



Galaksimizdeki 20 Açık Yıldız Kümesinin CCD UBVRI Fotometrisi

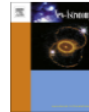
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CCD $UBV(RI)_C$ photometry of twenty open clusters

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HIGHLIGHTS

- We publish a homogeneous set of the reddenings, distances and ages of 20 open clusters from CCD $UBVR_I$ photometry of SPMO.
- Morphological ages are in good agreement with the isochrone ages of 12 clusters with red clump/giant candidates.
- We do not find any metal abundance gradient and age–metallicity relation.

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Galaxy; abundances

Galaxy; evolution

ABSTRACT

Fundamental astrophysical parameters have been derived for 20 open clusters (OCs) using CCD $UBV(RI)_C$ photometric data observed with the 84 cm telescope at the San Pedro Mártir National Astronomical Observatory, México.

The interstellar reddenings, metallicities, distances, and ages have been compared to the literature values. Significant differences are usually due to the usage of diverse empirical calibrations and differing assumptions, such as concerning cluster metallicity, as well as distinct isochrones which correspond to differing element-abundance ratios, internal stellar physics, and photometric systems. Different interstellar reddenings, as well as varying reduction and cluster-membership techniques, are also responsible for these kinds of systematic differences and errors.

The morphological ages, which are derived from the morphological indices (ΔV and ΔI) in the CM diagrams, are in good agreement with the isochrone ages of 12 OCs, those with good red clump (RC) and red giant (RG) star candidates. No metal abundance gradient is detected for the range $6.82 < R_{GC} < 15.37$ kpc, nor any correlation between the cluster ages and metal abundances for these 20 OCs.

Young, metal-poor OCs, observed here in the third Galactic quadrant, may be associated with stellar over-densities, such as that in Canis Major (Martin et al.) and the Monoceros Ring (Newberg et al.), or signatures of past accretion events, as discussed by Yong et al. and Carraro et al.

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1. Introduction

Open clusters (OCs) are valuable for studying stellar evolution models, and the age–metallicity relation and metal-abundance gradient in the Galactic disc (e.g. Cameron, 1985; Carraro and Chiosi, 1994; Friel, 1995), as well as luminosity and mass functions (Piskunov et al., 2008). By fitting the photometric observations of open clusters to theoretical isochrones, the fundamental parameters such as interstellar reddening, metallicity, distance modulus, and age can be precisely and accurately inferred.

The aims within the Sierra San Pedro Mártir National Astronomical Observatory (SPMO, hereafter) open cluster survey (cf.

Schuster et al., 2007; Tapia et al., 2010; Akkaya et al., 2010) are the following:

1. a common $UBVR_I$ photometric scale for open clusters,
2. an atlas of colour–colour and colour–magnitude diagrams for these clusters,
3. a homogeneous set of cluster reddenings, distances, ages and, if possible, metallicities,
4. an increased number of old, significantly reddened, or distant open clusters, and
5. a selection of interesting clusters for further study.

The OCs for the present study have been selected from the large (and mostly complete) catalogue, “Optically Visible Open Clusters and Candidates” (Dias et al., 2012), which is now also available

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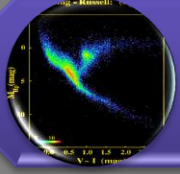
Doktora Tezi, "Açık Yıldız Kümelerinin Fotometrik İncelenmesi"
İSTANBUL ÜNİVERSİTESİ
Fen Bilimleri Enstitüsü, Astronomi ve Uzay Bilimleri Nisan, 2012

San Pedro Mártir Açık Yıldız Küme Projesi

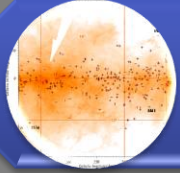
Projenin Amaçları: Yaklaşık 300'den fazla AYK'si için;



Ortak bir *UBVRI* fotometrik ölçeği kullanmak



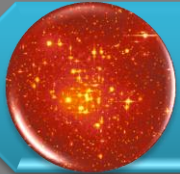
CC ve *CM* diyagramlarına ait bir atlas oluşturmak



Kızarma, uzaklık ve yaşa ait homojen bir set oluşturmak



Yaşlı ve uzak kümelerin gözlem sayısını artırmak



İlginç küme adaylarını seçmek

SPM Açık Yıldız Küme Taraması: Fotometrik Gözlemler, Veriler ve İndirgeme Teknikleri

- Kuzey yarı küreden gözlenen açık yıldız kümelerinin fotometrik CCD UB $V(RI)_C$ gözlemlerine dayanan bir hızlı taramadır.
- Gözlenen açık yıldız kümelerinin çoğunluğu Dias ve diğ. (2002, 2010) kataloğundan alınmıştır.
- Gözlemler aynı teleskop, CCD ve filtreler ile alınmıştır.
- Gözlemsel prosedürler, indirgeme yöntemleri ve Landolt (1983, 1992) standart yıldızları kullanıldığından gözlemler ve indirgemeler homojendir.
- Fotometrik gözlemler SPM'deki 84 cm'lik f/13 Ritchey-Chretien teleskop ile yapılmıştır.

Gözlemler

Kümeler için verilen ortalama poz süreleri

Filtre	U	B	V	R	I
Süre (s)	3 x 240	3 x 180	3 x 100	3 x 100	3 x 120

Standart alanlar için verilen ortalama poz süreleri

Filtre	U	B	V	R	I
Poz Süresi (s)	1 x 240	1 x 120	1 x 60	1 x 60	1 x 60

her gece için;

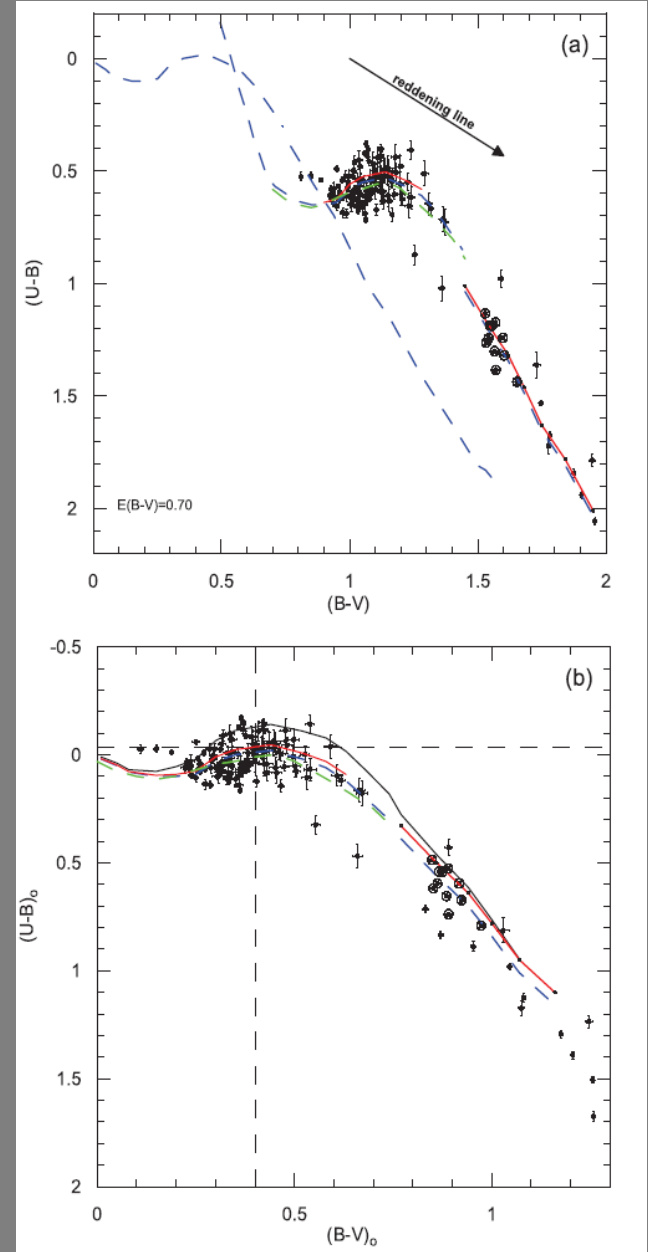
- 100 civarında “bias”
- 4-15 saniye süre ile de en az 50 “dark”
- her filtre için “flat” ölçümü yapılmıştır.
- CCD ile alınan görüntüleri “IRAF” indirgeme programındaki *CCDRED* ve *DAOPHOT*

Seçim kriterleri:

300 küme içerisinde;

- ❖ Literatürde çok fazla verisi olmayan
- ❖ F-tipi yıldızlar içeren
- ❖ Varsa kırmızı dev/kırmızı yığın yıldızları bulunan kümeler seçilmiş
- ❖ $(U-B)-(B-V)$ iki renk diyagramında kümeye üye F tayf türü yıldızların $\delta(U-B)$ morötesi artışı, fotometrik metal bolluğu $[Fe/H]$ ve Z ağır element bolluğunun tayininde kullanılmıştır.

Cluster	$(B-V)$ range	$\langle(B-V)_0\rangle$	$\langle(U-B)_H\rangle$	$\langle(U-B)_0\rangle$	$\delta(U-B)$	$\delta_{0.6}$	N
NGC 6694	(0.50 – 1.00)	0.39	0.010	-0.025	0.035	0.042 ± 0.025	58
NGC 6802	(0.90 – 1.20)	0.30	0.044	-0.010	0.054	0.079 ± 0.020	71
NGC 6866	(0.30 – 0.60)	0.44	0.000	-0.040	0.040	0.044 ± 0.010	36
NGC 7062	(0.70 – 1.10)	0.37	0.022	-0.044	0.066	0.080 ± 0.015	31
Ki 05	(0.90 – 1.30)	0.40	0.010	-0.036	0.046	0.058 ± 0.040	42
NGC 436	(0.50 – 1.10)	0.40	0.010	-0.090	0.100	0.119 ± 0.050	46
NGC 1798	(0.70 – 0.90)	0.31	0.041	-0.046	0.087	0.111 ± 0.040	41
NGC 1857	(0.60 – 0.90)	0.33	0.036	-0.034	0.070	0.088 ± 0.030	14
NGC 7142	(0.60 – 1.00)	0.50	0.030	-0.020	0.050	0.056 ± 0.023	40
Be 73	(0.50 – 0.70)	0.32	0.038	-0.012	0.050	0.064 ± 0.010	18
Haf 04	(0.50 – 0.90)	0.28	0.054	+0.004	0.050	0.084 ± 0.030	14
NGC 2215	(0.50 – 1.00)	0.37	0.022	-0.056	0.078	0.095 ± 0.040	37
Rup 01	(0.40 – 0.80)	0.38	0.018	-0.042	0.060	0.070 ± 0.030	14
Be 35	(0.40 – 0.80)	0.49	0.024	-0.025	0.049	0.052 ± 0.030	35
Be 37	(0.40 – 0.70)	0.40	0.010	-0.020	0.030	0.036 ± 0.020	52
Haf 08	(0.60 – 0.90)	0.44	0.000	-0.080	0.080	0.093 ± 0.040	34
Ki 23	(0.40 – 0.60)	0.44	0.000	-0.040	0.040	0.046 ± 0.020	18
NGC 2186	(0.50 – 1.00)	0.44	0.000	-0.080	0.080	0.093 ± 0.030	34
NGC 2304	(0.30 – 0.60)	0.37	0.002	-0.050	0.052	0.062 ± 0.030	23
NGC 2360	(0.30 – 0.60)	0.44	0.000	-0.040	0.040	0.046 ± 0.020	70



Ki 05 AYK'nin iki-renk diyagramı

20 Kümenin Analizi

- 1) SAFE Programı ile Açık Yıldız Kümelerinde Küme Üyeliğinin Belirlenmesi
- 2) Açık Yıldız Kümelerinin Temel Astrofiziksel Parametrelerinin Elde Edilmesi: Renk Artığı, Metal ve Ağır Element Bolluğu, Uzaklık Modülü, Uzaklık, Yaş
- 3) Açık Yıldız Kümelerinin Temel Astrofiziksel Parametrelerine ait Belirsizlikler ve Ortalama Değerin Hesaplanması
- 4) Morfolojik Yaş İndeksleri δV ve δI Tekniğı ile Yaş Tayini
- 5) Açık Yıldız Kümelerinin Galaksi Merkezinden R_{GC} Uzaklıkları ve Güneş ve Galaksi Merkezli X, Y, Z Kartezyen Koordinatlarının Hesaplanması

MAKALELER

Tapia ve diğ. (2010), MNRAS
Akkaya ve diğ. (2010), RevMex
Akkaya Oralhan ve diğ., (2015), NewAst
Yöntemler ve teknikler kabul edildi

İNDİRGE ME

CCD UBVRI verileri
IRAF

ÇAKIŞTIRMA

(U-B)-(B-V)

SK82 ve HYADES anakolu

SAFE JAVA Programı ile alan

yıldızları ve saçılmış yıldızlar
çıkarıldı

E(B-V)

[Fe/H], Z

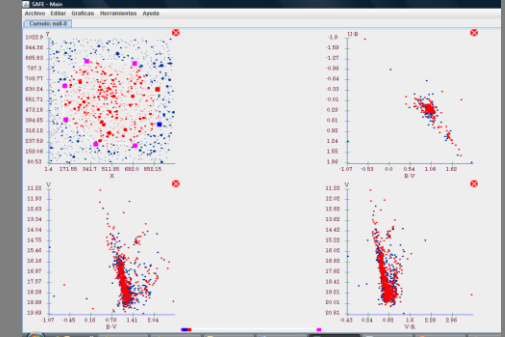
Kızarma doğrusu, $\delta(U-B)$ tekniği

ÇAKIŞTIRMA

V-(B-V), V-(R-I), V-(V-R), V-(V-I), V-(B-R)

Marigo ve diğ. (2008) eşyaş eğrileri

V-Mv, d (kpc), yaş (Gyıl)



Paunzen ve Netopil (2006,2010)
(2010) tarafından vurgulanan kümelerin
fiziksel parametrelerinin literatür ile
karşılaştırıldı

E(B-V)
değerlerinin
Schlegel toz
haritayla
karşılaştırıldı

KY, KD,
MM
yıldızları nın
tespiti

Eşyaş eğrilerinden
elde edilen yaşlar ile
morfolojik yaşların
karşılaştırıldı
Phelps ve diğ. (1996)

[Fe/H]-Rgc
Yaş-[Fe/H]
gözlemsel ilişkilerinin
araştırıldı

Spiral kollara göre X,Y
düzelmünde merkez ve zıt
doğrultudaki kümelerin
doğası araştırıldı

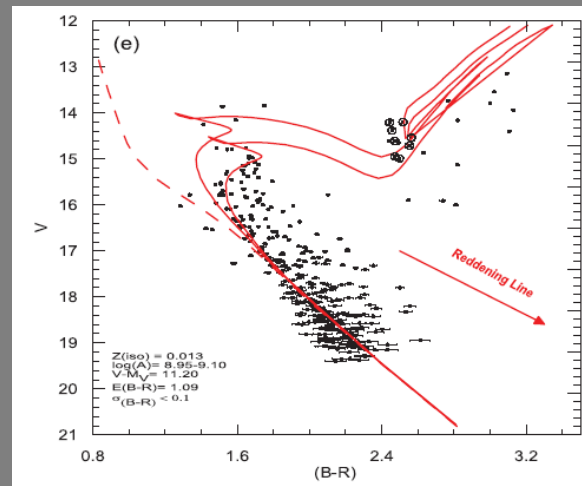
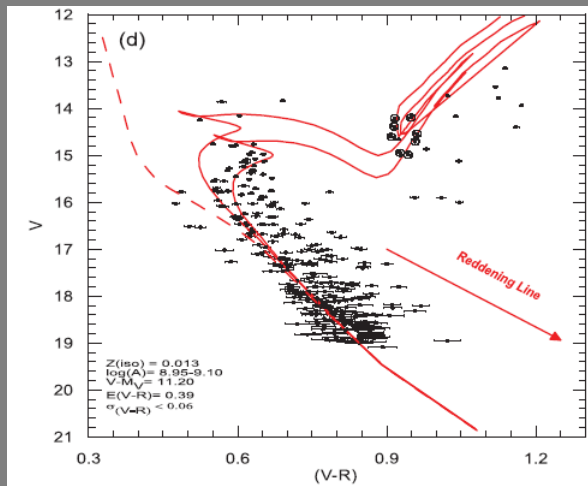
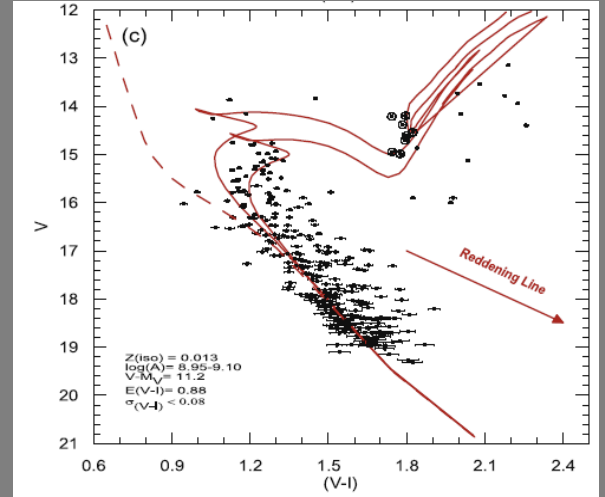
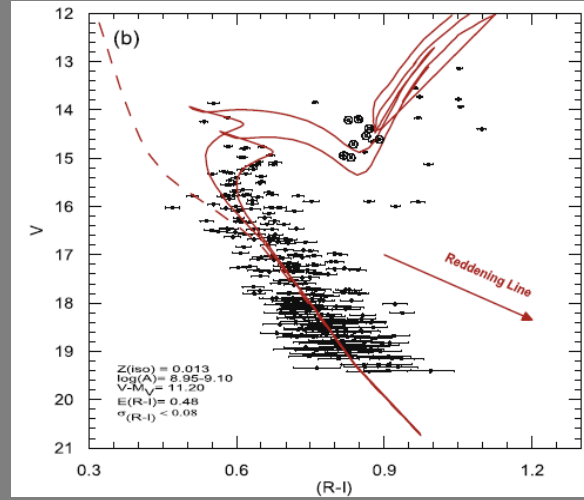
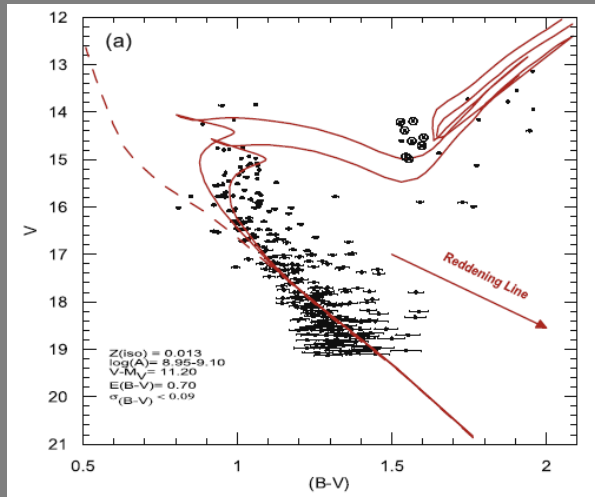
E(B-V), (V-Mv), d, yaş
literatür ile karşılaştırıldı

Farklılıkların nedenlerinin ortaya
konulması

Tayf
çalışmalarına
aday olarak
önerildi

Galaktik
diskin
kimyasal
evrim
modelleriyle
açımlandı

Anti merkezdeki genç metalce zengin
kümelerin ve metalcefakir genç
kümelerin çüce galaksi ve Canis Major
ile ilişkisine bakıldı



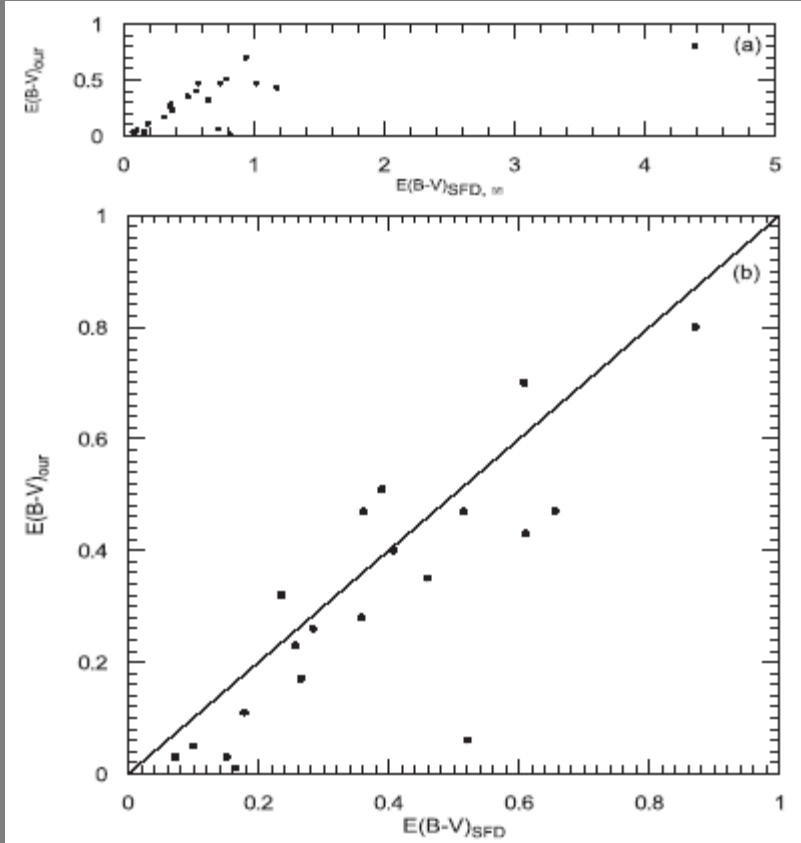
Ki 05 kümesinin beş farklı renk-kadir diyagramı

Ki 05 kümesinin temel astrofiziksel parametreleri

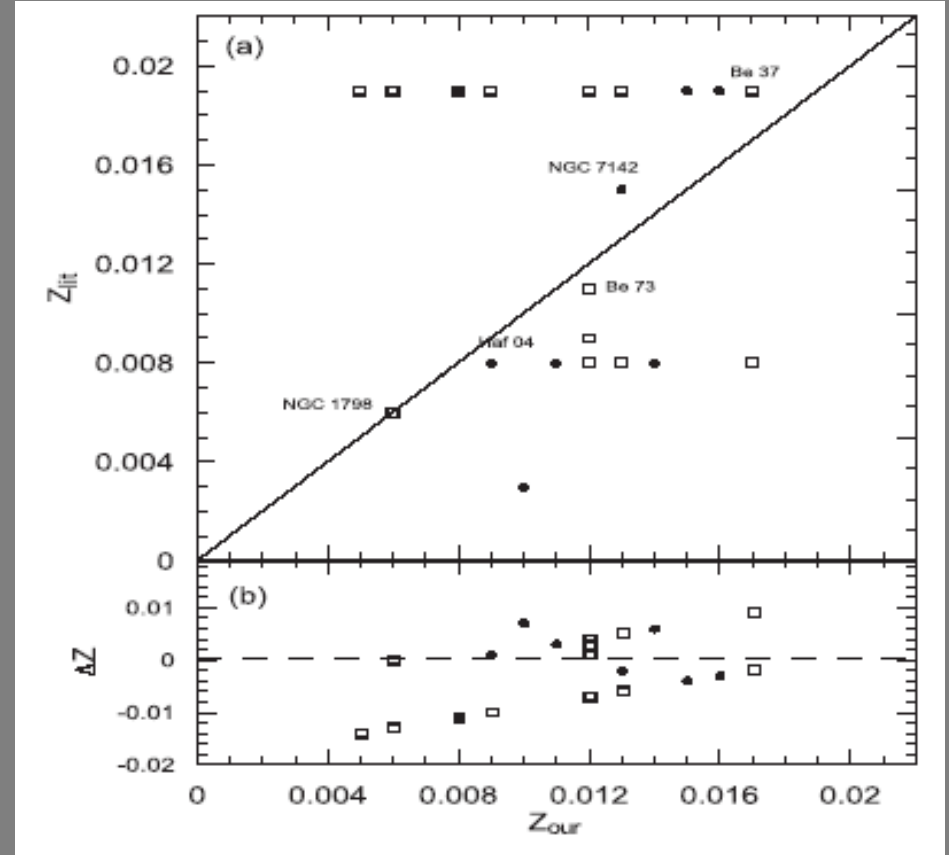
Colour	$(V_0 - M_V)$	d (kpc)	log(A)-range	log(A)	A (Gyr)
$E(B-V) = 0.70 \pm 0.08, [Fe/H] = -0.17 \pm 0.25, Z = 0.013 \pm 0.007$					
(B-V)	11.20 ± 0.12	1.74 ± 0.09	8.95 – 9.10	9.10 ± 0.10	1.26 ± 0.33
(R-I)	11.20 ± 0.20	1.74 ± 0.16	8.95 – 9.10	9.10 ± 0.15	1.26 ± 0.52
(V-I)	11.20 ± 0.10	1.74 ± 0.08	8.95 – 9.10	9.10 ± 0.10	1.26 ± 0.33
(V-R)	11.20 ± 0.10	1.74 ± 0.08	8.95 – 9.10	9.10 ± 0.10	1.26 ± 0.33
(B-R)	11.20 ± 0.10	1.74 ± 0.08	8.95 – 9.10	9.10 ± 0.10	1.26 ± 0.33
Mean	11.20 ± 0.05	1.74 ± 0.04		9.10 ± 0.05	1.26 ± 0.16

20 Küme için elde edilmiş temel astrofiziksel parametreler

Cluster	l°	b°	$E(B-V)$	[Fe/H]	Z	$(V_0 - M_V)$	A(Gyr)	d (kpc)
NGC6694	23.88	-2.91	0.51 ± 0.06	-0.09 ± 0.14	0.016 ± 0.005	11.10 ± 0.04	0.18 ± 0.01	1.66 ± 0.03
NGC6802	55.34	+0.92	0.80 ± 0.07	-0.30 ± 0.13	0.009 ± 0.003	11.19 ± 0.05	1.12 ± 0.08	1.73 ± 0.04
NGC6866	79.56	+6.84	0.06 ± 0.05	-0.10 ± 0.05	0.015 ± 0.002	10.61 ± 0.02	0.75 ± 0.04	1.32 ± 0.01
NGC7062	89.96	-2.75	0.43 ± 0.08	-0.31 ± 0.09	0.010 ± 0.002	11.40 ± 0.02	0.71 ± 0.04	1.91 ± 0.02
Ki05	143.78	-4.29	0.70 ± 0.08	-0.17 ± 0.25	0.013 ± 0.007	11.20 ± 0.05	1.26 ± 0.16	1.74 ± 0.04
NGC436	126.11	-3.91	0.40 ± 0.07	-0.55 ± 0.33	0.005 ± 0.004	11.90 ± 0.05	0.18 ± 0.03	2.40 ± 0.05
NGC1798	160.70	+4.85	0.47 ± 0.07	-0.50 ± 0.28	0.006 ± 0.004	12.70 ± 0.04	1.78 ± 0.22	3.47 ± 0.06
NGC1857	168.40	+1.26	0.47 ± 0.08	-0.36 ± 0.19	0.008 ± 0.003	11.98 ± 0.04	0.32 ± 0.04	2.49 ± 0.05
NGC7142	105.35	+9.48	0.35 ± 0.08	-0.16 ± 0.12	0.013 ± 0.004	11.60 ± 0.05	3.55 ± 0.57	2.10 ± 0.05
Be 73	215.28	-9.42	0.28 ± 0.06	-0.21 ± 0.06	0.012 ± 0.002	14.50 ± 0.03	1.41 ± 0.08	7.93 ± 0.11
Haf 04	227.94	-3.59	0.47 ± 0.09	-0.33 ± 0.19	0.009 ± 0.008	13.22 ± 0.05	0.42 ± 0.05	4.39 ± 0.10
NGC 2215	215.99	-10.10	0.23 ± 0.07	-0.40 ± 0.27	0.008 ± 0.005	9.60 ± 0.03	0.64 ± 0.05	0.83 ± 0.01
Rup 01	223.99	-9.69	0.17 ± 0.06	-0.25 ± 0.18	0.011 ± 0.005	10.85 ± 0.04	0.48 ± 0.04	1.48 ± 0.03
Be 35	212.60	+5.35	0.11 ± 0.07	-0.13 ± 0.18	0.014 ± 0.006	13.50 ± 0.04	0.89 ± 0.06	5.01 ± 0.10
Be 37	217.23	+5.94	0.05 ± 0.05	-0.05 ± 0.08	0.017 ± 0.003	13.60 ± 0.02	0.63 ± 0.06	5.25 ± 0.06
Haf 08	227.53	+1.34	0.32 ± 0.07	-0.39 ± 0.26	0.008 ± 0.005	11.88 ± 0.04	0.56 ± 0.07	2.38 ± 0.04
Ki 23	215.53	+7.20	0.03 ± 0.02	-0.11 ± 0.11	0.015 ± 0.004	12.40 ± 0.02	1.78 ± 0.07	3.02 ± 0.03
NGC 2186	203.54	-6.19	0.26 ± 0.07	-0.39 ± 0.26	0.008 ± 0.005	11.40 ± 0.03	0.32 ± 0.04	1.91 ± 0.03
NGC 2304	197.21	+8.90	0.03 ± 0.03	-0.20 ± 0.18	0.012 ± 0.005	12.79 ± 0.02	0.93 ± 0.03	3.61 ± 0.03
NGC 2360	229.81	-1.42	0.01 ± 0.07	-0.11 ± 0.11	0.015 ± 0.004	10.25 ± 0.02	1.12 ± 0.07	1.12 ± 0.01



20 küme için elde edilmiş kızarma değerlerinin SFD ile karşılaştırılması



20 küme için elde edilmiş ağır element bolluklarının literatürdekilerle karşılaştırılması

Kümelerin analizinden elde edilen $E(B-V)$ değerleri genelde SFD ile uyumlu.

Fakat $|b| > 2.5^\circ$ de açık ve küresel kümeler için SFD değerleri daha büyük değerler vermektedir (Chen et al. (1999)).

Kümelerin Literatur ile Karşılaştırılması

Cluster	$E(B-V)$	Z	$(V_0 - M_V)$	d (kpc)	A (Gyr)	$E(B-V)$	Z	ZAMS/OMS	$(V_0 - M_V)$	d (kpc)	A (Gyr)	References
NGC 6694	0.51	0.016	11.10	1.66	0.18	0.59	0.019	OMS	10.00	1.00	0.08	1
NGC 6802	0.80	0.009	11.19	1.73	1.12	0.85	0.019	OMS	10.34	1.17	0.74	2
						0.89	0.019	Claret et al. (2003); ZAMS	11.64	2.13	0.50	3
NGC 6866	0.06	0.015	10.61	1.32	0.75	0.17	0.019	OMS	10.80	1.45	0.38	2
NGC 7062	0.43	0.010	11.40	1.91	0.71	0.46	0.003	Van den Bergh and McClure (1980); ZAMS	12.18	2.73	0.28	4
Ki 05	0.70	0.013	11.20	1.74	1.26	0.67	0.019	Bertelli et al. (1994); ZAMS	11.74	2.23	1.26	5
						0.78	0.008	Van den Bergh and McClure (1980); ZAMS	11.40	1.90	1.00	6
						0.76	0.008	Bertelli et al. (1994); ZAMS	11.40	1.90	0.66	7
NGC 436	0.40	0.005	11.90	2.40	0.18	0.48	0.019	Bertelli et al. (1994); ZAMS	12.34	2.94	0.06	8
						0.50	0.019	Maeder and Meynet (1991); ZAMS	12.55	3.24	0.04	9
						0.48	0.019	Maeder and Meynet (1989); ZAMS	12.06	2.58	0.06	10
NGC 1798	0.47	0.006	12.70	3.47	1.78	0.37	0.019	Bertelli et al. (1994); ZAMS	12.75	3.55	1.58	11
						0.51	0.006	Bertelli et al. (1994); ZAMS	13.10	4.17	1.41	12
NGC 1857	0.47	0.008	11.98	2.49	0.32	0.49	0.019	Barbaro et al. (1969); ZAMS	13.15	4.27	0.07	13
NGC 7142	0.35	0.013	11.60	2.10	3.55	0.35	0.015	Mermilliod (1981); ZAMS	11.40	1.91	3.47	14
Be 73	0.28	0.012	14.50	7.93	1.41	0.10	0.008	Bertelli et al. (1994); ZAMS	14.20	6.92	2.29	15
						0.12	0.008	Girardi et al. (2000); ZAMS	14.93	9.68	1.51	16
						0.11	0.011	Girardi et al. (2000); ZAMS	14.93	9.68	1.51	17
						0.26	0.008	Bertelli et al. (1994); ZAMS	14.63	8.43	2.19	18
Haf 04	0.47	0.009	13.22	4.39	0.42	0.32	0.008	Bertelli et al. (1994); ZAMS	13.16	4.29	1.30	18
NGC 2215	0.23	0.008	9.60	0.83	0.64	0.30	0.019	OMS	9.63	0.84	0.23	19
Rup 01	0.17	0.011	10.85	1.48	0.48	0.25	0.008	Girardi et al. (2002); ZAMS	10.88	1.50	0.25	20
Be 35	0.11	0.014	13.50	5.01	0.89	0.10	0.008	Bertelli et al. (1994); ZAMS	13.82	5.81	1.12	18
Be 37	0.05	0.017	13.60	5.25	0.63	0.00	0.008	Bertelli et al. (1994); ZAMS	13.75	5.62	1.58	18
						0.12	0.019	Bonatto et al. (2004); ZAMS	13.40	4.79	0.89	21
Haf 08	0.32	0.008	11.88	2.38	0.56	0.00	0.019	SK65; OMS	11.10	1.66	0.03	22
						0.36	0.019	SK65; OMS	11.04	1.61	-	23
						0.24	0.019	Girardi et al. (2000); ZAMS	12.07	2.59	0.50	17
Ki 23	0.03	0.015	12.40	3.02	1.78	0.16	0.019	Bonatto et al. (2004); ZAMS	12.60	3.31	0.89	21
NGC 2186	0.26	0.008	11.40	1.91	0.32	0.31	0.019	SK65; OMS	11.31	1.83	-	23
						0.27	0.019	Girardi et al. (2002); ZAMS	12.16	2.70	0.20	24
NGC 2304	0.03	0.012	12.79	3.61	0.93	0.10	0.009	Bertelli et al. (1994); ZAMS	13.00	3.98	0.79	25
						0.10	0.019	Girardi et al. (2002); ZAMS	13.24	4.45	0.63	24
NGC 2360	0.01	0.015	10.25	1.12	1.12	0.07	0.019	Eggen (1968); ZAMS	10.30	1.15	-	26

(1) Cuffey (1940), (2) Hoag et al. (1961), (3) Netopil et al. (2007), (4) Peniche et al. (1990), (5) Maciejewski and Niedzielski (2007), (6) Durgapal et al. (2001), (7) Carraro and Vallenari (2000), (8) Pandey et al. (2003), (9) Phelps and Janes (1994), (10) Huestamendia et al. (1991), (11) Maciejewski and Niedzielski (2007), (12) Park and Lee (1999), (13) Babu (1989), (14) Crinklaw and Talbert (1991), (15) Ortolani et al. (2005), (16) Carraro et al. (2005), (17) Carraro et al. (2007), (18) Hasegawa et al. (2008), (19) Becker et al. (1976), (20) Piatti et al. (2008), (21) Tadross (2008), (22) Fenkart et al. (1972), (23) Moffat and Vogt (1975), (24) Lata et al. (2010), (25) Ann et al. (2002), (26) Eggen (1968).

Dokuz kümenin metal bolluklarının literatür ile karşılaştırılması

Cluster	[Fe/H]	σ	[Mg/H] _{lit}	[Fe/H] _{lit}	σ	References	Remarks	N
NGC 7062	-0.31	0.09	-0.35	-0.35		1	Strömgren photometry	
Ki 05	-0.17	0.25	-0.38	-0.38		2	Bertelli et al. (1994) ZAMS	
			-0.26	-0.30	0.17	3	Spectroscopy – Giants	
			-0.77	-0.77		4	$\delta(U-B)$ -UBV photometry	
NGC 436	-0.55	0.33	-0.47	-0.47		5	Bertelli et al. (1994) ZAMS	
NGC 1798	-0.50	0.28	-0.46	-0.46		4	$\delta(U-B)$ -UBV photometry	
NGC 7142	-0.16	0.12	-0.10	-0.10	0.10	6	Washington photometry	
			-0.17	-0.17		7	Washington photometry	
			-0.20	-0.23	0.13	8	Spectroscopy	11 Giants
			-0.08	-0.10	0.10	3	Spectroscopy	12 Giants
			+0.14	+0.14	0.01	9	Spectroscopy	4 Giants
Haf 08	-0.39	0.26	-0.09	-0.09	0.10	10	DDO-Washington photometry	
			+0.06	+0.06	0.06	11	DDO photometry	
			+0.06	+0.06	0.04	12	DDO photometry	
			-0.19	-0.22		13	Spectroscopy	2 Giants
Be 73	-0.21	0.06	-0.32	-0.32		14	Bertelli et al. (1994) ZAMS	
NGC 2304	-0.20	0.18	-0.09	-0.09		15	$\delta(U-B)$ -UBV photometry	
NGC 2360	-0.11	0.11	-0.14	-0.14	0.07	11,16	DDO photometry	
			-0.12	-0.12	0.03	17	DDO photometry	
			-0.15	-0.15	0.11	12	DDO photometry	
			-0.29	-0.29	0.04	7	Washington photometry	
			-0.24	-0.28	0.05	8	Spectroscopy – Giants	
			-0.22	-0.26	0.02	3	Spectroscopy – Giants	
			+0.08	+0.07	0.07	18	Spectroscopy	7 Giants

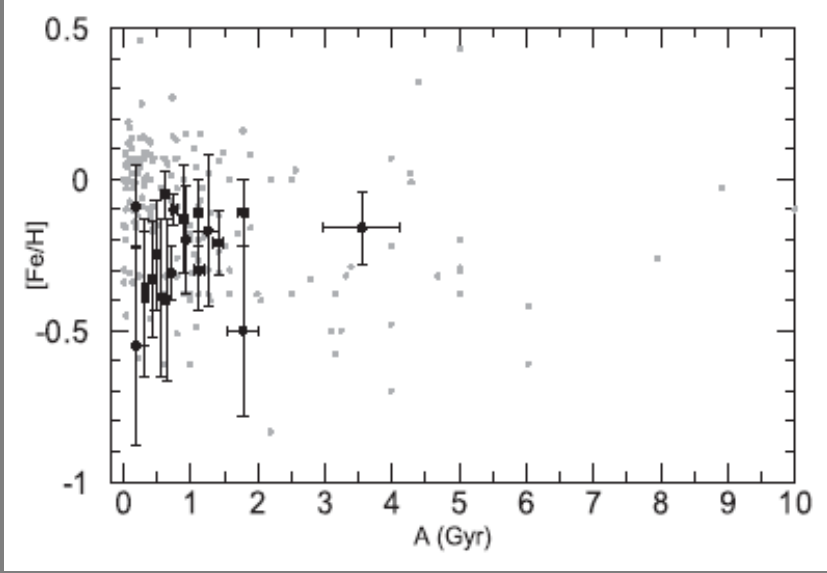
(1) Peniche et al. (1990), (2) Carraro and Vallenari (2000), (3) Friel et al. (2002), (4) Tadross (2003), (5) Park and Lee (1999), (6) Canerna et al. (1986), (7) Geisler et al. (1991, 1992), (8) Friel and Janes (1993), (9) Jacobson et al. (2008), (10) Claria et al. (1989), (11) Piatti et al. (1995), (12) Twarog et al. (1997), (13) Carraro et al. (2007), (14) Ann et al. (2002), (15) Cameron (1985), (16) Claria et al. (1999), (17) Claria et al. (2008), (18) Hamdani et al. (2000).

Kümelerin morfolojik yaşları

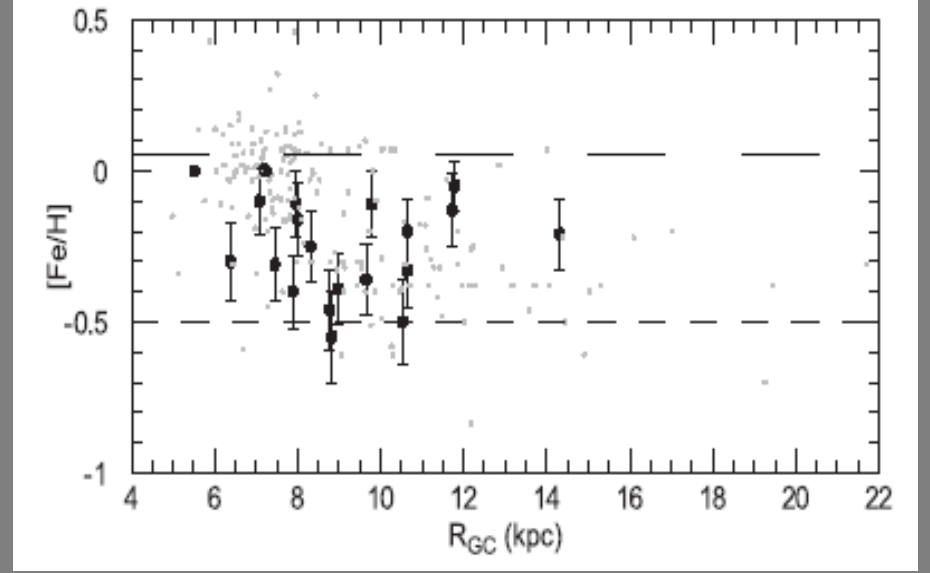
Cluster	V_{TO}	$V_{RC/RC}$	$(B-V)_{TO}$	$(B-V)_{RC/RC}$	δV	δI	$\log A_{mi}$	$\log A_{iso}$	RC/RC
NGC 6802	15.20	14.88	1.00	1.73	0.32	0.73	8.87 ± 0.03	9.05 ± 0.03	RC
NGC 6866	12.07	11.07	0.18	1.14	0.18	0.96	8.82 ± 0.03	8.89 ± 0.02	RG
NGC 7062	13.85	13.18	0.51	1.39	0.66	0.88	9.00 ± 0.04	8.85 ± 0.02	RC
Ki 05	15.63	14.71	0.09	1.60	0.92	1.50	9.11 ± 0.04	9.10 ± 0.05	RC
NGC 1798	16.56	15.75	0.72	1.35	0.81	0.63	9.06 ± 0.03	9.25 ± 0.03	RC
NGC 7142	16.19	15.19	0.81	1.31	1.89	0.50	9.55 ± 0.04	9.55 ± 0.06	RG,RC
Ru 01	12.14	12.02	0.18	1.12	0.12	0.94	8.78 ± 0.04	8.68 ± 0.03	RG
Be 35	15.32	14.83	0.30	0.96	0.49	0.67	8.94 ± 0.01	8.95 ± 0.03	RC
Be 37	14.90	14.43	0.16	0.89	0.47	0.73	8.93 ± 0.07	8.75 ± 0.05	RC
Ki 23	15.08	14.08	0.41	0.63	1.40	0.23	9.31 ± 0.08	9.25 ± 0.02	RC
NGC 2304	14.37	13.37	0.19	1.06	0.54	0.86	8.96 ± 0.06	8.97 ± 0.02	RG
NGC 2360	12.48	11.35	0.35	0.97	1.13	0.62	9.19 ± 0.03	9.05 ± 0.02	RC

12 küme için morfolojik yaş tayini yapılmıştır

Elde edilen yaş değerleri eş-yaş çizgilerinden elde edilenlerle uyumludur.



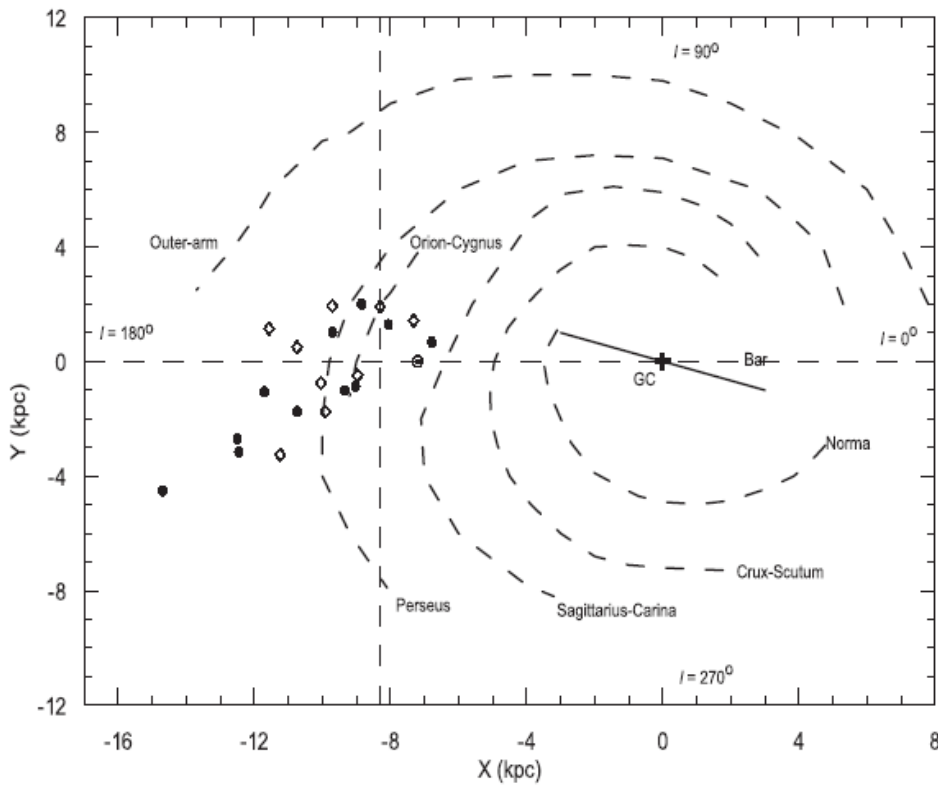
20 kümenin metal bolluğu-yaş ilişkisi



20 kümenin metal bolluğu-RGC ilişkisi

Galaktik diske göre örnek sayımız az olmasına rağmen, 20 küme için 0.5 dex 'lik aralıkta yaş-metal bolluğu ilişkisi bulunamamıştır. Nedeni, diskteki AYK'lerin homojen olmayan kimyasal zenginleşmesi (Haywood, 2008; Jacobson et al., 2011), radyal göçleri... (Schönrich and Binney, 2009). Bu AYK'leri farklı Galaktik çaplarda ve/veya farklı yıldız oluşum bölgelerinde doğmuşlardır (Lepine et al., 2011).

Benzer şekilde bu 20 AYK için, herhangi bir [Fe/H]-RGC ilişkisi bulunamamıştır.

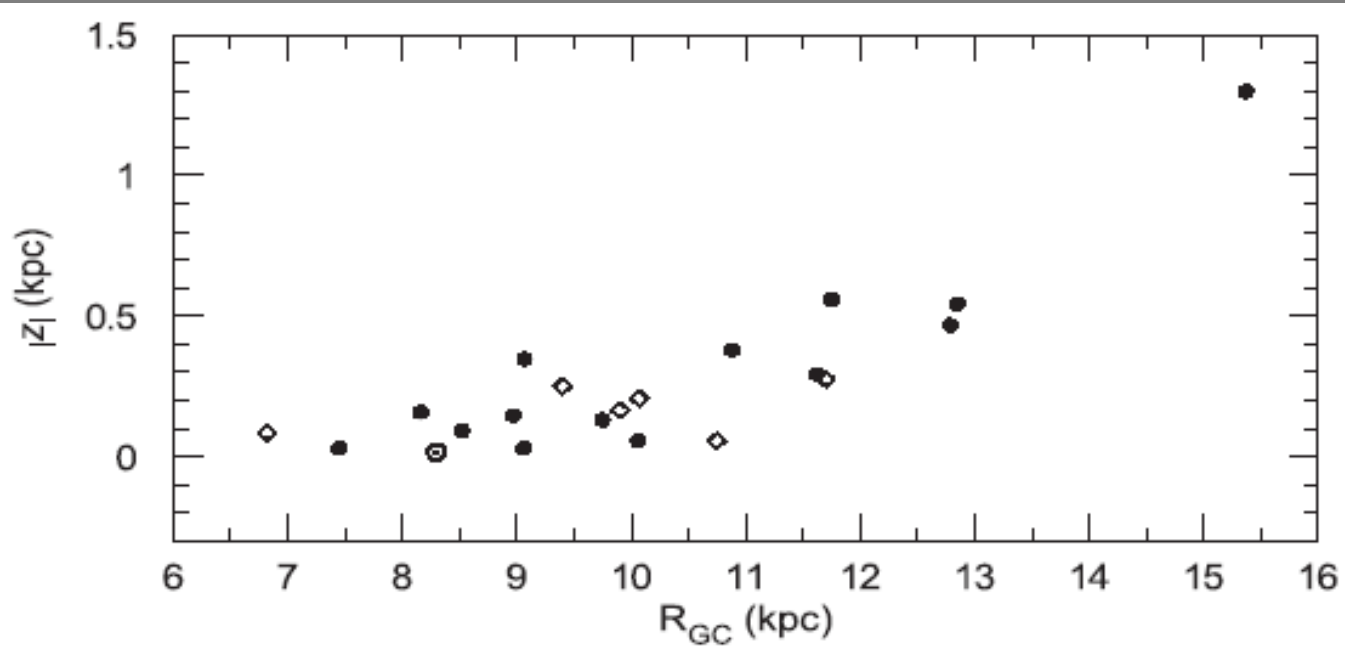


İkinci ve üçüncü galaktik çeyreklerde metalce fakir genç AYK'lerinin bulunması bunların Canis Major (Martin et al., 2004; Bellazzini et al., 2004) veya Monoceros ring (Newberg et al., 2002) gibi yoğun bölgelerde oluşmuş olabileceğini göstermektedir (Carraro et al. (2010)).

$R_{GC} > 8.3$ kpc olan dış galaktik diskteki genç AYK'lerin olması da galaksimizle birleşen bir cüce galaksi ile ilişkilendirilebilir (Yong et al. (2005)).

I. Quadrant				II. Quadrant				III. Quadrant			
OC	[Fe/H]	R_{GC} (kpc)	A (Gyr)	OC	[Fe/H]	R_{GC} (kpc)	A (Gyr)	OC	[Fe/H]	R_{GC} (kpc)	A (Gyr)
NGC 6802	-0.30	7.45	1.12	NGC 7142	-0.16	9.07	3.55	NGC 2215	-0.40	8.97	0.64
NGC 6866	-0.10	8.16	0.75	NGC 1798	-0.50	11.62	1.78	Haf 04	-0.33	11.70	0.42
NGC 6694	-0.09	6.82	0.18	NGC 1857	-0.36	10.75	0.32	Be 73	-0.21	15.37	1.41
NGC 7062	-0.31	8.52	0.71	NGC 436	-0.55	9.90	0.18	Rup 01	-0.25	9.40	0.48
				Ki 05	-0.17	9.75	1.26	Be 35	-0.13	12.79	0.89
								Be 37	-0.05	12.85	0.63
								Haf 08	-0.39	10.06	0.56
								Ki 23	-0.11	10.88	1.78
								NGC2186	-0.39	10.07	0.32
								NGC2304	-0.20	11.75	0.93
								NGC2360	-0.11	9.06	1.12

Kümelerin uzaysal dağılımları: İçi dolu ve boş daireler sırası ile $[Fe/H] \geq -0.25$ ve $[Fe/H] < -0.25$ olan kümeler



20 kümenin $|z|$ ve R_{GC} ilişkisi. Baklava ve içi dolu yuvarlaklar sırası ile $A \leq 0.5$ Gyl ve $A > 0.5$ Gyl olan kümeleri temsil etmektedir

$R_{GC} > 11$ kpc ve $|z| > 0.5$ kpc olan altı kümenin konumları, Galaktik bükülmenin ve yerel kolların, Perseus ve Dış-kolun varlığından kaynaklanıyor olabilir (Carraro et al. (2008))

HEDEFLER

- ✓ Şu ana kadar Açık Yıldız Küme çalışma gurubumuz tarafından toplamda 30 kümenin temel astrofiziksel parametreleri literatüre kazandırılmıştır.
- ✓ Şu anda 20 farklı kümenin hem UVBRI hem de 2MASS'de detaylı analizleri yapılmaktadır.
- ✓ Bundan sonraki aşamada O-B tayf türünden genç yıldızlar içeren kümelere yoğunlaşılacaktır.
- ✓ Analizlerimizde küme üyesi olabilecek kırmızı dev veya mavi mücadeleci yıldız olarak tespit ettiğimiz yıldızların tayf gözlemlerinin yapılması planlanmaktadır.

DİNLEDİĞİNİZ İÇİN TEŞEKKÜR EDERİM