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PHOTOMETRIC ANALYSIS OF NEWLY DISCOVERED OPEN CLUSTERS SAI 24 AND SAI 94 BASED ON PPMXL CATALOGUE

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SUMMARY: In our present work, we studied the photometric characteristics (core radius, limiting radius, reddening . . . etc.) as well as their dynamical state of the two newly discovered open clusters, SAI 24 and SAI 94. We investigated their photometric properties in the J, H, and K_s bands with the PPMXL catalogue. A method of separating open cluster stars from those belonging to the stellar background has been employed. The results of our calculations indicate that the numbers of probable members in SAI 24 and SAI 94 are 202 and 199, respectively. We have estimated the cluster center for SAI 24, i.e. $\alpha_{2000} = 02^{h}\ 59^{m}\ 26\overset{s}{.}36$ and $\delta_{2000} = 60^\circ\ 33'\ 02\overset{''}{.}50$ and for SAI 94 is $\alpha_{2000} = 08^{h}\ 10^{m}\ 16\overset{s}{.}36$, $\delta_{2000} = -46^\circ\ 17'\ 07\overset{''}{.}91$. The core radii $r_{\rm core}$ for SAI 24 and SAI 94 are found to be (1.92 ± 0.38) arcmin and (1.22 ± 0.10) arcmin, respectively and in the same manner the limiting radii $r_{\rm lim}$ are about (2.45 ± 0.64) and (3.07 ± 0.57) arcmin. From the color-magnitude diagram, in view of the approximate logarithmic ages for SAI 24 and SAI 94 of 7.20 ± 0.20 and 9.10 ± 0.05, their distances are estimated to be (930 ± 30) pc and (3515 ± 60) pc, respectively. Also, we have calculated their projected distances ($X_\odot$ and $Y_\odot$) to the Galactic plane and the projected distance $Z_\odot$ from the Galactic plane.

The luminosity and mass functions of SAI 24 and SAI 94 clusters were outlined; accordingly, the masses were calculated to be (285 ± 17) $M_\odot$ and (317 ± 18) $M_\odot$, respectively. Finally, we concluded that these two clusters are dynamically relaxed according to our estimation of their dynamical evolution parameter τ as a function of their crossing time $T_{\rm cross}$. The evaporation time $\tau_{\rm ev}$ as a function of their relaxation time $T_{\rm relax}$ is about 6.18 Myr and 25.38 Myr for SAI 24 and SAI 94, respectively.

Key words. Techniques: photometric - Open clusters and associations: individual: SAI 24, SAI 94

1. INTRODUCTION

Open clusters are important celestial objects in understanding star formation (Joshi et al. 2016). Stellar clusters are born embedded within giant molecular clouds (GMCs) and during their formation and early evolution are often only visible at infrared wavelengths (Lada and Lada 2003).

Further, Lada and Lada (2003) classified the open cluster to two environmental classes based on their stellar association with the interstellar matter. The first: exposed clusters – clusters with little or no interstellar matter within their boundaries (i.e. almost all open clusters found in standard catalogues fall into this category). The second: embedded clusters – clusters that are fully or partially embedded in interstellar gas and dust. This class is invisible at an optical wavelength and best detected in the infrared region.

Koposov et al. (2008) searching for Galactic star clusters in large multiband surveys and Glushkova et al. (2010) listed 168 newly discovered open clusters, among which 26 are the embedded ones. From this list we have selected two clusters, SAI 24 ($\alpha_{2000} = 02^{\rm h}\ 59^{\rm m}\ 05\overset{\rm s}{.}4$, $\delta_{2000} = 60°\ 33'\ 58\overset{''}{.}00$) and SAI 94 ($\alpha_{2000} = 08^{\rm h}\ 44^{\rm m}\ 39\overset{\rm s}{.}80$, $\delta_{2000} = -46°\ 17'\ 46\overset{''}{.}00$) to subject them to a Photometric analysis.

To extract the J, H, and Ks photometry and astrometry data, we used the Virtual Observatory resource named Sternberg Astronomical Institute Catalogue Access Services (SAI CAS; http://vo.astronet.ru), allowing us to access the largest astronomical catalogs (Koposov et al. 2007 and Glushkova et al. 2010).

The structure of this article is as follows: Section 2 is concerned with the data extraction and analysis; Section 3 is devoted to the color magnitude diagram and isochrones fitting; Section 4 deals with the luminosity and mass functions; Section 5 shows the dynamical state of the clusters under investigations. The conclusion is presented in the Section 6.

2. DATA EXTRACTION AND ANALYSIS

Results for both clusters obtained earlier are listed in Table 1 with the corresponding references. Some of these data are used in the present work but the basic parameters are generally here reobtained.

In our calculations, the download data are taken from the PPMXL[1] catalogue (Roeser et al. 2010). Although the apparent diameters of these two clusters are about 6 arcmin and 5 arcmin, respectively, we exceeded the download data diameters of both clusters by about 10 arcmin in order to reach the background field stars. This way, we get from the PPMXL catalogue a complete worksheet data including the angular distance from the center, right ascension, and declination for the J, H, and K_s (near infrared) region for both two clusters, SAI 24 (778 points) and SAI 94 (617 points).

Table 1: Basic parameters of SAI 24 and SAI 94 open clusters.

Parameter	SAI 24	SAI 94	References
α_{2000}	$02^{\rm h}\ 59^{\rm m}\ 24\overset{\rm s}{.}41$	$08^{\rm h}\ 44^{\rm m}\ 40\overset{\rm s}{.}22$	Kharchenko et al. (2016)
	$02^{\rm h}\ 59^{\rm m}\ 05\overset{\rm s}{.}40$	$08^{\rm h}\ 44^{\rm m}\ 39\overset{\rm s}{.}80$	Glushkova et al. (2010)
	$02^{\rm h}\ 59^{\rm m}\ 25\overset{\rm s}{.}00$	$08^{\rm h}\ 44^{\rm m}\ 40\overset{\rm s}{.}00$	Dias et al. (2002)
δ_{2000}	$60°33'52\overset{''}{.}40$	$-46°44'54\overset{''}{.}60$	Kharchenko et al. (2016)
	$60°33'58\overset{''}{.}00$	$-46°17'46\overset{''}{.}00$	Glushkova et al. (2010)
	$60°32'58\overset{''}{.}00$	$-46°17'46\overset{''}{.}00$	Dias et al. (2002)
l	$138\overset{\circ}{.}037$	$265\overset{\circ}{.}422$	Kharchenko et al. (2016)
	$138\overset{\circ}{.}030$	$265\overset{\circ}{.}434$	Dias et al. (2002)
b	$01\overset{\circ}{.}485$	$-02\overset{\circ}{.}171$	Kharchenko et al. (2016)
	$01\overset{\circ}{.}502$	$-02\overset{\circ}{.}180$	Dias et al. (2002)
$r_{\rm core}$ (arcmin)	0.96 ± 0.34	0.93 ± 0.20	Kharchenko et al. (2013)
$r_{\rm lim}$ (arcmin)	2.70	2.82	Kharchenko et al. (2013)
$r_{\rm t}$ (arcmin)	13.34	11.50	Kharchenko et al. (2013)
Distance (pc)	1000	3886	Kharchenko et al. (2016)
	1000	3910	Dias et al. (2002)
Distance modulus (m-M)	10.401	13.365	Kharchenko et al. (2016)
Diameter (arcmin)	9.00	5.00	Glushkova et al. (2010)
E(B-V)	0.500	0.521	Kharchenko et al. (2016)
	0.500	0.480	Dias et al. (2002)
E(J-K_s)	0.240	0.250	Kharchenko et al. (2013)
E(J-H)	0.160	0.167	Kharchenko et al. (2013)
log (age)	7.20	9.09	Kharchenko et al. (2016)
	7.20	9.10	Dias et al. (2002)

[1]http://vizier.cfa.harvard.edu/viz-bin/VizieR?-source=1/317

2.1. Clusters Centers and Radial Density Profile RDP

In our calculations, we started the data analysis by re-determining the cluster centers using the procedure presented by many authors e.g., Maciejewski and Niedzielski (2007), Maciejewski et al. (2009). In this procedure, two perpendicular strips were cut along α and δ at an approximate center of the cluster, and then the Histograms of the star counts have been built along each strip.

The Histogram of both coordinates α and δ is fitted by a Gaussian distribution function in which the location of the maximum peak indicates the new cluster center. Table 2 presents values of new centers for both clusters, and Fig. 1 gives the position of the new cluster centers, respectively.

Table 2: Our estimated centers of SAI 24 and SAI 94 open clusters.

Parameter	SAI 24	SAI 94
α_{2000}	$02^{h}\ 59^{m}\ 26^{s}.36$	$08^{h}\ 10^{m}\ 16^{s}.36$
δ_{2000}	$60^{\circ}33'02''.50$	$-46^{\circ}17'07''.91$
l°	$138^{\circ}.093$	$261''.975$
b°	$1''.489$	$-07^{\circ}.017$

By comparing our results with Dias et al. (2002) and Kharchenko et al. (2016), we notice that:

- For SAI 24, our new estimation of right ascension is greater by about $1^{s}.36$ and $1^{s}.95$ of the values obtained by the two authors, respectively. On the other hand, our new estimation of declination is greater than that of Dias et al. (2002) by about $4''.5$ and smaller than that given by Kharchenko et al. (2016) by about $49''.9$.

- For SAI 94, our new estimation of right ascension is smaller than that given by Dias et al. (2002) and Kharchenko et al. (2016) by about $34^{m}\ 23^{s}.64$ and $34^{m}\ 23^{s}.86$, respectively. On the other hand, our estimated declination is greater than that given by Kharchenko et al. (2016) by about $13''.31$ and smaller than that given by Dias et al. (2002) by about $38''.09$.

For these two clusters, and by using our new estimation of centers (α,δ) shown in Table 2, we get a new worksheet data (sources), i.e. angular distance, right ascension, and declination with the PPMXL catalogue of SAI 24 and SAI 94 clusters with radii of 6 and 5 arcmin, respectively.

Due to the internal and/or external dynamical process-taking place in/out of the cluster, the spatial shape of the cluster may not be perfectly spherical.

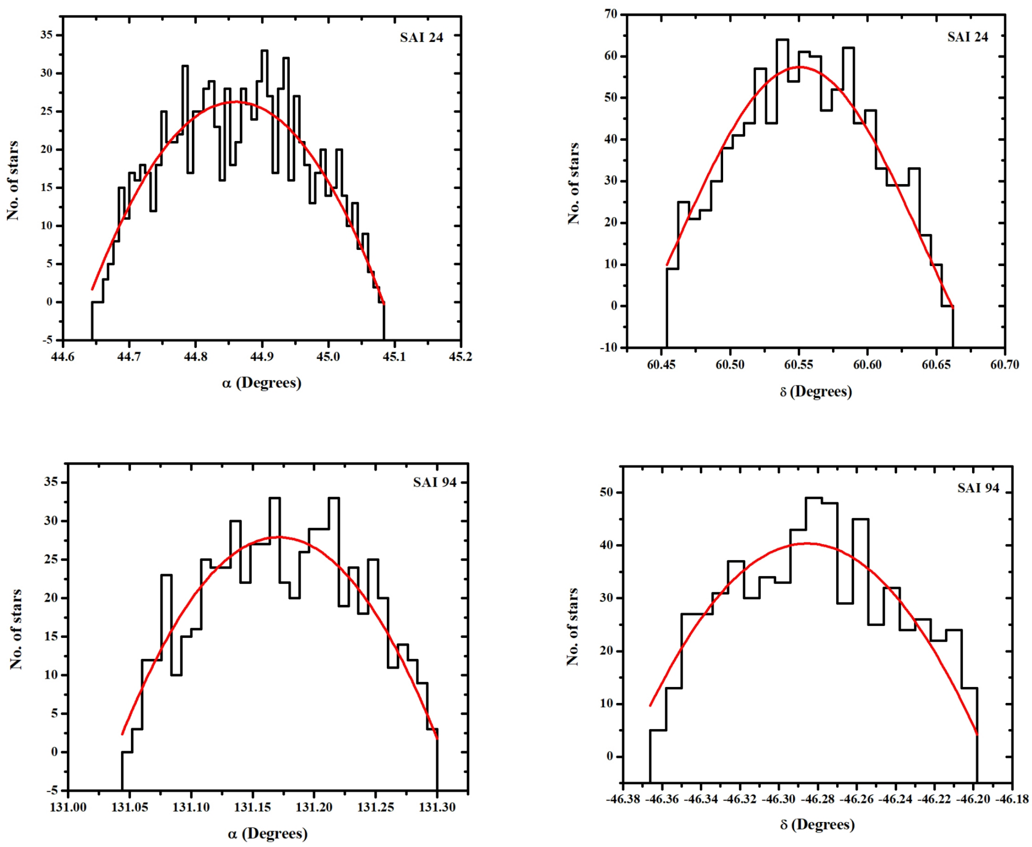

Fig. 1. *The Gaussian fit provides the coordinates of the highest density areas in α and δ of SAI 24 (upper panel) and SAI 94 (lower panel).*

The King's (King 1962) surface density distribution $\phi(R)$ as a function of tidal radius r_t and core radius r_{core}, is:

$$\phi(R) = k[(1+(r/r_{core})^2)^{-1/2} - (1+(r_t/r_{core})^2))^{-1/2}]^2. \quad (1)$$

where k is a constant.

For our study, and in order to calculate the density function $\rho(r)$ in concentric rings as a function of the radius r from the cluster center outward (i.e. Radial Density Profile RDP), we apply the King's model (King 1966), which approximates King's formula of Eq. (1), i.e.:

$$\rho(r) = f_{bg} + \frac{f_o}{1 + (r/r_{core})^2}, \quad (2)$$

where f_{bg}, f_o, and r_{core} are the background, central star density, and the core radius of the cluster, respectively. Fig. 2 gives our calculations for the surface density distribution $\rho(r)$. The numerical values of f_{bg}, f_o, and r_{core} are listed in Table 3.

Table 3: RDP parameters of both clusters.

Parameter	SAI 24	SAI 94
f_{bg} (stars/arcmin^2)	0.550 ± 0.038	0.589 ± 0.019
f_o (stars/arcmin^2)	0.30 ± 0.03	0.416 ± 0.123
r_{core} (arcmin)	1.92 ± 0.38	1.22 ± 0.10
r_{lim} (arcmin)	2.45 ± 0.64	3.07 ± 0.57

By comparing our estimated core radius r_{core} for both clusters with that given by Kharchenko et al. (2013) we notice that our calculated value for the SAI 24 open cluster is greater by about 0.955 arcmin, while for the SAI 94 open cluster it is greater by about 0.291 arcmin.

In our calculations of the limiting radius r_{lim} of the cluster, we apply the relation of Tadross and Bendary (2014), which states that:

$$r_{lim} = r_{core}\sqrt{\frac{f_o}{3\sigma_{bg}} - 1}. \quad (3)$$

where σ_{bg} is the uncertainty of the background surface density f_{bg}. Table 3 presents our estimated r_{lim} for both clusters. For the SAI 24 cluster, our value of r_{lim} is smaller than that given by Kharchenko et al. (2013) by about 0.25 arcmin, while for the SAI 94 cluster our value of r_{lim} is much greater than that given by Kharchenko et al. (2013) by about 0.25 arcmin.

Nilakshi et al. (2002) concluded that the angular size of the coronal region is about $6r_{core}$. While Maciejewski and Niedzielski (2007) reported that r_{lim} ranged between $2r_{core}$ and $7r_{core}$. Our estimation of the concentration parameter ($C = r_{lim}/r_{core}$) for both clusters are about 1.28 and 2.52 for the SAI 24 and SAI 94 open clusters, respectively. So that our calculations are in a good agreement with Maciejewski and Niedzielski (2007).

3. COLOR MAGNITUDE DIAGRAM ANALYSIS

One of the main purposes of our work is to determine many of the astrophysical parameters which are deduced by constructing the color magnitude diagram CMD with reduced field star contamination (i.e. to establish the membership). Zhao et al. (1982) used the criterion of multicolor photometry and proper motion used to define the membership in open clusters. In what follows, we used two computational algorithms described by Amin and Elsanhoury (2017) which depends on the method of Sanders (1971). In the first method, we used proper motions of individual stars based on the maximum likelihood method while in the second method we set the probability P limits to 50 % and by imposing this restriction we actually considered all-stars with probabilities less than the proposed one as the field stars. As results of these above procedures, we have 202 and 199 members of the SAI 24 and SAI 94 open clusters, respectively. Our calculation of membership portability P distribution for two clusters is illustrated in Table 4.

The reddening E(B-V) and the distance modulus (m-M) can be determined for both clusters from CMD using fitting by theoretical Padova isochrones http://stev.oapd.inaf.it/cgi-bin/cmd, as an example given by Marigo et al. (2008) and Girardi et al. (2010).

In our study, we constructed CMDs for (J, J-H) and (K_s, J-K_s). The fitting of isochrones with Solar metallicity ($Z = 0.019$) and different ages of the observed CMDs for the SAI 24 and SAI 94 are shown in Fig. 3. In our calculations we obtained a good fitting of the CMDs by visual inspection with log (ages) 7.2 ± 0.2 yr and 9.10 ± 0.05 yr for SAI 24 and SAI 94 clusters, respectively, which is in agreement with Dias et al. (2002) and Kharchenko et al. (2016).

Table 4: The total probabilities P of membership stars.

Cluster	$50 \leq P < 60$	$60 < P < 70$	$70 < P < 80$	$80 < P < 90$	$90 < P \leq 100$	Total stars
SAI 24	9	10	11	5	167	202
SAI 94	6	5	9	10	169	199

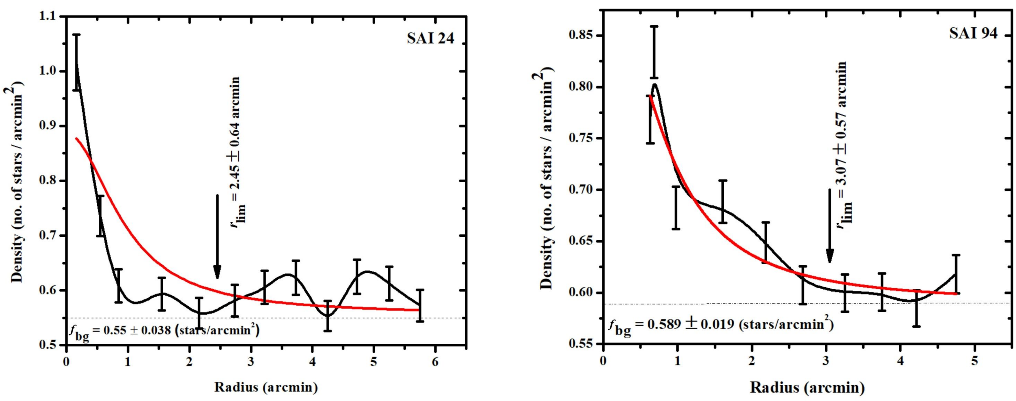

Fig. 2. *RDP of SAI 24 (left panel) and SAI 94 (right panel). The curved solid lines represent the fitting of the King (1966) model and the dashed lines represent the background field density f_{bg}.*

The reddening determination is a major step in cluster compilation guided by Schlegel et al. (1998), and Schlafly and Finkbeiner (2011). To calculate the color excess transformations of both clusters SAI 24 and SAI 94, we used the coefficient ratios A_J/A_V = 0.276 and A_H/A_V = 0.176 from Schlegel et al. (1998), and the ratio A_{Ks}/A_V = 0.118 from Dutra et al. (2002). By applying the algorithm of Fiorucci and Munari (2003), we calculated: E(J-H)/E(B-V) = 0.309 ± 0.130 and E(J-K$_s$)/E(B-V) = 0.485 ± 0.150, and $R_V = A_V$/E(B-V) = 3.1. By using the last relations to correct the effects of reddening in CMDs with extinction coefficients equal to 0.401 mag and 0.417 mag for SAI 24 and SAI 94, respectively, we obtained:

• For the SAI 24 open cluster, $(m\text{-}M)_V$ = 10.243 mag, E(J-K$_s$) = 0.063, E(J-H) = 0.040, E(B-V) = 0.13, E(J-K$_s$)/E(B-V) = 0.485, and E(J-H)/E(B-V) = 0.308.

• For the SAI 94 open cluster, $(m\text{-}M)_V$ = 13.15 mag, E(J-K$_s$) = 0.066, E(J-H) = 0.042, E(B-V) = 0.135, E(J-K$_s$)/E(B-V) = 0.489, and E(J-H)/E(B-V) = 0.311.

By comparing our obtained values of reddening E(B-V) with other values we notice that for SAI 24 our value is much smaller than that given by Dias et al. (2002) and Kharchenko et al. (2016) by about 0.37 mag, while for SAI 94 our value is smaller by about 0.345 mag and 0.386 mag than that of Dias et al. (2002) and Kharchenko et al. (2016), respectively.

Our calculations refer to the distance for SAI 24 to be about 930 ± 30 pc [1 arcmin: (0.271 ± 0.009) pc], which is less than that given by Dias et al. (2002) and Kharchenko et al. (2016) by about 70 pc. For SAI 94 the distance is about 3515 ± 60 pc [1 arcmin: (1.022 ± 0.017) pc], which is smaller than that given by Dias et al. and Kharchenko et al. (2016) by about 395 pc and 371 pc, respectively.

In our calculations, and in order to estimate the cluster's distance to the Galactic center R_{gc}, we use the Sun's distance from the Galactic center ($R_\odot$ = 8.5 kpc) and equations of Tadross (2011), i.e.:

$$X_\odot = R_\odot \cos b \cos l,$$
$$Y_\odot = R_\odot \cos b \sin l,$$
$$Z_\odot = R_\odot \sin b,$$

and:

$$R_{gc} = \sqrt{(R_\circ + \mid X_\odot \mid)^2 + {Y_\odot}^2 + {Z_\odot}^2}.$$

By using our above estimated distances the coordinates of the clusters with respect to the Sun, $X_\odot$, $Y_\odot$ (in the equatorial plane) and $Z_\odot$ (perpendicular to the plane of the Galactic equator) are:

• For SAI 24:
$X_\odot = -692 \pm 26$ pc.
$Y_\odot = 621 \pm 25$ pc.
$Z_\odot = 24 \pm 5$ pc.
$R_{gc} = 9.213 \pm 0.096$ kpc.

• For SAI 94:
$X_\odot = -487 \pm 22$ pc.
$Y_\odot = -3454 \pm 59$ pc.
$Z_\odot = -429 \pm 21$ pc.
$R_{gc} = 9.637 \pm 0.098$ kpc.

4. LUMINOSITY AND MASS FUNCTIONS

The measurements of the number of stars in a cluster with a given color and magnitude ranges are very important to understand the characteristic properties of the evolutionary stages of our studied objects.

In our study, we can refer to the luminosity function LF for open clusters as the total number of stars per unit area (in a certain region). To determine the cluster LF, the apparent magnitudes for members converted into absolute ones, and hence we constructed the Histogram sizes of LFs to include a reasonable number of stars in each absolute J magnitude bins for the best counting statistics. The resulting LFs for both clusters shown in Fig. 4 infer that the massive bright stars seem to be centrally concentrated more than the low masses and fainter (Montgomery et al. 1993).

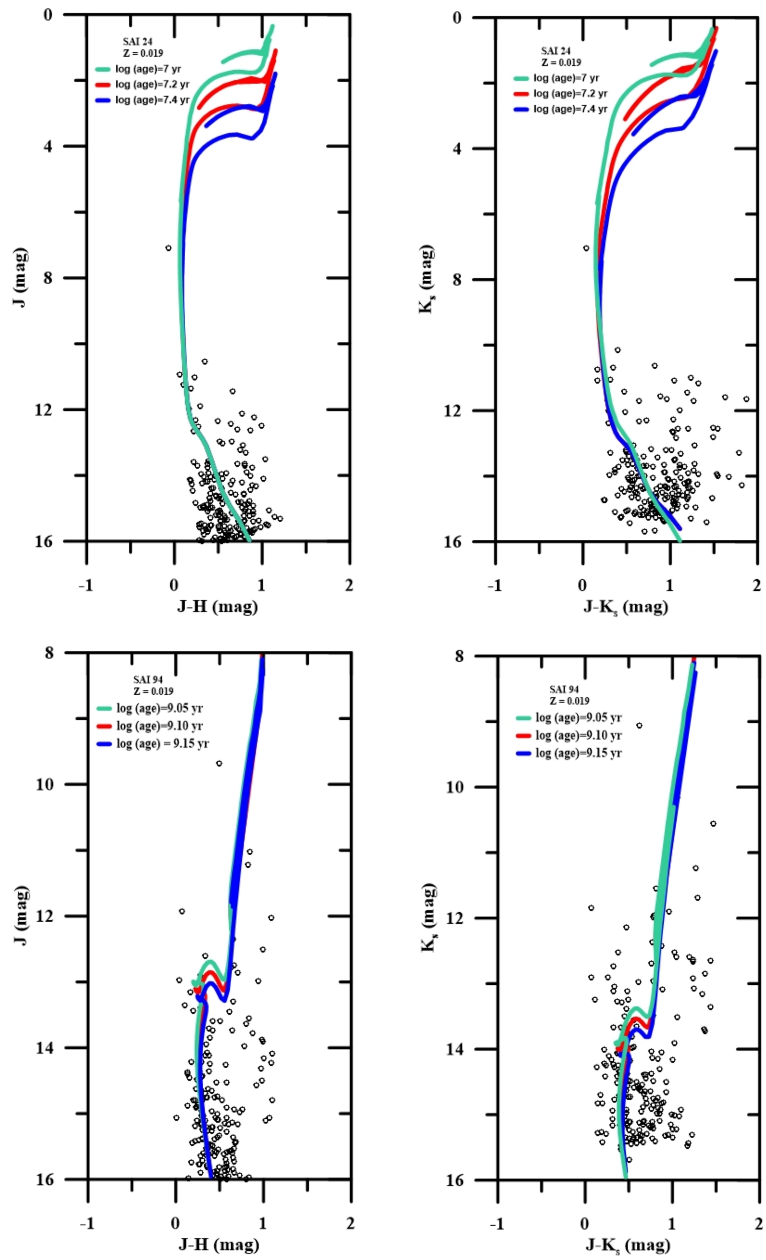

Fig. 3. *Padova CMD with Solar metallicity (Z = 0.019) isochrones with log ages 7.0, 7.2, and 7.4 for SAI 24 (upper panel) and log ages 9.05, 9.10, and 9.15 for SAI 94 (lower panel).*

The main attributes of studying the open clusters are to study the mass function MF (i.e. histogram of stellar masses). We can define the initial mass function IMF in terms of a power law as follows:

$$\frac{dN}{dM} \propto M^{-\Gamma}. \quad (4)$$

where, dN/dM is the number of stars on the mass interval (M: $M + dM$), and Γ is a dimensionless exponent. According to Salpeter (1955), the IMF for massive stars ($> 1M_{\odot}$) has been studied and well established, i.e. $\Gamma = 2.35$.

As we know LF and MF are correlated to each other according to the mass-luminosity relation MLR, we can get for the both clusters a polynomial relation of the second order between masses $M/M_{\odot}$ vs. absolute magnitudes $\mathrm{M_k}$ based on the adopted isochrones of Marigo et al. (2008) and Girardi et al. (2010), i.e.

$(M/M_{\odot})_{\mathrm{SAI\ 24}} = (4.30 \pm 0.03) - (1.370 \pm 0.002)\mathrm{M}_K + (0.1130 \pm 0.0003)\mathrm{M}_K^2$,

$(M/M_{\odot})_{\mathrm{SAI\ 94}} = (1.97 \pm 0.02) - (0.299 \pm 0.001)\mathrm{M}_K + (0.0080 \pm 0.0001)\mathrm{M}_K^2$.

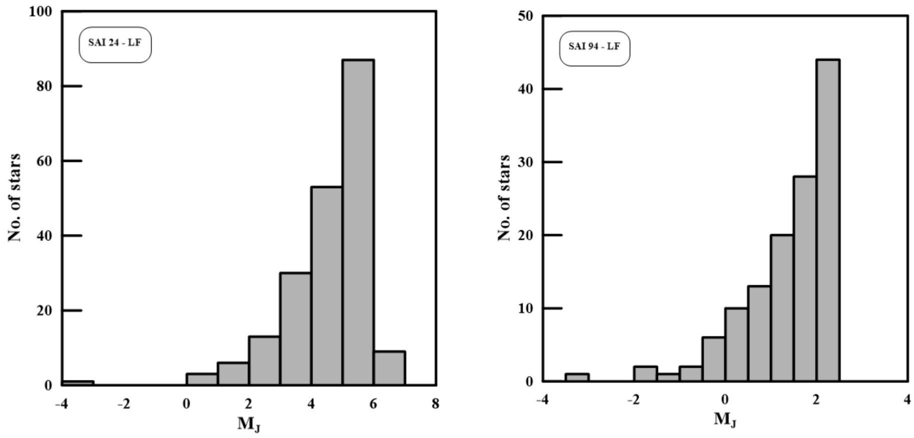

Fig. 4. *The LFs of SAI 24 (left panel) and SAI 94 (right panel) open clusters.*

From the last polynomials, we can get the total estimated masses M_C to be 285 ± 17 $M_\odot$ and 317 ± 18 $M_\odot$ for SAI 24 and SAI 94, respectively. By using the total estimated masses, we can calculate their tidal radii (i.e. $r_t = 1.46\sqrt[3]{M_C}$) by Jeffries et al. (2001); our results give a tidal radius of about 9.61 pc and 9.95 pc for both clusters, respectively. Such values for the tidal radius agree well with the assumed spatial distribution Eq. (1), because this equation, as an approximation, is applicable if the values of r are significantly smaller than r_t.

In the same manner, Fig. 5 shows the MFs of these clusters with slopes -2.31 ± 0.66 and -2.53 ± 0.63, which are in agreement with Salpeter (1955). The steep slope of the IMF indicates that the number of low-mass stars is greater than the high-mass ones.

5. DYNAMICAL STATE

In what follows, we are going to demonstrate the dynamical state of SAI 24 and SAI 94 clusters. For open clusters, the time needed for the cluster to build itself and reach the stable state against constructive and destructive forces (e.g. turbulence, gas pressure, rotation, and magnetic field) is called the relaxation time $T_{\rm relax}$ (Maciejewski and Niedzielski 2007). The relaxation time $T_{\rm relax}$ is mainly depending on the number N of members and the cluster diameter D. Mathematically, $T_{\rm relax}$ as a function of the number of members takes the expression (Lada and Lada 2003):

$$T_{\rm relax} = \frac{N}{8 \ln N} T_{\rm cross}. \qquad (5)$$

where $T_{\rm cross} = D/\sigma_{\rm v}$ is the dynamical crossing time (for open clusters $\simeq 10^6$ yr) of the system and $\sigma_{\rm v}$ is the velocity dispersion (Binney and Termaine, 1998). Suppose D corresponds to the limiting radius obtained by Table 1, and if the virial theorem is applied, i.e. ${\sigma_{\rm v}}^2 \simeq {\rm G}M_{\rm C}/r_{\rm lim}$, one would obtain $T_{\rm cross} \approx 1.3 \times 10^6$ yr for SAI 24 and $T_{\rm cross} \approx 5.4 \times 10^6$ yr for the other cluster.

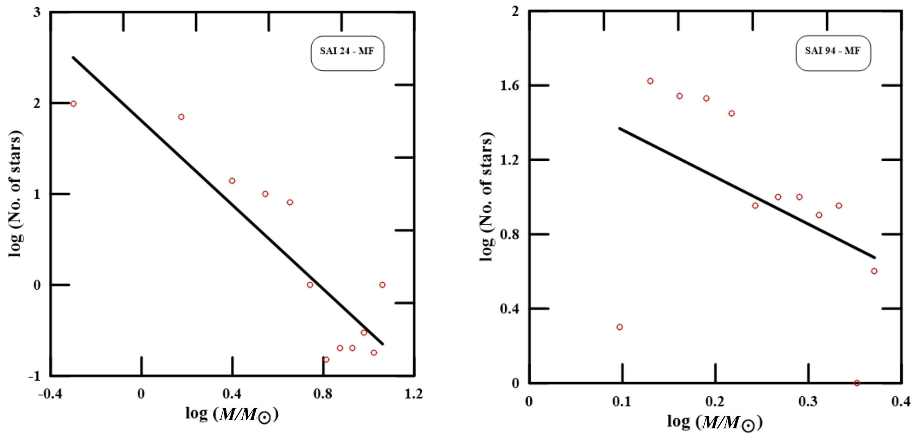

Fig. 5. *The MFs of SAI 24 (left panel) and SAI 94 (right panel) open clusters.*

To describe the dynamical state of open clusters, we calculate the dynamical evolution parameter $\tau = T_{\rm age}/T_{\rm relax}$. If the cluster's age is found greater than its relaxation time, i.e. $\tau \gg 1$, then the cluster was dynamically relaxed and vice versa. For our study, the dynamical evolution parameter τ is about 2.6 and 50 for SAI 24 and SAI 94 clusters, respectively, so the clusters may be dynamically relaxed.

Furthermore, we adopt the additional criterion (e.g. Adams and Myers 2001) that the cluster consists of enough members to ensure that its evaporation time $\tau_{\rm ev} = 10^2\ T_{\rm relax}$. This means that the time it takes for internal stellar encounters to eject all its members, be greater than 10^8 yr. For SAI 24 and SAI 94 clusters, we have the evaporation time $\tau_{\rm ev}$ of about 618 Myr and 2538 Myr, respectively. Table 5 presents the numerical values of the dynamical state parameters for SAI 24 and SAI 94 clusters.

Table 5: The dynamical state parameters of SAI 24 and SAI 94 clusters.

Parameter	SAI 24	SAI 94
No. of members	202	199
M_J (mag.)	4.85	1.94
$T_{\rm age}$ (log) yr	7.2 ± 0.2	9.10 ± 0.05
M_C ($M_\odot$)	285 ± 17	317 ± 18
r_t (pc)	9.61	9.95
$T_{\rm cross}$ (Myr)	1.3	5.4
$T_{\rm relax}$ (Myr)	6.18	25.38
τ	2.5	50
$\tau_{\rm ev}$ (Myr)	618	2538

6. CONCLUSION

In this work, we scope on the photometric analysis in the region of near-infrared (J, H, and K_s) of SAI 24 and SAI 94 recent observed clusters. The analysis devoted with PPMXL catalogue. Our calculated results are summarized in the following points:
• In our study, we have calculated astrometric and photometric parameters, e.g. $r_{\rm core}$, $r_{\rm lim}$, reddening, distance, etc. These parameters for both SAI 24 and SAI 94 are in good agreement with that given by Dias et al. (2002) and Kharchenko et al. (2013 and 2016).
• We have determined the membership probability by means of the maximum likelihood method. The results of the memberships are 202 and 199 for SAI 24 and SAI 94, respectively.
• We have constructed the RDP, showing that the core radius $r_{\rm core}$ is about 1.92 ± 0.38 and 1.22 ± 0.10 arcmin and limiting radius $r_{\rm lim}$ is about 2.45 ± 0.64 and 3.07 ± 0.57 arcmin for the SAI 24 and SAI 94 clusters, respectively.
• From our calculations of the luminosity function, we notice that the massive bright stars seem to concentrate in the center more than the low masses.
• On the other hand, according to the mass-luminosity relation MLR, we have estimated the mass functions of SAI 24 and SAI 94 of slopes are −2.31 ± 0.66 and −2.53 ± 0.63 which are in agreement with Salpeter (1955). These values of the slope indicate that the number of low-mass stars is greater than the high mass. The total masses calculated to be around 285 ± 17 $M_\odot$ and 317 ± 18 $M_\odot$ for the SAI 24 and SAI 94 clusters, respectively.
• Finally, we have calculated the dynamical evolution parameter τ and evaporation time $\tau_{\rm ev}$ for both clusters; the calculations show that SAI 24 and SAI 94 could be considered as dynamically relaxed clusters. The evaporation time $\tau_{\rm ev}$ is about 618 Myr and 2538 Myr for SAI 24 and SAI 94 clusters, respectively.

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ФОТОМЕТРИЈСКА АНАЛИЗА НОВООТКРИВЕНИХ РАЗВЕЈАНИХ ЈАТА SAI 24 И SAI 94 ЗАСНОВАНА НА КАТАЛОГУ PPMXL

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Стручни чланак

У раду који представљамо проучавали смо фотометријске карактеристике (радијус језгра, гранични радијус, поцрвењење, итд), као и динамичко стање два новооткривена развејана јата, SAI 24 и SAI 94. Истраживали смо њихове фотометријске особине у J, H и K_s филтерима, користећи PPMXL каталог. Коришћена је метода раздвајања звезда из развејаног јата од звездане позадине. Резултати наших израчунавања дају да је број вероватних чланова јата SAI 24 и SAI 94 202 и 94, респективно. Проценили смо да је центар јата за SAI 24 $\alpha_{2000} = 02^{\rm h}\ 59^{\rm m}\ 26^{\rm s}.36$ и $\delta_{2000} = 60^\circ\ 33'\ 02''.50$, а за SAI 94 је $\alpha_{2000} = 08^{\rm h}\ 10^{\rm m}\ 16^{\rm s}.36$, $\delta_{2000} = -46^\circ\ 17'\ 07''.91$. Нашли смо да је радијус језгра, $r_{\rm core}$, за SAI 24 и SAI 94, (1.918 ± 0.38) лучних секунди и (1.22 ± 0.10) лучних секунди, респективно, а слично гранични радијус, $r_{\rm lim}$, је око (2.45 ± 0.64) лучних секунди и (3.07 ± 0.57) лучних секунди. Са дијаграма боја-магнитуда, имајући у виду приближну логаритамску старост за SAI 24 и SAI 94 од (7.20 ± 0.20) и (9.10 ± 0.05), њихове удаљености су процењене на (930 ± 30) pc и (3515 ± 60) pc, респективно. Такође смо израчунали њихове пројектоване удаљености $X_\odot$ и $Y_\odot$ у Галактичкој равни, и пројектовану удаљеност $Z_\odot$ до Галактичке равни.

Описане су фукције луминозности и масе за јата SAI 24 и SAI 94, и у складу са тим, израчунате су масе од $(285.383 \pm 17)\ M_\odot$ и $(316.837 \pm 17.80)\ M_\odot$, респективно. Најзад, из процене параметра динамичке еволуције ова два јата, τ, као функције њиховог времена преласка $T_{\rm cross}$, закључили смо да су ова два јата динамички релаксирана. Времена испаравања, $\tau_{\rm ev}$, као функција времена релакасације $T_{\rm relax}$, износе око 6.18 Myr и 25.38 Myr за SAI 24 и SAI 94, респективно.