SOCS and Scheduler Progress and Process

for the OCS, Scheduler, Simulation Teams

The Scheduler and Simulation Framework

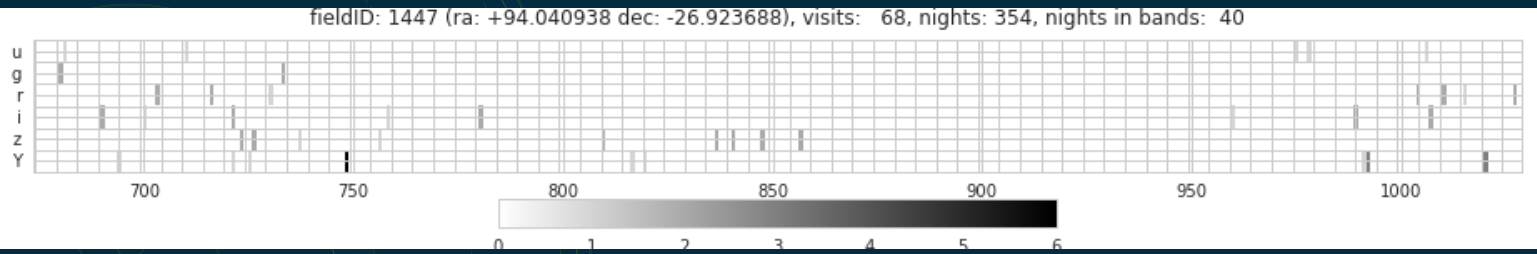
- An integrated development and testing environment for the Scheduler
  - Simulated Observatory Control System (SOCS): simulation of the state of the LSST system, telemetry from OCS, current and predicted weather, sky conditions, prior observations, and override requests
  - Scheduler: determines (given constraints and science requirements/ objective function) the next sequence of fields

- Priorities of the Scheduler and SOCS
  - *Provide a tested and validated scheduler for the LSST project that meets science requirements in SRD (LPM-17), Scheduler Requirements (LTS-347), and SOCS Requirements (LSE-259)*
  - ***Deliver*** prior to the start of commissioning (by mid 2019) and then optimize during commissioning and early operations as we understand the performance system
  - Deliver an initial implementation of the scheduler to ensure that the OCS communication mechanisms can be tested and validated

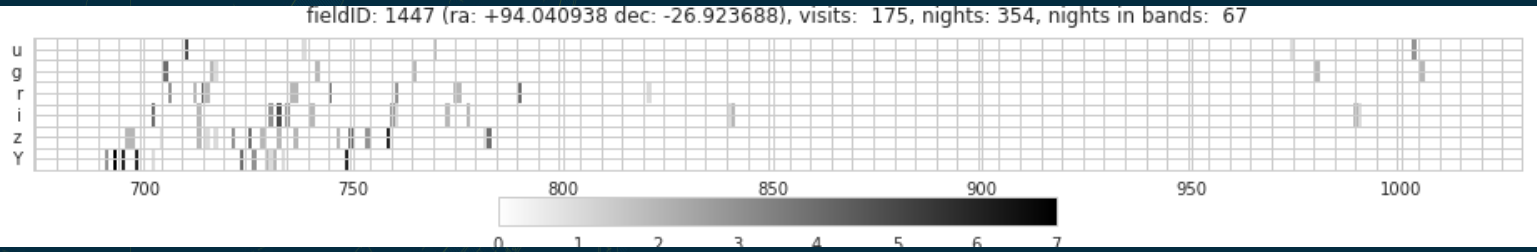
Baseline and rolling cadence (OpSim v3)

- Baseline Minion 1016 (Aug 2016)
  - Removal of end of survey panic, improved estimation of FWHM, improved downtime model, refactoring of proposal configurations
  - 2,447,931 visits: WFD (85.1%), NES (6.5%), GP (1.7%), SCP (2.2%), DD (4.5%)
  - Mean slew time to 6.8s, median seeing (0.93 arcsec)
- Rolling cadence
  - Block rolls: divide the sky into 3 contiguous regions and observed each region for 3 continuous years
  - Sandwich rolls: divide the sky into a full sky and 3 contiguous sub-regions, observed the full sky in year 1 and 10, observe the sub-regions in years 2-9 cycling through each of the sub-regions for 8/9 of a year at a time
- What v3 can and cant do
  - Rolling regions must be separated in space and time for v3.3.5 (i.e. a rolling region cannot be active at the same time as the full sky WFD)
  - We cant limit the number of visits per night
  - Footprint of the rolling cadence regions can be arbitrary

Rolling Cadence vs baseline (OpSim v3)

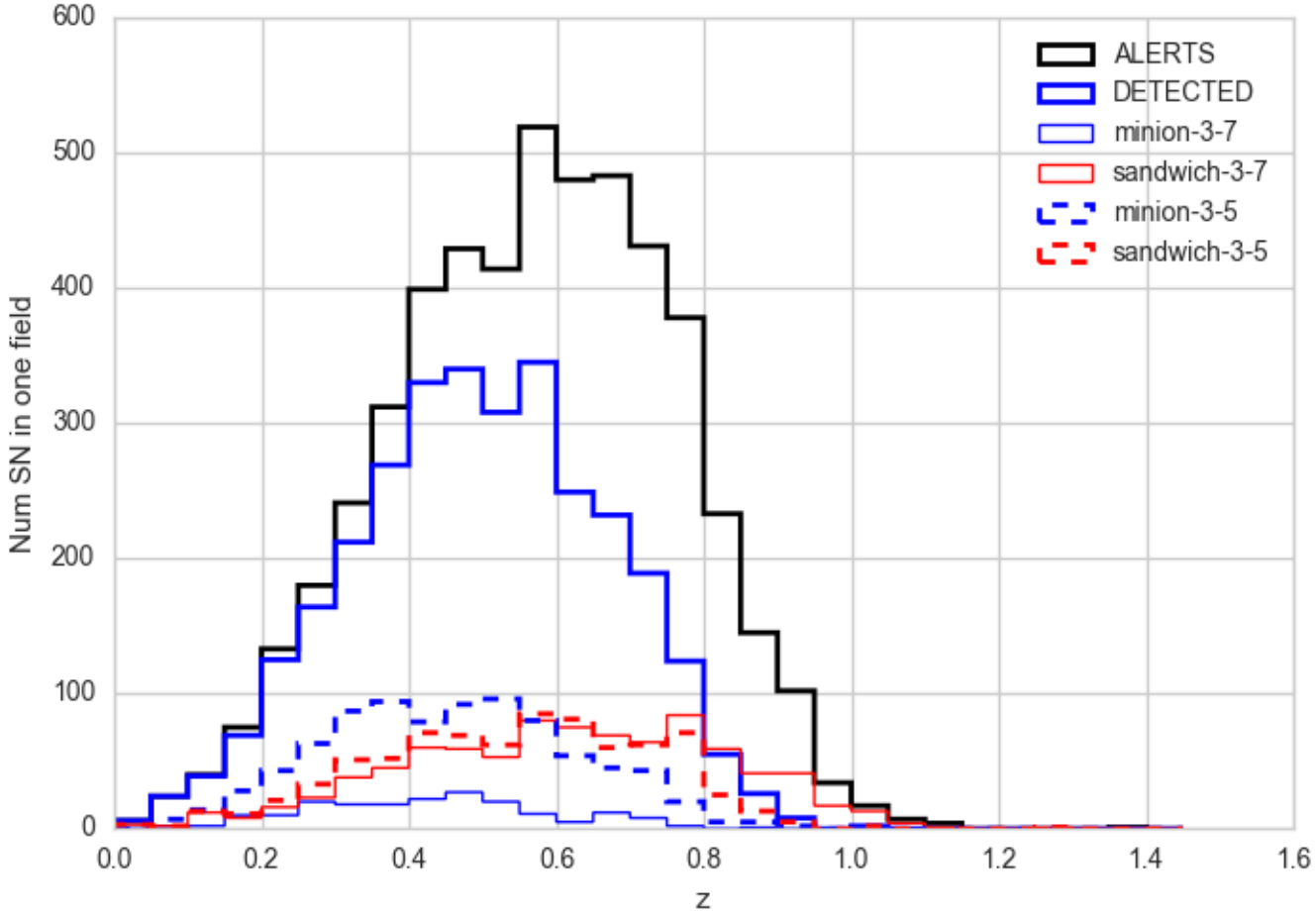


One year of observations for Minion 1016



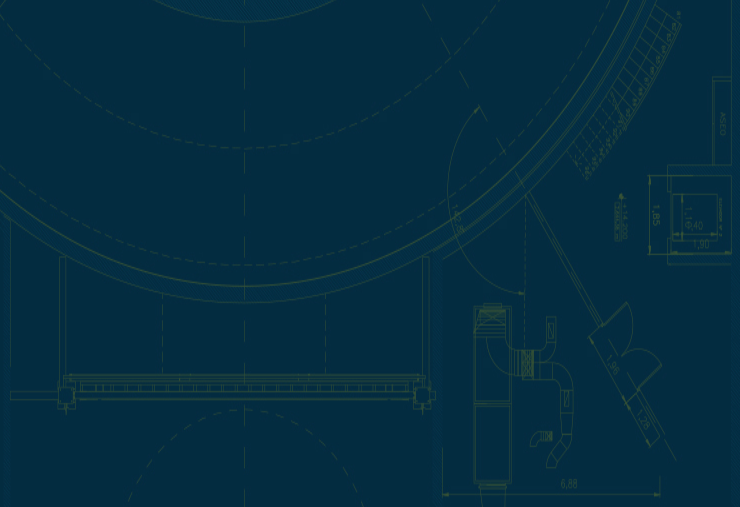
One year of observations for a sandwich roll

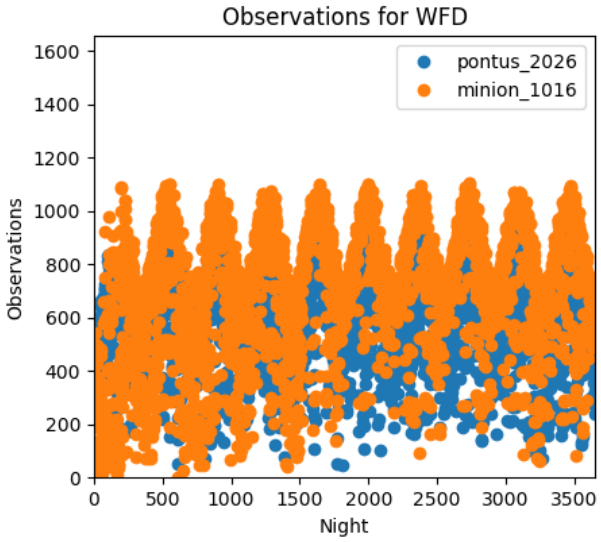
Distribution of SN given a sandwich rolling cadence

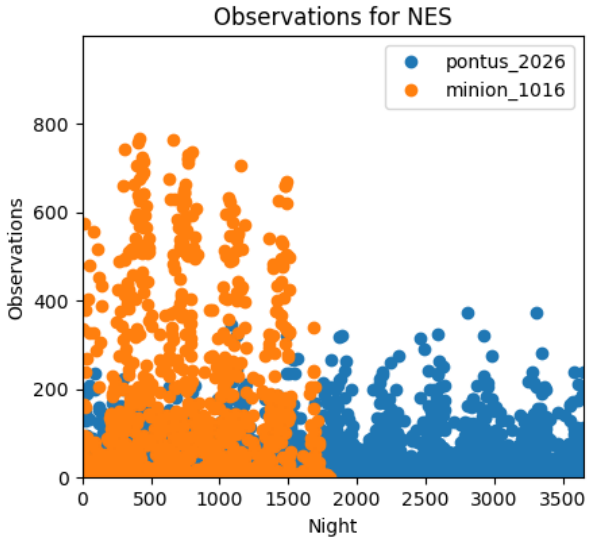


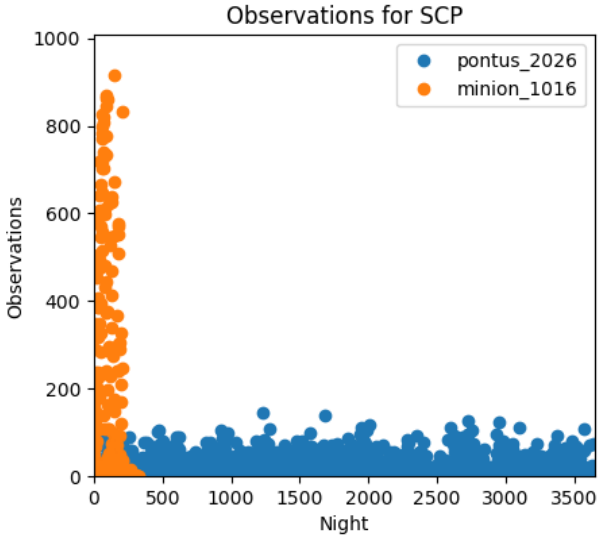
OpSim v4: SOCS and Scheduler

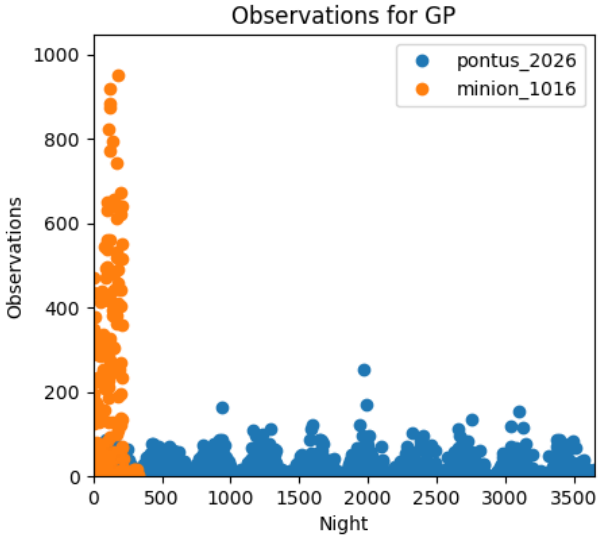
- Status
  - Requirements for SOCS and Scheduler (LTS-347, LSE-259) under change control
  - Delivery of v1.0 codebase (1 March 2017)
  - In the process of extensive engineering testing, optimization of configuration, and validation
- Features of v4
  - Rolling cadence, improved distribution of proposals, western bias addressed, better time uniformity, reproducible, sky region selection using coordinate cuts, new sky brightness model, configuration parameter user Interface




Observations for WFD
pontus_2026
minion_1016
Observations
Night
0
200
400
600
800
1000
1200
1400
1600
0
500
1000
1500
2000
2500
3000
3500


Observations for NES
pontus_2026
minion_1016
Observations
Night
0
200
400
600
800
0
500
1000
1500
2000
2500
3000
3500


Observations for SCP
pontus_2026
minion_1016
Observations
Night
0
200
400
600
800
1000
0
500
1000
1500
2000
2500
3000
3500


Observations for GP
pontus_2026
minion_1016
Observations
Night
0
200
400
600
800
1000
0
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1000
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2000
2500
3000
3500

Timeline for SOCS and Scheduler

- Integrated development timeline publicly available on Confluence since 30-09-2015

Release Date: 2016-05-20

SOCS Workplan	Scheduler Workplan

• Refactor and integrate Astronomical Sky
• Integrate Observatory Model slew and track behavior for observing visits
• Implement observing behavior in simulation sequencer
• Integrate DB storage of targets received and visits performed
• Integrate and benchmark performance with Scheduler
  • Test multiple AD proposals survey with slew time cost and sky brightness
  • Test repeatability
  • Test speed under simulation
	• Refactor and integrate Astronomical Sky
	• Integrate Observatory Model slew time estimations
	• Implement Survey Conductor with slew time cost
	• Refactor and integrate Area Distribution Science Proposals
	• Integrate and benchmark performance with SOCS
	  • Test multiple AD proposals survey with slew time cost and sky brightness
	  • Test repeatability
	  • Test speed under simulation

Combined Release v1.0

Release Date: 2017-02-28

SOCS Workplan	Scheduler Workplan

• Refactor and integrate Environment Model
• Simulate weather telemetry, clouds and seeing
• Incorporate filter swaps during new moon
• Incorporate downtime simulator
• Implement Scheduler configuration via commands
• Integrate with Scheduler
  • Test with complete survey
  • Test repeatability
  • Test execution speed
	• Refactor and integrate Time Distribution Science Proposals
	• Incorporate filter swaps during new moon
	• Implement inter-proposal self balancing priority
	• Incorporate weather telemetry handling
	• configuration
	• Integrate with SOCS
	  • Test with complete survey
	  • Test repeatability
	  • Test execution speed

Date	SOCS/Scheduler Development	Opsim4 Deliverables	Project Deliverables	Community Deliverables
Jan 2017	Status: Baseline cadence Opsim v3.3.5	SOCS requirements (LSE-259) Scheduler requirements (LTS-347)		
Mar 2017	Status: refactored code, rolling cadence, new sky model, improved proposal balancing, new configuration management Opsim4 v1.0	Initial rolling cadence simulations		
Sept 2017	Status: deterministic look ahead, weather simulator Opsim4 v1.1	Current DDF cadence simulations and full rolling cadence simulations, new baseline	Define boundary conditions for DDF and issue RFP	Publish OSWP with timeline and process
Dec 2017	Status: Look ahead for time distribution proposals Opsim4 v1.2	Evaluation of community proposed DDF cadences		Community whitepapers on DDFs
Apr 2018	Status: performance optimizations Opsim4 v1.3	New baseline cadence		SAC recommends DDF strategy
Sept 2018	Status: warm start, image quality metrics, degraded system operations Opsim4 v1.4		Call to update OSWP with FOM Publish DDFs	
Apr 2019	Status: dithering, spatial distribution of weather modeling Opsim4 v1.5	Assistance with simulations and metrics for the community proposed FOMs		Updated OSWP with FOM
July 2019	Status: publication of future targets, comcam scheduler Opsim4 v2.0		Establish a survey strategy committee	
Dec 2019	Status: weather forecast in look ahead model Opsim4 v2.1	Proposed baseline cadence	Announce survey strategy with baseline simulation	
Apr 2020	Status: community and alternate scheduler optimization algorithms			

Process for community engagement

- The definition of the Deep Drilling Fields (DDFs) and associated cadences.
  - September 2017: LSST will issue a call for proposals to define the cadence and properties of the currently selected DDFs and to propose a new set of DDFs.
    - Project will publish known boundary conditions (e.g. the definition of a DDF, the current division of survey time, constraints on the number of filter exchanges).
    - Response will require science objectives, positions, depth, filters, cadence of observations, and metrics to demonstrate requirements
  - December 2017: Delivery of these white-papers
  - April 2018: SAC makes recommendation to the project
  - September 2018: project responds to recommendations

This is a proposed process with dates dependent on resource loading and agreement by SAC

Process for community engagement

- The definition of community Figure of Merits (FOMs) for the survey strategy.
  - September 2018: LSST issues a request to update the Observing Strategy White-paper with Figures of Merit to evaluate both the Wide-Fast-Deep and the mini-surveys
    - These FOMs will be required to evaluate the efficacy of different survey strategies on a range of LSST science (e.g. the tradeoff between a rolling cadence for supernova classification vs transient detection or long period variability).
    - Details of the design of the FOMs (including units, thresholds, speed) will be defined at a later date
    - FOMs will need to work in the evaluation framework (currently MAF)
  - April 2019: Delivery of FOMs by the community

This is a proposed process with dates dependent on resource loading and agreement by SAC

Process for community engagement

- Establishment of a Survey Strategy Committee (SSC).
  - July 2019: Project will establish a committee to evaluate competing survey strategy proposals and to propose a survey strategy for commissioning and operation
    - This committee will be chaired by the LSST Project Scientist
    - Comprised of project and non-project personnel with SAC making recommendations for committee membership
    - Committee will report to the LSST Director
  - December 2019: Project will announce an initial survey strategy and publish a baseline simulation that reproduces that strategy.

This is a proposed process with dates dependent on resource loading and agreement by SAC

Support

Given the limited availability of resources in the SOCS and Scheduler team, support of external users who wish to use OpSim v4 will be on a best effort basis. OpSim v4 will likely be delivered as a Docker container and its use and operation will be documented. It is unlikely that we will be able to guarantee support or timeliness in responses to requests for support from external users given current resources