LSST:UK Newsletter 6 (November 2020)

Introduction

The main news from Chile is that the number of people working on the summit continues to increase, with one priority being completion of the dome cladding, in preparation for the return of the Telescope Mount Assembly team in January.

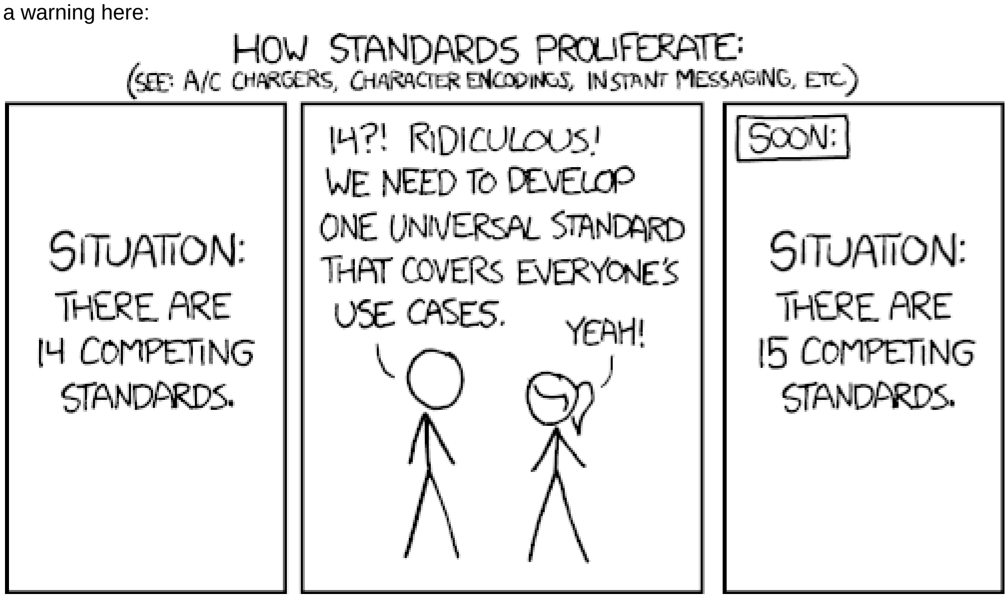
This newsletter contains an item from Raphael Shirley on the potential for use of the LSST pipeline on data from other instruments, while most of the rest comprises material from our latest Project Assurance Report (PAR). The PAR is a document that we provide to STFC periodically, and it reports on the process with the STFC-funded LSST:UK Science Centre (LUSC) programme. We provide below a brief per-Work Package progress summary, as well as a list of the leadership positions held by LSST:UK members within the international Rubin community, which is another indicator of progress that we include in the PAR; please let us know if you have any amendments to make to this impressive list.

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. Given the Christmas and New Year break, the next newsletter will be a December/January issue, to be circulated towards the end of January.

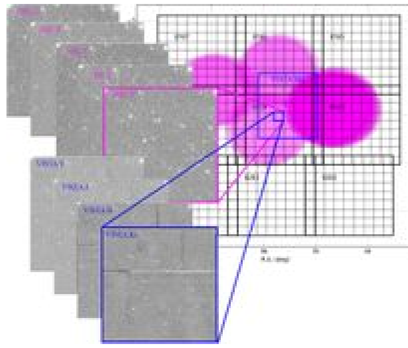
@ Bob Mann

A new standard for photometry

Building the Vera C. Rubin Observatory is an immense engineering and scientific challenge and software engineering in particular is going to be a significant aspect of preparation and operations. Software development is of course well under way in both the core US teams and the UK. Due to the fact early software versions have already been used to process the HyperSuprimeCam imaging we have a large sky area of data on which to test performance and start to understand how to use the eventual LSST data products. For various reasons the LSST team decided to build a bespoke software stack built on C base functions and all tied together with Python. Starting from scratch in this way has the key benefit that the software can be relatively self contained and consistent. It does however remind me of an old XKCD comic that serves as a warning here:



There are however reasons to be optimistic that the LSST software stack will become widely adopted by the general astronomical community and hopefully 'the' standard for optical and near infrared photometry. LSST data will be used by the majority of working astronomers in the coming decade and the sheer scale of the project means many other telescopes may well choose to leverage the huge amount of work that has gone into the LSST photometry pipelines for their own data. For this reason myself, Manda Banerji, and a team based between Southampton and Cambridge, are working on using the stack to process near infrared imaging from the VISTA telescope using the LSST software stack. Given that other telescope teams such as the Dark Energy Survey have started to develop the LSST stack for their own data there is aso a great hope that by processing your imaging with the LSST code you not only open up fusion between your own data and LSST data but you also make other telescope data accesible in the same framework.



James Mullaney, at the University of Sheffield, has produced a general package called 'obs_necam' which helps teams such as ours start to to use the stack with 'Any Camera'. I am hopeful that the whole astronomy community can work towards using the LSST software as a kind of standard. This will mean that when LSST observations begin, utilising imaging from a large number of other telescopes will be possible and accessing VISTA imaging and photometry will be straightforward in the standard LSST formats people will be familiar with. This will enable the legacy of VISTA and other existing and indeed upcoming datasets to be optimally harnessed. Conducting forced photometry, multiband colour and shape measurements, in addition to standard cutout and imaging tasks might be simple tasks all within the same software framework. This will make multi-wavelength astronomy with Vera C. Rubin, VISTA, and other instruments easier and more widely used.

@ Raphael Shirley

Work Package highlights from STFC Project Assurance Report (PAR)

Work Package	Highlights
WP 1.4 Coordination of LSST:UK Contributions to Commissioning	Issued to the UK community an EoI Call for Rubin Observatory Commissioning. An accompanying briefing paper aims to assist colleagues in preparing for and contributing to commissioning. This is in the context of the current pause in Rubin construction, and the ongoing negotiations of the UK's in-kind contributions to the Rubin Observatory and LSST Science Collaborations. This call closed on October 30th 2020.
WP 2.1 DAC Management	Data Access Centre requirements have been integrated into the LSST:UK Science Requirements Document (Version 3.0, April 2020).
WP2.2 Data Ingestion and Publication	A set of data transfer and ingest experiments were undertaken, between IN2P3 (the Rubin data-processing facility in France) and the Royal Observatory Edinburgh. These are documented in D2.2.1. Following on from this, work is underway to ingest ancillary data for the next iteration of the DAC (UKDAC1), including ingestion of PanSTARSS DR2 and ZTF DR2.
WP2.4 Provision of the DAC Platform	The DAC team has begun collaborating with Rubin Observatory staff in the United States and France around the development of the Rubin Science Platform (RSP). WP2.4 staff are customising the baseline RSP for UK-specific ancillary datasets and IRIS IAM authentication, towards the roll-out of an updated RSP in the UK DAC in 2021Q1.
WP2.5 Science Support	Deliverable D2.5.1 "Training resources for LSST:UK DAC users" was completed. This describes an initial release of documentation for users of current and future services accessed via the UK's LSST Data Access Centre (DAC). This documentation release is necessarily limited in scope given that the UK DAC is still being developed. It comprises existing documentation for the Lasair alert broker and a very preliminary set of documentation for the LSST Science Platform (LSP). The LSP is the set of data services to be provided by the Rubin Observatory to support analysis of LSST data products.
WP2.3/3.2 Lasair	The team has: completed and released Lasair v2.0; tested the Cassandra database architecture on IRIS and reviewed it as a future implementation for LSST scale alerts (Report in preparation at the time of writing); completed a science requirements and functionality review led by the LSST:UK PoCs; tested the RAPID light-curve classifier and published a technical summary paper.
WP3.5 LSST and near-infrared data fusion	The WP team has copied over onto the IRIS HPC infrastructure all publicly available VISTA imaging survey datasets and work is now ongoing to develop the pipeline to process the VISTA pixels through the Rubin stack. Current efforts in the WP are focused on understanding photometric calibration issues as well as better understanding the noise properties of the resulting images produced by the pipeline. The current plan is to have a test region in the SXDS field processed and available for scientific validation by December 2020.

WP3.7 Low-surface-brightness science using LSST	Team member Aaron Watkins has been appointed as Deputy Chair of the LSST Low Surface Brightness Working Group. He is working alongside Sarah Brough from the University of New South Wales Australia to help coordinate international community effort in infrastructure development related to intra cluster light and dwarf galaxy science. This includes, although not restricted to, activity related to international LoI proposals. Aaron also gave an update of his WP 3.7 work at the LSB Session of the Rubin Project and Community Workshop in August. He presented results quantifying the over subtraction in different versions of the current data pipeline to an audience of well over 100 participants. Aaron has also given virtual seminars at LJMU and Hertfordshire and to the LSST Galaxies forum and the LSB Challenge 1 meeting, of which he is co-chair.
WP3.9 LSST Point Spread Function, sensor characterisation and modelling	This WP team have established the following. • Confirmation of optimal gate width settings in e2v CCDs – this WP were working on finding what setting of the CCD gate width parameter was optimal from the perspective of correlation and full well effects. The investigation has shown that one particular setting outperforms all others in most reasonable scenarios, and by coincidence this was the setting already used by LSST camera. • Confirmation that silicon di-vacancies cause trap-related parallel CTI in e2v CCDs – investigations over the last year have produced strong evidence of the particular type of trap species that dominates in the operating conditions used in the LSST camera. From this, timing recommendations can be made to substantially reduce parallel CTI, an important performance degrading effect. Other CTI mechanisms than trapping exist in these devices and it is not yet fully clear what proportion of CTI is caused by trapping, but in a traditional CCD it is the dominant effect. • Calibration Improvements in Oxford LSST testbench – due to renewed efforts to carefully track down systematics and calibration errors in our lab equipment and testbench, and thanks to the help of very strong undergraduate project students, this WP have been able to reliably reduce the illumination fluctuations in experiments performed on the OPMD lab testbench. This will aid in future WP efforts that require much more stable operation than was previously possible. • Evidence that previous assumptions used in the theory of charge trapping in CCDs are incorrect – the WP have noted for quite a while that previous analyses of charge trapping in CCDs contained a somewhat unjustified assumption in the derivation of the equation governing trapping rate that essentially only applies to traps which happen to lie in high charge density areas of the device. Since traps are uniformly distributed in space this assumption does not hold in reality. The WP have made significant progress in developing an analysis method that relaxes this assumption. Results from the WP new analysis method are so far consistent with previous methods, yet have two advantages: a) they pave the way in future to use the same data to extract more detail about charge density than was previously possible, and b) they reduce the unexplained variance in individual trap energy levels that have been measured with the old methods
WP3.10 UK Contributions to DESC Operations	Deliverable D3.10.5 “Processing DC2 data using the LSST DM Stack on UK Facilities, was completed. This deliverable describes how to process the images generated by DESC's Data Challenge 2 using the LSST software pipeline. Instructions for installing the software, setting up a data repository and running each stage of the pipeline are provided. Possibilities for using container and workflow technologies to improve the process are also discussed.
WP3.11 Cross matching and astrometry at LSST depths	The WP team completed their first deliverable, D3.11.1, an investigation into the model for contamination of sources due to crowding at LSST depths. WP 3.11 are confident that they can model the astrometric perturbations and photometric contaminations of sources due to faint, blended objects within their PSFs and have algorithms in place that improve the accuracy of the simulated models across a wide range of signal-to-noise ratios, from bright, photon-dominated objects to (important for LSST) faint, sky background-dominated objects. In addition, this WP have started building the software framework for fully symmetric, many-to-many Bayesian cross-matches. This code will serve as the preliminary test bed for investigations in integrations with the DAC workflow, user interaction with the end products, profiling to LSST data sizes, and an analytic groundwork from which to probe reproducibility, recovery rates, etc. The WP are also are working with the LSST:UK DAC team to establish a “data challenge” with the preliminary codebase. This involves a full end-to-end test — using Gaia and WISE, with WISE serving as a proxy for LSST in sources-per-PSF space — to verify and test a full-scale DAC-DEV product creation. Finally, this WP have also begun discussions with various US-based teams — both the DM team within LSSTC itself, and science collaborations — on coordinating efforts on understanding the LSST datasets. Links have also been made with the TVS SC, with potential collaboration efforts on the cross-matching of LSST alerts in real-time, the SMWLV SC, focussing on the importance of our cross-match algorithms in crowded Milky Way fields, and the Crowded Field Task Force in the LSSTC DM, again linking the WP 3.11 cross-match expertise but also working with them to ensure that the WP 3.11 implementation uses as robust and precise a description of the LSST data processing as possible.

If you are interested in more detail please contact Terry Sloan via lusc_pm@mlist.is.ed.ac.uk in the first instance.

@ Terry Sloan

LSST:UK leadership

Here's a list of significant leadership positions held by members of the LSST:UK consortium in the project and international Science Collaborations. If you are aware of any corrections or additions please contact the LSST:UK Project Managers (@ George Beckett and @ Terry Sloan: lusc_pm@mlist.is.ed.ac.uk)

D. Alonso: co-convenor of the DESC Large Scale Structure WG and member of DESC Council;

D. Alonso: member of the LSST DESC Membership Committee

M. Banerji: co-chair of the LSST Galaxies Science Collaboration;

R. Bowler: co-chair of the SED fitting and Photometric Redshifts WG in the LSST Galaxies Science Collaboration;

B. Burningham: co-chair of solar neighbourhood WG in Stars, Milky Way and Local Volume Science Collaboration (from summer 2017);

T. Collett: co-convenor of the LSST DESC Strong Lensing Working Group;

P. Hatfield: co-chair of the Galaxy Environment WG in the LSST Galaxies Science Collaboration;

S. Kaviraj: co-chair of the LSST Galaxies Science Collaboration (from Summer 2018);

S. Kaviraj: member of the Rubin Observatory LSST Contribution Evaluation Committee representing the Galaxies Science Collaboration (from Spring 2020);

B Leistedt: member of the LSST DESC Equality, Diversity & Inclusion Committee;

D. Leonard: member of the LSST DESC Publication Board and Collaboration Council;

C. Lintott: leads the LSST EPO development of Zooniverse as a citizen science platform;

J. Mullaney: Co-Chair of the Active Galactic Nuclei WG in the LSST Galaxies Science Collaboration;

M. Schwamb: co-chair of Solar System Science Collaboration (re-appointed May 2020);

M. Schwamb: member of the Rubin Observatory LSST Contribution Evaluation Committee representing the Solar System Science Collaboration (from Spring 2020);

S. Smartt: member of the LSST Science Advisory Committee (from 2018);

G. Smith: co-chair of the LSST Strong Lensing Science Collaboration;

M. Sullivan: co-chair of DESC Follow-up Task Force;

M. Sullivan: co-lead of the DESC External Synergies Analysis Working Group;

A. Verma: chair of the Strong Lensing Working Group in the Galaxies Science Collaboration;

A. Verma: a member of the Rubin Observatory LSST Contribution Evaluation Committee representing the Strong Lensing Science Collaboration (from Spring 2020);

A. Watkins: co-lead of the LSST LSB challenge 1: "How do LSST algorithms do at detecting LSB sources?" (from March 2020);

A. Watkins: co-chair of the low-surface-brightness working group within the LSST Galaxies Science collaboration (from Autumn 2020);

J. Zuntz: Leader of Lensing/Largescale structure cross-correlation project.

@ Terry Sloan

Recent LSST:UK outputs

LSST:UK has recently produced the following technical reports.

Title	Author	Description
D2.3.1 Lessons learned from ZTF	Roy Williams, Ken Smith, Stephen Smartt, Andy Lawrence, Gareth Francis	The LSST:UK project has built Lasair, (https://lasair.roe.ac.uk), a community broker for the LSST alerts that will encourage a variety of users in a variety of science investigations. The objective is twofold: to give UK and other scientists access to the LSST stream in near-real-time, and also to add value to those alerts. In 2018, a web-database

		prototype broker for the Zwicky Transient Facility (ZTF) was built, that has a similar structure to what is expected for LSST, using Kafka to deliver alerts to their brokers. Both LSST and ZTF send an alert whenever a source is significantly (5) brighter than it was in an earlier reference sky. This paper reports on experiences of running this prototype.

@ Terry Sloan