Presenting a comprehensive library of SMC X-Ray Pulsars: A Public Resource for Scientific Analysis

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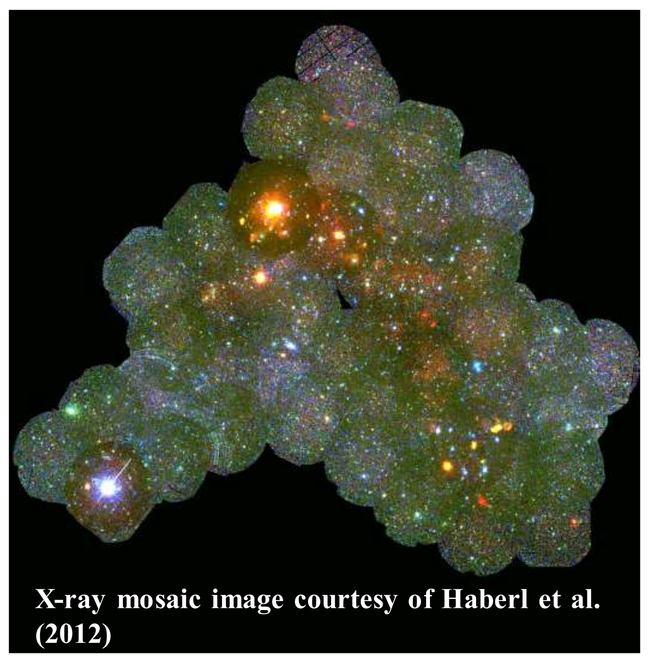
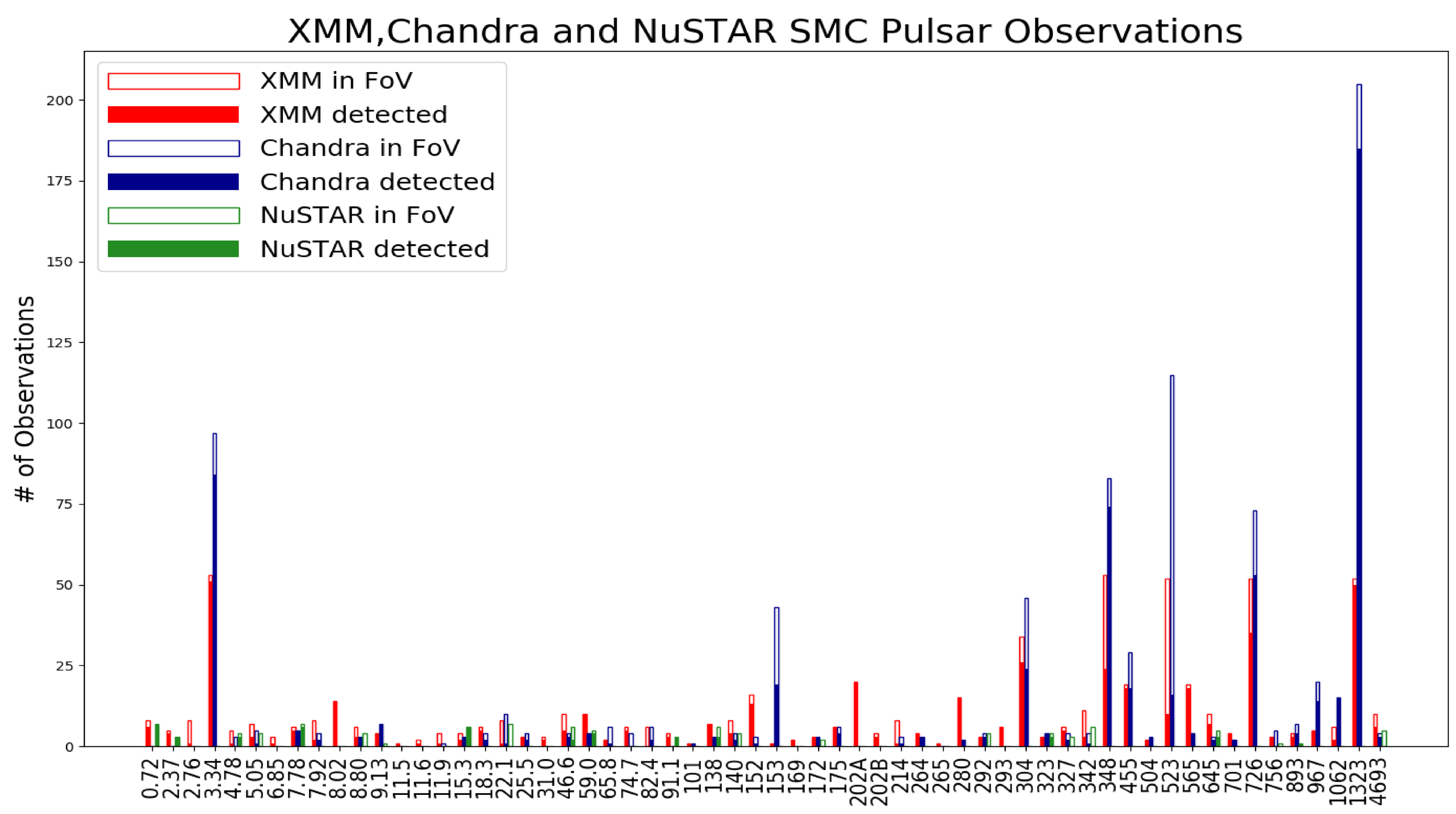
Introduction

The Small Magellanic Cloud (SMC) is an irregular dwarf galaxy and the second nearest star forming galaxy (62 kpc, **Scowcroft et al. 2016**) after the Large Magellanic Cloud. Some salient features of this galaxy are:


X-ray mosaic image courtesy of Haberl et al. (2012)

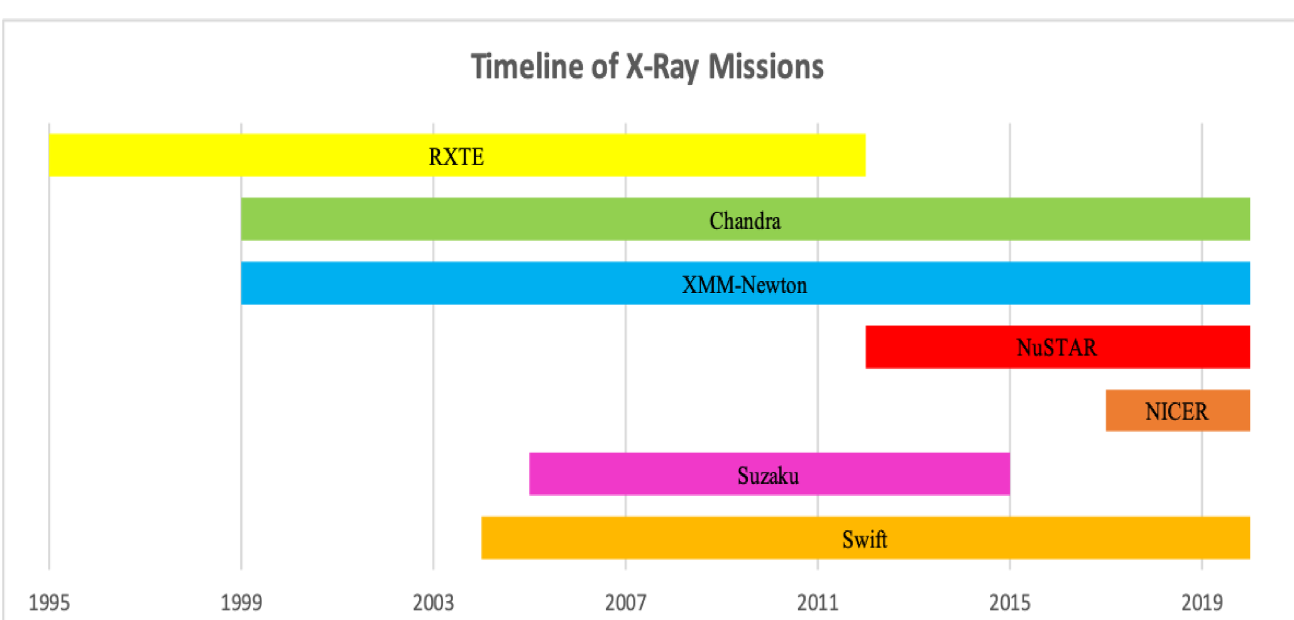
- It has low foreground absorption and extinction.
- It has a large population of High Mass X-ray Binaries (HMXBs) of which most are Be-XRBs, making it an interesting system to study these objects. **Here we present a comprehensive catalog of SMC X-Ray pulsars (Coe et al. 2015) since first light till date from the following missions: Chandra, XMM-Newton and NuSTAR.**

SXP Observations



The figure to the left depicts the number of times an SMC X-ray Pulsar (SXP) was in the field of view and the number of detections as a point source for three different telescopes: XMM-Newton (Red), Chandra (Blue) and NuSTAR (Green). The solid bars represent the number of detections while the outline bars show the number of times it was found in the FoV. The Horizontal axis denotes the SXP designation.

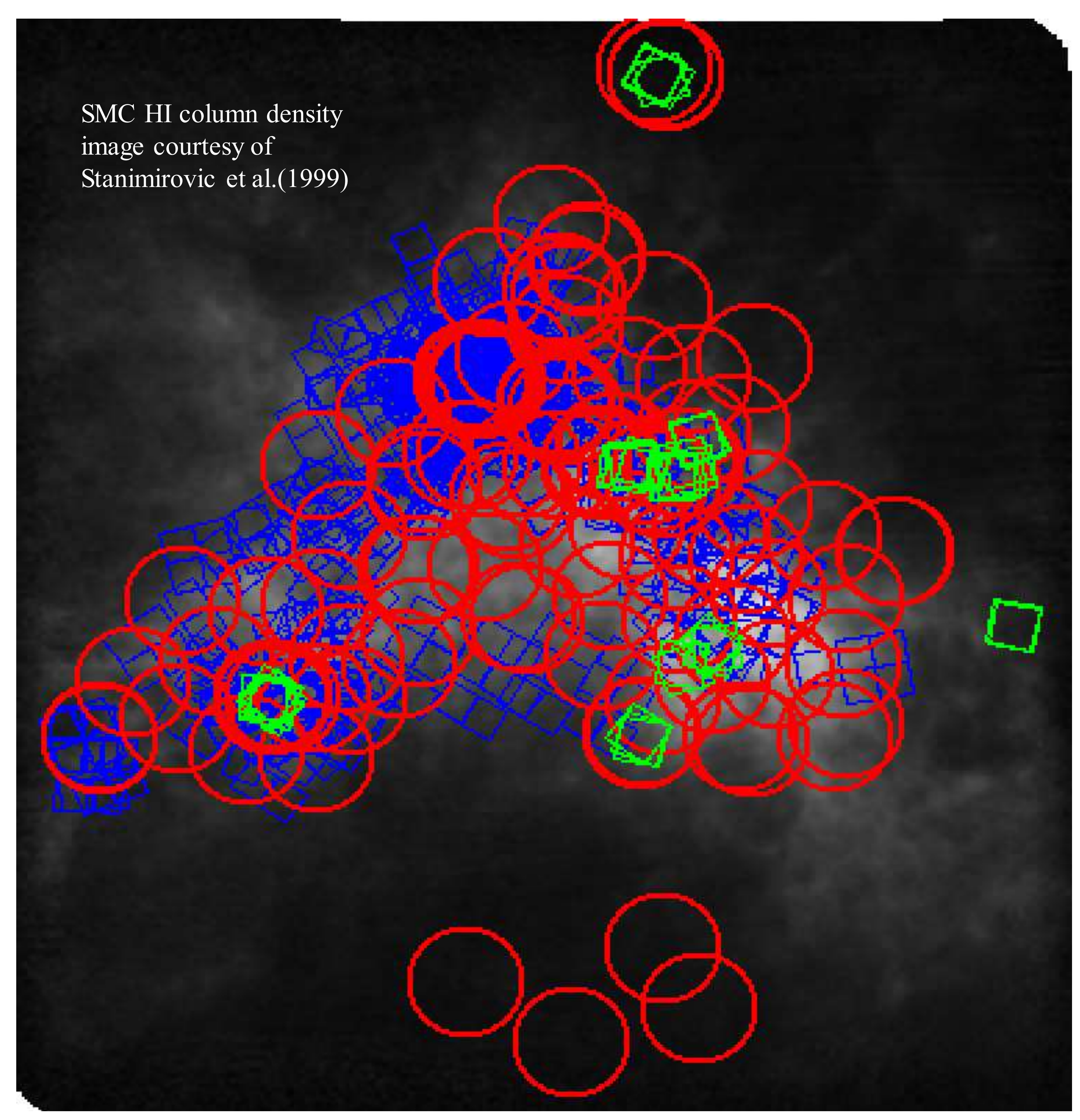
Archive Overview



The archive will contain data and high end scientific products for SMC X-Ray pulsars from seven different X-ray missions: RXTE, Chandra, XMM-Newton, NuSTAR , NICER, Suzaku and Swift.

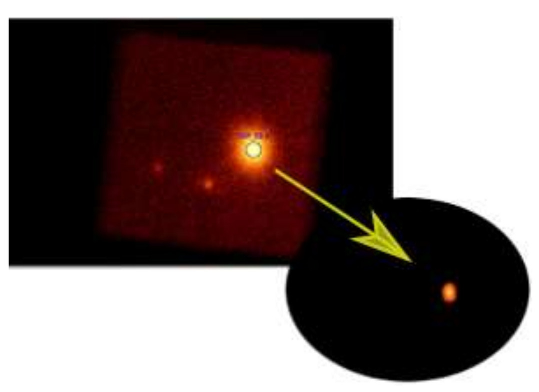
This observational library will provide a comprehensive view of the temporal, physical and statistical properties of these pulsars and will serve as a resource of processed data useful in modelling and probing the physics of accretion processes.

SMC Observations



The various Observations (Obs) from the three missions are mapped in this composite image of the SMC. The XMM obs (Red) have a radii of 900″. The Chandra obs boxes (Blue) are 8.3′ to a side. The NuSTAR obs boxes (Green) are 12′ to a side.

Conclusion



The figure to the left shows a source specific event file isolated and extracted from the observation event file.

- This archive will serve as a versatile resource containing high end scientific products for all pulsars in the SMC compiled from different X-Ray missions.
- With **source specific event files**, users can directly probe into the analysis for individual detected sources lying in the FoV.

Future plans

- A public release of this archive is planned soon.
- Data from other missions like NICER, Suzaku and Swift will also be incorporated into the library.
- Constant monitoring of the archive and new pulsars will be updated as and when they are discovered.

Detection Methods

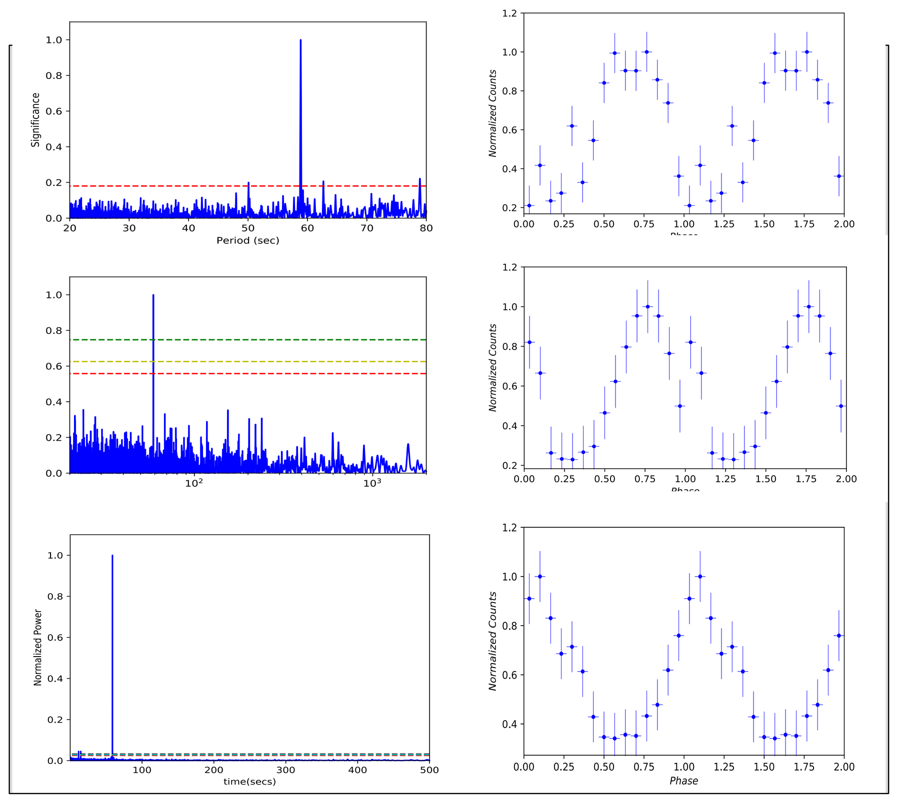
The pulsars were detected for the three missions; Chandra, XMM-Newton and NuSTAR in the following ways:

- **Chandra**: Unique sources were identified for each Chandra observation by running Ciao wavedetect with a threshold significance of 10^{-6} at wavelet scales of 1, 2, 4, 8, and 16 pixels.
- **XMM-Newton**: The point sources in the catalog were matched with the XMM-Newton Epic Summary source list obtained from the XSA within 3σ of the positional offset.
- **NuSTAR:** Bright sources were identified from images of each observation. But due to lack of any unique source detection package (i.e *wavedetect* etc.) , products were created for all known sources in FOV.

Products

The archive will contain data products like: light-curves, periodograms, pulse profiles, **source specific event files**, spin periods and spectra.

For every detected source a background-subtracted light-curve was extracted at fine time resolution and a power-spectrum was constructed using the Lomb-Scargle technique to search for significant pulsations.



From top to bottom: Periodogram and pulse profile for SXP 59.0 from XMM-Newton, Chandra and NuSTAR respectively. Products like these are created for all pulsars in the library.

Acknowledgements

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