



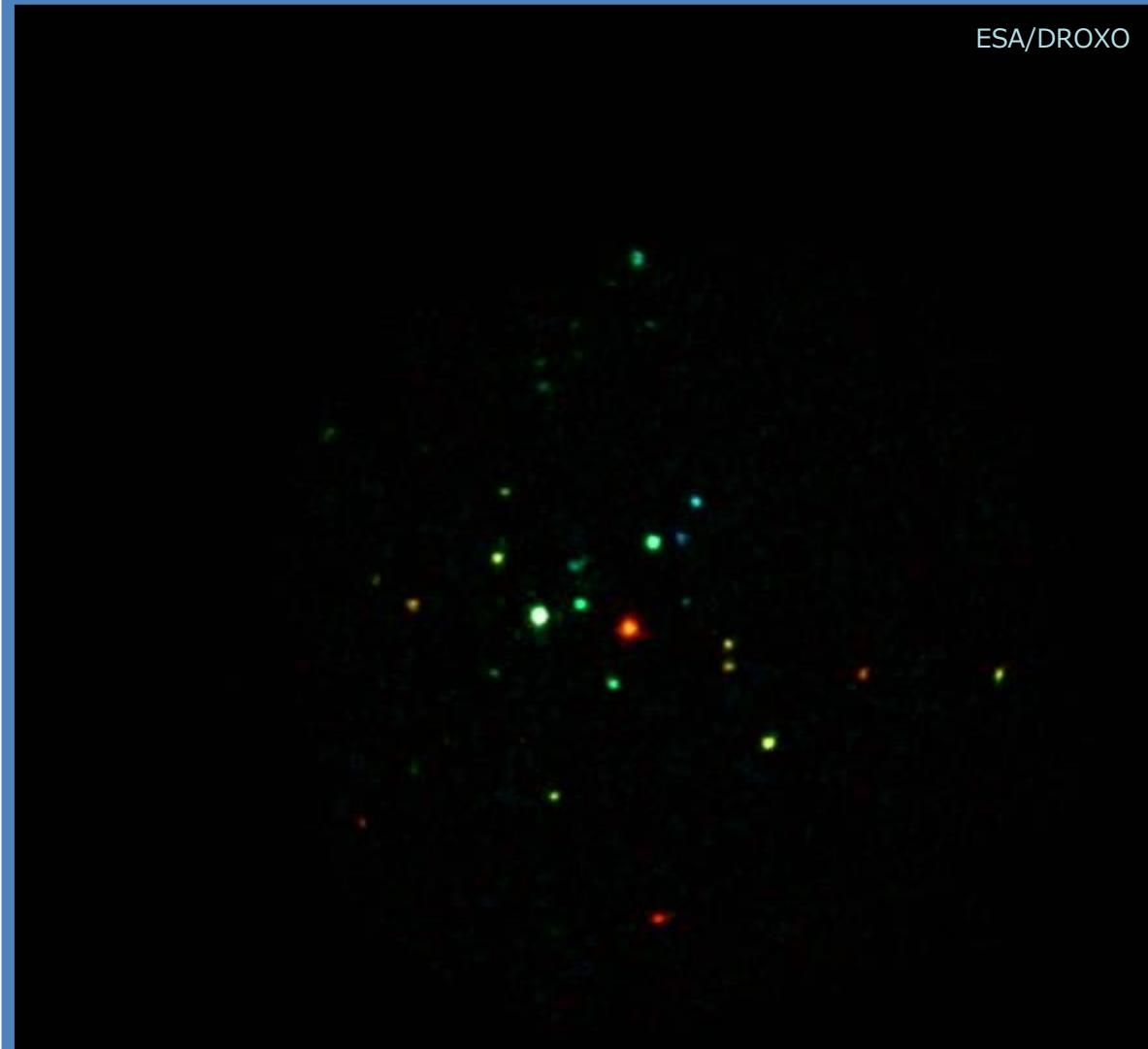
# Exploring the X-ray Transient and variable Sky

Andrea De Luca  
INAF/IASF Milano

on behalf of the EXTras collaboration

# EXTraS: the rationale

1. Variability
2. Serendipity
3. XMM/EPIC



ESA/DROXO

# EXTraS in short

**The most sensitive and complete investigation of variability in the soft X-ray sky**

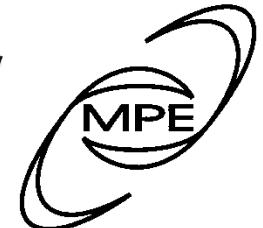
explore the **serendipitous** content of the **XMM-Newton/EPIC** database in the **time domain**

make it **available** and **easy to use** to the whole **community**.

allow to do **more, new science**

Funded by EU  
FP7-Space-2013-1

2014-2016



# The XMM-Newton/EPIC database

**Pointed obs. → 3XMM catalogue\***

794 deg<sup>2</sup> non-overlapping

531261 sources (373268 unique)

66728 with >1 detection (up to 44)

0.5-2 keV sensitivity  $3(1) \cdot 10^{-15}$  cgs

2-10 keV sensitivity  $1.5(0.8) \cdot 10^{-14}$  cgs

\*by the XMM SSC

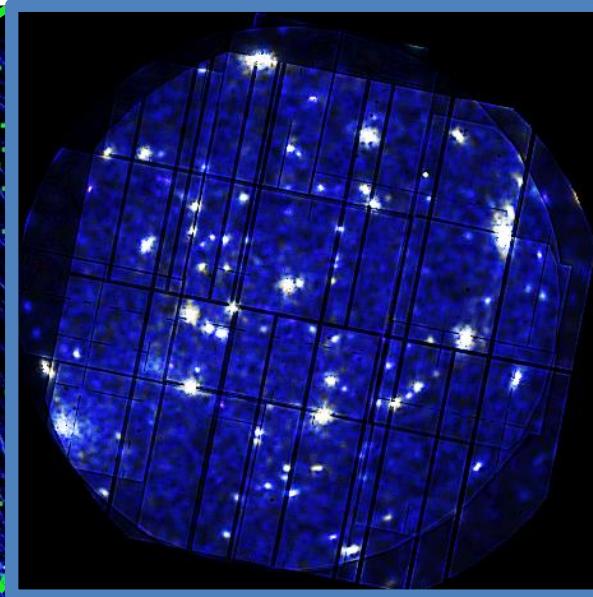


image by S.Rosen



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# The XMM-Newton/EPIC database

image by A. Read

## Slew obs.

68% sky (22% >1 epoch)  
7-10 s per epoch

## Slew obs. → XSS catalogue

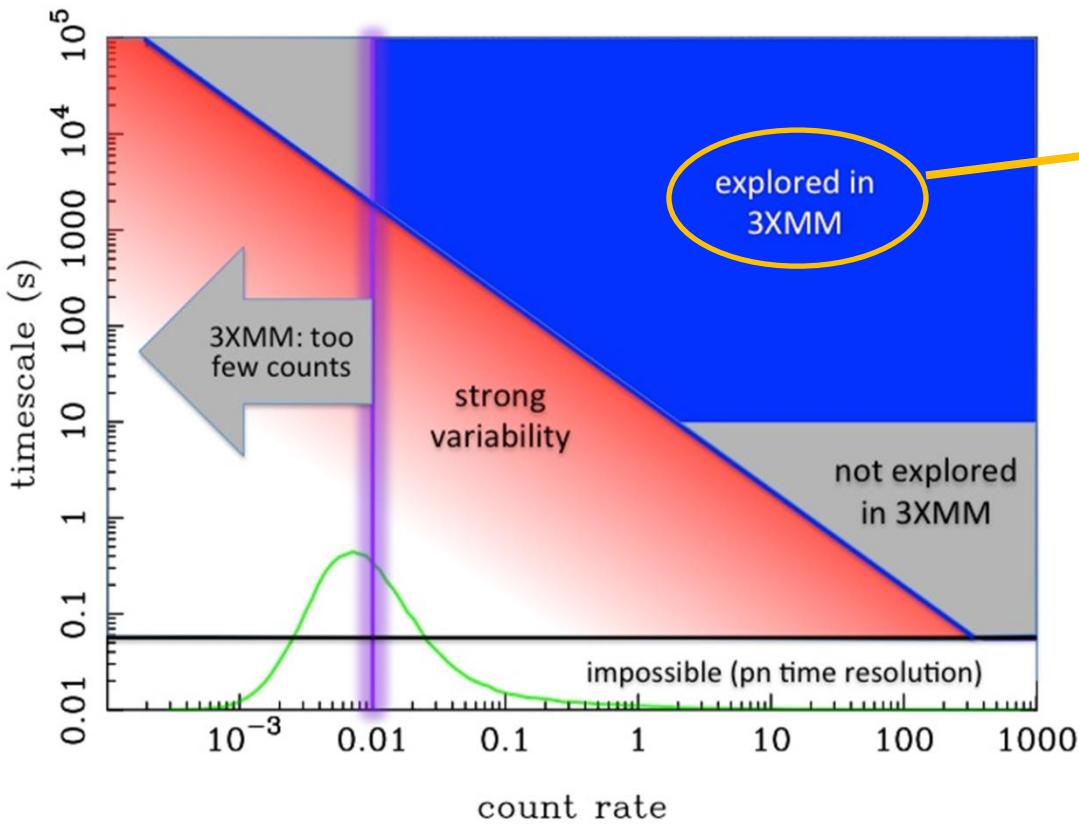
20163 sources (18400 unique)  
950 with >1 detection (up to 8)  
0.5-2 keV sensitivity  $6 \cdot 10^{-13}$  cgs  
2-10 keV sensitivity  $2 \cdot 10^{-12}$  cgs

image by S.Rosen



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# Exploring EPIC data – short-term variability



## Pointed obs.

LCs with uniform binning  
Basic variability test

EXTras will  
**explore and characterize**  
full parameter space

# Exploring EPIC data – short-term variability

## 1. Aperiodic variability

## 2. Periodicity

## 3. New (fast) transients

Systematic study of **all point sources**

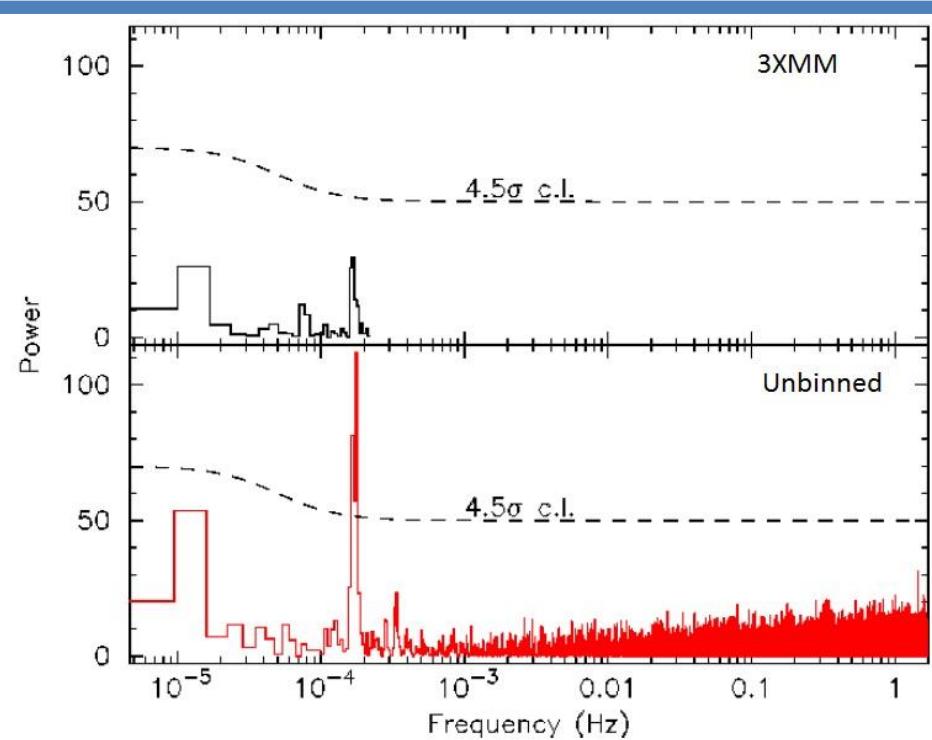
- **Light curves** (uniform/nonuniform bin); hardness ratios
- **FFT spectra**
- Set of **synthetic parameters**

# Exploring EPIC data – short-term variability

## 1. Aperiodic variability

## 2. Periodicity

## 3. New transients



Systematic study of  $\sim 300,000$  sources

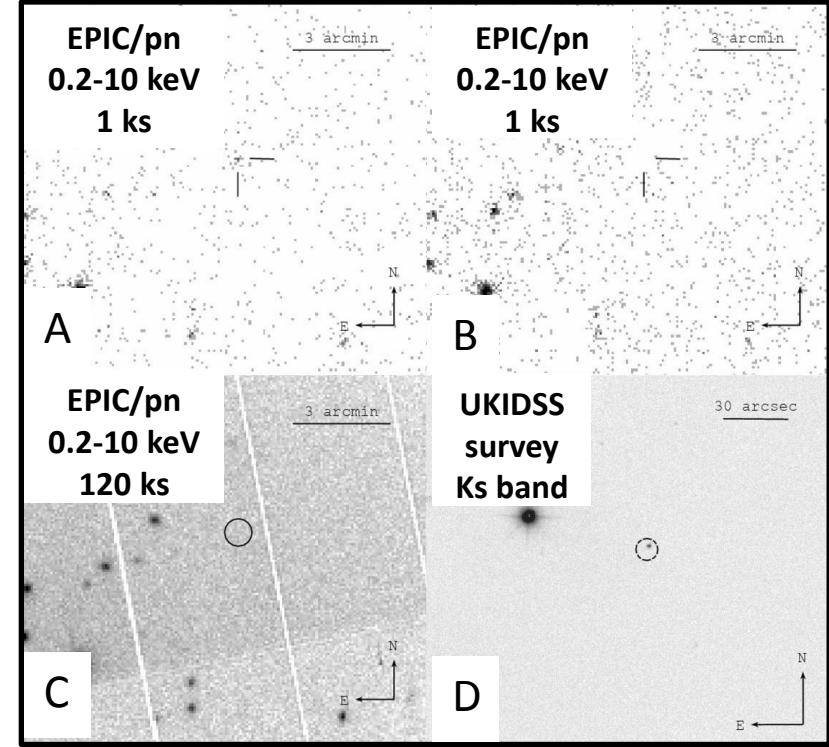
- **Unbinned** analysis
- Folded LCs, hardness ratios, U.L.

# Exploring EPIC data – short-term variability

## 1. Aperiodic variability

## 2. Periodicity

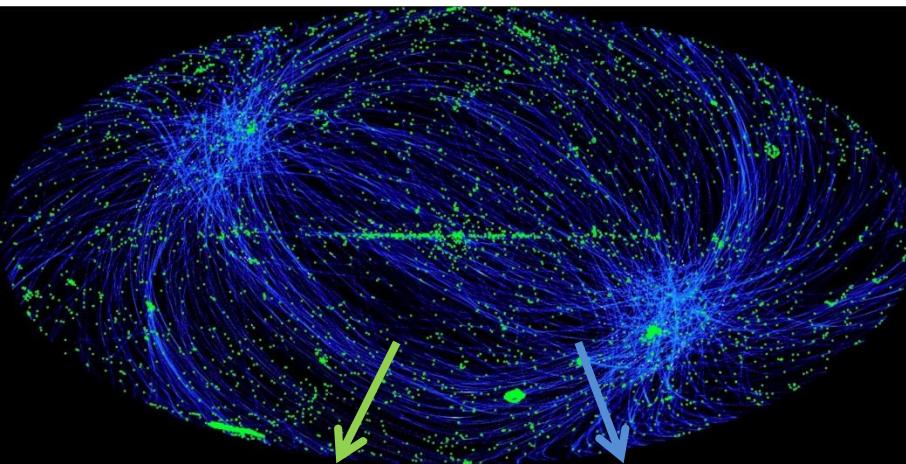
## 3. New transients



Missed by standard source detection

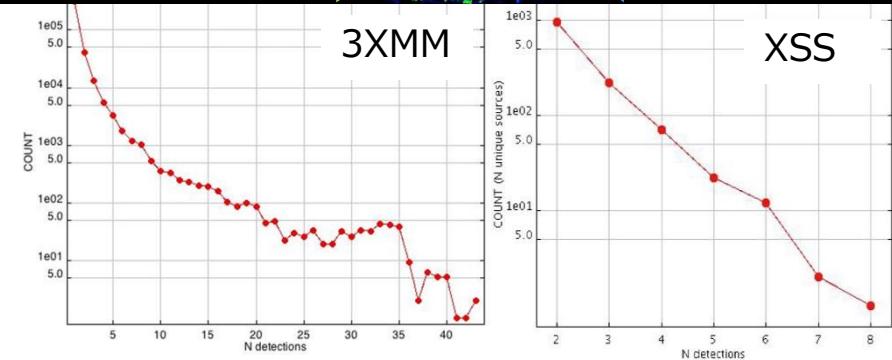
- Position
- Light curve
- Constraints on spectrum

# Exploring EPIC data – long-term variability



3XMM

XSS



Sources with multiple detections

Data span up to **12+ yr**

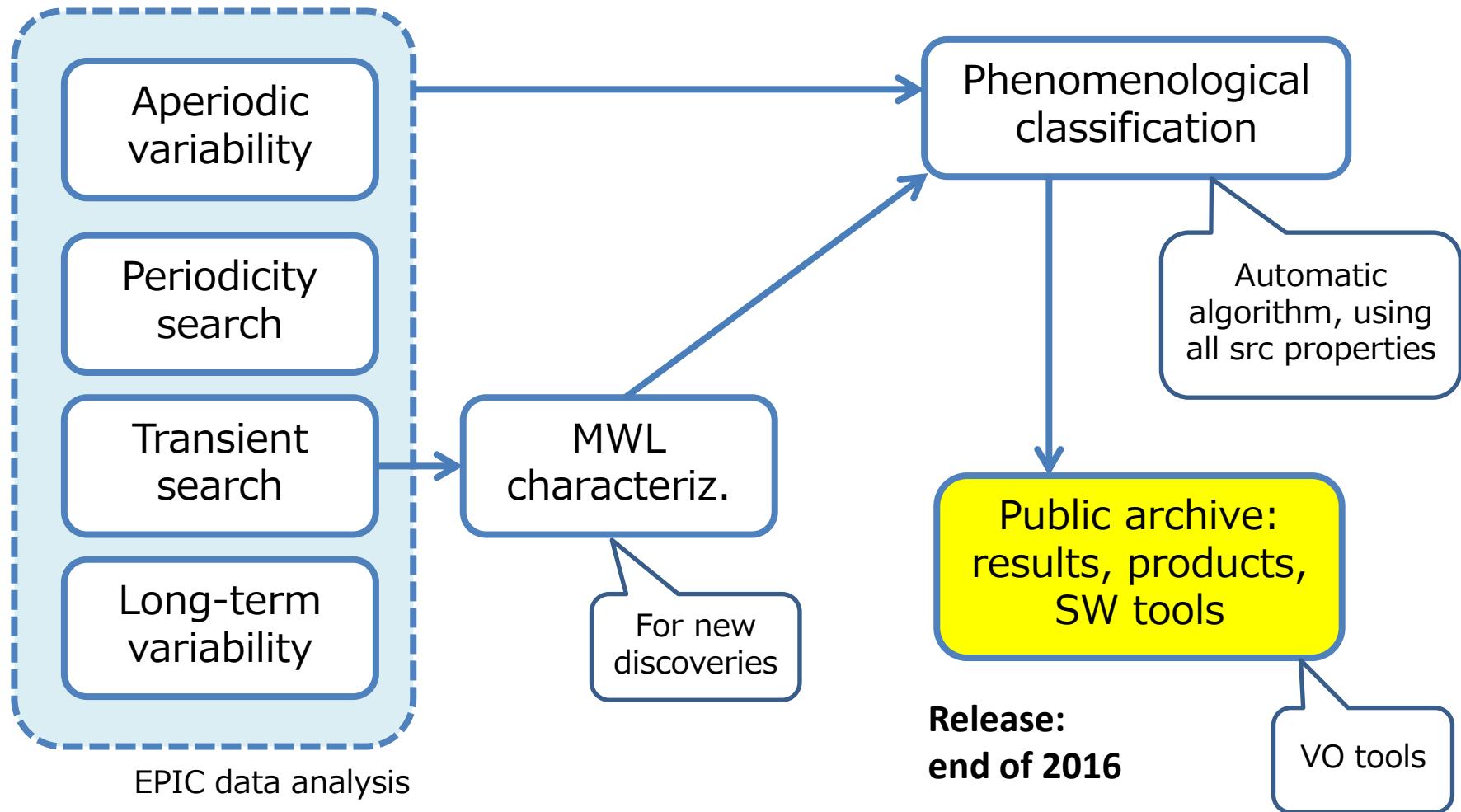
No systematic studies so far

## EXTras will fill the gap

- **Flux** measurements & **Upper limits** for all srcts. using all available data
- Production of **long-term LCs**
- Test & quantification of variability
- Characterization of variability

→ See poster M2 by S. Rosen

# EXTraS: the output

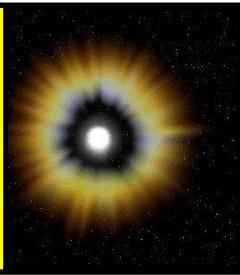


## Supernovae

X-ray burst from shock-wave  
(as SN 2008D and XRF060218)

EXTras expects ~10 events

→ measure of SN rate  
independent from optical data



**GRBs:** early afterglow  
of faint bursts

## Orphan GRBs?

→ ~0-20 GRBs

Possible to see the  
first orphan GRB?  
→ model constraints



## Tidal Disruption Events

X-ray: flares and  
flux decay

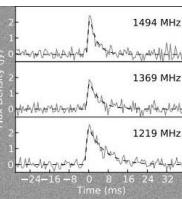
Variability time scale

↓  
Info on physics

Constrain TDE rates



# What science will you do with EXTras ?



## Fast Radio Bursts

~ms in radio  
X counterparts?

EXTras potential: ~ 100 FRBs!  
Very interesting discovery space



## Magnetars/ SGRs / XDINSs

Bursts and  
pulsations  
from >~40  
new objects



**Stellar Flares:** hundreds of  
bursts from a broad  
population of stars and  
prestars

Bursts and orbital  
modulations from Dwarf  
Novae and CVs.



Dwarf Nova

Flare  
star

## ULX

-Charact. variability, also for faint  
sources



-Blind search for spin  
and orbital periodicity

-Look for outbursts

## X-ray Binaries LMXB-bursters

HMXB-SFXT:  
Monitor for bursts and flares  
Search for periodicity and pulsations



# The EXTras contacts

Project Coordinator	A. De Luca	(INAF/IASF Milano)
For general information	A. De Luca R. Salvaterra D. D'Agostino A. Tiengo M. Watson F. Haberl J. Wilms	(INAF/IASF Milano) (INAF/IASF Milano) (CNR-IMATI Genova) (IUSS Pavia) (Leicester Univ.) (MPE) (ECAP)
Aperiodic variability	A. Belfiore	(INAF/IASF Milano)
Periodicity search	G. Israel	(INAF/OA Roma)
Transient search	A. Tiengo	(IUSS Pavia)
Long-term variability	S. Rosen	(Leicester Univ.)
Screening of results	F. Haberl	(MPE)
MWL & Classification	J. Wilms	(ECAP)
Archive management	D. Law-Green	(Leicester Univ.)
Outreach & education	S. Sandrelli	(INAF/OA Brera)

visit

**www.extras-fp7.eu**

(under construction)

Specific requests?  
Suggestions?

Want to collaborate?

Contact us!



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