XMM-Newton CCF Release Note

XMM-CCF-REL-55

OM Astrometry

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1 CCF components

Name of CCF	VALDATE	List of Blocks changed	CAL VERSION	XSCS flag
OM_ASTROMET_0008	2000-01-01T00:00:00	FILTER-U		Yes
		FILTER-B		Yes
		FILTER-UVW1		Yes
		FILTER-UVW2		Yes
		FILTER-UVM2		Yes
		FILTER-WHITE		Yes
		FILTER-MAGNI		Yes
		FILTER-GRISM1		Yes
		FILTER-GRISM2		Yes
		POLYNOM_MAP		No

2 Changes

Compared to the previous version the distortion maps of the U-, B- and the three UV-filters have been updated. The old distortion maps of these filters were replaced by the V-filter distortion map. The magnifier, white light filter and the two 1st order grism distortion maps were replaced by the V-distortion map as well. The extension holding the paramtrization of the distortion maps was updated accordingly.
The CCF file describes the redundant detector chain.

Analysis has shown that the offsets between source positions measured in the different filters are reduced when applying the V-filter distortion map to all filters. This is not suprising, as the main component of the distortion is caused by the fibre taper of the detector, which introduces a distortion independent of the filter selection. At the moment the V-distortion map has the highest accuracy, because it was computed based on the positions of more than 230 sources.

Although the comparison of source position offsets was limited to the V-, U-, UVW1- and UVW2-filter, the results can also be applied to other filters, as the main distortion component introduced by the fibre taper is indepedant of the filter selection.
The approach to use the V-filter distortion map throughout all filters won't account for the small global offset (at the pixel level) of the source positions between the different filters. This small global source position offset will be subject of further calibration and will be included into later versions of the ASTROMET file.

3 Scientific Impact of this Update

After update of the distortion maps the source positions measured in different filters match up better. The offsets between source positions measured in different filters are reduced, which is illustrated in Fig 1 and 2.

The average offset of the source positions is reduced between the V-filter and the UVW1- and UVW2-filter respectively, when using the V-distortion map throughout the calculation. It becomes obvious when comparing the scatter of the offset positions between Figure 1 top and bottom (V- vs. UVW1-positions) and between Figure 2 top and bottom (V- vs. UVW2-positions). The data points in the lower diagram do no longer show the systematic offset and the data points are less scattered. The offset positions are centered around (0,0). The improvement was expected for two reasons:

- the computation of all distortion maps except the V-distortion map was based on only a few (several tens) sources and thus had an intrinsically lower accuracy.
- the main distortion component is caused by the fibre taper and thus is independant on the filter selection. As the V-filter distortion has the highest accuracy, it describes the fibre taper distortion best.

The performed study confirms the expectations and justifies the usage of the V-distortion map for all filters.

4 Estimated Scientific Quality

The positional accuracy of the V-filter is unchanged, which means the source positions in the V-filters are internally accurate at the one arcsec level.
The bottom diagram of Figure 1 and 2 should be representative enough to estimate the positional accuracy of all other filters. The average difference between the V-filter and any other filter is estimated as 2 arcsec from these two diagrams. The resulting overall accuracy of any filter is calculated as the internal unertainty of the V-filter plus the filter-to-filter accuracy of 2 arcsec (except for the V-filter, where the filter-to-filter accuracy is 0). From this the overall positional accuracy is estimates as 1 arcsec for the V-filter and 3 arcsec (=1 arcsec + 2 arcsec) for any other filter.

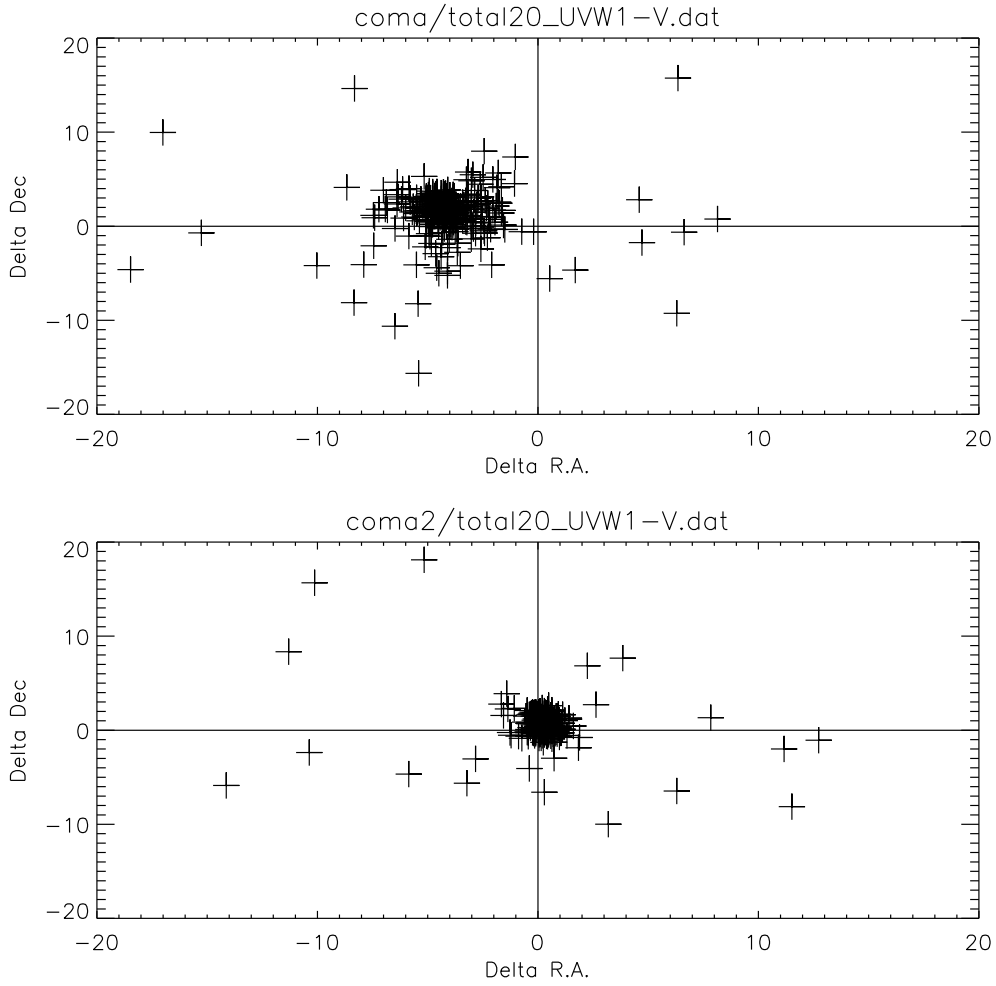

Figure 1: The offset vectors between the source positions of the Coma PV observatons in the V-filter and the UVW1-filter along the Ra- and Dec-direction (in units of arcsec). The offsets calculated with the old UVW1-distortion map are shown at the top and the offsets with the new UVW1-distortion map (which is identical to the V-distortion map) are shown at the bottom. After introduction of the new distortion map the average offset is reduced and the offsets are centered around (0/0).

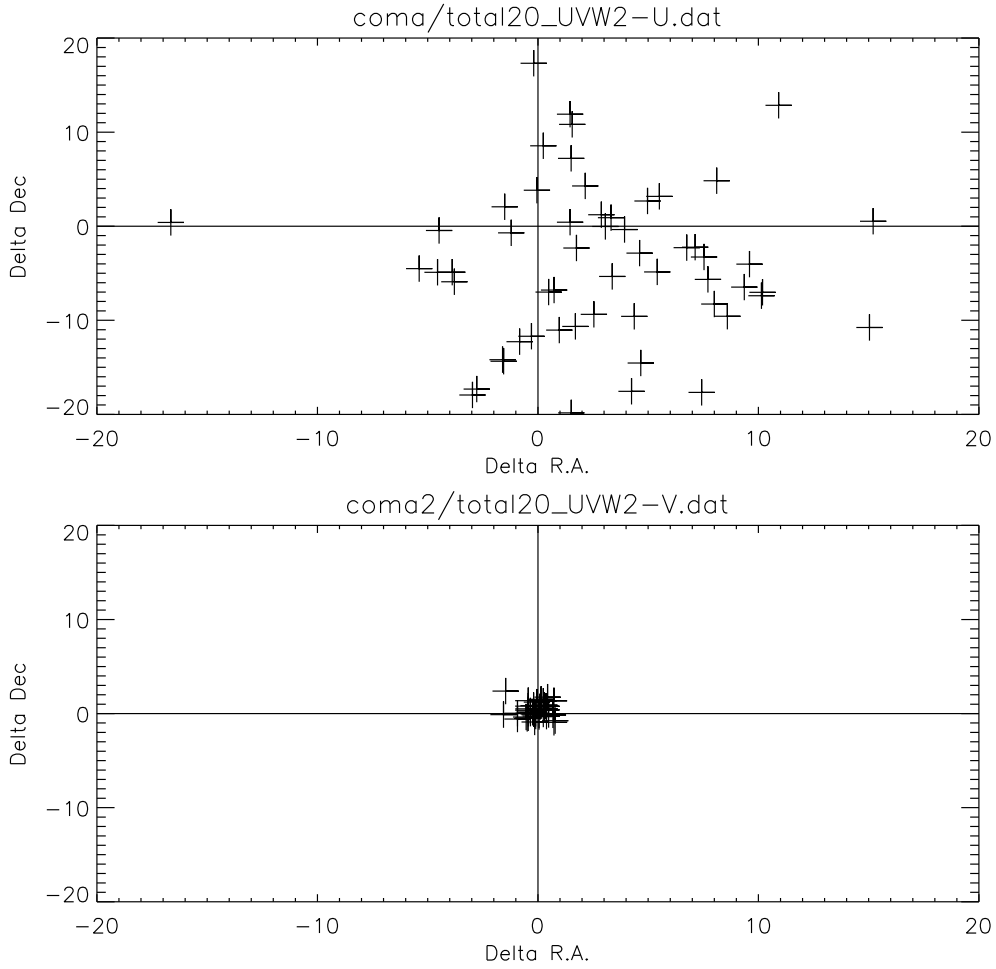

Figure 2: The offset vectors between the source positions of the Coma PV observatons in the V-filter and the UVW2-filter along the Ra- and Dec-direction (in units of arcsec). The offsets calculated with the old UVW2-distortion map are shown at the top and the offsets with the new UVW2-distortion map (which is identical to the V-distortion map) are shown at the bottom. After introduction of the new distortion map the average offset is reduced and the offsets are centered around (0/0).

At the time of writing the positional RMS accuracy was found to be 1.0 arcsec in the V-filter and ≈1.5 arcsec in the other filters. The analysis was performed outside the SAS.
Inside the SAS only one field was studied sofar. The mean scatter was about ±1 arcsec both in right ascension and declination, however a global pointing offset of 11 and 7 arcsec was seen in right ascension and declination direction respectively.
Note that the statement on the absolute positional uncertainty made in the previous ASTROMET release note is still applicable: The calculated offset between OM and STR boresight derived for different observations (=the OM-STR boresight offset was determined in a fit whereby the offsets between catalogued and detected positions were minimized) has a large scatter, which led to the conclusion that the uncertainty of the STR-OM offset calibration is limited by the accuracy of the AHF files (or the OM-STR offset is variable with time). Based on the observed scatter of the STR-OM boresight offset the absolute positional accuracy is conservatively estimated to be better than 8 arcsec.

5 Expected Update

There is a small (less than 2 pixels) global positional offset between the source positions in different filter elements. These offsets are subject of further calibration analysis and will be included in later versions of the astromet CCF file.

6 Acknowledgements

Thanks to Jon Mittaz (MSSL) who verified in his analysis that the V-filter distortion map improves the positional accuracy when applied to other filters.