Computational synergies between LSST and SKA

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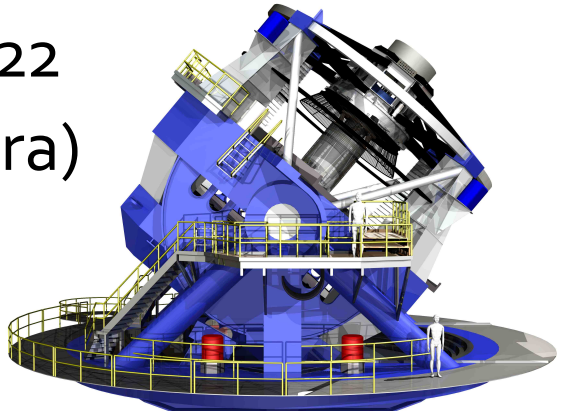
LSST:UK Science Centre

Synergies between LSST & SKA

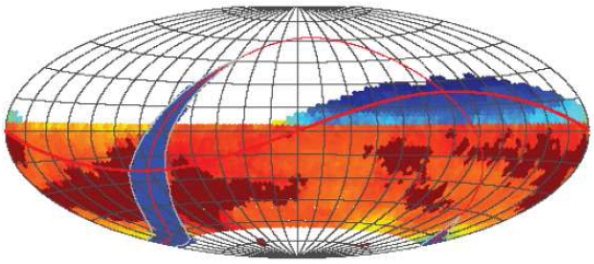
- Scientific synergies
  - Bacon et al (arXiv: 1501.03977) summarise synergies from cosmology, galaxy evolution, transients
  - **UK in unique position to exploit the combination of SKA and LSST (and Euclid)**
- Computational synergies (& complementarities)
  - Both technical and political/financial
  - **Now is the time to start discussing details**

LSST Basics

- Large optical survey telescope to be located in Chile
  - annular primary 6.5m effective; 9.6 sq. deg FOV
- Ten year survey from ~2022
- US-led: NSF + DoE (camera) plus foreign partners



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

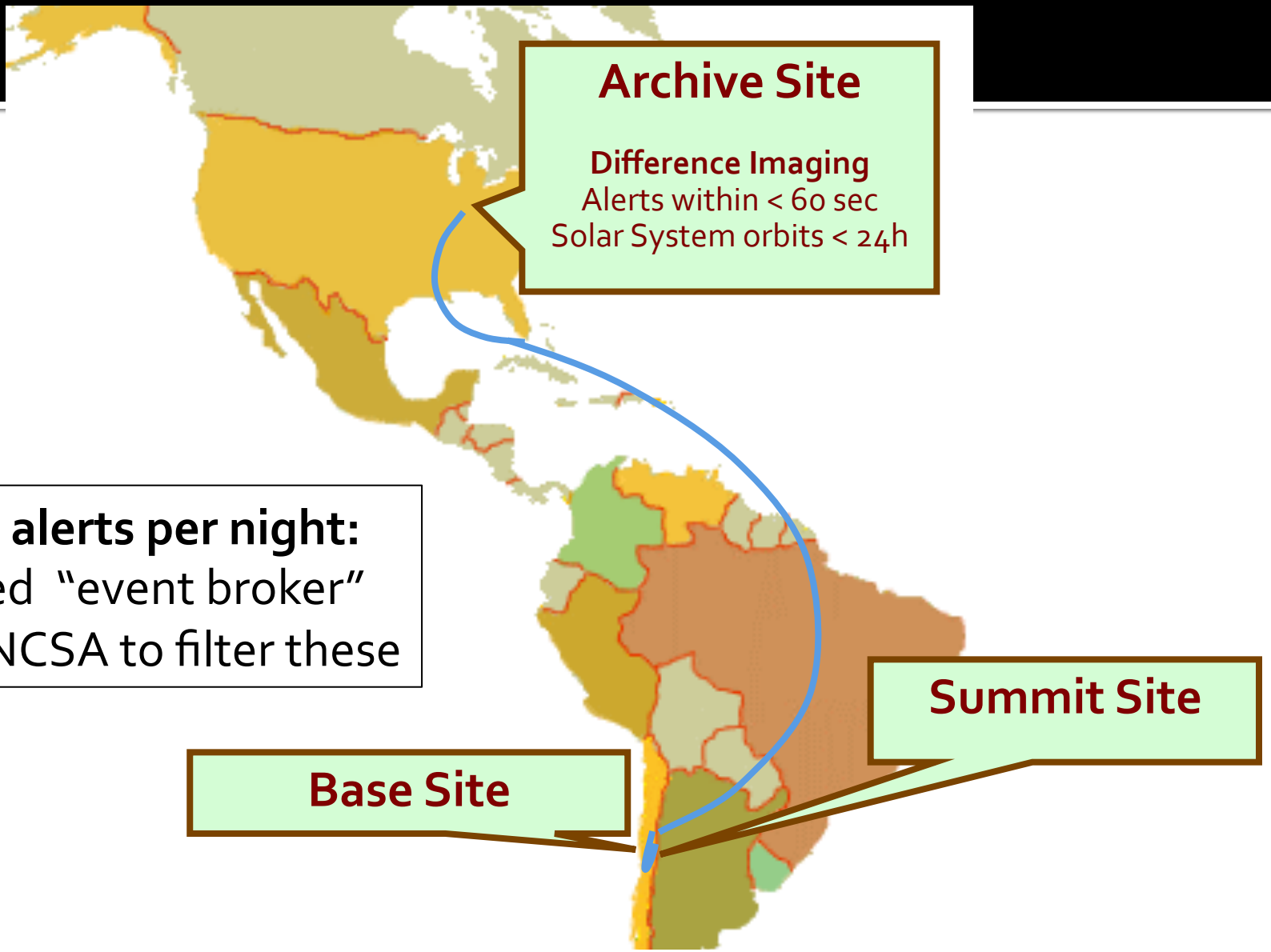


system design: Ivezic et al (arXiv:0805.2366)

High-level survey requirements

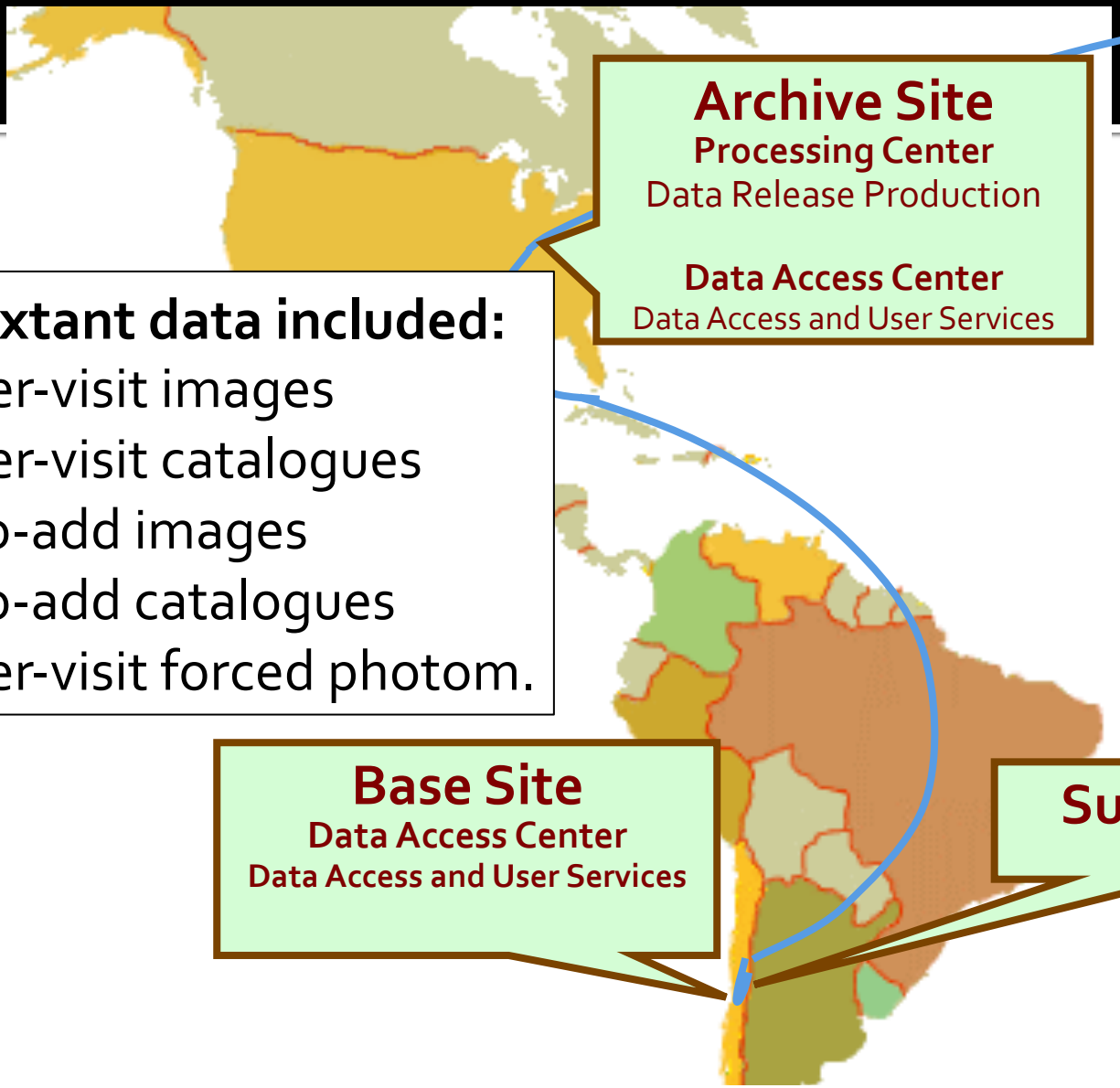
Survey Property	Performance
Main Survey Area	18000 sq. deg.
Total visits per sky patch	825
Filter set	6 filters (ugrizy) from 320 to 1050nm
Single visit	2 x 15 second exposures
Single Visit Limiting Magnitude (5σ point source, AB)	u = 23.9; g = 25.0; r = 24.7; i = 24.0; z = 23.3; y = 22.1
Integrated limiting mag (5σ ps, AB)	u = 26.3; g = 27.5; r = 27.7; i = 27.0; z = 26.2; y = 24.9
Photometric calibration	< 2% absolute, < 0.5% repeatability & colors
Median delivered image quality	~ 0.7 arcsec. FWHM
Transient processing latency	< 60 sec after last visit exposure
Data release	Full reprocessing of survey data annually

Data Products: Level 1 – nightly processing



10^6 alerts per night:
need "event broker"
at NCSA to filter these

Data Products: Level 2 – annual data release*



Archive Site
Processing Center
Data Release Production

Data Access Center
Data Access and User Services

French Site
Processing Center
Data Release Production

UK Site
Data Access Center
Data Access and User Services

All extant data included:

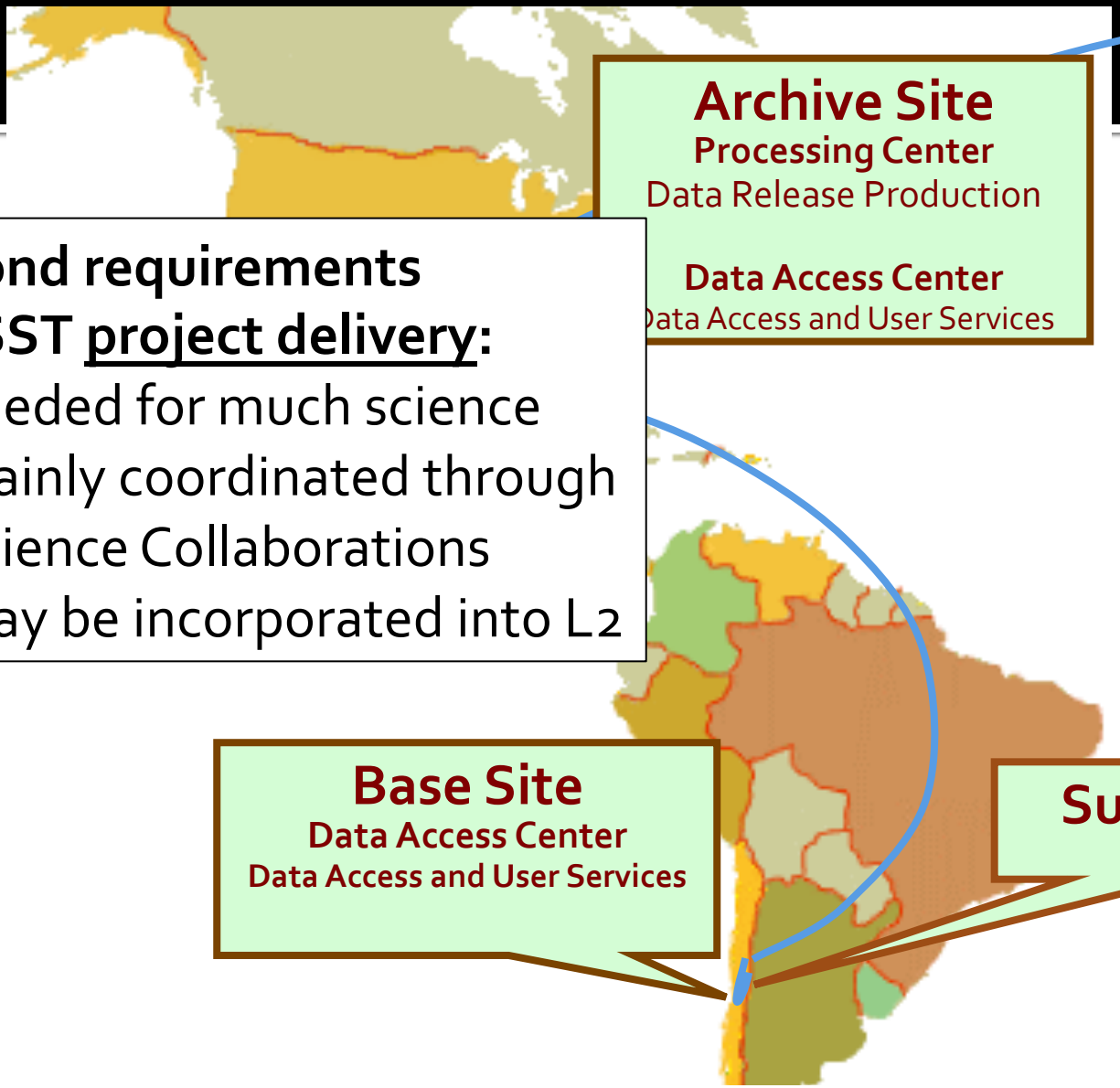
- per-visit images
- per-visit catalogues
- co-add images
- co-add catalogues
- Per-visit forced photom.

Base Site
Data Access Center
Data Access and User Services

Summit Site

* Twice in Year 1

Data Products: Level 3 – user-created products



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Beyond requirements of LSST <u>project delivery</u>:

- needed for much science
- mainly coordinated through Science Collaborations
- may be incorporated into L2

UK participation in LSST

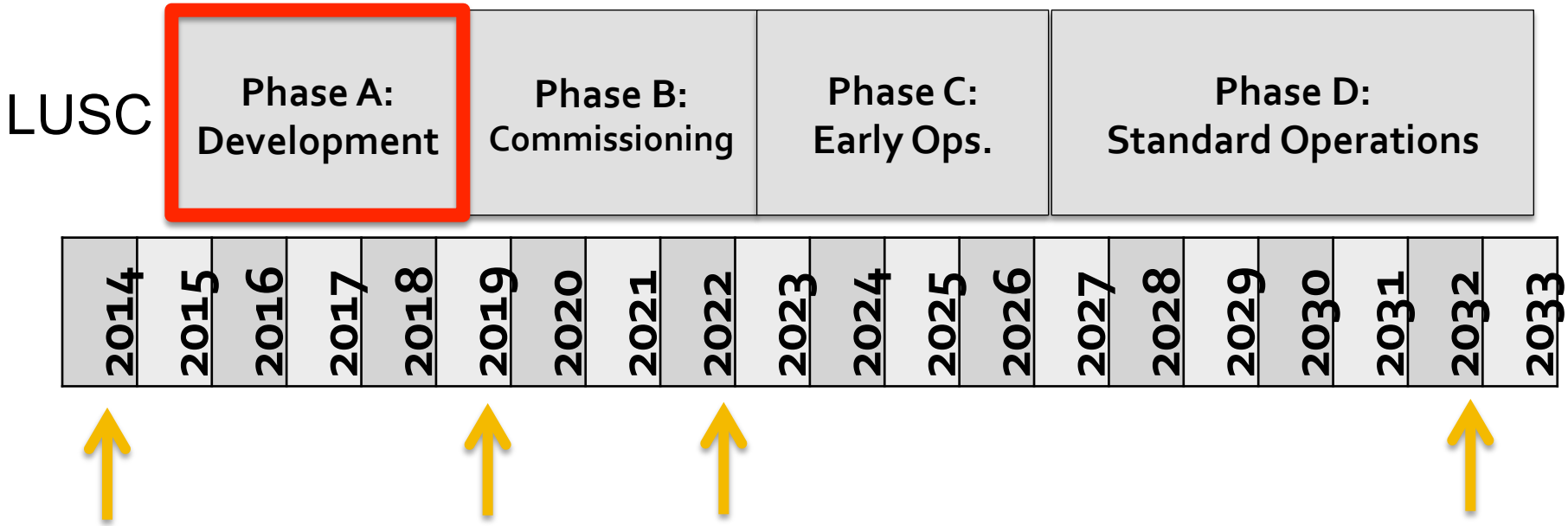
LSST:UK Consortium

Defines the programme of work for…

Works on behalf of…

LSST:UK Science Centre (LUSC)

Timeline for LSST and LUSC



- 1 August 2014: start of construction project
- October 2019: telescope First Light
- October 2022: start of main survey operations
- September 2032: end of main survey

Phase A funding from PPRP

- £15M set aside for operations contribution
- Phase A programme (July 2015 – March 2019)
  - LUSC-DAC (Data Access Centre prep): 6 staff-years
    - DAC testbed, Data Challenges, supporting LUSC-DEV (Edin)
  - LUSC-DEV (Level 3 prep/development): 16 staff-years
    - Weak lensing: sims., PSF, deblending, Euclid synergy (Man/Oxf/UCL)
    - Milky Way: star/galaxy separation, tidal stream detection (Cam)
    - Transients: alert handling, classification, cadence (QUB/UCL/Soton)
    - Solar System: postage stamps, lightcurves (QUB)
    - Sensor characterisation: image analysis systematics (Oxf)

UK Data Access Centre

- **Supporting UK community's use of LSST data**
- Provide access to Level 1 and 2 data products
  - Generated in the US and France
- Ingest and serve ancillary datasets
- Support running of Level 3 data analysis
  - Providing LSST software stack & environment
  - Providing compute and storage facilities
  - Operating helpdesk, etc
- Likely to be a coordinated network of DACs
  - Details unclear as yet…

UK DAC computational requirements

- DACs similar to the SKA Regional Centres
  - But with smaller computational requirements
- Expectations:
  - Database: ~2PB in 2022 growing to ~31PB in 2032
  - Images*: ~30-50PB flat file storage
  - Compute*: ~20 TFlops in 2022 → ~140TFlops in 2032

*Very uncertain: depend on science goals and degree of coordination between DAC network

UK LSST/SKA synergies

- Scientific pull
  - Joint analyses: e.g. weak lensing, transients
- Political/financial push
  - STFC want common computing infrastructure across the PPAN area
    - Extension of GridPP?…or something cloudy?
  - Both projects need to understand how well they could fit a generic model and whether they share specific requirements – e.g. multi-PB databases

UK LSST/SKA complementarities

- Focus on different computational challenges
  - SKA: bulk processing, data transport
  - LSST: large databases, high transient rates
- Can we share expertise?
- Can we coordinate astro requirements for proposed STFC computing infrastructure?

Summary

- Strong scientific synergies
  - Key contacts: Sarah Bridle (LSST:UK PS),
    David Bacon (LSST:UK SKA Liaison)
- Potential for technical collaboration
  - Key contacts: Bob Mann (LSST:UK PL),
    George Beckett (LSST:UK PM)
- Now is time to start discussing details
  - Plans for DACs and Regional Centres are taking shape
  - Future of STFC computing under discussion