

Dynamical Formation of Globular Cluster X-ray Sources

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(MIT)

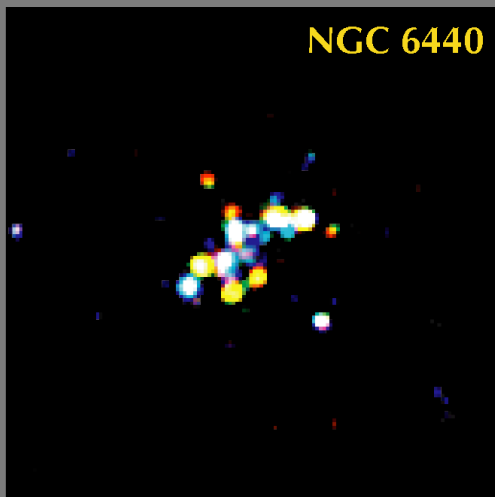
(soon to be Berkeley)

- **Brief history**
- **The *Chandra* Era**
- **GC Dynamics**

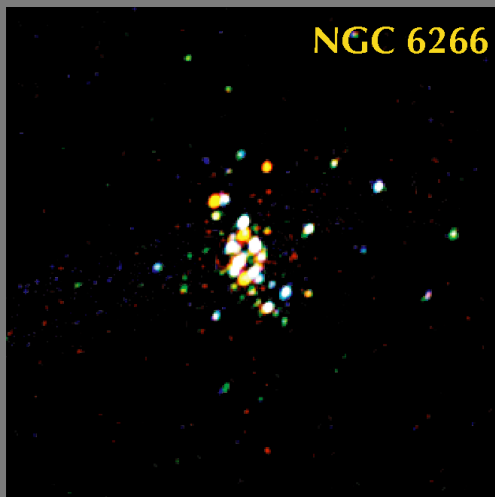
Brief History of GC X-ray Sources

- Bright Sources with *Uhuru* (Clark 1975)
- Dim Sources with *Einstein* (Hertz & Grindlay 1983)
- Dozens of Dim Sources with *ROSAT* (Verbunt 2001)
- Hundreds of Dim Sources with *Chandra*

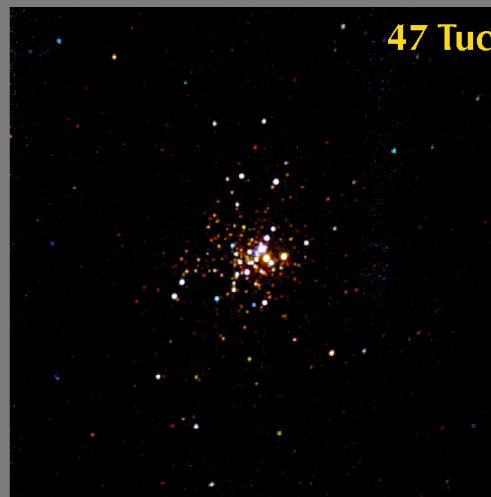
NGC 6440



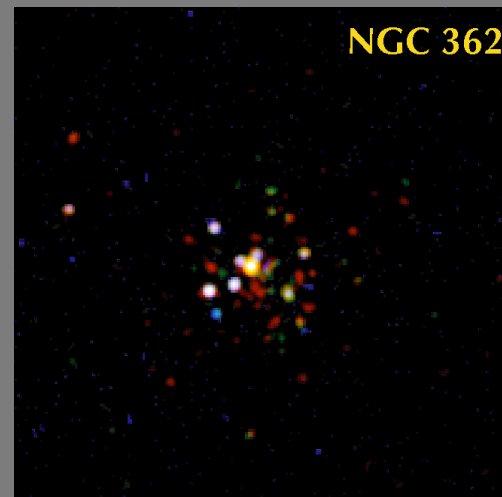
NGC 6266



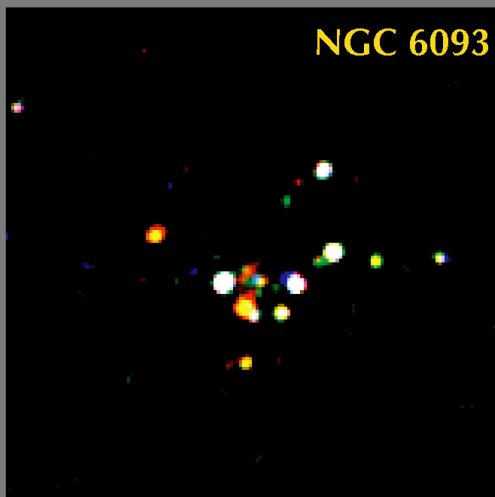
47 Tuc



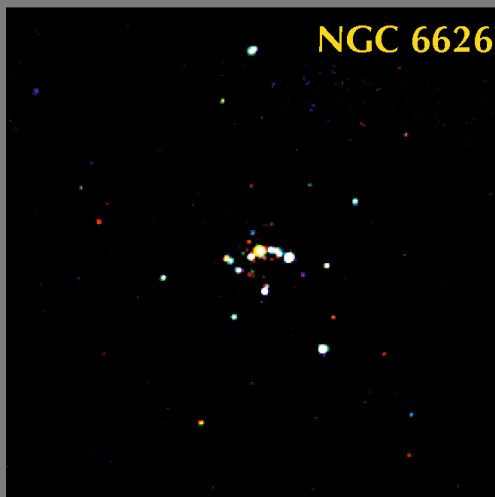
NGC 362



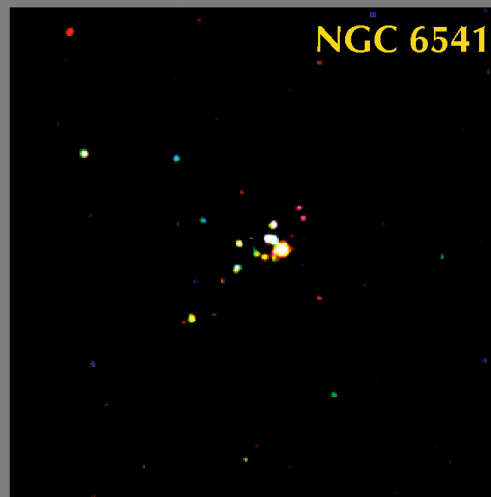
NGC 6093



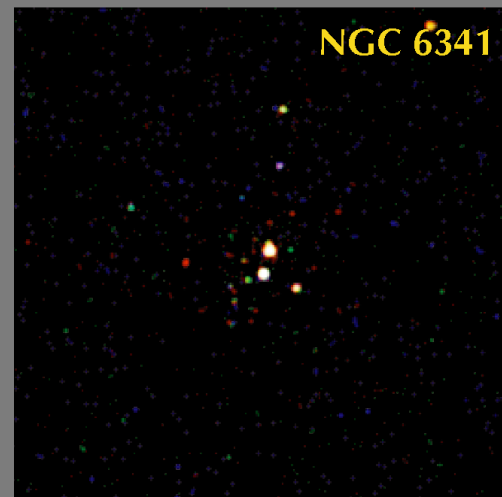
NGC 6626



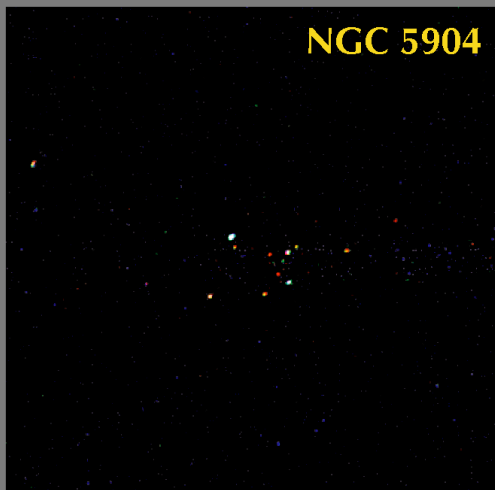
NGC 6541



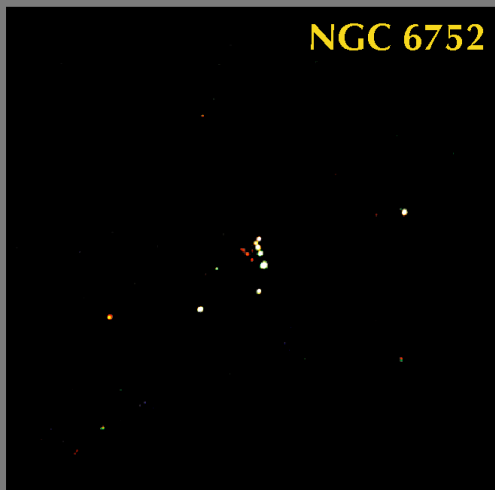
NGC 6341



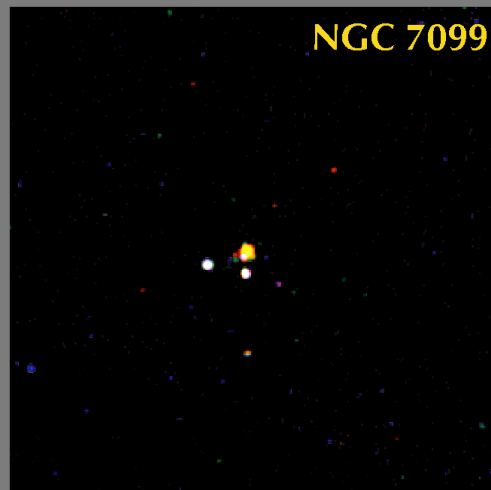
NGC 5904



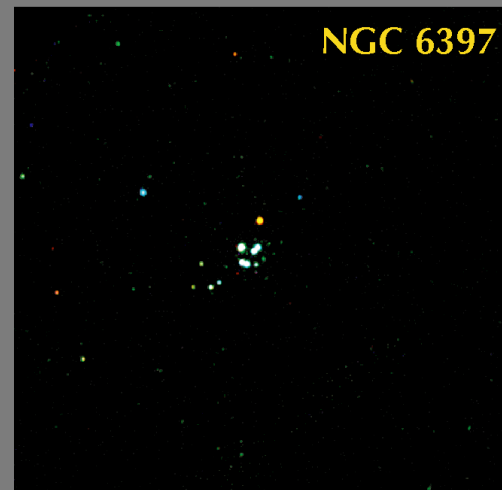
NGC 6752



NGC 7099

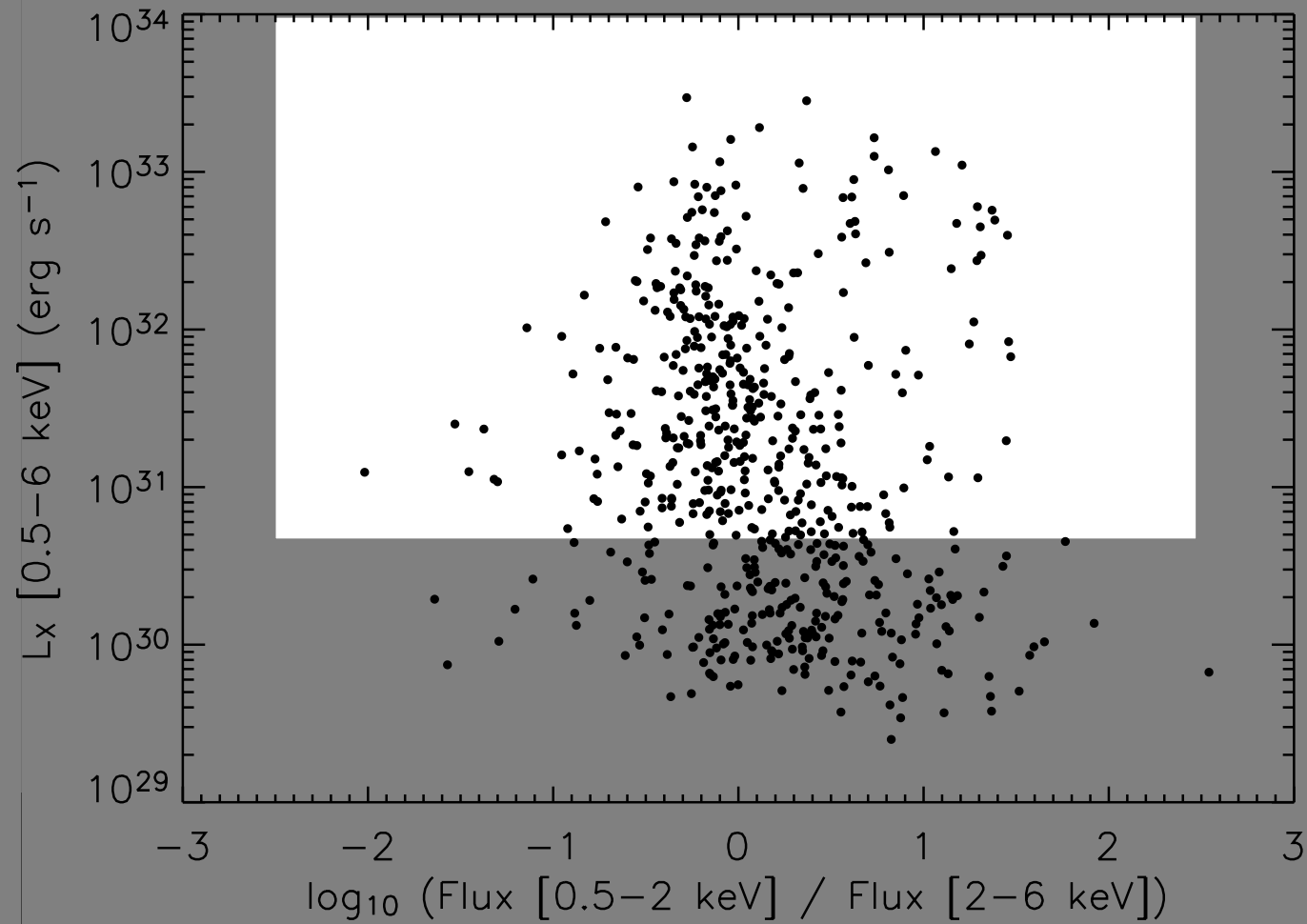


NGC 6397



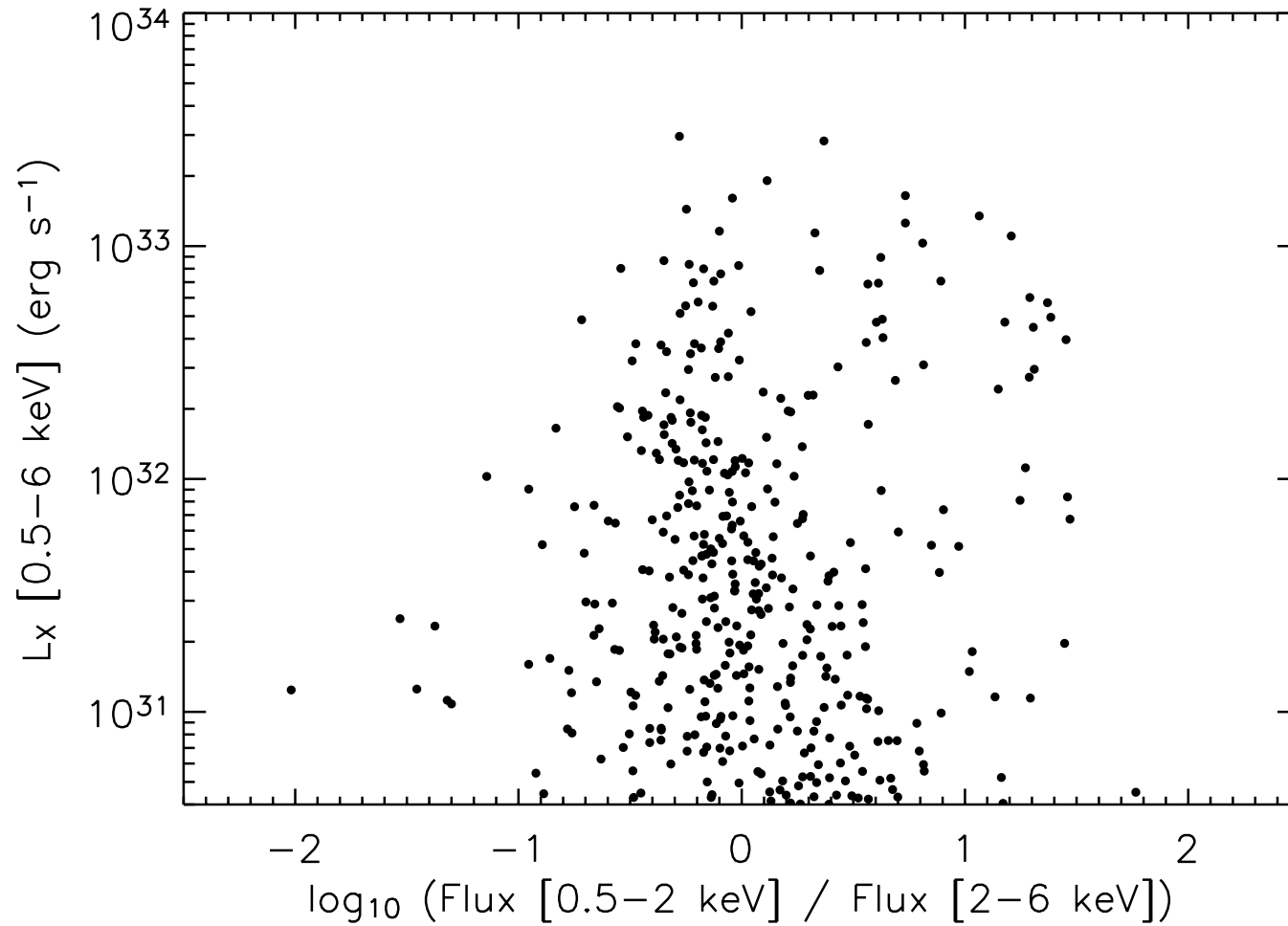
X-ray CMD

19 GCs 756 sources ~150 background

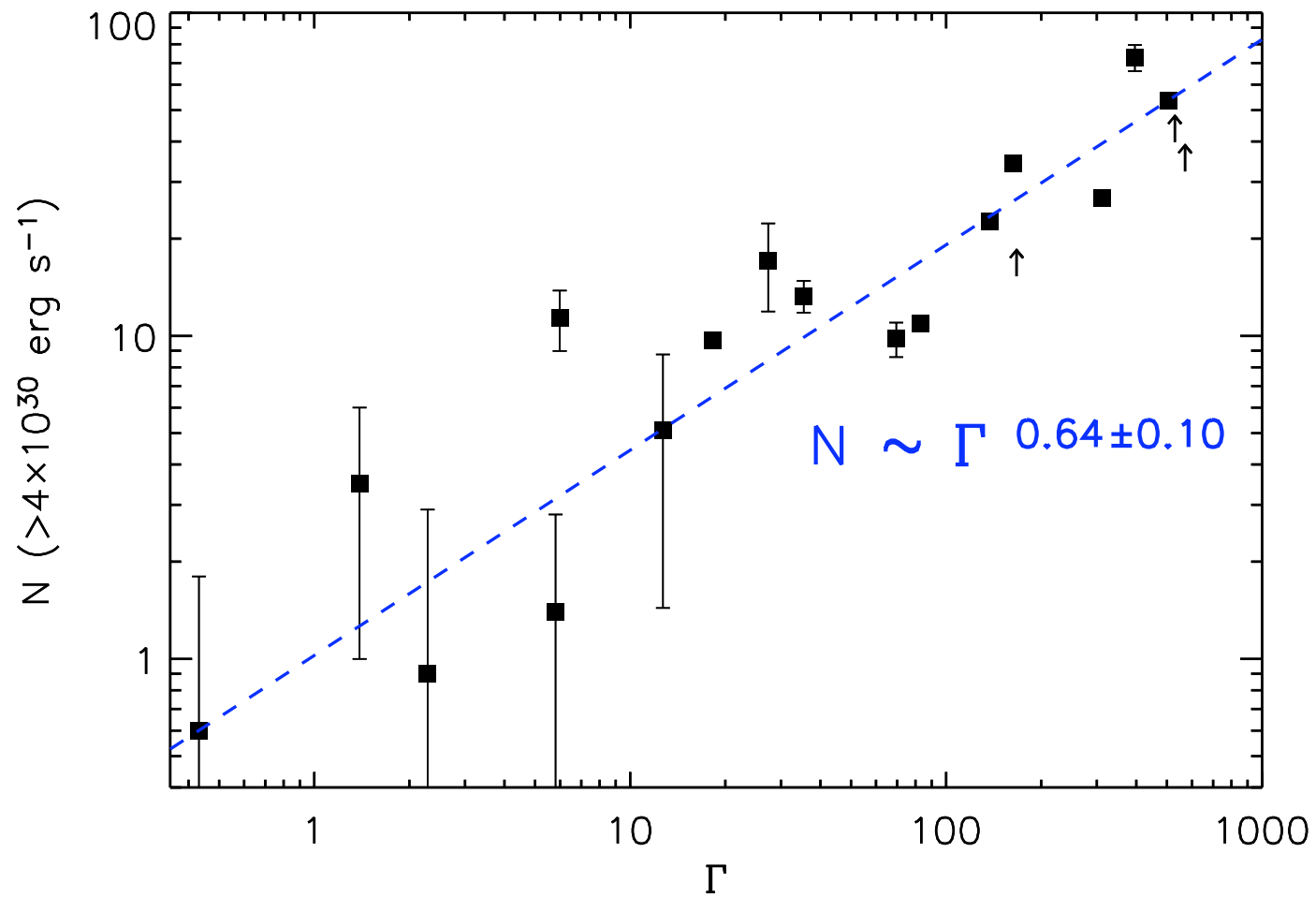


X-ray CMD

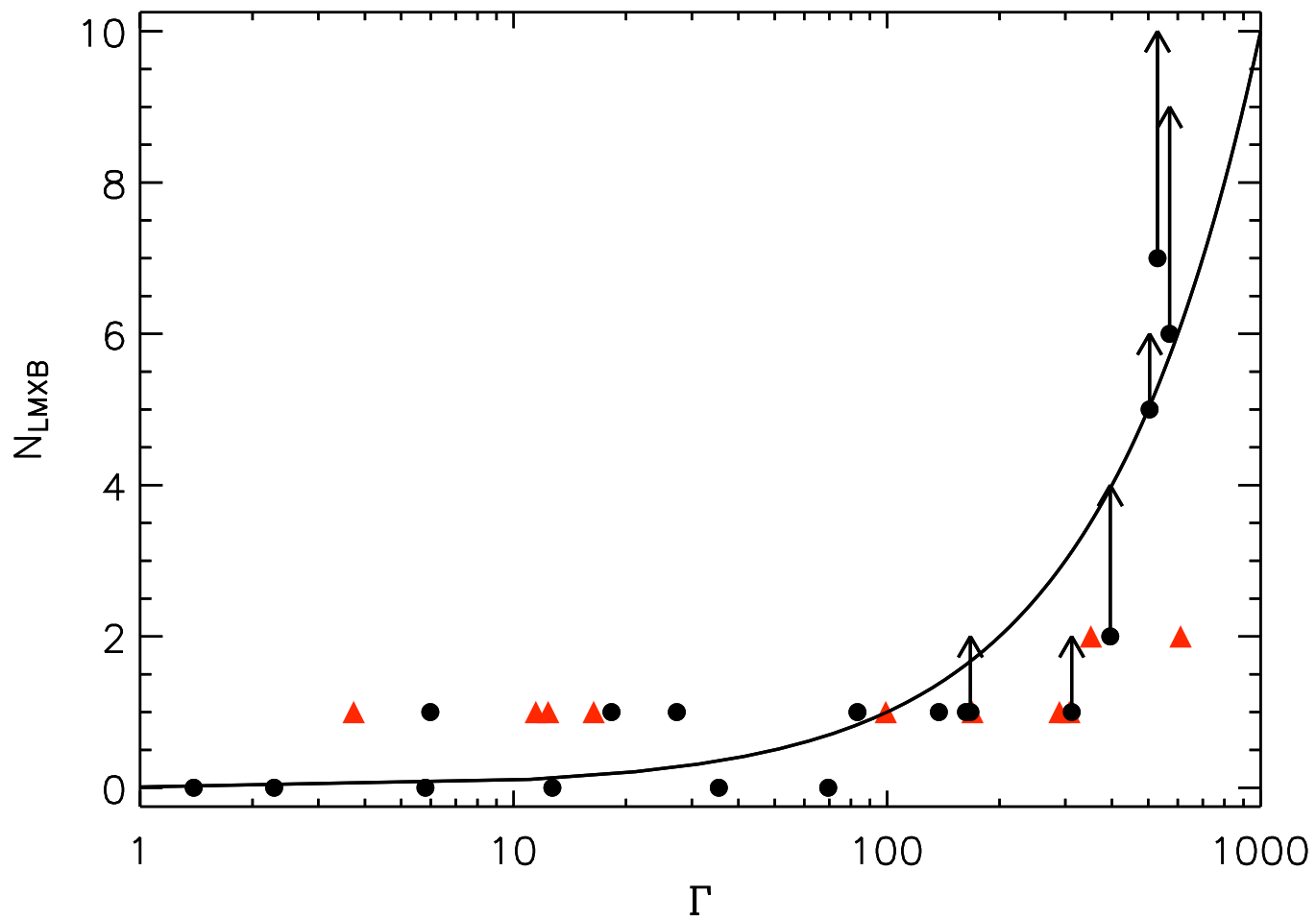
479 sources ~100 background



N vs. Γ



N_{LMXB} vs. Γ



Dynamical Formation of Globular Cluster X-ray Sources

- The dim X-ray sources in GCs are cooked
- qLMXBs have a \sim linear relation with Γ
- Expect ~ 95 LMXBs in Galactic globulars
- Much work to be done
 - Individual IDs; Subpopulation Dynamics
 - Variability; Period Distributions
 - Radial Distributions

Dynamical Formation of a Globular Cluster Collaboration

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Jon Miller (CfA)

Jeroen Homan (MIT)

Michiel van der Klis (Amsterdam)

Bryan Gaensler (CfA)

Vicky Kaspi (McGill)

Nichi D'Amico (Bologna)

Lee Homer (UW Seattle)

Cees Bassa (Utrecht)

Scott Anderson (UW Seattle)

Bruce Margon (STScI)

Alex Filippenko (Berkeley)

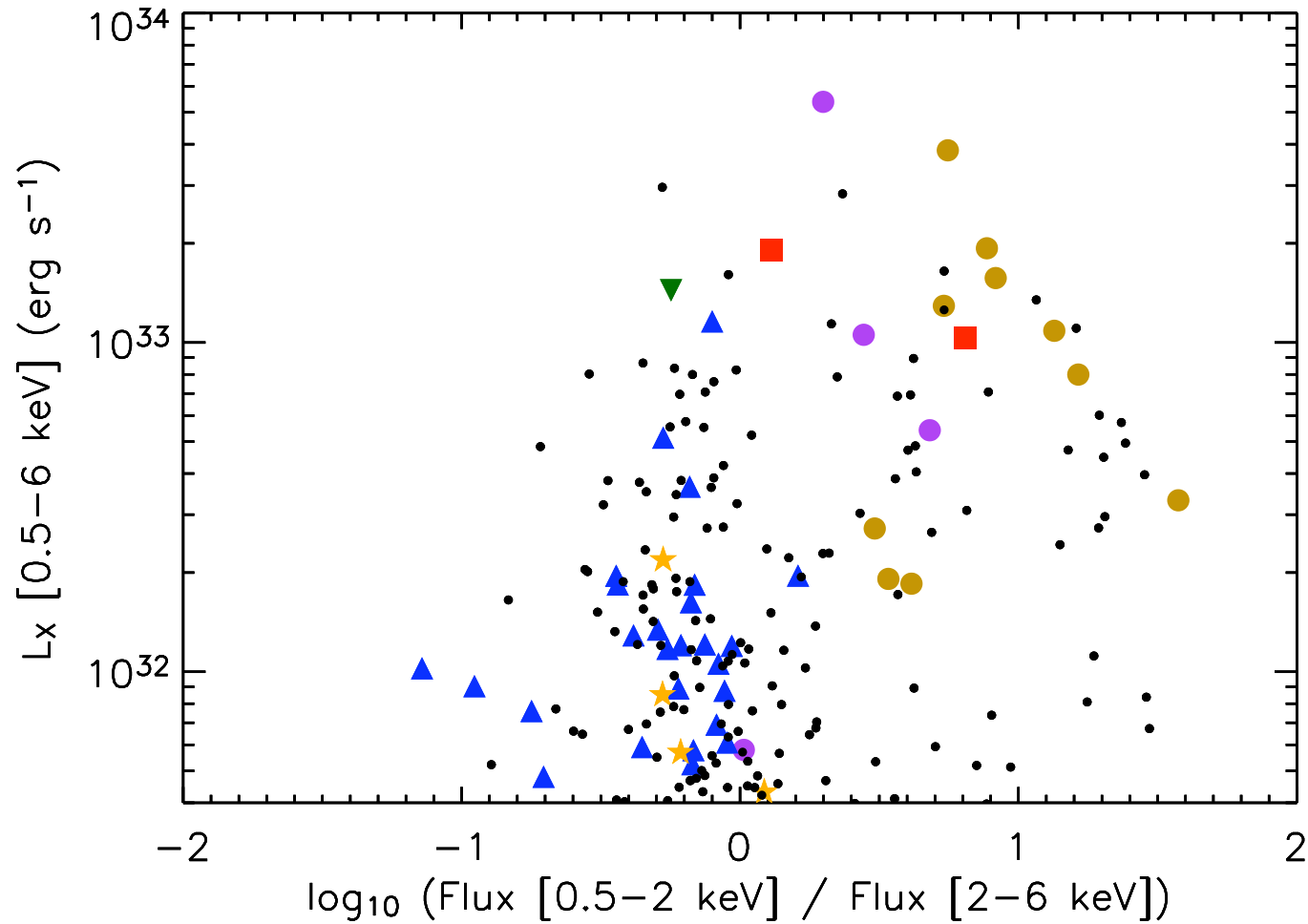
Piet Hut (IAS)

Jun Makino (Tokyo)

Steve McMillan (Drexel)

Simon Portegies Zwart
(Amsterdam)

X-ray CMD



183 sources ~15 background

Γ (\sim Encounter Frequency)

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

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

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

$$\Gamma = \int_0^{r_h} R dV$$