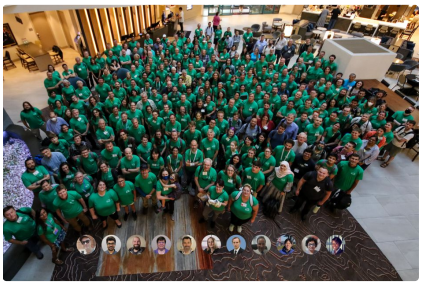
LSST:UK Newsletter 36 (August 2023)

Introduction



Credit: Rubin Obs./NSF/AURA

The photo to the right shows many of the 300 in-person attendees of the 2023 Rubin Project and Community Workshop, which took place in Tucson during the week of 7-11 August. A further 160 people registered to attend virtually, with all plenary sessions and some parallel sessions allowing remote participation. Recordings of those sessions, and slide sets from most others, are available through the workshop website (Rubin Observatory Project & Community Workshop | Project & Community Workshop 2023), although that currently requires Rubin login credentials (which some may have as registrants for previous PCWs, if not for the 2023 meeting). These sessions showed good progress across a wide range of activities, but perhaps the most interesting information for LSST:UK was the update on the schedule, which is summarised in an item below. The next PCW, which will take place on **5-9 August 2024**, will be ***all virtual***.

As the start of operations approaches, more information is becoming available through the new rubinobservatory.org website, including the first of a series of "science releases" describing, for the general public, some of the discoveries expected from the LSST. This first article - Visitors from Distant Stars: Rubin Observatory Will Detect an Abundance of Interstellar Objects Careening Through Our Solar System - talks about the survey's potential for discovering interstellar objects. A new website is also being developed by the LSST Discovery Alliance, which is the new name for the LSST Corporation, although its goal remains the same, namely "*to maximize the impact of Rubin LSST through support from member institutions, grants from foundations, and donations from corporations and private donors*".

August saw the release of Data Preview 0.3, which comprises a set of simulated solar system catalogue data products. These have hitherto been missing from Data Preview 0 because it is based on simulations perfomed by the Dark Energy Science Collaboration that did not include solar system objects, a situation that has now been rectified by the Solar System Science Collaboration. DP0.3 is available to registered users of the Rubin Science Platform, with full documentation at Vera C. Rubin Observatory Documentation for Data Preview 0.3 (DP0.3).

Closer to home, I am delighted to report that Eleanor O'Kane (pictured right) will be joining us on 1 September as LSST:UK Communications Officer. Eleanor has a wealth of experience coordinating communications, including as part of a multi-institutional consortium analogous to our own but in a different scientific domain. She will introduce herself more fully, and outline her plans for the post, in a later Newsletter, once she has settled in.

Finally, the third news item has been published on the EPCC website by a member of the LSST:UK Science Centre team. In that article, @Gareth Francis describes the Lasair alert broker from a computational perspective.

Those with ideas for future newsletter items should contact the LSST:UK Project Managers (@George Beckett and @Terry Sloan lusc_pm@mlist.is.ed.ac.uk), while everyone is encouraged to subscribe to the Rubin Observatory Digest for more general news from the US observatory team.

@Bob Mann

2023H2 Data Rights call

The UK's Data Rights Agreement has still to be signed by STFC and the US Department of Energy, necessitating another interim data rights round, in which we extend the terms of existing data rights holders (to 30/09/2024) and allow applications for new Principal Investigator and Junior Associate positions that will enable further UK researchers to benefit from restricted resources, such as the Rubin Data Previews.

The call, which will be announced in an email to the lusc-announce list, will open on September 4th and will close on **Tuesday 26th September 2023 at 4:00pm.**

Those who have existing data rights terms that end before 30/09/24 will be emailed by @Terry Sloan and asked whether they want their current term to be extended to that date, so only new applicants will have to complete a (lightweight) application form.

Detailed information will be provided in the email to ***lusc-announce***, but we wanted to forwewarn you that this call will be running during September, and to note that preparation for the call has necessitated a minor update to the LSST:UK Privacy Statement, as it covers the use of data collected in data rights calls.

@Bob Mann , @Terry Sloan and @Mike Watson

Schedule updates from PCW2023

As we approach the end of Rubin Construction, the timeline between now and routine survey operations is becoming firmer, and the key milestones along the timeline clearer, although, inevitably, some uncertainty remains. What follows is an outline of that timeline, as presented in PCW plenary sessions by Zelkjo Ivezic and Bob Blum (Directors for Construction and Operations, respectively).

- **November 2023**: **LSSTCam is shipped from SLAC to Chile**. Its arrival is followed by ~9 months of integration work leading to…
- **August 2024: "First Photon"**. This is the first image of the night sky obtained with LSSTCam. A further three months of fine-tuning leads to…
- **December 2024: "System First Light"**. This marks the end of on-sky engineering and is followed by ~5 months of further commissioning, including two months of Science Validation surveys.
- **February 2025: Data Preview 1**. This will be the first release of non-simulated Rubin data products, based on a subset of science-grade observations taken in a few nights around the time of System First Light.
- **June 2025: Start of Operations**. At this point, scheduler-driven observations will be underway, but it may be necessary to use operations contingency prior to the start of the ten-year Legacy Survey of Space and Time (LSST). It may also be decided to use some of this time to extend and enhance the commissioning datasets to be released in Data Preview 2: some of these issues are discussed in more detail in Rubin Tech Notes RTN-011, which also describes which data products will be available in which previews/releases.
- **Mid/Late 2025: Start of the LSST**.
- **Early 2026: Data Preview 2**. This will comprise a homogeneous reduction of all science-grade data taken during commissioning.
- **Late 2026: Data Release 1**. The full set of LSST data products, derived from the first six months of LSST survey observations.

At the moment, these dates are uncertain at the level of a few months, but that uncertainty should be reduced significantly once System First Light has been achieved and the decision has been made as to what will be done between the Start of Operations and the Start of the LSST.

@Bob Mann

Strategies for optimal sky-subtraction in the low-surface-brightness regime

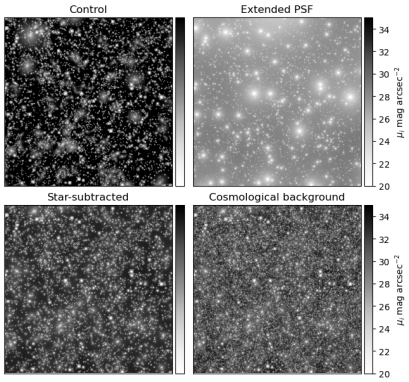
Paper submitted to MNRAS (Watkins et al.) based on work performed by LSST:UK Phase B WP 3.7

Myself (Aaron Watkins) and my collaborators completed and submitted a paper to MNRAS detailing the investigations we did into various sky-subtraction algorithms optimized for low surface brightness science. Using idealized simulated images, we investigated two algorithms commonly used in LSB-oriented surveys--a masking and modeling approach, and an approach in which average sky models are generated via median-combination of science exposures taken close on the sky and in time--as well as a third experimental algorithm meant to remove the flux of static objects prior to sky estimation via subtraction of a preliminary sky-subtracted image coadd.

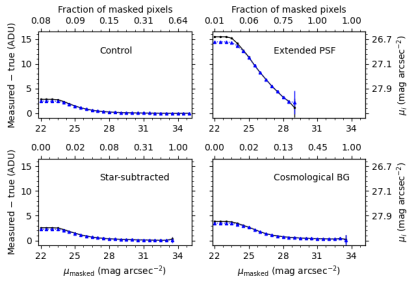
In general, we find that contamination from non-sky sources will always tend to bias sky estimates to brighter levels, with the level of bias dependent on the amount of contamination from non-sky sources present during estimation of the model. This bias makes the experimental coadd-subtraction approach untenable, as the background in said coadd inevitably is negative, a result of background over-subtraction in the coadded images. This artifact is then imprinted on every image when the coadd is subtracted to remove the static sources, leading to a continual propagation of any errors made during the initial round of sky estimation. Also, when the sky is modeled using a complex fitting function or a spline interpolation of local sky estimates, the bias induced by contaminated sources can lead to local sky overestimation, which is difficult to correct for. This effect is most prominent around either extended sources (galaxies, intracluster light, tidal features) or highly clustered sources (either real star or galaxy clusters, or sources which simply cluster in projection on the sky).

That said, while a perfect sky estimation remains a future endeavor, fairly accurate sky models are still achievable via careful, deep masking of non-sky sources, and via the use of simple fitting functions (either empirical, as in the image combination method, or by using a low-order fit such as a constant or a plane) to reduce the likelihood of local sky over-estimation. The two commonly used LSB-oriented approaches tested should thus be viable for LSST given the survey's anticipated surface brightness limits. Given the survey cadence, the masking and modeling approach is the most viable for LSST. The primary causes for concern are sources of contamination not tested for in this study: scattered light, bright star reflections, satellite trails, and other artifacts with large angular size, the removal of which prior to sky estimation is a critical component of any LSB-oriented data reduction pipeline.

We have shared the results of this study with Data Management and are working to find the best path toward implementing our recommendations in the pipeline. The ultimate goal is to ensure that an LSB-friendly image coadd becomes a standard pipeline data product.



Distributions of synthetic sources used to test different sky-subtraction algorithms. We evaluated the influence of stellar scattered light (“extended PSF”), galactic scattered light (“star-subtracted”), and the cosmological background, comparing against a low-density control sample.



The difference between the measured and true background means (black curves) and medians (blue curves) as a function of the depth to which synthetic sources are masked, in surface brightness units. Each panel shows a different experimental setup (as demonstrated in the left figure). For deep masks, the measured values converge very close to the true values, but are limited by things like scattered light or other extended sources; in the “extended PSF” experiment, the simulated scattered light generated a background with a surface brightness of ~28 mag/arcsec^2. We found similar behavior for polynomial skies.

@aaron.watkins and @Sugata Kaviraj

Recent LSST:UK Science Centre outputs

The LSST:UK Science Centre has recently produced the following technical reports.

Title	Author(s)	Description
LUSC-C-02 Top Level Phase C Plan for Lasair-LSST	A.Lawrence, R.Williams, K.Smith, G.Francis, S.Smartt	This document provides a broad-brush top-level plan for the final stages of delivering Lasair, the UK broker for LSST-alerts, as part of Phase C of the LSST:UK project. With a complete working Lasair-ZTF prototype in place, the main purpose of Phase C work will be to port Lasair to Rubin/LSST, optimise performance, put Lasair into operation, complete work with DEV workpackages, and continue to both maintain and further develop the system. This document sets out the background, goals, timeline, and development and maintenance methodology.

@Terry Sloan

Forthcoming meetings of interest

Other meetings of potential interest for the coming months include:

Dates	Meeting Title/ Event	Meeting Website/ Contact	Venue
11/Dec/23—15/Dec/23	Unveiling the Dynamic Universe: Cosmic Streams in the Era of Rubin	Scientific Rational e	Puerto Varas, Chile
16/Oct/23—20/Oct/23	DESC Sprint Week	DESC Confluence (login required)	Carnegie Mellon University (CMU), Pittsburgh
25/Sep/23—29/Sep/23	LSST@Europe 5	LSST@Europe5 | Poreč, Croatia | Se ptember 25-29 202 3	Croatia, Poreč
13/Sep/23-14/Sep/23	Lasair LSST review and users meeting Oxford	LSST:UK website here	Oxford, Department of Physics

Members of the Consortium (not in receipt of travel funding through one of the Science Centre grants) may apply for travel support for meetings of this kind via the the LSST:UK Pool Travel Fund. Details are available at Forthcoming LSST-related Meetings .

Note that the current list of forthcoming meeting is always available on the Relevant Meetings page. You may also wish to check information held on the LSST organisation website LSST-organised events and the LSST Corporation website.

@George Beckett

Announcements

If you have significant announcements that are directly relevant to LSST:UK and would like to share the announcement in a future newsletter, please contact the LSST:UK project managers.