



Identification of Candidate Be/X-Ray Binaries in the SMC using Archival Swift Data

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BeXRB 2024– 7/31/24

S-CUBED: The Swift SMC Survey

- Designed to discover and monitor BeXRBs:
 - Weekly observing cadence
 - 142 observed tiles
 - ~60s exposures
 - Utilizes both UVOT and XRT
- 1900+ X-ray sources detected to date
- Several new BeXRBs found

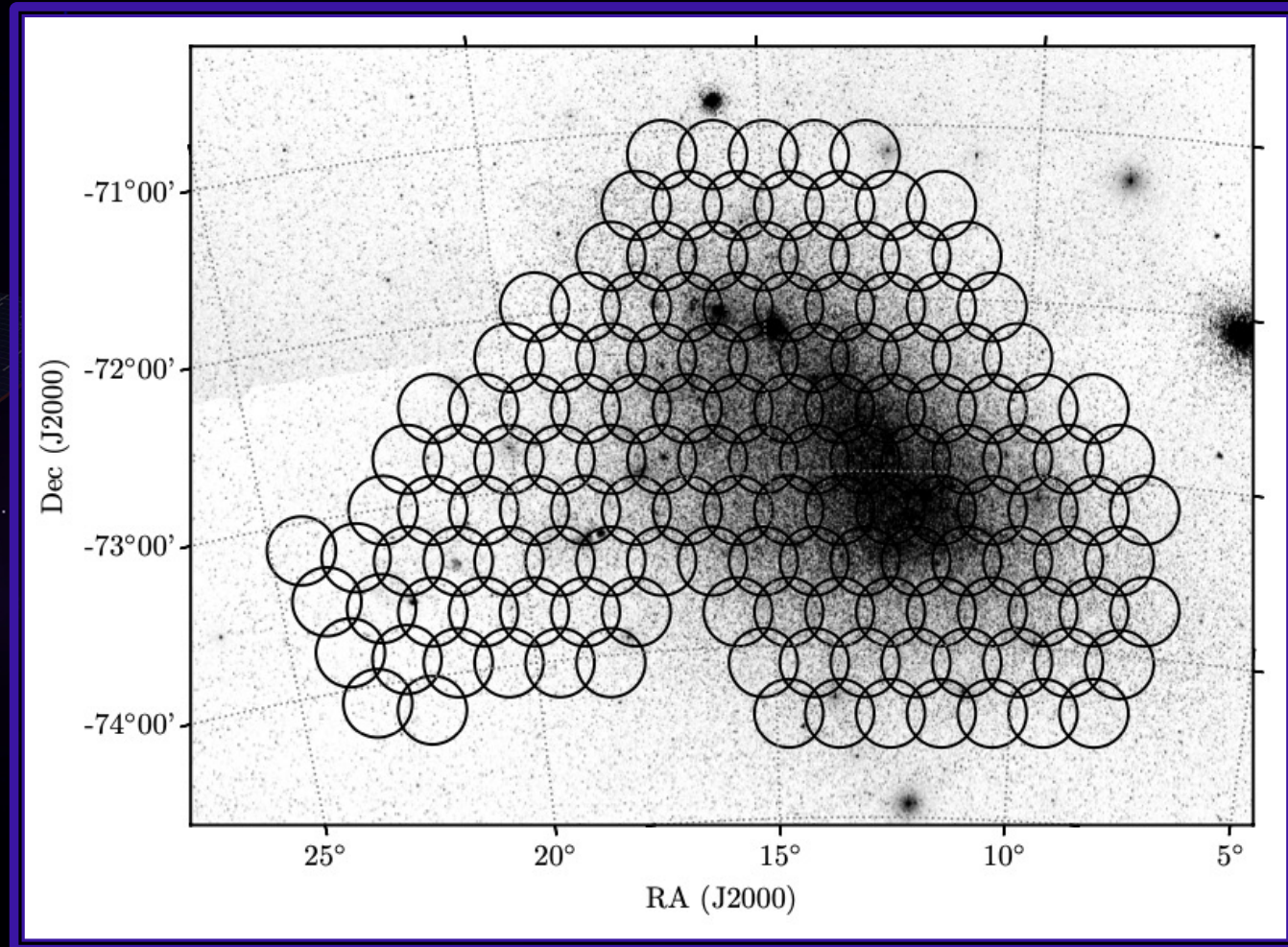


Image Credit: Kennea et al. 2018

The Search for Quiescent BeXRBs

BeXRBs are primarily identified via X-ray outbursts and emission line spectroscopy

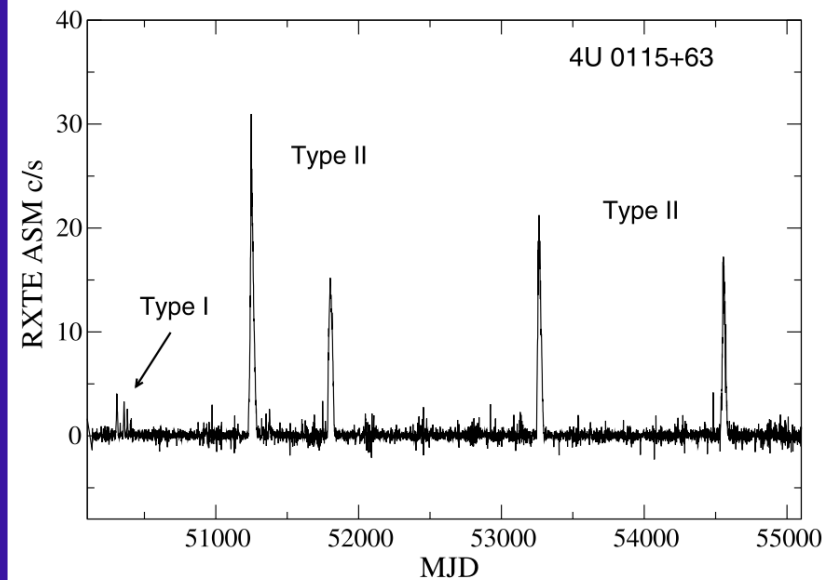


Image Credit: Reig 2011

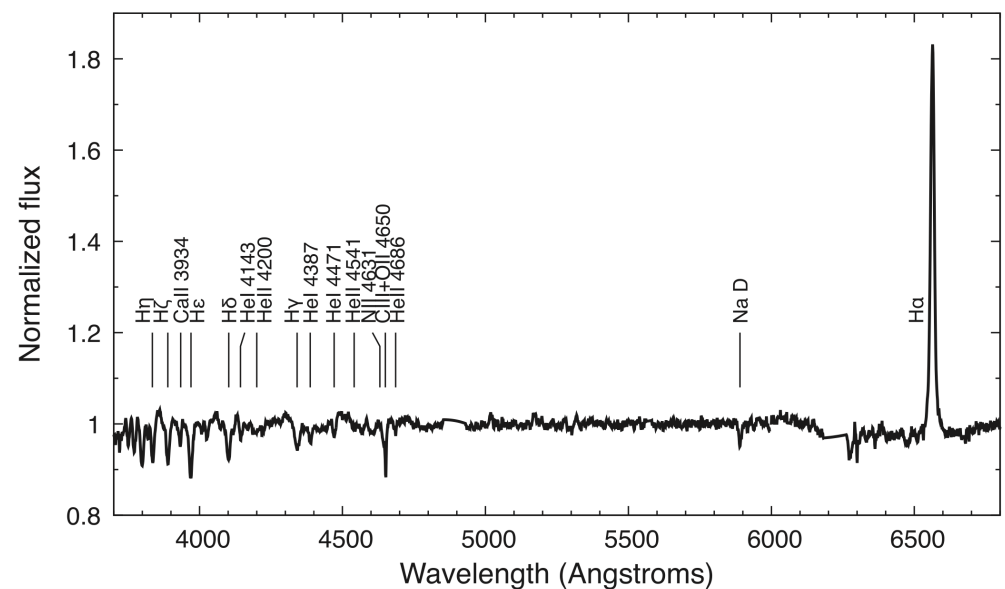
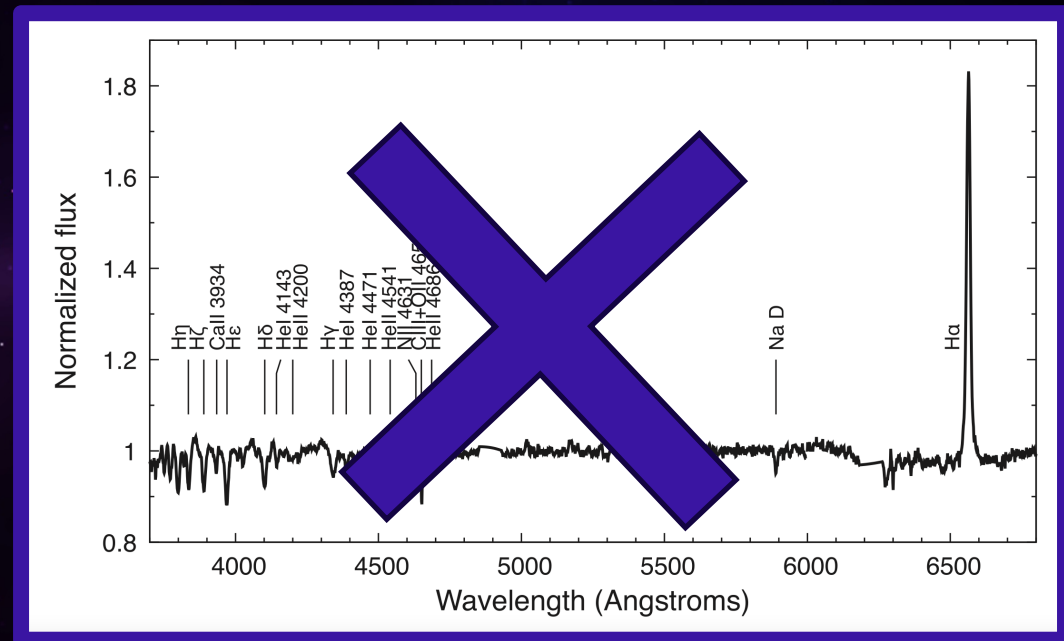
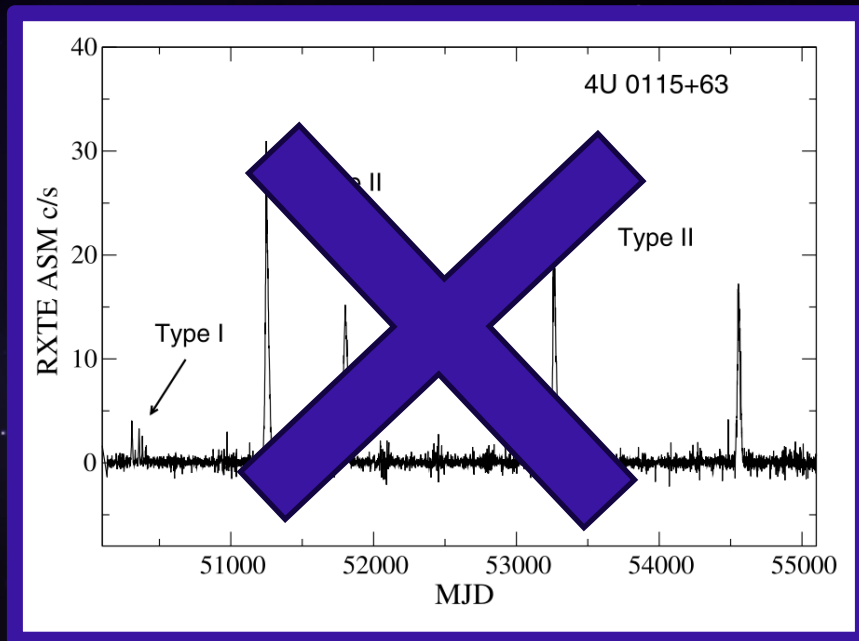


Image Credit: Coe et al. 2023

The Search for Quiescent BeXRBs

BeXRBs are primarily identified via X-ray outbursts and emission line spectroscopy



The background is a deep blue space scene. It features several large, glowing spiral galaxies in shades of blue and purple. Scattered throughout are numerous stars, some appearing as bright orange or yellow points, while others are smaller blue or white specks. A faint, diagonal streak of light, possibly a comet or a distant galaxy, is visible in the lower right quadrant.

Archival Analysis Method

Candidate Identification

- Sources were filtered based on their X-ray properties in the **S-CUBED Database**:
 - Remove all sources not flagged as “Good”
 - Remove all sources with a soft photon index ($\Gamma > 1.5$)
 - Keep all sources with no spectral fit

Candidate Identification

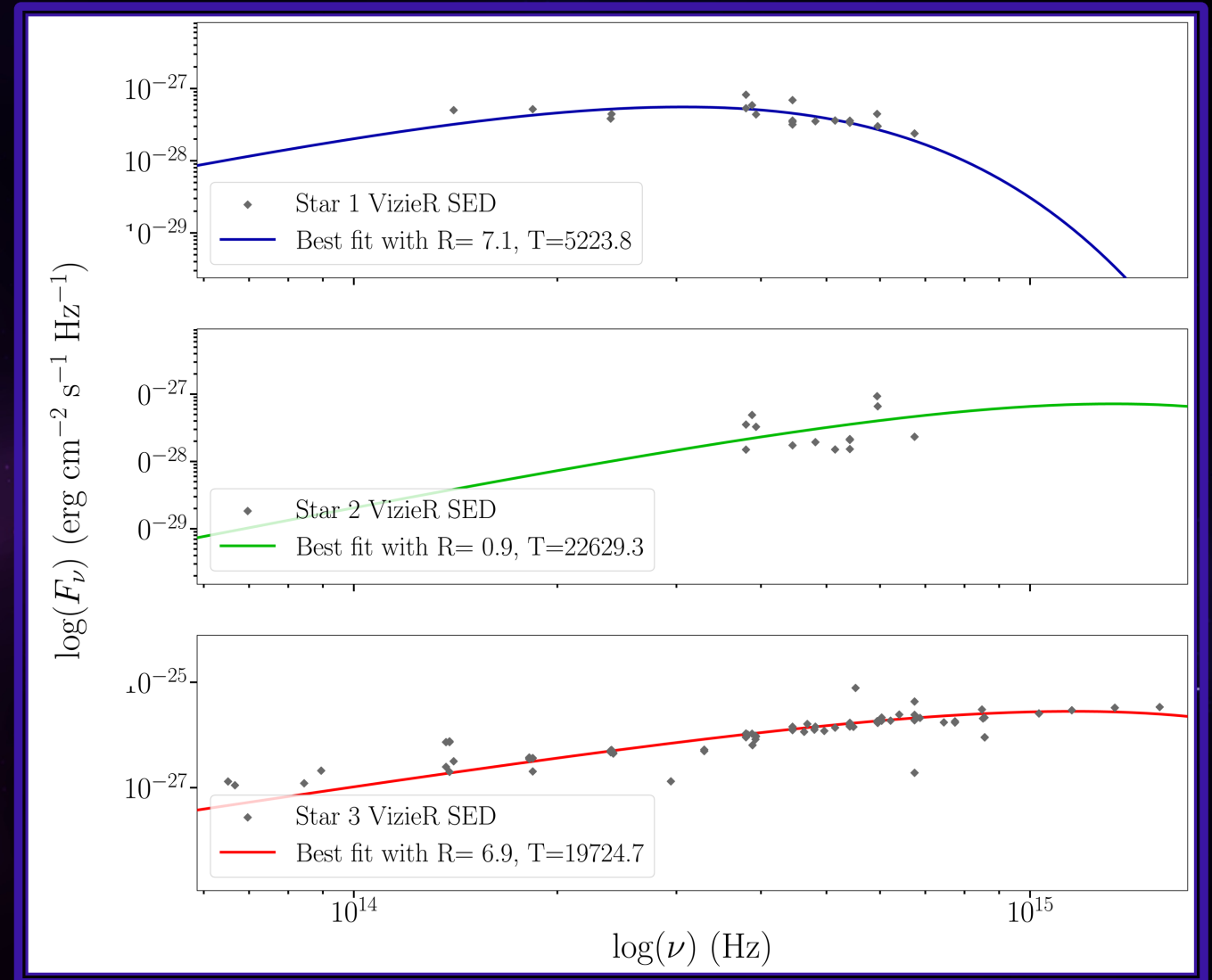
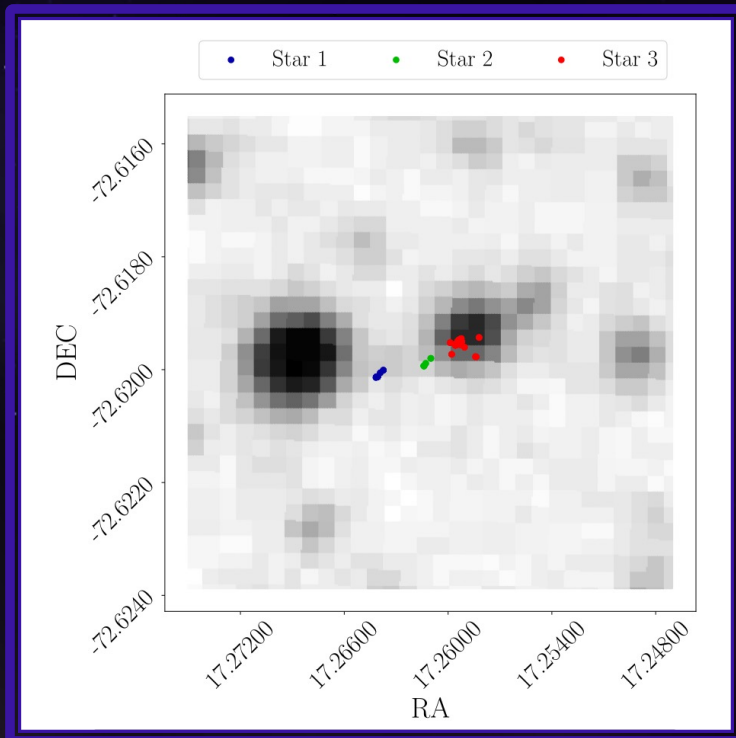
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- Removed sources with known X-ray emitters nearby using **SIMBAD**:
 - Known/Candidate HMXBs, Active Galactic Nuclei, Young Stellar Objects, Supernova remnants

Candidate Identification

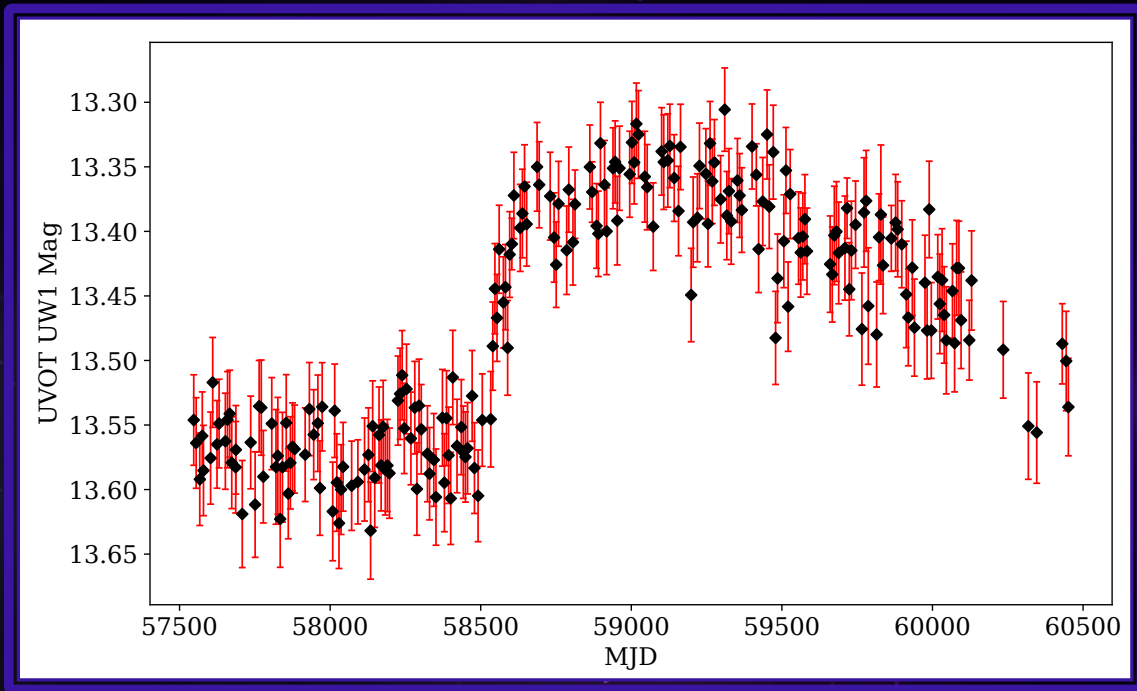
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- Removed sources with known X-ray emitters nearby using **SIMBAD**:
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- Searched for bright stars ($11.0 < B < 17.0$) nearby using **VizieR**

Determining Stellar Parameters: Curve Fitting

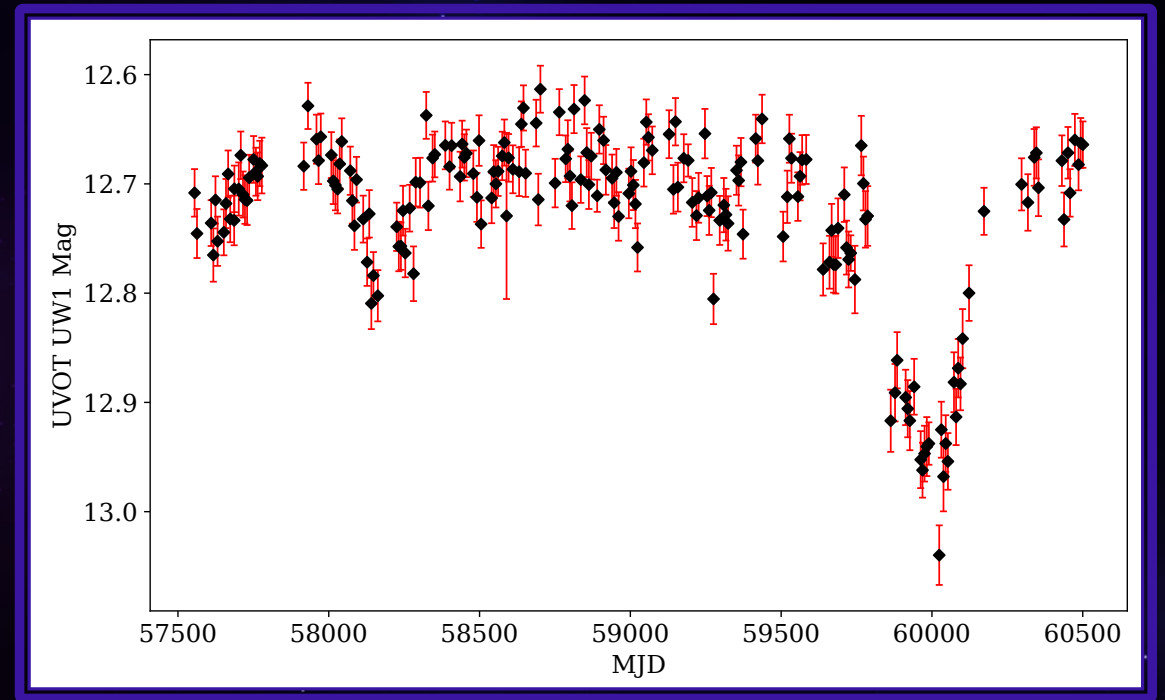
$$F(\nu, R, T) = \pi \left(\frac{R_*}{D} \right)^2 \left(\frac{2 h \nu^3}{c^2} \right) \left(\frac{1}{e^{\frac{h \nu}{k T}} - 1} \right)$$



Ultraviolet Variability



SXP 146.6



SMC X-2

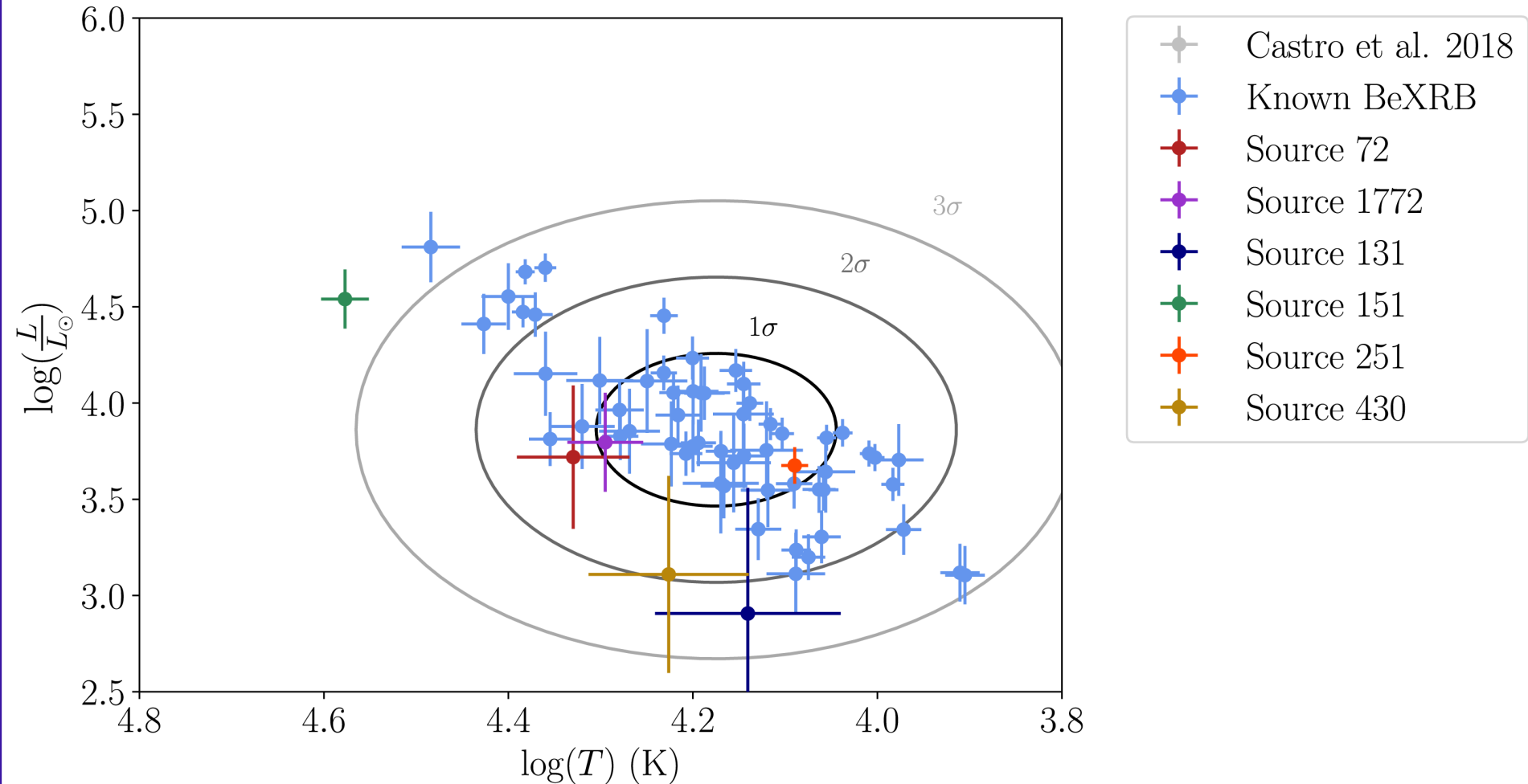
Candidate Sources

The background of the slide is a deep space image. It features a dark blue to black gradient. Scattered throughout are numerous small, bright stars in white and blue. Two large, prominent spiral galaxies are visible, one in the upper right and one in the lower right, both appearing as glowing blue and white structures. A thin, diagonal streak of light, possibly a comet or a distant galaxy, is visible in the lower right quadrant.

Companion Stellar Parameters

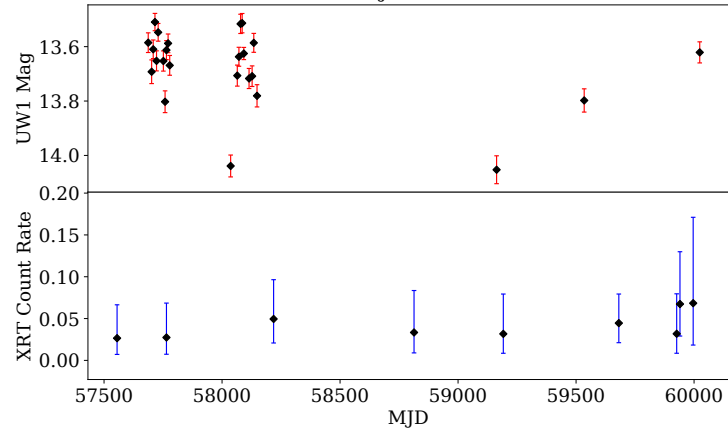
SC#	Source ID	Temperature (K)	Radius (R_{\odot})
72	1SCUBEDX J005606.0-722749	22500 ± 2700	5.1 ± 0.66
131	1SCUBEDX J010203.7-715130	13800 ± 2900	5.0 ± 1.3
151	1SCUBEDX J011535.0-731931	37800 ± 2200	4.42 ± 0.25
251	1SCUBEDX J003802.8-734458	12300 ± 400	15.4 ± 0.6
430	1SCUBEDX J005708.8-724202	16800 ± 3400	4.3 ± 1.0
1772	Swift J010902.6-723710	19700 ± 1800	6.9 ± 0.68

Companion Stellar Parameters

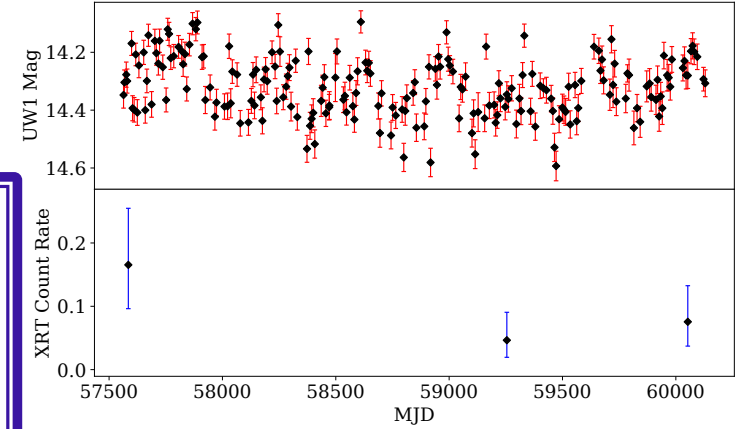


UV Light Curves

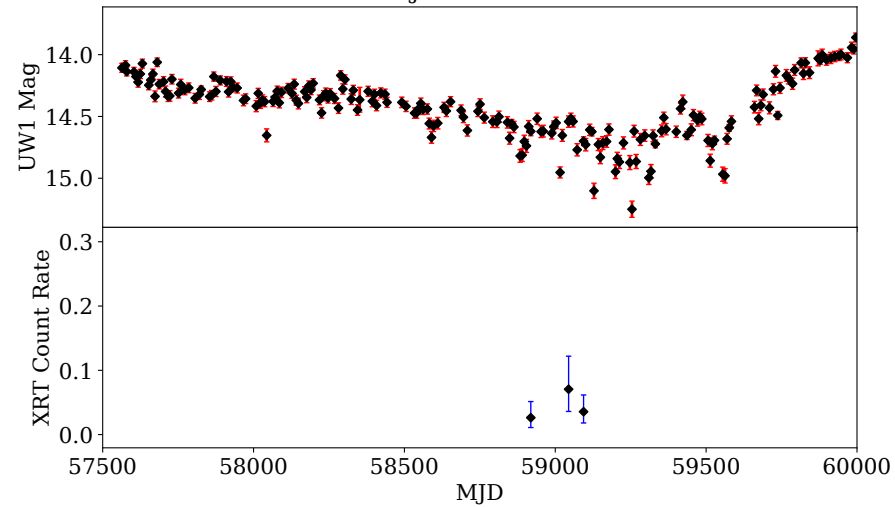
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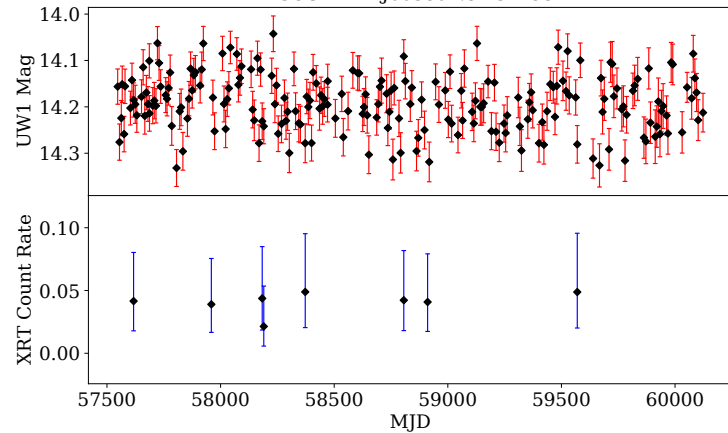
1SCUBEDX J005606.0-722749



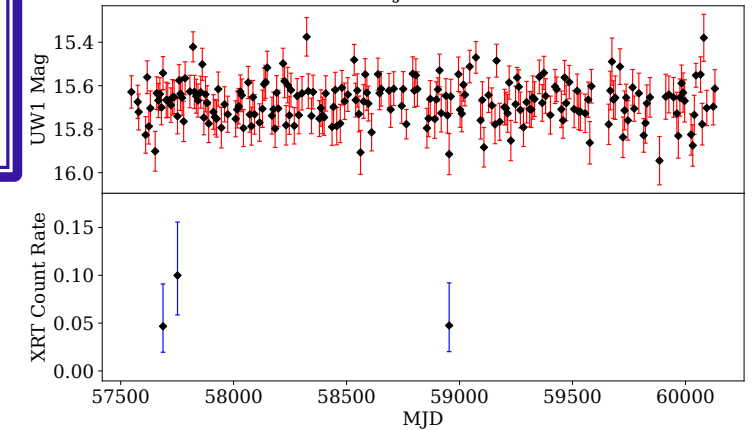
Swift J010902.6-723710



1SCUBEDX J003802.8-734458

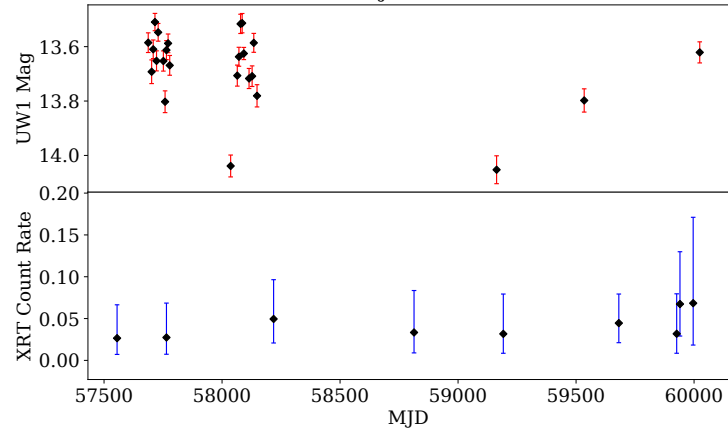


1SCUBEDX J005708.8-724202

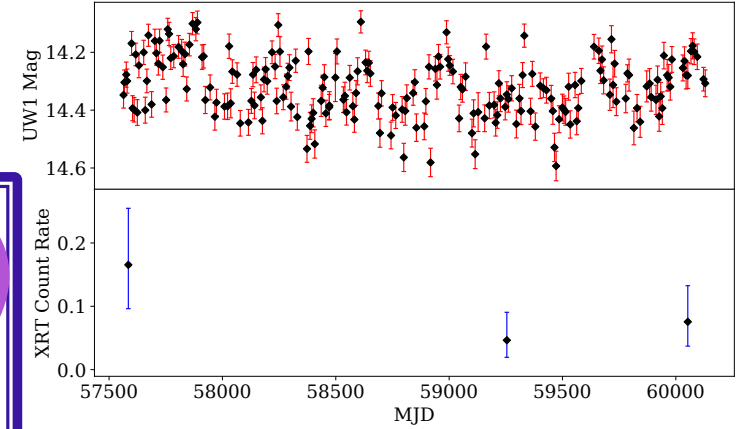


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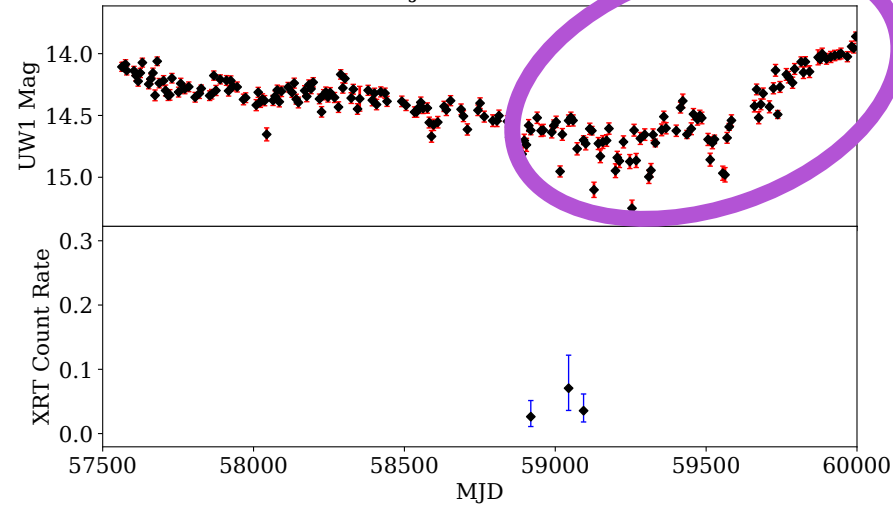
1SCUBEDX J011535.0-731931



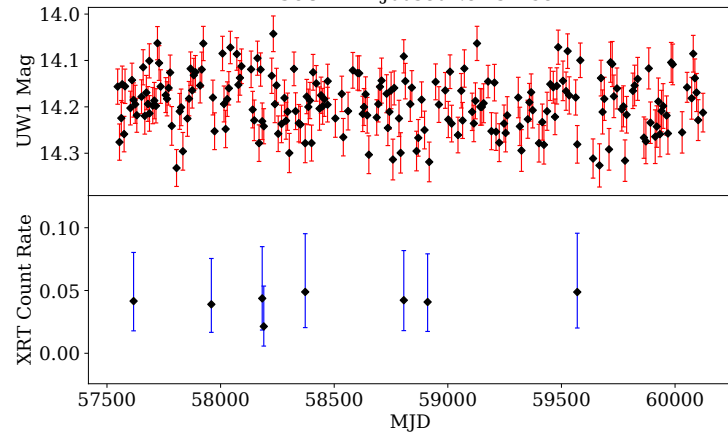
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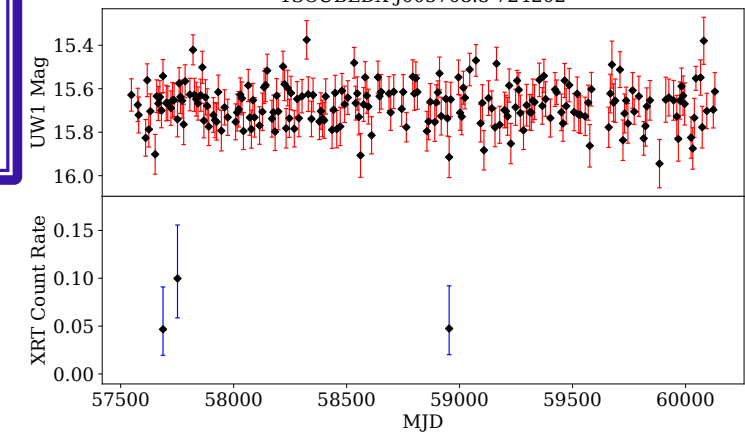
Swift J010902.6-723710



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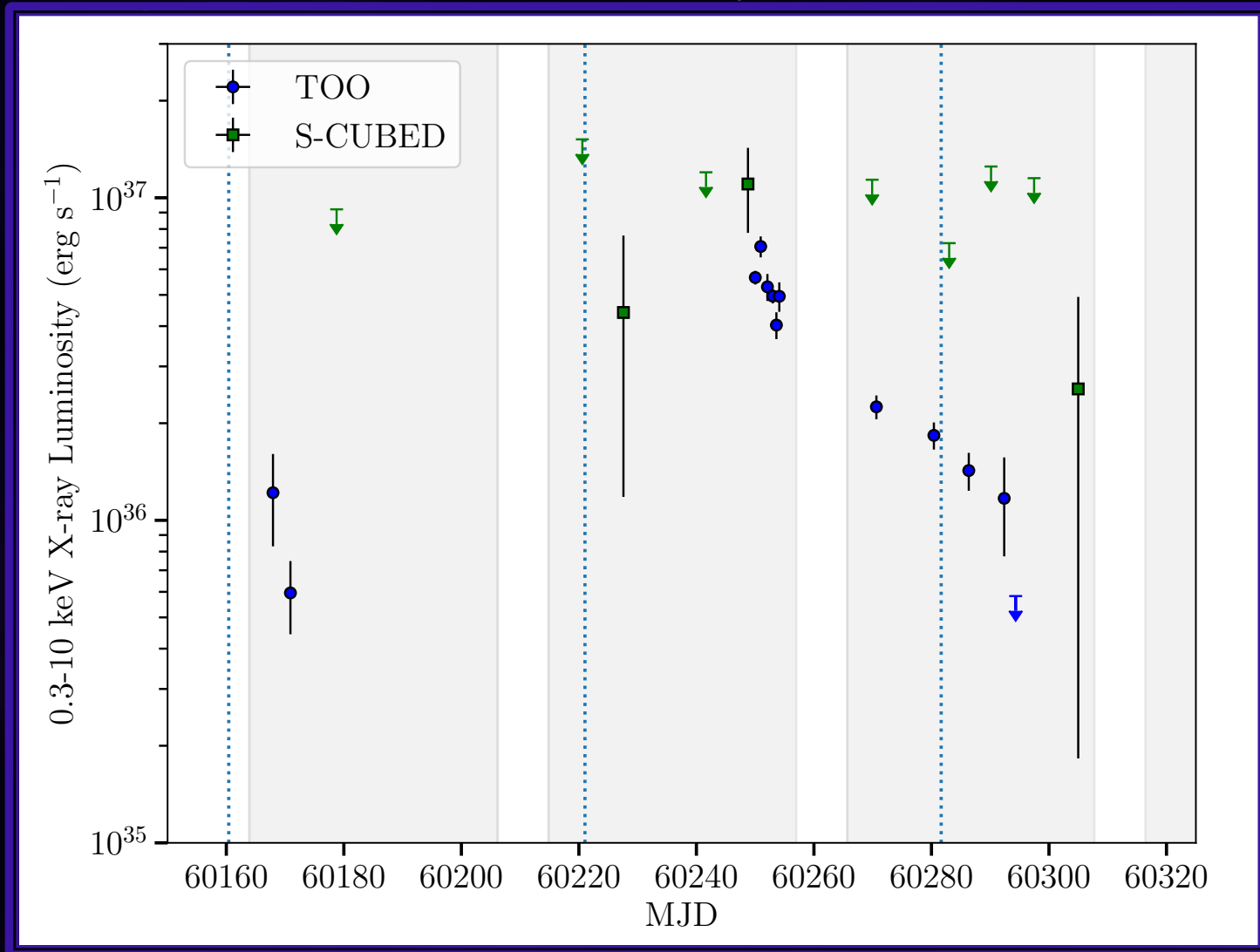
1SCUBEDX J005708.8-724202



The background of the image is a deep blue space filled with numerous stars of varying colors (white, blue, orange). Two large, glowing blue nebulae or galaxies are visible, one in the upper right and one in the lower right. A faint, diagonal streak of light, possibly a comet or a distant galaxy, is visible in the lower right quadrant.

The Outburst of Swift J010902.6-723710

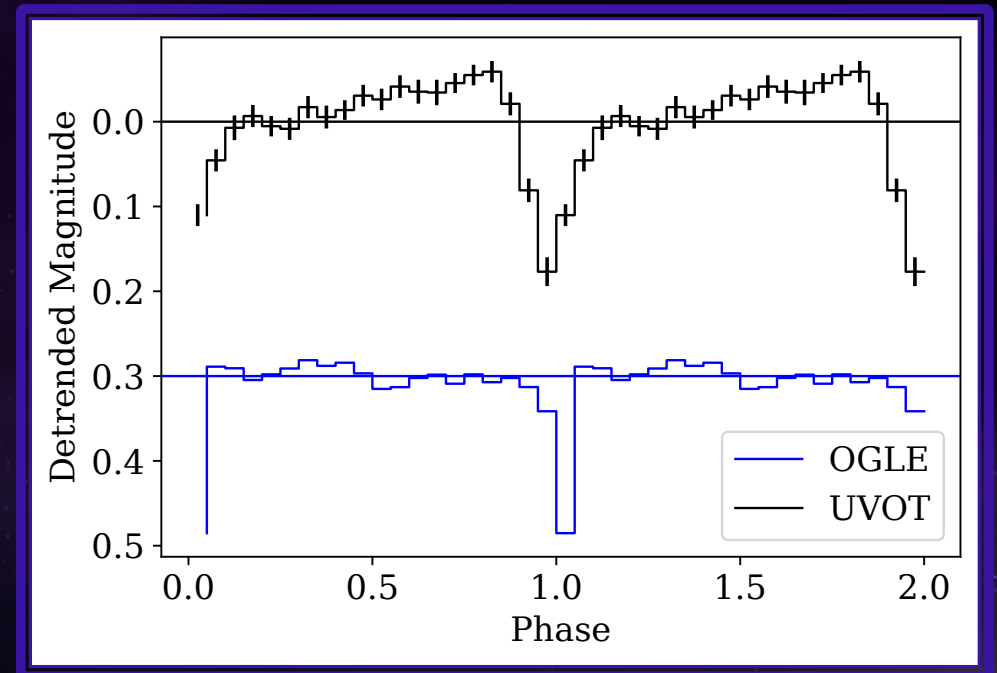
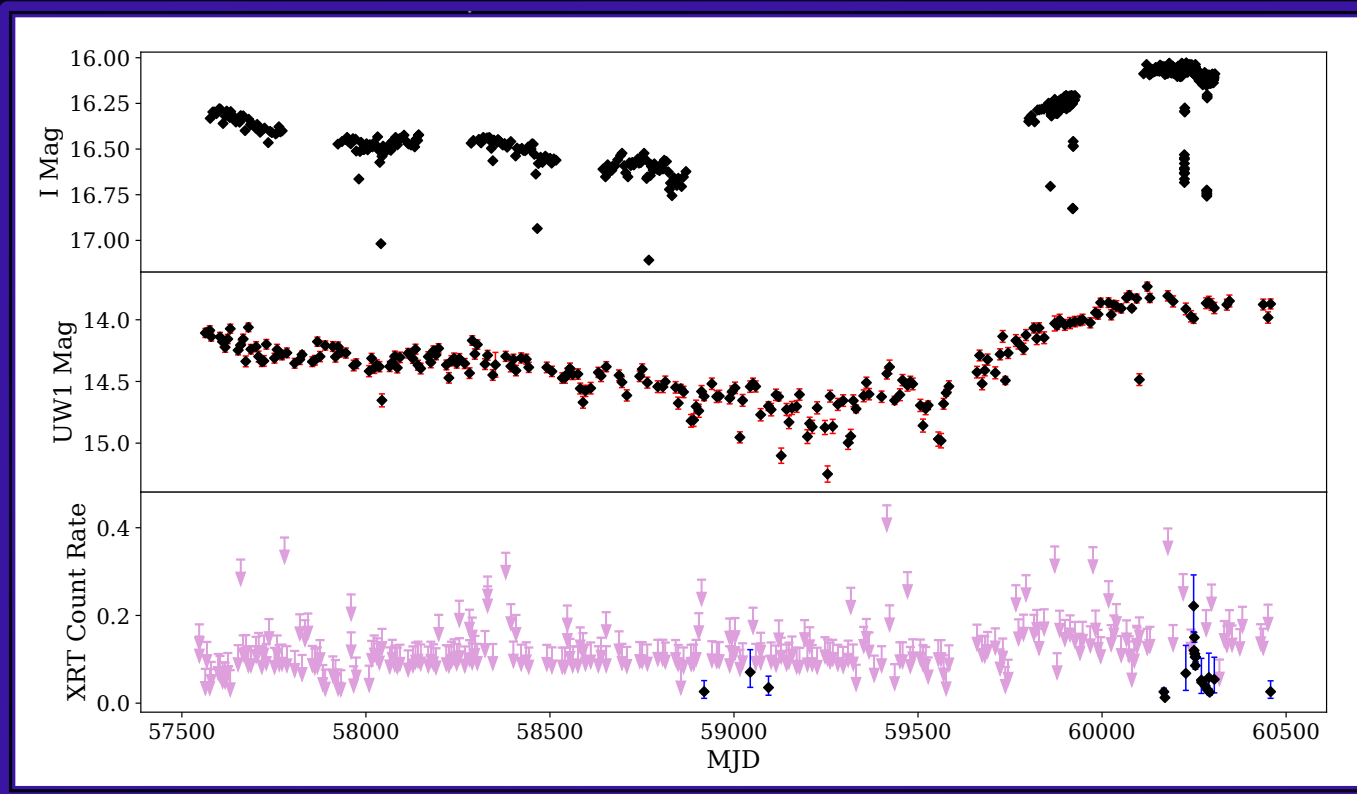
X-Ray Light Curve



Pulsar Spin Period: 182s
Decay time: ~77 Days

A Rare Eclipsing BeXRB

Orbital Period: 60.623 days
Size of Eclipsing Body: $3.3 R_{\odot}$



Conclusions

- We establish a new method for the detection of Be/X-ray Binaries using a combination of Swift SMC Survey data and Archival IR-UV data
 - Relies on UV variability and SED-fitting of blackbody curves to SMC stars
- We argue for the detection of 6 new candidate Be/X-ray Binaries using this new method
- We present the confirmation of one of these systems via X-ray outburst
 - SXP 182 becomes the 3rd confirmed eclipsing BeXRB

Paper on the newly discovered SXP 182 is now on ApjL!