

UK involvement in the Rubin LSST

Bob Mann

University of Edinburgh
LSST:UK Project Leader



Outline

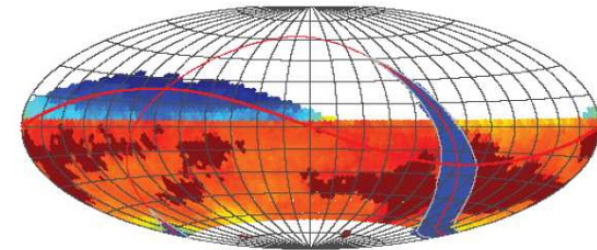
- Introduction to the Rubin LSST
- Outline of UK involvement
- Current status and next steps

Recap: Rubin LSST nomenclature

- Vera C. Rubin **Observatory**
- Simonyi Survey **Telescope**
- Legacy **Survey** of Space and Time (LSST)

Rubin LSST Basics

- Survey facility in Chile
 - Construction nearing completion
 - 9.6 sq. deg Field of View
 - annular primary 6.5m effective diameter
- Large étendue: can map **“wide, deep & fast”**
- 10-year survey in u, g, r, i, z, y
 - Different kinds of analysis from the same multi-colour, multi-epoch dataset



~800 visits per field

Single visit: $r=24.7$
10-year depth: $r=27.5$

The scope of Rubin LSST science

SCIENCE DRIVERS TO SURVEY PLAN

Four science themes

- Probing data energy and dark matter
- Taking an inventory of the solar system
- Exploring the transient optical sky
- Mapping the Milky Way

Full science case and survey plan in

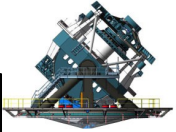
LSST Science Book
(arxiv:0902.0201) and
Overview Paper
(arxiv:0805.2366, v5 2018)

Survey cadence still
being optimised



SCIENCE COLLABORATIONS (AND UK POINTS OF CONTACT)

- **Galaxies:** Brooke Simmons
- **Stars, Milky Way and Local Volume:** Phil Lucas (Milky Way stars) and Annette Ferguson (Local Group and near-field cosmology)
- **Solar System Science:** Meg Schwamb
- **Dark Energy:** Benjamin Joachimi and Catherine Heymans
- **Active Galactic Nuclei:** Sebastian Hoenig
- **Transients and Variable Stars:** Sarah Casewell (variable stars) and Cosimo Inserra (transients)
- **Strong Lensing:** Aprajita Verma
- **Informatics & Statistics:** Jason McEwen



LSST Data Product Categories



OBSERVATORY

Prompt

Formerly "Level 1" data products

Real Time Difference Image Analysis (DIA)

- A stream of ~10 million time-domain events per night (Alerts), detected, characterized, and transmitted to event distribution networks with 60 seconds of shutter close.
- A catalog of orbits for ~6 million bodies in the Solar System

Data Release

Formerly "Level 2" data products

Reduced single-epoch & deep co-added images, reprocessed DIA products

- A catalog of ~37 billion objects (20bn galaxies, 17bn stars), ~7 trillion observations ("sources"), and ~30 trillion measurements ("forced sources")
- Produced annually and accessible through online databases.

COMMUNITY

User Generated

Formerly "Level 3" data products

User-produced added-value data products

- Deep KBO/NEO, variable star classifications, shear maps, etc
- Enabled by services and computing resources at the LSST Data Access Centers (DACs) and via the LSST Science Platform

More details in the **Data Products Definition Document**

<https://lsc-163.lsst.io/>

UK participation in LSST

LSST:UK
Consortium



Defines the
programme
of work for...

Works on
behalf of...

LSST:UK Science Centre (LUSC)

LSST:UK Consortium




Founded in 2014: every astronomy group* in the UK



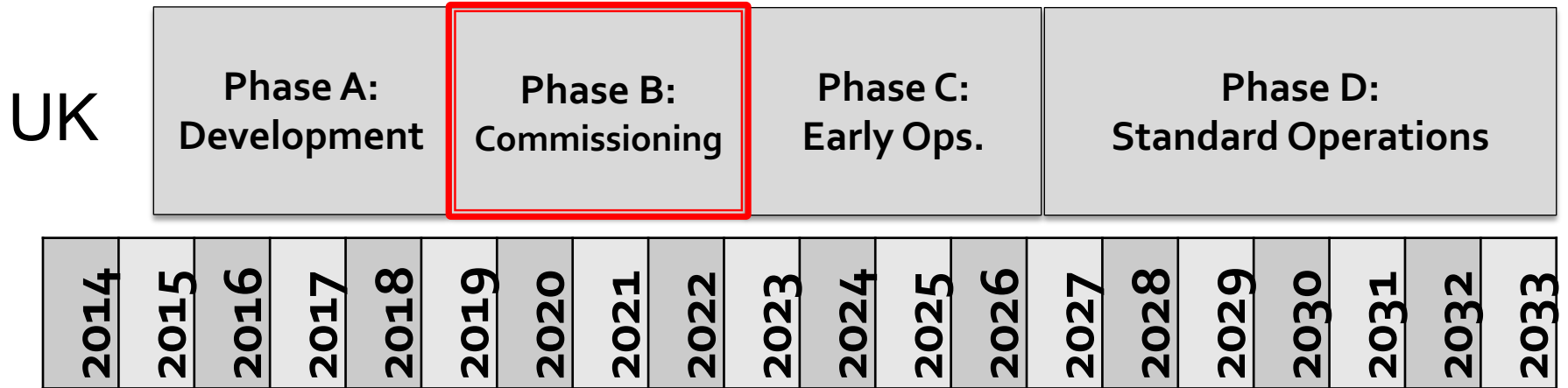
*Likely to move to individual membership model for operations



LSST:UK Science Centre

- Distributed entity, with two main components
- **LUSC-DAC:** UK Data Access Centre
 - Curating LSST data products and other datasets
 - Providing access to analysis resources  **iris**
 - Implemented within IRIS (www.iris.ac.uk) system
- **LUSC-DEV:** developing software, and preparing non-LSST data, for User Generated Products

Timeline for LUSC programme



- 1 August 2014: start of construction project
- October 2019*: telescope First Light
- October 2022*: start of main survey operations



*Pre-Covid



Rubin LSST funding and data

- Construction funding
 - Mainly US agencies -
NSF: \$437M & DOE: \$168M
- Data
 - Prompt: alerts world-public at once
 - Data Release images & catalogues:
two-year proprietary period
- Professional astronomers from the US and Chile (host) have rights to the proprietary data
- Others must gain them by making contributions to Rubin operations

International contributions

2015

- Cash subscription
- STFC signed Memorandum of Agreement to secure data rights for 100 PIs (and 400 Junior Associates)

PI = faculty;
JA = postdoc, PhD student, etc

2019

- In-kind contribution: either
 - **Offset costs** to US agencies - i.e. do work that would happen in US otherwise
 - **Add value** to US scientific return from Rubin LSST – e.g. other data or software for user-generated products

In-kind contributions model

- Great opportunity for the UK
 - Gain data rights credit for the LUSC work we're already doing
 - Invited to make cost-offsetting contributions
- Objectives of UK in-kind proposal
 1. Expand data rights – ideally to whole UK community
 2. Earn place within Rubin operations consortium

UK in-kind package

VALUE-ADDING

- Existing software development activities (LUSC-DEV Phase B)
- Planned future software dev. activities (Phases C and D)

Total value: equivalent to ~300 PI slots

COST-OFFSETTING

- 25% share of annual Data Release Processing
- Data Access Centre
- EPO software development
- **Contribute to Commissioning**
- International Prog. Coordin.
- Postdoc secondments

Bind us into ops. consortium

DAC + DRP: computing resources from IRIS

Status and next steps

- Covid has delayed the Rubin LSST schedule
 - Survey start no earlier than October 2023
- UK will secure data rights by in-kind contributions
 - In-kind proposal submitted last autumn: evaluation led to recommendation by Rubin Obs to US agencies.
 - STFC & US agencies to negotiate directly soon
 - Expect data rights agreement by end of 2021

Getting involved

- Join LSST:UK wiki: lsst-uk.atlassian.net
 - Mailing lists: e.g. lusc-announce@jiscmail.ac.uk
 - Outputs from UK All-Hands Meeting in May
- Find UK Point of Contact for your science area
 - Organised by Science Collaborations
 - See <https://www.lsst.ac.uk/governance>
- Await further news on lusc-announce list
 - e.g. UK data rights & Phase C funding opportunities