Star formation in the outer Galaxy: NGC 1893

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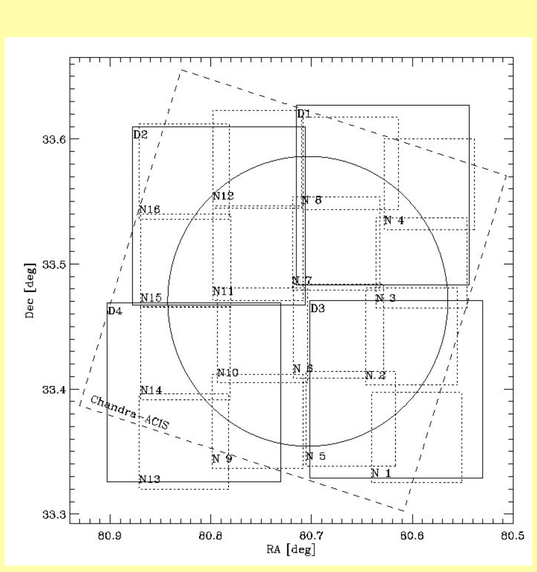
Introduction

We present the results of an ongoing large project of the cluster NGC 1893, a young cluster at large distance from the Galaxy center. This study is part of a larger effort to establish the role of physical conditions in the star formation process. Indeed in the outer galaxy the conditions should be much less conducive to star formation than in the solar neighborhood or in the inner Galaxy: the interstellar radiation field is weaker, prominent spiral arms are lacking and there are fewer supernovae to act as external triggers of star formation. Metal content is, on average, smaller, decreasing radiative losses and therefore increasing cloud temperatures consequently pressure support. Notwithstanding these unfavorable conditions star form also in the outer Galaxy.

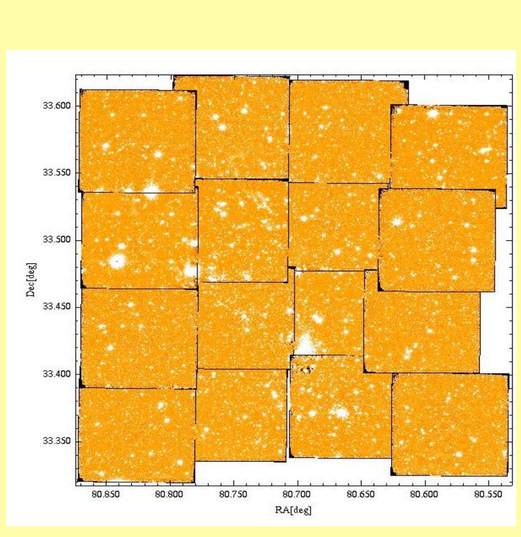
NGC 1893 is a young cluster(1–3 Myr) at a distance of 3600 pc in the anticenter direction, for a total distance of 12 kpc from galactic center. It was known for having several massive members (Tapia et al. 1991, Massey et al. 1995, Marco et al. 2001), with strong indication of large PMS population (Vallenari et al. 1999, Sharma et al. 2007).
We have studied the region adopting a multi wavelength approach, in which different energy bands probe different components of the stellar systems. In particular *optical band* is used to determine the stellar properties, *infrared observations* are the tool to measure the disk properties and *X-rays* are used as membership criterion since stellar X-ray emission is very intense at young ages.

Optical and Near Infrared Data

Dolores@TNG: 4 (8'.6 x 8'.6) fields – V(10-1000s), R(10-700s), I(10-1480s), Ha(60-1400s)
Cafos@CalarAlto: 1 (16') field - – V(15-1500s), R(10-600s), I(10-1500s), Ha(10-1500s)
NICS@TNG: 16 (4'.2x4'.2) fields – J(500s), H(600s), K(700s)



Observed region: optical band, circle and solid squares; NIR, dotted squares; X-rays, dashed square; all the region has been observed by Spitzer

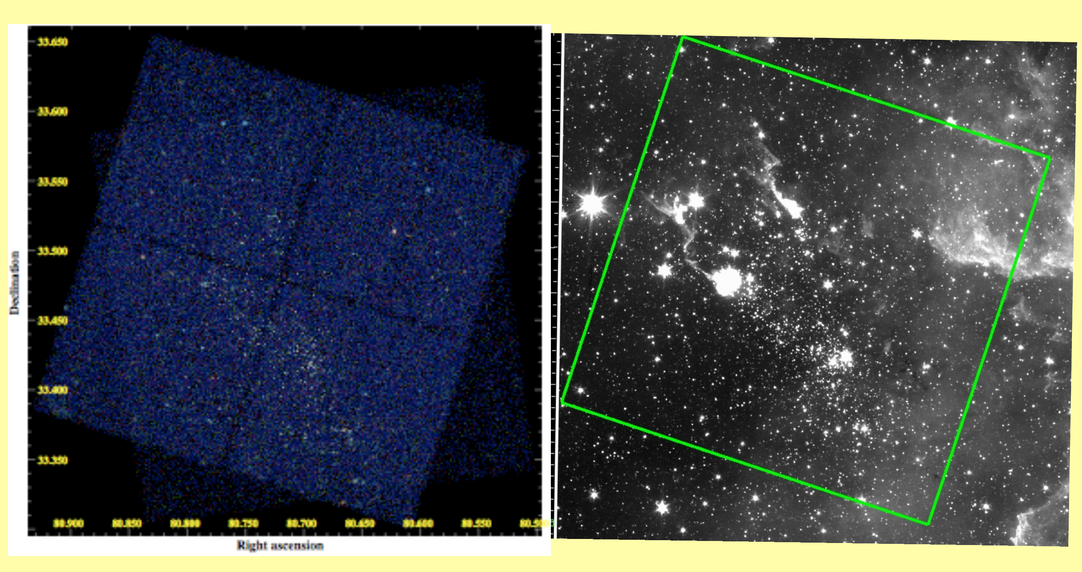


Mosaic of 4x4 fields (4.2'x4.2')
Js band combined image of NICS
Total FOV: 17'x18.5'

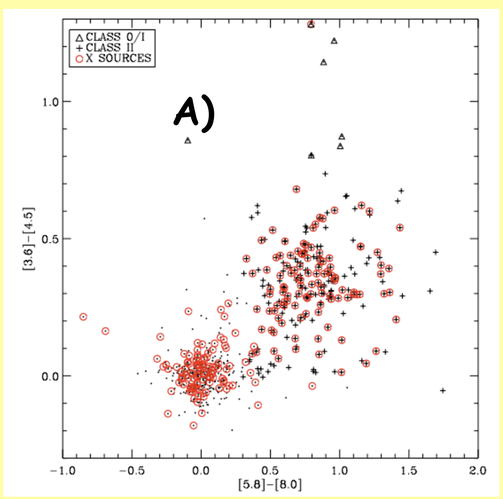
Space observations: Chandra and Spitzer data

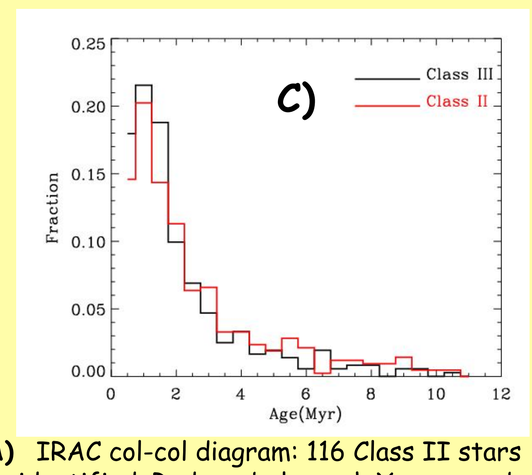
ACIS@Chandra: 17'x17' field (0.5-8.0) keV, 450 ksec

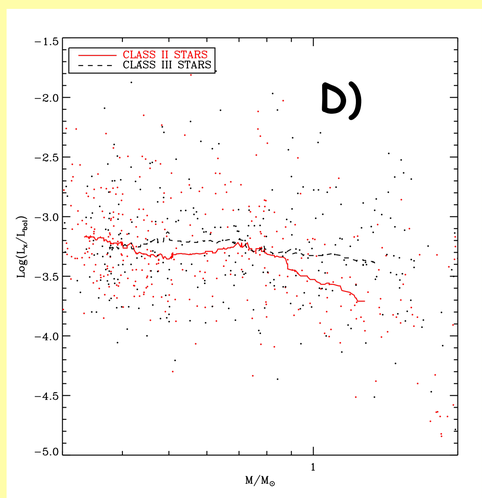
IRAC@Spitzer: mosaic of 26'x30' at 3.6, 4.5, 5.8, 8.0 μ

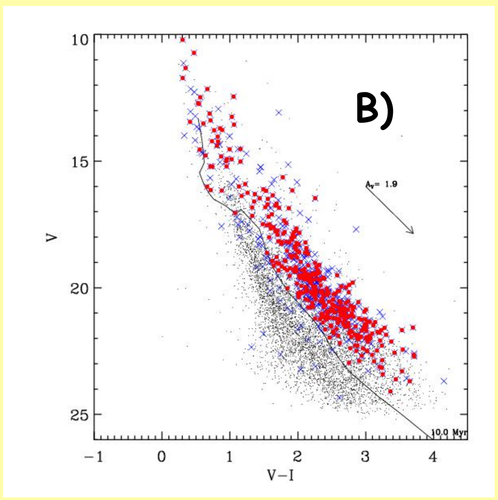


Chandra X-ray (left) and 4.5 micron Spitzer (right) images of NGC 1893. Green box marks the ACIS field of view

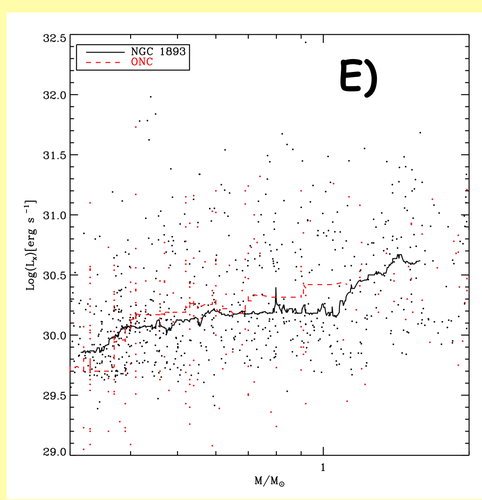








A) IRAC col-col diagram: 116 Class II stars identified. Red symbols mark X-ray members (Caramazza et al.2008 ,A&A,488, 21).
B) H-R diagram of NGC 1893:blue symbols mark X-ray detections, red points are X-ray detections without NIR excess (ClassIII members – 391 stars). (Prisinzano et al. 2010 in press).
C) Age distribution of Class II and Class III members. No significant difference is observed (Prisinzano et al. 2010, in press).
D) Lx/Lbol vs. stellar mass for ClassII and ClassIII members. Lines mark the running medians for the two classes. Note that ClassII stars of solar mass are underluminous (Caramazza et al. in prep.).
E) Lx for NGC 1893 members compared with analogous Orion stars. Lines mark the running medians for the two clusters (Caramazza et al. in prep.). No significant difference is observed.



Results

(Caramazza et al. 2008, 2010 Prisinzano et al. 2010)

- NGC 1893 is a rich cluster with a conspicuous population of PMS
  - 1057 members with circumstellar disk
  - 391 diskless members
- Mean cluster reddening E(B-V)=0.6±0.1
  - evidence of differential reddening
- cluster distance d=3600±200 pc (previous literature values are in the [3250 – 6000] pc range !)
- Class II and III YSOs show very similar age and mass distributions
- a disk fraction of about 70% (in agreement with that found in cluster of similar age, Haisch et al. 2001)
- Class II are less X-ray luminous than Class III stars at mass > 0.8 Msun
- The mass dependence of the X-ray luminosity of NGC 1893 members is similar to that of Orion stars

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