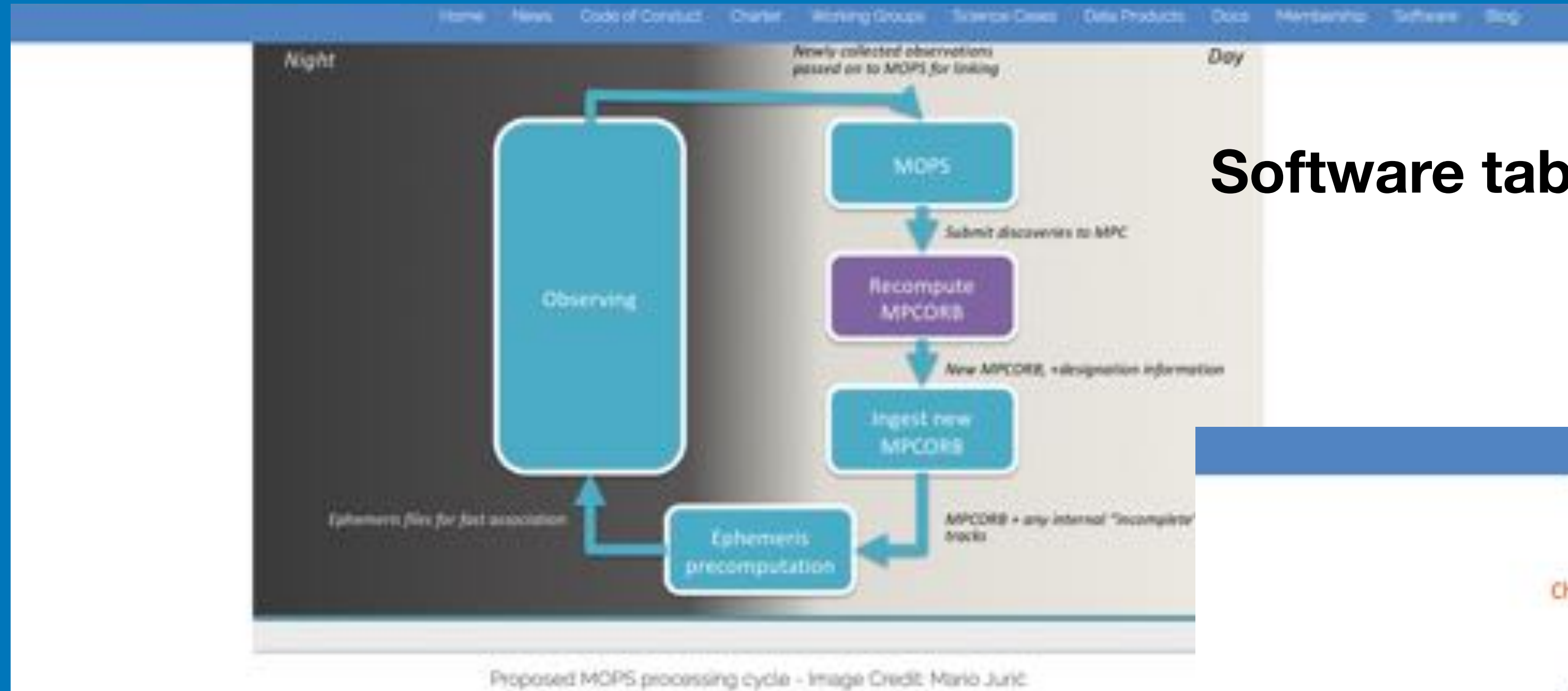
B612

 DEPARTMENT OF ASTRONOMY





# SSSC Website has latest info on MOPS and Alert Stream as presented at the Readiness Sprint



Software tab

## MOPS Frequently Asked Questions (FAQ)

What will be in the catalog? Can we still change what's going to be measured for Solar System Objects?

The Data Products Definition Document (DPDD) defines the outline of what the catalog will contain, but adding more detail via discussion can make changes as long as they don't affect budget and schedule, but before the end of 2018 the bulk of the data product format/iter

The goal is to quickly transmit information about new detections, enabling downstream classification & follow-up

**Challenge:** Identify & extract the subset of events of interest in the full alert stream

Image Credit: LSST Data Management/Leanne Guy

### LSST Alert Packets

**Alert Packet:** a text file containing the data & associated schema for one DIASource

**Each alert (a VOEvent packet) will at least include the following:**

- AlertID: An ID uniquely identifying this alert
- Prompt Products database ID
- Science Data
  - The DIASource record that triggered the alert
  - The entire DIAObject or SSObject record
  - Time series (up to 12 months) of all previous of DIASource detections
  - Matching Object IDs from the latest Data Release, and 12 months of DIASource records
  - Various summary statistics ("features") computed of the time series
- 30x30 pixel, cut-out of the difference image (FITS)
- 30x30 pixel, cut-out of the template image (FITS)

Image Credit: LSST Data Management/Leanne Guy

Data Products tab

<http://www.lsstsssc.org>

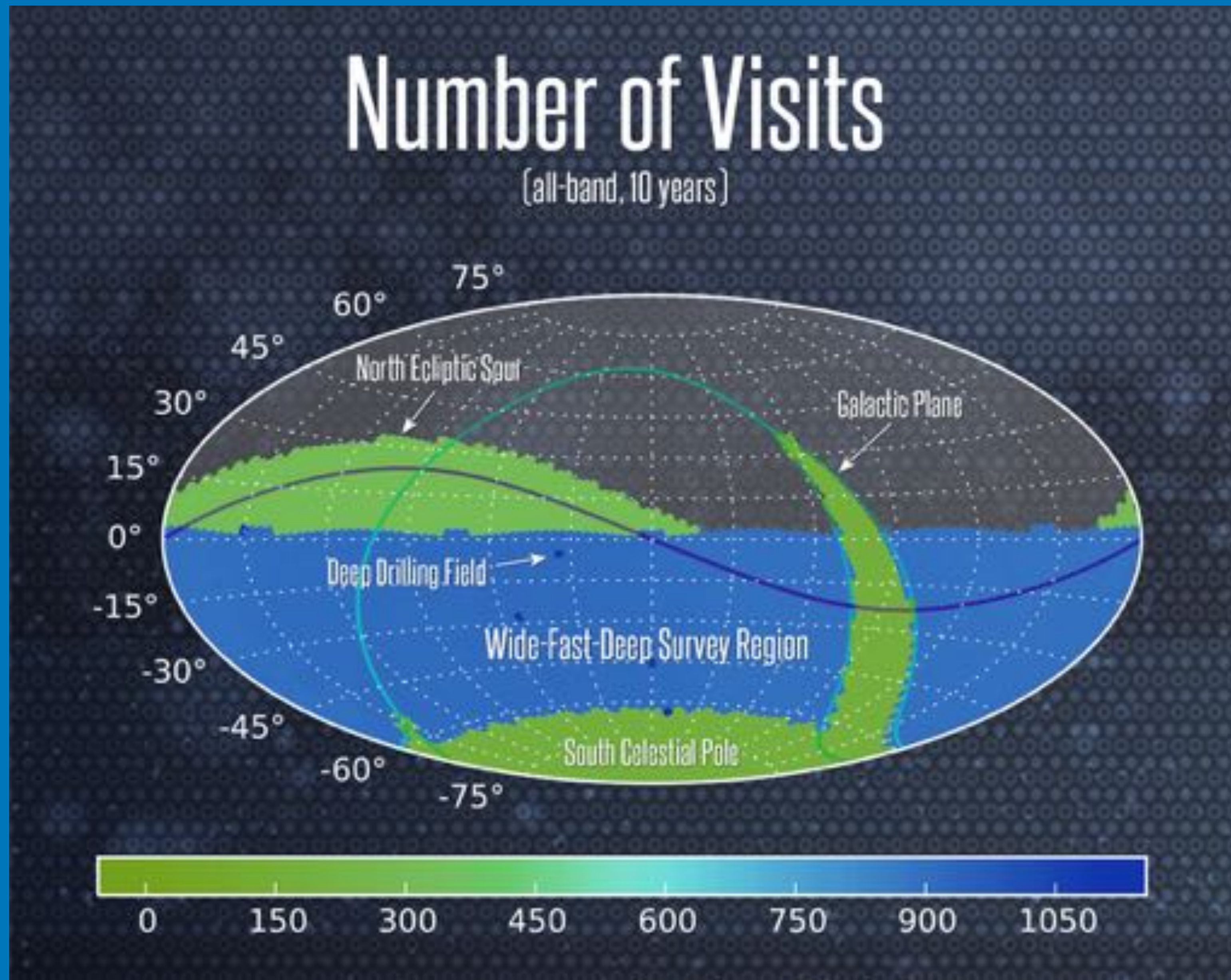


# Timeline set for in the LSST Cadence Optimization White Paper

Call for white papers	June 30, 2018
2018 Project and Community Workshop	Aug 13-17, 2018
White paper submission deadline	Nov 30, 2018
List of to-be-simulated survey strategies	April 2019
Simulated survey strategies available	End of 2019
Survey Strategy Committee (SSC) established	Early 2020
Advisory report from Project to SSC	Early 2020
SSC report on official initial LSST survey strategy	Early 2021
Baseline simulation of initial LSST survey strategy	Mid 2021
Start of LSST Operations	2022
Regular survey reviews by the SSC	2022-2032



# Supporting the Northern Ecliptic Spur





# Current Cadence Optimization White Paper Efforts

1. Deep Drilling Fields (Lead: David Trilling)
2. Northern Ecliptic Spur (Lead: Meg Schwamb)
3. Twilight Survey (Lead: Rob Seaman)
4. Should there be a white paper about 1 versus 2 snaps at each observation or discovery/recovery filter choice?

**More discussions and work on the Hackathon tomorrow**

**Still time to join, contact one of the white papers leads or the co-chairs**



# Co-Chair + Working Group Lead Elections in May 2019



Image credit: ratinasock (Carol Raabus) - flickr - <https://www.flickr.com/photos/ratinasock/4447403222/>



# 2nd LSST Solar System Readiness Sprint

June 4-6, 2019  
Chicago, IL

ADLER  
PLANETARIUM



Image credit: - Chris Smith - flickr





# Stop By Tomorrow

## **LSST Solar System Hackathon**

Thursday October 25, 2018

4:30-7:30pm

Room 200 B-C - Open to All DPS Registrants

Get together and work on pitched projects related to LSST Solar System science - cadence optimization white papers, brain storm follow-up observing proposals, discuss paper ideas, community software, work with python notebook metric analysis tutorials, and more

Pitch a project or join a suggested project

Food and refreshments provided thanks to AURA support

Image Credits: Anne Verbiscer

