Data mining:

Study of five open clusters using optical and infrared surveys

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From a sample of 305 open clusters covered by the Sloan Digital Sky Survey, we selected a group and studied them in a systematic and homogeneous way. For this pourpouse we developed a set of routines in Python. These routines perform multiband (u, g, r, i, z) aperture photometry and correlate this information with other photometric catalogues (APASS, WISE and 2MASS), and available spectroscopic stellar classification. Our procedure employ a statistical method to establish cluster's centers and covered region. On the other hand, it selects the most probable cluster members and possible YSO and/or PMS candidates using a phtometric criteria. In the this work we present a preliminary analysis of five open clusters of the sample estimating their fundamental parameters as their maximum density coordinates, reddening, distance and ages.

1-Introduction

In this work we intend to reflect and show the reliability and validity of the study and analysis of open clusters and star formation regions using the Sloan Digital Sky Survey (SDSS) phtometric system . In turn, these results are part of a general, homogeneous and systematic overview study of those objects identified as embedded and open clusters with SDSS images (Ahn C. P. et al. 2012) counterpart.

2-Selected open clusters

Berkeley 7 (Lata et al. 2014) and Berkeley 55 (Negueruela & Marco 2012), are two open clusters widely studied in the Johnson photometric system, with well established results in the literature. This provides us a comparison sample. On the other hand, Mayer 2 (Kharchenko et al. 2013), BDS2003-36 (Bica, E. et al. 2003) and Czernik 7 (Camargo et al. 2009) have been only identified and studied using 2MASS (Cutri et al. 2003) data.

3-Data, Methodology and Analisys

The developed code[1] takes as a starting point the fundamental parameters of open cluster catalogs (Dias et al. 2002, Bica et al. 2003, Kumar et al. 2006). For each object, it acquires spectroscopic information from Simbad database and photometric data from the 2MASS, WISE (Cutri et al. 2013) and APASS (Henden, A. A. et al. 2016) surveys. It correlates these catalogs and the results of the aperture photometry performed on SDSS images. In this procedure, the code employ a searching radius of $3''$.

The code selects the brightest sources ($J < 14$) to construct a stellar density map setting the coordinates of its maximum density, and the mean distribution value. Therefore, it defines the cluster area, selecting those stars that inhabit the stellar density region wich lies over its mean value. For each area, it performs the photometric diagrams, characterizing the different stellar populations: early type stars (blue circles), pre-main sequense populations (PMS) (orange squares), sources with abnormal redness, or that respond to the classical T-Tauri stars relation (red circles and dark red squares) (Meyer et al. 1997). In this procedure we use the criteria established in Molina-Lera et al. (2016).

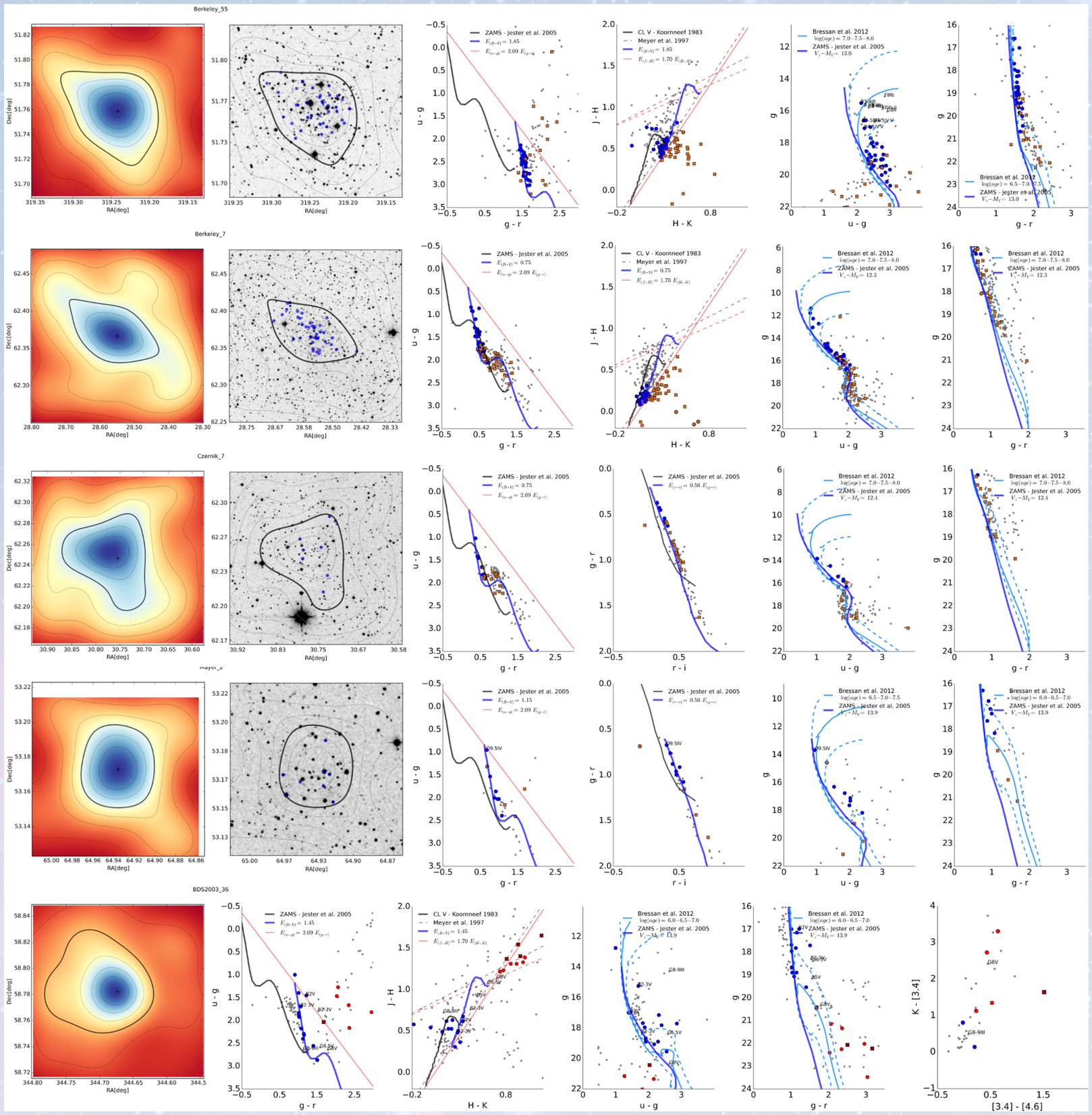
4-Prelimiray Results

The similarity between our results and those in the literature, for Berkeley 7 and 55, shows indications that validate our procedure (see Table).

Mayer 2 is a young cluster, possibly associated to the HII region LBN 151.25+02.12. It presents characteristics of a PMS star population. The estimated ages (nuclear and contraction) are similar and consistent with theoretical stellar evolution models of the earliest type star in the cluster (GSC 03719-00546, Spt O9.5IV). The spectrophotometric analysis yields restults for $E_{(B-V)} = 1.11$ and $MD = 13.96$, which are consistent with our photometric estimates.

Czernik 7 y Berkeley 7 shows very similar characteristics. Both are young open clusters, located at a distsance of $\sim$ 3 kpc, whith $E_{(B-V)} = 0.75$, and an angular separation of $\sim$ 55 arcsec.

BDS2003-36 is an young cluster embedded in the SH 2-152 HII region whith a confirmed population of B-type sources.



Left: Density stellar maps. Photometric diagrams: Black and blue curves coorespond to main sequense (MS) or ZAMS reference stars. Continuous red curves represent redness direction. Red dotted curves show Mayer et al. (2007) criterion. Posible stellar populations: blue dots, early type stars; PMS, orange squares; YSOs, red circles and dark red squares.

Cl	Berkeley 55	Berkeley 7	Czernik 7	Mayer 2	BDS2003-36
This work (* maximun density coordinates)					
α_{J2000}*	21:16:58.31	01:54:13.12	02:03:04.50	04:19:44.50	22:58:42.38
δ_{J2000}*	51:45:33.58	62:22:03.65	62:15:10.51	53:10:22.50	58:46:57.25
$E_{(B-V)}$	1.85	0.75	0.75	1.15	1.45
$V_\circ - M_V$	13	12.3	12.4	13.9	13.9
$\log(age - nuc[yrs])$	$\sim$ 7.5	$\sim$ 7.5	7.5-8.0	6.5-7.0	$<$ 6.5
$\log(age - cont[yrs])$	$\sim$ 7.5	$\sim$ 7.5	$\sim$ 7.5	$\sim$ 6.5	$\sim$ 6.5
(Dias et al. 2002, Bica et al. 2003, Kumar et al. 2006)					
α_{J2000}	21:16:58	01:54:12	02:03:01	04:19:45	22:58:41
δ_{J2000}	51:45:32	62:22:00	62:14:48	53:10:00	58:46:54
r [$'$]	2.1	2	5	1.5	–
$E_{(B-V)}$	1.85	0.8	0.7	1.06	–
$V_\circ - M_V$	13	12.05	12.6	11	–
$\log(age - nuc[yrs])$	7.7	6.6	8.34	7.4	–

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