Forensic Team:

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X-ray binary drawing

- Jet
- Accretion disc
- Disc wind
- X-ray heating
- Hot spot
- Accretion stream
- Companion star
### The Population of Low-Mass X-ray Binaries in the Galaxy

<table>
<thead>
<tr>
<th>Primary</th>
<th>Type</th>
<th>Number</th>
<th>Fraction</th>
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<tbody>
<tr>
<td>Neutron Star</td>
<td>Persistent</td>
<td>46</td>
<td>28%</td>
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<tr>
<td>Neutron Star</td>
<td>Transient</td>
<td>39</td>
<td>23%</td>
</tr>
<tr>
<td>Confirmed BH</td>
<td>Persistent</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Confirmed BH</td>
<td>Transient</td>
<td>16</td>
<td>9%</td>
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<tr>
<td>BH Candidate</td>
<td>Persistent</td>
<td>2</td>
<td>1%</td>
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<tr>
<td>BH Candidate</td>
<td>Transient</td>
<td>30</td>
<td>18%</td>
</tr>
<tr>
<td>Unidentified</td>
<td>Persistent</td>
<td>7</td>
<td>4%</td>
</tr>
<tr>
<td>Unidentified</td>
<td>Transient</td>
<td>3</td>
<td>2%</td>
</tr>
<tr>
<td>Little Information</td>
<td>Persistent</td>
<td>17</td>
<td>11%</td>
</tr>
<tr>
<td>Little Information</td>
<td>Transient</td>
<td>7</td>
<td>4%</td>
</tr>
</tbody>
</table>

Total transients: 95
X-ray transients: Discovery.

IGR J17497-2821: a new hard X-ray transient detected by INTEGRAL.

Subjects: X-ray, Gamma Ray, Transient
X-ray transients:

Black Hole
XTE J1118+480
During quiescence, the absorption lines of the companion star are visible and dynamical constraints on the mass of both stars can be determined.

Radial Velocity Curve fit:

\[ V = \gamma + K_z \sin \left( \frac{2\pi}{P_{\text{orb}}} (t - T_0) \right) \]

Mass function:

\[ f(M) = \frac{K_z^3 P_{\text{orb}}}{2\pi G} = \frac{M_1 \sin^3 i}{(1 + q)^2}, q = \frac{M_2}{M_1} \]
The GBS goals:

• Find (eclipsing) low-mass X-ray binaries in quiescence.
  
  Model independent mass measurements black-hole formation and neutron star Equation of State.

• Constraining common envelope evolution via number counts.
  
  Cataclysmic variables and ultra-compact low-mass X-ray binaries.

• Spatial distribution of LMXBs in the Bulge.
  
  Galactic Structure and formation.
The GBS area:

Extinction map i-band
The GBS predictions and strategy:

Predicted number of non-magnetic CVs, intermediate polars and quiescent LMXBs in the GBS area in function of source X-ray flux.

Survey upper limit: $(1-3)e^{-14}$ erg/s/cm$^2$
More GBS predictions:

<table>
<thead>
<tr>
<th></th>
<th>(I)</th>
<th>(II)</th>
<th>(III)</th>
<th>(IV)</th>
<th>(V)</th>
<th>(VI)</th>
<th>(VII)</th>
<th>(VIII)</th>
<th>(IX)</th>
<th>(X)</th>
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<tr>
<td>LMXB</td>
<td>$10^{35}$</td>
<td>Hard</td>
<td>0</td>
<td>0</td>
<td>140</td>
<td>6</td>
<td>7</td>
<td>7</td>
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<tr>
<td>qLMXB</td>
<td>$10^{33}$</td>
<td>BB</td>
<td>5</td>
<td>2</td>
<td>10000</td>
<td>120</td>
<td>86</td>
<td>221</td>
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<td>UCXB</td>
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<td>4</td>
<td>0</td>
<td>1000</td>
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<td>3</td>
<td>56</td>
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<td>qUCXB</td>
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<td>Hard</td>
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<td>10000</td>
<td>1</td>
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<td>605</td>
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<td>CV (non mag.)</td>
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<td>Brems</td>
<td>7.5</td>
<td>0</td>
<td>$2 \times 10^{-5}$</td>
<td>62</td>
<td>61</td>
<td>62</td>
<td>$1.4 \times 10^6$</td>
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<tr>
<td>CV (IP)</td>
<td>$10^{32}$</td>
<td>Brems</td>
<td>8.5</td>
<td>0</td>
<td>$1.5 \times 10^{-6}$</td>
<td>152</td>
<td>5</td>
<td>525</td>
<td>$7.7 \times 10^4$</td>
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<tr>
<td>RS CVn</td>
<td>$10^{31}$</td>
<td>Hard</td>
<td>2.5</td>
<td>1</td>
<td>$1 \times 10^{-4}$</td>
<td>596</td>
<td>596</td>
<td>596</td>
<td>$1.3 \times 10^6$</td>
<td></td>
</tr>
<tr>
<td>W UMa</td>
<td>$5 \times 10^{30}$</td>
<td>Hard</td>
<td>4.5</td>
<td>2</td>
<td>$7.5 \times 10^{-5}$</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>$2.3 \times 10^6$</td>
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<tr>
<td>Be X-ray binaries</td>
<td>$10^{34}$</td>
<td>Hard</td>
<td>0</td>
<td>0</td>
<td>500</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>10</td>
<td></td>
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<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>1142</td>
<td>1648</td>
<td></td>
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</tbody>
</table>
A multi-wavelength project!

- X-ray survey sensitive to faint sources and excellent position accuracy.

Complete in 2012. 1640 X-ray sources
A multi-wavelength project!

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  Complete in 2012. 1640 X-ray sources.

- Optical (Blanco) and infrared (VVV) PHOTOMETRIC survey.

  Observations and astrometry complete. Absolute calibration on-going.
A multi-wavelength project!

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  Complete in 2012. 1640 X-ray sources.
- Optical (Blanco) and infrared (VVV) PHOTOMETRIC survey.
  Observations and astrometry complete. Absolute calibration on-going.
- Optical SPECTROSCOPIC survey.
  On-going: VIMOS, FORS, X-SHOOTER (VLT), EFOSC2 (NTT), GMOS (Gemini), Goodman (SOAR)
- UV Coverage with GALEX. Complete 2011.
- Radio coverage with EVLA. Approved 2012.
A variability project!

- Optical (Blanco) and infrared (VVV) VARIABILITY survey.
  Optical complete. Analysis on-going. More than 120 optical variables.

- X-ray and UV VARIABILITY with Swift.
  Finished.
First results from shallow public surveys:

- Identification of radio counterparts in the NVSS catalogue: 12 sources.
- Tycho-2 counterparts + ASAS variability: 60
- Optical Gravitational Lensing Experiment (OGLE) variables: 209

First results from optical spectroscopy:

- 30 secure accreting X-ray binaries. Around 70 Hα emitting sources.
- First dynamical study. Confirmed CV.
IS IT ALL ABOUT EMISSION LINE OBJECTS?
SDSS J102347.6+003841