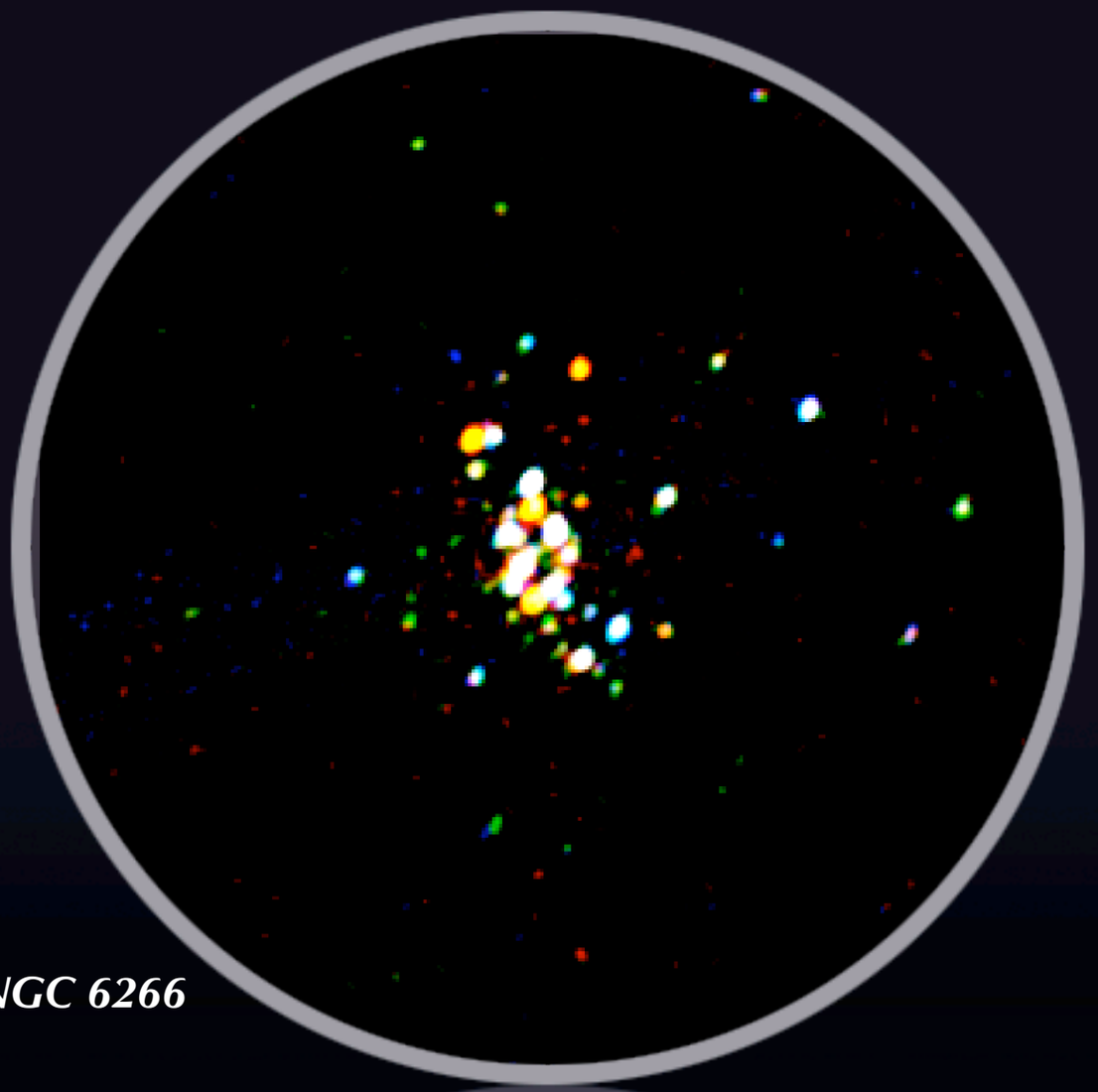
X-ray Sources in Galactic Globular Clusters

D. Pooley (UC Berkeley)



NGC 6266

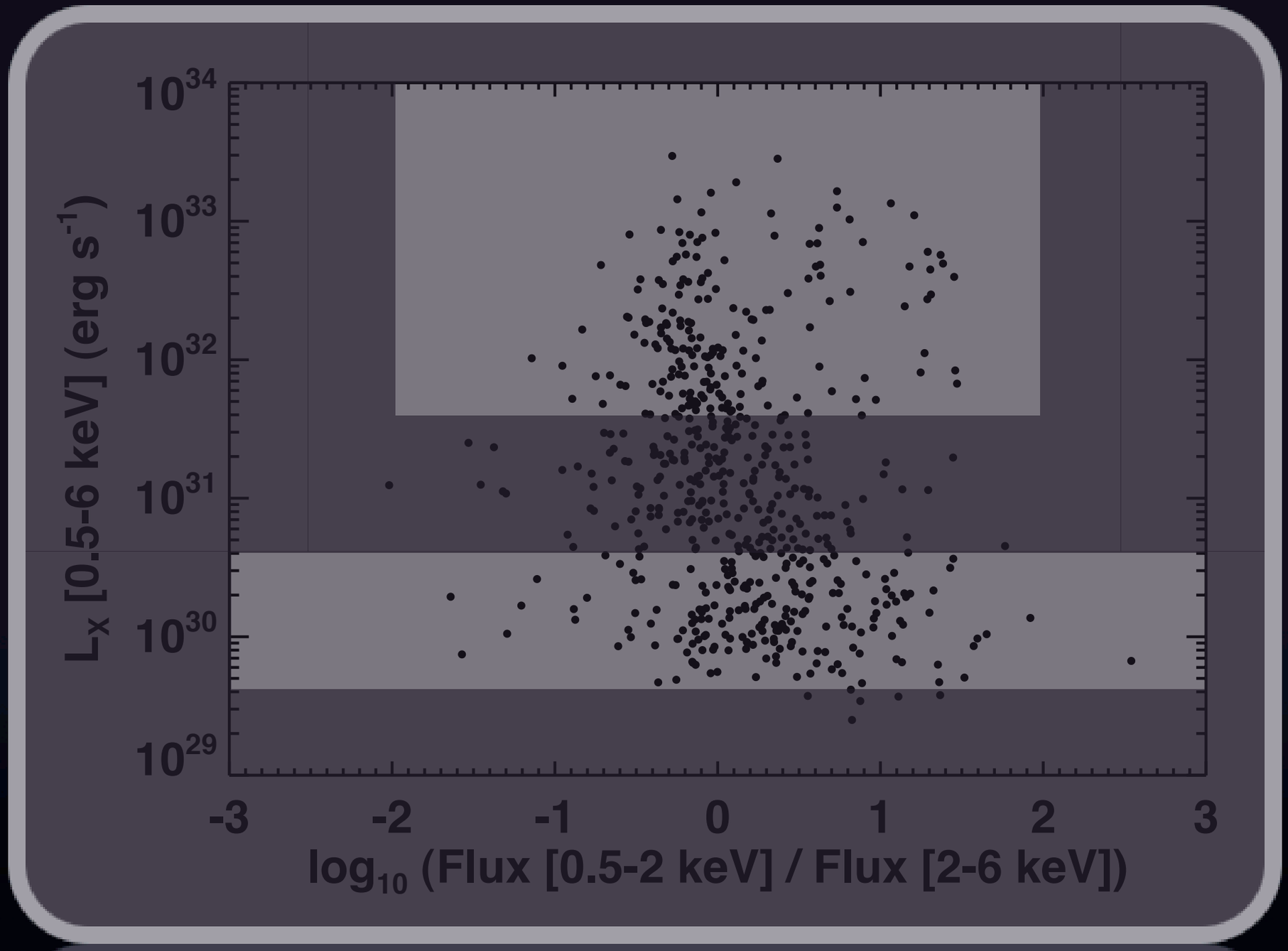
- *Chandra* results on the Galactic population (~20 clusters)
- Observational "complications"
- Current and future work

X-ray CMD

19 GCs

756 sources

~150 background



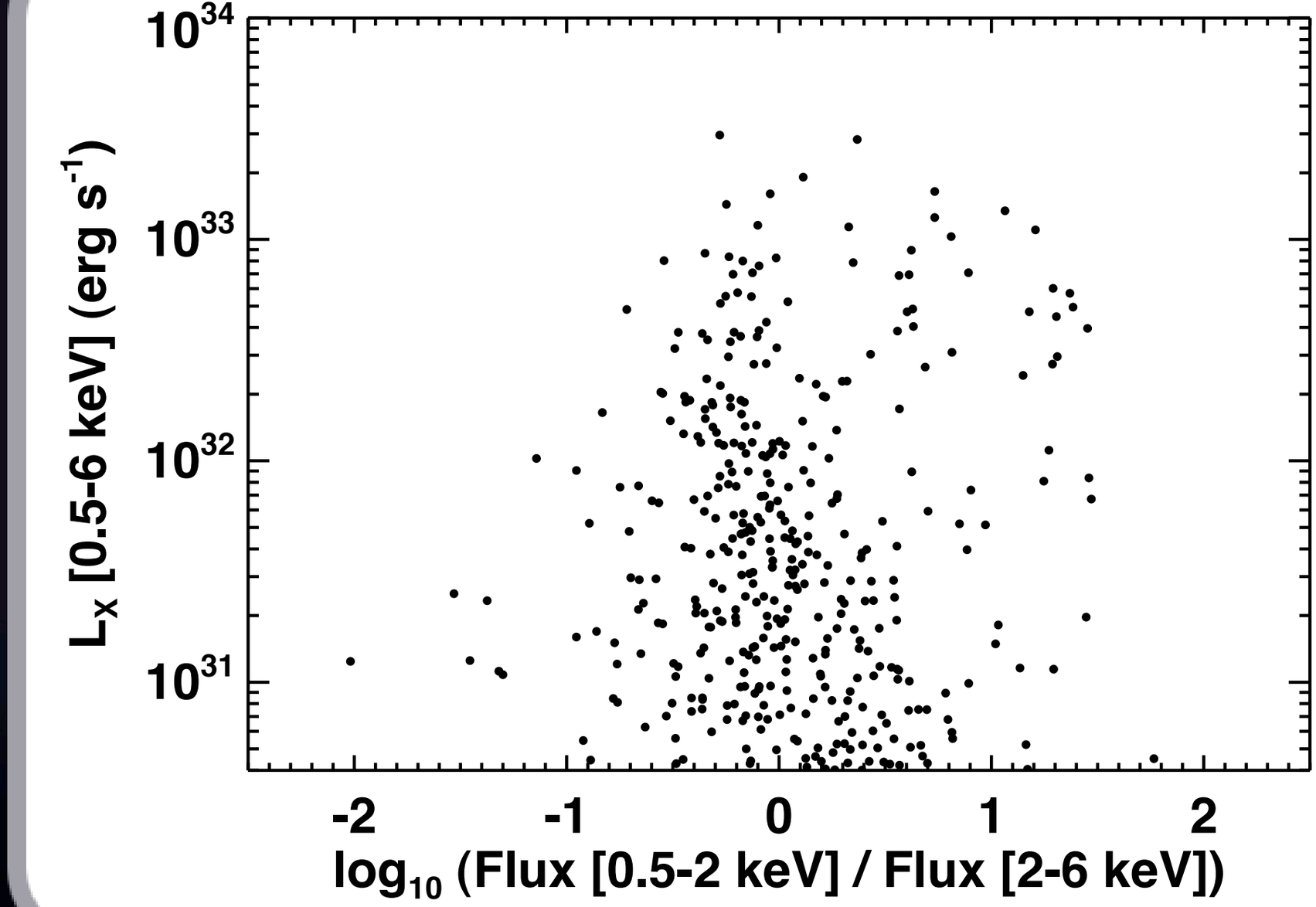
X-ray CMD

Uniform:
$L_x > 4\times10^{30}$ erg s^{-1}

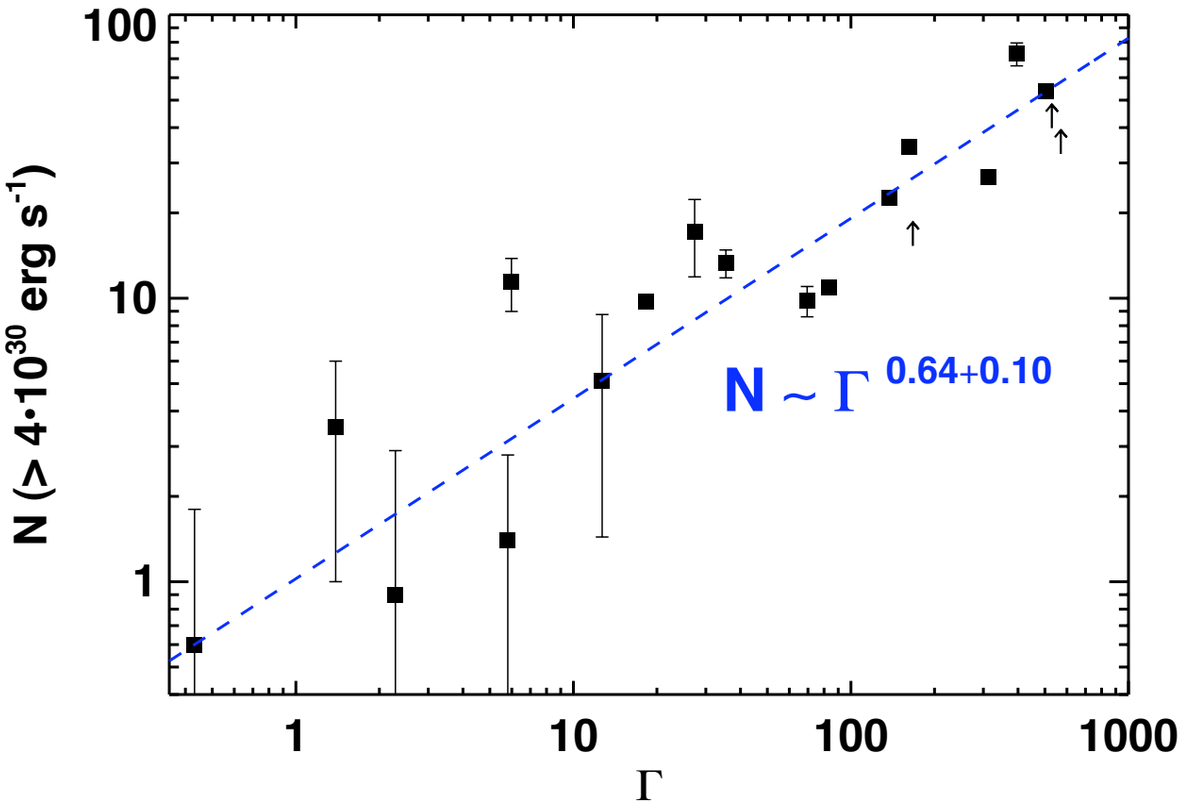
19 GCs

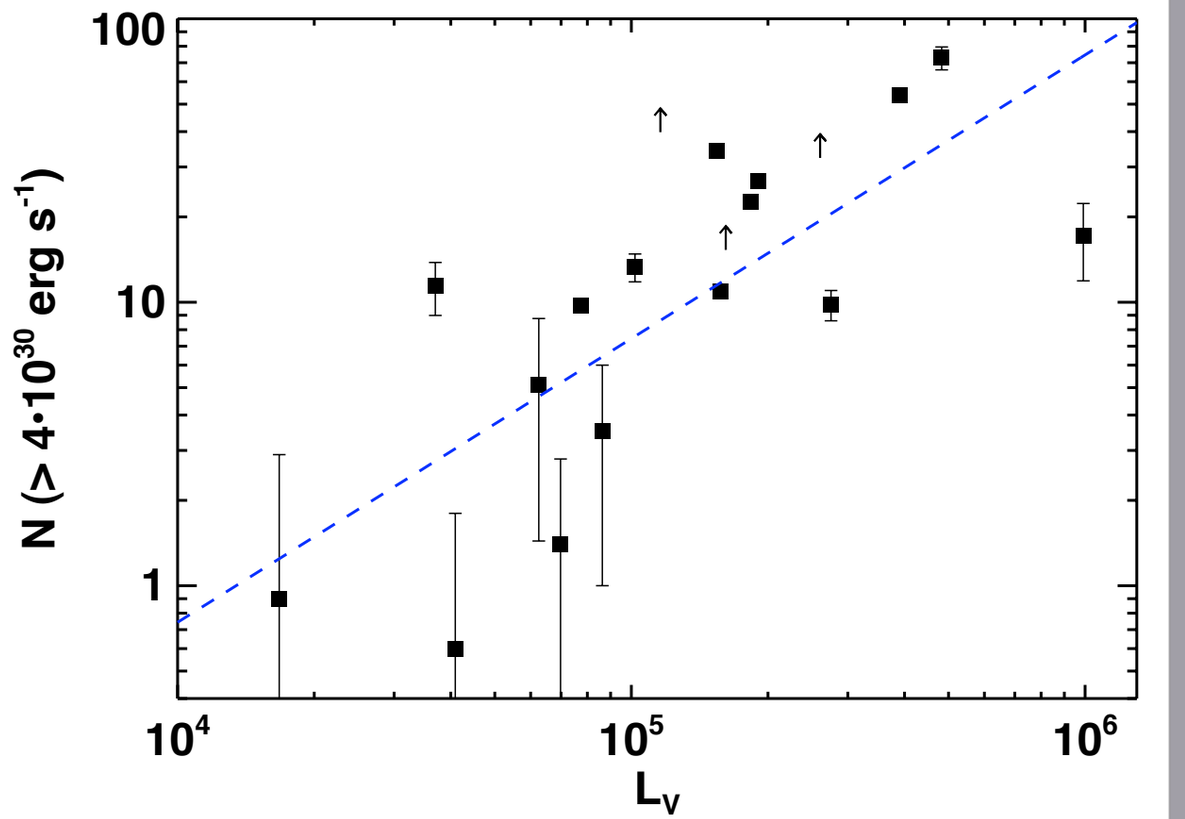
479 sources

~100 background



Dynamics vs. Mass





X-ray CMD

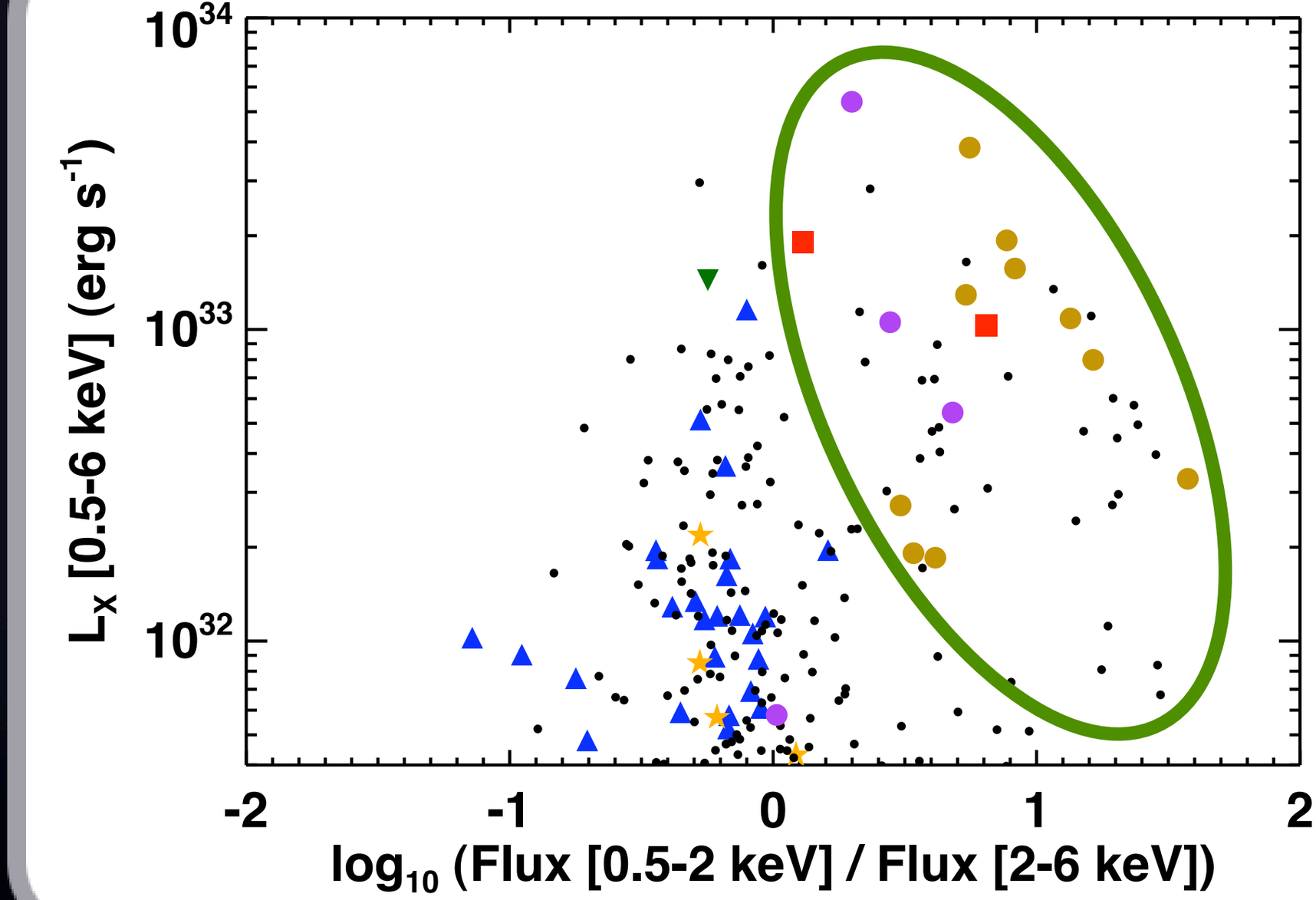
Uniform:
$L_x > 4\times10^{31}$ erg s^{-1}

19 GCs

183 sources

~15 background

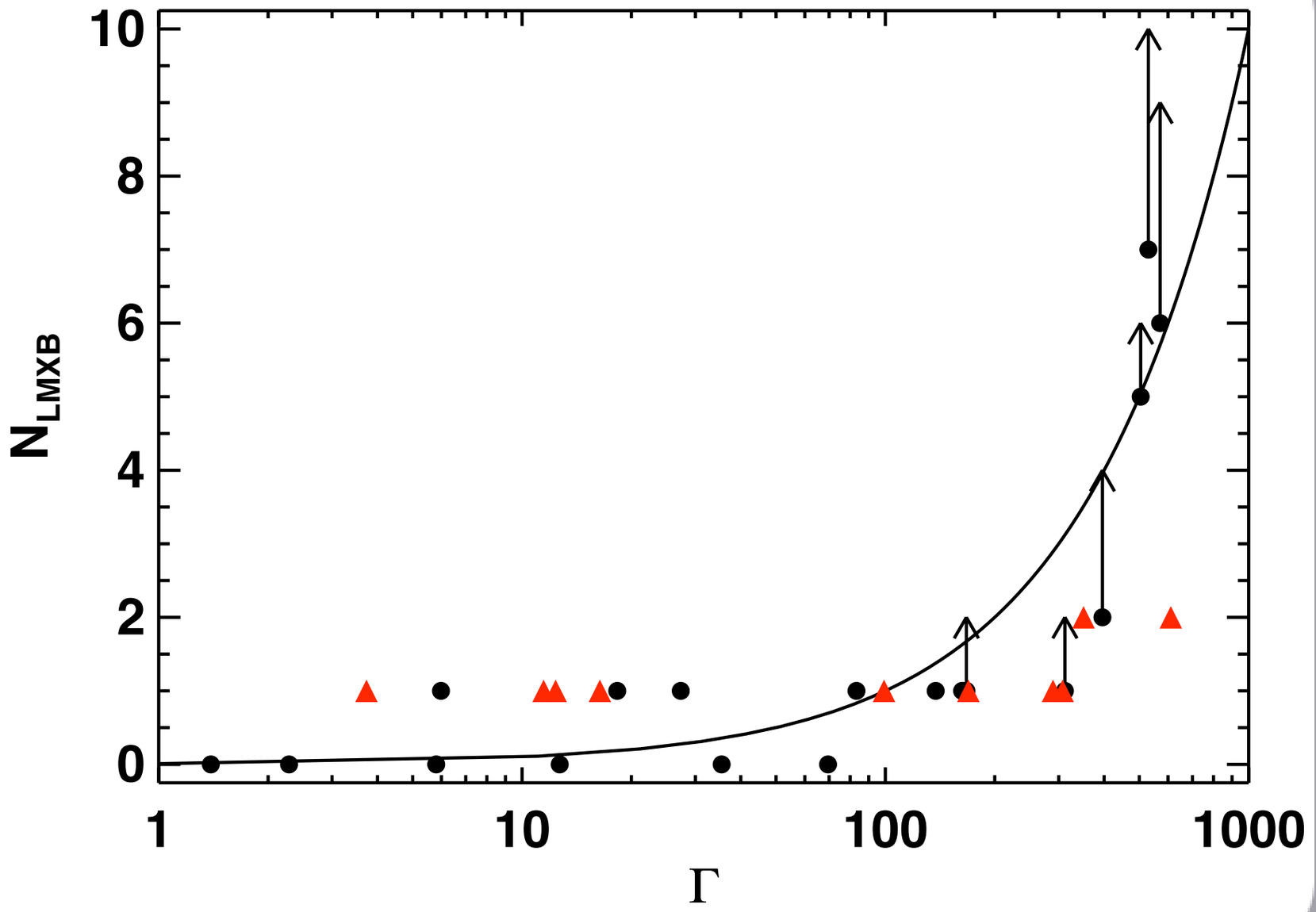
- qLMXB
- Pulsar
- Active Binary
- CV
- Field Burster
- Field Pulsar

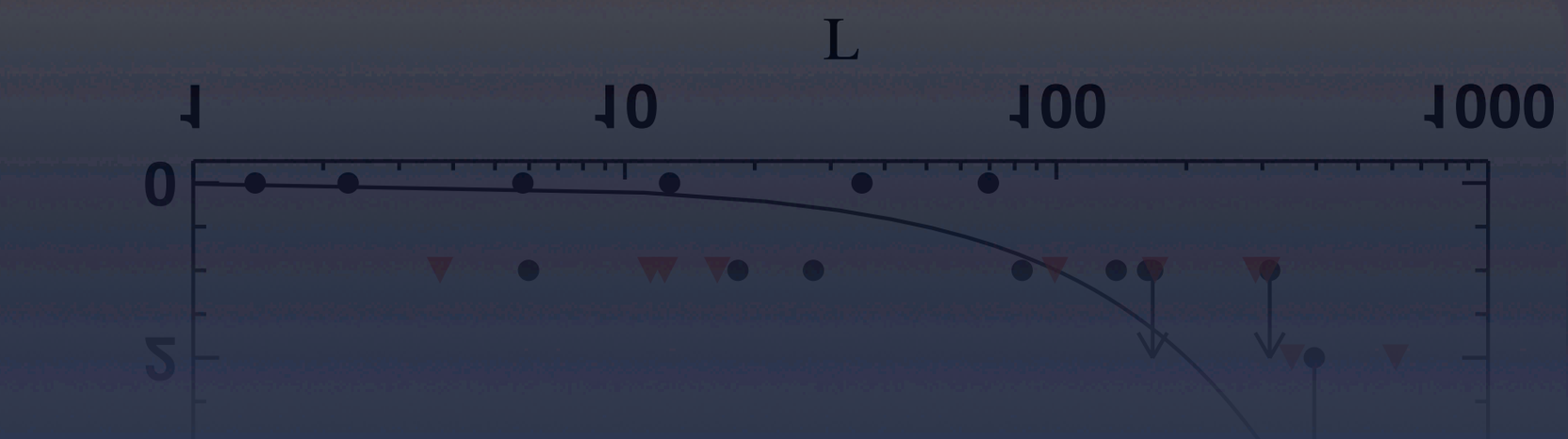


Cluster LMXBs

~Linear with Γ

⇒100 LMXB total





X-ray CMD

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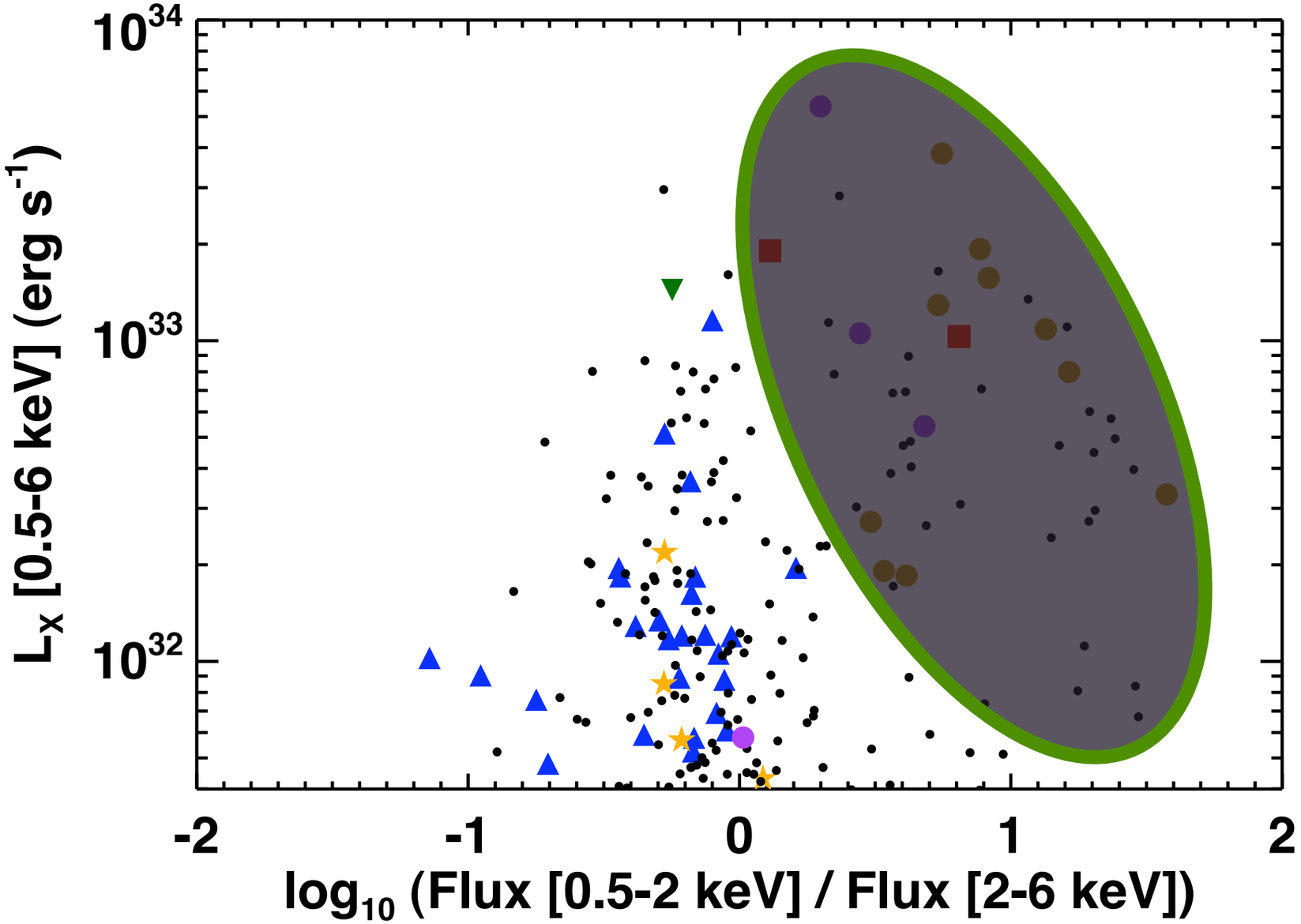
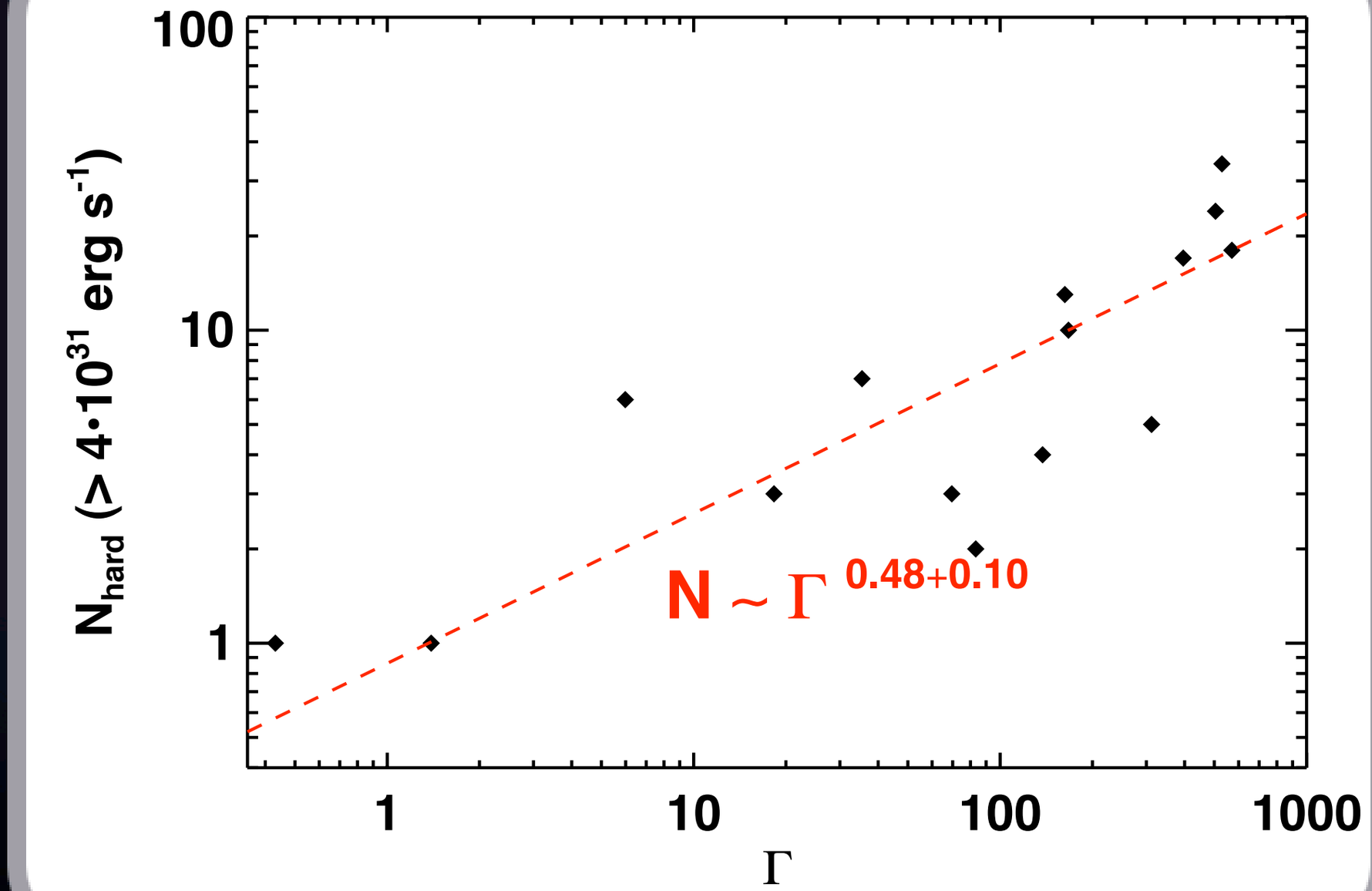


Bright, hard sources

Mostly CVs

Weaker dependence on Γ



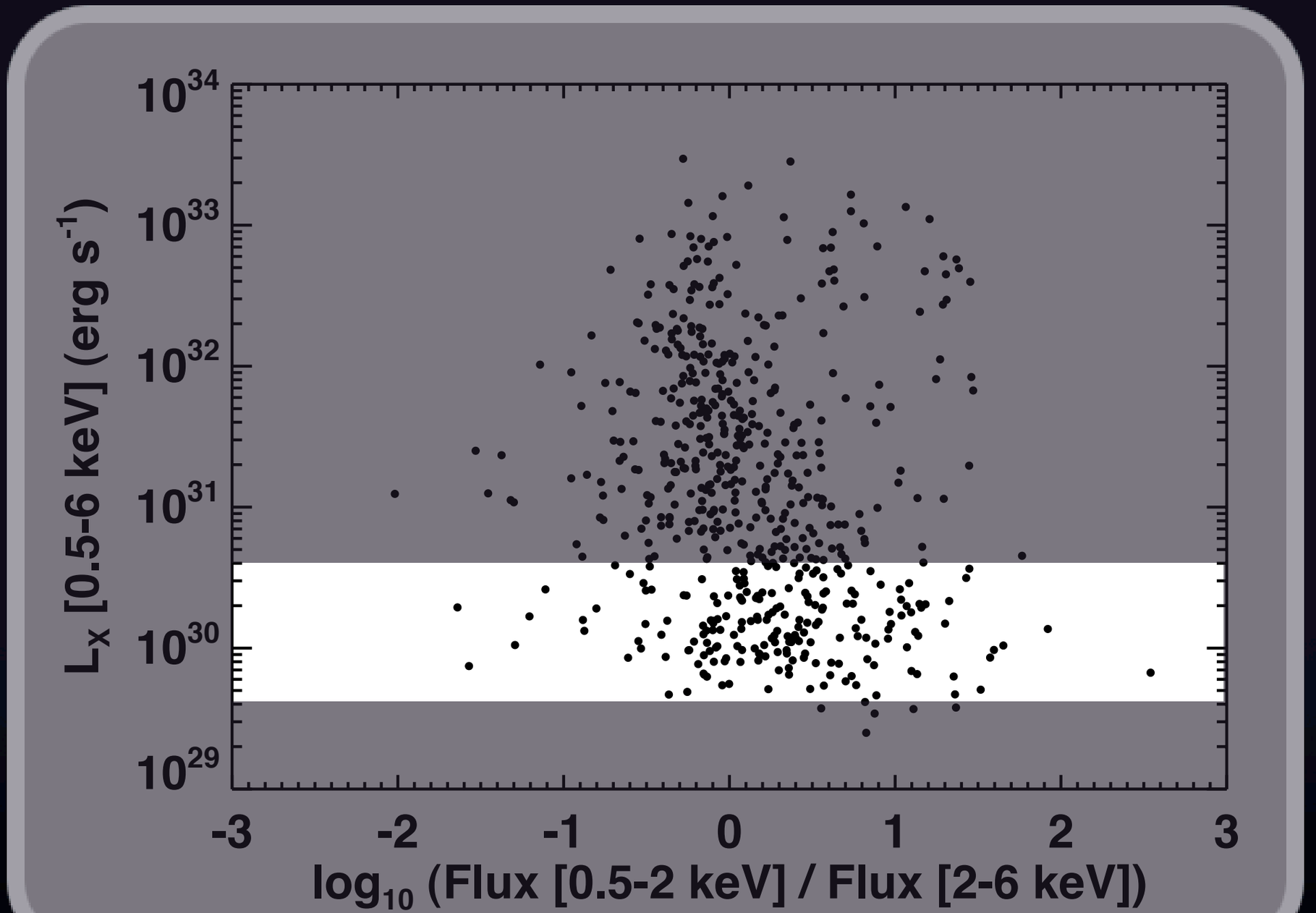
X-ray CMD

Very low L_x
$4\times10^{29} - 4\times10^{30}$
erg s^{-1}

3 GCs

243 sources

~35 background



Very Low Luminosity: 4×10^{29} – 4×10^{30} erg s^{-1}

(Mostly Active Main-sequence Binaries)

Cluster	Γ/Γ_{6397}	$L_V/L_{V,6397}$	N_{srcs}	$N_{srcs}/N_{srcs,6397}$
47 Tuc	74	13	180 – 200	36 – 40
NGC 6121	2.2	1.3	12 – 18	2.4 – 3.6
NGC 6397	1	1	4 – 6	1

Heinke et al. 2005, Bassa et al. 2004, Grindlay et al. 2001

Complication: Variability

(Uniform sample: $L_x > 4 \times 10^{30}$ erg s^{-1})

Cluster	Obs.	$N_{min} - N_{max}$	$\langle N \rangle \pm \sigma_N$	N_{unique}
47 Tuc	14	70 – 88	78.9 ± 6.4	180
NGC 6121	5	7 – 14	10.2 ± 2.1	22
NGC 6397	11	10 – 16	13.3 ± 2.1	25

Work in Progress & Future Work

- Individual IDs; subpopulation dynamics
- Variability
- Period distributions
- Radial distributions
- Sources outside r_h

Γ (~ Encounter Frequency)

$$R = n_1 n_2 v_{\mathrm{rel}} \sigma$$

$$\sigma = \pi d^2 \left(1 + \frac{2G(m_1 + m_2)}{v_{\mathrm{rel}}^2 d}\right) \approx \pi d \frac{2G(m_1 + m_2)}{v_{\mathrm{rel}}^2}$$

$$R \sim \rho^2 / v$$

$$\boxed{\Gamma = \int_0^{r_h} R \, dV} \qquad \boxed{\Gamma = \int_0^{r_c} R \, dV \approx \rho_0^2 \, r_c^3 / v = \rho_0^{1.5} r_c^2}$$