

Adler Supplementary Slides

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Overview

- Open source package (LINCC-Frameworks template) to enable detection/analysis of small body activity in the LSST alert stream, e.g.
 - Dynamically new comets/ISOs
 - Small body collisions
 - Cometary outbursts
- Enhance the LSST alert via analysis of the cutout image and predicted brightness
- Development between QUB and Edinburgh, LSST:UK Phase C (WP3.6) - community input welcome!

Cutout analysis

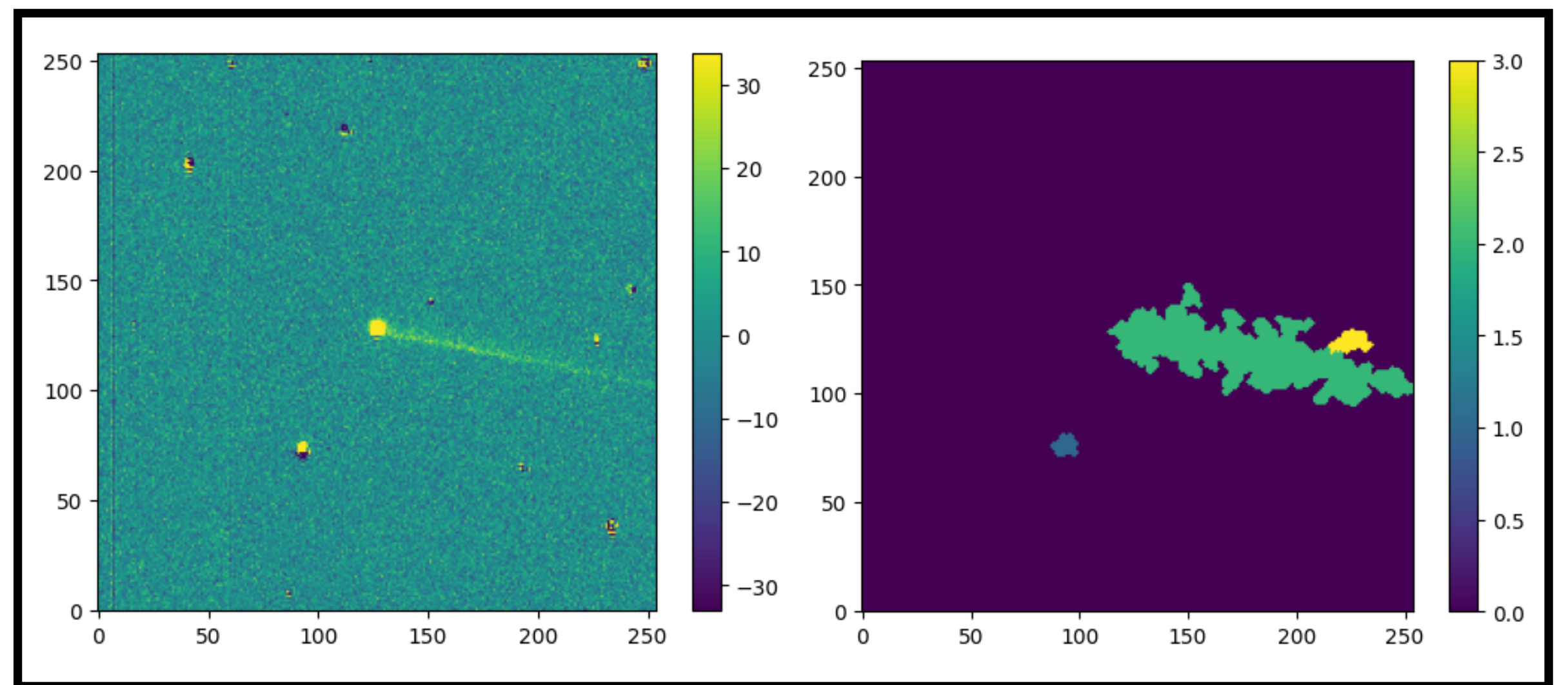
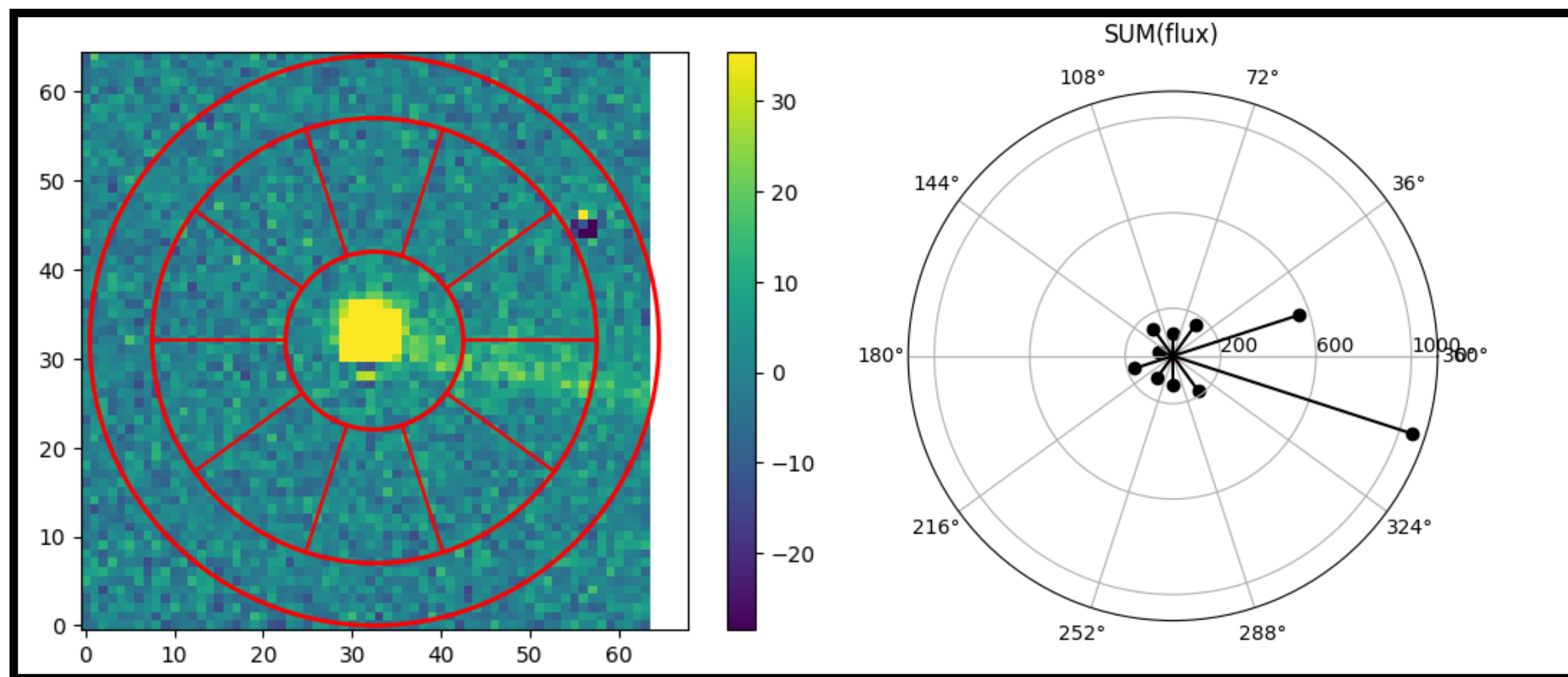
adler will perform additional analysis of cutout images in the LSST alert stream to **detect** and **quantify** activity

Wedge photometry

Excess flux in azimuthal bins, retrieve tail direction

Noisechisel

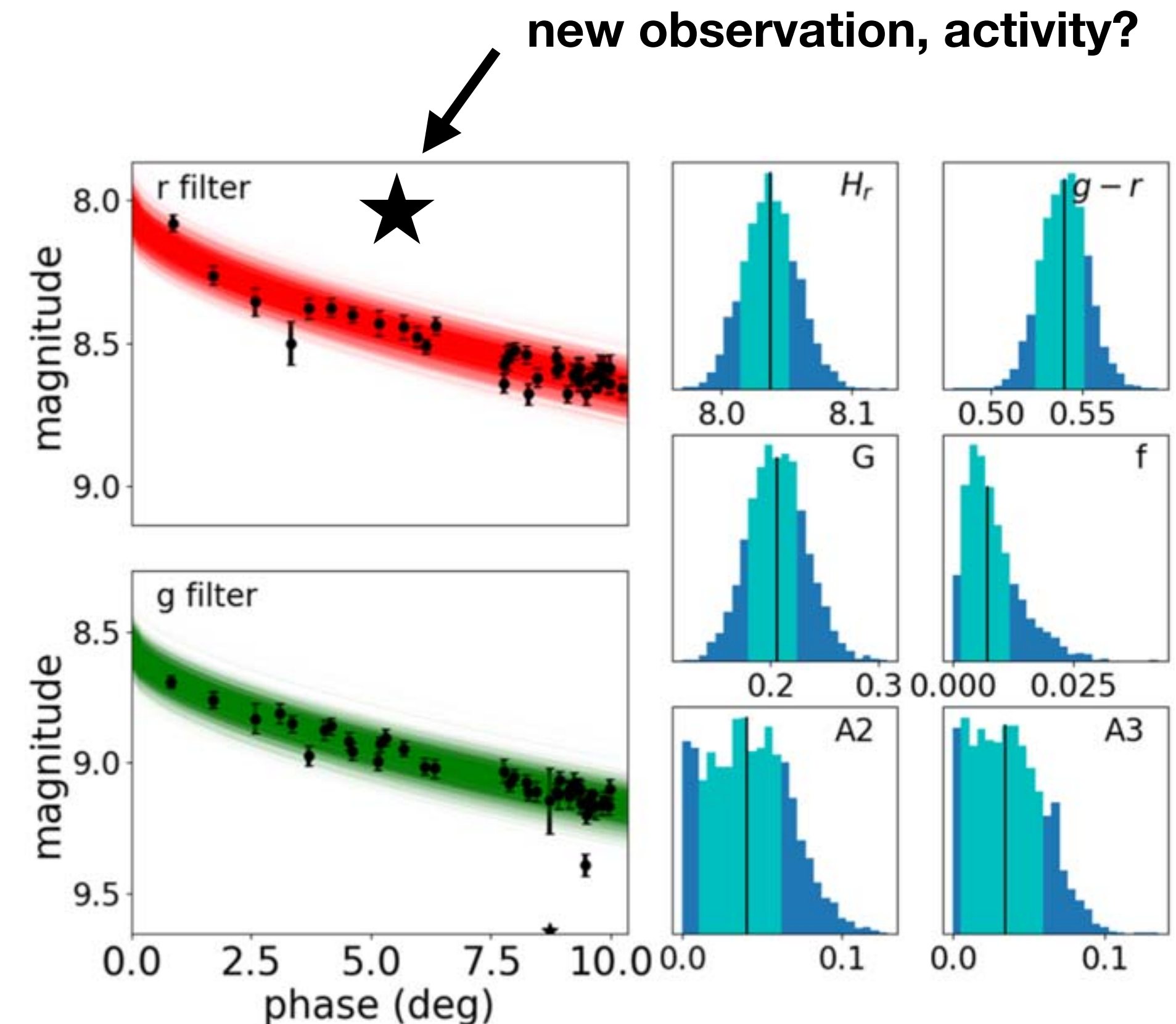
Image segmentation of low surface brightness sources



Didymos (ZTF difference image)

Phasecurve analysis

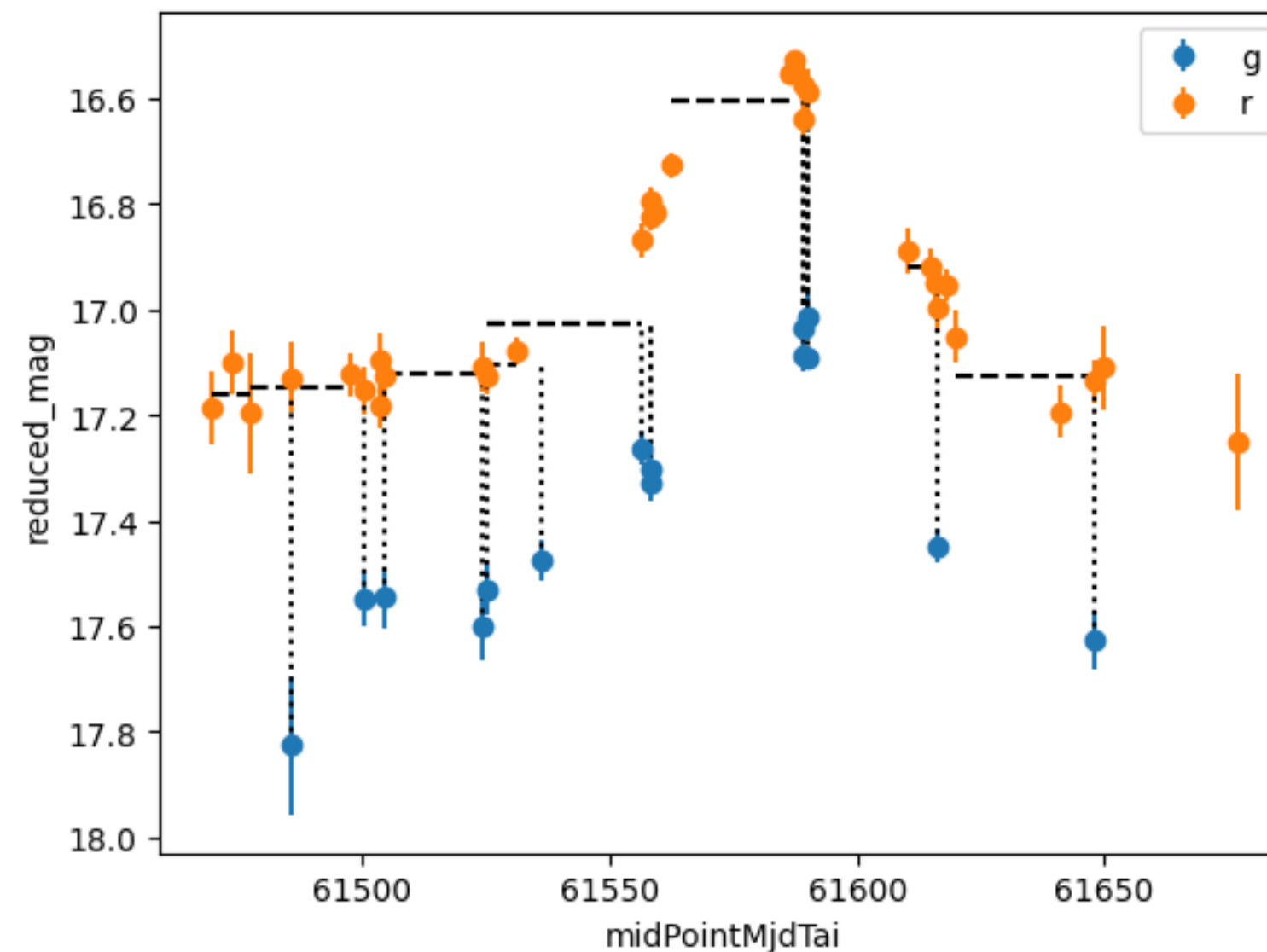
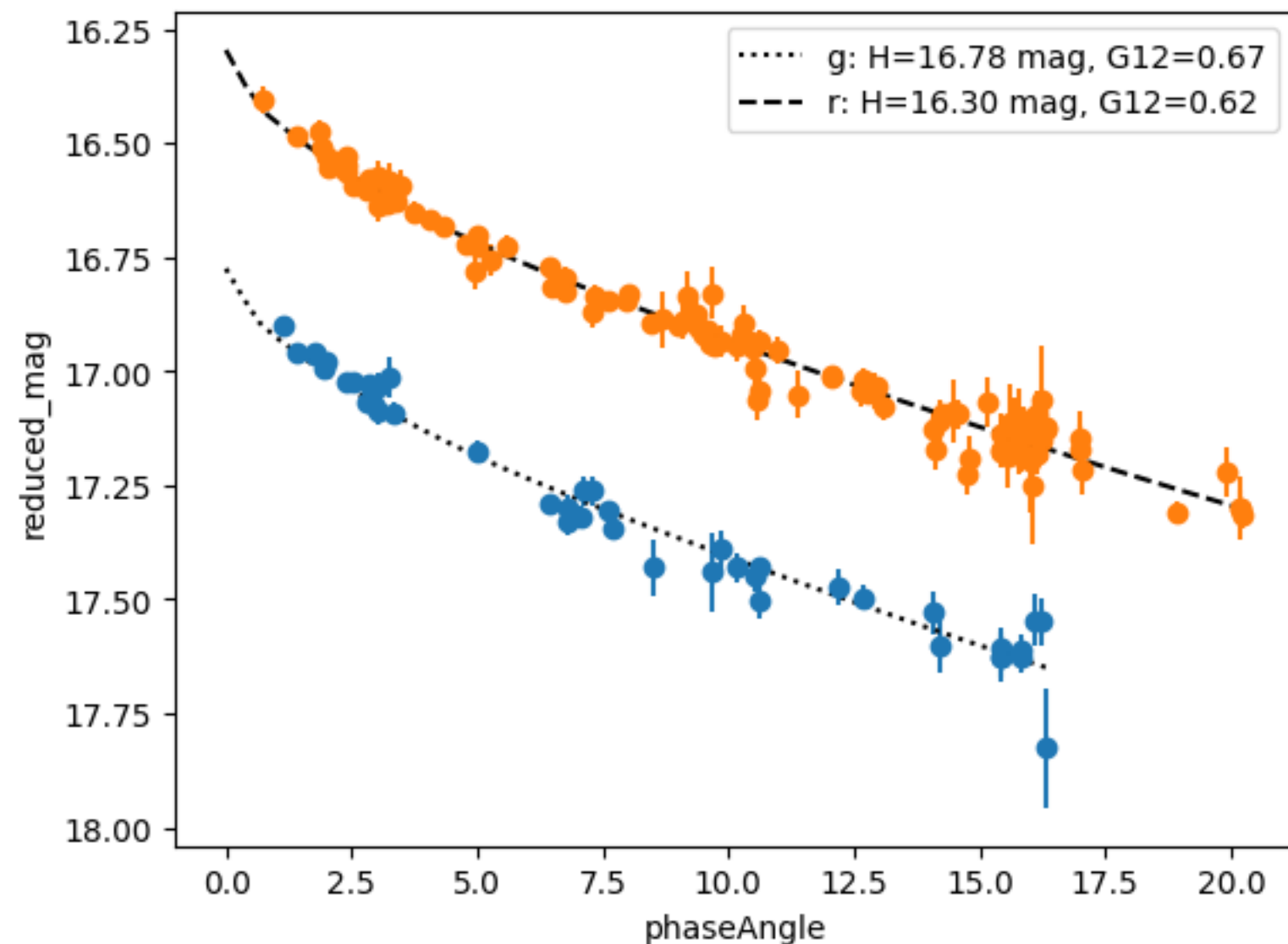
- Unresolved activity may appear as abnormal brightening: are new observations consistent with the existing phase curve model?
- Update the phase curve model when sufficient new observations are available
- LSST Solar System Processing (SSP) calculates phase curve parameters for each filter in the HG12 Penttilä et al. 2016 model (see DPDP Isst/LSE-163)
- Adler will search for outliers from expected phase curve



Schemel & Brown 2021

Small body colours

- A colour is generally calculated from well defined phase curves in multiple filters
- Adler will search for changes in colour, e.g. changing ratios of gas:dust during cometary activity
- Compare new data in observation filter to the brightness in the reference filter (parameters can be adjusted)



Updates

- Adler can ingest MPC and EDP2 catalogues.
- Image analysis:
 - dp1 cutout service (no comets, difference imaging not great)
 - 3I data (crowded field and no diffs)
 - ZTF (for testing) and LSST alerts (limited cutout size and fits header WCS)

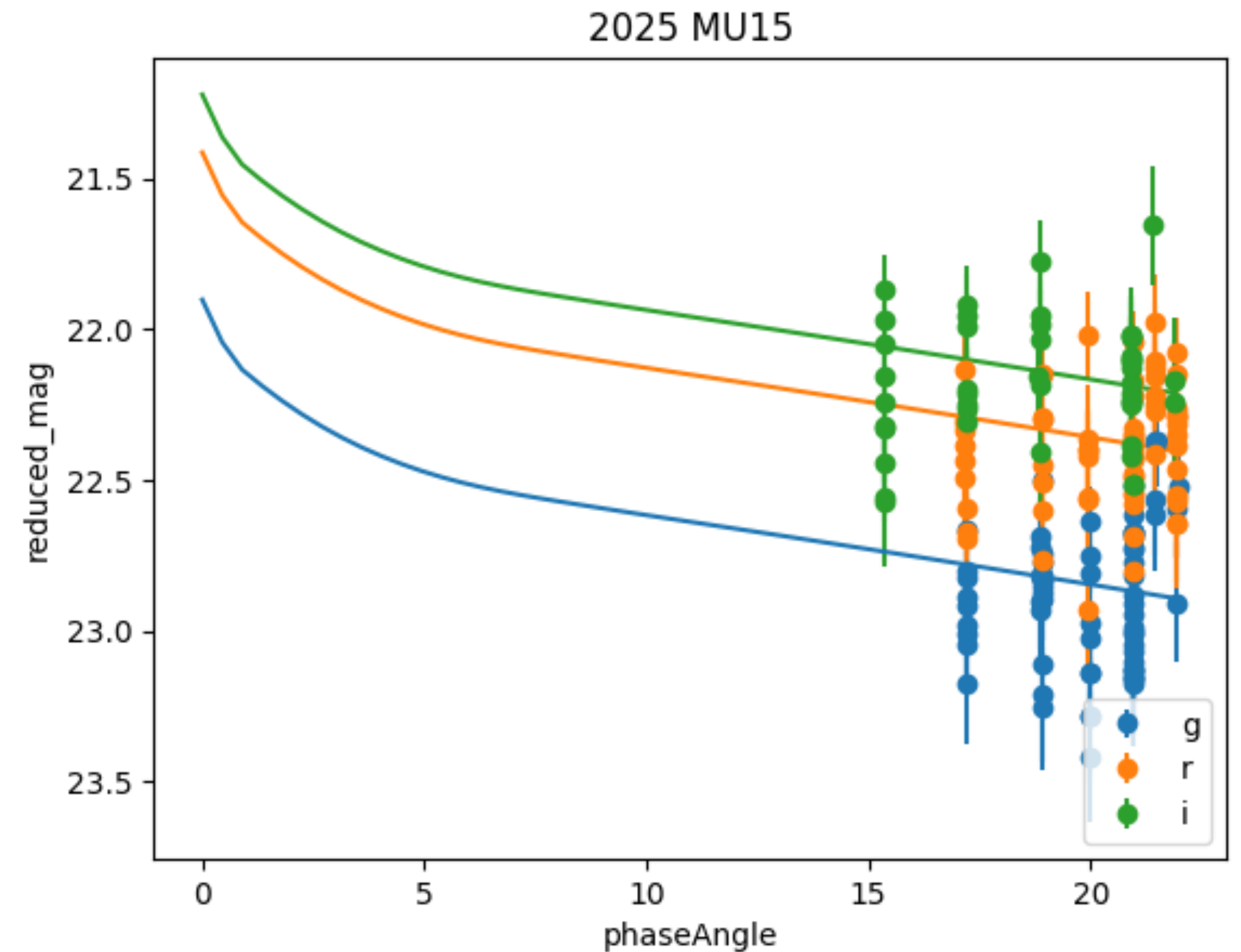
Current catalogue data

	DP1	MPC (processed)	EDP2
N_observations	5,988	3,386,502 (1,813,287)	8,136,150
N_sso	431	145827 (94,693)	299,343
Available at	RSP	https://b612.ai/rubin-mpc-downloads/ (Discovery Alliance #solar-system)	RSP

There is also data (photometry and cutouts) in the alert stream

Minor Planet Center

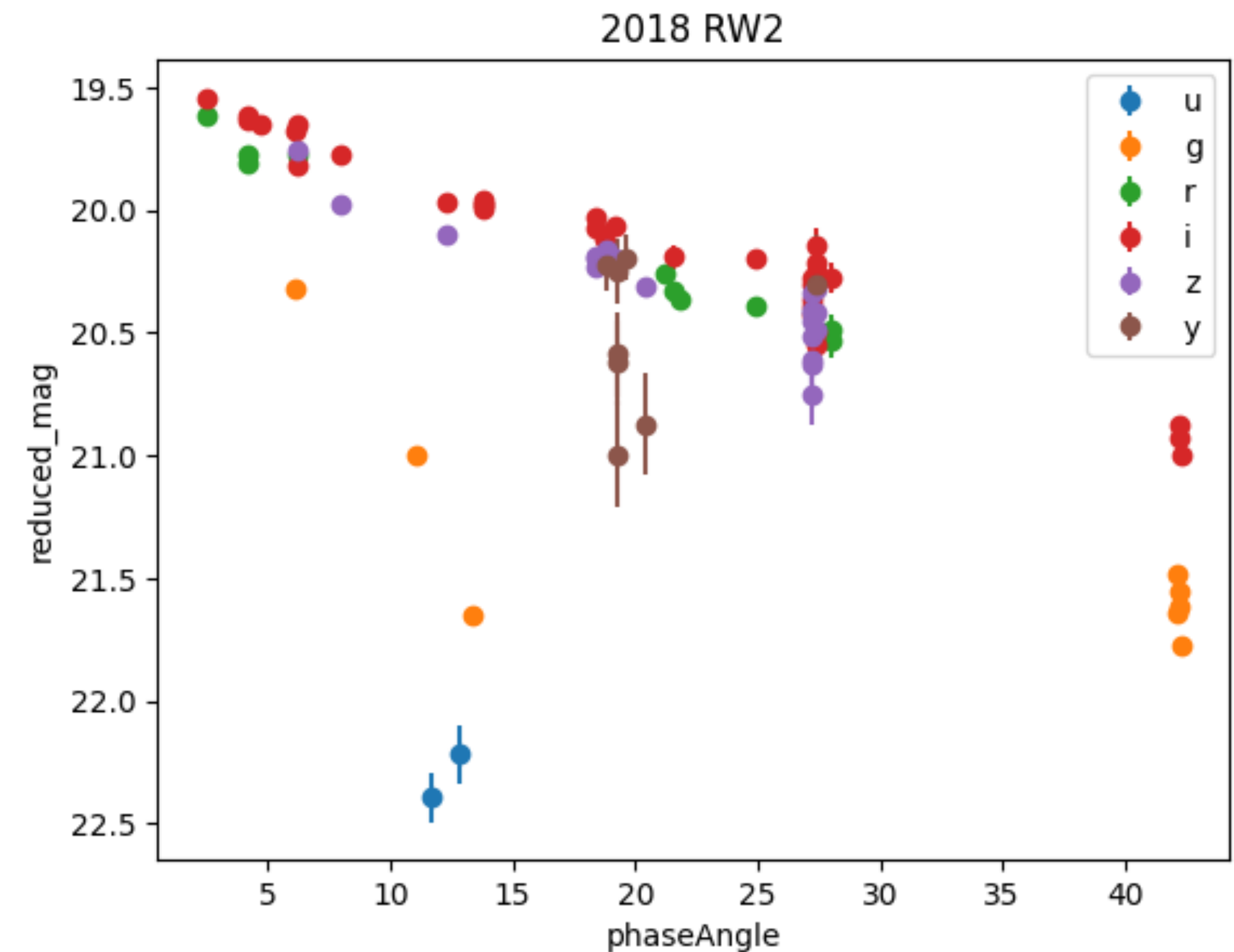
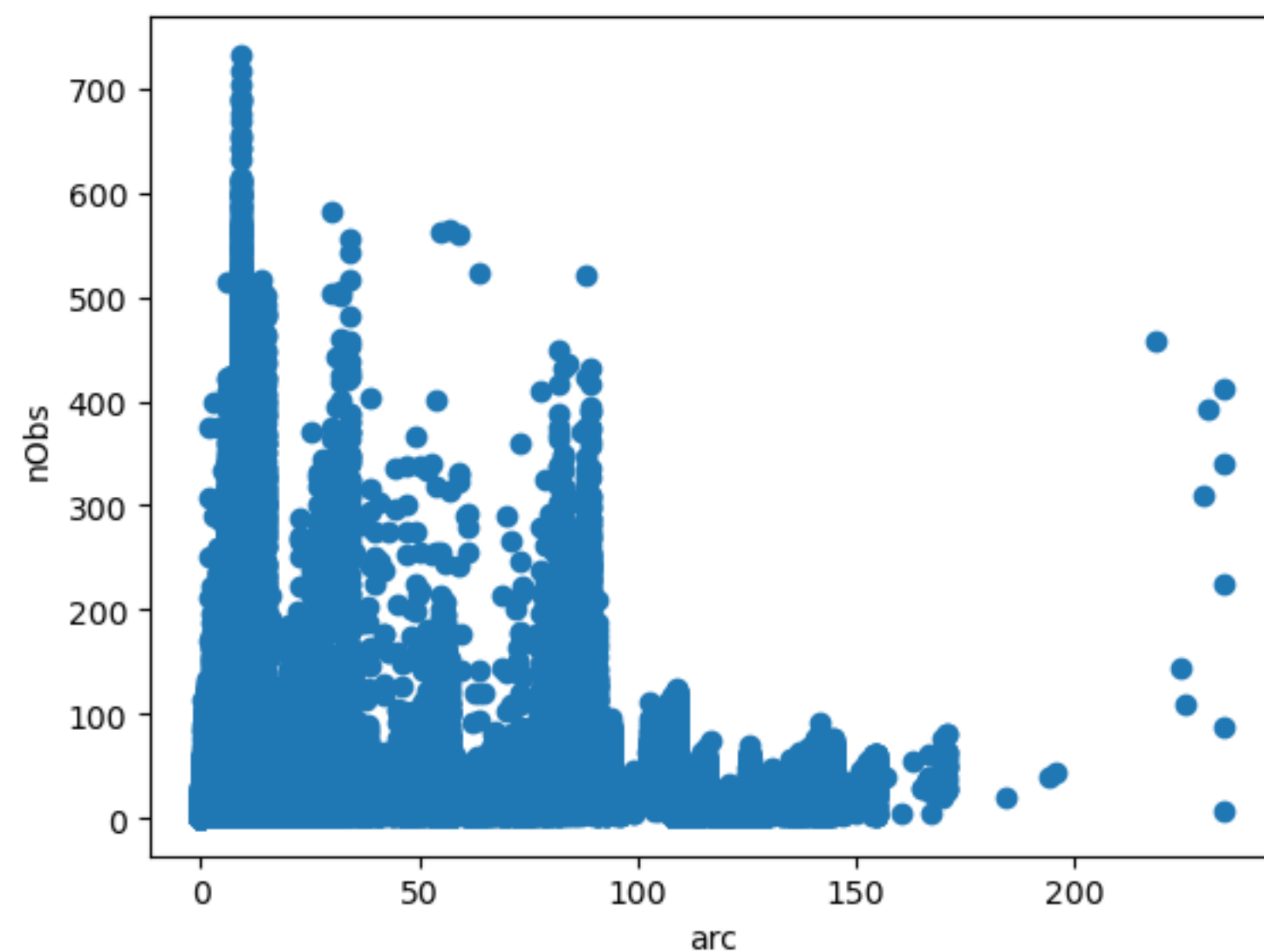
- SSSC effort (Meg Schwamb et al.) to use layup to calculate additional ephemerides information for each observation:
- phase angle, heliocentric distance, topocentric distance etc
- Generally poor phase angle coverage



<https://github.com/Smithsonian/layup>

Early Data Preview 2

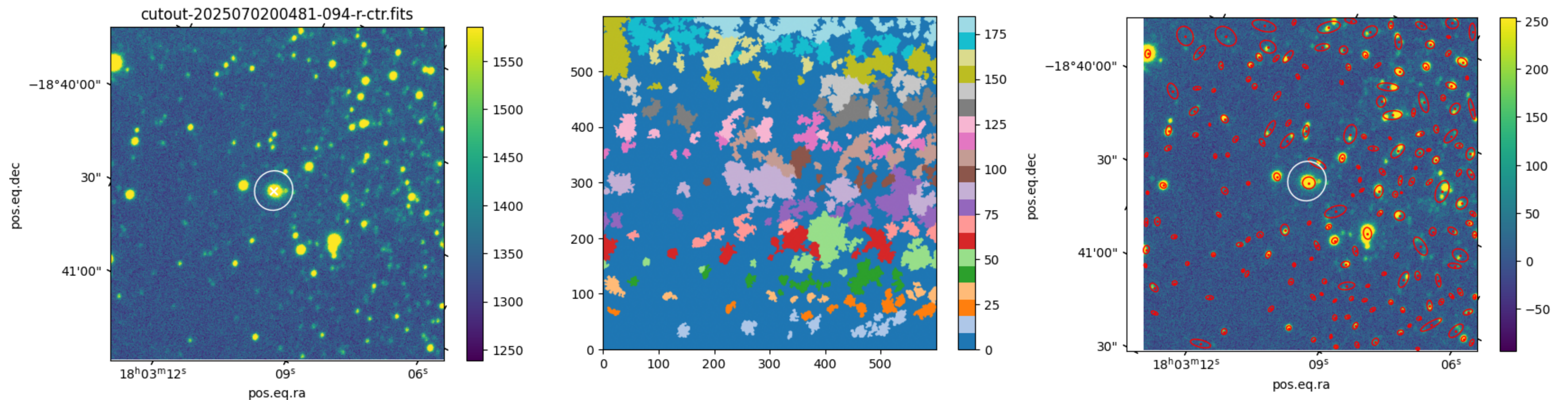
- Wide range of phase angle coverage
- Very large tables - need to start being sensible with queries...



EDP2 coverage (299343 objects)

3i commissioning data

- Special commissioning dataset for only official active object in Rubin data, no difference images:
<https://prompt-products.lsst.io/products/3i-atlas/index.html>
- Initial Noisechisel tests:



Input

Objects

Catalogue

Outstanding Issues

- **MPC:** submissions from Rubin not yet at full production - SSP are prioritising high confidence tracks
- **EDP2:** no comets associated (there are most likely some in there) and no visit images for activity detection
- **Prompt products:**
 - currently difficult to query brokers for SSO alerts (easy once we have ssObjectId/diaSourceIds!)
 - PPDB planned for Sep-Oct but expected limitations on queries (RTN-011 section 5.2.1)
 - no comets (successfully) associated by pipeline (see work by Madeleine McLeod*), requires association distance increase for comets? may get more diaSource matches - PPDB would be great for testing!
- **Brokers:**
 - Antares community filters: will be provided by Snaps broker instead (not much info)

*<https://doi.org/10.3847/2515-5172/ae8f39>

Planned Work

- Process larger numbers of objects using MPC and EDP2 photometry catalogues - build AdlerData summary table, search for brightness outliers
- Ingest alerts and analyse cutouts - ideally need prompt products db (to get relevant diaSourceId/ssObjectId) and probably limited to wedgephotometry (too small for noisechisel)
- Continue preparing Noisechisel analysis for upcoming full DP2 visit images