

OM Status

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XMM User Group meeting
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Overview

- Instrument status
- OM SUSS6 catalogue
- Calibration: OM time-dependent degradation update
 - general field correction
 - additional boresight correction
- Outlook
- *Artefact detection project*

Instrument status

- OM continues to operate nominally.
- Throughput degradation has now almost stopped
 - changes expected to be $\leq 2\%$ by 2030 in all filters (except at the boresight)

OM SUSS6 catalogue

- The 6th version of the XMM-OM Serendipitous UV Source Survey (SUSS6) was released in Oct 2023 ([UG recommendation 2023-05-11/05](#)).
- The first version generated from pipeline products rather than from a bespoke OM processing ([UG recommendation 2023-05-11/04](#)).
 - Harmonizes catalogue content with the OM data in the XMM archive
 - Based on the last bulk-reprocessing (2019) plus subsequent pipeline processing
 - Incorporates the impacts of SAS changes and calibration updates since 2020 *but not the recent ones used in the 2024 Bulk Reprocessing.*

OM SUSS6 catalogue - summary

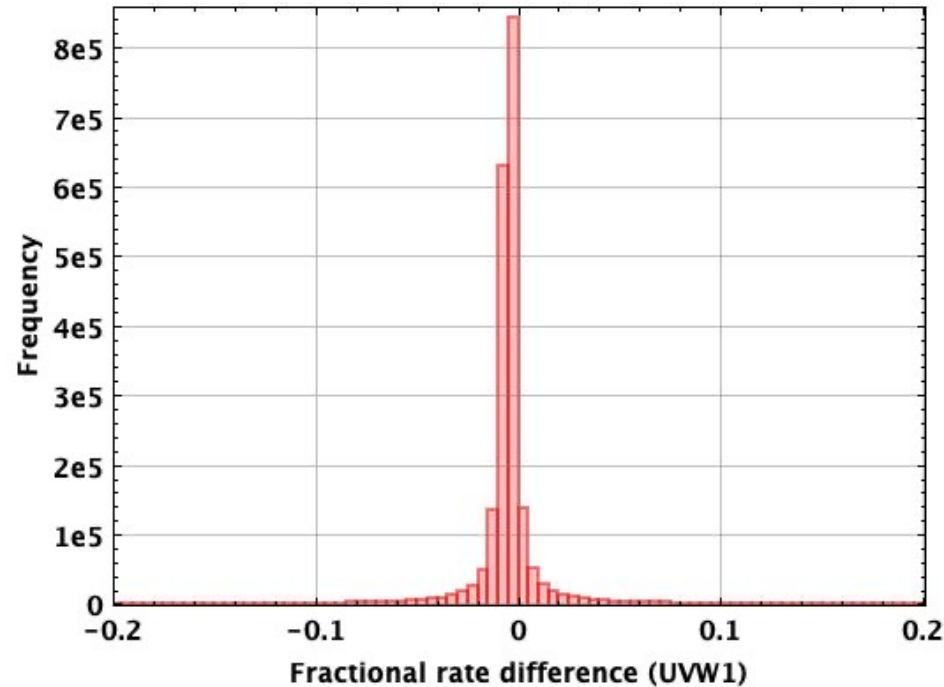
XMM-OM SUSS6 released, via XSA

<https://www.cosmos.esa.int/web/xmm-newton/xsa> (catalogue access)

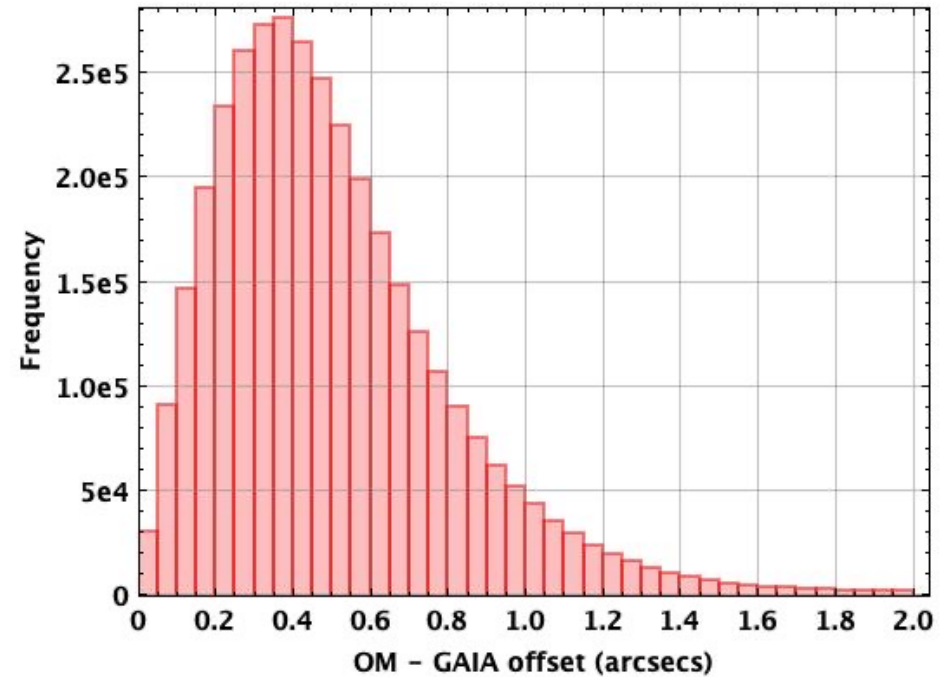
<https://www.cosmos.esa.int/web/xmm-newton/om-catalogue> (documentation)

Time-span	Feb 2000 – Nov 2022
Observations	12,057
Detections	9,920,390 (12% increase cf SUSS5)
	5.46x10 ⁶ in at least 1 UV filter ~131k in all 3 UV filters
Unique sources	6,659,554
Observed more than once 2 or more best quality dets	1,225,117 ~382k(W1), 80k(M2), 45k(W2)
Largest no. of repeat dets	103(W1), 64(M2), 61(W2)

OM SUSS6 catalogue - summary



94.4% of SUSS6-SUSS5 detections matched in 1", have UVW1 fractional rate difference $< 5\%$ ($2.8\% > 10\%$).



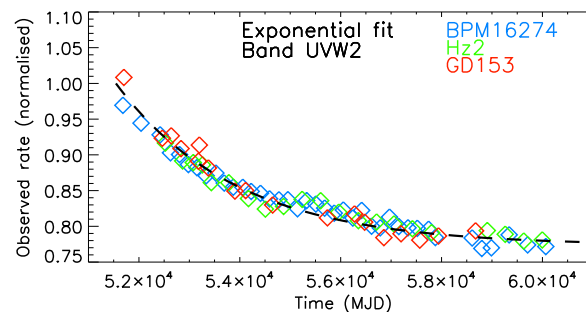
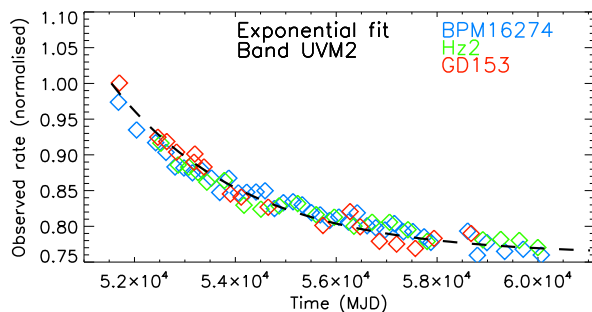
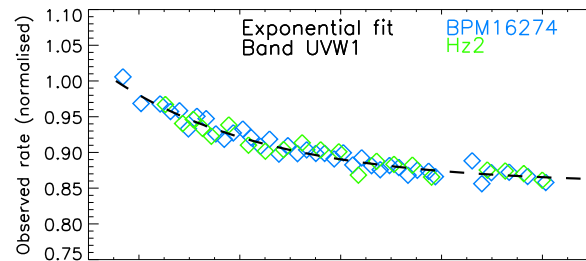
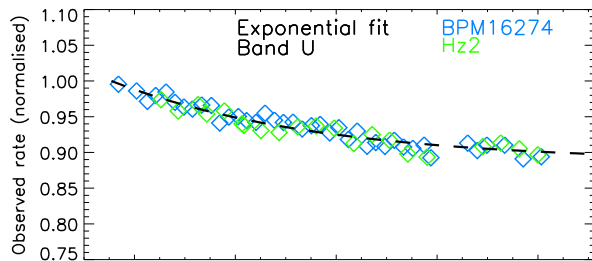
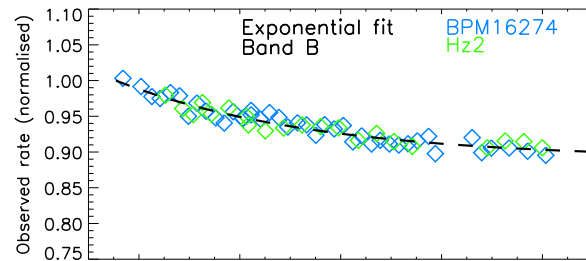
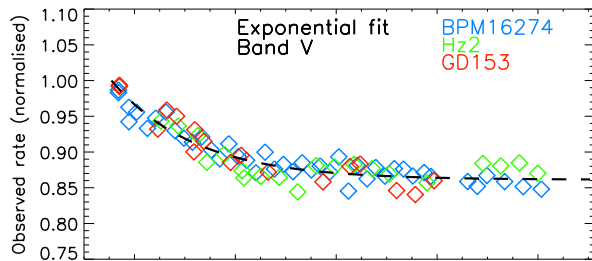
80.2% of 'clean', point-like OM SUSS6 detections have a GAIA match within 2" of which 93.2% have offsets $< 1''$ (mean offsets in $\Delta\alpha, \Delta\delta \leq 0.1''$)

OM SUSS catalogues – for the future

- Next version (2025)
 - will be based on 2024 Bulk Reprocessing: incorporates TDS updates ([UG Recommendation 2023-05-11/06](#)) and pipeline changes to exclude detections from singly-exposed regions of sky mosaics stacks (detector image already used)
- Further ahead (as project priorities permit)
 1. Aim to incorporate proper motion corrections – improve detection association to unique sources
 2. Seek to generate time-dependent flatfields in each filter to correct for spatial sensitivity variations (including/especially JP).
 3. Address flagging of sources near unrecognized read-out-streaks/smoke rings.
 4. Exploring use of pattern recognition algorithms (Iulia Dima/data science group) to recognize/define scattered light (and other) artefacts for flagging.

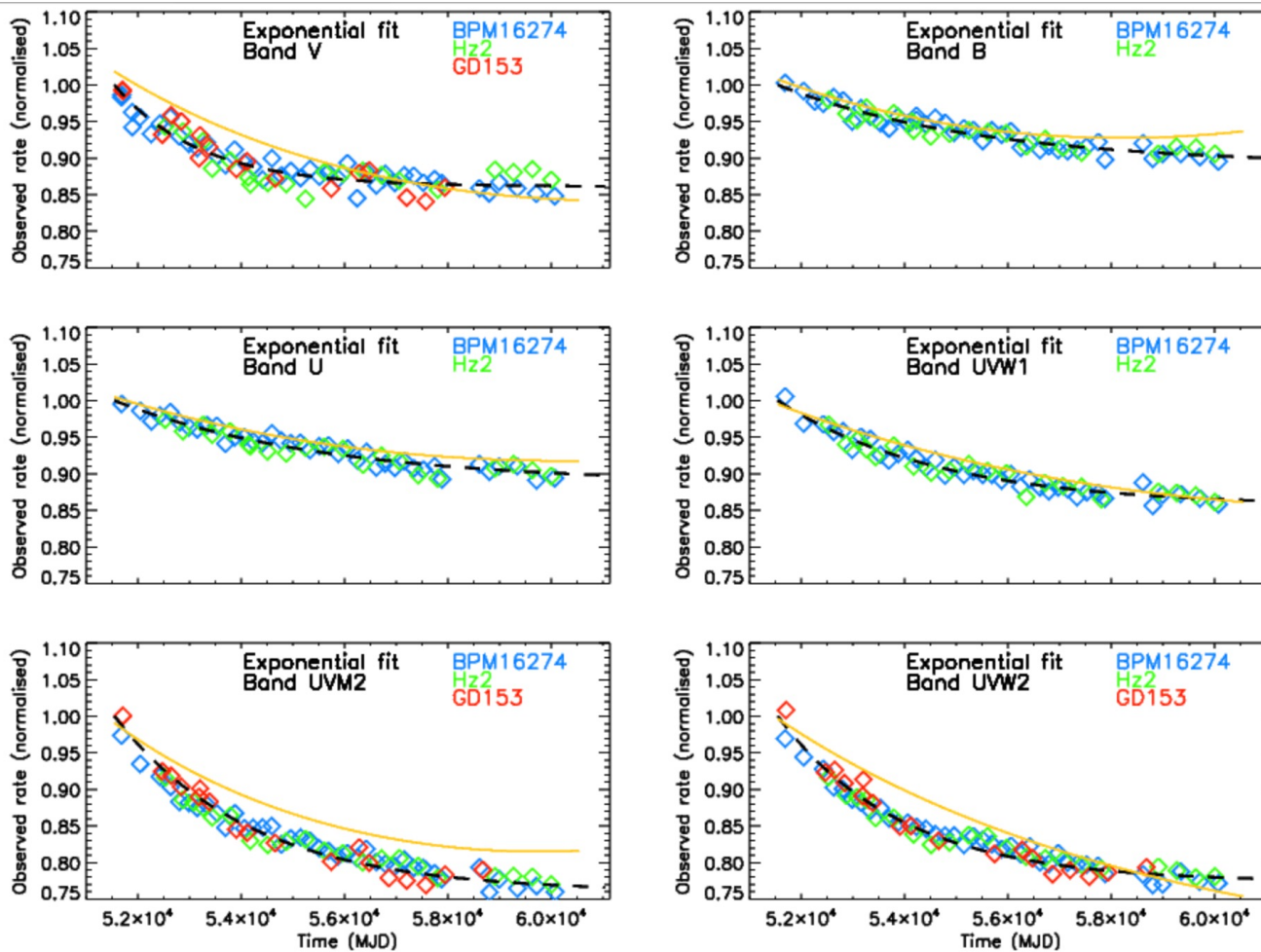
Calibration: General time-dependent sensitivity degradation

Previously noted that degradation analysis based on catalogue sources and standards differ by up to 4%. Decided to return to use of standards



- Since all filters show flattening, adopt exponential representation.
- Rev < 3224: Use boresight data
- Rev > 3224: use offset data
- Simultaneously fit to 3 Standard stars
- Generally good fits – scatter < 2%

General time-dependent sensitivity degradation



- New exponential fits to Standards (black) cf previous polynomial functions (orange) from 'constant' sources from the SUSS4 catalogue.
- Worst case, UVM2, systematic divergence of up to 4% => standards decline more (sources need larger correction).

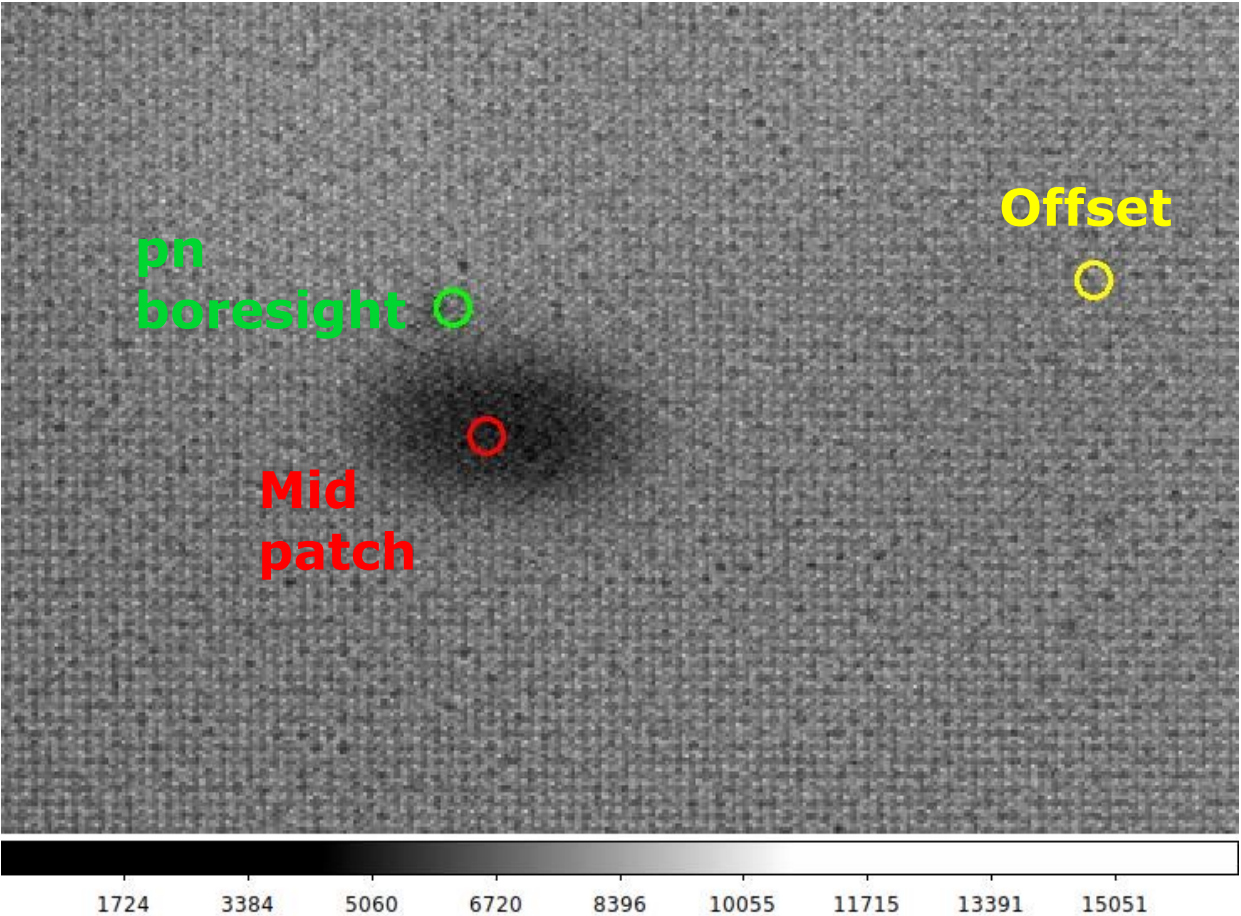
OM_PHOTONAT_0009 updated with these exponential forms

Calibration: Additional degradation at the pn boresight



For revs>3224, pn boresight affected by degradation in wings of Jupiter patch

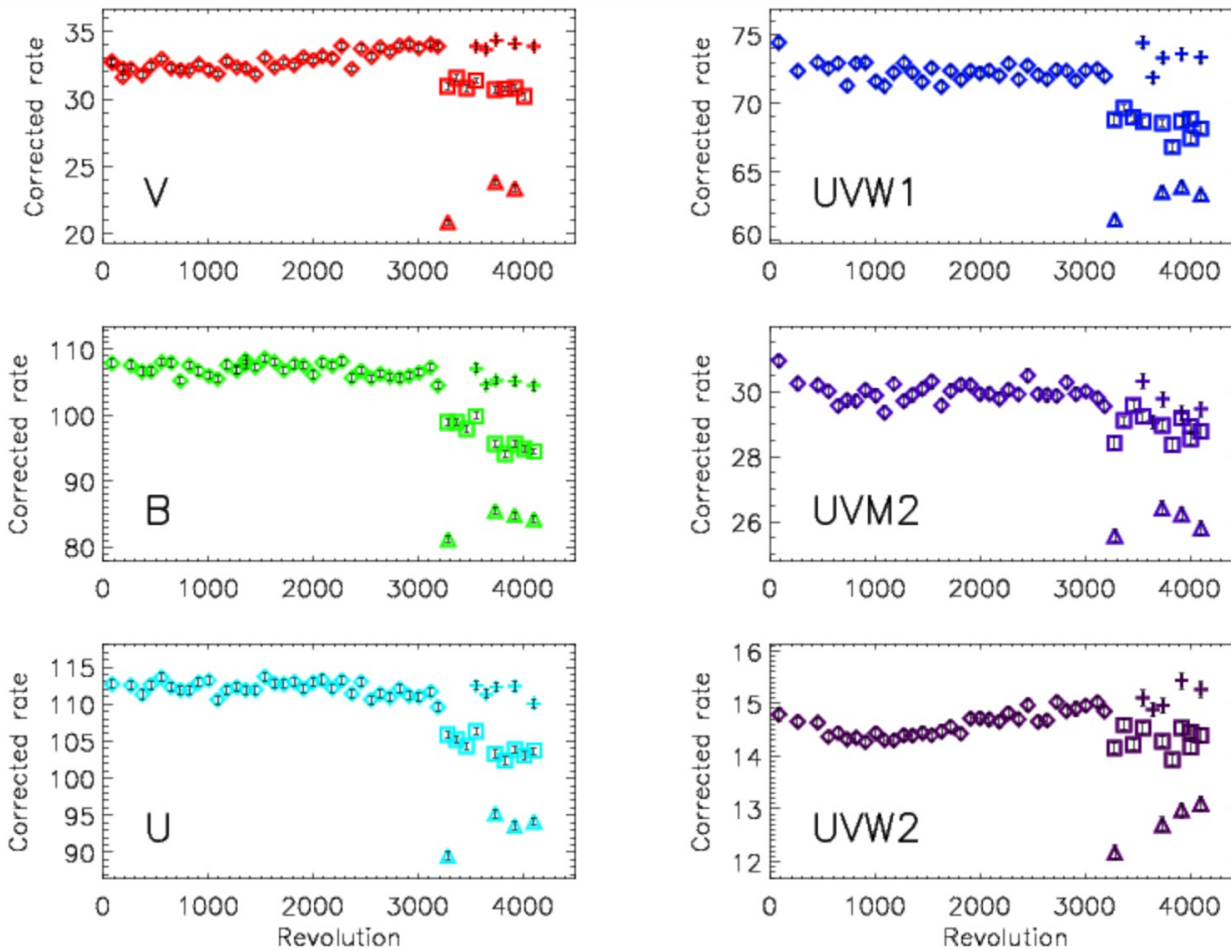
Zoomed region near the pn boresight



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Additional degradation at the pn boresight

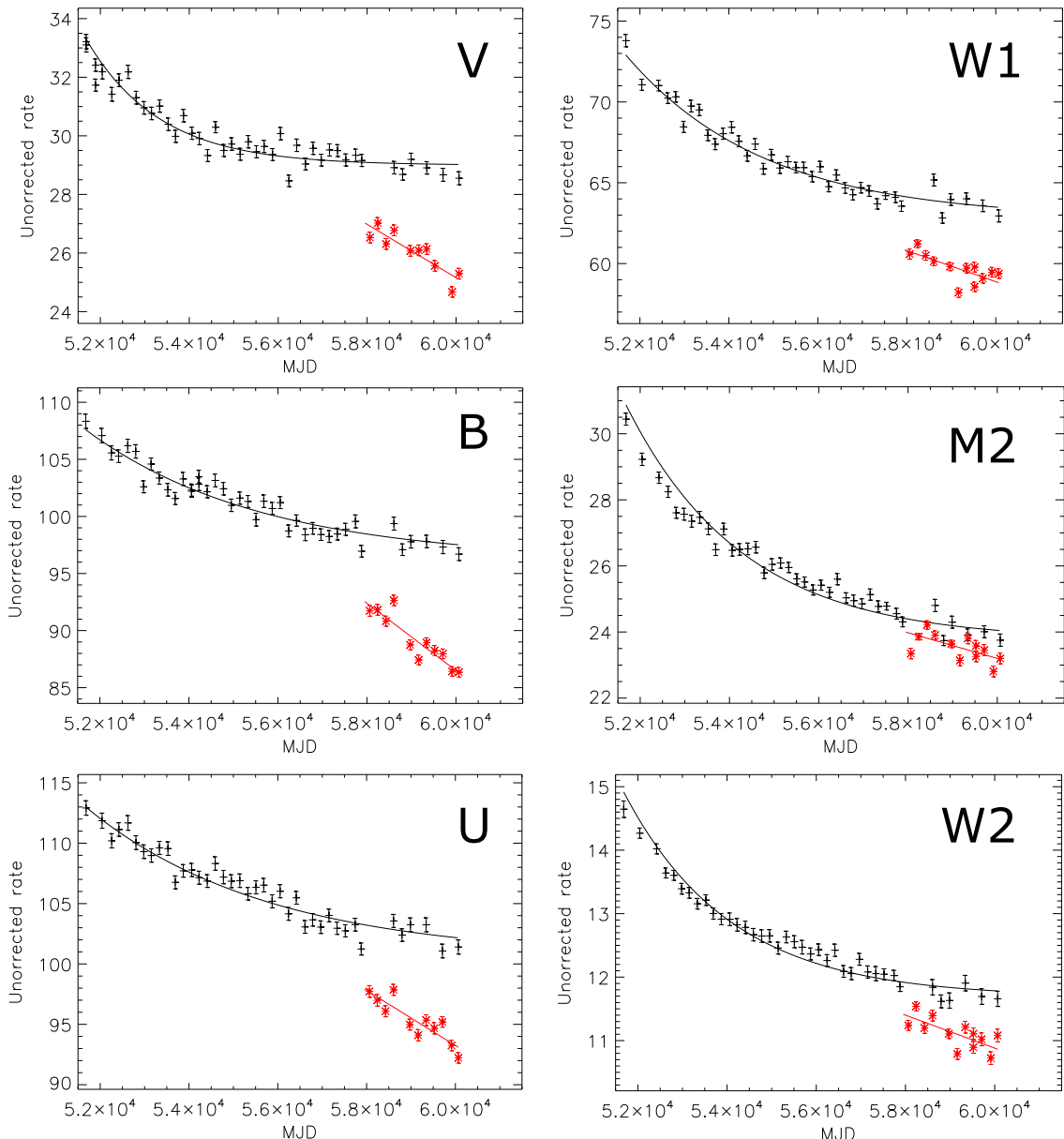


BPM16274 count rates
(corrected by previous
polynomial fit)

For rev > 3224 points
- pn boresight (squares)
- offset locations (crosses)

Post rev 3224 sensitivity
loss at pn boresight
documented in OM
Calibration Status
Document *but currently
not corrected in SAS < 22*

Additional degradation at the pn boresight



Decay curves of BPM16274 at boresight locations or offset after rev 3224 (black)

Measurements at pn boresight after rev 3224 (red)

Ratio of black to red curves => additional correction for pn boresight.

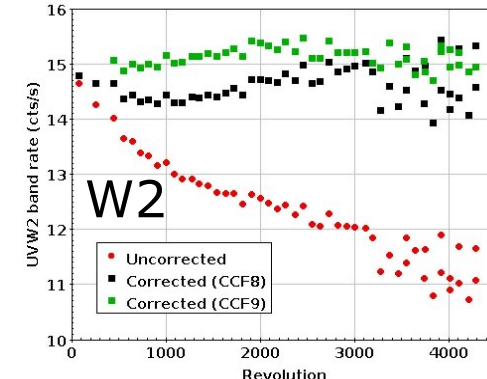
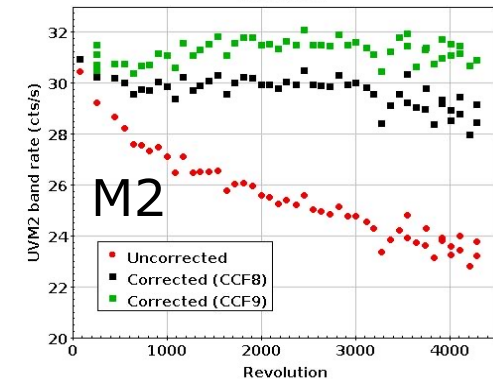
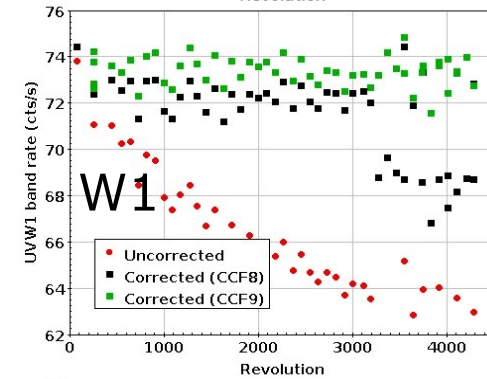
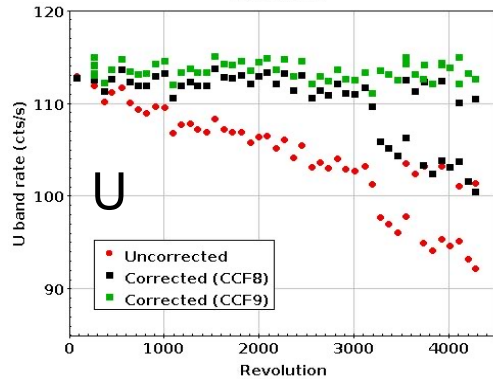
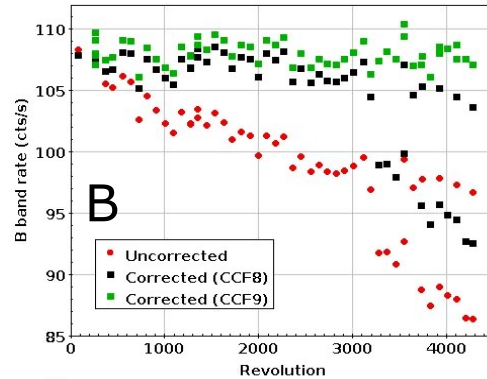
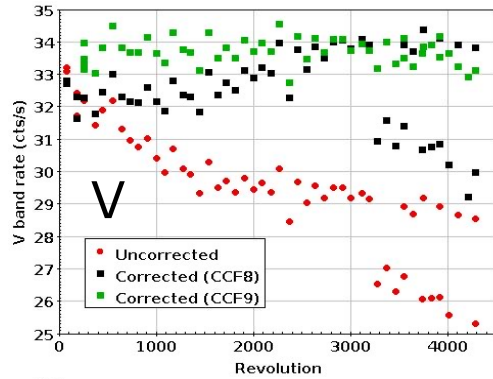
SAS 22 will correct, automatically, for extra pn boresight degradation but **ONLY** for objects (generally targets) within $7.5''$ of pn boresight. Correction in new extension in OM_PHOTONAT_0009 (will be made public with SAS 22).

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Corrections for TDS degradation

BPM16274 data

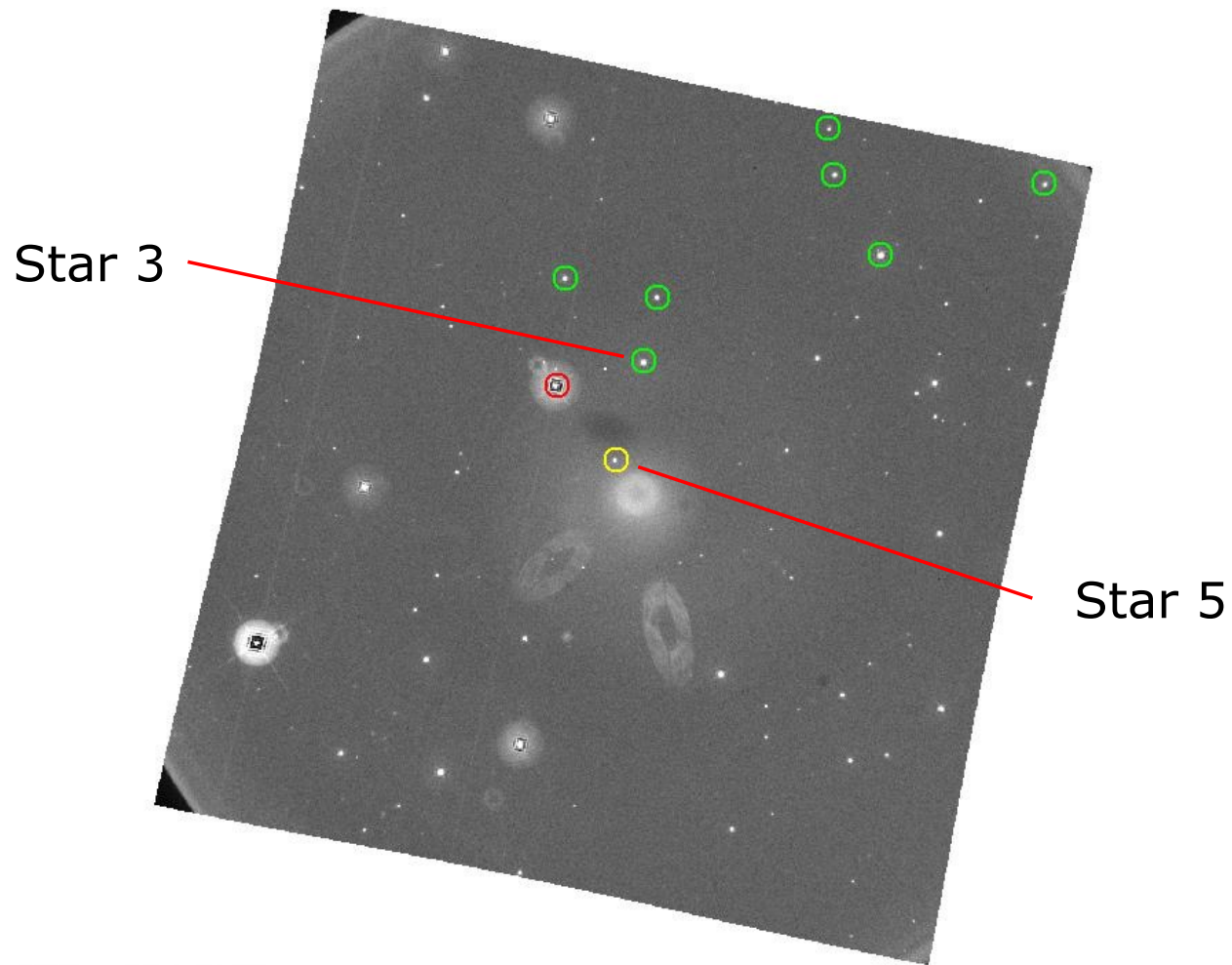


Red: uncorrected data

Black: Corrected for general TD degradation with previous CCF

Green: Corrected with new CCF + pn boresight correction

Time-dependent degradation – SA95 examples

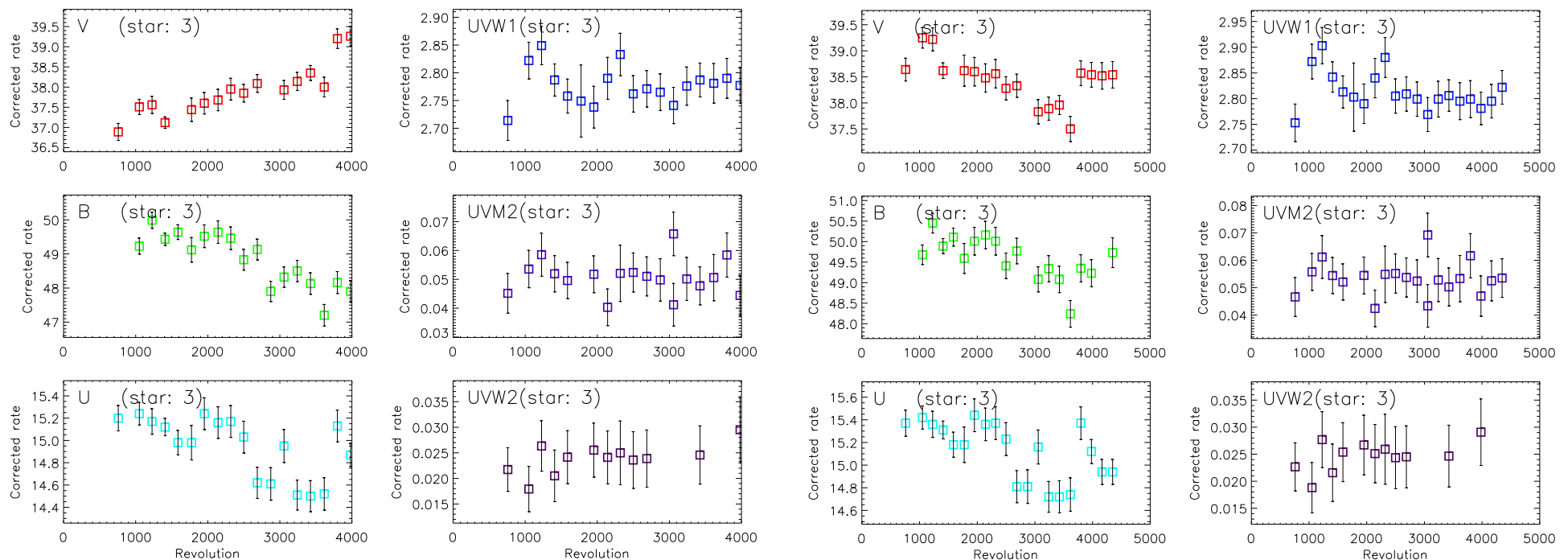


Time-dependent degradation – SA95 example

TDS corrections of standard star **(3)** from the SA95 field
 - well offset from pn boresight

Previous general TDS correction

New general TDS correction

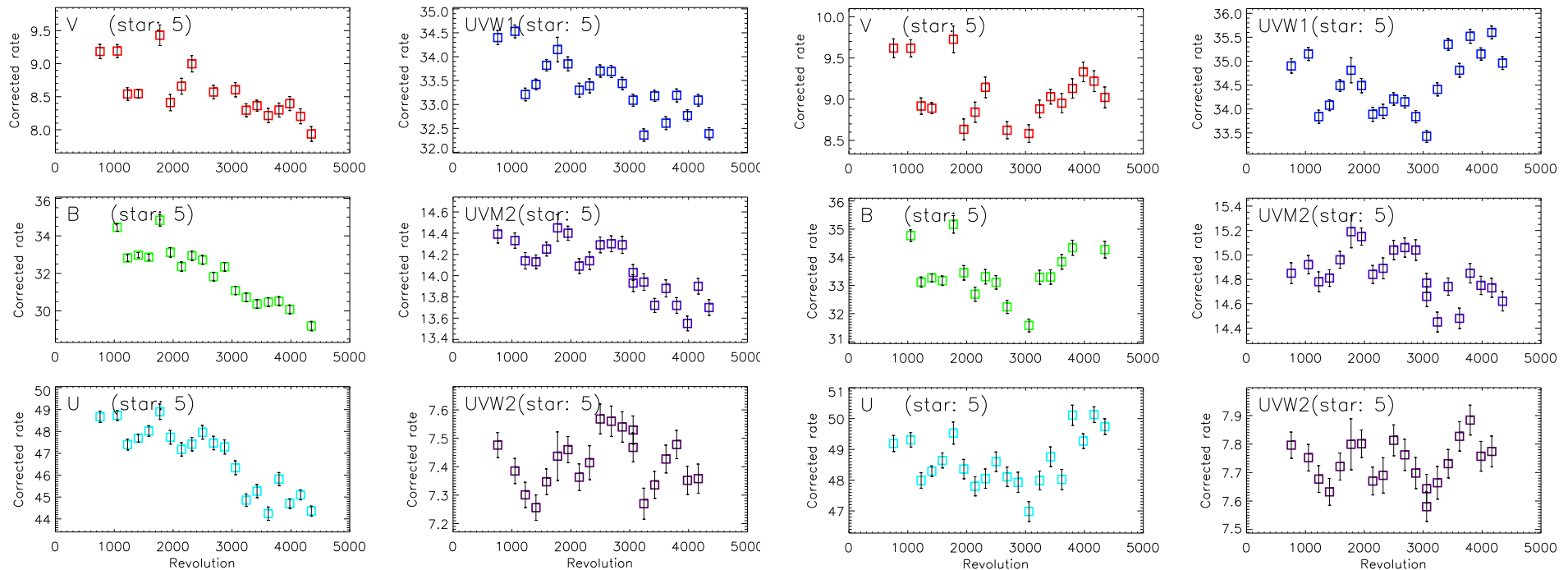


Time-dependent degradation – SA95 example

TDS corrections of standard star **(5)** from the SA95 field
 – **positioned at pn boresight**

Previous general TDS correction

New general TDS correction

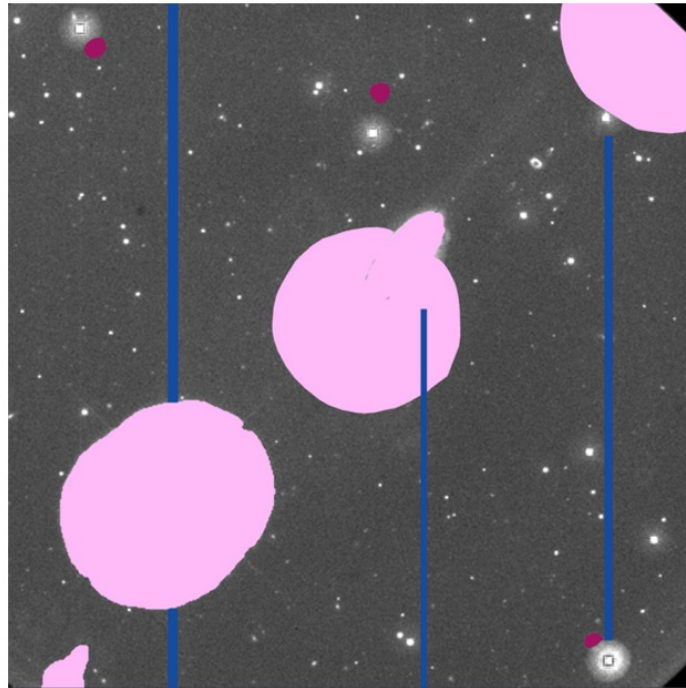


Forward look and other issues

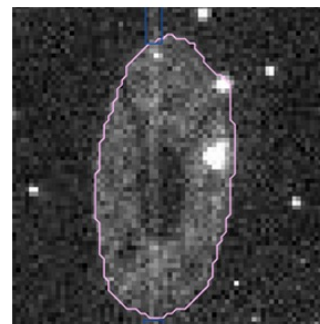
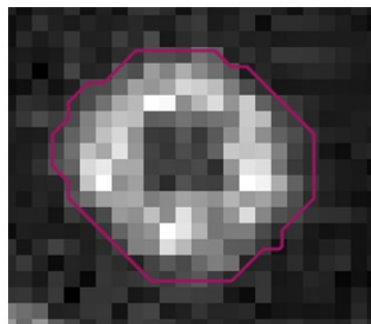


- Mosaics – pipeline no longer incorporates source detections from mosaic regions where there is only coverage by a single exposure (P. Rodriguez)
- Address the catalogue related issues
- Jupiter patch – evaluate statistical constraints and availability of suitable images for creation of flatfield images
 - Build stacks of survey field sky images in each filter to avoid the effects of target contamination at the boresight.
- Update bad pixel map if necessary
- Improve distortion map – many OM observations + GAIA positions.
- Interesting side-project: exploring use of machine-learning pattern recognition techniques to detect/mask scattered-light features for downstream source flagging (Iulia Dima).

Finding image artefacts: OM-focused machine learning project (Iulia Dima)

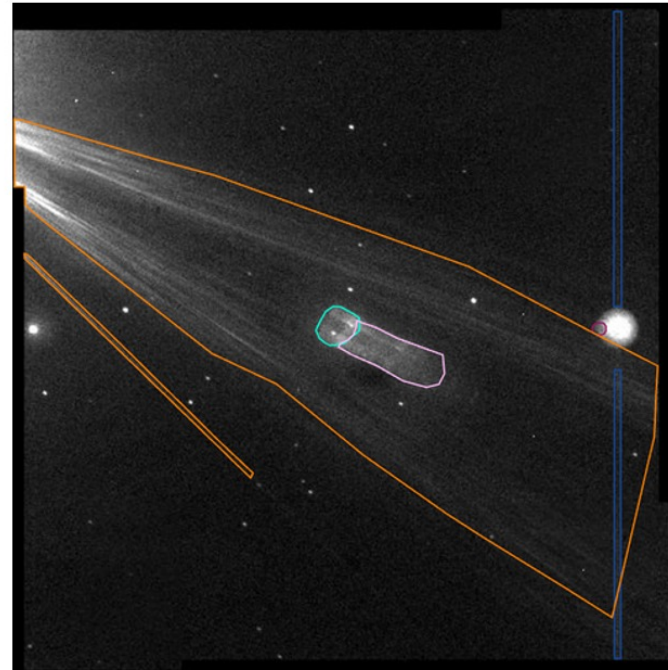
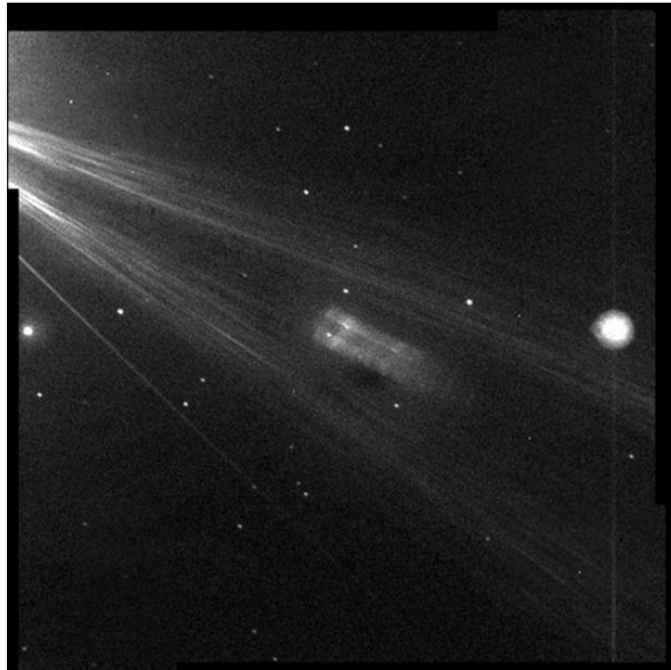


- central-ring
- other
- read-out-streak
- smoke-ring
- star-loop

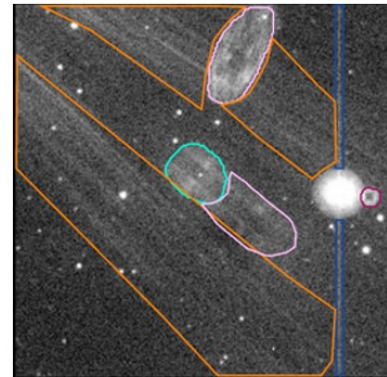


1σ background

GT masks



- central-ring
- other
- read-out-streak
- smoke-ring
- star-loop

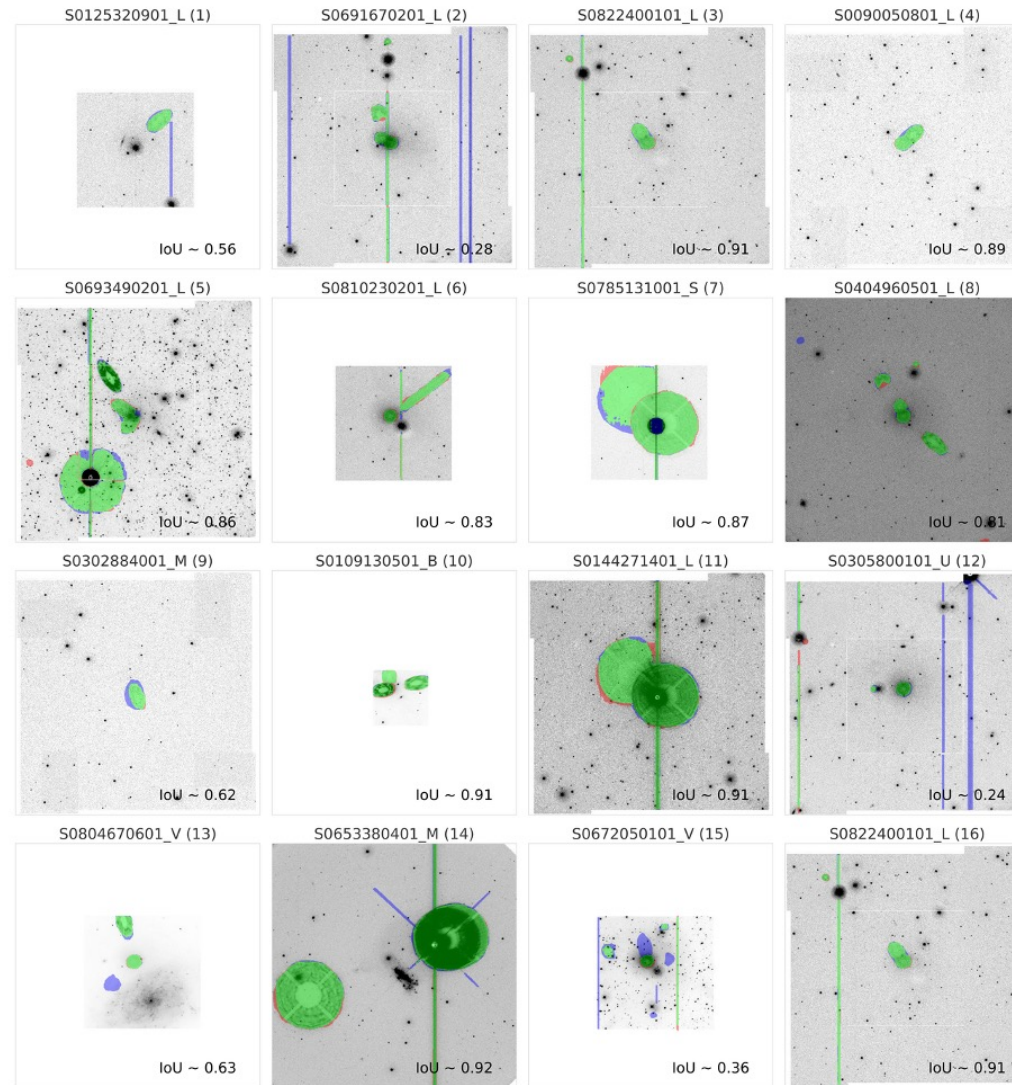
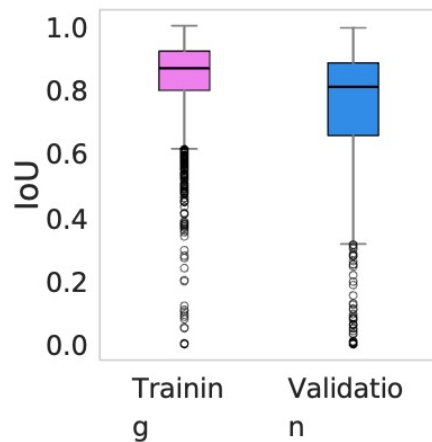
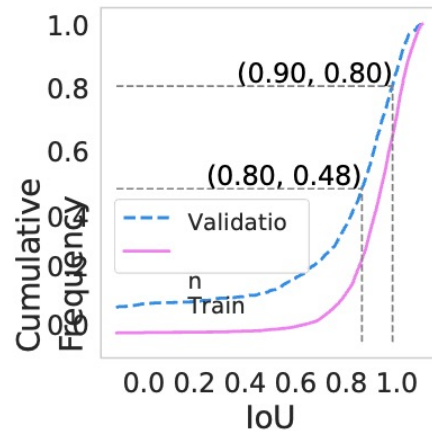


Summary

- OM still in good shape and functioning well
- A new (SUSS6) version of the OM catalogue has been released (Oct 2023). First one made from pipeline products to ensure consistency between catalogue and archive data.
- General time-dependent degradation is updated for all narrow band filters based on a simultaneous exponential fit to 3 main standard stars
- Additional, further correction provided to correct for the additional degradation at the pn boresight (only) – since rev 3224. Applied by SAS from SAS22
- Exploring ML methods to identify scattered light features for flagging
- Future aims include (i) evaluating/constructing time-dependent, spatial sensitivity maps for each filter (to characterize time evolution across the FoV and in the JP, to facilitate corrections in SAS), (ii) updating the bad-pixel map and (iii) improving the distortion map.

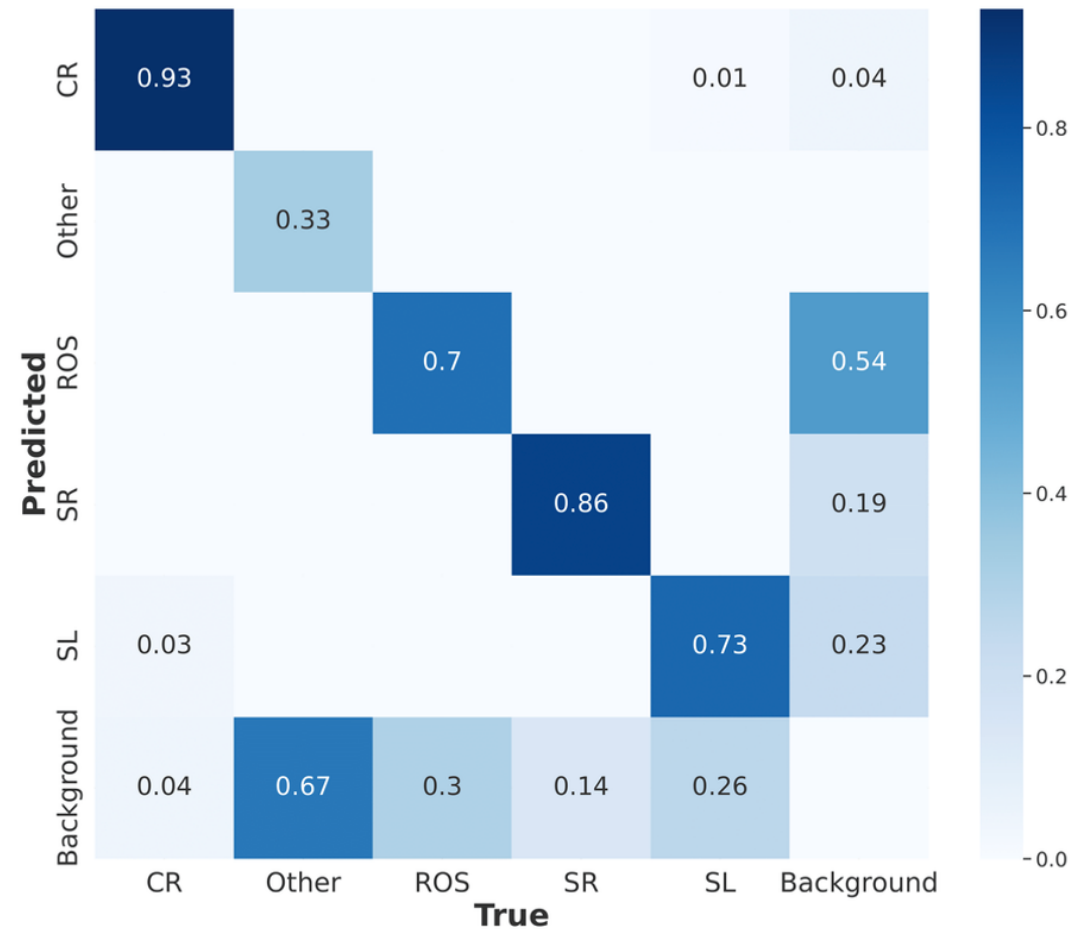
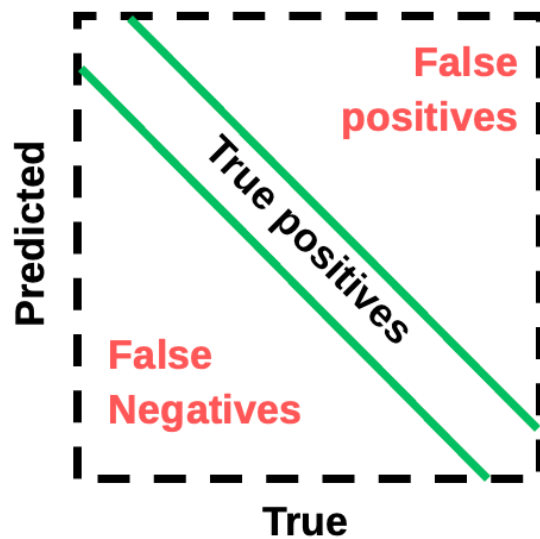


Finding image artefacts: OM-focused machine learning project (Iulia Dima)



True Positive False Positive False Negative

1723 predictions (classes)
in the validation set.



Confusion matrix for detections (validation set).