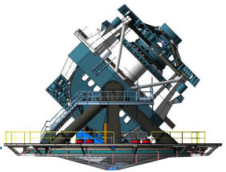


LSST Observing Strategy

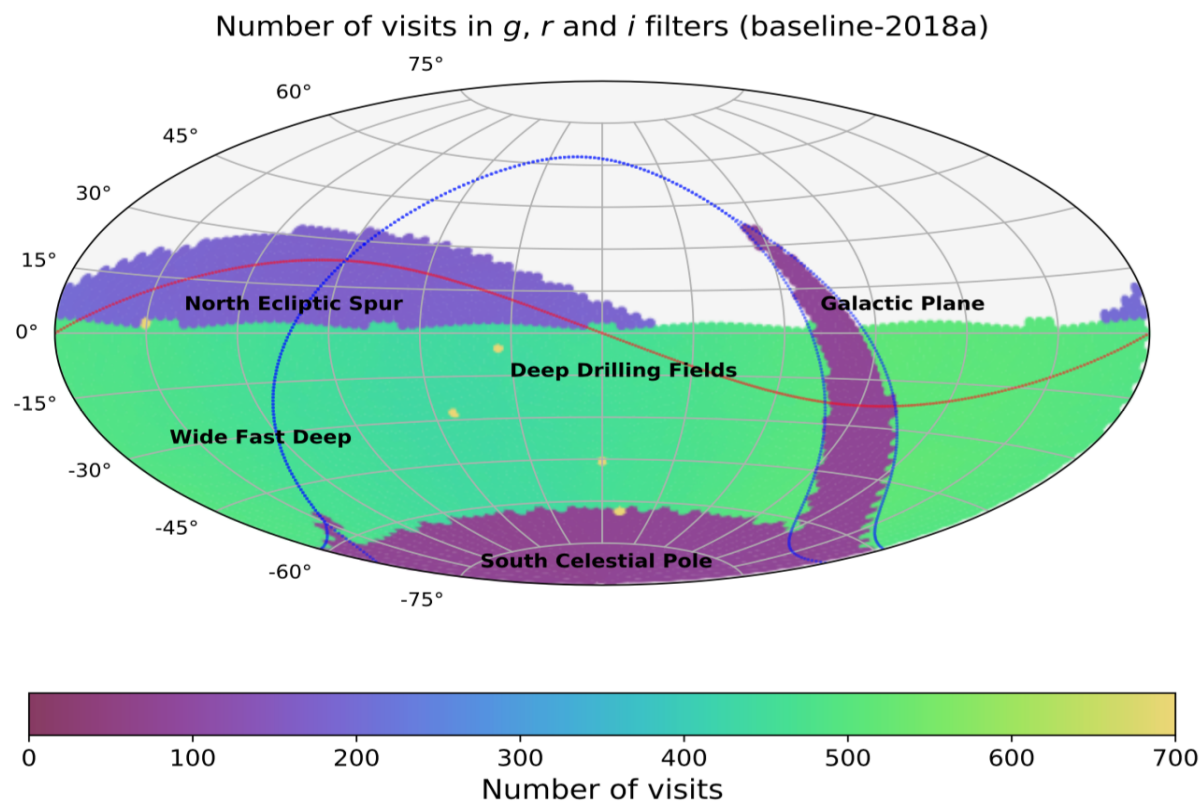
- Zeljko Ivezic, LSST Project Scientist
- Tiago Ribeiro, LSST Scheduler Scientist

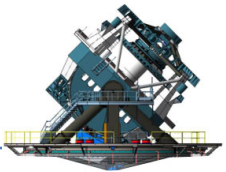


Outline



- 1) Call for white papers on LSST cadence optimization
- 2) Feature-based Scheduler





Scheduler Team Updates



- Software development (Tucson)
 - Tiago Ribeiro
 - Colin Winslow
 - Andrew Heyer
- Survey Simulations and Analysis (UW)
 - Lynne Jones (50%)
 - Owen Boberg
 - Peter Yoachim (10%)
 - Zeljko Ivezic (overall coordination)



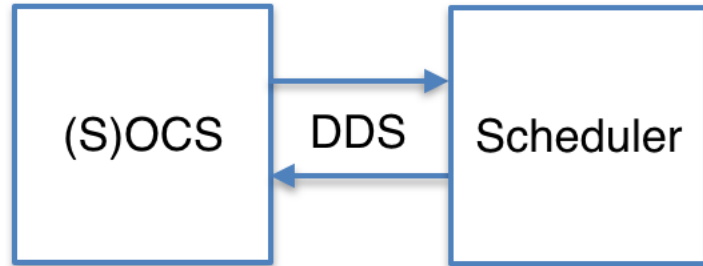
Scheduler Team Meeting @ UW



Updates on Scheduler



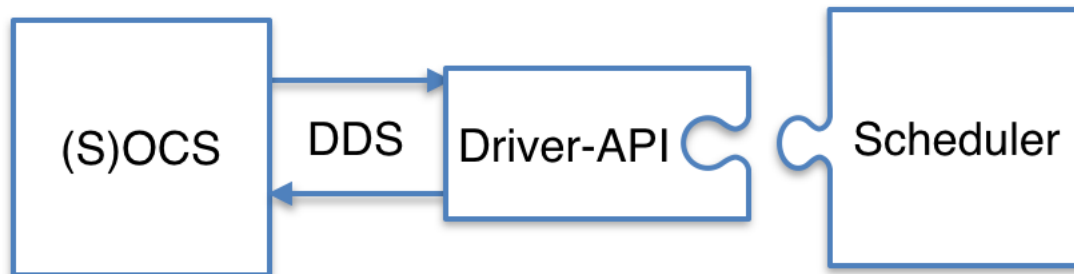
As it was...



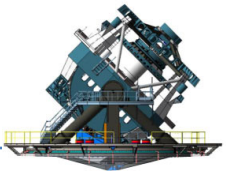
This year, the “Scheduler” is going to become a stand-alone algorithmic implementation in Python; communication with the LSST-specific Observatory Control System will be “abstracted away”

We are experimenting with a new algorithm, nick-named “Feature-based Scheduler”, developed by Elahesadat Naghib (Princeton University) and recently prototyped by Peter Yoachim (UW).

As it will be...



This new algorithm will be described in the second part of this talk by Tiago.

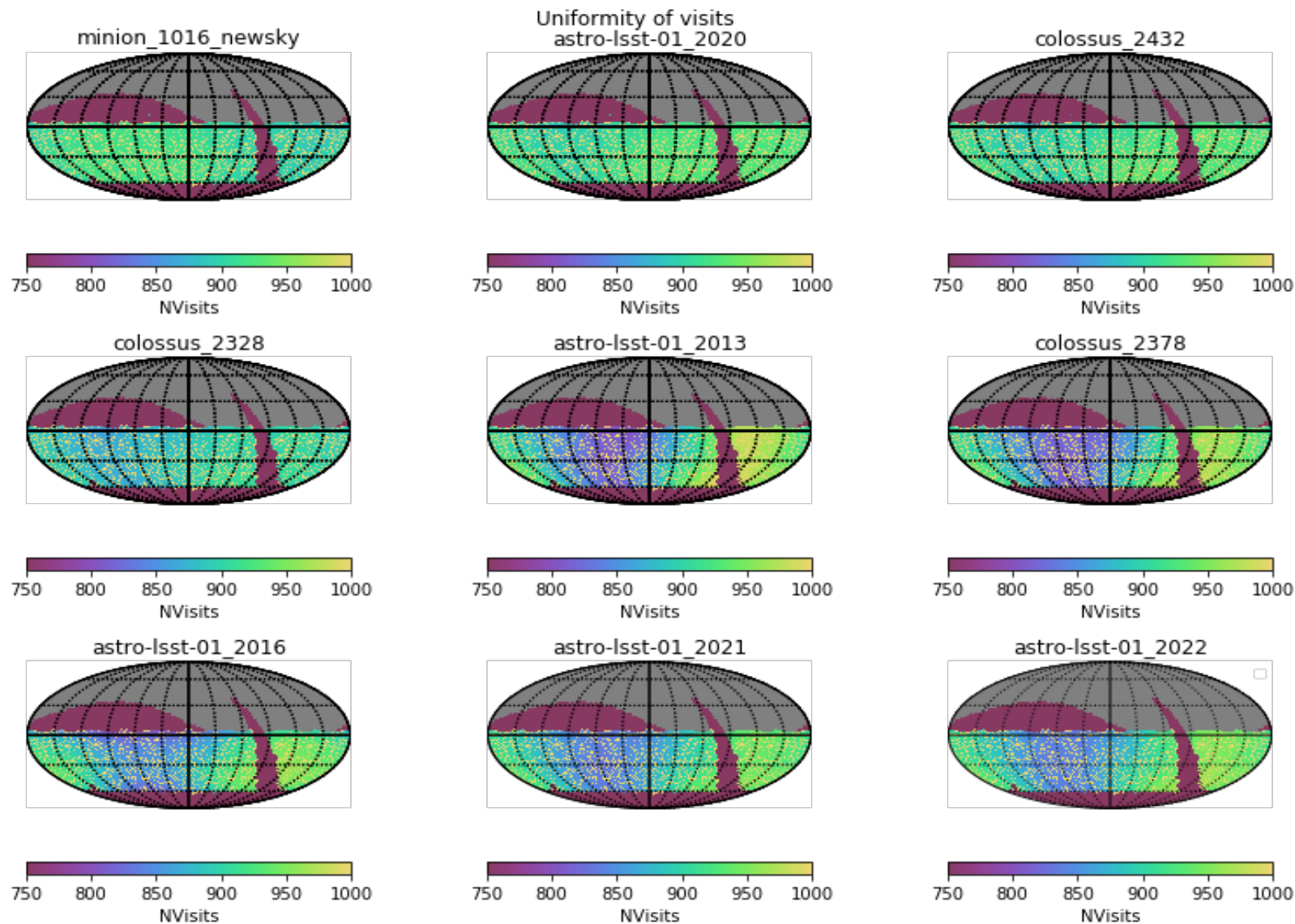


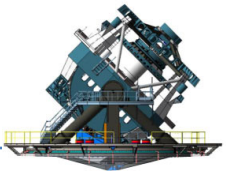
Call for white papers on LSST cadence



- The LSST community will be invited to play a key role in the refinement of LSST's Observing Strategy by submitting white papers that will describe proposed modifications of the current baseline survey strategy, including both the main survey, the so-called “deep drilling fields” and mini surveys.
- This call for white papers will be released by **June 30**.





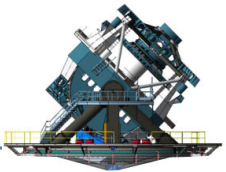


Call for white papers on LSST cadence

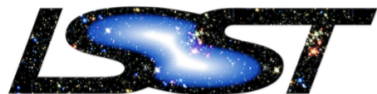


- While the footprint of the main LSST survey is fairly well-defined, the cadence of observations within this footprint has significant flexibility available. Further, the strategies and time balance for mini surveys and “deep drilling” fields are not yet finalized.
- We are requesting white papers to help plan these aspects of the LSST survey strategy. The deadline for submitting these white papers is **November 30, 2018**.





Call for white papers on LSST cadence



LARGE SYNOPTIC SURVEY TELESCOPE

Large Synoptic Survey Telescope (LSST)

Call for White Papers on LSST Cadence Optimization

Željko Ivezić, Lynne Jones, Tiago Ribeiro,
the LSST Project Science Team,
and the LSST Science Advisory Committee

Document-28382

Latest Revision: 2018-05-15

DRAFT



LARGE SYNOPTIC SURVEY TELESCOPE

Call for LSST Cadence White Papers

Document-28382

Latest Revision 2018-05-15

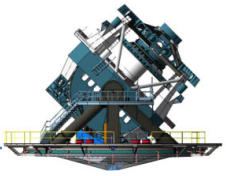
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iv

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Timeline



- 1) issue call for white papers in **June 2018** (deadline: **Nov 30, 2018**)
- 2) SAC: starting in **Dec 2018**, triage the submitted white papers and deliver the list of observing strategies to be simulated by **Apr 2019**
- 3) starting in **Apr 2019**, simulate the list of observing strategies recommended by the SAC by **the end of 2019**
- 4) deliver a report, including MAF analysis, on simulated strategies to the SAC by **Apr 2020**
- 5) SAC: starting in **Apr 2020**, make recommendations to the Operations Director by **Sep 2020**
- 6) starting in **Oct 2020**, produce, analyze and publish the adopted baseline strategy in **2021**



Additional support



- 1) There will be a session about observing strategy and white paper solicitation at the August 2018 Project and Community Workshop in Tucson
- 2) Jennifer (Jeno) Sokolski, the new LSSTC Science Director, is organizing LSST Cadence Workshop at the Simons Center for Computational Astrophysics in New York, September 2018
- 3) Several Science Collaborations are organizing their own activities to respond to the call (in particular, TVS and DESC)
- 4) LSSTC has agreed to provide partial funding support for attending the 2019 Project and Community Workshop

Codename: Grand canyon

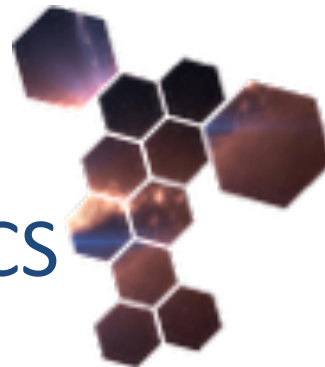


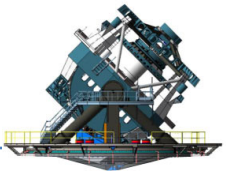


From the beginning: What is OpSim?



- OpSim: Operations Simulator
 - <https://www.lsst.org/scientists/simulations/opsim>
- It is composed of two main packages (and several other sub-packages).
- sims_ocs: The *Simulated* Observatory Control System or SOCS
- ts_scheduler: The main scheduler code base
- Provide a framework to perform realistic simulations and optimization studies mimicking the actual observatory operation
- Enable quick and easy swapping of SOCS by the actual OCS

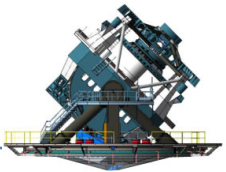




Progress and current status



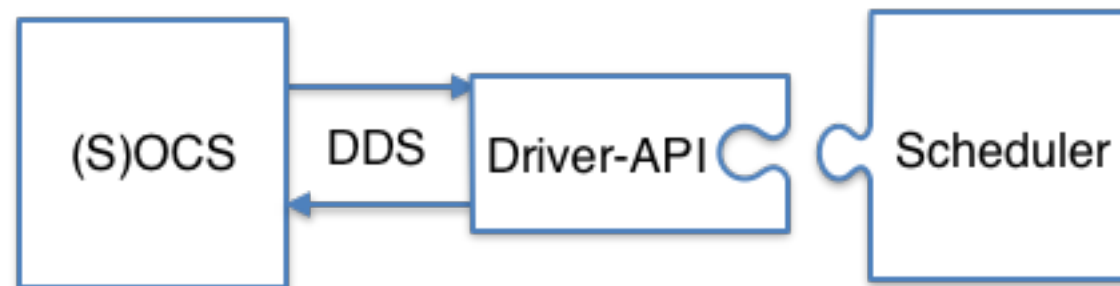
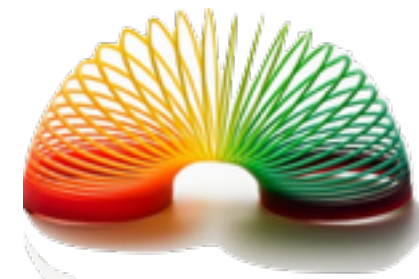
- OpSim v4 being used to produce new baseline strategy
- Contains important changes and improvements in both the main packages and other sub-packages (e.g. sky brightness models)
- Officially accepted by CCB on **May 30, 2018**
- Latest version of the Scheduler includes some new scheduling algorithmic features:
 - Time balancing between “proposals”
 - Better control of visit distribution with respect to airmass and hour angle
 - Look ahead for time series and area distribution* proposals
 - Driver-API v0



Driver-API: Flexibility



- Encapsulates the complexity of the DDS middleware communication interface
- Establish standard interface mechanism for scheduler functionalities
 - Input telemetry
 - Target generation
 - Target validation
 - Error handling
 - Commands/Events handling
- Support the T&S scheduler team path towards operations
- Support survey strategy team optimization efforts and community-driven cadence experiments in a realistic environment (a.k.a. OpSim)
- Support switch to a more flexible algorithm: **Feature Based Scheduler**





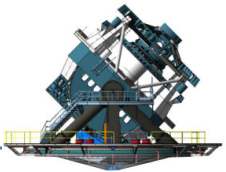
Feature-based Scheduler



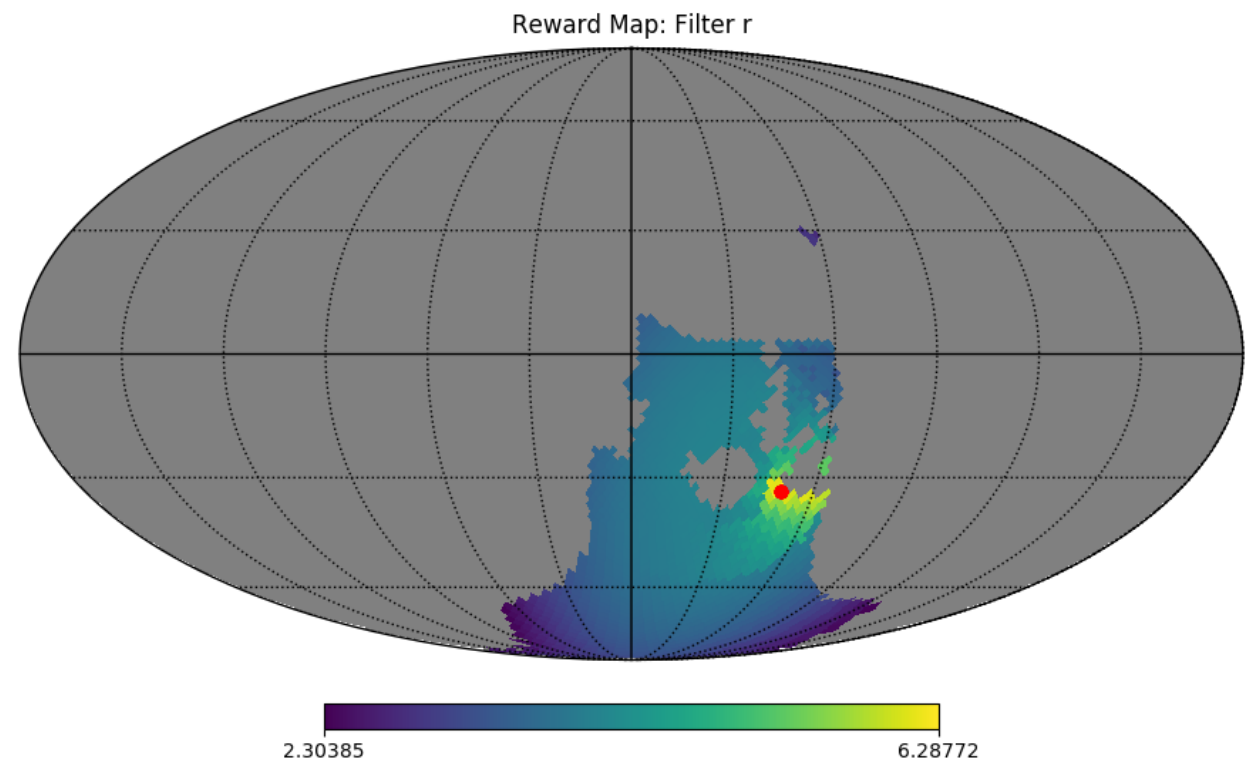
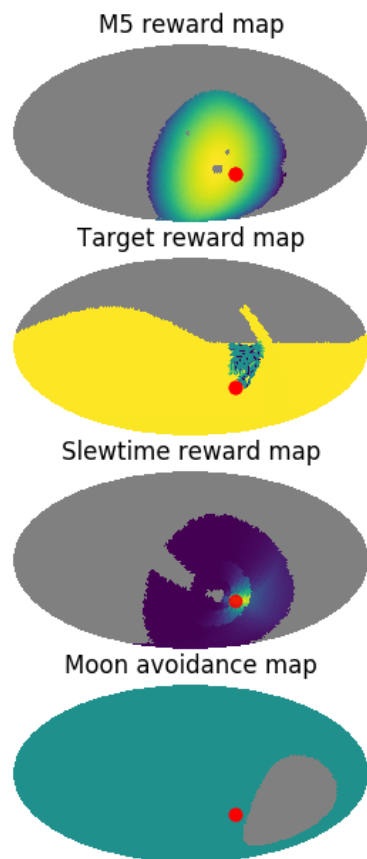
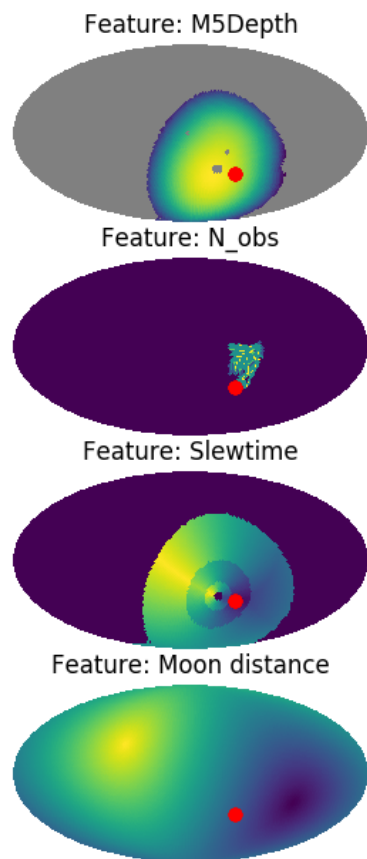
- Feature based scheduler is similar to current scheduler, but with some subtle and yet important changes

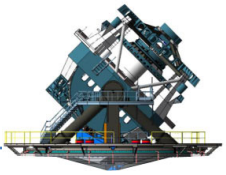
Features → Basis Functions → Reward Function → Decision Function (survey)

- Features
 - Current status of survey progress, sky conditions, telescope status
- Basis Functions
 - Computed from features. HEALpix maps (or scalars). Similar to the “time need” OpSim map, etc.
- Reward Function
 - Combination of the Basis Functions. “Similar” to the final ranking OpSim map
- Decision Function
 - Since we are at higher spatial resolution, this converts the Reward Function to an actual pointing



Feature-based Scheduler





Why is this design more suitable?



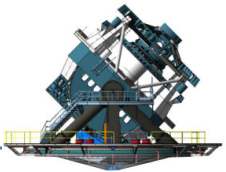
- On the “Proposal-based scheduler”:
 - No data abstraction. Telemetry is treated on a “case by case” basis.
 - Fixed sky resolution (adopted sky tessellation)
 - Reward methods are “hard coded” into the Proposals. New “rewards” requires digging down deep inside the software.
 - The decision method (a.k.a. greedy algorithm) is also “hard coded” into the system. Selecting a different method (or abstracting it) would require major changes to the software.
- On the “Feature-based scheduler”:
 - Features provide high level data abstraction
 - Arbitrary sky resolution (healpix maps) and easy strategy updates
 - Basis function provide high level reward abstraction
 - Base survey provides high level decision abstraction



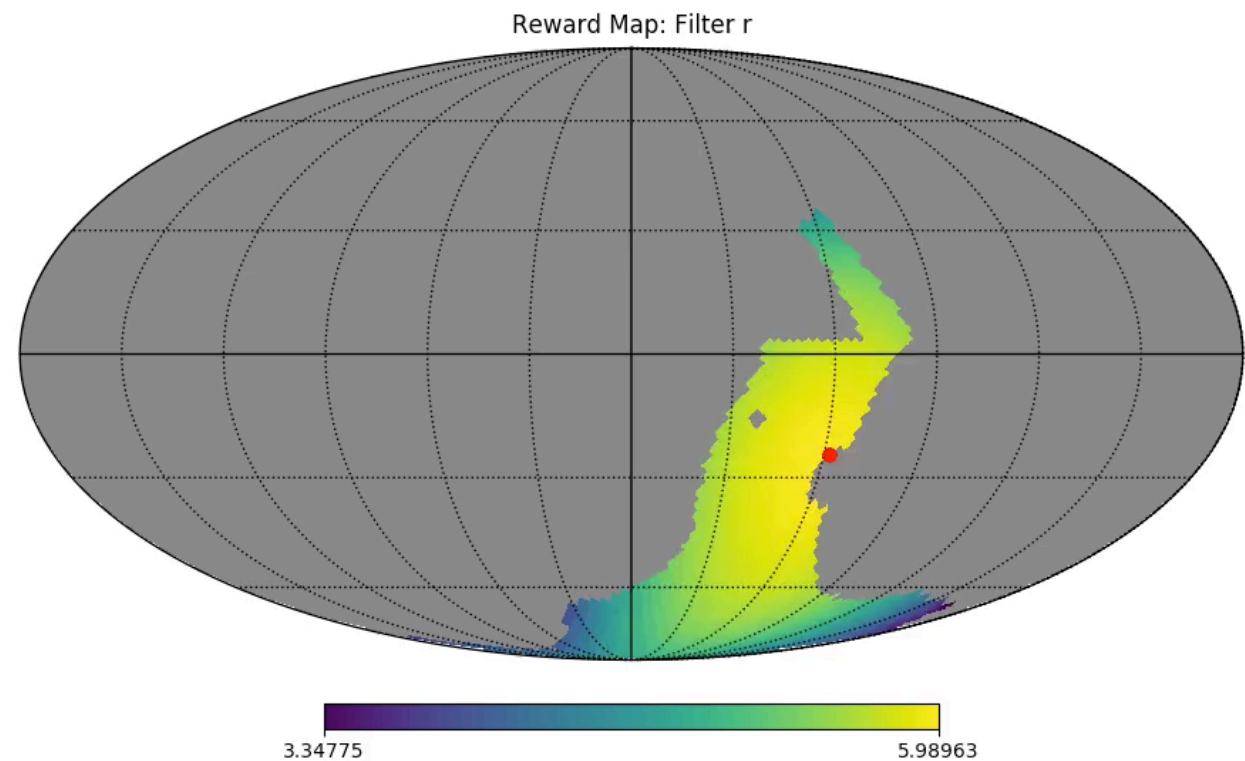
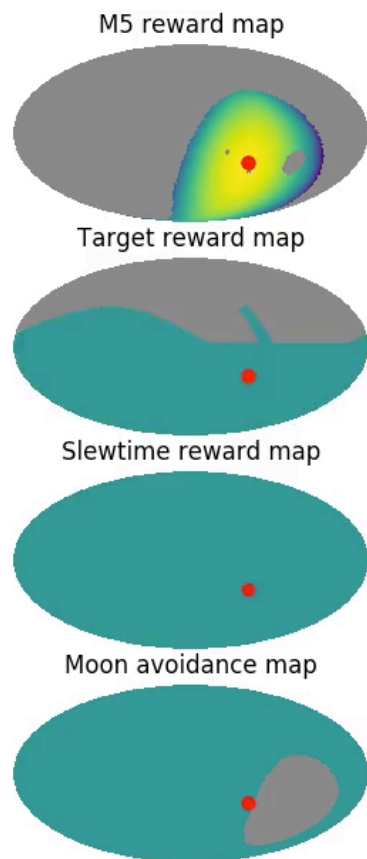
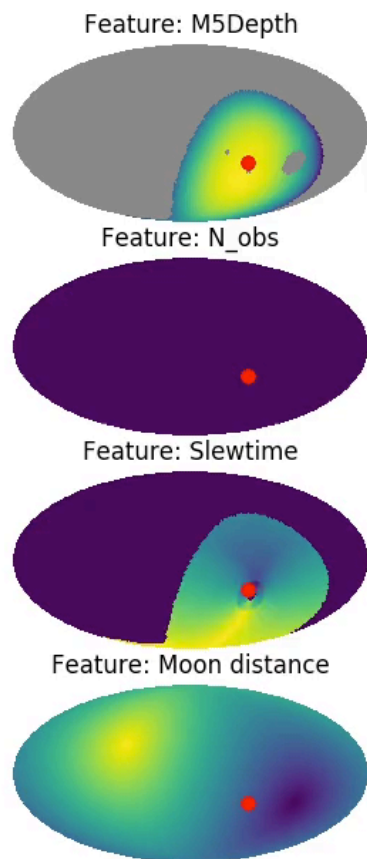
Timeline

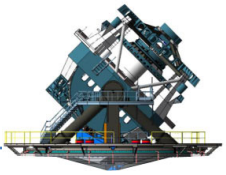


- 1) issue call for white papers in **June 2018** (deadline: **Nov 30, 2018**)
- 2) By **September 2018** official adoption of Feature based scheduler
- 3) SAC: starting in **Dec 2018**, triage the submitted white papers and deliver the list of observing strategies to be simulated by **Apr 2019**
- 4) starting in **Apr 2019**, simulate the list of observing strategies recommended by the SAC by **the end of 2019**
- 5) deliver a report, including MAF analysis, on simulated strategies to the SAC by **Apr 2020**
- 6) SAC: starting in **Apr 2020**, make recommendations to the Operations Director by **Sep 2020**
- 7) starting in **Oct 2020**, produce, analyze and publish the adopted baseline strategy in **2021**



Feature-based Scheduler





- Merci
- Thank you
- Gracias
- Obrigado
- Hvala

- More info about “Feature-based telescope scheduler”:
<https://www.spiedigitallibrary.org/conference-proceedings-of-spie/9910/1/Feature-based-telescope-scheduler/10.1117/12.2232053.full?SSO=1>
- Elahesadat’s webpage: <https://sites.google.com/view/elahesadatnaghib/home>