АСТРОФИЗИКА

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THE FIRST PHOTOMETRIC ANALYSIS OF THE OPEN CLUSTERS DOLIDZE 32 AND 36

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We present a first study of two open clusters Dolidze 32 and Dolidze 36, in the near-infrared region JHKs with aid of PPMXL catalog. In our study, we used a method able to separate open cluster's stars from those that belong to the stellar background. Our results of calculations indicate that for both cluster Dolidze 32 and Dolidze 36 the number of probable member are 286 and 780, respectively. We have estimated the cluster center for Dolidze 32 and Dolidze 36 are $\alpha = 18^h41^m4^s.188$, $\delta = -04^\circ04'57''.144$, $\alpha = 20^h02^m29^s.95$, $\delta = 42^\circ05'49''.2$, respectively. The limiting radius for both clusters Dolidze 32 and Dolidze 36 are about 0.94 ± 0.03 pc and 0.81 ± 0.03 pc, respectively. The Color Magnitude Diagram allows us to estimate the reddening $E(B-V) = 1.41 \pm 0.03$ mag. for Dolidze 32 and $E(B-V) = 0.19 \pm 0.04$ mag. for Dolidze 36, in such away the distance modulus $(m-M)$ is 11.36 ± 0.02, and 10.10 ± 0.03 for both clusters, respectively. On the other hand, the luminosity and mass functions of these two open clusters Dolidze 32 and Dolidze 36 have been estimated, showing that the estimated masses are in manner $437 \pm 21\, M_\odot$ and $678 \pm 26\, M_\odot$, respectively, while the mass function slopes are -2.56 ± 0.62 and -2.01 ± 0.70 for Dolidze 32 and Dolidze 36, respectively. Finally, the dynamical state of these two clusters shows that only Dolidze 36 can be considered as a dynamically relaxed cluster.

Key words: *Star clusters: stellar membership probability: color magnitude diagram: photometry*

1. *Introduction*. Studying the open clusters are one of the most important ways of understanding the star formation. On the other hand, determination of open cluster physical parameters (like distance, reddening, age... etc.) due to observational studies, helps us to understand the galactic structure and evolution [1]. Bukowiecki et al. [2] determined new coordinates of the centres, angular sizes and radial density profiles for 849 open clusters in the Galaxy based on the 2MASS database.

Fundamental parameters of these two poorly studied open clusters Dolidze 32 and Dolidze 36 (hereafter D_{32} and D_{36}) are listed below in Table 1. The images of these two clusters are given in the LEDAS Digitized Sky Survey (DSS).

In our study, we use the fundamental parameters taken from Kharchenko et al. [3] and Dias et al. [4] in the PPMXL[1] catalog [5] to determine the basic

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

Table 1

THE FUNDAMENTAL PARAMETERS OF TWO OPEN CLUSTERS D_{32} AND D_{36}

Parameter	D_{32}	D_{36}	References
α	$18^h41^m13^s.2$ $18^h41^m5^s$	$20^h02^m27^s.6$ $20^h02^m30^s$	Kharchenko et al. [3] Dias et al. [4]
δ	-4°02'00".6 -4°04'51"	42°09'54" 42°06'00"	Kharchenko et al. [3] Dias et al. [4]
l	28°.177 28°.120	77°.711 77°.659	Kharchenko et al. [3] Dias et al. [4]
b	0°.429 0°.438	6°.022 5°.982	Kharchenko et al. [3] Dias et al. [4]
r_{core} (arcmin) r_{lim} (arcmin)	0.6 5.4	0.6 4.2	Kharchenko et al. [3] Kharchenko et al. [3]
Distance (pc)	1381 1381	970 900	Kharchenko et al. [3] Dias et al. [4]
Diameter (arcmin)	9.80	14.0	Dias et al. [4]
E(B-V)	1.457 1.457	0.208 0.220	Kharchenko et al. [3] Dias et al. [4]
E(J-Ks) E(J-H)	0.700 0.467	0.100 0.067	Kharchenko et al. [3] Kharchenko et al. [3]
log (age)	6.00 6.00	8.920 8.83	Kharchenko et al. [3] Dias et al. [4]

astrometrical and photometrical properties of open clusters D_{32} and D_{36}. We get from the PPMXL catalog a complete worksheet data of right ascension, declination, and the angular distance from the cluster center are extracted for J, H, and Ks (near infra-red) region with radii of 5 and 7 arcmin for D32 and D36 open clusters, respectively.

The structure of this article follows as: in the Section 2 reveals the data analysis, the Section 3 show the color magnitude diagram and isochrone fitting, the Section 4 deals with the luminosity and mass functions. Section 5 present the dynamical state of these clusters. The conclusion was revealed in Section 6.

2. *Data Analysis.*

2.1. *Cluster Center Determination.* Since the diameter is unknown in the data of Kharchenko et al. [3] for D_{32} and D_{36}, we use in our study the data of Dias et al. [4] in the PPMXL catalog. After that, we used the total recorded number (worksheet) of stars 1046 and 1363 in the PPMXL catalog for open clusters D_{32} and D_{36}, respectively. To get the new center, we started the data analysis by re-calculating the location of both open clusters D_{32} and D_{36}, using the common procedure presented by many authors, e.g. Maciejewski and Niedzielski [6], Maciejewski et al. [7], and Haroon et al. [8,9]. In this procedure two perpendicular strips were cut along the right ascension and declination at approximate center of the cluster, and then histogram of the star counts then builds along each strip.

The histogram of both coordinates (α, δ) is fitted by a Gaussian distribution function for the two open clusters D_{32} and D_{36}, whereas the location of maximum number of stars (peak) indicated the new cluster center. The maximum values give the position of new cluster centers for D_{32} and D_{36} are shown in Table 2 and Fig.1.

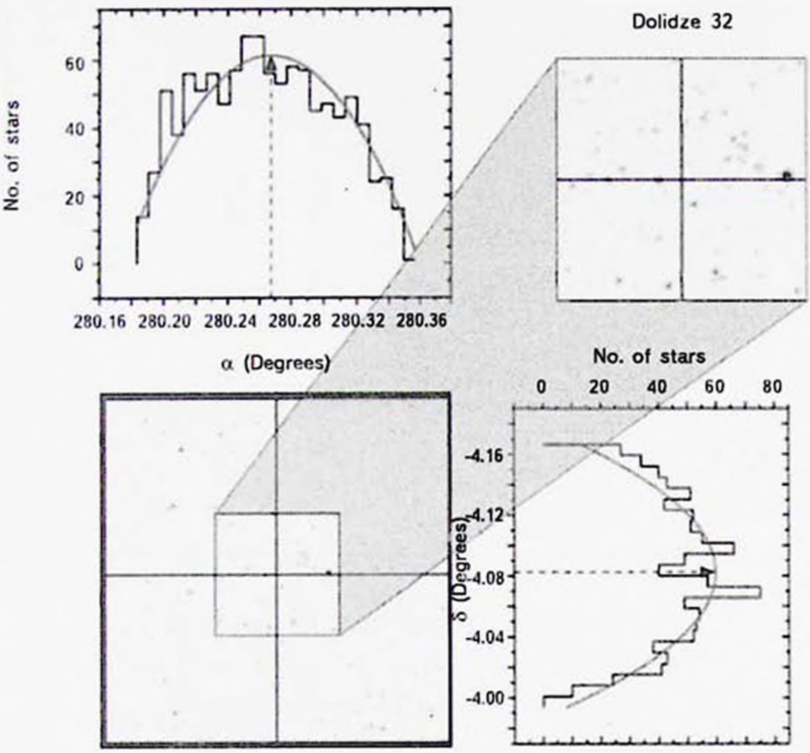

Fig.1a. The Gaussian fit provides the new center of highest density areas in $\alpha = 18^h41^m4^s.188$, $\delta = -04^\circ04'57''.144$, $l = 28^\circ.1173$ and $b = 0^\circ.4402$ of the image taken from LEDSA Digitized Sky Survey DSS, for open cluster D_{32}.

By comparing our results with that of Dias et al. [4] we noticed that:

- For D_{32} the calculated right ascension is less than that given by Dias et al. [4] by about $0^s.812$, while the calculated declination is greater than that given by Dias et al. [4] by about 6".144.

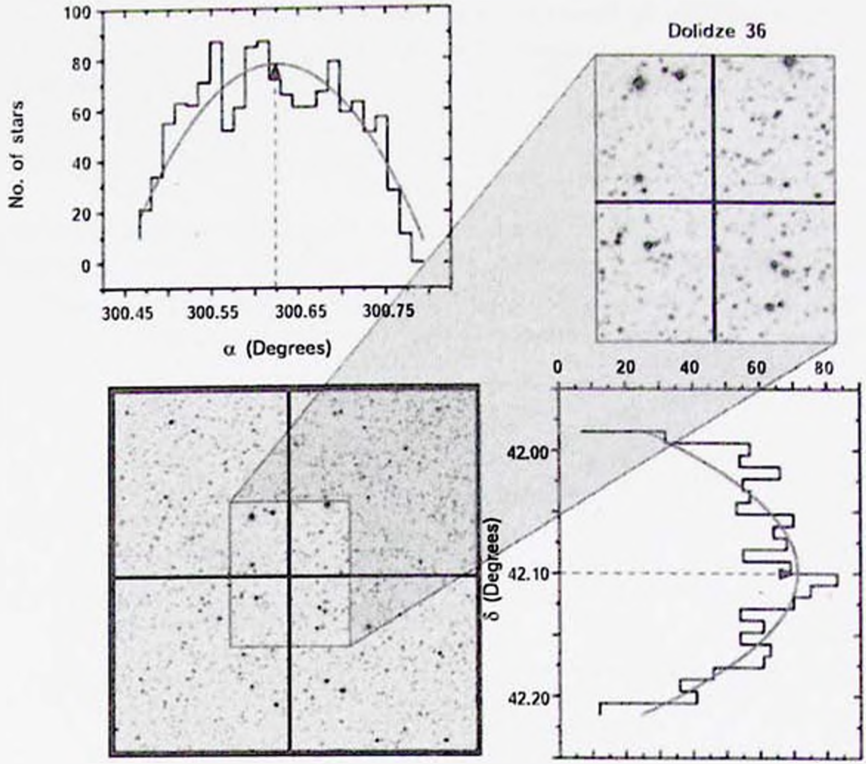

Fig.1b. The Gaussian fit provides the new center of highest density areas in $\alpha = 20^h02^m29^s.95$, $\delta = 42^\circ05'49''.2$, $l = 77^\circ.6865$ and $b = 5^\circ.1781$ of the image taken from LEDSA Digitized Sky Survey DSS. for open cluster D_{36}.

Table 2

ESTIMATED CENTERS OF D_{32} AND D_{36}

Parameter	D_{32}	D_{36}
α	$18^h41^m4^s.188$	$20^h02^m29^s.95$
δ	$-04^\circ04'57''.144$	$42^\circ05'49''.2$
l	$28^\circ.1173$	$77^\circ.6865$
b	$0^\circ.4402$	$5^\circ.1781$

- For D_{36} the calculated right ascension and the declination are both less than that given by Dias et al. [4] by about $0^s.05$ and $10''.8$, respectively.

2.2. *Radial Density Profile (RDP).* By using our calculated values of the new center (α, δ) again in the PPMXL catalog for open clusters D_{32} with a radius of 5 arcmin and a radius of 7 arcmin for D_{36} we get a new worksheet for these two clusters. The new worksheet data contains, right ascension, declination, and the angular distance from the cluster center with J, H, and Ks (near infrared) region for 1046 stars in D_{32} and 1357 stars in D_{36}, respectively.

Cluster density distribution, is a result of the internal and/or external dynamical process taking place in and out of the cluster. Although the spatial shape of the cluster may not be perfectly spherical, the fitting of the King [10] model has also been applied to derive the cluster limited radius and the core radius.

In our study, we find the surface density of stars in rings along a projected radius (with certain distances) from the core to the maximum distance from the center. We get the surface density distribution $\rho(r)$ by using the following equation of the King model [11],

$$\rho(r) = f_{bg} + \frac{f_0}{1+(r/r_{core})^2}, \tag{1}$$

where: f_{bg} - the background surface density, f_0 - the central star density, r_{core} - the core radius of the cluster, r - the radius of cluster at certain distance.

Fig.2 presents our calculations for the surface density distribution $\rho(r)$. The numerical values of r_{core}, f_{bg}, and f_0 are listed in Table 3. By comparing our results with that of Kharchenko et al. [3] we noticed that, the calculated r_{core} is greater than that obtained by Kharchenko et al. [3] by about 0.333 arcmin and 0.34 arcmin for D_{32} and D_{36}, respectively.

The limiting radius r_{lim} of the cluster defined as the radius which covers the entire cluster area and reaches enough stability with the background field density [12]. Mathematically, r_{lim} is defined as:

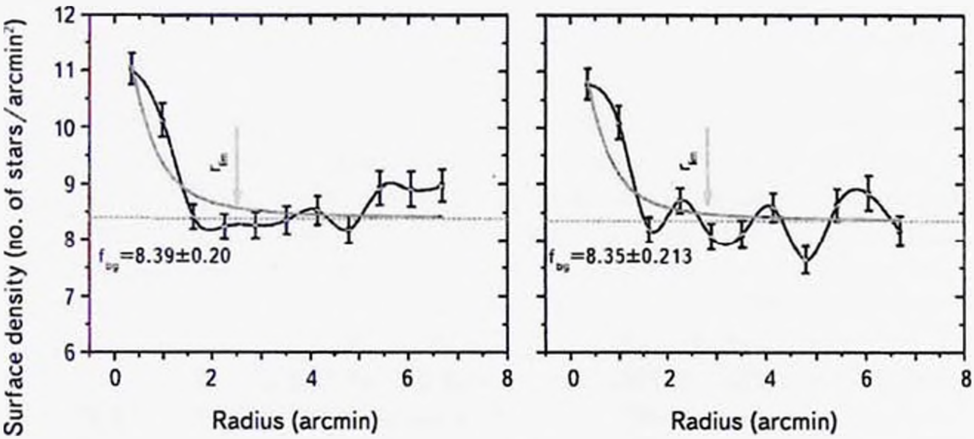

Fig.2. The RDP of the D_{32} and D_{36} open clusters, the solid lines denotes the fitted density distribution and the dashed lines represents the background field density f_{bg}.

Table 3

RDP PARAMETERS

Parameter	D_{32}	D_{36}
f_{bg} (stars/arcmin^2)	8.387 ± 0.20	8.35 ± 0.213
f_0 (stars/arcmin^2)	5.01 ± 0.915	6.32 ± 0.59
r_{core} (arcmin)	0.933 ± 0.15 0.6*	0.94 ± 0.21 0.6*
r_{lim} (arcmin)	2.53 ± 0.07 5.4*	2.81 ± 0.09 4.3*
C	2.71	3.00

* Values obtained by Kharchenko et al. [3].

$$r_{lim} = r_{core}\sqrt{\frac{f_0}{3\sigma_{bg}} - 1}, \tag{2}$$

where σ_{bg} is the uncertainty of the background surface density f_{bg}.

Our estimated r_{lim} for both clusters D_{32} and D_{36} are listed in Table 3. By comparing our results with that of Kharchenko et al. [3] we noticed that the estimated r_{lim} is less than that obtained by Kharchenko et al. [3] by about 2.87 arcmin and 1.39 arcmin for D_{32} and D_{36}, respectively.

As Nilakshi et al. [13] and Tadross [14] the concentration parameter C equal to r_{lim}/r_{core}. Our calculated values of C for for D_{32} and D_{36} are given in Table 3. Nilakshi et al. [13] concluded that the angular size of the coronal region is about 6 times the r_{core}. While Maciejewski and Niedzielski [6] reported that r_{lim} may vary for individual clusters between $2r_{core}$ and $7r_{core}$. In our study we notice that the limiting radius is about 2.71 and 3.00 times core radius for D_{32} and D_{36}, respectively. Therefore, we are in agreement with the results of Maciejewski and Niedzielski [6].

2.3. *Membership Probability*. One of the main purposes of our work is to produce and construct the Color Magnitude Diagram (CMD) with reduced field star contamination (i.e. cluster members). Zhao et al. [15] used the criteria of multicolor photometry, and proper motion to estimate the membership probabilities.

In our study we use the computational algorithm described by Amin and Elsanhoury [16] which depend on the method of Sanders [17]. In this method, we used a proper motion of individual stars based on the maximum likelihood method. For this method, the membership probabilities in a cluster field from their proper motions, we shall consider some objective criteria for pruning the Vector Point Diagram (VPD). Sanders [17] described for the purpose of orientation (i) a circular normal bivariate distribution function for the cluster, and (ii) an elliptical, normal bivariate distribution function of the field, following Vasilevskis et al. [18].

VPD rotation of the cluster has been done to isolate the field stars (which must remain fixed relative to the other cluster stars to get the real cluster members), using the following procedure developed by Sanders [17] and discussed in [15], i.e. pruning process, into which the stars are rotated in three quarters on the coordinates. By moving the stars located on the first quarter to the second and from the second to the third then in the fourth quarter and compare the resulting coordinates to the initial listed coordinates. By this rotation the field stars will be easily identified and separated and the real members will be listed [19].

At the beginning of our calculations of membership, we used a data file contained of 1046 and 1357 a single star in D_{32} and D_{36}, respectively. As given in Table 4 our calculation of membership starts with a probability limit greater than or equal to 50% for D_{32} and D_{36} indicates that the membership stars are 286 and 780 for D_{32} and D_{36}, respectively.

Table 4

MEMBERSHIP PROBABILITIES FOR D_{32} AND D_{36} AFTER THE FIRST, SECOND AND THIRD PRUNING

Cluster name	Pruning	No. of cancelled stars	No. of membership stars	Angle of rotation (θ)	Membership stars ($P \geq 50\%$)
D_{32}	First	320	726	0°.097	286
	Second	440	286	45°.065	
	Third	0	286	90°.442	
D_{36}	First	437	920	0°.108	780
	Second	140	780	45°.185	
	Third	0	780	90°.221	

3. *CMD and Isochrone Fitting*. The main photometric parameters including reddening E(B - V) and distance modulus (m - M) can be determined from the CMD using fitting with the theoretical Padova isochrones[1], as in an example given by Marigo et al. [20] and Girardi et al. [21]. In our study, we construct CMDs for (J, J-H & Ks, J-Ks) of the D_{32} and D_{36} open clusters. The fitting of isochrones with the observed CMDs of D_{32} and D_{36} are shown in Fig.3. In our results, the best fit was obtained with solar metallicity ($Z = 0.019$) isochrones with $\log(\text{age}) = 6.0 \pm 0.05$ and 8.85 ± 0.05 [yrs], respectively.

As we know, reddening determination is one of the major steps in cluster compilation. Therefore, the reddening of the cluster has been determined using

[1] *http://stev.oapd.inaf.it/cgi-bin/cmd*

Schlegel et al. [22] and Schlafly and Finkbeiner [23]. To calculate the color excess transformations, we used the coefficient ratios $A_J/A_V = 0.276$ and $A_H/A_V = 0.176$, which are derived using absorption ratios by Schlegel et al. [22], while the ratio $A_{K_s}/A_V = 0.118$ was derived by Dutra et al. [24]. In our calculation we used the following results for the color excess of photometric system by Fiorucci and Munari

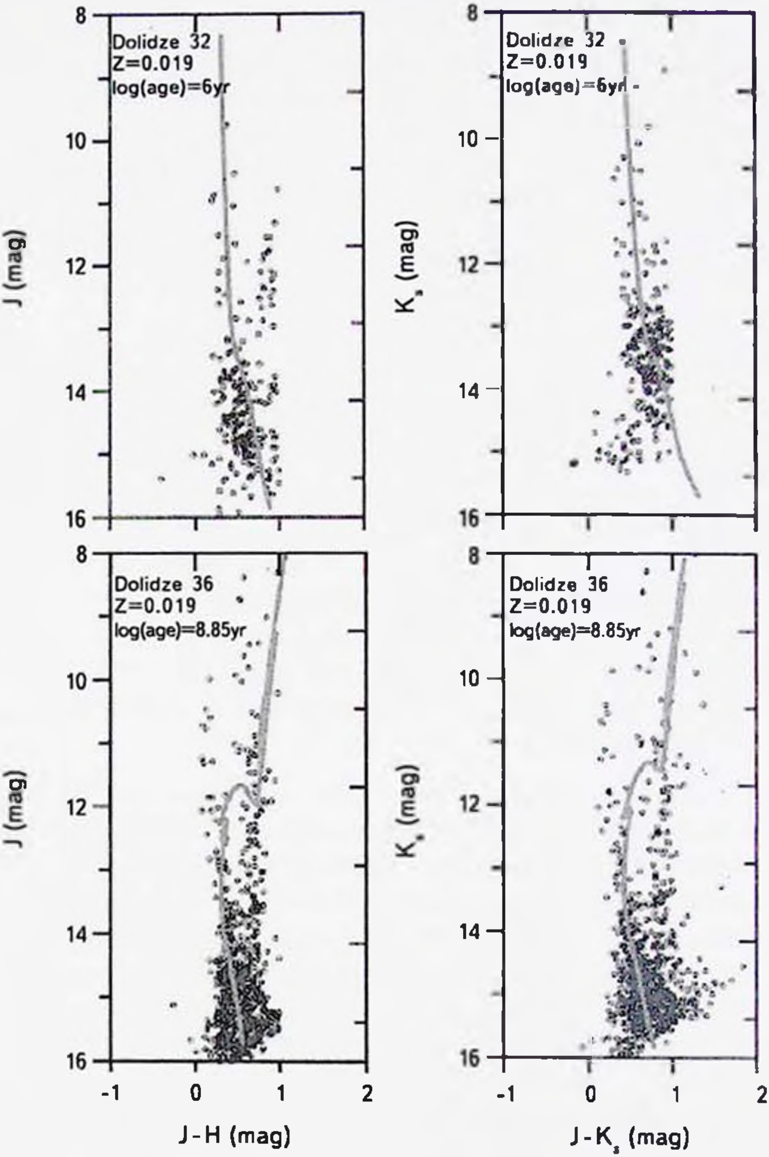

Fig.3. Padova CMD solar like stars (Z = 0.019), and log(age) over [J, (J-H) and (Ks, (J-Ks)] isochrones for D_{32} and D_{36} open clusters.

[25]: $E_{J-H}/E_{B-V} = 0.309 \pm 0.130$, $E_{J-K}/E_{B-V} = 0.485 \pm 0.150$, where $R_V = A_V/E_{B-V} = 3.1$. By applying the last relations to correct the effects of reddening in the CMDs with an extinction coefficient equal to 0.833 mag. and 0.117 mag. for D_{32} and D_{36}, respectively. We obtained, for D_{32} ($A_{Ks}/E_{B-V} = 0.368$ and $A_J/E_{B-V} = 0.848$) and for D_{36} ($A_{Ks}/E_{B-V} = 0.368$ and $A_J/E_{B-V} = 0.845$).

By comparing our results of log(age), E(B - V), E(J - H), E(J - Ks) and (m - M) with that obtained by Dias et al. [4] and Kharchenko et al. [3] as listed in Table 1, we notice that:

- For D_{32}: Our calculation of log (age) is in agreement with that of both Dias et al. [4] and Kharchenko et al. [3]. While the obtained value of reddening E(B-V) by Dias et al. [4] and Kharchenko et al. [3] is greater than our results by about 0.047 mag. Our results of the distance modulus (m-M) is greater than that of Dias et al. [4] and Kharchenko et al. [3] by about 0.66. Finaly, our calculations of E(J-H) and E(J-Ks) are less than that of Kharchenko et al. [3] by about 0.031 mag., and 0.016 mag., respectively.

- For D_{36}: Our log (age) is greater than that of Dias et al. [4] by about 0.02, and smaller than that of Kharchenko et al. [3] by about 0.07. Both reddening E(B-V) of Dias et al. [4] and Kharchenko et al. [3] are greater than our estimation with 0.03 and 0.018 mag., respectively. Our distance modulus (m-M) is greater than that of Dias et al. [4] and Kharchenko et al. [3] with about 0.33 and 0.16, respectively. Finaly, our calculations of E(J-H) and E(J-Ks) are less than that of Kharchenko et al. [3] by about 0.007 mag., and 0.008 mag., respectively.

Our calculation indicates that the cluster distance for D_{32} and D_{36} are equals to 1276 ± 35 pc [i.e. $(2.63 \pm 0.07) \times 10^{-5}$) arcmin] and 992 ± 31 pc [i.e. $(2.04 \pm 0.06) \times 10^{-5}$) arcmin], respectively. By comparing our result of distances with those listed by Dias et al. [4] and Kharchenko et al. [3] catalogs, we notice that our calculated distance for D_{32} is smaller than of them by about 105 pc, while for D_{36} our calculated distance is greater than of them by about 92 and 22 pc, respectively.

On the other hand, the cluster-Sun distance is used to determine the cluster's distance to the Galactic center R_{gc}, and the projected distance to the Galactic plane ($X_\odot$ and $Y_\odot$), and the distance from the Galactic plane $Z_\odot$. As based on Tadross [14], our calculations for R_{gc}, $X_\odot$, $Y_\odot$ and $Z_\odot$ are represented by:

- For D_{32}: 8595 ± 93 pc, 1126 ± 36 pc, 602 ± 25 pc and 9.81 ± 3.00 pc, respectively.
- For D_{36}: 8558 ± 93 pc, 211 ± 15 pc, 965 ± 31 pc, and 89 ± 9 pc, respectively.

4. *Luminosity and Mass Function.* The total number of the stars as a function of absolute magnitudes in a certain region of surface area can be described in our study as the luminosity function LF. The main attributes of studying the open clusters are to study the mass function MF, which describes the mass distribution (i.e. histogram of stellar masses) of a population stars in terms of their

theoretical initial mass (the mass they were formed before with). The Initial Mass Function IMF is defined in terms of a power law as follows:

$$\frac{dN}{dM} \propto M^{-\Gamma}, \tag{3}$$

where, dN/dM is the number of stars on mass interval $(M : M + dM)$, and Γ is a dimensionless exponent. From Salpeter [26], the IMF for massive stars ($>1\,M_{\odot}$) has been studied and well established i.e. $\Gamma = 2.35$. The steep slope of the IMF indicates that the number of low-mass stars is greater than the high-mass ones. MF correlated with LF by a relation called mass-luminosity relation MLR.

To determine the cluster LF, we count the observed stars in terms of absolute magnitude after applying the distance modulus. LF of these two open clusters D_{32} and D_{36} are constructed as shown in Fig.4, we can infer that the massive bright stars seem to be centrally concentrated more than the low masses and fainter ones [27].

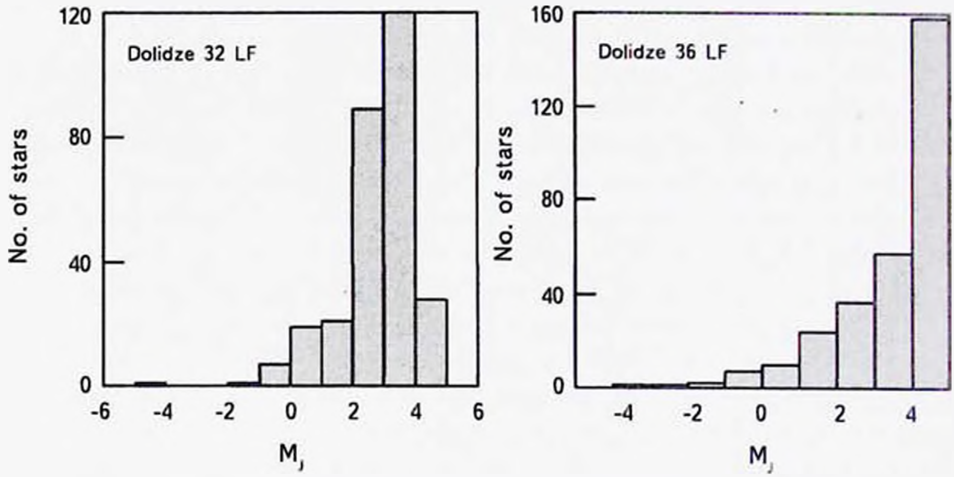

Fig.4. The distribution of the LF of D_{32} and D_{36} open clusters.

In our study the MF will be estimated due to MLR, which constructed based on the adopted isochrones Marigo et al. [20] and Girardi et al. [21], the relation is a polynomial function of second order, i.e.

- For D_{32}: $M/M_{\odot} = (2.910 \pm 0.007) - (0.610 \pm 0.004)M_J + (0.035 \pm 0.0003)M_J^2$.
- For D_{36}: $M/M_{\odot} = (2.370 \pm 0.008) - (0.423 \pm 0.005)M_J + (0.020 \pm 0.0009)M_J^2$.

From last polynomials we can get the total estimated mass M_C as $437 \pm 21\,M_{\odot}$ and $678 \pm 26\,M_{\odot}$ for D_{32} and D_{36}, respectively. Fig.5, shows the MF of these open clusters, the slopes are -2.56 ± 0.62 and -2.01 ± 0.70 for D_{32} and D_{36}. Our results are in agreement with Salpeter [26].

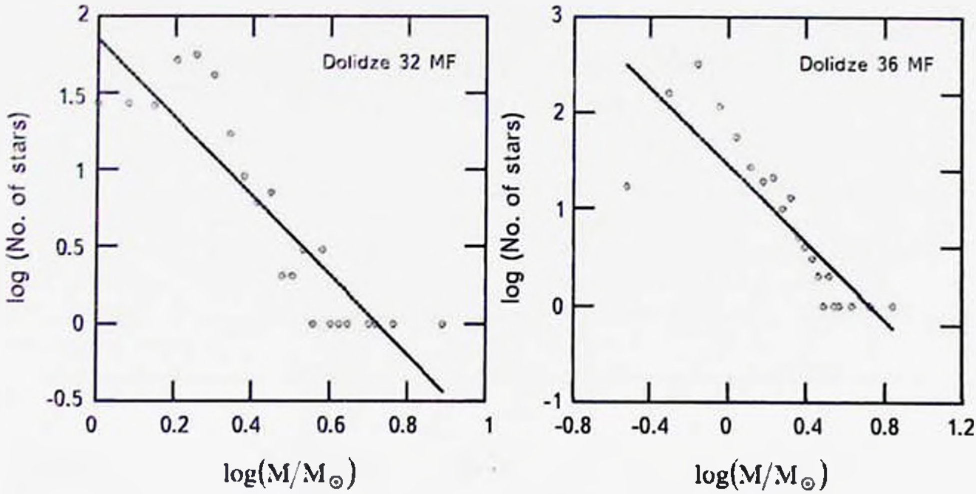

Fig.5. The MF of D_{32} and D_{36} open clusters.

By using our total estimated mass M_C and the relation 4, which is given by Jeffries et al. [28], our results give a tidal radius r_t of about 11.08 pc and 12.83 pc for D_{32} and D_{36}, respectively.

$$r_t = 1.46\sqrt[3]{M_C}\,. \tag{4}$$

5. *Dynamical State*. To describe the dynamical state of the open clusters, we calculate the dynamical evolution parameter (i.e. $\tau = T_{age}/T_{relax}$) where T_{relax} is the dynamical relaxation time, which defined as the time the cluster needs to reach a stability (Maxwellian state). During that time, the low mass star in a cluster possesses the largest random velocity, occupying a larger volume than the high mass does [29]. If $\tau >> 1$, then the cluster may be called dynamically relaxed and vice versa. Mathematically, the relaxation time has the form [30]:

$$T_{relax} = \frac{8.9\times10^5\sqrt{N}\,R_l^{3/2}}{\langle m\rangle^{1/2}\log(0.4N)}, \tag{5}$$

where R_h is the radius containing half of the cluster mass, N is the number of the cluster members and $\langle m\rangle$ is the average mass of the cluster stars. Assuming that the R_h is equal to half of the cluster radius linear units estimated in this study, we have adopted R_h for these clusters. Table 5 presents the numerical values of these parameters for both D_{32} and D_{36}. As seen from Table 5 the dynamical evolution parameter (i.e. τ), of both clusters D_{32} and D_{36} are 0.56 and 249, respectively. So that D_{36} can be considered as a dynamically relaxed cluster.

Table 5

THE DYNAMICAL STATE PARAMETERS OF D_{32} AND D_{36} OPEN CLUSTERS

Parameter	D_{32}	D_{36}
No. of members (N)	286	780
T_{age} (log) yrs	6.00 ± 0.05	8.85 ± 0.05
$\langle m \rangle$	1.53 ± 0.18	0.844 ± 0.350
R_h (pc)	0.450 ± 0.001	0.41 ± 0.01
T_{relax} (Myr)	1.78	2.85
τ	0.56	249

6. ***Conclusion***. Our aim of this study is to find main photometric parameters as a first study of open clusters Dolidze 32 and Dolidze 36. Our calculations based on near infrared region JHKs using PPMXL catalog.

Our calculated results are summarized as the following points:

- In our study, we have re-calculate the center of the clusters. For D32, our right ascension is less than that given by Dias et al. [4] by about $0^s.812$, and declination is greater than that given by him by about 6".144. While for D_{36}, both right ascension and the declination are less than that given by Dias et al. [4] by about $0^s.05$ and 10".8, respectively.

- We have determined the membership probability, by means of maximum likelihood method . The results of the memberships are 286 and 780 for D_{32} and D_{36}, respectively.

- We have constructed the RDP, showing that the limiting radius and for D_{32} is 0.94 ± 0.03 pc and about 0.81 ± 0.03 pc for D_{36}.

- Construction of CMD of solar metallicity ($Z = 0.019$), allows us to calculate some of the photometric parameters of these clusters, like distance modulus $(m - M) = 11.36 \pm 0.20$ mag and 10.10 ± 0.30 mag, which indicated the distance about 1276 ± 35 pc and 992 ± 31 pc for D_{32} and D_{36}, respectively. In the same manner the reddening $E(B - V) = 1.41 \pm 0.03$, and 0.19 ± 0.04 for D_{32} and D_{36}, respectively.

- The LF and MF are determined by applying the MLR, for LF showed a gradual increase towards low luminosity stars from the high luminous ones. On the other hand, the value of MF slopes was about -2.56 ± 0.62 and -2.01 ± 0.70 for D_{32} and D_{36} open clusters, respectively, which were found to be around the Salpeter's value.

- The total mass was calculated for these two open clusters to be around $437 \pm 21\, M_\odot$ and $678 \pm 26\, M_\odot$, for D_{32} and D_{36} respectively.

- Finally, we have calculated the dynamical evolution parameter τ. for both clusters, form our calculations, we can reveal that the D_{36} can be considered as dynamically relaxed cluster.

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ПЕРВЫЙ ФОТОМЕТРИЧЕСКИЙ АНАЛИЗ ОТКРЫТЫХ СКОПЛЕНИЙ ДОЛИДЗЕ 32 И 36

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Представлено первое исследование 2-х открытых скоплений Долидзе 32 и 36 в ближнем UK диапазоне JHK с помощью каталога PPMXL. Использован метод для выделения звезд скопления из звезд фона. Вычисления показали, что вероятное количество звезд в скоплениях Долидзе 32 и 36 составляет, соответственно 286 и 780. Определены центры координат скоплений Долидзе 32 и 36 - $\alpha = 18^h41^m4^s.188$, $\delta = -04°04'57''.144$ и $\alpha = 20^h02^m29^s.95$, $\delta = 42°05'49''.2$, соответственно. Радиусы скоплений примерно равны 0.94 ± 0.03 пк и 0.81 ± 0.03 пк. Оценены величины покраснений - $E(B-V)=1^m.41 \pm 0^m.03$ для Долидзе 32 и $E(B-V)=0^m.19 \pm 0^m.04$ для Долидзе 36, а также модули расстояний (m-M) - 11.36 ± 0.02 и 10.10 ± 0.03, соответственно. Получены также функции светимости и масс. Массы скоплений равны $437 \pm 21 M_{\odot}$ и $678 \pm 26 M_{\odot}$, с крутизной функции масс -2.56 ± 0.62 и -2.01 ± 0.70. Рассмотрение динамического состояния этих двух открытых скоплений показало, что скопление Долидзе можно рассмотреть как динамически релаксированное.

Ключевые слова: *звездные скопления: вероятность членства звезд: диаграмма цвет-величина: фотометрия*

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