Feedback from the Workshops and Data Sprints

LSST@Europe3

Compiled: NAW / 20180615

Workshop 7A Stars/MW

Mini-surveys and user-generated products

Conveners: Istvan Dekany and Johanna Jurcsik

Session 7A

Local Volume, Milky Way, Stars & Planets

L3 Requirements, Deep Drilling Fields, Minisurveys

Main question to the community:

What are priority issues and requirements concerning User Generated data products, DDFs, and minisurveys with an emphasis on early science?

Session 7A

TALKS

1. **Introduction: WFD strategies, L3, DDFs, minisurveys**
   István Dékány
2. **Prospecting for LMXB Periods with LSST**
   Michael Johnson
3. **Stellar Variability in Crowded Fields**
   Massimo Dall'Ora
4. **Pulsating stars as population tracers and distance indicators: Theoretical-Observational comparison**
   Ilaria Musella
5. **Discussion**

Session 7A

Prospecting for LMXB Periods with LSST
Michael Johnson

- Low mass X-ray binaries are key objects for understanding the physics of compact objects.
- LMXBs are RARE: ~ 200 such objects known in the MW.
- Only ~ 20 dynamically confirmed black hole masses.
- **~ 90% of LMXBs reside in the Galactic plane.**

LSST observations are desired to improve the census of LMXBs.

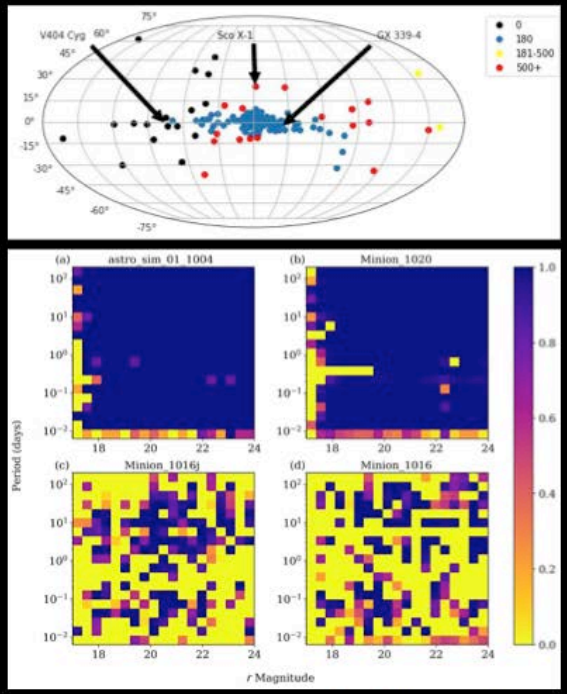
Issue: WFD strategy avoids the Galactic plane.

Simulations of period recovery for various survey strategies: $17 < r < 24$, $9 \text{ min} < P < 200$ days

Results:

Original mini-survey strategy for the Galactic plane is *insufficient* for a reasonable census.

At least an 'astro_sim_01_1004'-like strategy is required.



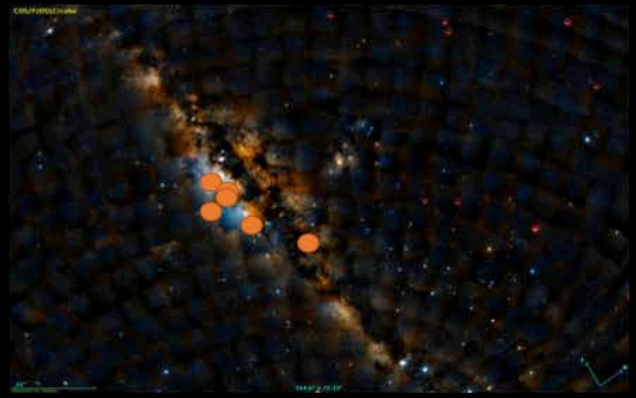
Conservative assumption: 1300 LMXBs in MW.

Observing Strategy	Total Number of Observations	Period Recovery (%)	Period Recovery in the Milky Way (%)	Period Recovery in the Milky Way (No. of Systems)
Minion_1016	180	43	11	143
Minion_1016j	180	43	11	143
Minion_1020	540	95	35	455
astro_lsst_01_1004	661	97	36	468

Session 7A

Stellar Variability in Crowded Fields
Massimo Dall'Ora

- LSST observations of crowded fields is expected for MW science.
- Create metrics to characterize pipeline, based on the recovery of observables: periods, magnitudes, astrometric precision.
- Identify the optimal available code for the science requirements (primarily pulsating stars) and optimize it if necessary.

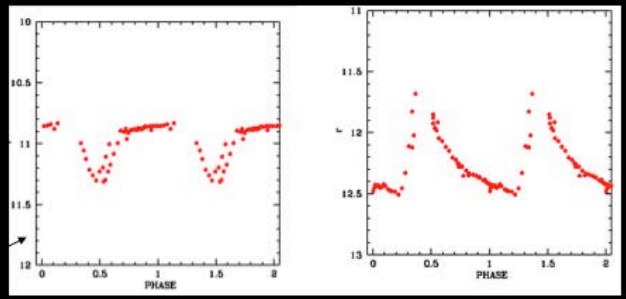


Tests: DECam images from the MW plane, DAOPHOT algorithm, *r* band, ~50 epochs, existing deep census of variables (OGLE).

Results:

Good variable star recovery rate for amplitudes >0.05 mag.

Hint:
Early time series would be desirable for optimization of crowded field photometry.

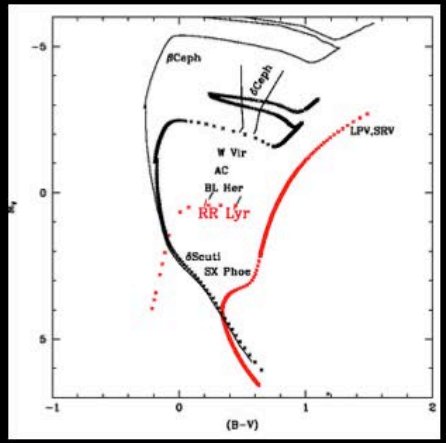


Session 7A

Pulsating stars as population tracers and distance indicators: Theoretical-Observational comparison

Ilaria Musella

- Pulsating variables are important for tracing stellar populations at various ages, and study the SFH of systems in the Local Volume.
- Theoretical input needed for constraining stellar parameters, and better understand how observables depend on chemical composition.
- Highlights from the theoretical framework of nonlinear convective pulsation models.



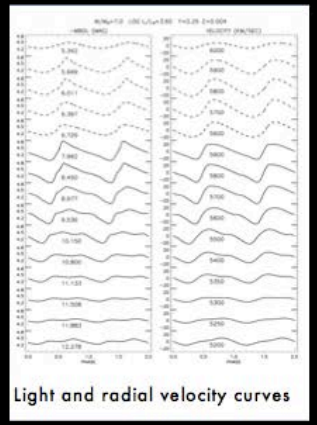
Ongoing work: theoretical predictions in the LSST filter system.

Proposed minisurvey:

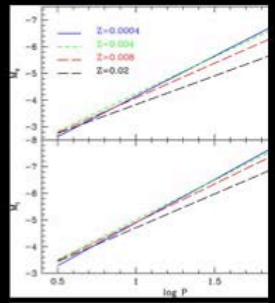
Fields with all sorts of classical pulsators with good coverage from Gaia and other surveys (*where?*).

Goals:

- inter-calibrate LSST, Gaia, etc. data
- test depth and completeness of LSST
- optimally translate different diagnostics and theoretical tools into LSST passbands



Light and radial velocity curves



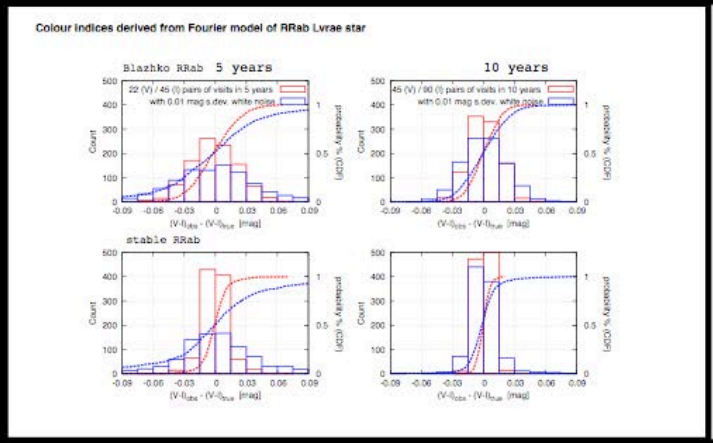
Theoretical cepheid Period-Luminosity at varying Z

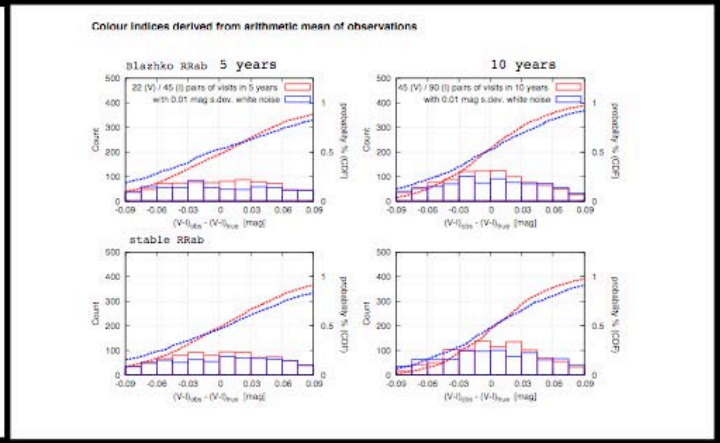
Session 7A

The problem of sampling in case of multi-periodicity
J. Jurcsik, I. Dékány

- Classical pulsators (Cepheids, RR Lyrae stars) are primary targets of LSST.
- Multi-periodicity of classical pulsators ignored in evaluation of LSST strategies.
- 10-20% of classical Cepheids are multimodal.
- > 50% of RR Lyrae stars are multi-periodic.

- **The "baseline universal cadence" is suboptimal for multi-periodic light curves.**
- ***Suggestion:***
  Consider alternative sampling (cadence) as a baseline survey strategy.
  Detailed evaluation of rolling cadences is suggested.





Session 7A

Hints & feedback from session.

- Large interest Milky Way science with LSST:
  higher priority desired for MW plane.
- Inclusion of MW plane in main survey suggested (fewer filters?)
- Mitigate source confusion by constraints on seeing.
- Accurate crowded-field photometry should be doable.
- Early DDF/minisurvey with many visits suggested for
  inter-calibration of diagnostic tools of puls. variables, and for testing
  completeness.
- Consideration of rolling cadences suggested in order to improve the
  sampling of multi-periodic variable stars.

Workshop 7B cosmology

Mini-surveys and user-generated products

Convener: Johan Comparat (MPE)

Mini-surveys

Fruitful discussions on what are mini-surveys, deep drills.

In the session, we explored the following possible mini-surveys :

- South ecliptic pole area
  - Euclid synergy. M. Jarvis, R Bowler.
  - eRosita synergy. A. Merloni.
  - Magellanic clouds science. M. Cioni.
- SN micro-lensing. S. Huber.
- Gravitational wave event follow-up. T. Tyson.

User-generated products

- Many proposed products !
  - Modelling intra-cluster light: diffuse component. S. Brough, L. Kelvin
  - Morphological classification of galaxies using unsupervised machine learning. S. Kaviraj
  - Zoo classification. L. Kelvin
  - Atmospheric transmission model for each exposure. S. Dagoret-Campagne
  - Surface brightness fluctuation. Michele Cantiello.

Aspects about data + software + computing time to be discussed individually.

Session 8
LSST Software Tutorial

Conveners : Jim Bosch, Robert Lupton

LSST Software Tutorial

Hosted on google Europe= Funded through GCP Research Credits Program) :

https://lsp-demo.lsst.codes/nb

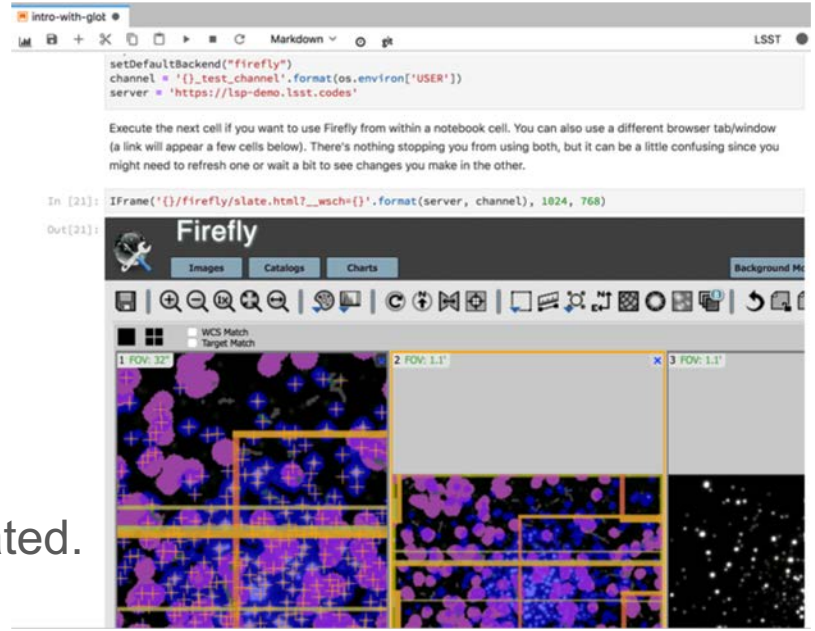
10 nodes 40vCpus - 50+ sessions

Some slowness on Firefly display

Some 503 -not confirmed GitHub mail

Some 504 - a bit of a mystery to be investigated.

Overall successful



Plenty of attendees

Cast

Jim Bosch - Excellent Notebook

Behind the scenes - Adam Thornton (Jupyter/Kubernetes), Simon Krughoff (Everything), David Shupe (Firefly) .. and many others.

In the room :

Hsin-Fang Chiang - Running Tutorial, Notebook testing, Robert Lupton = WIlliam O’Mullane helping

Workshop 12A
(exo)Planets and Asteroids

Convener: Mikael Granvik (U Helsinki)

Presentations

Bryce Bolin: *APO time-resolved color photometry of highly elongated interstellar object 1I/'Oumuamua*

- 1-10 interstellar objects expected to be discovered annually by LSST (Cook+ 2016)

Sebastien Bouquillon: *Gaia GBOT and asteroids*

- 50% of all asteroids new discoveries when going 0.5-1 mag fainter than current surveys
- automated pipeline that produces milliarcsec astrometry

Markus Hundertmark: *Lessons learned from microlensing – advanced alert filtering and rapid response*

- 15 minute sampling rate allows detection of Earth-mass planets
- false-positive rate may be larger than anticipated and depends on filter change rate

Discussion items

- needs and plans for alert brokers
  - microlensing follow-up groups have experience with alert brokers
- simulations needed for white paper
  - no time for discussion
- thoughts/ideas for minisurveys
  - no time for discussion
- plans for user-generated data products
  - no time for discussion
- 2x15s exposures vs 1x30s exposure
  - not necessarily bad, but needs more thought
- pros and cons with rolling cadence
  - difficult to assess due to lack of details (how sparse is sparse?)

Workshop 12B Galaxies

Conveners: Manda Banerji and Joe Mohr

Galaxy Science Splinter

- Talks given:
  - Maurilio Pannella: Galaxy Evolution Studies before and after LSST
  - Peter Hatfield: Small Scale Clustering in Large Galaxy Surveys
- Discussion items:
  - Strengthen communication among SWGs
  - GalaxiesSC collaboration with DESC on simulations?
    - Can DESC share their sims? Are they adequate for testing GalSWG algorithms and requirements?
  - Multi-wavelength needs:
    - NIR data (e.g., VISTA surveys, Euclid) CRUCIAL for galaxy science
    - Radio, X-ray, spectroscopy allow additional science

Galaxy Science Splinter

- Discussion items: (continued)
  - Multi-wavelength collaborations
    - Allow to develop "organically" or attempt to organize/prepare?
    - "Open Skies" vision drives LSST, but not all other collaborations
    - MOUs needed in some cases? (Euclid, eROSITA, ??)
    - Are there tools that will be needed for the science that aren't being built?
    - Possibility: Requirements gathering on project by project basis

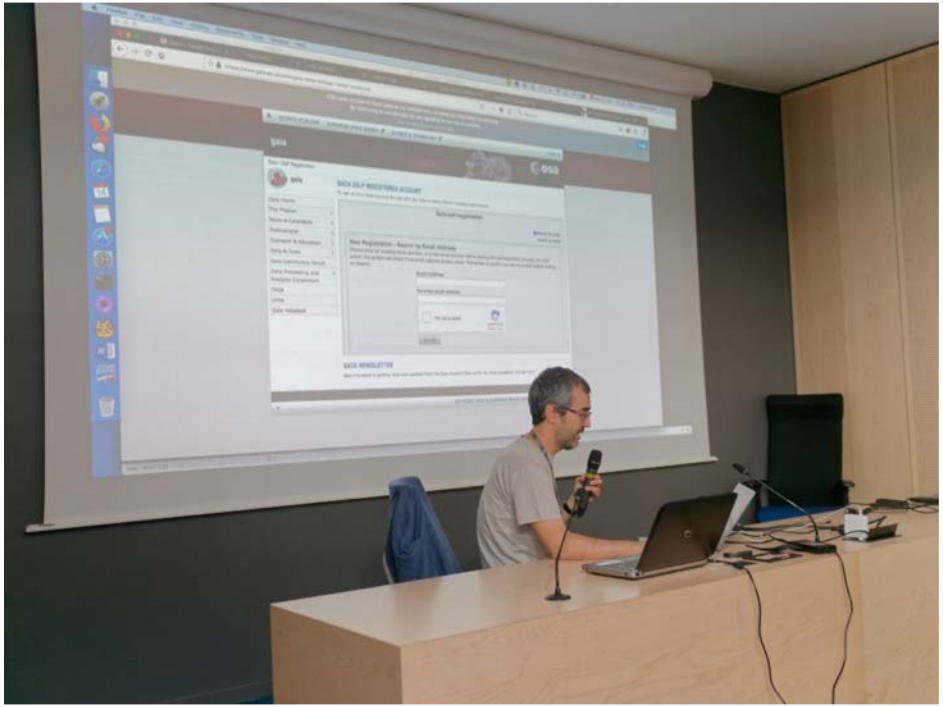
Session 13A: LSST/Gaia sprint

Conveners : Alcione Mora, WIliam O’Mullane

Day 1 - Gaia Archive examples

Mora worked through some examples with Gaia archive and Topcat. Especially showing of the epoch propagator.

See also https://drive.google.com/drive/folders/1WpFOYC0cXrDXMjyCyM-LES0SKaa5APnL



Session 13B: LSST/Euclid sprint

Conveners : Eric Aubourg & Jason Rhodes

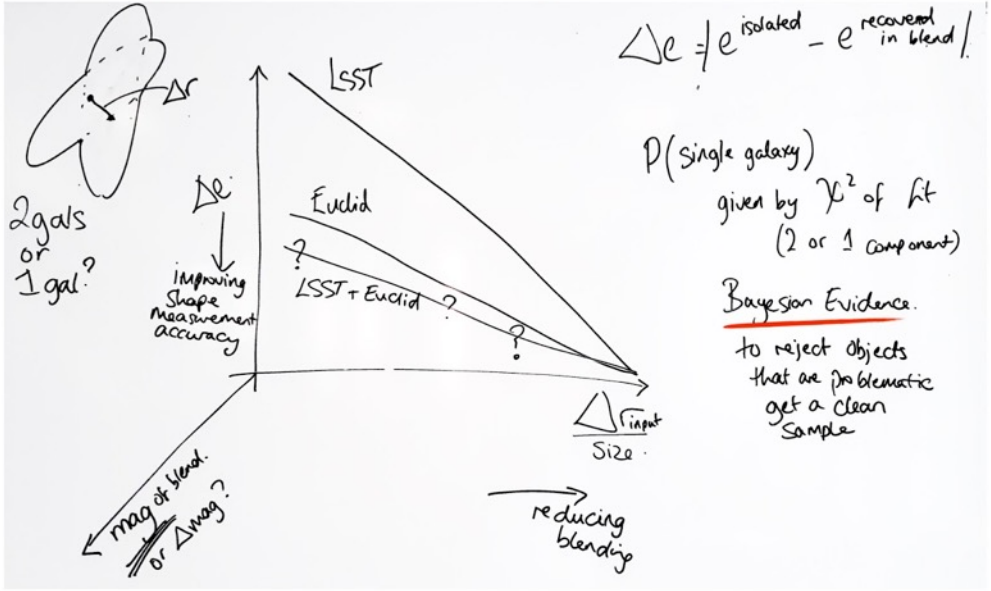
- We discussed the Euclid/LSST complementarity, focusing on science and not politics: on which topics and how can we make joint analyses.
- We had several presentations on deblending, shape measurement, Euclid ground segment and LSST, and photo-zs and SEDs.
- We discussed the interest of a deblending challenge, of sharing joint Euclid-LSST simulations.

Friday morning, two working groups formed on:

a) Deblending and shape measurement (led by Catherine Heymans)
b) Photo-zs and SEDs (led by Matt Jarvis)

LSST+Euclid deblending for weak lensing

Goal : quantify shape measurement accuracy for blended objects (detection)



TODO list
- P(Δmag,Δr) from Joachim's simulations
- similar input LSST+Euclid-like GalSim catalog
- get in touch/coordinate with BTF

A. Boucaud, C. Doux, X. Er, J. Harnois-Deraps, C. Heymans, R. Schuhmann, C. Roucelle, F. Virieux

Combining photometry to improve photo-zs and SED fitting

- Hydro Sims – replicate real structures of galaxies (Horizon-AGN – Clotilde)
- SAMS probably not great for this
- Real data HST (CANDELS/GOODS) + HSC etc
- Initially on full-depth LSST
- Test existing algorithms – close links to deblending!
  - TPHOT – Maurillio & Corentin
  - Tractor – Kristina Nyland & Mark Lacy
  - LAMBDAR – Angus Wright (Aaron)
  - Convolve to poorest seeing and do multi-aperture photometry
    - All as a function of ground-based seeing
- Test with limited set of template fitting code (EAZY, LePhare, BPZ, new code)
- Are spectral templates representative of the real galaxies
- Sub-sample simulation on likelihood of having a spectroscopic redshift – is zp vs zs better or worse?
- Metrics for photo-zs – follow DESC photo-z metrics (Schmidt et al. in prep)
- Calibration between LSST & Euclid
- Impact for individual galaxies vs total dN/dz

Workshop 14A Stars and the Milky Way

Conveners: Cristina Chiappini and Laszlo Kiss

Presentations

1. Short gamma-ray burst afterglows and kilo novae: perspectives with LSST (Paolo D'Avanzo)
2. Simulations of the LSST stellar content: Milky Way and Magellanic Clouds (Giada Pastorali)
3. Exploiting M-type star properties to discover young clusters (Loredana Prisinzano)
4. The K2 RR Lyrae survey (Robert Szabo) - the bias arising from light curve variability is yet to be studied for the LSST sampling.

Topic List (more tailored to LSST potential)

- Can MW studies constrain the nature of DM? (Ibata on Monday - streams)
- Need for large coverage of MW with 6D+[Fe/H](+[X/Fe])+Age
- The importance of the innermost regions/Bulge/Bar – so far “giants view” + Cepheids + RRLyrae (Gaia+LSST). Subgiants @ d > 5kpc? Microlensing?
- How to best spectroscopically follow-up these regions for greatest science impact? So far Gaia focused – should extend to LSST
    - Ø 4MOST+LSST: disk/Bulge -> preferred deep field?
    - Ø 4MOST+WEAVE+LSST: halo/outer-disk
- Structures on velocity maps -> strong constraints on Bar/spirals -> so far “local+” – need to extend towards inner/far-away regions with Gaia precision but d > 6 kpc from us
- GaiaNIR ideas – main drivers - how much are the missing 98% of stars in the Gaia data crucial for the complete picture of the MW?
- New European funding opportunities: e.g. FP9 (Horizon Europe) resources shall be used by new consortia, which may be formed through the helps of these kind of meetings and sessions.

Workshop 14B Cosmology

Conveners: Phil Marshall and Rachel Mandelbaum

Fabrice Feinstein - Millical: fitting star mags using GAIA & AuxTel

Simon Huber - Time Delay Measurement of SLSNe Ia with LSST

Mickael Rigault - Astrophysical Bias in SN Cosmology

Pierre-François Léget - Cosmic Shear and the LSST PSF

Jonathan Blazek - Projects in the TJP Working Group

Emille Ishida - PLAsTiCC

Peter Hatfield - GPz: Machine Learning Photometric Redshifts

Jim Chiang - Data Release Production for the DESC

Dominique Fouchez - DESC DRP SN/SL Processing

Mariana Penna-Lima - Cluster Mass Estimation

Cécile Roucelle - Deblending with Deep Learning

Éric Aubourg - LSST-Euclid Coordination

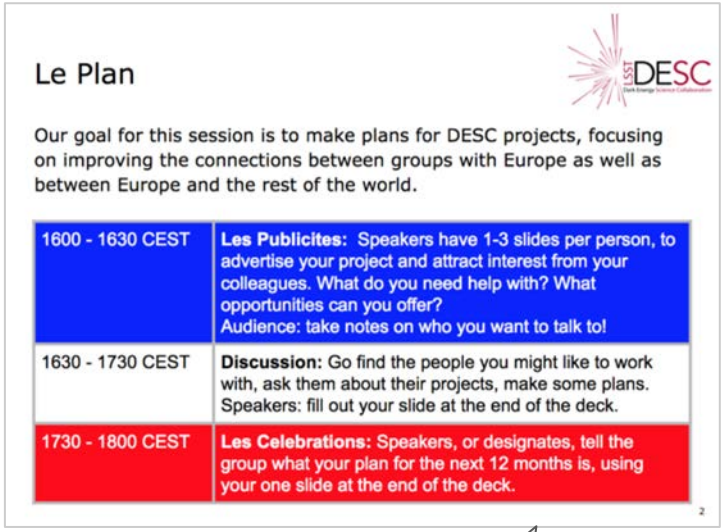
Elizabeth Swann - Spectroscopic Follow-up of LSST SN & Host Galaxies

Philippe Gris - Cadence optimization for supernovae in LSST

Joachim Harnois-Deraps: Cosmological Simulations for Weak Lensing+

Nicolas Regnault : what can we learn about LSST from SNIa Hubble diagram residuals

Catherine Heymans: Accurate Non-linear power spectra for modified gravity theories



17 Speakeurs Formidable!

Fabrice Feinstein - Improve error model using DC2, emulate star catalogs, visit SLAC

Simon Huber - Coordinate with TIDES, test time delay accuracy in SN WG's cadence sims

Mickael Rigault - Astrophysical Bias in SN Cosmology

Pierre-François Léget - Cosmic Shear and the LSST PSF

Jonathan Blazek - Modified gravity "beyond wCDM", test numcosmo & CCL in TJPCosmo

Emille Ishida - PLAsTiCC launches in late summer (practise here), prepare to publish

Peter Hatfield - investigate GPz cluster-finding, check n(z) accuracy for cosmology

Jim Chiang - Exercise new communication channels with DM, to unblock pipeline dev team

Dominique Fouchez - Make DC2 Run 1.2p DIAObject lightcurves, study efficiency/photom

Mariana Penna-Lima - Cluster Mass Estimation

Cécile Roucelle - Deblending with Deep Learning

Éric Aubourg - Execute projects defined in data sprint workshop

Elizabeth Swann - 4MOST simulation upgrades in Sept, join Obs Strategy Task Force

Philippe Gris - Develop tools and metrics to estimate the best cadences (white paper call)

Joachim Harnois-Deraps: Many ideas with Katrin & Salman, use SLICS in DES to practise?

Nicolas Regnault : coordinate with 4MOST (z precision & efficiency) - perform simulations

Catherine Heymans: Build emulator of NL matter power spectra in MG into TJPCosmo

Next Steps

- Feedback content to relevant LSST Science Collaborations
- Some common themes - synergies in defining observing strategies
  - Cadence - variable stars / SN
  - Alert brokers - GW/EM counterparts / microlensed planets
- Prepare for the LSST June White Paper Call
  - Into the bulge, the disk
- Software - requirements on interoperability
  - LSST/Gaia - towards a common approach in access to lightcurve photometry
  - LSST/Euclid -
- Follow up via the LSST Science Collaborations - or in the near term engage with the LSST@Europe attendees at ast-lsst-lyon18@lists.cam.ac.uk