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# The Survey Science Centre report to the XMM-Newton Users Group

Natalie Webb



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XMM-Newton Users Group  
11<sup>th</sup> - 12<sup>th</sup> May 2017, ESAC  
Natalie Webb, IRAP, Toulouse

# Topics

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- SSC status/activities
- The 3XMM catalogue
- Development : 4XMM and the stacked catalogue
- SSC outreach webpages
- Future plans
- Summary

# SSC Status/ Activities

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- No major evolution in status since the 2015 Users Group meeting
- Regular teleconferences with the 9 SSC points of contact
- 30<sup>th</sup> Consortium meeting held April 2017 at MPE, Garching
- Continued SAS task development + support
- Continued data products screening
- Ongoing source identification activities
- Enhancement of catalogue servers
- Continued input into SAS and pipeline development via monthly SAS-CCB and SASWG meetings

# SSC Status/ Activities

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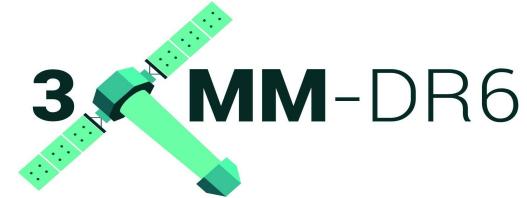
- 3XMM-DR6 released on 5<sup>th</sup> July 2016
- Published 3XMM paper, appeared June 2016 (63 citations)
- Worked on the stacked catalogue
- Participated in the SUSS 3.0 catalogue release
- Started putting together 3XMM-DR7
- Major improvements to the XMM-SSC outreach webpages

# SSC Status/ Activities

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- The Osservatorio Astronomico di Brera have unfortunately decided to retire from the XMM-Newton Survey Science Centre due to a lack of manpower
- They made a great success of the X-ray bright sample (XBS) : Bright Sample (BSS: selection 0.5-4.5 keV; 380 ID/389 total sources): ID rate=98%  
Hard Bright Sample (HBS: selection 4.5-7.5 keV; 67 ID/67 total sources): ID rate=100%
- They published 15 papers and contributed to other SSC papers
- We will miss their input for numerous SSC activities and thank them for their investment in the project and wish them all the best in future projects

# 3XMM-DR6

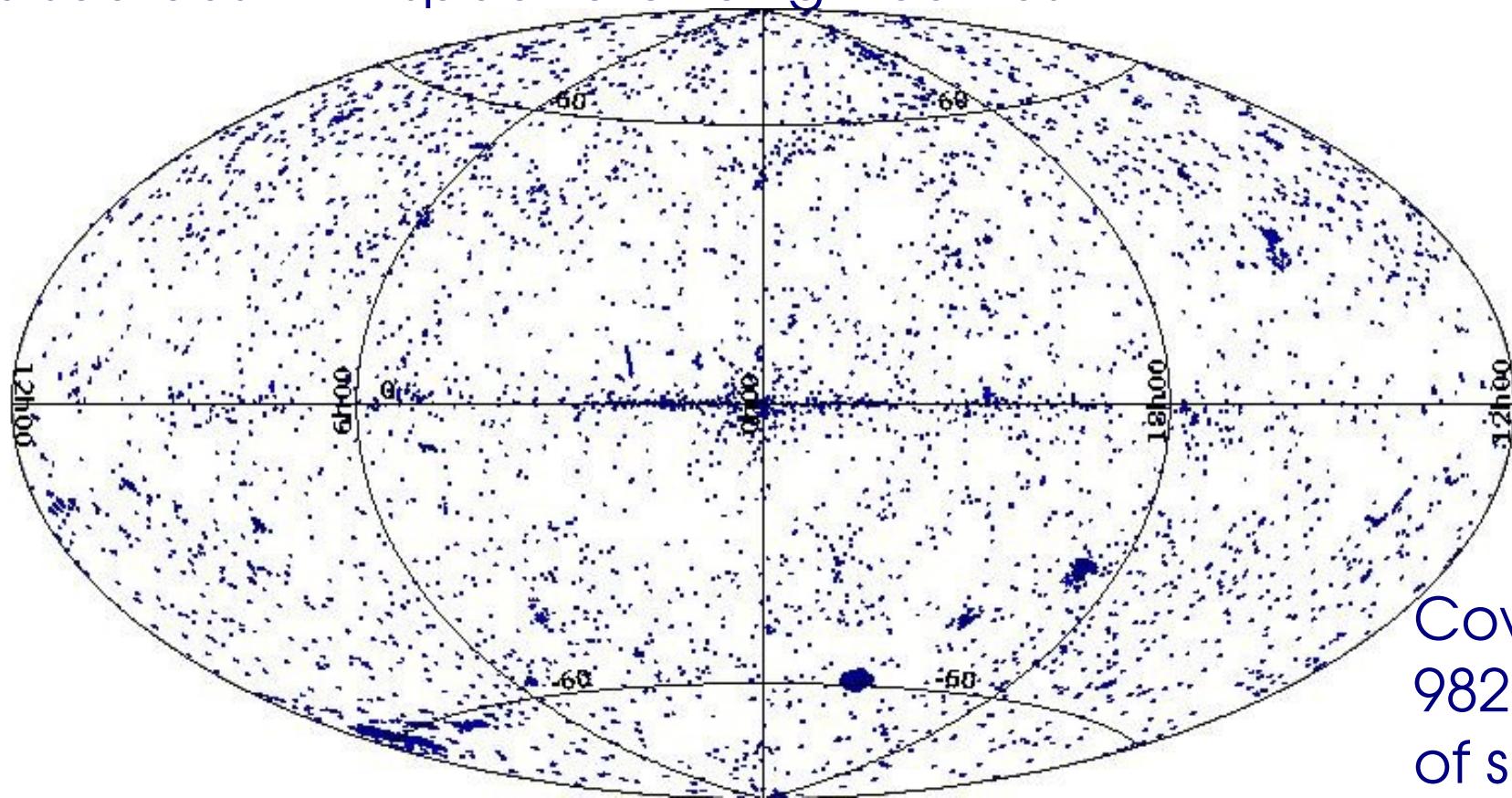


3 February 2000 – 4 June 2015

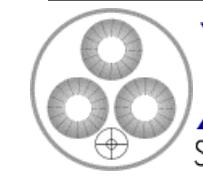
678680 detections, some sources up to 50 times

468440 unique sources

149968 sources with spectra and lightcurves



Covers  
982 sq.deg  
of sky



**XMM-Newton**  
SURVEY SCIENCE CENTRE

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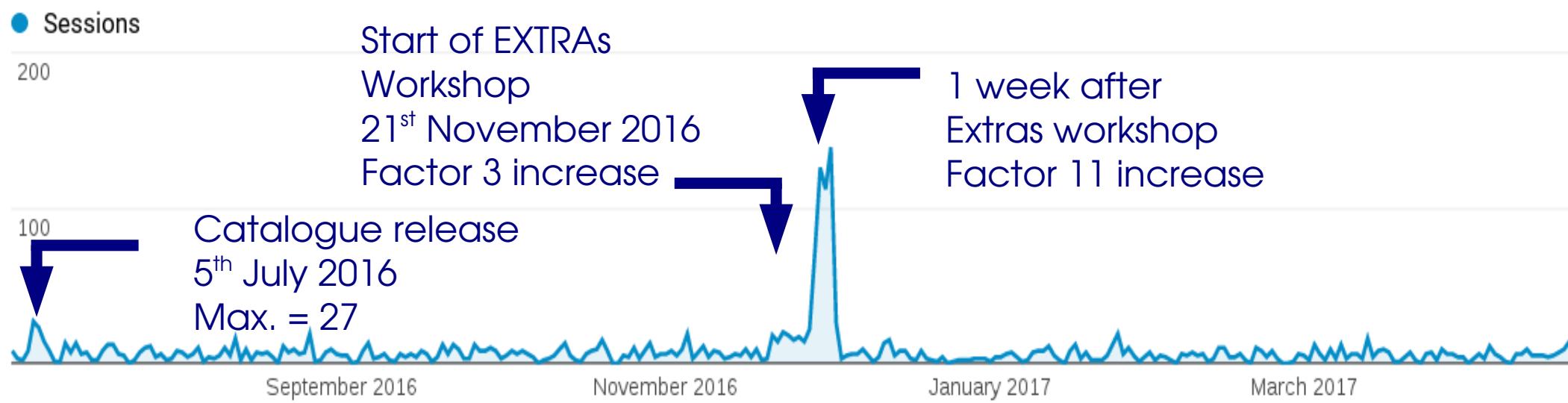
# Google analytics, xmssc.irap.omp.eu

More than 1300 users since the release of 3XMM-DR6, from 69 different countries



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More than 1300 users since the release of 3XMM-DR6, from 69 different countries



Moral : a workshop that is centred on the XMM-Newton catalogue(s) is great publicity!

# A workshop on the XMM-Newton catalogues

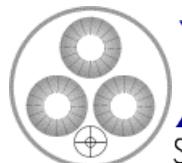
3 day workshop to be held at IRAP, Toulouse in 2<sup>nd</sup> quarter 2018

Expect to include : 3XMM-DR7/DR8 and 4XMM  
The stacked catalogue  
The slew catalogue  
The SUSS (OM) catalogue

and Swift, Chandra, Fermi, Integral + maybe Planck, Herschel,  
and future observatories i.e. SVOM, Athena, CTA

SOC : Natalie Webb  
Axel Schwope  
Mike Watson  
Christian Motch  
Jean Ballet  
Michael Freyberg  
Francisco Carrera  
Mat Page

LOC : Mickaël Coriat  
(TBC) Filippos Koliopanos  
Olivier Godet  
Didier Barret  
Etienne Pointecouteau  
Nicolas Clerc



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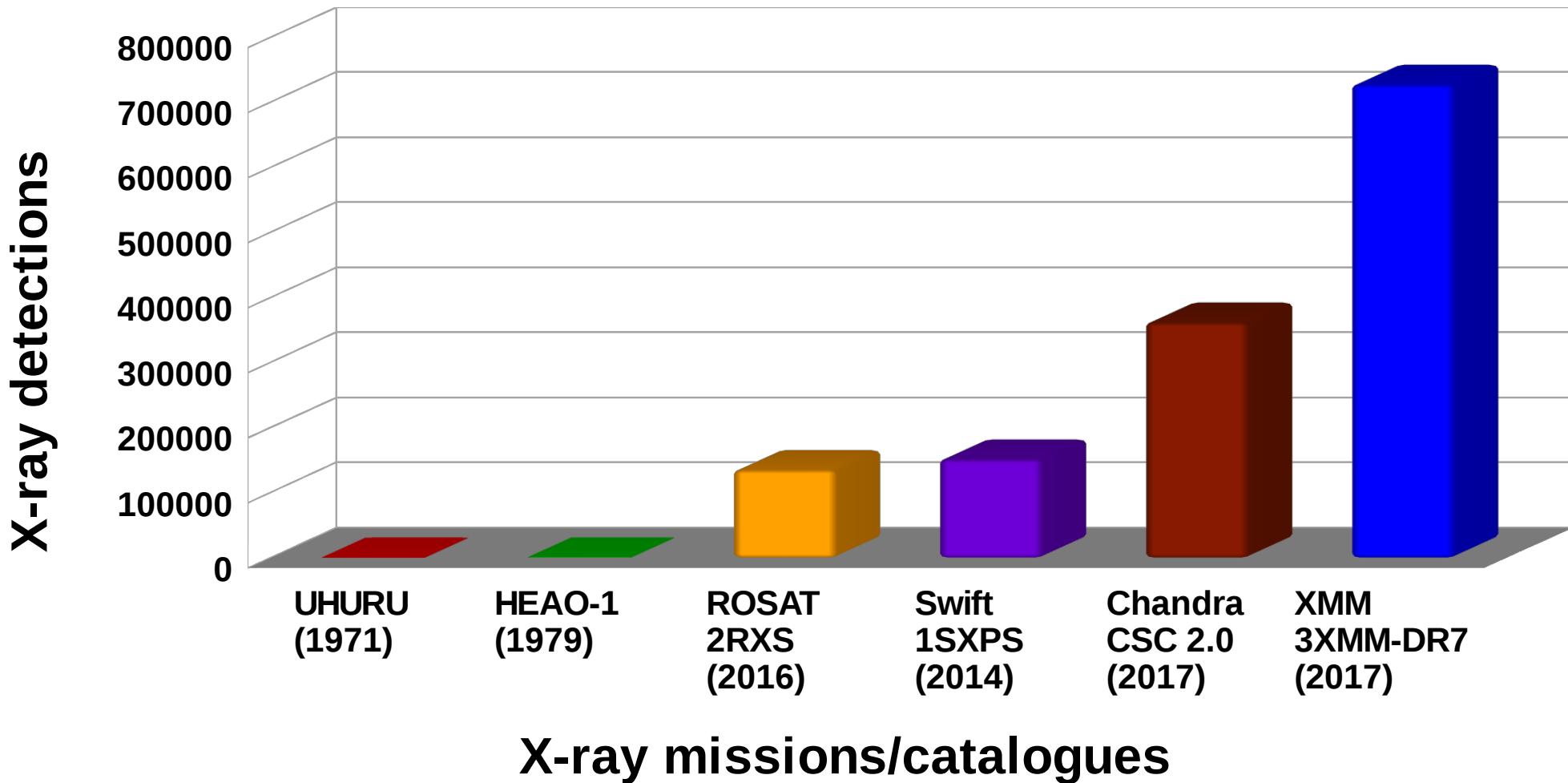
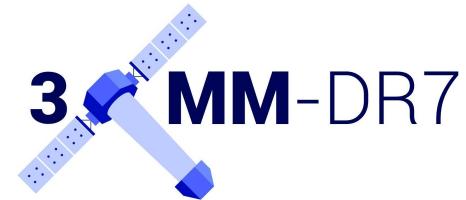
# 3XMM-DR7



Preliminary numbers for  
3XMM-DR7:

	DR7	DR6	Increment
Number of observations	9710	9159	551
Observing interval	03-Feb-2000 – 15-Dec-2016	03-Feb-2000 – 04-Jun-2015	1.5 yr
Sky coverage	> 982 sq.deg	982 sq.deg	> 0 sq.deg
Number of detections	727 790	678 680	49 110
Number of unique sources	499 266	468 440	30 826
Number of det. with spectra	162 082	149 998	12 084
Number of det. with time series	162 045	149 968	12 077

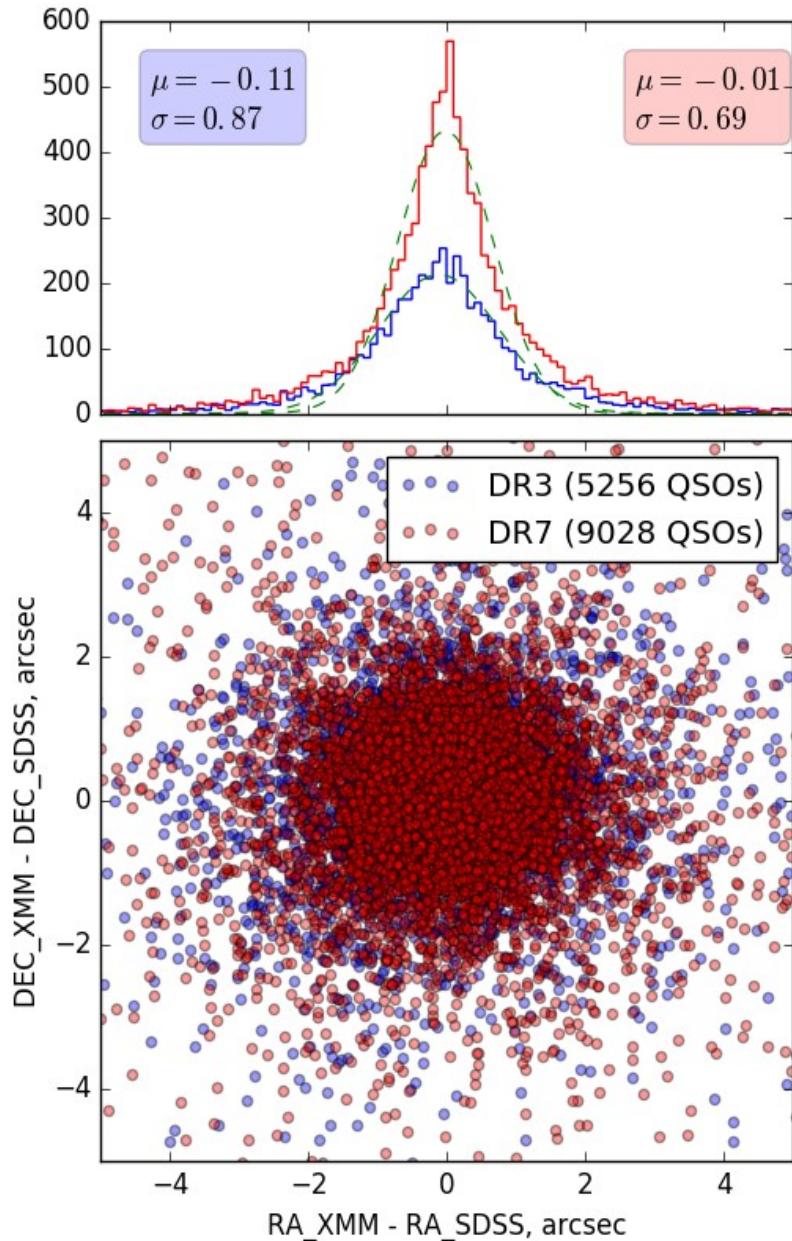
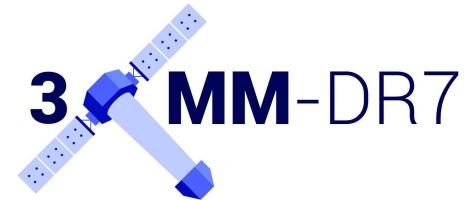
# 3XMM-DR7



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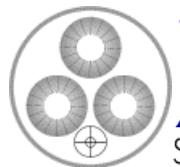
# 3XMM-DR7



## Astrometry

- Cross-match with latest version of SDSS quasars catalogue
- Comparison between 2XMM-DR3 and 3XMM-DR7

Planned release of catalogue within one month



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# Future catalogue versions

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3XMM-DR8 planned for first half of 2018

4XMM anticipated for 2019

- full re-reduction of all data (~10500 obs.) starting in 2018

What should we improve for 4XMM?

- Variability between observations in catalogue?
- Added variability analysis?
- Flagging piled-up sources, sources around hotspots?

Should we provide two versions of 4XMM – one highly robust catalogue with very reliable sources for the non-experienced user & a second, similar to 3XMM, for the expert user?

# Future catalogue versions

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Examples for the DR7 catalogue (727790 detections, 332 columns):

- 412805 excellent detections ( $\text{SUM\_FLAG}=0$  &  $\text{max. likelihood} \geq 10$ )
- 524146 good detections ( $\text{SUM\_FLAG} < 2$  &  $\text{max. likelihood} \geq 8$ )

DR7 Slim catalogue (499266 sources, 44 columns)

Note:

Max. likelihood  $10 \sim 4\sigma$

Max. likelihood  $8 \sim 3.5\sigma$

# Future catalogues : the stacked catalogue

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New stacked source detection tasks in SAS to

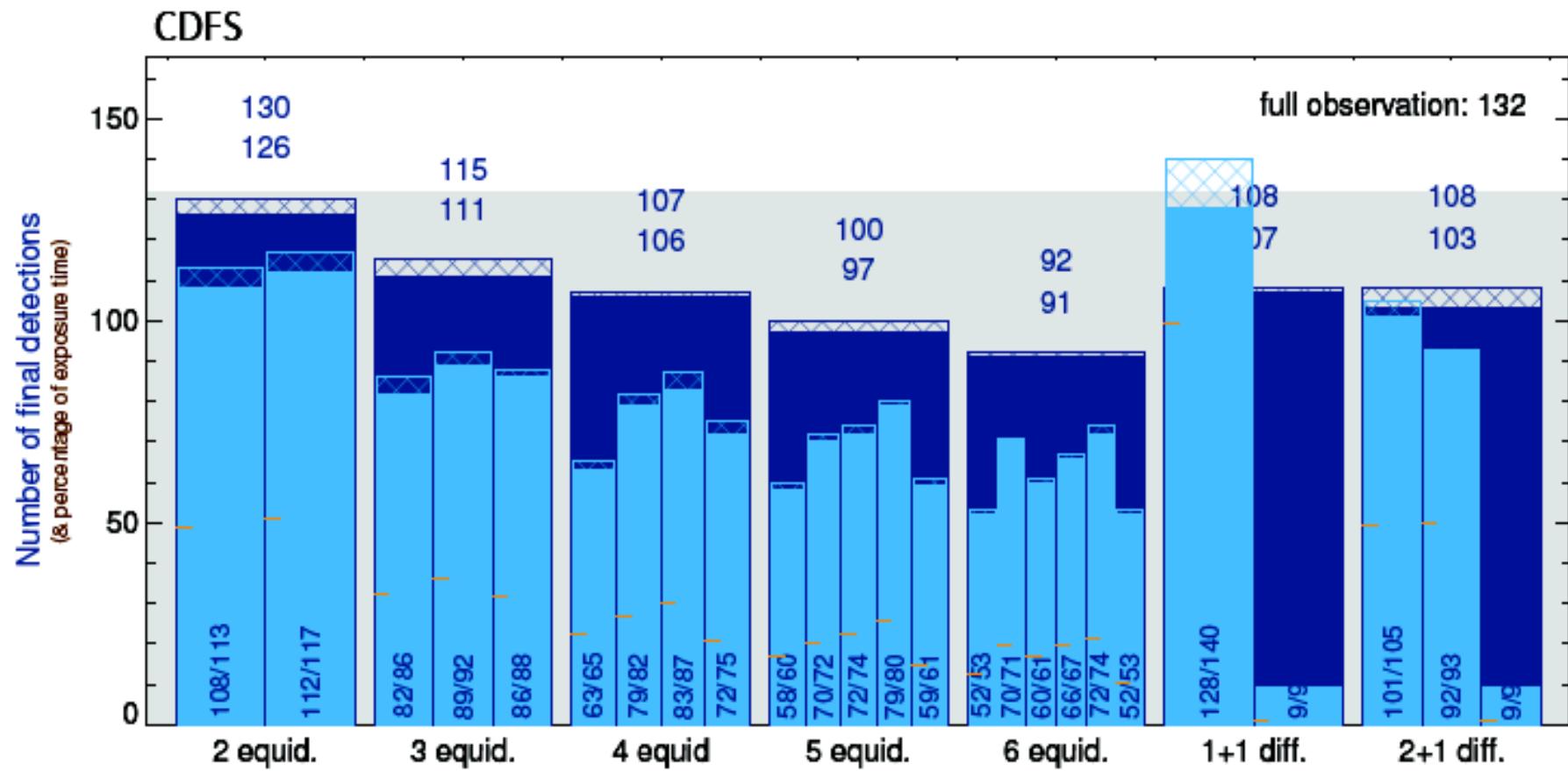
- provide a standardised source-detection method for overlapping observations
- more convenient handling of multiple pointings for the users
- optimize stacked source parameters
- basis of a “stacked catalogue” of repeatedly observed sources

Images stacked with `emldetect`

Source detection using `edetect_stack`

Testing to optimise the field and observation selection

# Future catalogues : the stacked catalogue



dark blue: stacks

light blue: per sub-exposure

solid: with valid 3XMM counterpart

shaded: without valid 3XMM counterpart

# Future catalogues : the stacked catalogue

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<u>#OBS</u>	<u>#grps</u>
2	204
3	40
4	10
5-8	4-6
9,10,12	1 each

Proto-catalogue: 736 observations, 278 stacks,  $\geq 25,500$  detections

Catalogue processing:

- several of the necessary scripts ready to use
- open: final field selection
- processing takes just a few weeks

# SSC outreach webpages

The screenshot shows the homepage of the XMM-Newton Survey Science Centre. The header features the XMM-Newton logo and a navigation menu with links to Welcome, The XMM-Newton project, Our universe (which is highlighted with a cursor), X-rays, Contact, For Astronomers, Kids, and Français. The main content area has a dark blue background with a starry field. It displays the text "Welcome to the XMM-Newton SURVEY SCIENCE CENTRE" and a paragraph about the observatory's purpose. Below this is a large image of the XMM-Newton satellite in space.

**XMM-Newton**  
SURVEY SCIENCE CENTRE

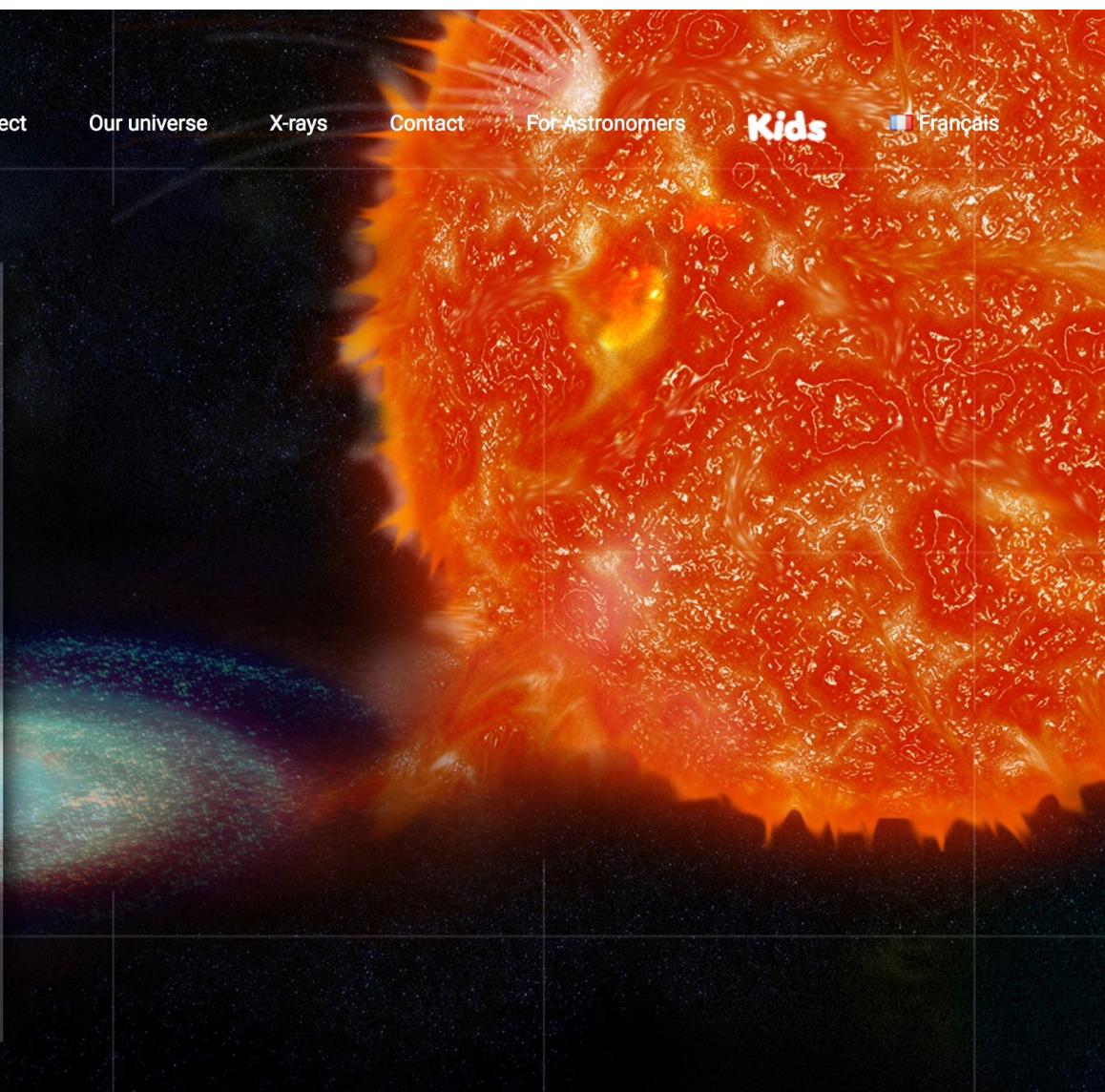
Welcome      The XMM-Newton project      Our universe      X-rays      Contact      For Astronomers      **Kids**      Français

## Welcome

to the XMM-NEWTON  
SURVEY SCIENCE CENTRE

XMM-Newton is an X-ray space observatory launched by the European Space Agency in December 1999 on an Ariane 5 rocket. It is used to study sources of soft X-rays such as the formation of stars in stellar nurseries, clusters of galaxies, supermassive black holes in the heart of galaxies as well as the other mysteries of space. You will find on this website the discoveries related to the XMM-Newton and its history.

# SSC outreach webpages



**XMM-Newton**  
SURVEY SCIENCE CENTRE

Welcome    The XMM-Newton project    Our universe    X-rays    Contact    For Astronomers    **Kids**    Français

## X-ray binaries

X-ray binaries are made up of two stars that orbit each other (like the Earth and the Moon). One of the stars is a "normal" star, like our Sun and the other is a neutron star or a black hole. These objects are so compact they have a huge gravitational force. Because of that, the compact star rips material from its companion star. This matter falls towards the compact star and is heated up to millions of degrees, so that it emits strongly in the X-ray domain.

The majority of stars in our Universe are in binary or multiple systems, that orbit about their common centre of mass. When one of the stars dies and if it is sufficiently massive, it can undergo a supernova explosion. The outer gaseous layers are ejected into Space, leaving only the dense core. These cores can continue to collapse until they become extremely dense, forming a neutron star or a black hole. Neutron stars have a mass similar to the Sun or as much as twice the mass of the Sun, but the matter is compressed into a sphere of only 10 km in radius. Black holes are even more compact – in fact they are the densest objects in the Universe. Their gravitational field is so extreme, that even light cannot escape the black hole, hence they are not visible.

The gravitational force of the black hole or the neutron star is so strong that it sucks material from the companion star. The material spirals towards the compact object and forms an 'accretion disc'. Sometimes we observe jets of material from the accretion disc. These jets travel rapidly, at almost the speed of light (the fastest speed possible).

2017, XMM-Newton Survey Science Center, Tous droits réservés.

# SSC outreach webpages

The screenshot shows the homepage of the XMM-Newton Survey Science Centre Kids website. At the top, the XMM-Newton logo is displayed with "SURVEY SCIENCE CENTRE" below it. A red "Kids" button is positioned above a row of five colored boxes: blue (ACCUEIL), purple (JE VEUX M'AMUSER), teal (JE VEUX CONSTRUIRE), yellow (JE VEUX APPRENDRE), and orange (JE VEUX ÊTRE LE HÉROS). To the left, there's a large graphic of Earth and a cartoon astronaut. The central content area features a blue background with a satellite icon and the text "BIENVENUE A BORD DU XMM-NEWTON SURVEY SCIENCE CENTER". Below this, a paragraph explains the purpose of the observatory and encourages exploration. At the bottom, there are links for YouTube and RSS, and a footer note about copyright.

localhost:8888/wordpress/kids/

XMM-Newton SURVEY SCIENCE CENTRE

**XMM-Newton**  
SURVEY SCIENCE CENTRE

Kids

ACCUEIL

JE VEUX M'AMUSER

JE VEUX CONSTRUIRE

JE VEUX APPRENDRE

JE VEUX ÊTRE LE HÉROS

BIENVENUE A BORD

DU XMM-NEWTON SURVEY SCIENCE CENTER

Le XMM-Newton est un observatoire de l'Agence Spatiale Européenne lancé le 10 décembre 1999 par une fusée. Il détecte des rayons appelés « X », c'est-à-dire une forme de lumière très énergétique. Il peut donc observer des phénomènes parmi les plus violents de l'Univers, comme des explosions d'étoiles par exemple. Tu trouveras ici des jeux qui t'aideront à en savoir davantage sur cet observatoire.  
Amuse-toi bien !

2015 XMM-Newton Survey Science Center, Tous droits réservés.

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# SSC outreach webpages

The screenshot shows a webpage with a dark blue background featuring a white grid of stars. On the left, there's a large illustration of a smiling astronaut in a white spacesuit standing next to a blue Earth. At the top, a navigation bar has five colored buttons: ACCUEIL (blue), JE VEUX M'AMUSER (purple), JE VEUX CONSTRUIRE (teal), JE VEUX APPRENDRE (yellow), and JE VEUX ÊTRE LE HÉROS (orange). The main content area is titled "COLORIAGES" with a purple pencil icon above it. Below the title is a text block: "Ta passion c'est le coloriage ? Super, tu trouveras ici de quoi t'amuser ! A tes crayons de couleurs ou tes feutres, laisse parler ton imagination ! Tu pourras également imprimer tes coloriages et ainsi faire de ta chambre un véritable vaisseau spatial !" Underneath this, the word "Facile" is centered above three coloring pages: an astronaut, a satellite, and a rocket ship. Each page has an "XMM-Newton" logo in the top left corner. At the bottom of the page are three printer icons and two small circular icons (one green with a play button, one yellow with a feed symbol).

ACCUEIL

JE VEUX M'AMUSER

JE VEUX CONSTRUIRE

JE VEUX APPRENDRE

JE VEUX ÊTRE LE HÉROS

COLORIAGES

Ta passion c'est le coloriage ? Super, tu trouveras ici de quoi t'amuser ! A tes crayons de couleurs ou tes feutres, laisse parler ton imagination ! Tu pourras également imprimer tes coloriages et ainsi faire de ta chambre un véritable vaisseau spatial !

Facile

XMM-Newton

XMM-Newton

XMM-Newton

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# SSC outreach webpages

XMM-NEWTON SIGNIFIE ?

eExtra-Massif Moteur

X-ray Multi-mirror Mission (Rayons X multi-miroirs mission)

eXtrême Mission à Mars

eExtra-terrestres Migrant vers Mercure

localhost:8888/wordpress/kids/quizz/#

2015 XMM-Newton Survey Science Center, Tous droits réservés.

# What else could we improve?

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To date the variable sky has not been significantly exploited

A systematic search in the pipeline for variable sources :

- new or highly variable sources :  $\gamma$ -ray bursts, tidal disruptions, X-ray binaries, CVs, grav. wave events, supernovae, magnetars
- sources that become bright for a very short time (few seconds) but not detected as lost in noise: bursting sources, giant pulses, ...

This would require :

- new algorithms
- PI to tick a box in RPS form (like was for XID project) to say that their data can be searched automatically and any new source announced (either to them or via an ATEL created automatically)

# Summary

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Continued SAS task development + support

Continued data products screening

Ongoing source identification activities

3XMM-DR7 expected for next month, 3XMM-DR8 for next year

Stacked source catalogue expected this year

Enhanced catalogue servers helping to disseminate data products

Planning for 4XMM started, re-reduction using new methods and upgraded products next year for release in 2019

Thanks to strong support from SSC members and the SOC,  
we are continuing to provide XMM-Newton legacy products  
to the astronomical community

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