

# The Extended Chandra Deep Field South Survey: Optical & NIR Properties of X-ray Detected Sources

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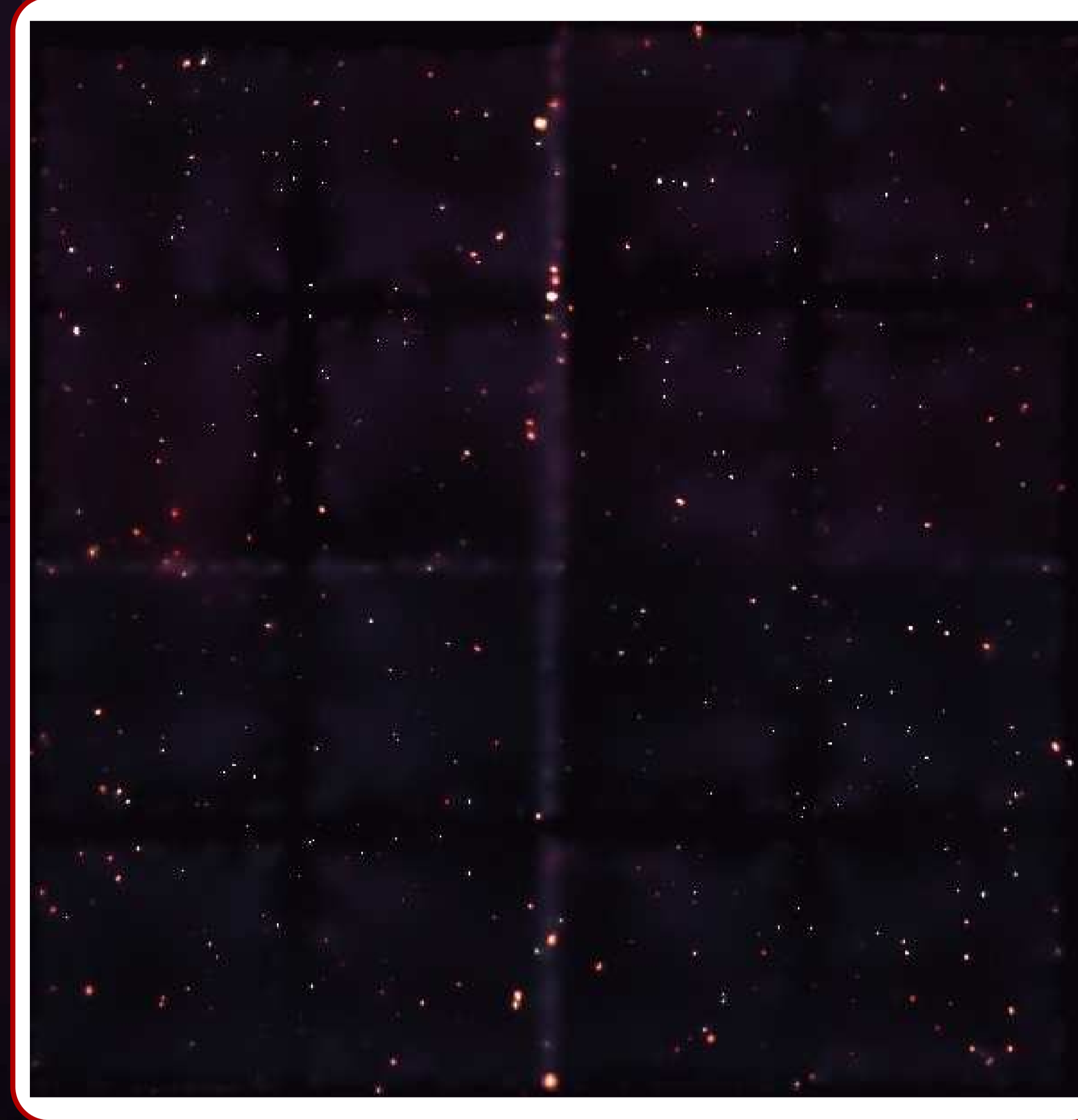
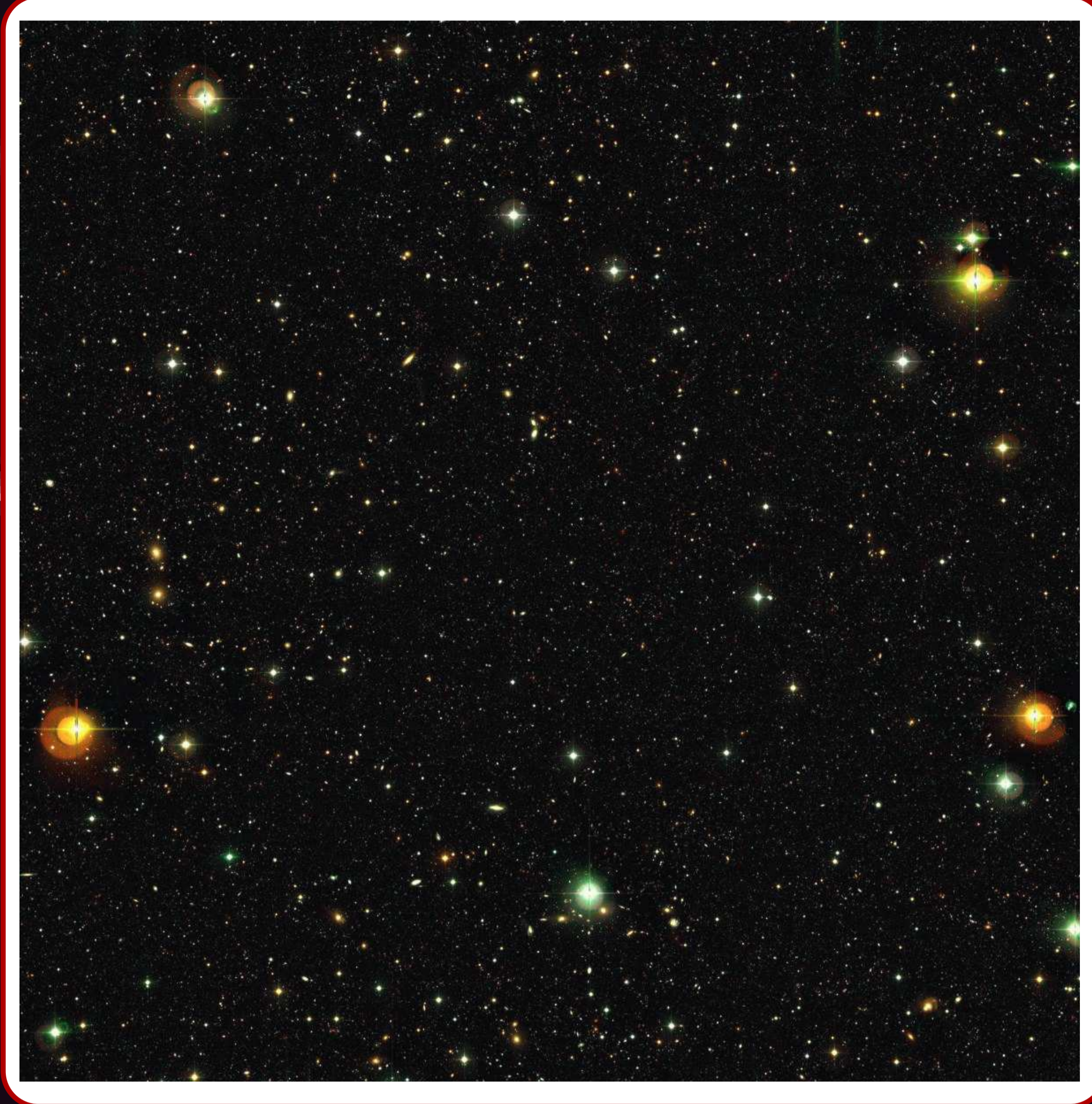
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MUSYC-BVR

X-RAY FALSE COLOR

MUSYC-JHK



## Multiwavelength Survey by Yale-Chile (MUSYC)

MUSYC is a 1 square-degree survey to AB limiting depths of U,B,V,R=26 and K=22 (K=23 in the central 10'x10' of each field), with extensive follow-up spectroscopy (Gawiser et al. 2005, astro-ph/0509202). The project comprises four 30'x30' fields, of which the E-CDF-S is one. Ground-based imaging has been completed and deep follow-up spectroscopy (to R~25) is underway (Magellan/IMACS, VLT/VIMOS, Gemini/GNIRS).

## ABSTRACT

The Extended Chandra Deep Field-South survey consists of 4 Chandra ACIS-I pointings and covers ~1100 square arcminutes (~0.3 deg<sup>2</sup>) surrounding the original CDF-S field, to a depth of approximately 228 ks (PI: Niel Brandt; Lehmer et al. 2005). This is the largest Chandra survey ever conducted at such depth. In our X-ray catalog of this field (Virani et al. 2005, astro-ph/0506551), we detect 651 unique sources, of which 561 are detected in the full 0.5–8.0 keV band, 529 in the soft 0.5–2.0 keV band, and 335 in the hard 2.0–8.0 keV band. In this paper, we present the optical and near-IR counterparts to these X-ray detected sources obtained as part of the MULTIwavelength Survey by Yale/Chile (MUSYC; Gawiser et al. 2005, astro-ph/0509202). Of these 651 X-ray sources, ~75% of these sources have optical and near-IR counterparts in deep MUSYC imaging of this field. We present the optical and near-infrared properties of these sources (ie, magnitude distributions and colors), as well as 7 new Extreme X-ray-to-Optical flux ratio objects (EXOs; Koekemoer et al., 2004) found in the E-CDF-S field.

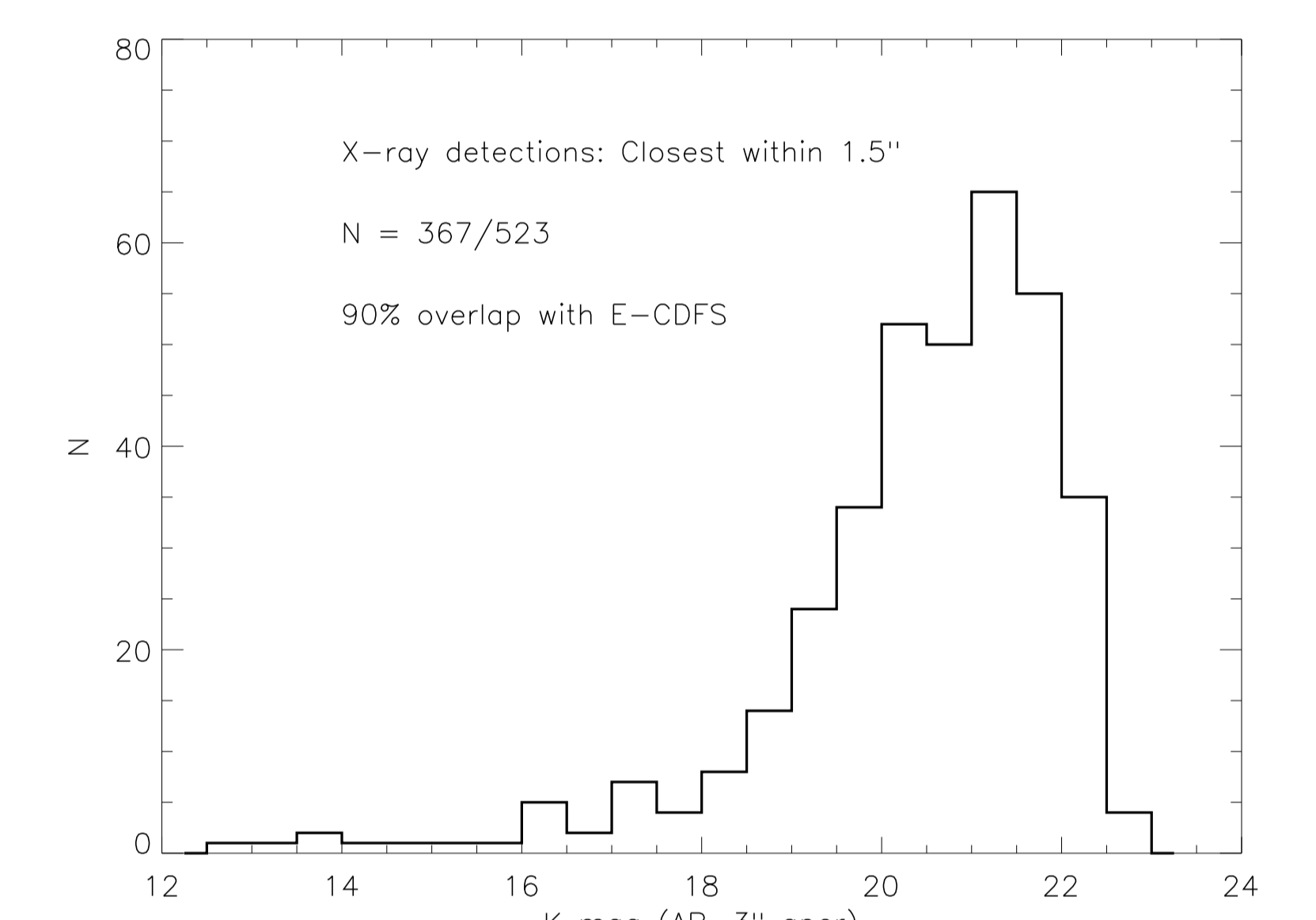


Fig. 2

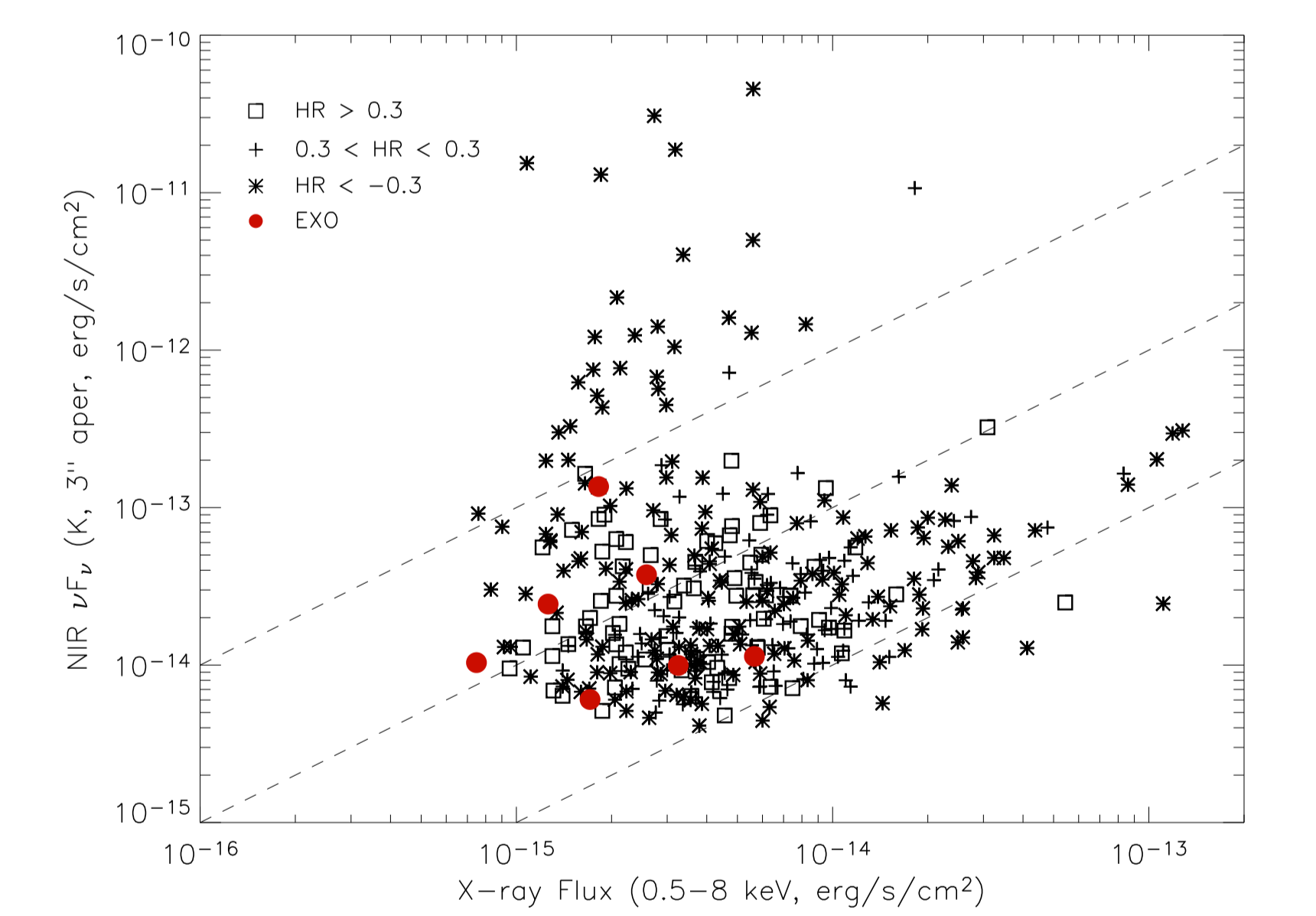
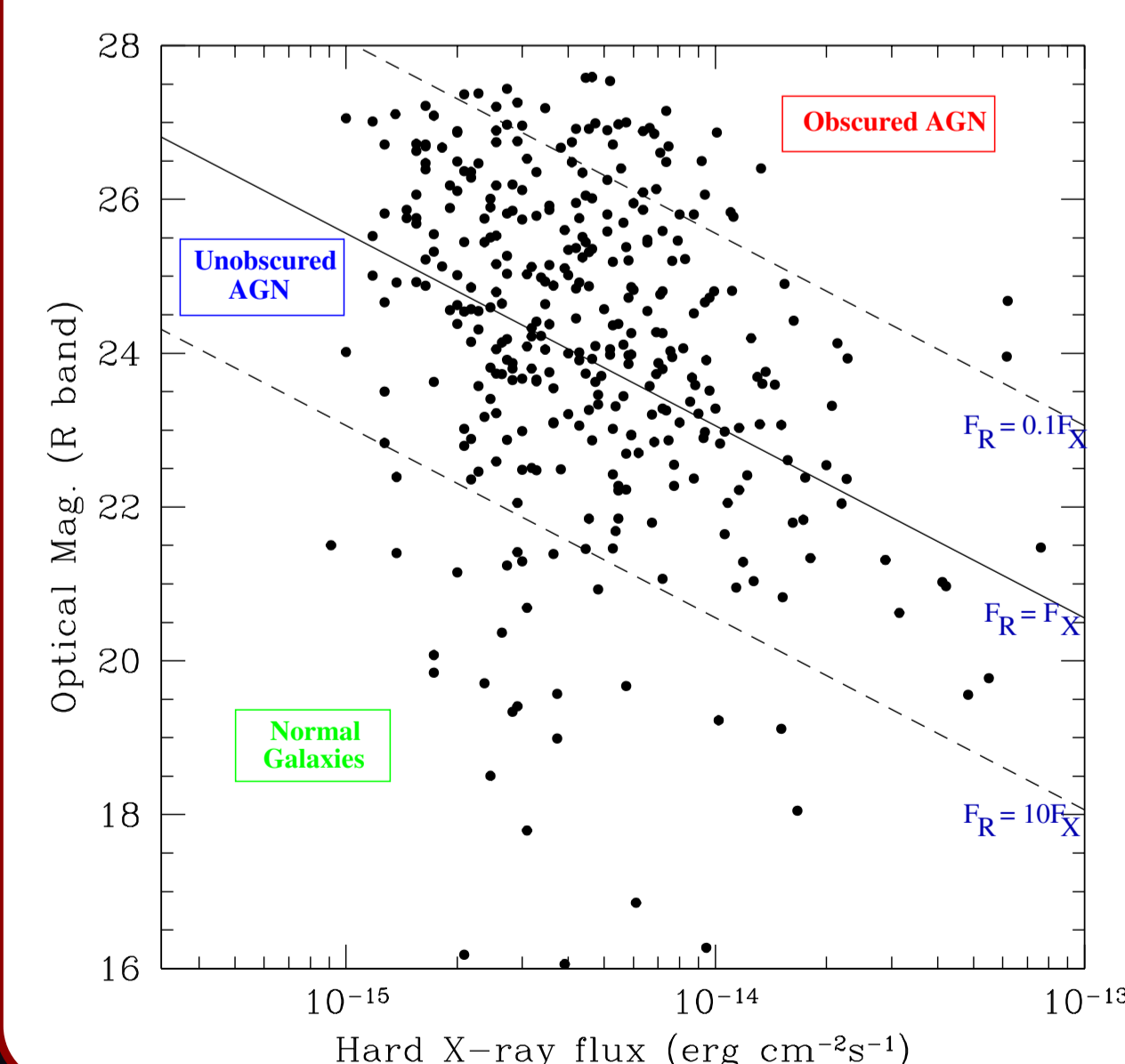
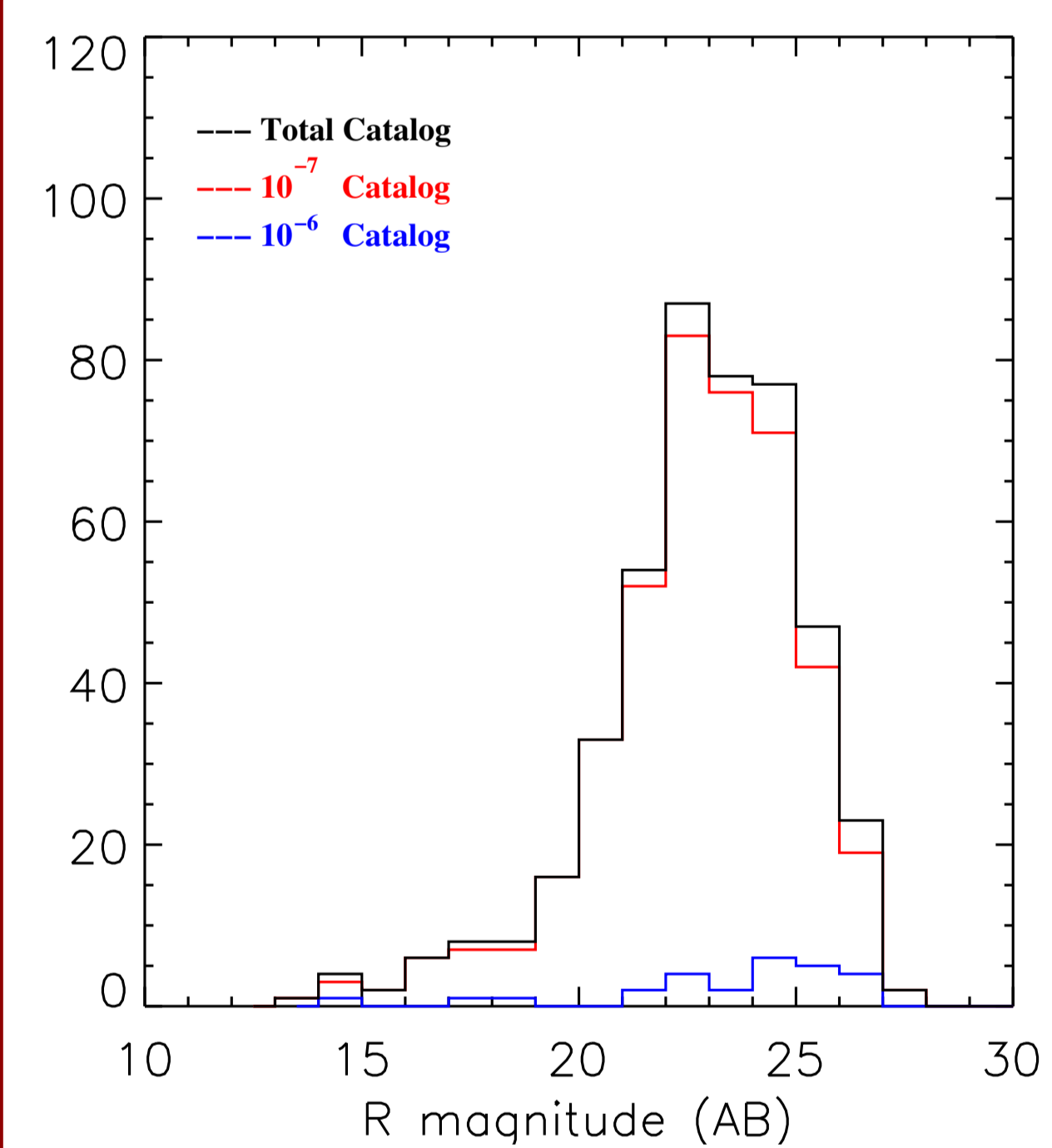


Fig. 1



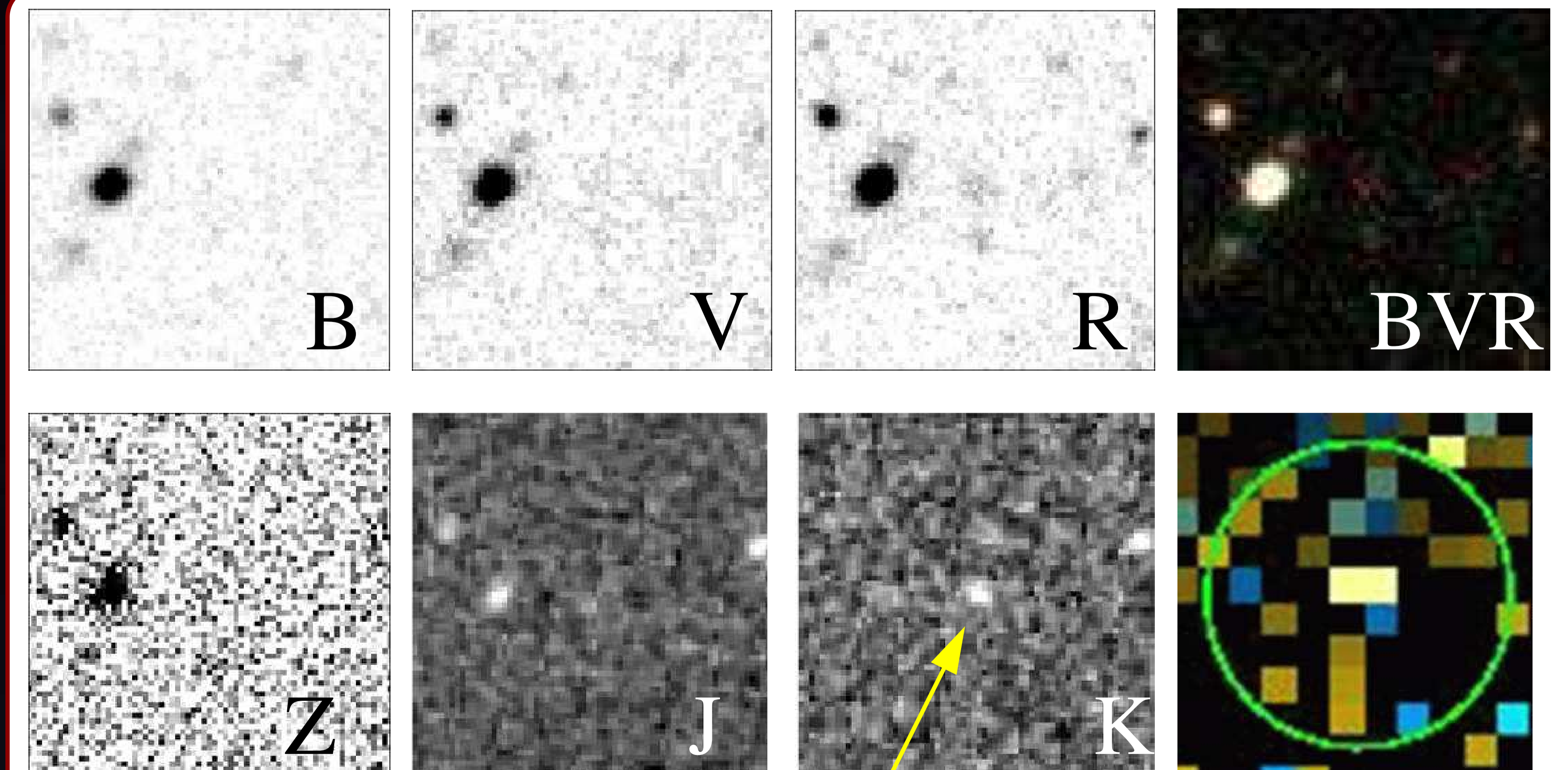
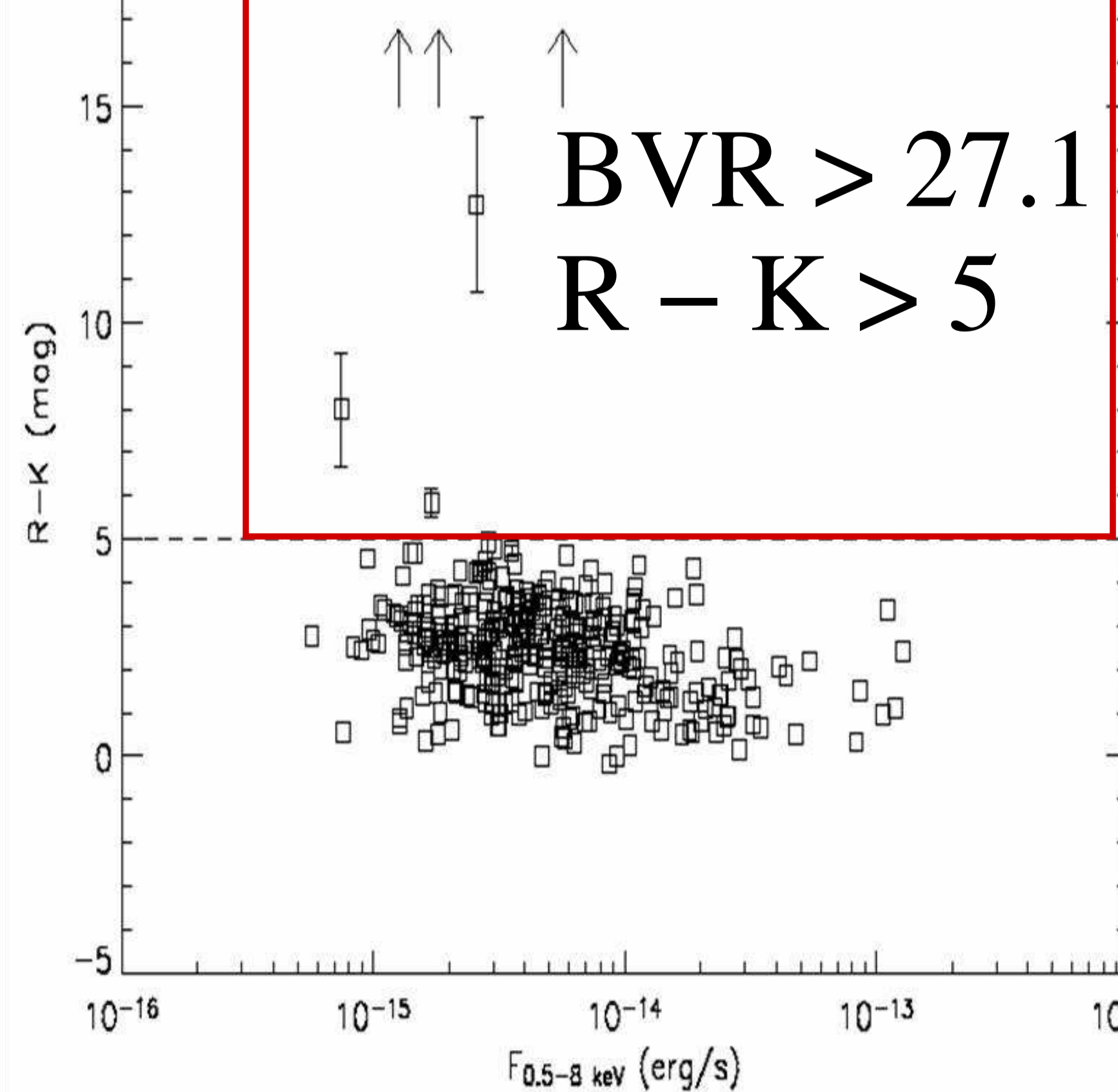
## MUSYC Optical & NIR Counterparts

Table 1: MUSYC-E-CDFS 5σ AB Point Source Limits

| BVR  | U    | B    | V    | R    | I    | z    | NB5000 |
|------|------|------|------|------|------|------|--------|
| 27.1 | 26.0 | 26.9 | 26.4 | 26.4 | 24.6 | 23.6 | 25.5   |

In the optical, 420 out of 587 X-ray sources (72%) have a unique optical counterpart within 1.5'' of the X-ray source position (3 X-ray sources have multiple optical counterparts) in the deep MUSYC catalog of 84,410 BVR-selected sources. In the NIR, 367 out of 523 X-ray sources (70%) have a unique NIR counterpart within 1.5'' of the X-ray source position in the deep MUSYC catalog of 12,546 JHK-selected sources. Figure 1 and 2 show the R-band magnitude and K-band distributions for these sources, respectively. The bottom panel plots the R-band magnitude and the K-band flux vs. the X-ray flux.

## EXO Selection



Example EXO

$$K_{AB} = 21.4 \quad F_{0.5-8 \text{ keV}} \sim 2 \times 10^{-14}$$