

Advanced web application for X-ray research with *XMM-Newton*

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and the team of *citizen scientists*

Talk outline

- *XMM-Newton* catalog and motivation
- Website: what batteries inside?
- New development model (citizen science)
- Demo

XMM-Newton catalog

- XMM-Newton is X-ray observatory by ESA launched in Dec 1999
- Large FOV: ~70 sources / pointing
- 3XMM-DR5 is the largest X-ray source catalog ever created: 2.5% of the sky, 560k detections, 400k sources (credit: XMM Science Survey Center)



Motivation

- I was main responsible for the 3XMM-DR5 catalog compilation
- Old *XMM-Newton* catalog webpages: expensive to take over
- Time cost comparable to reimplementing improved version from scratch
- Unlimited source of a manpower as an experiment: why not trying it?

XMM-Newton catalog

LEDAS:
ARNIE services Leicester Database and Archive Service

ARNIE Index
ARNIE Quick Help
ARNIE Tutorial

Search...
All Databases
All Helpfiles

For comments or help, e-mail:
ledas-help@star.le.ac.uk

Database: 3XMM Database HELP
XMM Third Serendipitous Source Survey Data Release 4: 3XMM-DR4

[Database Index](#) | [Basic Search](#) | [Advanced Search](#)

Name Resolver HELP **Search Co-ordinates** HELP

Name: Co-ords:

RESOLVE NAME
SUBMIT QUERY

Co-ordinate system:
 Equatorial Ecliptic Galactic
Equinox: 1950 2000

Search Type HELP **Output Options** HELP

Cone search, radius: arcmin.
 Square search, width: arcmin.
 Rectangle search, size: x arcmin

Display Columns HELP

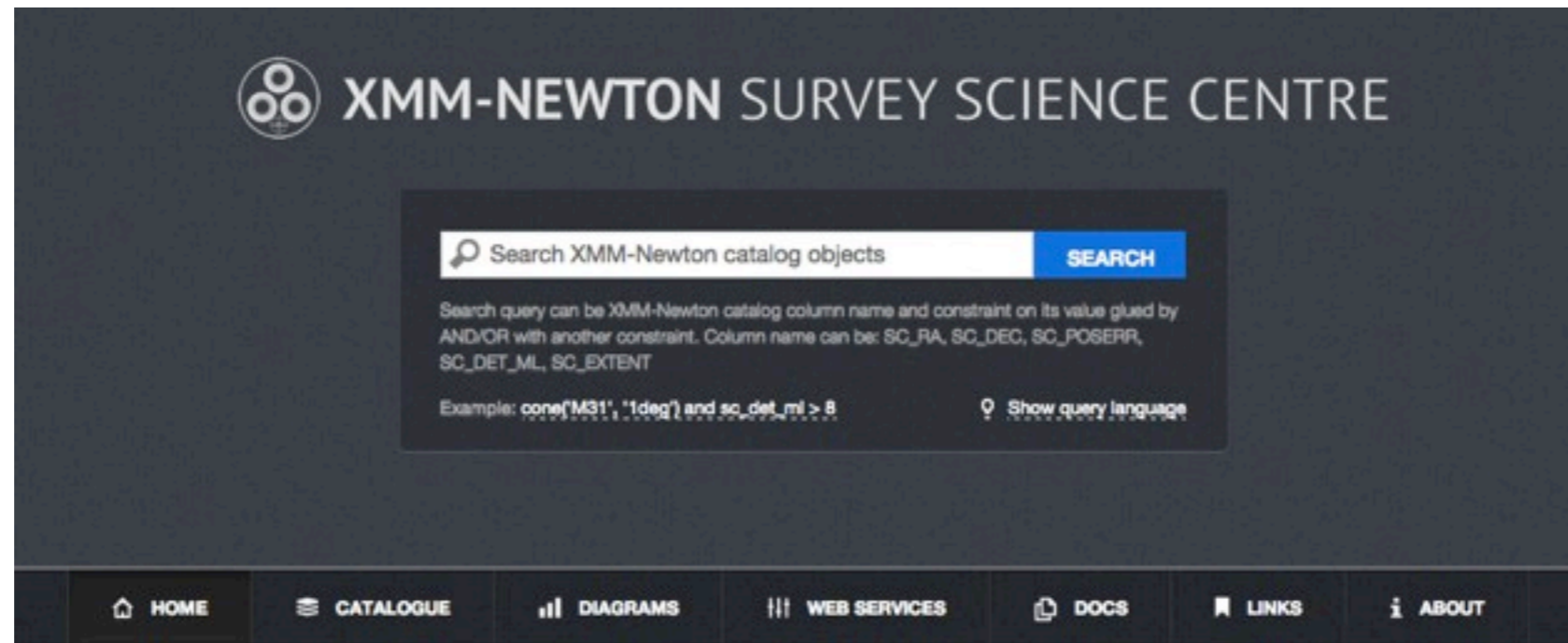
Display **default** table columns
 Display **all** table columns

Output coordinates in:
 Decimal Sexagesimal
Output system:
 Equatorial Ecliptic Galactic
Output epoch:
 J2000 B1950
Output format:
HTML Table

Output number of lines: **SUBMIT QUERY**

before

XMM-Newton catalog



The screenshot shows the XMM-Newton Survey Science Centre website. At the top left is the logo, a circle containing three smaller circles. To its right is the text "XMM-NEWTON SURVEY SCIENCE CENTRE". Below this is a search bar with the placeholder text "Search XMM-Newton catalog objects" and a blue "SEARCH" button. Under the search bar, there is explanatory text: "Search query can be XMM-Newton catalog column name and constraint on its value glued by AND/OR with another constraint. Column name can be: SC_RA, SC_DEC, SC_POSERR, SC_DET_ML, SC_EXTENT". Below this is an example query: "Example: cone('M31', '1deg') and sc_det_ml > 8". To the right of the example is a link "Show query language". At the bottom of the page is a navigation menu with the following items: HOME, CATALOGUE, DIAGRAMS, WEB SERVICES, DOCS, LINKS, and ABOUT.

NEWS

23
Nov 2014

28th XMM-Newton SSC consortium meeting to be held 22-23 January 2015 at MSSL, London, UK

12
Mar 2014

28th XMM-Newton SSC consortium meeting to be held 10-11 May 2014 at AIP, Potsdam, Germany

SSC OVERVIEW

Launched in 1999, the XMM-Newton satellite is the major European X-ray observatory-class telescope, carrying also a co-aligned UV/optical monitor telescope, that is operated by the European Space Agency (ESA). The XMM-Newton Survey Science Centre (SSC) has responsibilities within the XMM-Newton project in four main areas:

- ✓ The compilation of the XMM-Newton Serendipitous Source Catalogue.
- ✓ The follow-up/identification programme for the XMM-Newton serendipitous X-ray sky survey: the

after

Legacy

Reincarnation of the world reference
exoplanet database, <http://exoplanet.eu>



The screenshot shows the Exoplanet.eu website. At the top right, there are flags for the United Kingdom, France, Spain, Portugal, Germany, Hungary, and Italy. Below the flags is a dark navigation bar with the Exoplanet.eu logo on the left and a menu with items: Home, All Catalogs, Diagrams, Bibliography, Research, Meetings, Other Sites, and VO. The main content area is divided into several sections. On the left, there is a large heading 'The Extrasolar Planets Encyclopaedia' with a sub-heading 'Established in February 1995' and a description: 'Developped and maintained by the [exoplanet TEAM](#) update : Dec. 17, 2014 (1854 planets) Please report any problems to vo.exoplanet@obspm.fr'. To the right of this are two boxes: 'Catalog' with a spreadsheet icon and the text 'Filter, sort, export — arbitrary data manipulations with the Extrasolar Planets Encyclopaedia', and 'Diagrams' with a 3D pie chart icon and the text 'Analyze the Extrasolar Planets Encyclopaedia data online. Simple plotting tool right in the browser'. Below these are four columns of links: 'News' with a list of recent updates (May 13, 2014; May 1, 2014; March 6, 2014; Feb. 19, 2014), 'Tutorials' (update: Aug. 14, 2014), 'Bibliography' (update: Dec. 17, 2014), 'Research' (update: Oct. 8, 2014), 'Meetings' (update: Dec. 15, 2014), 'Theory Work' (update: March 11, 2014), and 'Other sites' (update: Jan. 12, 2014).

Technology stack

- RDMBS: **PostgreSQL**



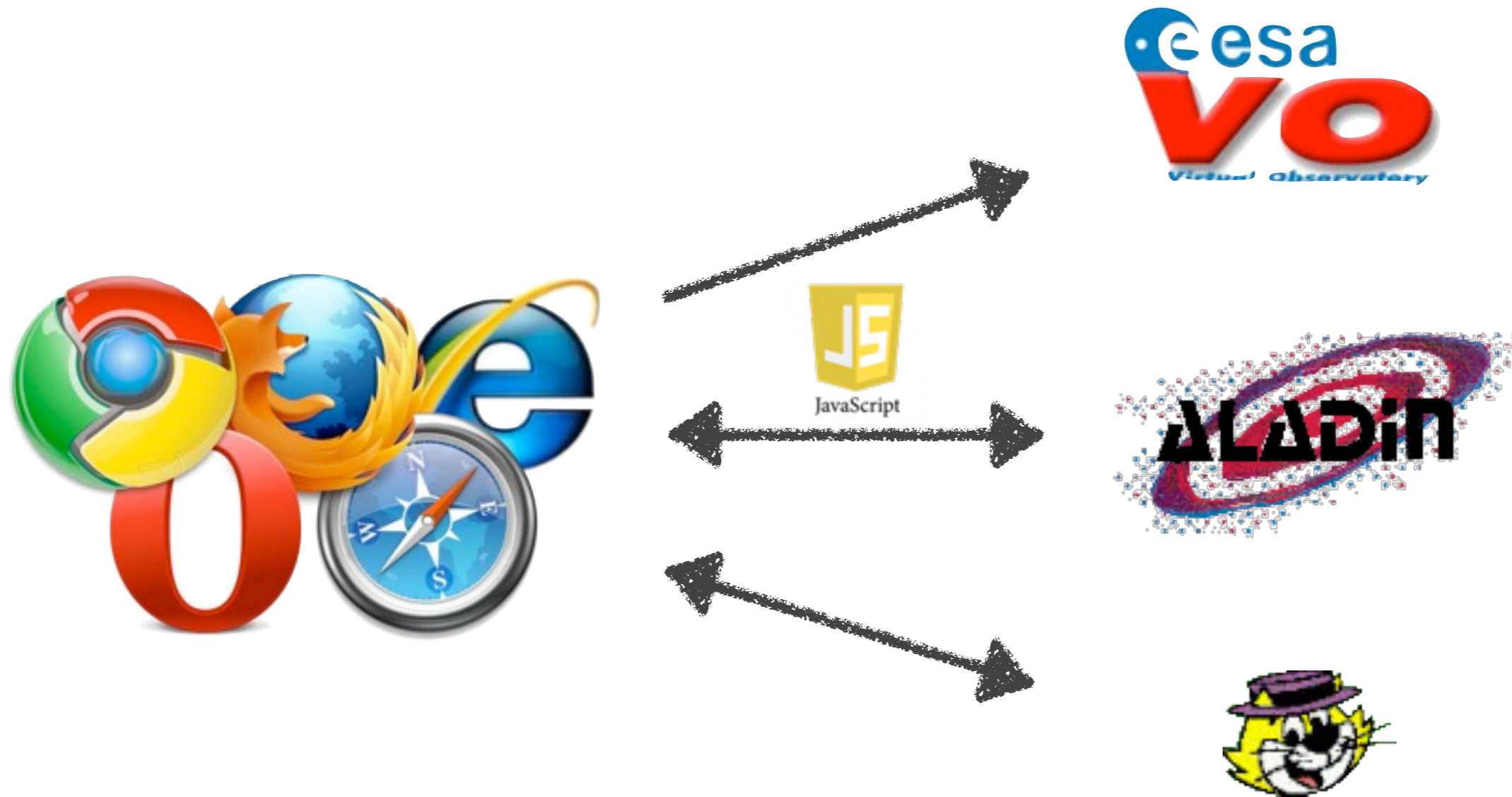
- Application language: **Python**



- Web framework: **Django**



SAMP in a browser



AstroTools library: <http://goo.gl/zyF0id>

X-ray spectral fitting

- Web implementation of a complex thing: source, background, RMF, ARF

- Wrapper over Sherpa



- Powered by Xspec



Query language

Boolean expressions instead of endless forms (think Google) + SIMBAD resolver

Query examples



- `M82` – select sources in 10 arcmin vicinity of M82 center
- `cone('M31', '1deg') AND sc_det_m1 < 100` – select faint X-ray sources not
- `is_ulx = true AND n_detections > 2` – select ULXs which were detected n
- `iauname IN {"3XMM J053406.7+220337", "3XMM J053406.6+220438"}` – select
- `srcid IN {3, 4}` – select specific sources by their source IDs (useful for la

More batteries

- Web sessions (personalization)
- Name resolver
- JavaScript diagrams (jQuery, Angular)
- Aladin Lite by CDS
- Java WebStart of Aladin and TOPCAT



New development model

- High-level full-time employed IT engineers
a.k.a. volunteers   **git**
- Coordination through Bitbucket (git)
- New type of **citizen science**? Unlimited source of free manpower?

New development model

- **Alexey Sergeev**, Moscow, 10+ years of experience – design
- **Maxim Chernyshov**, Vladivostok, 10+ years of experience but 1st Django project – backend
- **Askar Timirgazin**, Moscow, 5 years of experience – frontend

New development model

- Project duration: ~1 yr
- My time: 5% FTE
- Volunteers time: up to 3 months FTE
- This team is so far unique, but there are much more citizen science enthusiasts!

Short demo at

<http://xmm-catalog.irap.omp.eu>

(to see why researchers are excited and make
100 clicks 2-hrs long sessions)

What's next

- A&A paper on this website as a research tool
- *XMM-Newton* photon database – database of all photons ever registered by the *XMM-Newton* (~100 billion)
- + papers on discoveries already made with it!