Stars with circumstellar disks in NGC 6611

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1. Introduction

We present a multi band study of the stars with circumstellar disk in the young open cluster NGC 6611. We aim at studying the influence of UV radiation from massive stars on the evolution of nearby disks. The young open cluster NGC 6611, in the Eagle Nebula, is a suitable target for this kind of study thanks to its large population of massive stars (more than 50 members with spectral class earlier than B5) distributed irregularly in the central region of the cluster. To reach our objective, we compiled a multi band catalog using optical WFI observations in BVI bands (to determine stellar properties), 2MASS catalog and IRAC data from the GLIMPSE survey (to detect disk presence) in a region of 33′×34′ centered in the cluster, and a Chandra X-ray observation in the central region of 17′×17′ (for membership criterion).

2.Cluster properties

Using X-ray emission as a membership criterion (especially useful for Class III stars, see Fig. 1), in Guarcello et al. (2007) we have determined:

- a distance of 1750 parsec, from the fact that the radiation from background stars is strongly absorbed by the Eagle Nebula;
- an age interval of 0.1-3 Myrs, obtained fitting the isochrones to the locus of massive X-ray sources;
- an average extinction for cluster members (A_V=2.6^m) and an anomalous reddening law (R_V=3.27);
- a core radius (1.4±0.1pc) and a relaxation time for the core of 4.2 Myrs, greater than the age of the pre-main sequence population (see Fig. 2).

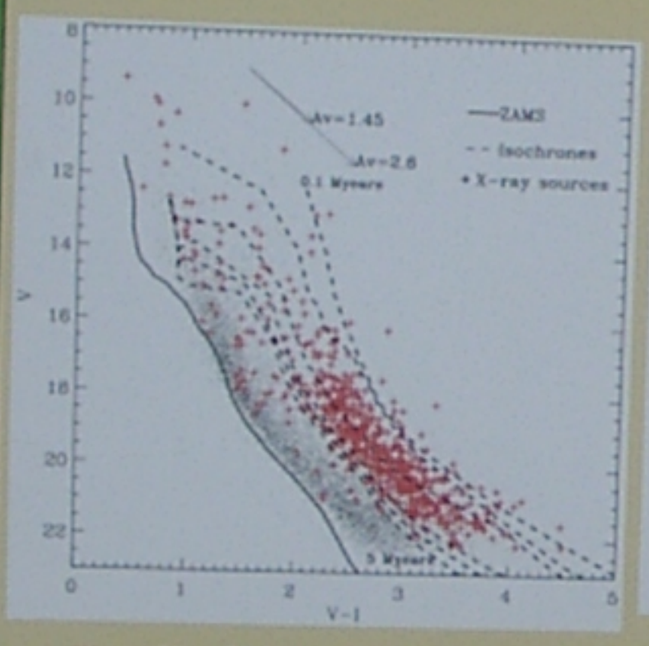

Fig 1: V *vs* V-I *diagram of the stars in 33′×34′ FOV. ZAMS and the isochrones are from Siess et al. (2000), while the extinction vectors were obtained from the reddening law from Munari & Carraro (1996).*

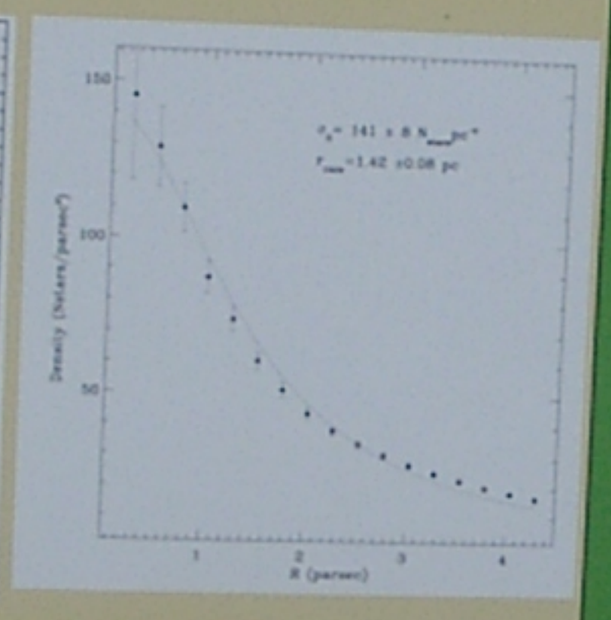

Fig 2: *Observed radial density profile of the cluster (points) and best-fit 2-parameters profile (dotted line) from King (1966)*

3. Selection of stars with circumstellar disk

- We identified the circumstellar disks thanks to the infrared excess detected by suitable free-reddening optical-2MASS and optical-IRAC color indices, that are more negative for stars with excesses (e. g. Fig.3):

$$Q_{ABCD} = (A - B) - (C - D) \times E_{A-B}/E_{C-D}$$

where A, B, C and D are four generic magnitudes in four different bands and E_{A-B} and E_{C-D} are the corresponding reddening. With this method, we identified 360 stars with disk in the 33′×34′ WFI Field Of View (FOV).

- With the Color-Color IRAC diagram (see Fig. 4) we confirmed the selected members with disk and we identified 110 more stars with circumstellar disk, 64 of which are classifiable as Class II stars.

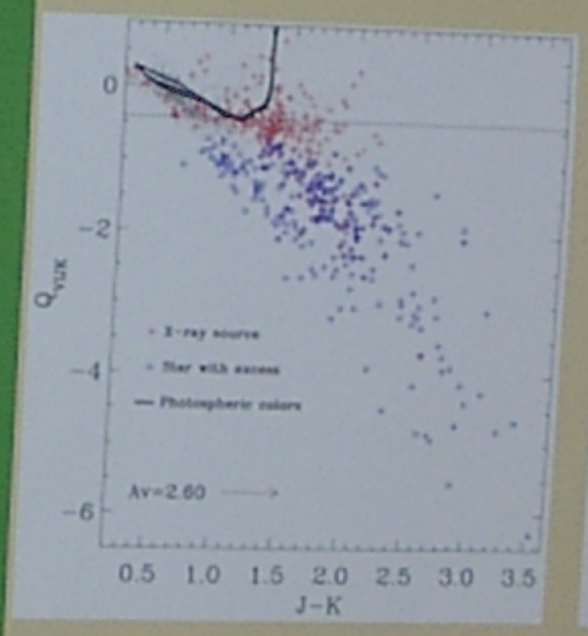

Fig 3: Diagram *used to identify stars with excess in K, i.e. stars with the Q_{VJK} index smaller than the photospheric limit (dotted line) for more than 3σ.*

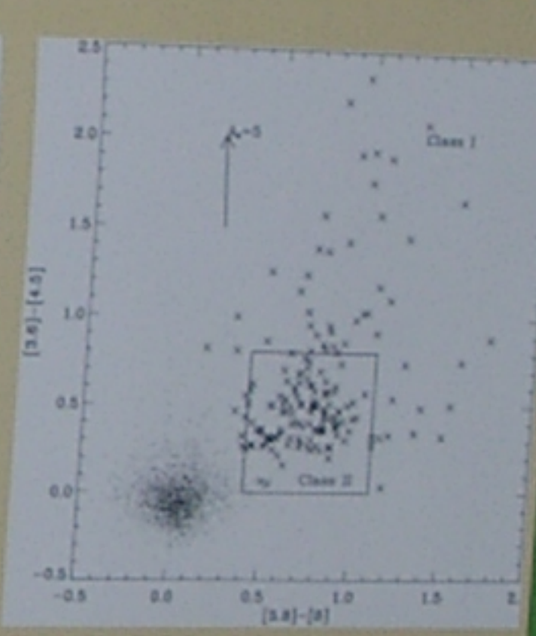

Fig 4: *IRAC Color-Color diagram of the stars in 33′×34′ FOV. The box delimits the locus of Class II stars (Allen et al., 2004; Megeath et al., 2004). The reddening vector was obtained from the reddening law of Flaherty et al. (2007)*

4. Spatial distributions

We calculated the UV flux, in the central 17′×17′ region, emitted by massive members and incident on the members with and without disk. To this aim, we used the histogram of the ratio between the number of members with disk with respect of those without disk, versus the incident UV flux, shown in Fig. 5.

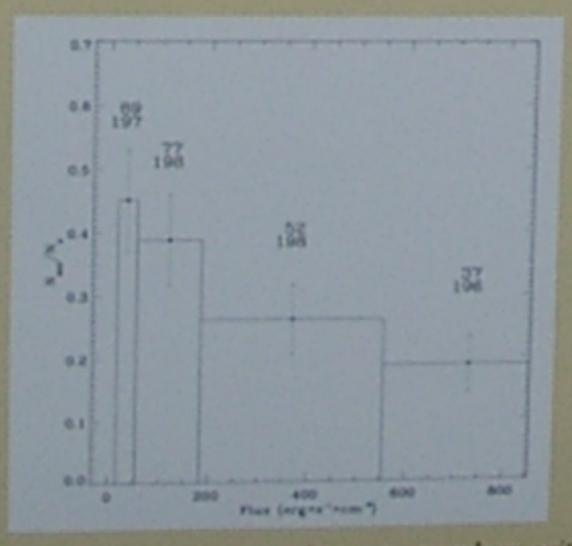

Fig 5: *Histogram of the ratio between members with (upper numbers) and without disk (lower numbers) versus the incident UV flux*

We needed to study this ratio because of the irregular spatial distribution of the cluster, as traced by X-ray sources. The histogram shows that the members with disk are more frequents at low values of incident UV flux, i.e. at larger distances from massive stars. Considering that the central region is not yet relaxed and that we have no evidence of sequential star formation, we conclude that this result is in agreement with the hypothesis that the evolution timescales of the circumstellar disks may be modified by the photoevaporation process.

5. Preliminary SED analysis

We started to study the Spectral Energy Distributions (SED) of members with disk (e. g. Fig. 6). With the use of the theoretical models of stars with circumstellar disk (developed by Robitaille et al., 2007; D'Alessio et al., 1998, 1999 and 2001) and data at longer wavelength, we will study the disk physical properties at different values of incident UV flux.

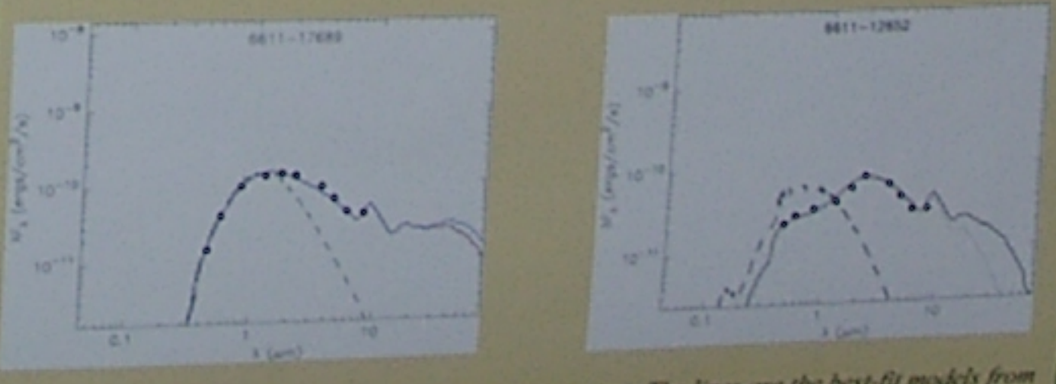

Fig 6: *Observed SED of two members with disk (point). The lines are the best-fit models from Robitaille et al., 2007. The dotted lines are the photospheric models.*

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