Example PP technology application: LSST

Ulrik Egede

LSST in a nutshell

LSST : an integrated survey system designed to conduct a decade-long, *deep, wide, fast* time-domain survey of the optical sky.

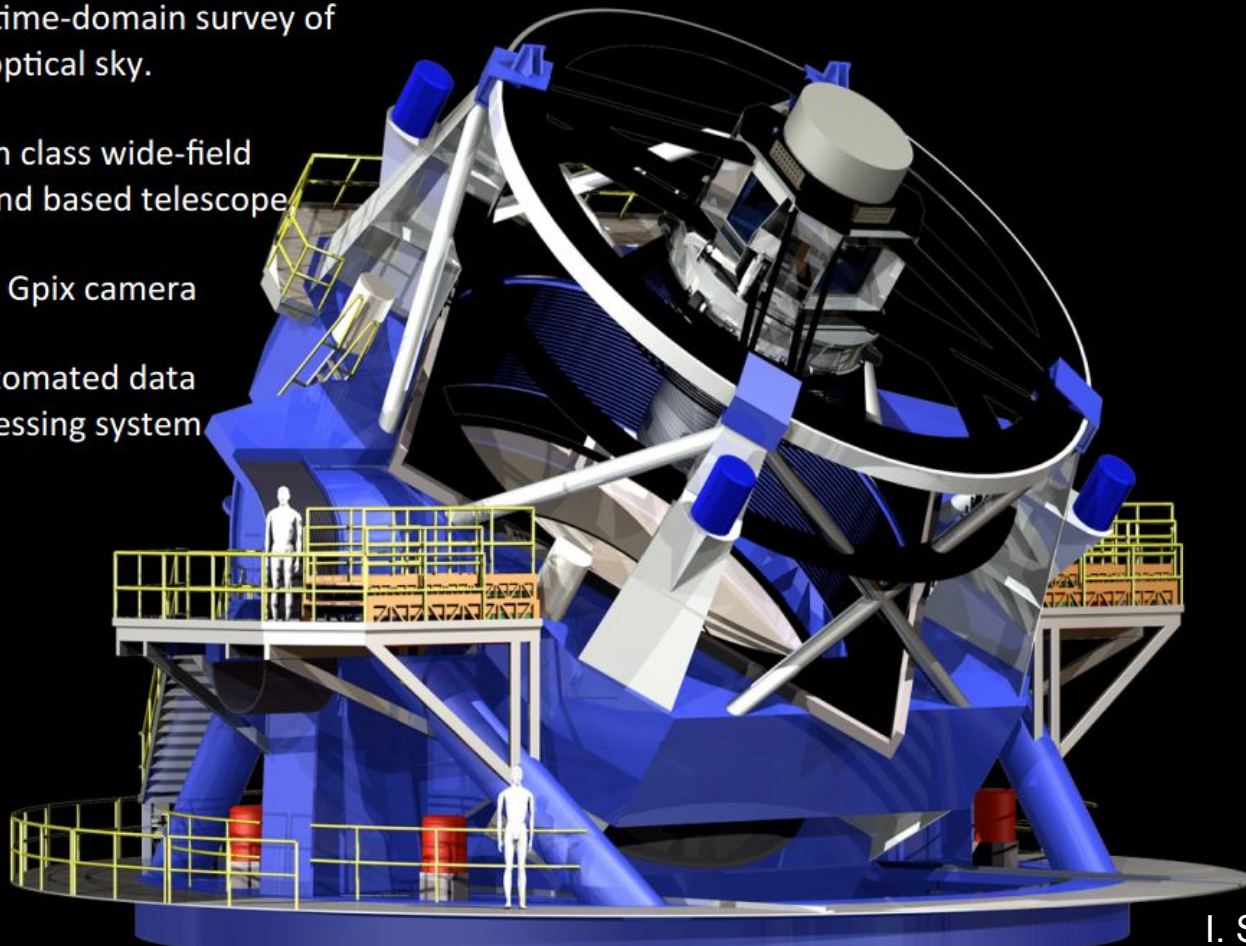* 8-m class wide-field ground based telescope

* 3.2 Gpix camera

* automated data processing system
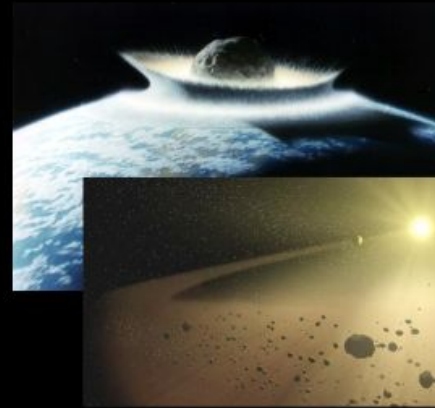
Synoptic = Big Picture

I. Shipsey

LSST science
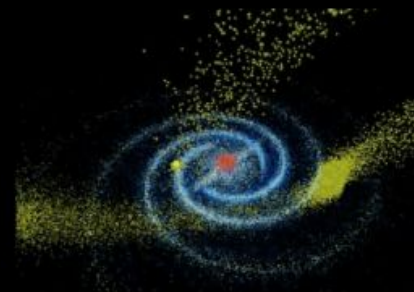
Community

The interest in LSST is growing within the particle physics community

- Edinburgh (Clarke)
- Imperial (Colling, Egede)
- Lancaster(Love, Jones)
- Liverpool (Barrett, Bowcock, Coleman)
- Manchester(Pilkington, Price)
- Open (Stefanov, Holland)
- Oxford (**Shipsey**, Azfar, Tseng)
- Swansea (Tasinato, Zavala)
- UCL (Korn)

For scientific exploration, everybody is involved in the Dark Energy Science Collaboration (DESC). (DESC met for the first time outside the US last week in Oxford, >120 attendees with ~60 (~40) from US (UK).)

Sensor characterisation

LSST CCD Camera (3 Gpix) largest ever constructed for astronomy

Thick 100 micron red-sensitive full depletion CCDs grew out of SSC silicon work in 1990's.

LSST prototype sensors meet project requirements.

Procurement under way with e2v (UK) & ITL (US)
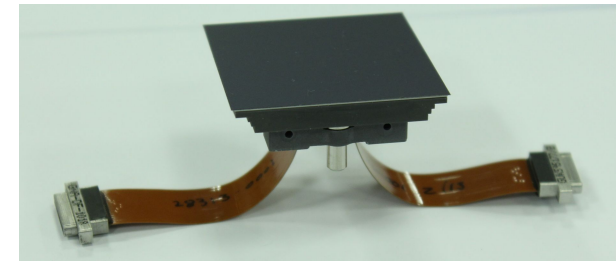
Sensor delivery rate is the critical path pacing item for the LSST camera.

Oxford (Shipsey) UK liaison between U.S. LSST and e2v. A joint LSST/Oxford PDRA in place, 50% paid by LSST supporting sensor delivery & sensor characterization (under an NDA).

New Oxford Sensors Lab

Data acquisition

- Cluster on a Board (COB) used to route and preprocess data
- Toolkit planned to be used in ATLAS and DUNE
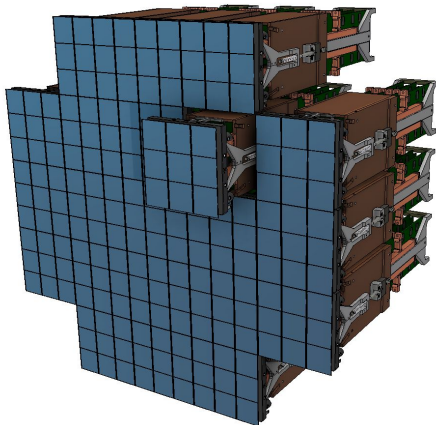- Test stands at Oxford & UCL allow development and testing of online processing software

CCD sensors
CCDs

raft baseplate

flex cables

V-grooves for kinematic mount

thermal straps

conductance barrier

pre-tensioning arm

cooling planes

FEE boards

housing (cold mass)

Science Raft
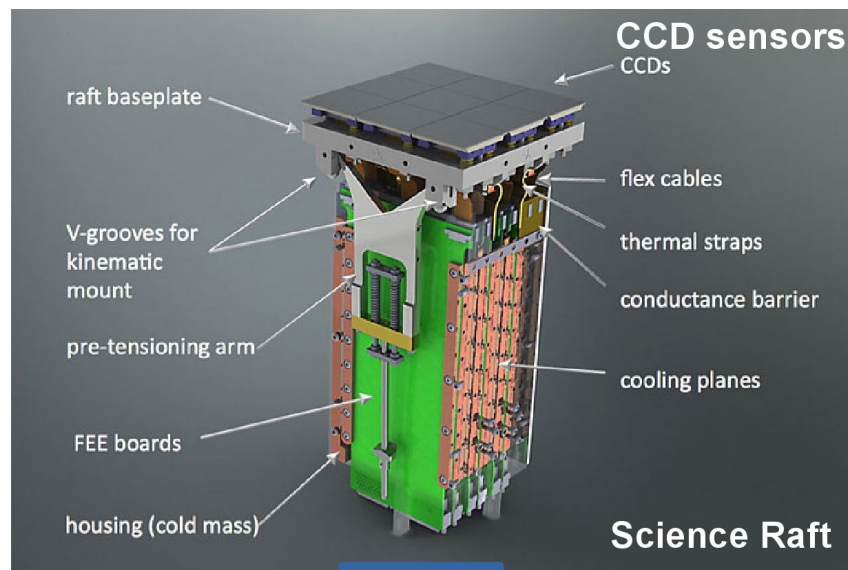
Image data

(Compute) Cluster on a Board

Data Processing Modules
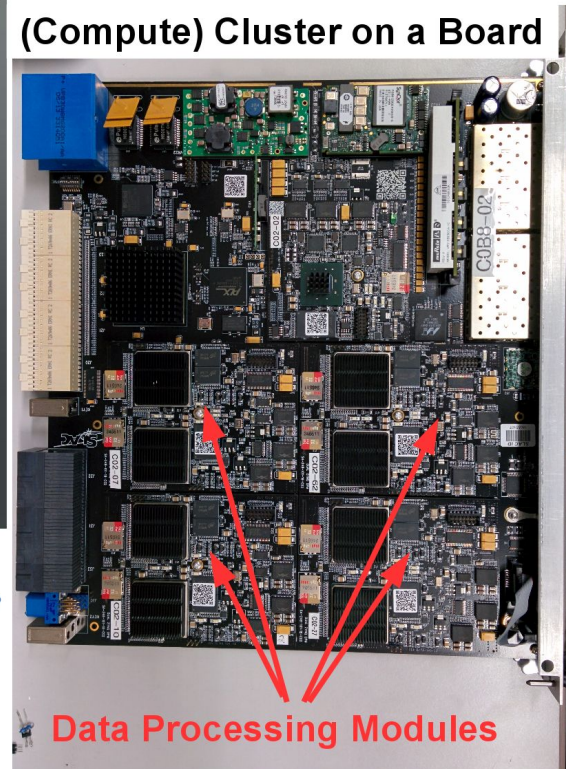
Computing

- A joint LSST/GridPP technical post is in place, paid 50% by LSST to transfer expertise and technology. Working on developing the LSST UK Data Access Centre
- A successful pilot (processing galaxy shears) has been developed as collaboration between Manchester astronomers (Zunzt, Bridle) and GridPP
- LSST-UK has requested GridPP to provide support for LSST-DESC at modest level (~ 2% resources). This has been possible using leveraged resources at collaborating sites.
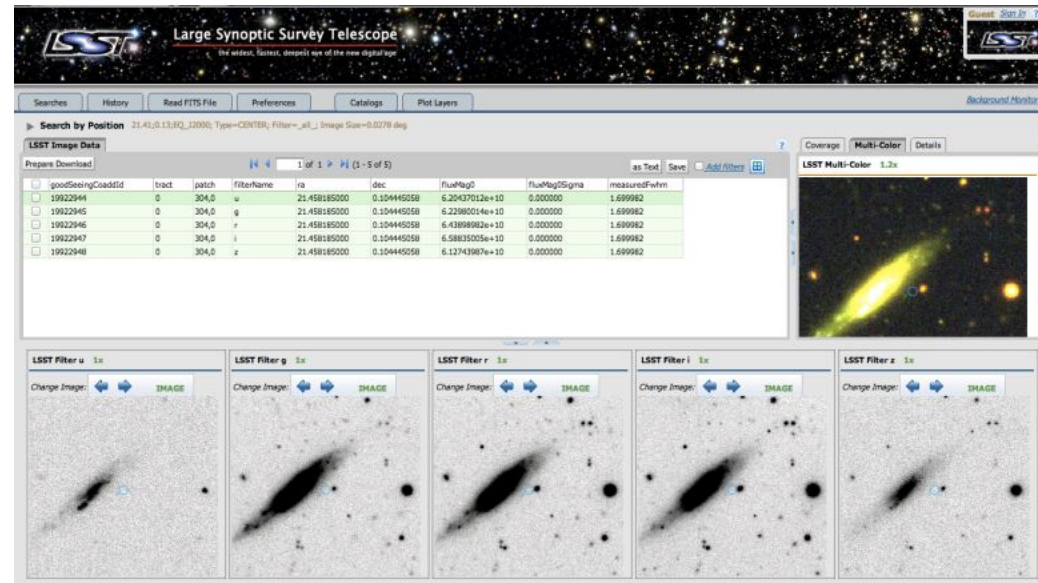
Data management

LSST is developing *qserv* for managing multi-PB, distributed offline data products

- Supports SQL-like queries, e.g.,
  - all white dwarves within X of red giants
  - time series for supernova Y
  - trillions of detections over ten years
- More random access, less sequential
- More general than LSST
  - Edinburgh pursuing UKIDSS data ingest, setup for UK DAC
  - Also have record of queries - useful for anticipating further use cases
- Oxford (Tseng) to investigate query performance, construction
  - Why do certain queries fail or perform badly (or should they)?
  - Are there better ways to construct physics-relevant queries than SQL?
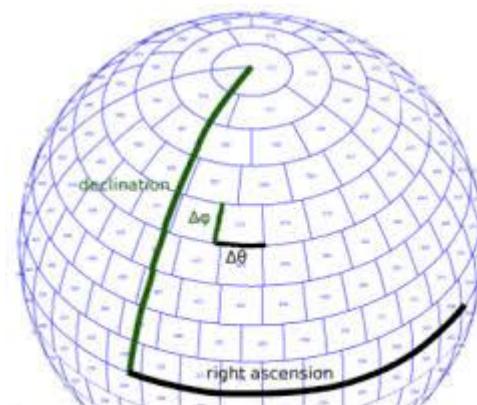
Timing

- Telescope site currently under construction
- Mock Data challenges under way to refine data management plan
- First light in 2020 with science starting in 2022

	FY	2016				2017				2018				2019				2020				2021			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
LSST DESC Pre-commissioning Data Challenges	DC1	RQ Prep'n → Analysis →																							
	DC2					RQ Preparation → Analysis →																			
	DC3									RQ Preparation → Analysis →															
LSST Project Verification & Commissioning	DM Verification																								
	ComCam																								
	Science Verification																								

Scope of the 2015 LSST DESC Science Roadmap — LSST Commissioning

We are here!

- Project is currently well within schedule