A Spectroscopic Census of the young sigma Orionis cluster

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OVERVIEW

We present a spectroscopic survey of the stellar population of the sigma Orionis cluster. Using low resolution spectra and the SPTCLASS code, we have obtained spectral types for 340 stars. Spectroscopic data for spectral typing come from several spectrographs with similar spectroscopic coverage and resolution. More than half of the stars of our sample are members confirmed by the presence of lithium in absorption, strong Hα line in emission or presence of weak gravity-sensitive features. In addition, we have obtained high resolution (R∼34,000) spectra in the Hα region for 169 stars in the cluster. Radial velocity was calculated from this data set. The radial velocity distribution for members of the cluster is in agreement with previous works. Analysis of the profile of the Hα line and infrared observations reveals two binary candidates or fast rotators that mimic the Hα width expected in stars with accretion disks. On the other hand there are stars with optically thick disks and narrow Hα profiles not expected in accreting stars. This contribution constitutes the largest homogeneous spectroscopic data set to date.

Table 1: Instruments used in this work

Observatory	Instrument	Resolution	Range(A)
MMTO	HECTOCHELLE	34000	6535-6717
MMTO	HECTOSPEC	1094	3650-9200
FLWO	FAST	1094	3800-7200
OAN-SPM	Boller&Chiven	1193	3900-7200
MDMO	OSU-CCDS	1010	3900-7300
GH-Cananea	Boller&Chiven	656	4100-7300

The sigma Ori cluster is a natural laboratory to study stars and protoplanetary disks in the first stages of their evolution. Regardless that substantial efforts have been devoted to identify and characterize stars in the cluster, from its most massive members to planetary mass objects, spectroscopically determined spectral types exists for a fraction of members or candidates. Since spectral typing is a cornerstone to derive stellar parameters of individual stars, we have obtained spectral types for most of the photometric candidates of the sigma Ori cluster with V<16.5 (M>0.35Msun). We have used SPTCLASS, a tool designed to analyze low resolution spectra of young stars (see Poster by M. Contreras). We complete our study analyzing high resolution Hectochelle spectra obtained for a sample of photometric candidates of the cluster

Figure 1 shows the distribution of the spectral types obtained for our sample (red histogram). Most stars with derived spectral types are likely members on the basis that: (1) they have LiI in absorption, weak gravity sensitive features or strong Hα line, (2) they have infrared excesses, (3) they have radial velocities expected for the cluster, or (4) they are X ray emitters (blue histogram). **Figure 2** shows the distribution of extinctions derived for the total sample and for the likely members.

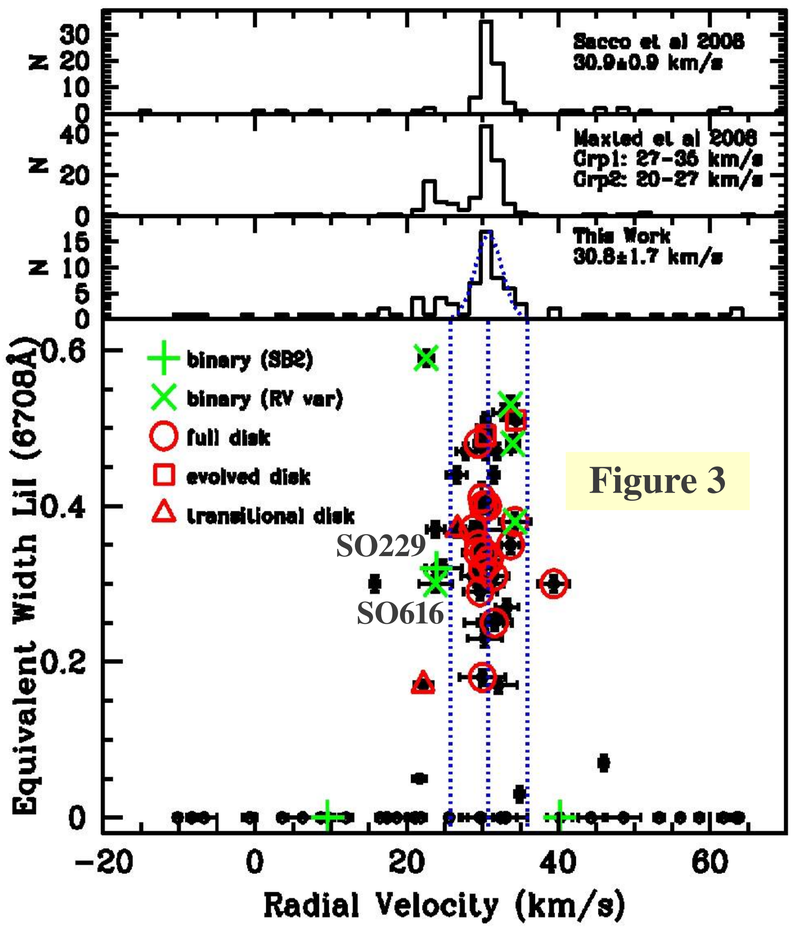

Figure 3

Fig 3: Radial Velocity (RV) Distribution. RV were derived from Hectochelle data using the IRAF package rvsao which cross-correlates each spectrum with a set of templates. SB2 are binary candidates that show double peaks in the cross-correlation function. There are binary candidates that show RV variability comparing our measurements to RV reported by other works. Our RV distribution can be described by a Gaussian function centered at 30.8 km/s with a sigma of 1.7 km/s. In general stars with LiI in absorption have radial velocities in or near the region defined by a 3 sigma criteria. Disk classification are from Hernandez et al (2007).

Figure 4 shows the relation between the width of Hα at 10% of the line peak (WHα[10%]) and the IRAC SED slope determined from the [3.6]-[8.0] color.

The dotted vertical line defines the limit to distinguish between accreting and not accreting stars (White and Basri, 2003). In general, diskless stars have WHα[10%]<200 km/s. Only two diskless stars, identified in **Figure 3** as binary candidates with LiI in absorption (SO229 and SO616), mimic the Hα width expected in stars with accretion disks. In **Figure 5**, we compare the spectra of SO229 and SO616 to stars with similar spectral types (G2.5 for SO229 and K7 for SO616). It is apparent that SO299 and SO616 have wider photospheric features. The broadening of spectral lines can be caused by fast rotation or by combined spectroscopic features from component in binary stars with similar spectral types. We are doing a multi-epoch photometric analysis to reveal the nature of these objects.

Figure 4 also shows a group of stars with full disks and WHα[10%]<270 km/s (no accreting stars). These stars can be in a passive accreting phase or have completely stopped the accretion from the disk to the star. We will need multi-epoch high resolution spectroscopic data to distinguish between these two possibilities.

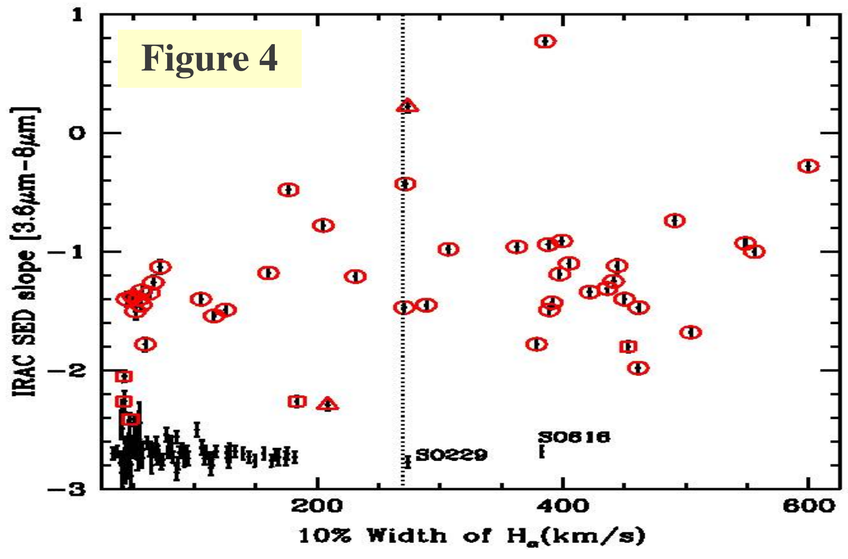

Figure 4

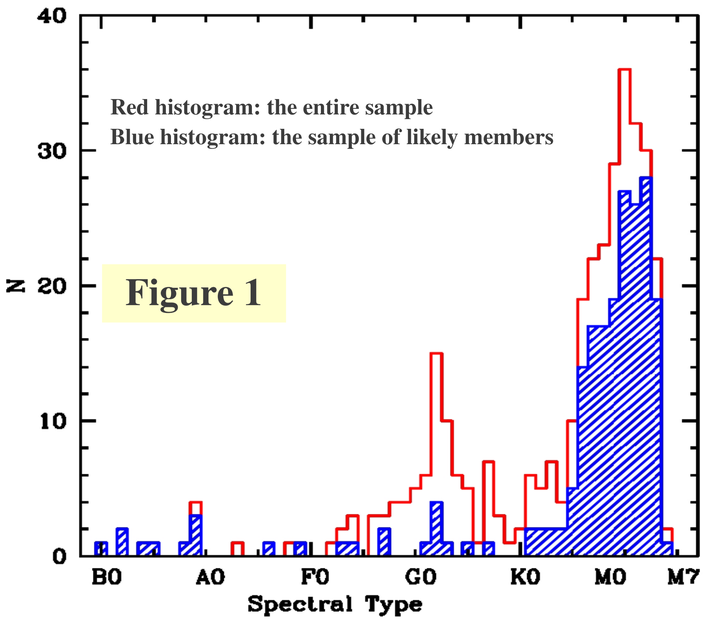

Figure 1

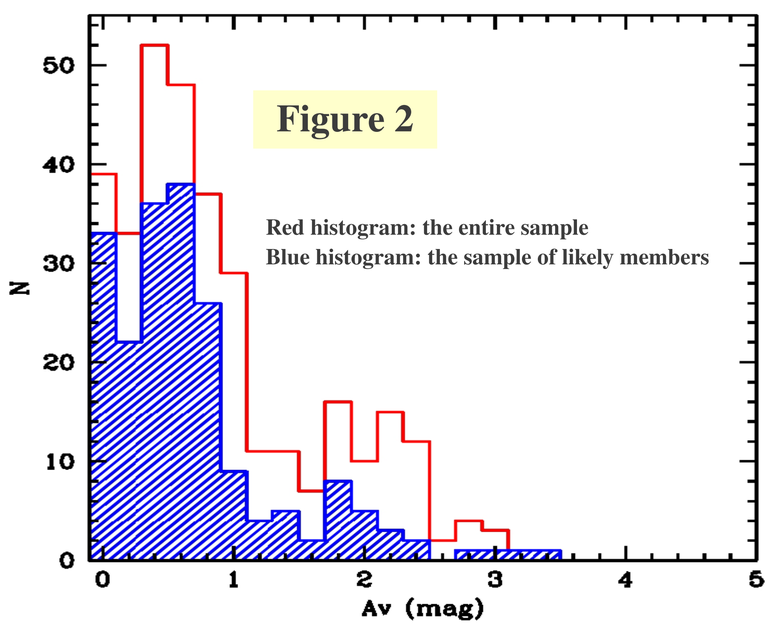

Figure 2

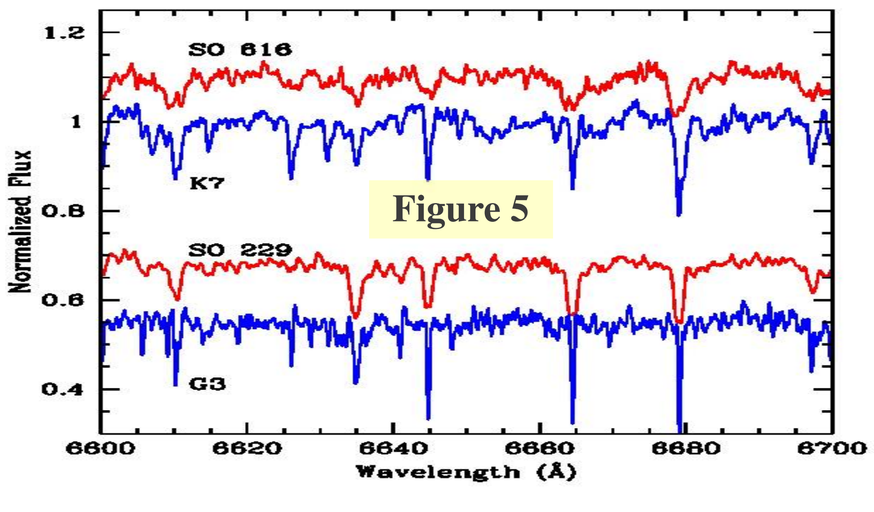

Figure 5

References

[1] Hernandez et al 2007, ApJ 662, 1067; [2] Sacco et al 2008, A&A, 488, 167; [3] Maxted et al 2008, MNRAS, 386, 261; [4] White and Basri 2003, ApJ, 582, 1109