Chandra ACIS-I study of the Eagle Nebula (M16)

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1. INTRODUCTION

The Eagle Nebula (M16) and its central cluster NGC6611 is a young star forming region, at 1750 pc from the Sun (1). This region hosts 54 OB stars (2) and ~2000 pre-Main Sequence stars with a median age of 1 Myr but with a large age spread (3). These characteristics make M16 an ideal target to study the star formation in presence of massive stars and the X-ray activity of both OB stars and low mass pre-Main Sequence stars. We studied the population of M16 by combining optical-infrared photometric data with 3 Chandra/ACIS-I observations, obtaining a deep (down to subsolar masses) census of the stars associated to this region and the opportunity of studying the X-ray properties of cluster members in detail.

2. X-RAY DATA

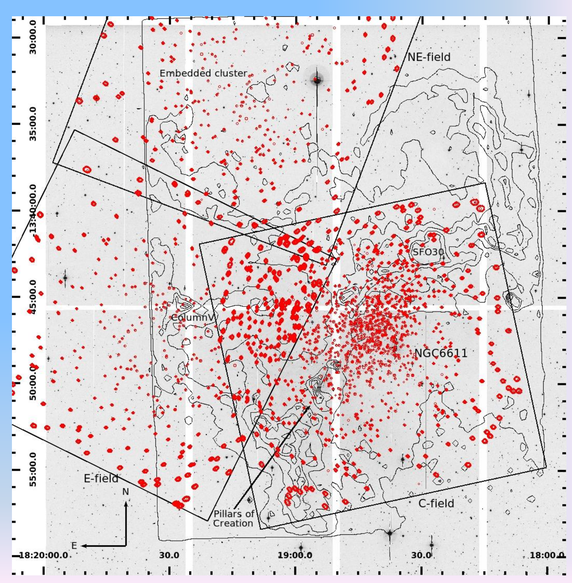
• One archival observation (4) of the central cluster (78Ksec); 2 new observations (80Ksec) centered on the ColumnV and an embedded young cluster at NE (5,6)

•1755 X-ray sources detected with PWDetect (7)

•Individual PSF and background, photons extraction and light curves obtained with ACIS Extract (8)

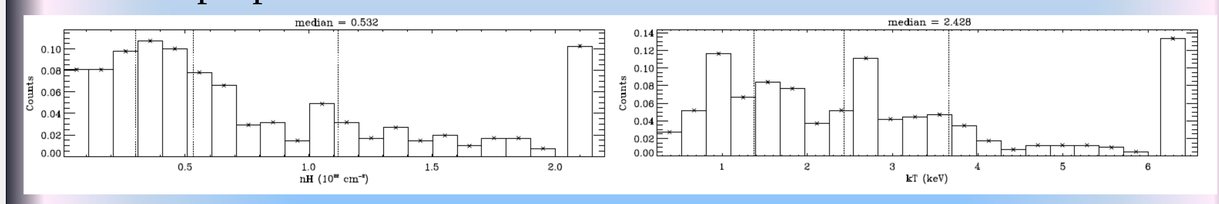
• X-ray properties (N_H, plasma temperature and X-ray luminosity) obtained with spectral analysis with XSPEC and quantile analysis (9)

Optical image of M16 (I band) with: [8.0] emission countours, the field observed with ACIS, and the sources photons extraction regions



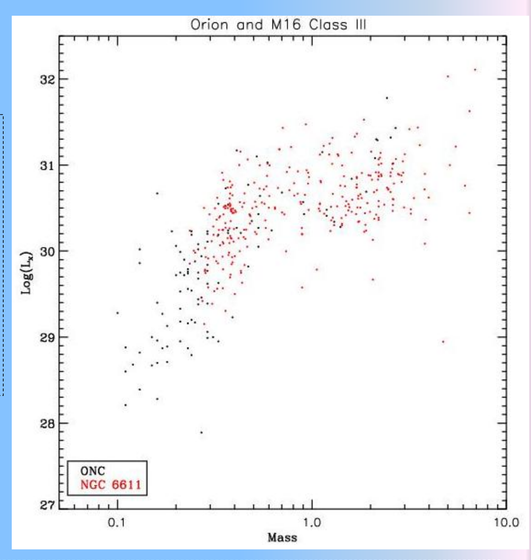
3. X-RAY PROPERTIES

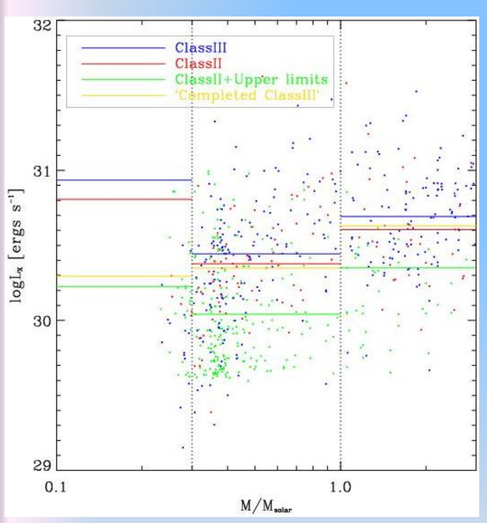
- X-ray sources classified as “member with disk”, “member without a disk”, and “foreground/background source” based on the optical-infrared properties.



- Distributions of N_H, kT for cluster members. The median N_H corresponds to Av=2.7^m. Median values of kT well compare with other regions with similar age.

- X-ray luminosity vs. mass for the ClassIII sources in M16 and Orion. The Lx vs. mass relation is similar in both clusters. (Orion data from COUP (10))



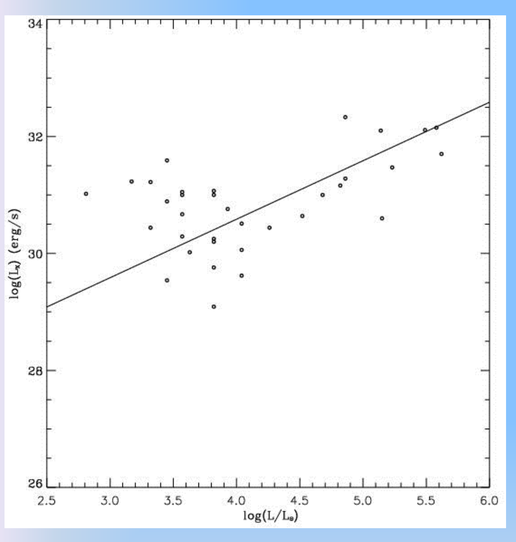


- Lx vs. mass for M16 members, with the upper limits for non detected ClassII objects. The comparison between the median Lx of ClassII+ Upper Limits and the ClassIII sample corrected for the missing population[1], suggests a stronger X-ray activity in disk-less than in disk-bearing members.

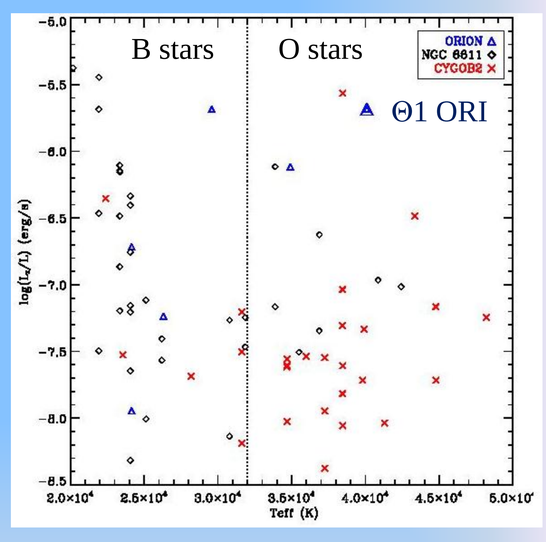
[1]We adopted the most conservative assumption for the upper limits distribution., based on Orion COUP data (11).

4. X-RAY ACTIVITY IN OB STARS

- OB stars detected: 85% O stars (11/13); 43% B0-B2 stars (19/44); 25% B3-B9 stars (9/36)
- All the O stars have soft spectra (kT<1keV), with no hard component: no evidence for the presence of mechanisms for the emission of hard X-ray photons (wind+wind interaction, magnetic reconnection)
- Variability detected in all the B stars with intermediate and hard spectra (kT>1keV)



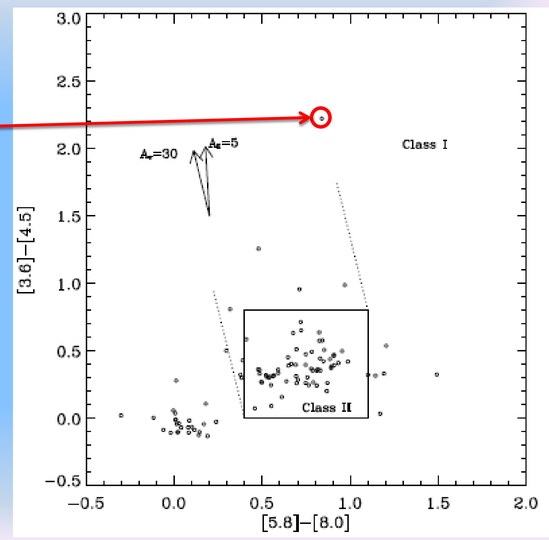
- OB stars in M16 follow the Lx/Lbol ~ 10^{-7}



- Lx/Lbol vs Teff for OB stars in Orion, M16 and CygOB2 (12)

5. DETECTION OF A PROTOSTAR WITH HIGH Lx

- ClassI from the IRAC color-color diagram
- N_H =48.2×10^{22} cm^{-2}, log(Lx)=32.14 erg×s^{-1}; lying in a clump of embedded young objects
- More active than the low-mass protostars in Orion (13), but comparable to an active protostar in M17 (14)



REFERENCES:

(1) Guarcello et al. 2007; (2) Hillenbrand et al. 1993; (3) Guarcello et al. 2010; (4) Linsky et al. 2007; (5) Guarcello et al. 2009; (6) Indebetouw et al. 2007; (7) Damiani et al. 1997; (8) Broos et al. 2010; (9) Hong et al. 2004; (10) Getman et al., 2005; (11) Feigelson et al. 2005; (12) Wright et al. 2009 (13) Prisinzano et al. 2008; (14) Broos et al. 2007