Serendipitous UV source catalogues for 10 years of XMM and 5 years of Swift

Vladimir Yershov

Mullard Space Science Laboratory
University College London

*v.yershov@ucl.ac.uk*

On behalf of the UVOT and OM teams:

A. A. Breeveld, M. J. Page, S. Oates, N. P. M. Kuin, R. P. Mignani, M. Siegel,

B. M. De Pasquale, P. J. Smith, I. Ferreras, W. Landsman, S. Hunsberger, M. Carter,

P. W. A. Roming, S. T. Holland, F. E. Marshall, M. Chester, S. Koch, P. J. Brown,

A. Talavera, E. Ojero, and others

V.N.Yershov
Serendipitous UV source catalogues for 10 years of XMM and 5 years of Swift

Outline

❖ UV telescopes of XMM and Swift
❖ Input data
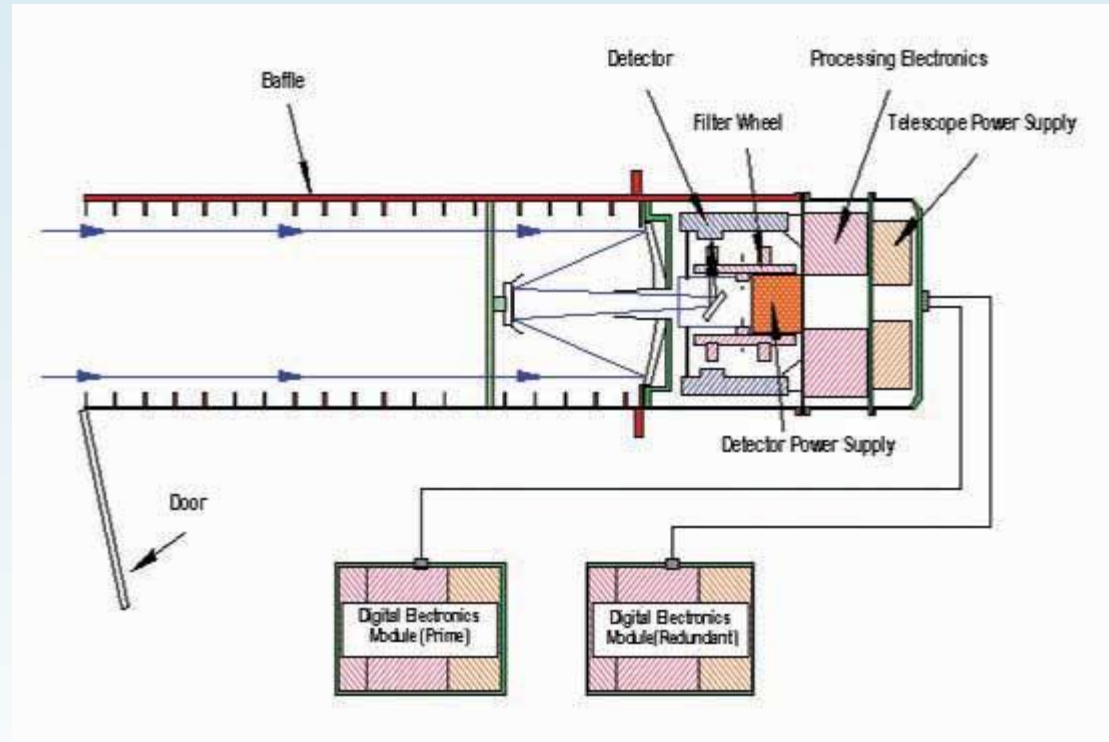❖ Source catalogue processing chains
❖ Catalogue features
❖ Validation

Challenges in UV Astronomy, ESO, Garching, 7-11 October 2013
Serendipitous UV source catalogues for 10 years of XMM and 5 years of Swift

UCL
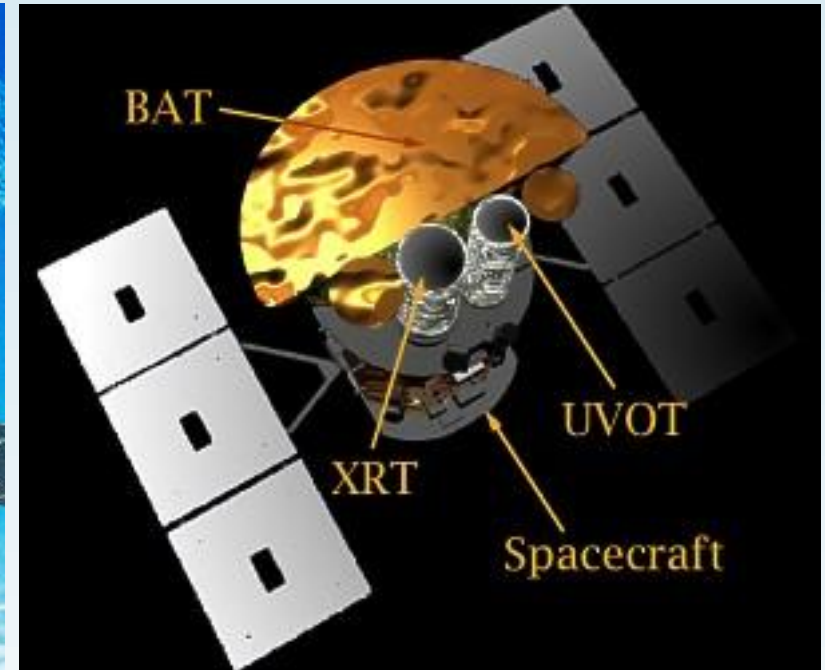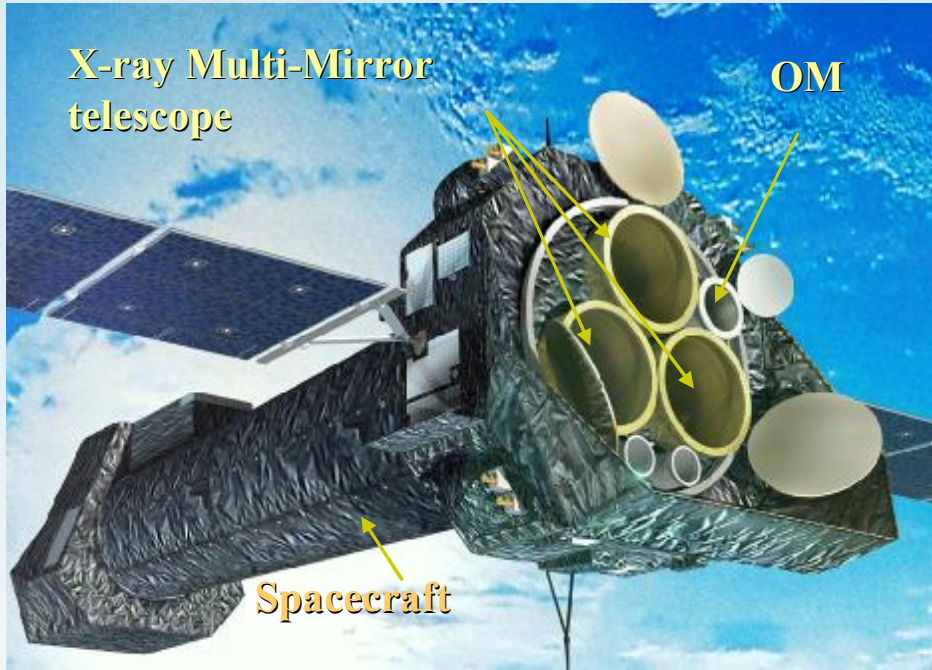
Mission	XMM Newton (ESA)	Swift (NASA)
Start	10.12.1999	20.11.2004
End	~ 2019 (?)	~ 2021 (?)
UV telescope	OM	UVOT

γ

γ

Both observatories have almost identical UV telescopes

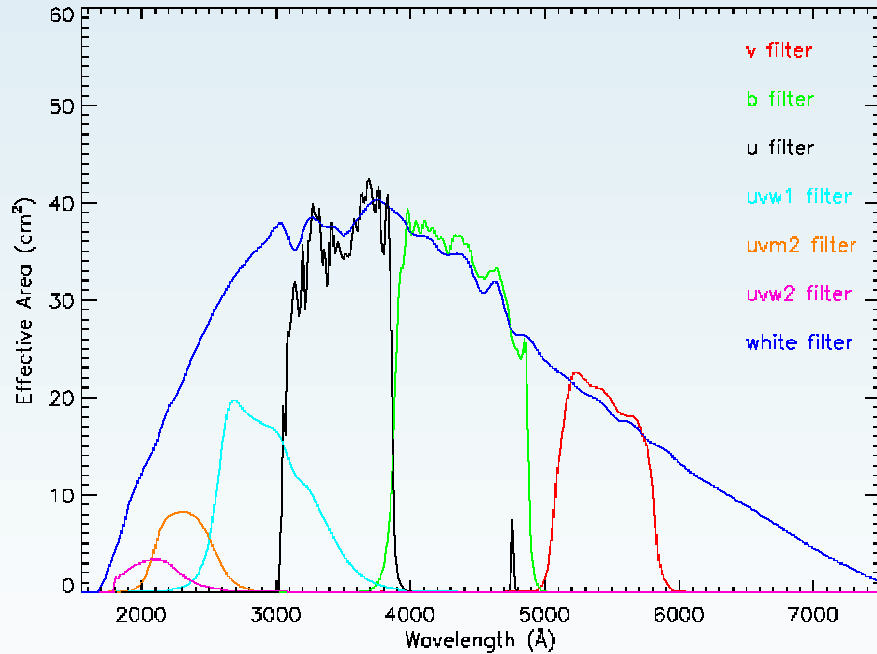OM / UVOT is a relatively small 0.3-m Ritchey - Chretien UV telescope

Focal length: 3.8 m
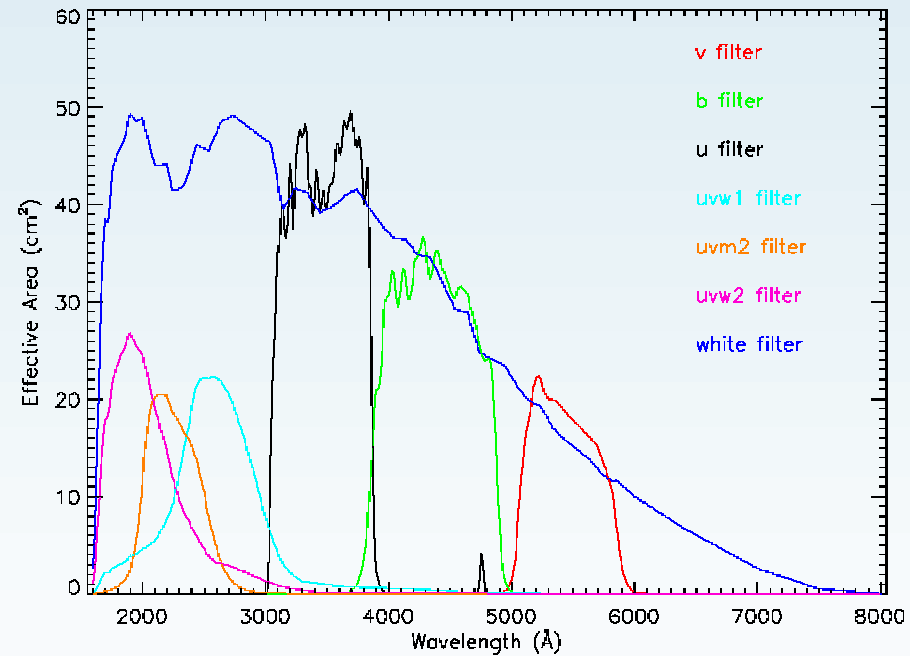
Field of view: 17' x 17'

Detector: photocathode with a MCP photomultiplier

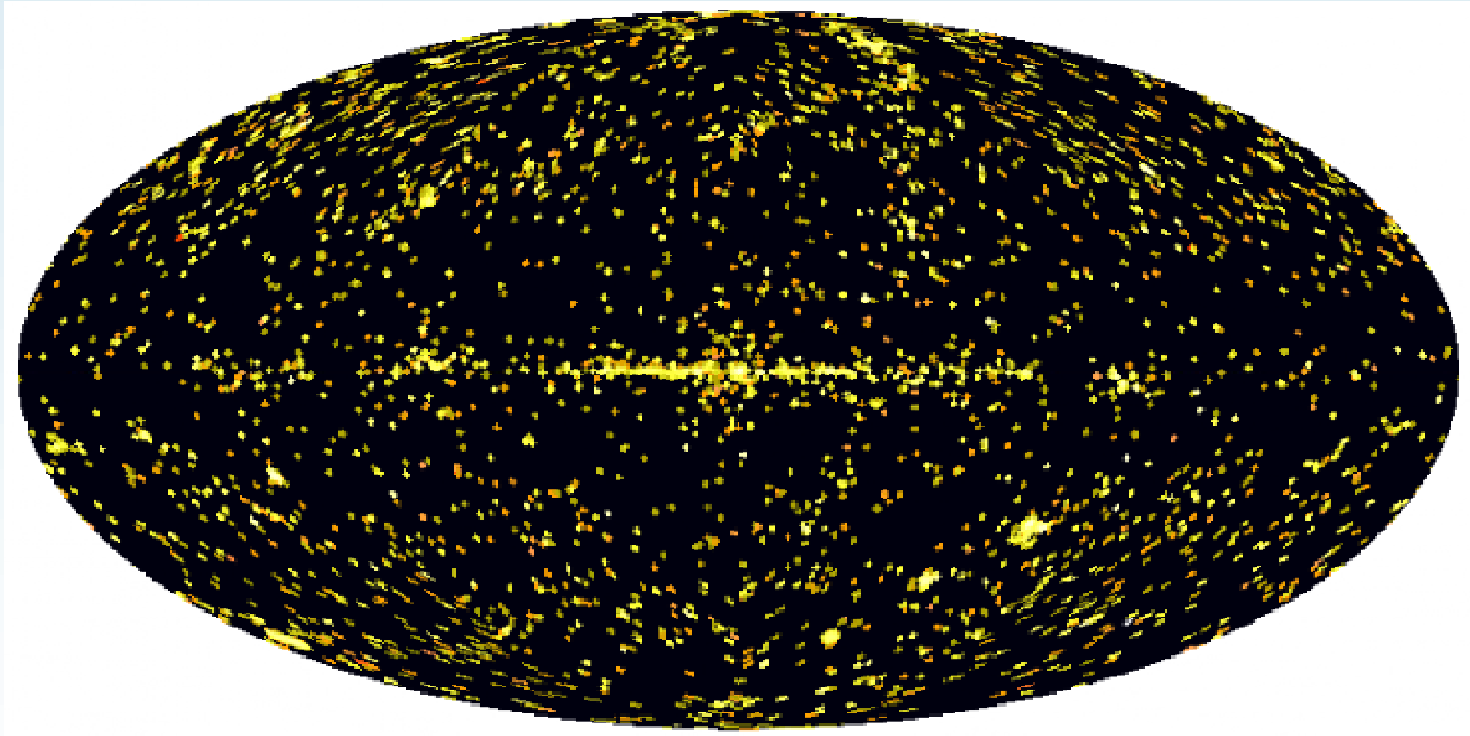Filters: UVW2, UVM2, UVW1, U, B, V

Effective areas of the UV filters:

OM filters

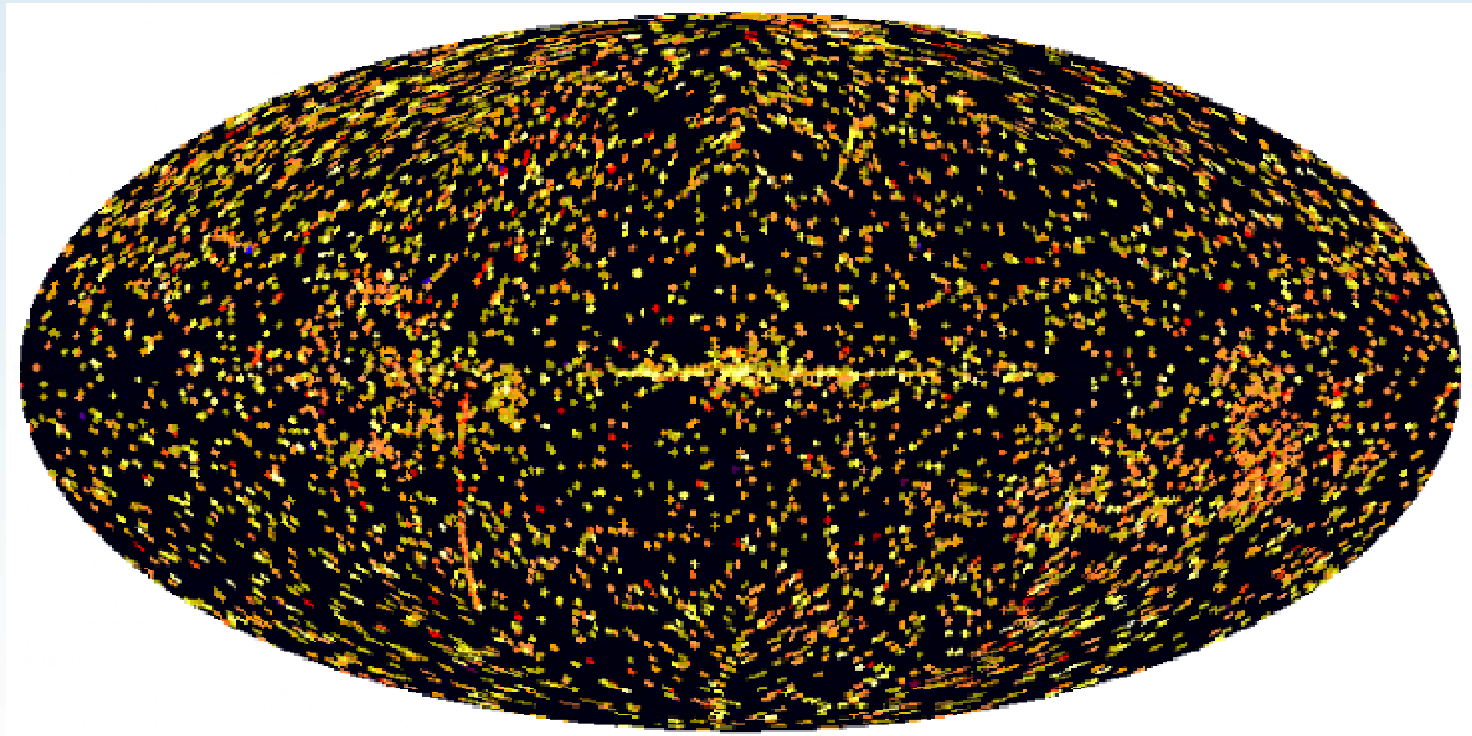UVOT filters

OM observations in the Galactic coordinates

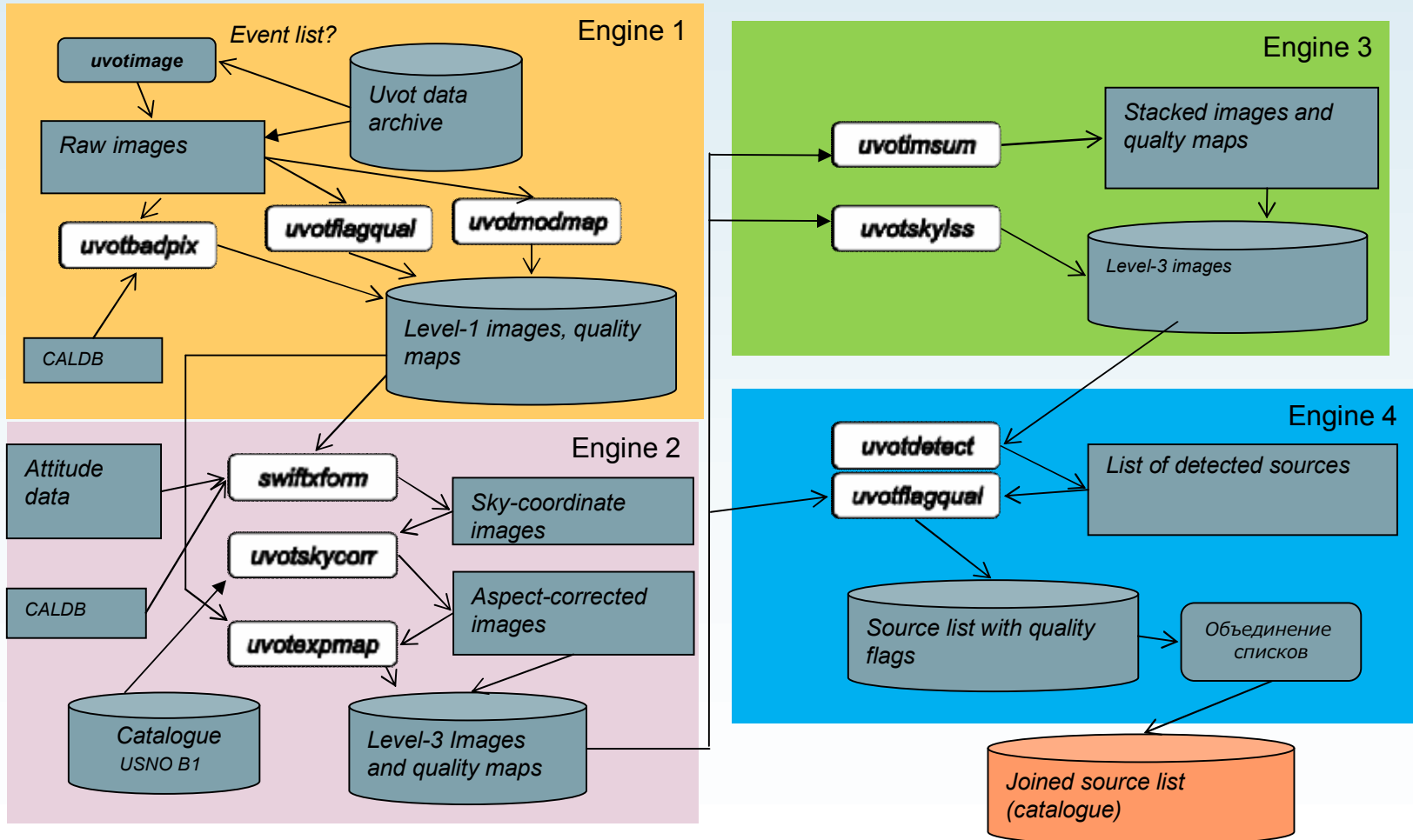UVOT observations in the Galactic coordinates
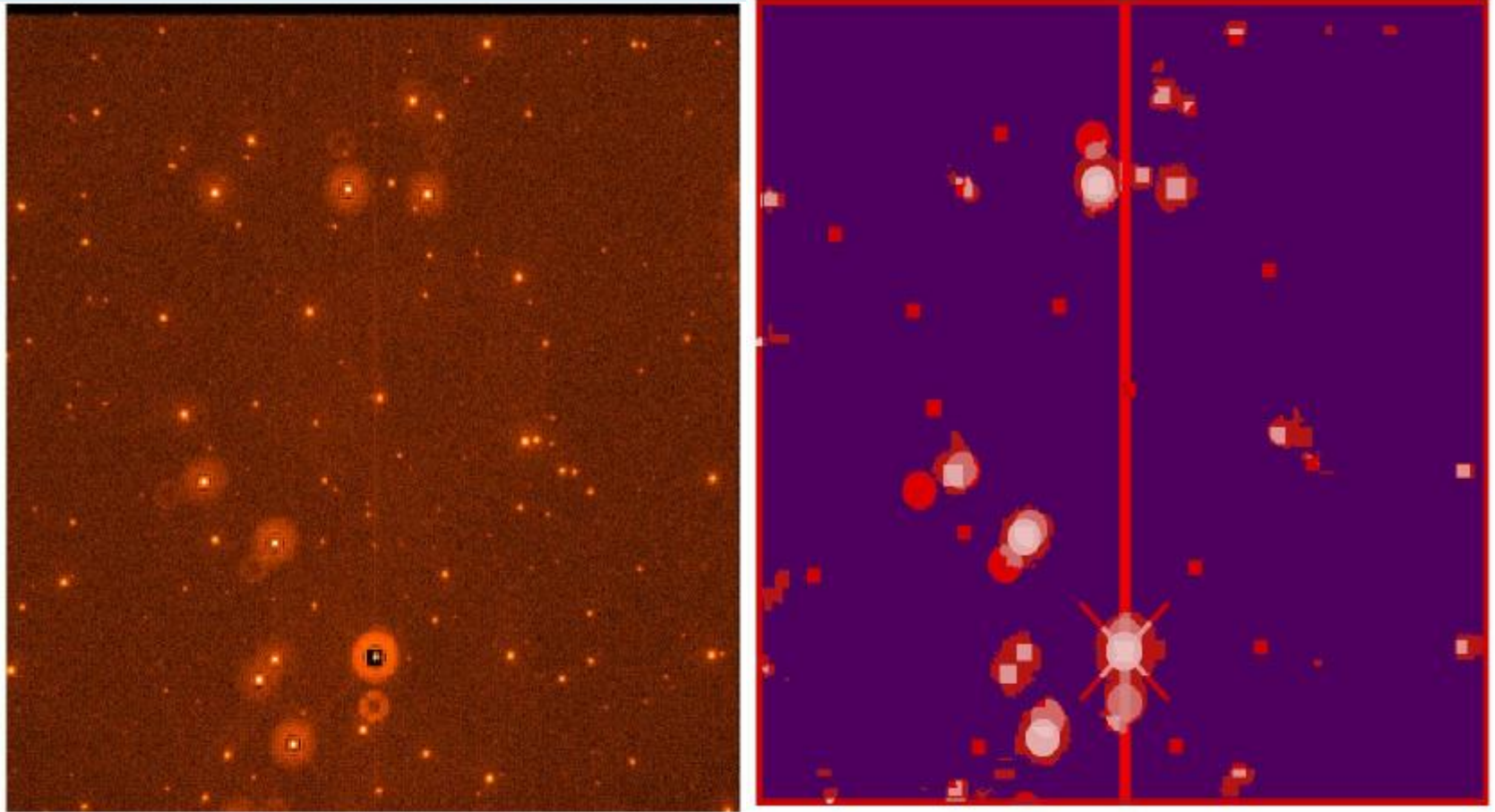
Data used for creating the OM and UVOT catalogues

	Catalogue SUSS-2	Catalogue UVOTSSC
Period of observations	2000 - 2011	2005 - 2010
Total observations	6240	23428

Catalogue processing chart (UVOT catalogue)

Engine 1

- *Event list?*
- uvotimage
- *Uvot data archive*
- *Raw images*
- uvotbadpix
- uvotflagqual
- uvotmodmap
- *CALDB*
- *Level-1 images, quality maps*

Engine 3

- uvotimsum
- *Stacked images and qualty maps*
- uvotskylss
- *Level-3 images*

Engine 2

- *Attitude data*
- swiftxform
- *Sky-coordinate images*
- uvotskycorr
- *CALDB*
- uvotexpmap
- *Aspect-corrected images*
- *Catalogue USNO B1*
- *Level-3 Images and quality maps*

Engine 4

- uvotdetect
- uvotflagqual
- *List of detected sources*
- *Source list with quality flags*
- *Объединение списков*
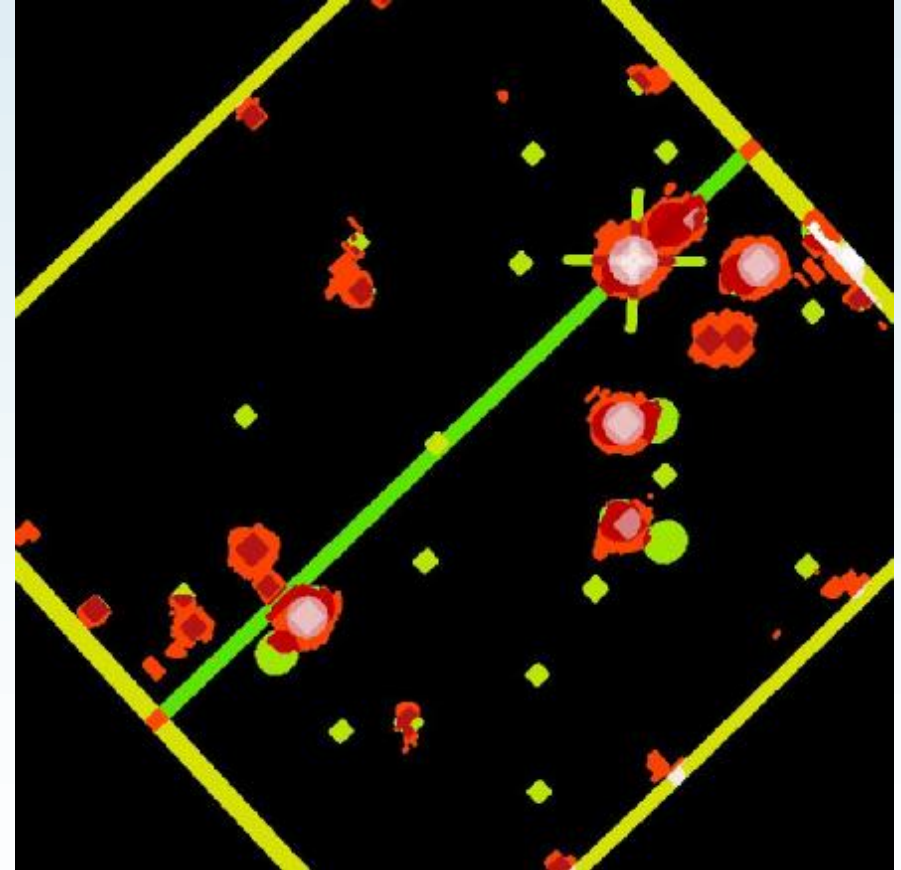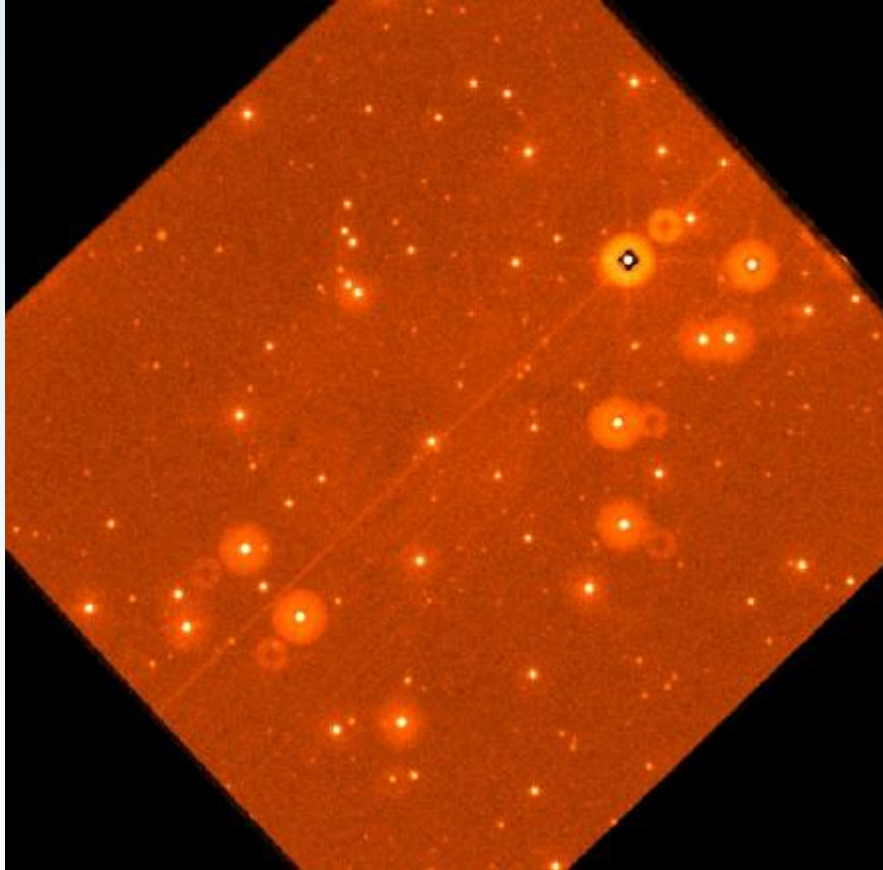- *Joined source list (catalogue)*

Example of the UVOT image with its corresponding quality map

Products of the Level-3 processing engine – stacked images and quality maps

Main features of the OM and UVOT catalogues

	Catalogue SUSS-2	Catalogue UVOTSSC
Period of observations	2000 - 2011	2005 - 2010
Total observations	6240	23428
Total sources	3 312 623	6 375 495
Repeated obs.	694 715	2 065 036
Total entries	4 918 082	15 015 935

Challenges in UV Astronomy, ESO, Garching, 7-11 October 2013
Serendipitous UV source catalogues for 10 years of XMM and 5 years of Swift

UCL

FITS files

File	Edit	Tools	Help					

Index	Extension	Type	Dimension	View					
■ 0	Primary	Image	0	Header	Image			Table	
■ 1	SRCLIST	Binary	114 cols X 923467 rows	Header	Hist	Plot	All	Select	
■ 2	SUMMARY	Binary	35 cols X 6246 rows	Header	Hist	Plot	All	Select	

File	Edit	Tools	Help

		■ IAUNAME	■ N_SUMMARY	■ UVW2_VEGA_MAG	■ UVM2_VEGA_MAG	■ UVW1_VEGA_MAG
Select		22A	J	E	E	E
■ All				mag	mag	mag
Invert						

Source table

	IAUNAME	N_SUMMARY	UVW2_VEGA_MAG	UVM2_VEGA_MAG	UVW1_VEGA_MAG
1	XMMOM J000000.0+623853	1	NULL	NULL	NULL
2	XMMOM J000000.1+622734	1	1.747867E+001	1.724070E+001	1.600135E+001
3	XMMOM J000000.1+623201	1	NULL	NULL	NULL
4	XMMOM J000000.1-250257	2	NULL	NULL	NULL
5	XMMOM J000000.2+622610	1	1.586626E+001	1.571957E+001	1.488039E+001
6	XMMOM J000000.2+624059	1	NULL	NULL	1.894545E+001
7	XMMOM J000000.2+623734	1	NULL	NULL	1.946458E+001
8	XMMOM J000000.2+623330	1	NULL	NULL	NULL
9	XMMOM J000000.2+622336	1	NULL	NULL	NULL
10	XMMOM J000000.2+622932	1	NULL	NULL	NULL
11	XMMOM J000000.3+443805	3	NULL	NULL	1.972667E+001
12	XMMOM J000000.3+443836	3	NULL	NULL	2.029916E+001
13	XMMOM J000000.4+622823	1	NULL	NULL	NULL
14	XMMOM J000000.4-321030	6246	NULL	NULL	2.107738E+001
15	XMMOM J000000.4+622248	1	NULL	NULL	NULL
16	XMMOM J000000.4+623844	1	NULL	NULL	1.889623E+001
17	XMMOM J000000.5+622153	1	1.416193E+001	1.414053E+001	1.327825E+001

Challenges in UV Astronomy, ESO, Garching, 7-11 October 2013
Serendipitous UV source catalogues for 10 years of XMM and 5 years of Swift

UCL

FITS files

	Index	Extension	Type	Dimension	View					
■	0	Primary	Image	0	Header	Image		Table		
■	1	SRCLIST	Binary	114 cols X 923467 rows	Header	Hist	Plot	All	Select	
■	2	SUMMARY	Binary	35 cols X 6246 rows	Header	Hist	Plot	All	Select	

Summary table

fv: Binary Table of suss2_00_04h.fit[2] in G:/omswift/om_catalogue/

File Edit Tools Help

	N_SUMMARY	FILTERS	RA_PNT	DEC_PNT
Select	J	30A	E	E
■ All			degrees	degrees

1	1	UVW2, UVM2, UVW1, U, B	3.208360E-002	6.249802E+001
2	2	U, B, V	1.221564E-001	-2.512193E+00
3	3	UVW2, UVM2, UVW1, U	1.964872E-001	4.461314E+001
4	4	UVM2, UVW1, U	4.726913E-001	-3.480373E+00
5	5	UVW1	4.955880E-001	-1.545555E+00
6	6	U, V	6.948951E-001	-3.000822E+00
7	7	UVM2, UVW1, U	7.762773E-001	-2.004830E+00
8	8	UVM2, UVW1, U	7.768553E-001	-1.805427E+00
9	9	UVM2, UVW1, U	7.948853E-001	-6.100173E+00
10	10	UVW2, UVW1, U	8.112291E-001	-3.592956E+00
11	11	UVM2, UVW1	9.576669E-001	2.055688E+000
12	12	U	1.021296E+000	7.032944E+001
13	13	UVM2	1.176344E+000	1.290394E-001
14	14	UVM2, UVW1, B	1.351010E+000	-8.758560E+00
15	15	UVW2, UVW1	1.509402E+000	-3.473212E+00

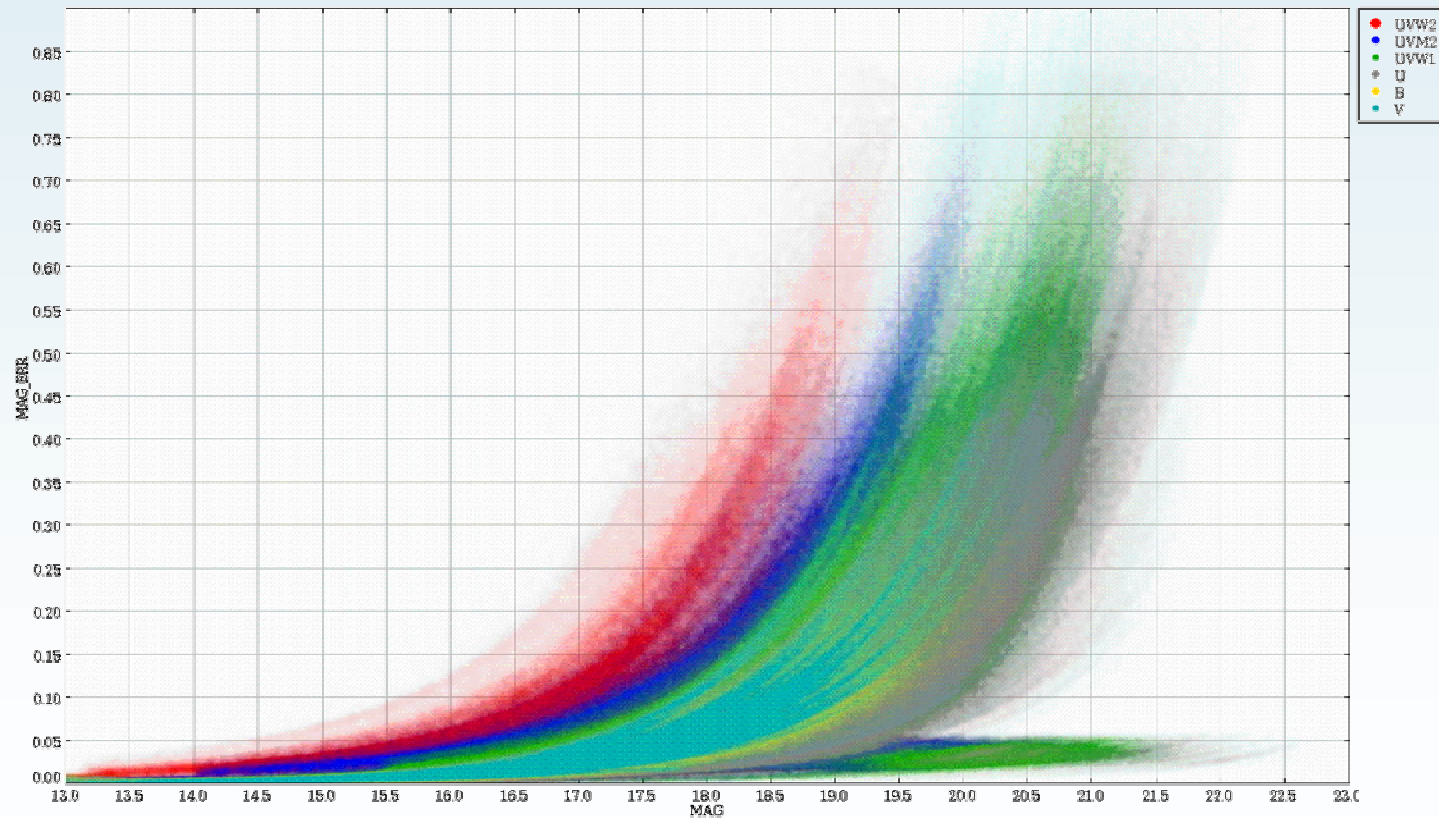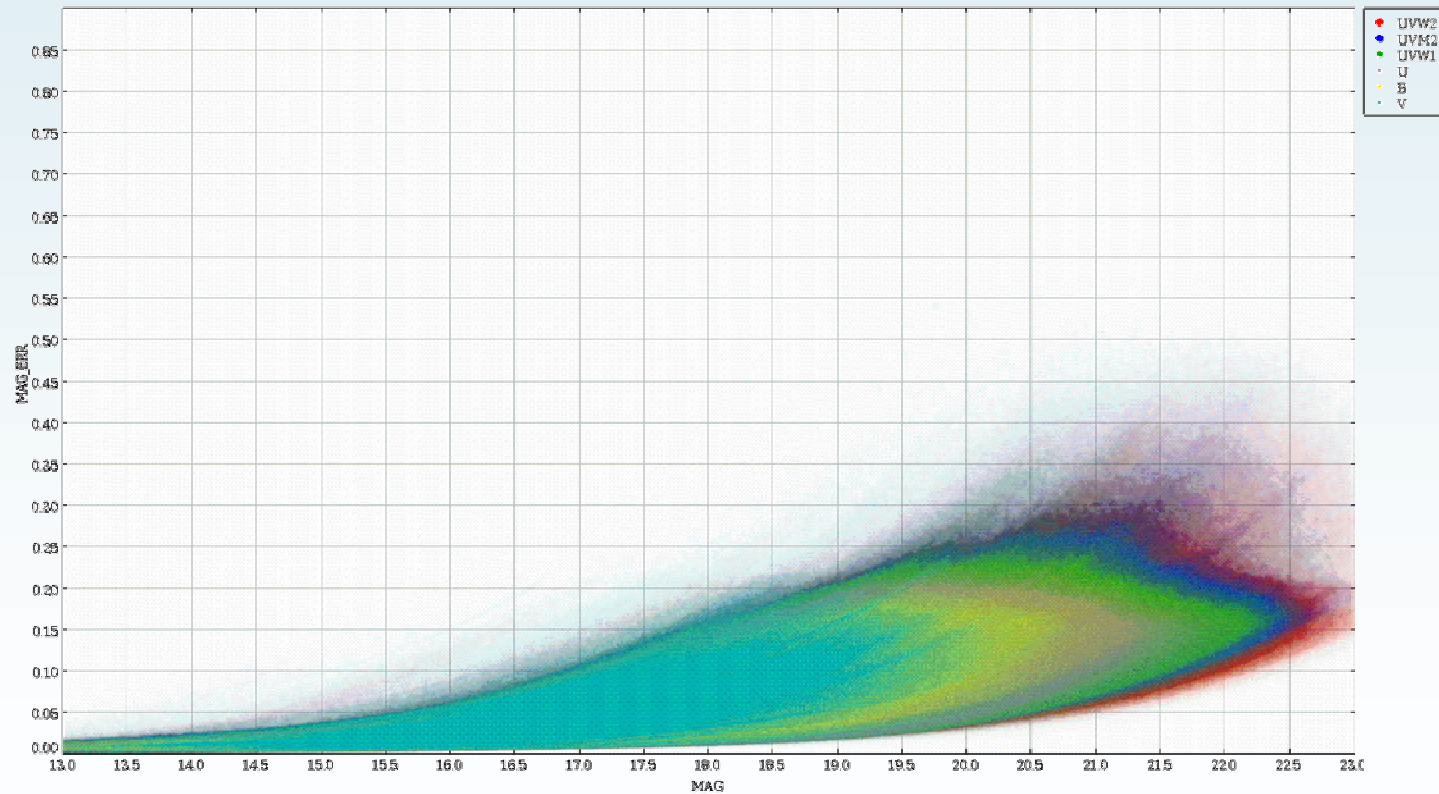# Number of sources as a function of source magnitude
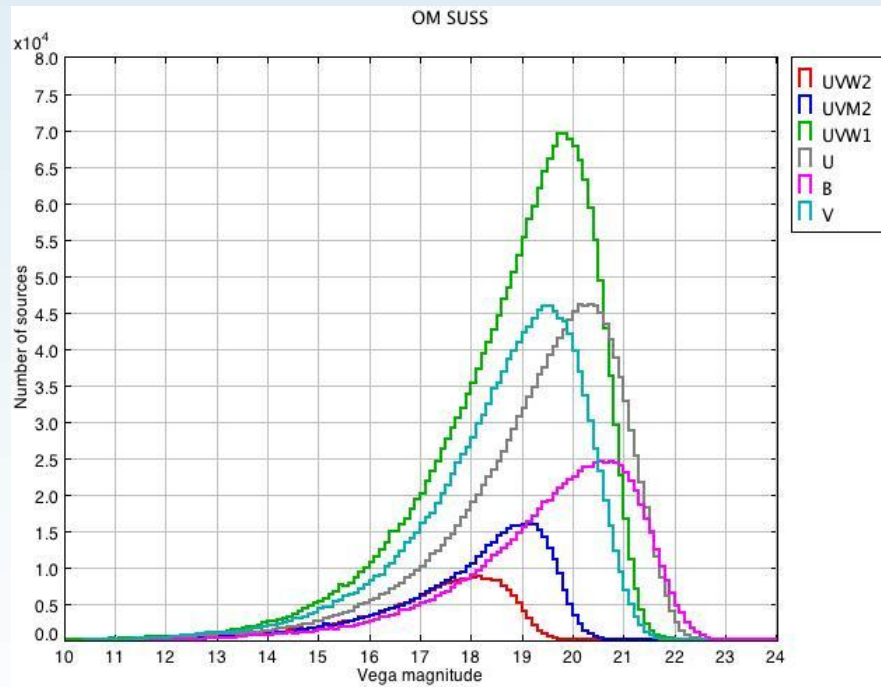
OM
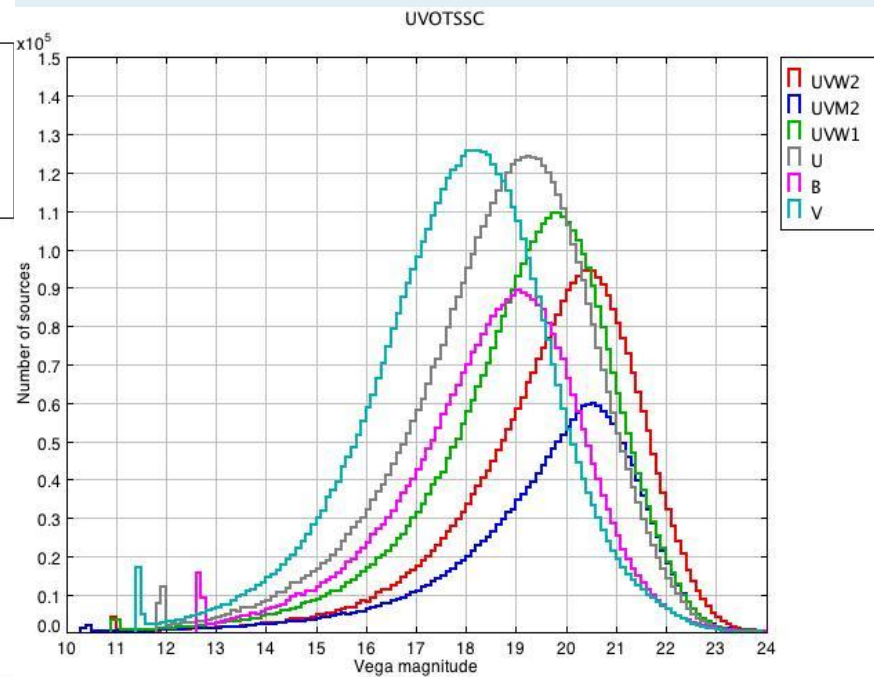
UVOT

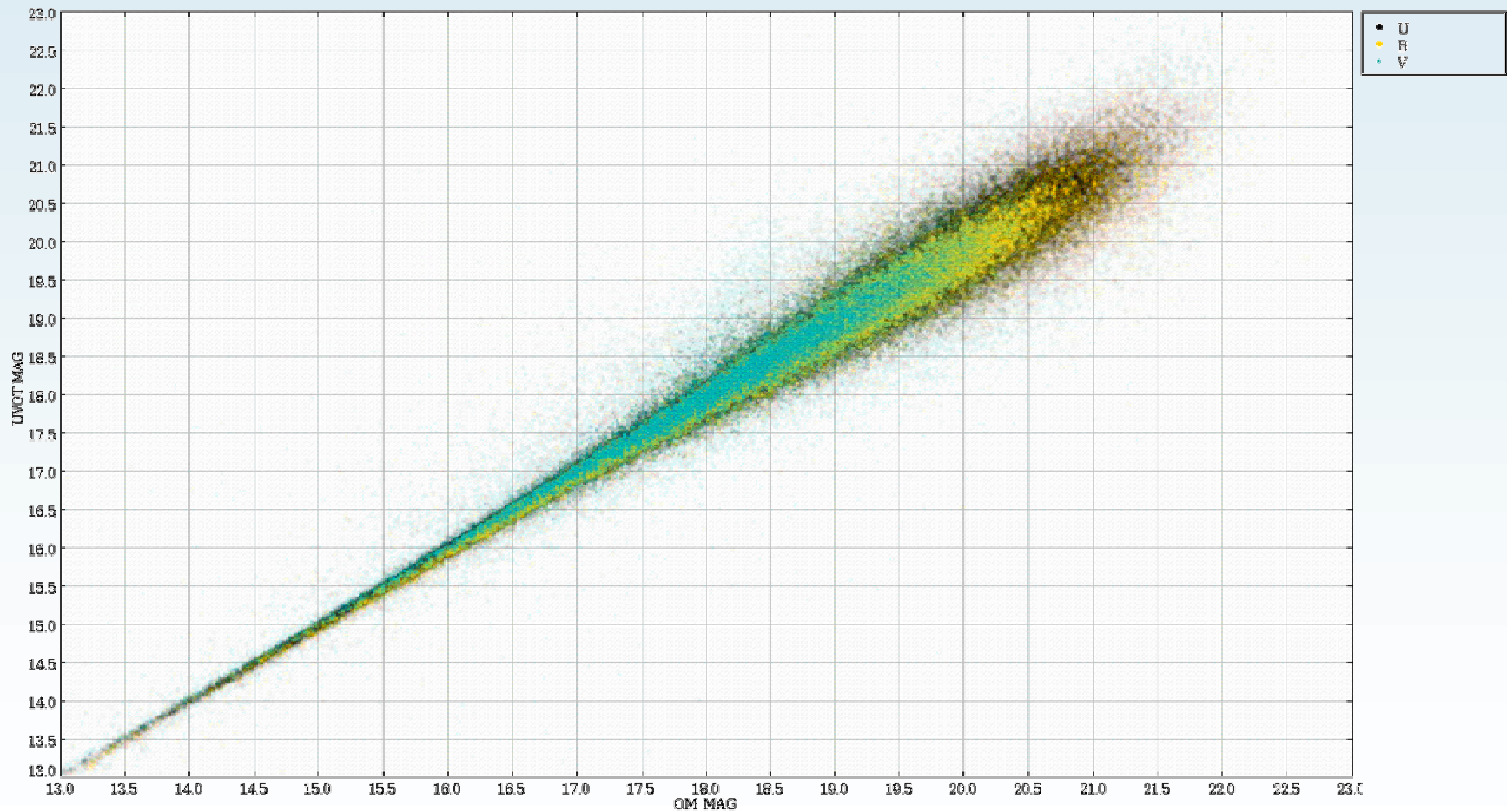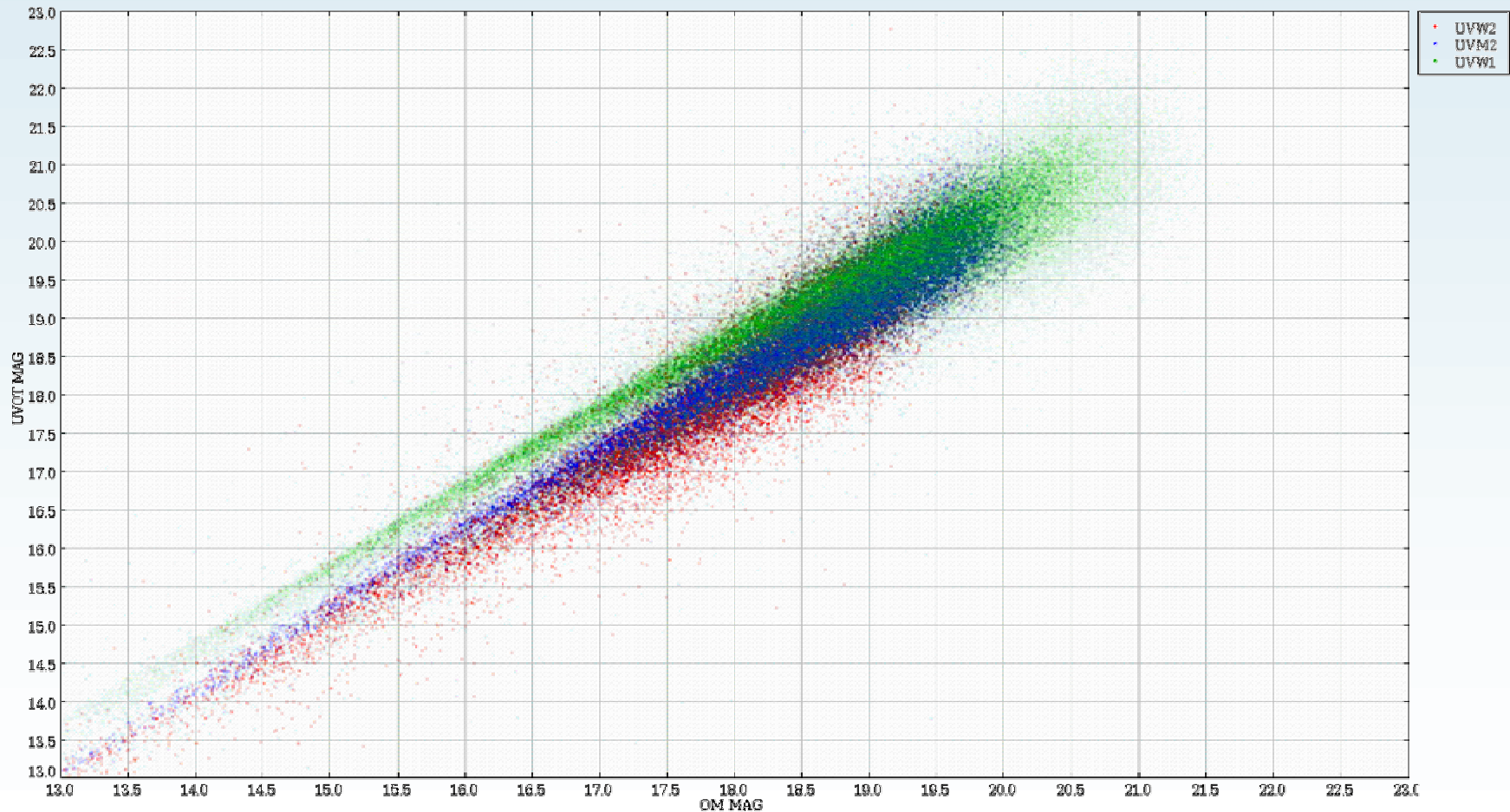## Magnitude errors as a function of source magnitude (OM catalogue)

Magnitude errors as a function of source magnitude (UVOT catalogue)
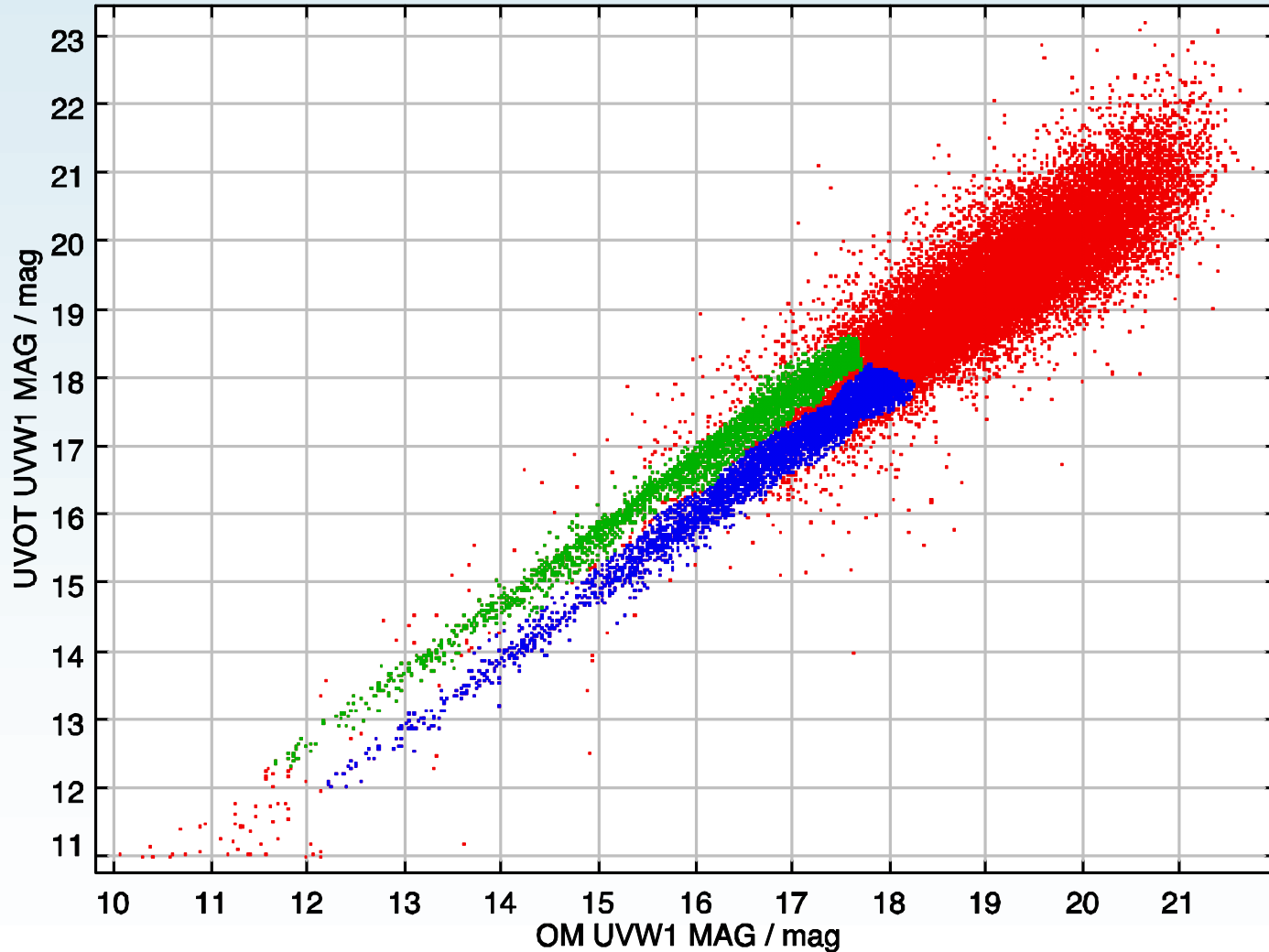
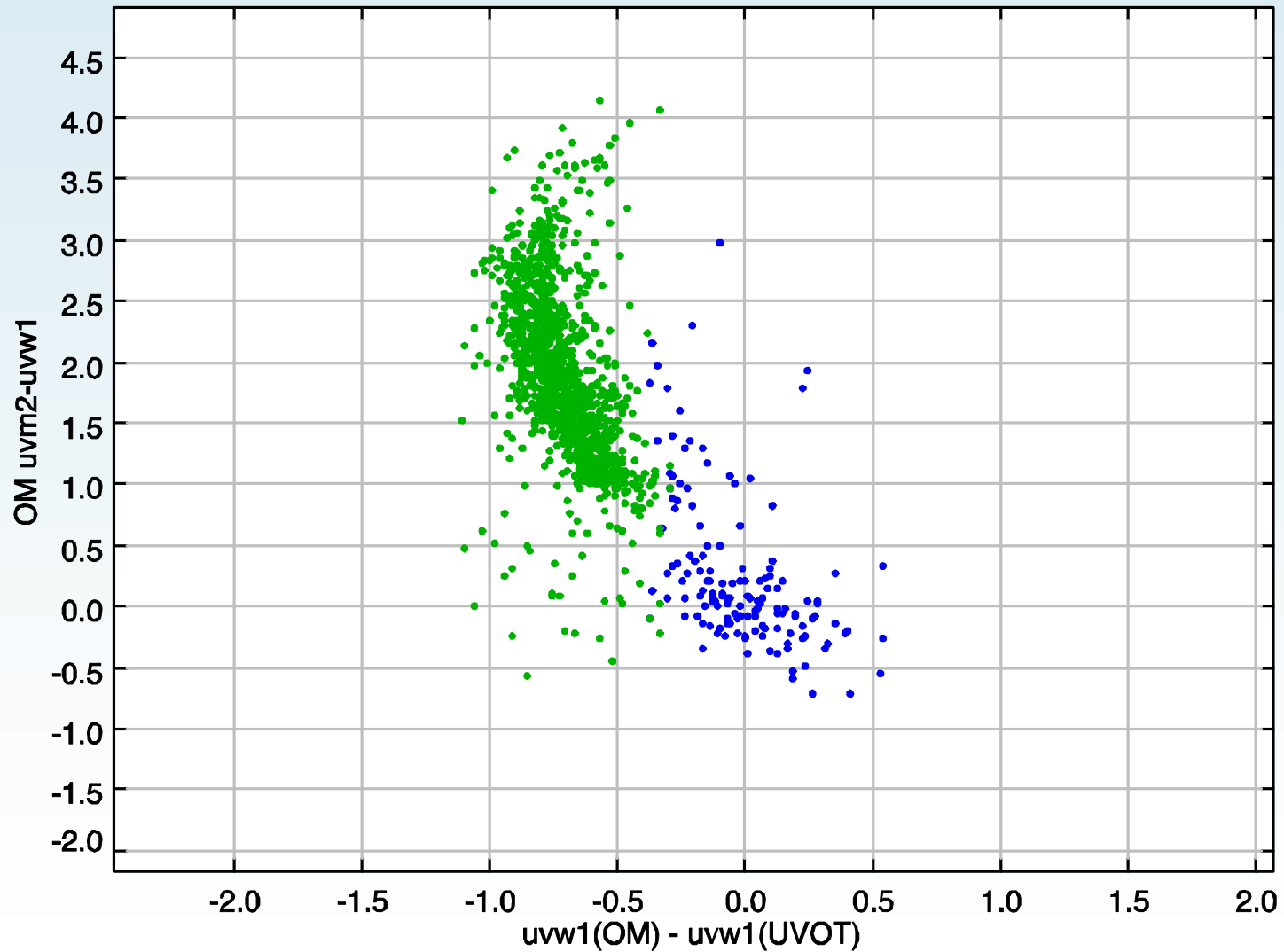## Comparison of the OM and UVOT catalogue for three optical filters

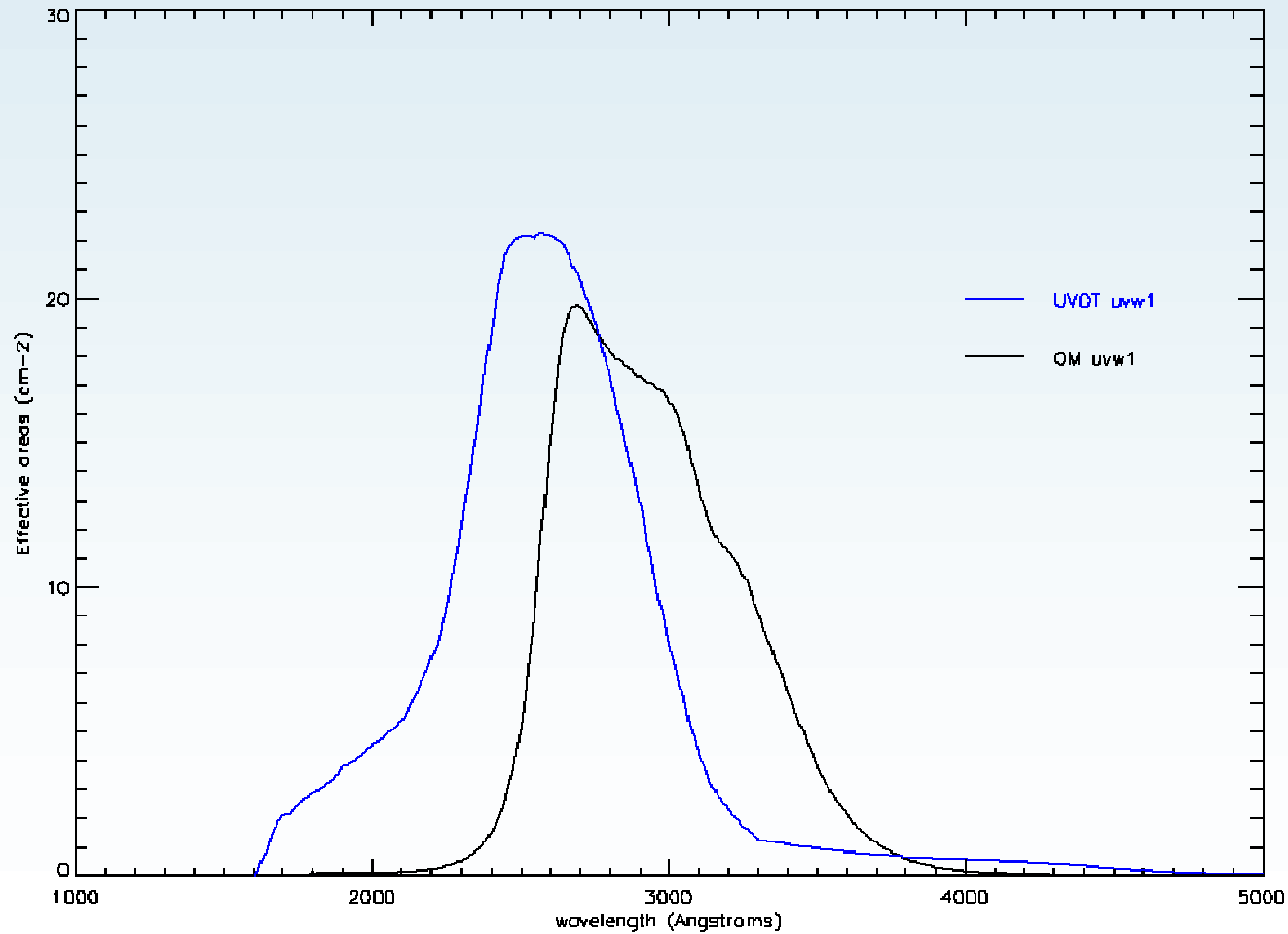## Comparison of the OM and UVOT catalogue for three UV filters
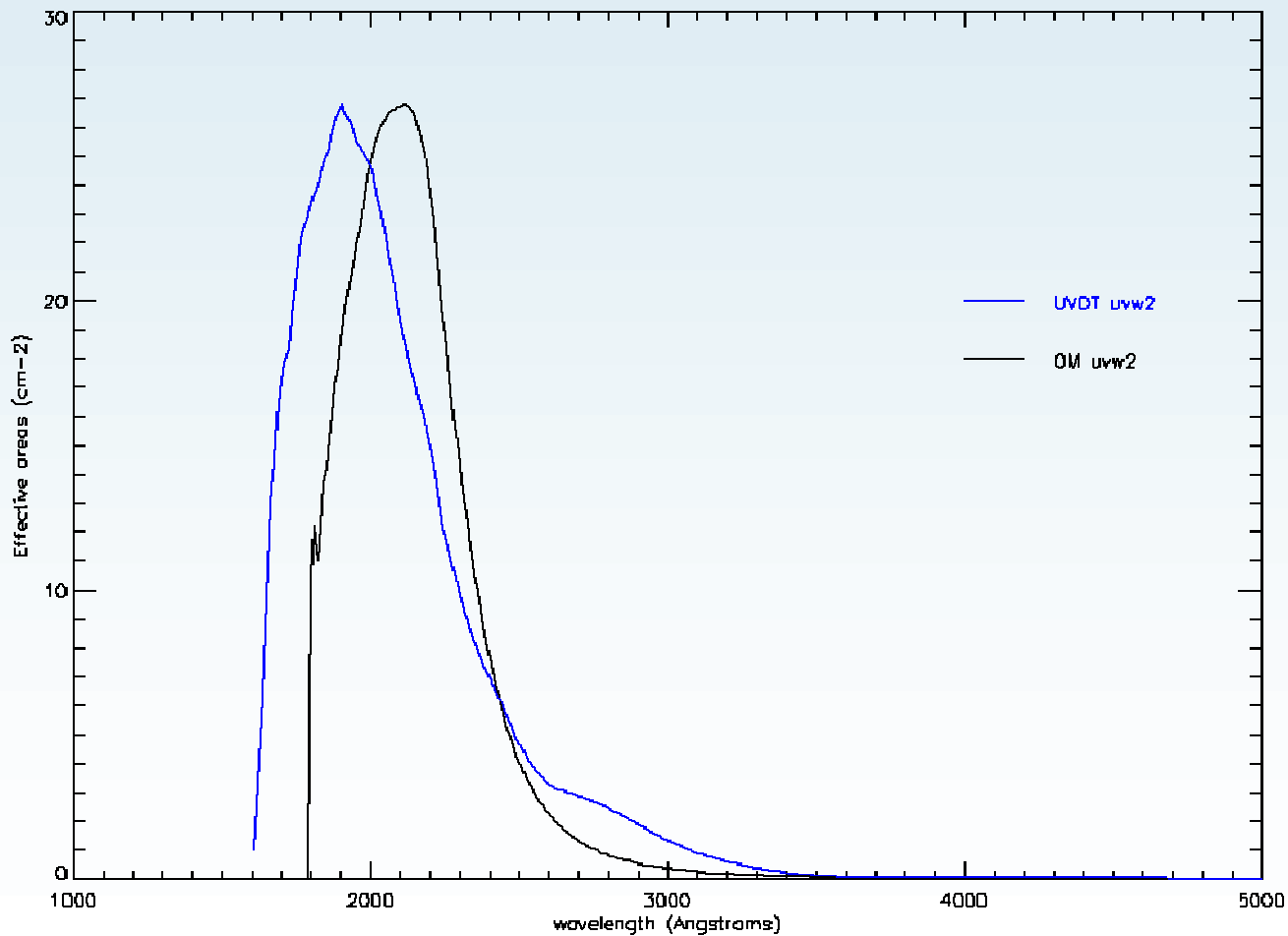
UCL

Comparing uvw1 magnitudes for the two catalgoues

Comparing the two populations in uvw1 filter

Comparison of the filter UVW1 for UVOT and OM

Comparison of the filter UVW2 for UVOT and OM

Challenges in UV Astronomy, ESO, Garching, 7-11 October 2013
Serendipitous UV source catalogues for 10 years of XMM and 5 years of Swift

≜UCL

Conclusion notes

❖ The UV source catalogues for 10+ years of XMM Newton and 5+ years of Swift observations could be powerful tools, in particular, for:

❖ studying extreme physical processes in compact objects;

❖ selecting UV sources for additional follow-up;

❖ finding and studying variable UV sources;

❖ characterising dust clouds in different regions and regimes of star-formation;

❖ detecting dust in stellar winds;

❖ determining the fraction of young generation stars in galaxies with high SFR;

❖ constraining the IMF

❖ etc. etc.