COMMISSION 37: STAR CLUSTERS AND ASSOCIATIONS
(AMAS STELLAIRES ET ASSOCIATIONS)

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1. Introduction

The last three years have been very productive for cluster research. This report, on activities in the field, has been compiled by the members of Commission 37. It begins with sections on recent meetings, and on data catalogs (G. Lynga). Detailed tables of work on associations (P.E. Nissen), open clusters (G.L.H. Harris) and globular clusters (R.E. White) are then given. A section on cluster dynamics (D.C. Heggie) follows, and the final section concerns present trends in cluster research (C. Pilachowski).

2. Symposia and Colloquia

Major recent meetings on star clusters include:
IAU Colloquium 68, "Astrophysical Parameters for Globular Clusters" (31.012.023).
The Prague Conference on "Star Clusters and Associations and their Relation to the Evolution of the Galaxy" (34.012.068).
IAU Symposium 113, "Dynamics of Star Clusters", (Reidel; ed. J. Goodman and P. Hut), in press.

Other meetings, at which the subject of star clusters figured more or less prominently, include 32.012.006 and 065; 33.012.016; 34.012.008, 026, 049, 057,061, 062 and 065, and IAU Colloquium 88 "Stellar Radial Velocities" (L. Davis Press: ed. A.G.D. Philip), in press.

At the 19th General Assembly, Commission 37 is participating in Joint Discussion VI, "Evolution in Young Populations in Galaxies", organised by G. Lynga.

3. Catalogs of Cluster Data

Several new catalogs or updates of old catalogs have been made available by the data centers in Strasbourg and at NASA:

Catalog number	Content	Authors	Year
5041	Open cluster data	Lynga, G	1983
5044	Globular cluster bibliography	Ruprecht, J., Balazs, B. and White, R.E.	1983
5045	Masses and ages of stars in twelve open clusters	Myatzutin, V., Sagar, R. and Joshi, U.	1984

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5046	Stars in stellar associations and young clusters	Humphreys, R.M. and McElroy, D.B.	1984

A bibliography of radial velocities for stars in open clusters is presented by Mermilliod (1984: Bull. Inform. CDS, No. 26, 9) and a compilation of proper motion studies of stars in an around open clusters is given by van Leeuwen (1984: IAU Symposium 113, in press).

Mermilliod (1985: "International Course on Data Handling in Astronomy and Astrophysics", Trieste, in press) is updating his catalogs on cross identifications and on UBV data and MK types of stars in open clusters.

Janes and Adler (32.153.005) have re-examined color magnitude diagrams for open clusters, while Philip and White (Steward Observatory) are making a reference catalog of globular cluster color magnitude diagrams.

4. Stellar Associations

Papers on associations in general, and on OB, T and R associations are listed in the following four tables. The abbreviations are

abund = chemical abundance(s)	em = emission	pol = polarization
	IR = infrared	rv = radial velocity
ass = association(s)	ist = interstellar	sp = spectra
cl = cluster(s)	mol = molecular	UV = ultraviolet
d = distance(s)	obs = observations	var = variable
distr = distribution(s)	phot = photometry	vel = velocity

TABLE 1. ASSOCIATIONS IN GENERAL

Reference	Subject
Brinks (29.152.002)	holes in HI distr and ass in M31
Casse et al (29.143.063)	cosmic rays from OB ass
Cowie et al (30.152.004)	search for supershells in OB ass
Garmany et al (30.064.080)	mass loss rates from O stars
Tomisaka et al (30.125.026)	model of superbubble formation
Gull et al (30.131.044)	theory of superbubbles
Olive, Schramm (31.107.022)	abund ejected from supernovae in ass
Efremov (32.152.007)	age and dimensions of OB ass
Salukvadze (32.118.027)	trapezium star systems in T ass
Voshchinnikov, Marchenko (32.131.319)	pol of starlight in R ass
Beltrametti et al (32.132.004)	gas dynamics around OB ass
Tenorio-Tagle et al (32.132.005)	gas dynamics around OB ass
Bruch, Sanders (33.153.029)	mass of OB ass
Elmegreen (33.153.029)	formation of ass and cl
Vanbeveren (34.152.001)	evolution of massive stars in cl and ass
Schramm, Olive (34.152.016)	chemical evolution of OB ass
Tenorio-Tagle (34.152.018)	dynamical evolution of OB ass
Mirzoyan (34.152.019)	instability in stellar ass
Bodenheimer et al (34.125.075)	evolution of OB ass
Klein et al (34.131.092)	star formation in OB ass
Cesarsky, Montmerle (34.143.018)	energetics of OB ass, gamma rays
Nissen (34.153.010)	helium abund in cl and ass
Zhilyaec, Marchenko (34.153.074)	rotation of stars in cl and ass

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TABLE 2. OB ASSOCIATIONS

Name	Observer	Type of data
Aur OB2	Aiello et al (32.131.318)	uv extinction
Car OB1	Forte, Orsatti (29.114.033)	obj. prism survey
Cas OB6	Braunsfurth (31.152.002)	HI obs
	Braunsfurth (33.131.014)	HI around HII regions
Cep OB3	Evans et al (29.131.058)	IR obs of mol cloud
	Panagia, Thum (29.131.154)	radio obs of mol cloud
	Perinotti, Panagia (30.112.025)	mass loss of O7n star
	Barsella (32.131.010)	peculiar extinction in UV
	Fabian, Stewart (33.152.001)	X-ray emitting bubble
	Sargent et al (34.131.008)	IR and CO obs, star formation
Cep OB4	Rossano et al (34.131.175)	radio obs, kinematics
Cyg OB1	Turner (33.152.002)	membership of X Cyg
Cyg OB2	Hutchings (29.112.014)	stellar winds
	Abbott et al (30.064.079)	mass loss rates
	Leitherer (30.112.039)	mass loss rates
	Persi et al (30.113.052)	IR phot of X-ray stars
	Iyengar et al (30.133.013)	ist OI line
	Leitherer (31.114.049)	sp, IR phot, mass loss
Lac OB1	Bijaoui (30.111.005)	rv
Mon OB1	Ogura (PAS Jap 36 139 1984)	H-alpha em stars
Mon OB2	Guseva (34.131.284)	distr of dust
Ori OB1	Joncas, Borra (29.152.001)	frequency of Ap stars
	Oganesyan, Gasparyan (29.114.017)	UV sp of B stars
	Parsamyan (29.122.010)	frequency of stellar flares
	White, Phillips (29.131.013)	mol line obs
	Guetter (30.152.002)	MK sp, d, age spread
	Borra (30.116.018)	magnetic fields
	Anthony-Twarog (32.111.004)	d from H-beta phot
	Gieseking (33.153.002)	kinematics from rv
	Isobe (34.152.015)	distr and age of stars
	Cowie (34.131.253)	UV obs, supershells of gas
Per OB1	Phillips, Gondhalekar (30.152.001)	high-vel ist lines
	Krelowski, Strobel (34.152.009)	UV extinction
Per OB2	Markkanen (30.156.011)	pol obs, magnetic fields
Pup OB2	Turner (29.153.003)	membership of Ruprecht 44
Sco OB1	Gieseking (32.120.004)	massive binaries
	Aiello et al (32.131.318)	UV extinction
Sco OB2	Olano, Poppel (29.131.064)	HI feature, formation model
	Herbst, Warner (30.121.001)	phot of stars in dust cloud
	Krelowski, Strobel (34.152.009)	UV extinction
	Lipovka et al (34.152.012)	radio em
Sco-Cen OB1	Borra et al (32.113.008)	search for Ap stars
Vel OB1	Eggen (32.152.003)	phot, d
Vel OB2	Eggen (32.152.003)	phot, d, cepheid members

TABLE 3. T ASSOCIATIONS

Name	Observer	Type of data
Cyg T1	Gol'dberg (34.152.006)	content of B stars
Mon T1	Erastova (31.122.090)	number of irregular var

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Pho T1	Cersosimo, Arnal (30.152.003)	HI obs
Tau T1	Nurmanova (30.113.067)	phot of T Tauri stars
	Nurmanova (30.152.010)	new member
	Nurmanova (30.113.067)	phot of T Tauri stars

TABLE 4. R ASSOCIATIONS

Name	Observer	Type of data
CMa R1	Baierlein et al (30.125.069)	stellar clustering
	Herbst et al (31.152.001)	reddening law
Mon R1	Herbst et al (31.152.001)	reddening law
Simeis 188	Herbst et al (31.152.001)	reddening law
Vul R1	Herbst et al (31.152.001)	reddening law
Vul R2	Herbst et al (31.152.001)	reddening law

5. Open Clusters

Papers and projects which refer to individual open clusters are listed in Table 5, where the clusters are ordered according to IAU number. At the end of this section, references are given to survey papers on open clusters. Abbreviations used are:

abund = abundance(s)	lf= luminosity function	RG = reg giant
agesp = age spread	ms = main sequence	rot = rotation(al)
bin = binar(y,ies)	memb = membership	rv = radial velocity
d = distance	pg = photographic	SG = supergiant(s)
distr = distribution	pec = peculiar	sp = spectra(l)
E = color excess	phot = photometry	UV = ultraviolet
em = emission	pm = proper motions	var = variable
IR = infrared	pol = polarization	vel = velocity

TABLE 5. OPEN CLUSTERS

Number	Name	Reference, and type of data
C0039+850	NGC 188	34.153.048 abund 34.153.054 PDS phot
		Baliunas et al (1984) W UMa bin, mass ratios, space vel
C0040+615	NGC 225	34.153.023 UBV pg phot
C0057+636	Be 62	30.153.011 UBV phot, E, d, age
C0115+580	NGC 457	30.153.026 uvby$H\beta$ phot, agesp
		32.153.043 uvby$H\beta$ phot, d, F supergiants
		33.153.013 memb, pre-ms
C0126+630	NGC 559	32.113.048 UBVRI phot
C0129+604	NGC 581	34.153.044 UBV phot, d, age,E
C0140+616	NGC 654	33.153.011 UBV phot, E, d, age
C0142+610	NGC 663	30.153.026 uvby$H\beta$ phot, agesp
C0155+552	NGC 744	30.122.134 carbon star, var
C0154+374	NGC 752	33.153.017 uvby phot, ms bimodality, E, d, age, abund
C0211+590	Stock 2	31.115.004 giants, linear radii
C0215+569	NGC 869	30.153.026 uvby$H\beta$ phot, agespread
	(h Per)	31.153.011 ANS phot, circumstellar matter
		31.153.034 SG, var 33.153.037 memb, catalog

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C0218+568	NGC 884	31.153.011 ANS phot, circumstellar matter
	(χ Per)	31.153.034 SG, var 33.153.037 memb, catalog
C0228+612	IC 1805	33.153.013 memb, pre ms 31.112.013 UV sp, mass loss
		33.153.020 UBV phot, var E, d, star formation
		34.153.046 UBV phot, d, E, R, age
C0238+425	NGC 1039	31.153.006 pg phot, white dwarfs
C0311+470	NGC 1245	30.153.015 lf
C0318+484	NGC 1252	30.153.003 kinematics, "supercorona"
	Mel 20	34.153.037 internal structure
		34.153.017 UBV phot, age, d, carbon star
C0341+321	IC 348	34.153.046 UBV phot, d, E, R, age
C0344+239	Pleiades	30.153.007 X-ray phot, variability
		30.121.028 sp, em lines, Li abund
		31.153.005 UV phot, 2 color phot. E, age, Be stars
		31.153.036 X-ray survey 31.153.043 var K stars
		31.113.069 phot, var stars 31.113.076 slow flare curves
		31.113.077 flare stars
		31.122.037 flare stars, spatial distr
		32.153.028 BVRIJHK phot, sp, bin, ms
		32.113.069 phot, variability
		32.114.053 Mg II h and k, chromospheric activity
		33.153.030 X-ray sources 34.153.015 Li abund, agesp
		34.153.038 sp types, vsini, age, d
		34.153.065 lf 34.153.051 sp, rot vel, K
		34.153.076 flare stars, statistics
		34.153.066 sp age criteria, kinematics
		Vandenberg, Bridges (1984) ZAMS models, abund
C0417+368	Hyades	30.153.023 X-ray em, stellar coronae
		30.114.040 UV, optical data, giants
		30.122.149 V697 Tau, memb
		31.153.003 rot vel, macroturbulence, giants
		31.153.016 uvby phot, He abund
		31.153.040 IUE sp, X-ray sources, em
		31.153.037 UBVR phot 31.153.048 VRIK phot, bin
		31.153.049 Hipparchos 31.111.033 pm survey, memb
		31.113.076 slow flare curves 31.114.010 sp
		31.115.004 giants, linear radii
		31.116.013 Ca II H and K em, rot vel
		31.120.004 HD 27130, bin, mass-luminosity relation, d
		31.120.006 bin, rv, memb 32.153.003 UBVRI phot, memb
		32.153.023 uvbyHβ,RI phot, d, agesp
		32.153.029 JHK phot, bin 32.153.039 bin, He abund, d
		32.114.053 Mg II h and k studies, chromospheric activity
		33.153.001 BVRI phot, memb 33.153.021 phot, ms
		33.153.025 d 33.153.027 reticon sp, CN abund
		33.153.034 pm, phot, rv, subluminous stars
		33.153.041 stellar orbits
		33.114.097 chromospheric activity, dwarfs
		34.153.015 Li abund, agesp 34.153.016 IUE sp, giants, em
		34.153.020 X-ray activity 34.153.034 Ca II H and K em
		34.153.026,.027 Hyades problems 34.153.039 structure
		34.153.065 lf 34.113.032 phot, variability
		34.153.058 d, pm 34.153.067 X-ray lf
		34.153.077 A stars, motion 34.153.073 bright stars, distr
		Vandenberg, Bridges (1984) ZAMS models, abund, d
		Upgren et al (van Vleck) BVRI phot
C0443+108	NGC 1662	34.153.012 Ap stars
C0447+436	NGC 1664	30.122.193 carbon star, var star

C0459-058	HR 1614	32.153.006 DDO phot, CN abund
C0532+099	Orion	30.153.005 pm, memb 31.113.077 flare stars
		34.153.002 UV flux distr, extinction curves
		34.153.014 MK types, rv, memb
		34.153.018 Vsini, X-ray phot, rot, T Tauri stars
		34.153.022 pm, memb 34.153.025 sp, HI lines
		34.153.061 low mass stars, IR pg
		Lee et al (Yale) pm, internal motions
C0532+341	NGC 1960	30.153.026 uvbyHβ phot, agesp
		Barkhatova et al (1984)
C0533-01	Cr 70	33.153.002 vel distr
C0540-022	NGC 2023	34.153.003 IR phot, reflection nebulae, star formation
C0540+002	NGC 2068	34.153.003 IR phot, reflection nebulae, star formation
C0546+336	King 8	29.153.037 BV phot, E, d, age, metallicity
C0548+217	Berk 21	32.153.010 slitless sp, automated sp classification, memb
C0549+325	NGC 2099	30.122.194 carbon star, var star
		31.115.004 giants, linear radii 32.153.021 UBV phot
C0604+241	NGC 2158	Smith, Norris (1984) sp, giants, Ca II H and K, CN
		Cudworth (Yerkes) pm, phot
C0605+243	NGC 2168	Cudworth, McNamara (Yerkes) internal motions
C0611+128	NGC 2194	30.153.022
C0613-186	NGC 2204	34.153.050 phot, d, E, age, lf
		Claria (Cordoba) UBV, CMT_1T_2 phot, abund
C0624-047	NGC 2232	34.153.041 DDO phot
		Claria (Cordoba) UBV, DDO phot
C0627-312	NGC 2243	31.153.035 high disp sp, RG, abund, age
C0629+049	NGC 2244	30.114.015 IUE data, energy distr 32.153.027 pm
C0634+031	CV Mon	33.153.004 uvbyHβ phot, d, E
C0635+020	Coll 10	32.153.013
C0638+099	NGC 2264	30.153.009 X-ray phot 30.115.006 theor HR diagram
		33.122.025 UBVRI phot, light curve, W92
		34.153.021 UBV phot, var E, d
		34.153.046 UBV phot, d, E, R, age
		34.153.059 pre ms stars, star formation, model comparison
		Claria (1984) UBV, DDO phot, evolved stars, memb, abund
C0639-480	IC 2395	Claria et al (Cordoba) UBV phot, sp, lf, d, age, abund
C0644-206	NGC 2287	30.153.003 uvbyHβ phot, E, d, age
		34.153.041 DDO phot 34.153.012 Ap stars
		34.153.028 MK sp, star counts, d, E
C0645+411	NGC 2281	30.153.025
C0649+005	NGC 2301	34.153.045 phot, d
C0650+030	Berk 28	Bijaoui et al (1984) UBV phot, E, d, age, lf
C0652-245	Coll 121	30.153.003 uvbyHβ phot, E, d, age 34.153.011 Ap stars
C0658-204	Tomb 1	33.153.019 UBV phot, cepheid, memb, d, age
C0700-082	NGC 2323	Claria, Lapasset (Cordoba) UBV phot, E, age
		34.153.045 UBV phot, d, diameter, E, memb
C0701-207	Tomb 2	32.153.042 pg phot, E, d
C0704-100	NGC 2335	Claria (1984) UBV, DDO phot, evolved stars, memb, abund
C0705-105	NGC 2343	Claria (1984) UBV, DDO phot, evolved stars, memb, abund
C0712-102	NGC 2353	34.153.028 UBV phot, MK sp, d, var E, star counts
C0712-310	Coll 132	33.153.007 uvbyHβ phot, age, space motion
C0715-155	NGC 2360	Mermilliod (Geneva) 7-color phot, RG
		Mermilliod, Mayor (Geneva), rv, RG
C0715-367	Coll 135	33.153.007 uvbyHβ phot, age, space motion
C0716-248	NGC 2362	32.153.024 BV phot, Ap stars
C0722-321	Coll 140	33.153.007 uvbyHβ phot, age, space motion
C0724-287	Ru 20	Claria (Cordoba) DDO, CMT_1T_2 phot, abund
C0724-476	Mel 66	31.153.035 high dispersion sp, d, age, abund

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		Claria (Cordoba) UBV, CMT_1T_2 phot, abund
C0735+216	NGC 2420	31.153.035 high dispersion sp, RG, abund, age
		33.153.042 structure, memb, surface densitydistr
C0734-205	NGC 2421	Mermilliod, Mayor (Geneva) rv, RG
C0734-143	NGC 2422	33.153.041 stellar orbits 34.153.012 Ap stars
C0734-137	NGC 2423	33.153.006 phot, var stars, d, age, RG
		Claria (Cordoba) CMT_1T_2 phot, abund
		Mermilliod (Geneva) 7-color phot, RG
C0739-147	NGC 2437	30.153.024 uvby$H\beta$ phot, E, d, age
C0740-354	Ru 31	Claria (Cordoba) UBV phot
C0742-237	NGC 2447	33.153.005 phot, d, age, abund
		Mermilliod (Geneva) 7-color phot, RG
		Mermilliod, Mayor (Geneva) rv, RG
C0743-328	NGC 2451	33.153.007 uvby$H\beta$ phot, age, space motion
		33.114.023 c Pup, companion, E, T_e, angular diameter, d
		34.153.041 DDO phot
		Claria (1984) UBV, DDO phot, evolved stars, memb, abund
		Mermilliod, Mayor (Geneva) rv, RG
C0750-384	NGC 2477	33.153.003 JHK phot Mermilliod, Mayor (Geneva) rv, RG
		33.153.035 sp, blue stragglers, rot, age, abund, rv
		Claria (Cordoba) CMT_1T_2 phot, abund
C0752-241	NGC 2482	34.153.042 CMT_1T_2, DDO phot, RG, abund, homogeneity
		Mermilliod, Mayor (Geneva) rv, RG
C0754-299	NGC 2489	Mermilliod, Mayor (Geneva) rv, RG
C0757-607	NGC 2516	30.114.119 coude sp, HD 66318 32.120.002 rv, bin
		32.153.030 UVR search, white dwarfs, mass limit
		34.153.009 VBLUW phot, E, d
		34.153.012 Ap stars
		Mermilliod, Mayor (Geneva) rv, RG
C0802-461	Coll 173	33.153.007 uvby$H\beta$ phot, age, space motion
C0803-280	NGC 2527	Claria (1984) UBV, DDO phot, evolved stars, memb, abund
		Mermilliod, Mayor (Geneva) rv, RG
C0808-126	NGC 2539	Claria (Cordoba) DDO, CMT_1T_2 phot, abund
		Mermilliod, Mayor (Geneva) 7-color phot, RG
C0810-374	NGC 2546	32.153.024 BV phot, Ap stars, var E
		Claria (1984) UBV, DDO phot, evolved stars, memb, abund
		Mermilliod, Mayor (Geneva) rv, RG
C0809-491	NGC 2547	31.153.004 uvby$H\beta$ phot, E, d, age, lf, RG, var, ms gap
C0811-056	NGC 2548	Claria (1984) UBV, DDO phot, evolved stars, memb, abund
C0816-304	NGC 2567	Claria (1984) UBV, DDO phot, evolved stars, memb, abund
C0837+201	NGC 2632	30.153.010 BVRI phot 31.153.006 pg phot, white dwarfs
	Praesepe	31.113.026 slow flare curves 31.114.197 sp, abund
		31.115.004 giants, linear radii
		32.153.019 BVRI phot, lower ms
		33.153.008 pm, memb 33.153.018 MK sp, d
		34.153.073 bright stars, distr
		Anthony-Twarog (1984) phot survey, white dwarfs
		Vandenberg (1984) ZAMS models, abund, d
C0838-528	IC 2391	33.122.037 var, o Vel, HR 3467
		Levato, Garcia (1984) rot vel, axial rot, bin
		Levato, Malaroda (1984) sp types, pec stars, d
C0840-447	NGC 2659	30.153.024 uvby$H\beta$ phot, E, d, age
C0840-469	NGC 2660	33.153.003 JHK phot
C0843-527	NGC 2669	Mermilliod, Mayor (Geneva) rv, RG
C0847+120	NGC 2682	30.153.002 uvby$H\beta$ phot, E, d, blue stragglers
	M 67	30.113.059 phot
		31.115.004 giants, linear radii
		31.153.035 high dispersion sp, RG, d, age, abund

		32.153.040 pm, memb Lopez (Yale) pm 34.153.048 abund
		Peterson et al (1984) IR phot, sp, blue stragglers, bin
		Janes, Smith (1984) UBV, DDO phot, RG, sp, abund, bin
		Schild (1984) BVRI CCD phot
C0921-770	E 3	34.153.050 phot, d, E, age, lf
C0925-549	Ru 77	32.153.002 RGU phot, d, E, earliest sp type
C0927-534	Ru 78	32.153.002 RGU phot, d, E, earliest sp type
C0931-561	Basel 20	32.153.002 RGU phot, d, E, earliest sp type
C0938-501	NGC 2972	Mermilliod, Mayor (Geneva) rv, RG
C0939-536	Ru 79	33.153.004 uvbyHβ phot, d, E
C0947-543	Ru 83	32.153.002 RGU phot, d, E, earliest sp type
C0947-561	NGC 3033	Mermilliod, Mayor (Geneva) rv, RG
C0949-529	Pis 16	32.153.002 RGU phot, d, E, earliest sp type
C1001-598	NGC 3114	31.153.042 uvbyHβ phot, d, E, age, blue stragglers
		Claria (Cordoba) UBV, DDO, CMT_1T_2 phot, abund
		Mermilliod, Mayor (Geneva) rv, RG
C1019-514	NGC 3228	32.153.024 BV phot, Ap stars
		Mermilliod, Mayor (Geneva) rv, RG
C1025-573	IC 2581	32.153.043 uvbyHβ phot, d, F SG
C1033-579	NGC 3293	32.153.026 UBV phot, agesp, lf, initial mass function
		33.122.011 B phot, β Cep stars
		34.153.031 uvbyHβ phot, ZAMS, d, β Cep stars
C1035-583	NGC 3324	32.114.081 sp types, O stars
C1041-593	Tru 14	32.114.081 sp types, O stars
		34.153.035 UBVRI phot, memb, var E, d, age
C1041-597	Coll 228	31.153.002 MK sp types, d, bin, shell stars 31.153.017
C1042-591	Tru 15	31.153.019
C1043-594	Tru 16	32.153.001 UBVRI phot 32.153.037 sp types, bin, shell star
		32.114.081 sp types, O stars
C1104-584	NGC 3532	32.152.020 UBVRI phot
		Mermilliod, Mayor (Geneva) rv, RG
C1112-609	NGC 3603	32.114.081 sp types, O stars
		34.153.060 SIT Vidicon surface phot
C11115-624	IC 2714	Mermilliod (Geneva) 7-color phot, RG
		Mermilliod, Mayor (Geneva) rv, RG
C1123-429	NGC 3680	34.153.042 CMT_1T_2, DDO phot, RG, abund, homogeneity
		Mermilliod (Geneva) 7-color phot, RG
		Mermilliod, Mayor (Geneva) rv, RG
C1141-622	NGC 3960	30.153.017 BV, DDO phot, E, d, age, CN abund
		Mermilliod, Mayor (Geneva) rv, RG
C1141-622	Stock 14	32.153.018 UBV phot, d, age V810 Cen
		34.153.013 MK sp types, E, cepheid
C1148-554	NGC 3960	30.153.017 BV, DDO phot, E, d, age, Cn abund
		Mermilliod, Mayor (Geneva) rv, RG
C1204-609	NGC 4103	30.153.024 uvbyHβ phot, E, d, Be star, age
C1221-616	NGC 4349	Claria (Cordoba) UBV, CMT_1T_2 phot, abund
		Mermilliod, Mayor (Geneva) rv, RG
C1222+263	Mel 111	31.153.016 uvby phot, He abund 32.111.012 pm
	(Coma)	32.114.053 Mg II h and K studies, chromospheric activity
		34.153.065 lf 34.153.073 bright stars, distr
C1226-605	Coll 258	Mermilliod, Mayor (Geneva) rv, RG
C1227-645	NGC 4463	Mermilliod, Mayor (Geneva) rv, RG
C1232+365	Upgren 1	31.153.041 uvby phot, rv, cluster identification, d, age
C1236-508	Ru 106	31.153.021 HI
C1239-627	NGC 4609	Claria (Cordoba) UBV, DDO, CMT_1T_2 phot, abund
		Mermilliod, Mayor (Geneva) rv, RG
C125+275	NGC 4745	33.153.041 stellar orbits
C1250-600	NGC 4755	Shobbrook (1984) uvbyHβ phot, ZAMS, d, age

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C1313+179	NGC 5053	31.153.046 UBV phot catalog
C1315-623	Stock 16	34.153.029 star formation
C1315-669	Coll 268	Mermilliod, Mayor (Geneva) rv, RG
C1324-587	NGC 5138	Claria (Cordoba) CMT_1T_2 phot, abund
		Mermilliod, Mayor (Geneva) rv, RG
C1343-626	NGC 5281	Mermilliod, Mayor (Geneva) rv, RG
C1350-616	NGC 5316	Mermilliod, Mayor (Geneva) rv, RG
C1404-480	NGC 5460	31.153.021 HI Mermilliod, Mayor (Geneva) rv, RG
		Claria (Cordoba) UBV, DDO, CMT_1T_2 phot, abund
C1426-605	NGC 5617	32.153.044 UBV phot, cepheid, memb
		Mermilliod, Mayor (Geneva) rv, RG
C1440+697	Coll 285	32.114.053 Mg II h and k studies, chromospheric activity
	U Ma	33.153.026 Sirius moving group, supercluster, abund
		34.153.005 sp, A stars, memb
		34.153.037 internal structure
		34.153.066 sp age criteria, kinematics
C1445-543	NGC 5749	Mermilliod, Mayor (Geneva) rv, RG
C1501-541	NGC 5822	30.153.024 uvbyHβ phot, E, d, age
		Claria, Lapasset (1984) UBV, DDO, CMT_1T_2 phot, G and K stars, memb, E, d, age, abund, mass of RG
		Anthony-Twarog (Kansas), van Altena (Yale) pm, memb
		Mermilliod (Geneva) 7-color phot, RG
		Mermilliod, Mayor (Geneva) rv, RG
C1502-554	NGC 5823	30.153.017 BV, DDO phot, E, d, age, CN abund
		Mermilliod, Mayor (Geneva) rv, RG
C1601-517	Lynga 6	33.153.004 uvbyHβ phot, d, E
		Mermilliod, Mayor (Geneva) rv, RG
C1609-540	NGC 6067	33.153.009 phot, cepheids
		Claria (Cordoba) DDO, CMT_1T_2 phot, abund
		Mermilliod, Mayor (Geneva) rv, RG
C1614-550	Coll 299	Topaktas et al (1984) RGU phot
C1614-577	NGC 6087	33.153.043 pm memb Mermilliod, Mayor (Geneva) rv, RG
C1622-405	NGC 6124	Mermilliod, Mayor (Geneva) rv, RG
C1636-432	NGC 6192	32.153.017 UBV phot 34.153.007
C1650-417	NGC 6231	33.153.016 uvby, Hγ, Hϵ phot, sp, abund
		33.122.089 β Cep stars 34.153.068 rv, rot vel
		34.153.032 uvbyHβ phot, d, ZAMS
		34.122.053 β Cep stars, statistics
		Keenan et al (1984) high resolution sp, abund
C1652-394	NGC 6242	Claria (Cordoba) UBV, DDO, CMT_1T_2 phot, abund
		Mermilliod, Mayor (Geneva) rv, RG
C1654-447	NGC 6249	Mermilliod, Mayor (Geneva) rv, RG
C1657-446	NGC 6259	Mermilliod, Mayor (Geneva) rv, RG
C1658-396	NGC 6268	Mermilliod, Mayor (Geneva) rv, RG
C1701-378	NGC 6281	Claria (Cordoba) UBV, DDO, CMT_1T_2 phot, abund
		Mermilliod, Mayor (Geneva) rv, RG
C1715-387		31.153.012 Walraven, VRIJHKL phot, Of stars, WN stars
C1717-360	NGC 6334	32.114.081 sp types, O stars
C1720-499	IC 4651	31.153.007 DDO phot, E, D, abund, blue stragglers
		34.153.042 CMT_1T_2, DDO phot, RG, abund, homogeneity
		34.114.022 sp, CN and CH bands, giants
		Mermilliod (Geneva) &-color phot, RG
		Mermilliod, Mayor (Geneva) rv, RG
C1725-294	Tru 26	Mermilliod, Mayor (Geneva) rv, RG
C1732-334	Tru 27	33.153.015 UBVRI, JHKLM phot, R, d, age
C1734-362	Ru 127	Mermilliod, Mayor (Geneva) rv, RG
C1736-321	NGC 6405	31.153.006 pg phot, white dwarfs
C1741-323	NGC 6416	Mermilliod, Mayor (Geneva) rv, RG

C1743+057	IC 4665	30.153.029 Vilnius phot, MK types
C1743-315	NGC 6425	Mermilliod, Mayor (Geneva) rv, RG
C1753-190	NGC 6494	33.153.010 pm, cluster mass
C1757-442	NGC 6496	33.153.041 stellar orbits
C1800-279	NGC 6520	Mermilliod, Mayor (Geneva) rv, RG
C1801-243	NGC 6530	30.115.012 UBV Hβ phot, d, pre-ms
		33.153.039 pm 33.153.041 stellar orbits
		Feinstein (La Plata) UBVRI phot
C1804-233	NGC 6546	Mermilliod, Mayor (Geneva) rv, RG
C1806-240	Coll 367	Claria, Lapasset (Cordoba) UBV phot, OB association ?
C1816-138	NGC 6611	34.112.058 pol, Be stars
		Feinstein (La Plata), Westerlund (Uppsala) UBVRI phot
		The, Walraven (Amsterdam) WULBV, JHKL phot
C1828-192	IC 4725	31.153.049 uvbyHβ phot, memb, d, E
	(M25)	33.154.041 stellar orbits
C1834-082	NGC 6664	32.153.004 uvbyHβ phot, d, var E, age, blue stragglers
C1836+054	IC 4756	33.153.036 DDO phot, abund
C1848-063	NGC 6705	32.153.012 dynamics
C1849+102	NGC 6709	33.153.014 pm, memb
C1850-204	Coll 394	31.153.021 HI
C1919+377	NGC 6791	30.153.027 UBV phot, E, d
		Cudworth, Anthony-Twarog (Yerkes) pm
C1941+231	NGC 6823	31.114.086 sp types
C2014+374	IC 4996	32.113.063 pg phot, E, d
C2018+385	Berk 86	30.153.011 UBV phot, E, d, age
C2019+372	Berk 87	32.153.036 UBV phot, molecular cloud complex
C2021+406	NGC 6910	34.153.062 pm, memb
C2022+383	NGC 6913	30.114.183 UBVRI phot, energy distr
		31.111.010 pm, memb
		34.153.024 UBV phot, var E, d, agesp
C2032+281	NGC 6940	32.153.033 structure of cluster
		Gotz (1984) FG Vul, light curve
C2042+355	X Cyg	30.153.006 new cluster, cepheid, UBV phot, sp, E, d
C2059+679	NGC 7023	34.153.003 IR phot, reflection nebulae, star formation
C2111+422	NGC 7044	31.153.010
C2130+482	NGC 7092	30.153.029 Vilnius phot, MK types
	(M39)	32.153.038 phot sequence
		33.153.026 Sirius moving group, supercluster, abund
		Platais (1984) UBV phot, pm, memb
C2137+573	Tru 37	32.113.048 UBVRI phot
		Marschall (Gettysburg), van Altena (Yale) pm, memb
C2144+655	NGC 7142	30.153.029 d
C2152+623	NGC 7160	30.153.015 phot 32.113.048 UBVRI phot
C2227+551	Berk 96	Del Rio (1984) UBV phot, d, earliest sp
C2245+578	NGC 7380	33.153.013 memb, statistical methods, pre-ms
C2313+602	Mark 50	34.153.004 UBV phot, d, age, WN star, mass loss
C2322+613	NGC 7654	30.153.012 uvbyHβ phot, E, d, SG
C2354+564	NGC 7789	30.122.192 BVR phot, carbon stars, var stars
		31.153.024 RG 31.153.025 He abund
		31.115.004 giants, linear radii
		32.153.025 pol, memb, blue stragglers
		Stryker and Hrivnak (1984) blue stragglers
		34.153.057 giant branch
Sco-Cen		33.153.028 Bp, Ap stars 34.153.037 internal structure

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6. Globular Clusters

In this edition of the triennial report is found a noticeably greater abundance of information concerning clusters in galaxies other than our own. Obviously the impact of high quantum efficiency detectors and large telescopes is being felt. Catalogs of cluster information are given in Table 6. Then Table 7 presents new data for the galactic globular clusters, and Table 8 gives data for globular clusters in other galaxies. Information about variable stars in globular clusters (except that found here which pertains to cluster chemical abundance estimates etc) will be given in the Commission 27 (Variable Star) Report. Abbreviations used are :

abund = abundance(s)
atm = atmosphere(s)
betw = between
BHB = blue horizontal branch
bl = blue
br = brightness
BV = Johnson B and V mag
By = billion years
chem = chemical
cl = cluster(s)
CMD = color-magnitude diagram
col = color(s)
comp = compared
disc = discussion
distr = distribution
el = element(s)
em = emission
evol = evolution(-ary)
gt = giant(s)
HB = horizontal branch
he = heavy elements
integr = integrated
lf = luminosity function
m-p = metal poor
m-r = metal rich
ms = main sequence
no. = number
obs = observation(s)
pe = photoelectric
pd = period(s)
phot = photometry, photometric
res = resolution
RG = red giant(s)
rv = radial velocity
seq = sequence(s)
sp = spectrum (-tra,-tral)
sp-phot = spectrophotometry
st = stars
str = strength(s)
synth = synthetic(-esis)
temp = temperature
theo = theoretical
UV = ultraviolet
var = variation

IR = infrared w/ = with

TABLE 6. CATALOGS OF CLUSTER INFORMATION

Bica, Pastoriza (33.154.038) integr DDO and UBV phot (91 cl)
Brodie, Hanes (31.154.054) integr sp-phot (27 cl)
Cacciari et al (32.154.019) UV and optical sp-phot w/IUE of Magellanic Cloud cl
Freeman, Illingworth, Oemler (34.156.010) rv, kinematics of 35 LMC cl
Frenk, Fall (31.154.014) ellipticity-age relation (93 cl in Galaxy, 52 in LMC)
Frogel, Cohen, Persson (34.154.102) V-K col, CO, abund (31 cl)
Geyer, Richtler (31.154.044) axial ratios for 25 LMC cl
Grindlay (29.154.017) survey for X-ray sources (30 cl)
Hertz, Grindlay (34.154.100) X-ray survey, 14 new sources in 8 cl (71 cl)
Hodge (31.159.017) ages for 48 LMC and 18 SMC cl, abund for 24 LMC and 5 SMC cl
Huchra, Stauffer, van Speybrock (32.154.014) dynamics, abund of M31 cl
Kontizas, Kontizas (33.156.010) radii and structural parameters (23 SMC cl)
Kontizas, Danezis, Kontizas (31.159.036) radii and structural parameters (23 SMC cl)
Mould, Aaronson (32.154.041) extended giant granch (30 LMC, 12 SMC cl)
Persson et al (33.156.006) integr IR phot of 84 LMC, SMC cl
Sandage (31.154.001) Oosterhoof pd groups, cl ages (30 cl)
Sharov, Lyutyj, Esipov (32.154.011) pe phot of 58 M31 cl
Straizys (31.154.010) 2D classification (75 cl)
van Albada, de Boer, Dickens (29.154.017) far UV phot (27 cl)
van den Bergh (30.159.010) UBV integr phot for 147 LMC and 61 SMC cl; ages
Zdanavicius (33.154.005) integr phot in Vilnius system (39 cl)

TABLE 7. NEW DATA FOR INDIVIDUAL CLUSTERS

C0021-723 (NGC 104, 47 TUC)

29.154.007 ratio of HB to RG st
33.154.017 abund comp to Arcturus
33.154.054 Hα em in RG
31.154.066 CMD turnoff
31.154.058 He abund
31.159.020 age-abund relation
29.154.018 CN and Na anomalies
32.154.008 var in N on ms
32.154.007 abund -0.8 dex
34.154.012 apparent flattening
31.154.025 optical, X-ray positions
31.154.022 possible diffuse X-ray em
32.154.024 TiO band str for RG
31.154.003 anticorrelation of C, N
34.154.036 correlation of Al I, CN
34.154.005 high res sp, abund
33.154.019 Stromgren phot, RG
31.154.051 evol seq, isochrones
33.154.062 sp of 11 dwarfs, 5 subgt
34.154.036 He abund, Iben's R-method
29.154.002 faint BV pe seq
32.154.005 sp abund indicators
31.154.064 disc of cl ages
34.154.002 abund for RG in m-r cl
32.154.001 st counts, ms lf
31.154.021 supra-bl st UV col
29.154.032 IR phot 64 RG
31.154.059 cl lf differences
33.154 061 BV CMD to V = 22
34.154.056 rv for 169 RG
29.154.037 UV energy distr
31.154.034 CN distr in RG
31.154.033 abund, cl near Gal center
32.154.017 integr sp of cl
34.154.061 abund in m-r cl
33.154.013 synth CMD

C0050-268 (NGC 288)

31.154.066 cl CMD turnoffs
31.154.064 disc of cl ages
33.154.055 [Fe/H] = -1.0
33.154.013 synth CMD
32.154.005 sp abund indicators
31.059.020 age-abund relation
33.154.019 Stromgren phot, RG

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C0100-711 (NGC 362)
34.154.028 UBV br profiles
33.154.054 Hα em in RG
32.154.005 sp abund indicators
31.154.029 abund in m-r cl
32.154.040 UBV CMD
34.154.005 high res sp, abund
33.154.015 chem inhomogeneity, CN
34.154.036 He abund, Iben's R-method
30.154.033 IUE sp of central region
31.059.020 age-abund relation
34.154.012 apparent flattening
31.154.034 CN distr in RG
32.154.017 integr sp of cl

C0310-554 (NGC 1261)
33.154.059 Anticorrelation between Y, Z confirmed

C0354-498 (AM-1)
33.154.063 BV CMD

C0443+313 (Pal 2)
30.154.001 IR studies

C0512-400 (NGC 1851)
34.154.036 He abund, Iben's R-method
31.154.025 optical, X-ray positions
29.154.037 UV energy distr
31.154.027 radial UBV distr
32.154.032 CN strong st
29.154.030 BV CMD

C0522-245 (NGC 1904, M79)
31.154.059 cl lf differences
33.154.019 Stromgren phot, RG
32.154.017 integr sp of cl

C0911-646 (NGC 2808)
33.154.029 IUE sp of cl nucleus
32.154.026 m-p st abund
34.154.101 CN distr of RG
31.154.027 radial UBV distr
33.154.003 Hα em in RG

C1015-461 (NGC 3201)
30.154.030) BV CMD to ms (1452 st)
33.154.054 Hα em in RG
34.154.002 abund for RG in m-r cl
32.154.037 structure comp to NGC 1806
32.154.026 m-p st abundances
31.154.059 cl lf differences
34.154.036 correlation of Al I, CN
31.154.004 CN distr
33.154.013 synth CMD
34.154.036 He abund, Iben's R-method
31.159.020 age-abund relation
30.154.013 IR phot for 26 RG
34.154.012 apparent flattening
33.154.003 Hα em in RG
31.154.034 CN distr in RG
34.154.005 high res sp, abund
34.154.001 RR Lyr [Fe/H]

C1126+292 (Pal 4)
34.154.011 search for HI

C1207+188 (NGC 4147)
34.154.036 He abund, Iben's R-method
34.154.050 echelle sp of RG, abund
33.154.059 anticorrelation of Y,Z

C1223-724 (NGC 4372)
34.154.012 apparent flattening

C1236-264 (NGC 4590, M68)
33.154.059 anticorrelation of Y,Z
34.154.001 RR Lyr [Fe/H]

C1256-706 (NGC 4833)
34.154.012 apparent flattening
31.154.059 cl lf differences

34.154.005 high res sp, abund

C1320+184 (NGC 5024, M53)
33.154.059 anticorrelation of Y,Z
31.154.059 cl lf differences
29.154.011 synth HB

C1313+179 (NGC 5053)
34.154.011 search for HI
34.154.050 echelle sp of RG, abund
31.154.064 disc of cl ages
33.154.013 synth CMD

C1323-472 (NGC 5139, ω Cen)
33.154.054 Hα em in RG
29.154.002 faint BV pe seq
29.154.008 He abund from RR Lyr
31.154.066 CMD turnoff
30.154.007 abund in RG
34.154.012 apparent flattening
31.154.059 cl lf differences
34.154.020 10 S-st from ZrO bands
30.154.044 BV pe seq
34.154.036 correlation of Al I, CN
34.154.041 integrated br and col
33.154.013 synth CMD
31.154.032 he abund in RG
29.154.003 CMD from 300 faint st
33.154.059 anticorrelation of Y,Z
31.154.064 disc of cl ages
31.154.069 CMD of subgt branch
33.154.003 Hα em in RG
31.154.022 possible diffuse X-ray em
29.154.001 he abund variations in RG
31.154.034 CN distr in RG
30.154.011 RR Lyr, PLA relation
29.154.028 abund gradient of Ca

C1339+286 (NGC 5272, M3)
33.154.041 BV CMD near center
34.154.036 He abund, Iben's R-method
31.154.064 disc of cl ages
32.154.027 isochrone fitting to CMD
31.154.059 cl lf differences
31.154.012 width of subgt, HB seq
30.154.037 Ca, C, N abund for RG
33.154.013 synth CMD
34.154.011 search for HI
31.154.058 He content
34.154.088 rv for bl stragglers
34.154.012 apparent flattening
30.154.011 RR Lyr, PLA relation
33.154.060 br st phot in nucleus
31.154.037 C, N abund for RG

C1353-269 (AM-4)
31.154.077 discovery

C1403+287 (NGC 5466)
34.154.011 search for HI
34.154.034 membership of br st
34.154.050 echelle sp of RG, abund
31.154.016 proper and space motion
31.154.059 cl lf differences

C1500-328 (NGC 5824)
30.154.033 IUE sp of central region
29.154.037 UV energy distr

C1513+000 (Pal 5)
29.154.027 str of sp features for RG

C1516+022 (NGC 5904, M5)
30.154.034 IUE sp
29.154.007 ratio of HB to RG st
33.154.044 N-rich, UV-br st
31.154.072 BV phot, CMD
34.154.036 He abund, Iben's R-method
31.154.058 He abund
32.154.027 isochrone fitting
31.154.036 sp comp w/RG in M71
31.154.034 CN distr in RG
33.154.016 IUE sp, synth models
34.154.011 search for HI
30.154.002 BV phot, CMD
30.154.005 radial col distr
33.154.054 Hα em in RG
31.154.064 disc of cl ages
34.154.082 energy distr for HB A-st
33.154.031 UV sp
34.154.036 correlation of Al I, CN

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32.154.004 high res sp of Hα in RG
31.154.033 abund, cl near Gal center
33.154.002 CN distr in RG
33.154.013 synth CMD
33.154.018 errors in high res RG sp
34.154.005 high res sp, abund
34.154.061 abund in m-r cl

C1524-505 (NGC 5927)
34.154.002 abund for RG in m-r cl

C1608+150 (Pal 14)
31.154.090 CMD
32.154.003 st counts, structure

C1614-228 (NGC 6093, M80)
30.154.019 IUE obs
29.154.037 UV energy distr
30.154.033 IUE sp of central region

C1620-264 (NGC 6121, M4)
29.154.007 ratio of HB to RG st
33.154.054 Hα em in RG
31.154.038 high res sp of BHB st
31.154.034 CN distr in RG
31.154.068 faint bl st: 2 WD st ?
34.154.036 He abund, Iben's R-method
33.154.059 anticorrelation of Y,Z
30.154.012 CN distr from sp of 45 RG
34.154.036 correlation of Al I, CN
30.154.011 RR Lyr, PLA relation

C1629-129 (NGC 6171, M107)
34.154.036 He abund, Iben's R-method
34.154.002 abund for RG in m-r cl
31.154.033 abund, cl near Gal center
34.154.001 [Fe/H] for RR Lyr
33.154.059 anticorrelation of Y,Z
31.154.059 cl lf differences
30.154.011 RR Lyr, PLA relation

C1639+365 (NGC 6205, M13)
29.154.007 ratio of HB to Rg st
31.154.058 He abund
31.154.021 UV col for supra-bl st
32.154.027 isochrone fitting
31.154.059 cl lf differences
34.154.082 energy distr of HB A-st
31.154.037 C, N anund for RG
33.154.013 synth CMD
34.154.011 search for HI
31.154.064 disc of cl ages
32.154.007 theo calib of metallicity
34.154.012 apparent flattening
31.154.055 abund, temp of Pop II gt
30.154.037 Ca, C, N abund for 29 RG
30.154.003 far UV phot, energy distr

C1644-018 (NGC 6218, M12)
34.154.036 He abund, Iben's R-method
33.154.056 rv, UV-br st

C1645+476 (NGC 6229)
34.154.050 echelle sp, [Fe/H] for RG

C1654-040 (NGC 6254, M10)
34.154.036 He abund, Iben's R-method
31.154.059 cl lf differences
34.054.074 BV phot, ms turnoff st
33.154.054 Hα em in RG
34.154.005 high res sp, abund

C1656-370 (NGC 6256)
34.154.007 provisional CMD

C1658-300 (NGC 6266, M62)
29.154.011 synth HB
34.154.012 apparent flattening

C1659-262 (NGC 6273, M19)
34.154.012 apparent flattening

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C1715+432 (NGC 6341, M92)
34.154.006 st near cl center, BV CMD
31.154.058 He abund
32.154.009 C,N abund for RG st
32.154.027 isochrone fitting
31.154.059 cl lf differences
34.154.082 energy distr of HB A-st
34.154.003 isochrones: age = 18 By
30.154.003 far UV phot, energy distr
34.154.036 He abund, Iben's R-method
31.154.064 disc of cl ages
32.154.007 theo calib of cl abund
34.154.012 apparent flattening
31.154.055 abund, temp for Pop II gt
29.154.037 UV energy distr
34.154.002 width and lf for ms
33.154.013 synth CMD

C1721-484 (NGC 6352)
34.154.002 abund for RG in m-r cl
31.154.076 ms phot
31.154.030 metallicity
31.154.033 abund, cl near Gal center

C1720-177 (NGC 6356)
34.154.012 apparent flattening

C1724-307 (Ter 2)
31.154.025 optical, X-ray positions

C1726-670 (NGC 6362)
34.154.012 apparent flattening
31.154.033 abund, cl near Gal center

C1725-050 (NGC 6366)
30.154.042 B lf

C1728-34x (4U/MXB 1728-34, GX 354+0)
29.154.035 discovery via JHK photometry

C1730-333 (Liller 1)
31.154.025 optical, X-ray positions

C1732-447 (NGC 6388)
29.154.009 BV CMD

C1732-304 (Trz 1)
29.154.036 discovery of new X-ray burster

C1736-536 (NGC 6397)
34.154.039 age, abund for turnoff st, Pop II calibration for uvby system
31.154.071 uvby phot, turnoff st
33.154.054 Hα em in RG
31.154.066 CMD turnoff
33.154.024 IUE sp of 3 BHB st
31.154.024 synth from IUE sp
32.154.026 m-p st abund
31.154.055 abund, temp of Pop II st
31.154.020 age
33.154.013 synth CMD
31.154.102 structure of core
29.154.002 faint BV pe seq
31.154.064 disc of cl ages
32.154.001 st counts, ms lf
31.154.021 UV col for supra-bl st
33.154.003 Hα em in RG
31.154.038 high disp sp of BHB st
30.154.003 far UV phot, energy distr

C1745-247 (Trz 5)
29.154.036 discovery of new X-ray burster

C1746-370 (NGC 6441)
31.154.025 optical, X-ray positions

C1804-250 (NGC 6544)
33.154.023 BV CMD

C1806-259 (NGC 6553)
34.154.002 abund for RG in m-r cl

C1820-303 (NGC 6624)
30.154.020 em line sp from IUE
29.158.062 IUE obs comp to NGC 6624
31.154.025 optical, X-ray positions

C1821-249 (NGC 6626, M28)
29.154.031) BV CMD

C1827-255 (NGC 6638)
34.154.004 BV CMD

C1828-323 (NGC 6637, M69)
34.154.002 abund for RG in m-r cl
34.154.012 apparent flattening
31.154.029 abund in m-r cl

C1832-330 (NGC 6652)
34.154.012 apparent flattening

C1833-239 (NGC 6656, M22)
34.154.021 BV CMD to ms
30.154.007 abund in RG
34.154.012 apparent flattening
33.154.003 Hα em in RG
33.154.011 chem inhomogeneity
34.154.036 correlation of Al I, CN
30.154.003 far UV phot, energy distr
33.154.054 Hα em in RG
31.159.020 age-abund relation
32.154.026 m-p st abund
31.154.022 possible diffuse X-ray em
31.154.034 CN distr in RG
32.154.028 abund in six st

C1838-198 (Pal 8)
30.154.001 IR studies

C1840-323 (NGC 6681, M70)
34.154.012 apparent flattening

C1850-057 (NGC 6712)
33.154.059 anticorrelation of Y,Z
30.154.031 BV CMD
31.154.025 optical, X-ray positions
34.154.061 abund in m-r cl

C1856-367 (NGC 6723)
33.154.059 anticorrelation of Y,Z
34.154.012 apparent flattening
31.154.033 abund, cl near Gal center
31.154.029 abund in m-r cl
31.154.059 cl lf differences
34.154.061 abund in m-r cl

C1902+017 (NGC 6749)
30.154.001 IR studies
30.154.038 BV phot near center

C1906-600 (NGC 6752)
34.154.036 He abund, Iben's R-method
29.154.002 faint BV pe seq
31.154.058 He abund
29.154.018 CN, Na anomalies
32.154.027 isochrone fitting
31.154.055 abund, temp of Pop II gt
29.154.006 bimodal CN distr for RG
34.154.036 correlation of Al I, CN
33.154.054 Hα em in RG
31.154.066 CMD turnoff
31.154.064 disc of cl ages
32.154.001 st counts, ms lf
34.154.012 apparent flattening
29.154.037 UV energy distr
31.154.034 CN distr for RG
34.154.005 high res sp, abund

31.154.006 C, N abund var
33.154.013 synth CMD
30.154.003 far UV phot, energy distr

C1914+300 (NGC 6779, M56)
34.154.011 search for HI
30.154.021 memb via proper motion
33.154.056 rv, UV-br st

C1916+184 (Pal 10)
30.154.001 IR studies

C1936-310 (NGC 6809, M55)
34.154.036 He abund, Iben's R-method
31.154.059 cl lf differences
31.154.004 CN distr
30.154.003 far UV phot, energy distr
34.154.012 apparent flattening
31.154.034 CN distr in RG
34.154.054 CN, CH bands for 2 st

C1951+186 (NGC 6838, M71)
31.154.007 synth col, [M/H] = -0.9
31.154.064 disc of cl ages
32.154.007 [M/H] = -0.8
31.154.034 CN distr in RG
32.154.004 high res sp at $H\alpha$ in RG
31.154.074 Stromgren 4-col CMD
31.154.033 abund, cl near Gal center
31.154.051 grid of isochrones
33.154.017 abund comp to Arcturus
34.154.002 abund for RG in m-r cl
31.154.036 sp comp w/RG in M5
31.154.035 abund
33.154.018 errors in high res sp of RG
34.154.083 [Fe/H] = -1.0
31.154.004 CN distr
33.154.013 synth CMD

C2050-127 (NGC 6981, M72)
33.154.059 anticorrelation of Y,Z
30.154.011 RR Lyr, PLA relation
31.154.059 cl lf differences

C2003-220 (NGC 6864, M75)
32.154.017 integr sp of cl

C2059+160 (NGC 7006)
31.154.008 CNO not 2nd parameter
29.154.027 str of sp features in RG
32.154.046 C, N, Fe-peak abund

C2127+119 (NGC 7078, M15)
30.154.004 BV CMD near center
31.154.072 BV phot, CMD
34.154.036 He abund, Iben's R-method
32.154.005 abund indicators
31.154.058 He abund
29.154.011 synth HB
32.154.027 isochrone fitting
31.154.059 cl lf differences
34.154.082 energy distr of HB A-st
33.154.030 pop synth, ANS, IUE
32.154.017 integr sp of cl
33.154.037 phot, central core
30.154.003 far UV phot, energy distr
34.154.011 search for HI
33.154.006 UBV phot, CMD
33.154.054 $H\alpha$ em in RG
33.154.059 anticorrelation of Y,Z
31.154.064 disc of cl ages
31.159.020 age-abund relation
34.154.012 apparent flattening
31.154.025 optical, X-ray positions
29.154.037 UV energy distr
31.154.074 Stromgrn 4-col CMD
34.154.003 isochrones, age = 18 By
33.154.012 C, N abund for RG
33.154.013 synth CMD

C2130-010 (NGC 7089, M2)
33.154.007 BV CMD for central st
31.154.059 cl lf differences
32.154.005 abund indicators from sp
32.154.017 integr sp of cl

C2137-234 (NGC 7099, M30)
32.154.012 UBV phot near center
33.154.054 $H\alpha$ em in RG

31.154.025 optical, X-ray positions	32.154.017 integr sp of cl
30.154.003 far UV phot, energy distr	33.154.013 synth CMD

C2143-214 (Pal 12)

32.154.005 abund indicators from sp	31.154.064 disc of cl ages
31.154.051 grid of isochrones	33.154.013 synth CMD

C2304+124 (Pal 13)

32.154.046 C,N,Fe-peak abund for RG	29.154.027 str of sp features for RG
32.154.006 [Fe/H] = -1.67	

TABLE 8. NEW DATA FOR CLUSTERS IN OTHER GALAXIES

LARGE MAGELLANIC CLOUD

NGC 1466	29.159.016 cl memb to LMC	32.159.001 [Fe/H], rv of gt
	31.154.021 UV col from IUE sp	31.159.019 new data
	31.159.021 rv, [Fe/H]	32.154.017 integr sp of cl
NGC 1672	31.159.020 age-abund relation	
NGC 1783	31.159.020 age-abund relation	32.154.017 integr sp of cl
NGC 1786	32.159.001 [Fe/H], rv of gt	31.159.018 IUE sp
	31.159.021 rv, [Fe/H]	
NGC 1806	31.154.021 UV col from IUE sp	
NGC 1835	31.159.018 IUE sp	33.154.024 integr IUE sp
	32.159.001 [Fe/H], rv of gt	31.154.021 UV col from IUE sp
	31.159.021 rv, [Fe/H]	
NGC 1841	31.159.020 age-abund relation	32.159.001 [Fe/H], rv of gt
	29.159.016 cl memb to LMC	31.159.019 new data
	31.159.021 rv, [Fe/H]	32.154.017 integr sp of cl
NGC 1846	31.159.020 age-abund relation	32.154.017 integr sp of cl
NGC 1855	31.159.020 age-abund relation	
NGC 1866	33.154.024 integr IUE sp	31.154.021 UV col from IUE sp
	30.159.011 superluminous gt	
NGC 1898	32.154.017 integr sp of cl	
NGC 1978	31.159.018 IUE sp	32.159.001 [Fe/H], rv of gt
	31.154.021 UV col from IUE sp	31.159.021 rv, [Fe/H]
	32.154.017 integr sp of cl	
NGC 1984	31.159.020 age-abund relation	
NGC 1987	31.154.021 UV col from IUE sp	32.154.017 integr sp of cl
NGC 1994	31.159.020 age-abund relation	
NGC 2004	33.154.024 integr IUE sp	31.159.020 age-abund relation
	31.154.021 UV col from IUE sp	
NGC 2019	31.154.021 UV col from IUE sp	
NGC 2100	31.159.020 age-abund relation	
NGC 2121	31.159.020 age-abund relation	34.154.098 age, abund, BV CMD
	32.154.017 integr sp of cl	
NGC 2155	32.159.001 [Fe/H], rv of gt	31.159.021 rv, [Fe/H]
NGC 2173	31.159.020 age-abund relation	32.154.017 integr sp of cl
NGC 2193	31.159.020 age-abund relation	
NGC 2209	31.159.019 new data	32.154.017 integr sp of cl
NGC 2210	31.159.018 IUE sp	31.159.020 age-abund relation
	32.159.001 [Fe/H], rv of gt	31.154.021 UV col from IUE sp
	31.159.021 rv, [Fe/H]	
NGC 2257	31.159.020 age-abund relation	32.159.001 [Fe/H], rv of gt
	29.159.016 memb to LMC	31.159.019 new data
	31.159.021 rv, [Fe/H]	33.156.005 BV CMD to V = 22.4
	31.159.025 BV CMD	

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H11	32.159.001 [Fe/H], rv of gt	31.159.021 rv, [Fe/H]

SMALL MAGELLANIC CLOUD

NGC 121	31.159.018 IUE sp	31.159.019 new data
	32.154.017 integr sp of cl	
NGC 339	32.154.017 integr sp of cl	
NGC 411	32.154.017 integr sp of cl	
NGC 416	32.154.017 integr sp of cl	
NGC 419	31.154.021 UV col from IUE sp	32.154.017 integr sp of cl
Kron 3	31.159.019 new data	32.154.017 integr sp of cl
Linds 1	31.159.019 new data	

31.159.012 lf comp to cl in Milky Way: Lindsay 3, 11, 13, 14, 15, 20, 82 and HW 62

OTHER EXTERNAL GALAXIES

NGC 55	33.154.015 3 candidates	33.157.002 51 diffuse objects found
NGC 224	31.154.013 cl search	32.154.016 X-ray cl Bo 158
(M31)	32.154.021 X-ray cl Bo 158	29.158.062 IUE comp to NGC 6624
NGC 253	33.157.014 61 candidates found	
NGC 598	32.158.032, 34.154.099 integr phot and sp of cl candidates	
NGC 891	31.154.011 search for cl, no candidates	
NGC 3226	30.154.040 cl systems detected	
NGC 3311	34.157.082 cl search and distr	
NGC 3377	30.154.040 cl systems detected	
NGC 3379	29.158.062 IUE comp to NGC 6624	30.154.040 cl systems detected
NGC 3607	30.154.040 cl systems detected	
NGC 4278	30.154.040 cl systems detected	
NGC 4374	29.158.109 cl comp to spheroidal pop of elliptical galaxies	
NGC 4406	20.158.109 cl comp to spheroidal pop of elliptical galaxies	
NGC 4472	30.154.040 cl systems detected	29.158.062 IUE comp to NGC 6624
NGC 4486	32.158.285 origin of cl system	29.158.132 system of halo cl
NGC 4565	31.154.011 search for cl: 100 candidates	
NGC 4621	29.158.109 cl comp to spheroidal pop of elliptical galaxies	
NGC 5813	30.154.040 cl systems detected	
NGC 5846	30.154.040 cl systems detected	
Fornax	34.157.030 rv for 4 cl	33.154.010 JHK phot for 3 cl

7. Dynamics of Star Clusters

(In this section, three figure references are to Astronomy and Astrophysics Abstracts and two-figure references are to Physics Abstracts.)

In June, 1984, at the end of the review period for these reports, IAU Symposium 113 on the Dynamics of Star Clusters was held in Princeton. The Proceedings will form the most useful summary of recent research for the next few years. Nevertheless the topics which were emphasised at the symposium do not always coincide with those which are most prominent in the literature of the review period, which is the subject of this report.

Many papers were devoted to the fundamental dynamical process of relaxation. While a number of investigations reman close to the original formulations of Chandrasekhar (29.151.038, 30.151.070-2, 34.151.081-2, 87.72989), there have been some attempts to examine the effects of inhomogeneities, non-rectilinear orbits and so on (31.151.051, 34.151.115). There have been numerical tests of the standard theory (29.151.008, 31.151.014) and consideration of the strong encounters which are usually neglected (34.151.019 and .022). Nevertheless, the Fokker-Planck equation remains the standard tool in applications to the dynamics of star clusters.

Another fundamental process on which much work has been done is the dynamics of binary stars: their interactions with single stars (31.151.021, 34.151.037), which involves consideration of the decay of bound triple systems (29.042.054,1) and their interactions with each other (34.151.014, 87.47653). Which of the observable types of active binary may be formed in globular clusters is a topic which has also received attention from a dynamical point of view (33.154.020, 86.121747, 87.63219).

Now we turn to the application of these processes in the dynamical evolution of star clusters. The main consequence is core collapse, which is now well established, and occurs for some clusters on a short enough timescale to be of importance (32.154.029, 34.154.097; but cf 34.151.032). Therefore much attention has been given to the reversal of the collapse and the subsequent evolution. Binaries are especially important, as can be shown from the very simplest evaporative models (32.151.002-3, 87.22448) or from Monte-Carlo studies (34.154.091). The nature of post-collapse evolution is still in doubt; some studies suggest smooth expansion (eg 34.151.056) but the evolution may be oscillatory (87.77887). Another mechanism, less favoured now, for reversing core collapse is a central black hole (31.151.016, 32.066.070, 34.151.107).

Several of these evolutionary phenomena can be seen as manifestations of certain instabilities, eg the mass-segregation instability (29.151.014, 33.151.008, 34.151.020). Single component collisional systems may also be unstable (29.151.026, 29.151.096), and the role of anisotropy in the stability of collisionless systems has also been studied (34.151.112, 87.13375).

Two other processes are beginning to receive the attention which their importance merits. One is mass loss, which is especially important in the evolution of open clusters (30.151.036, 31.151.061, 32.151.075). The other is the effect of the Galactic tidal field. On one approximation, this can be dealt with by simple generalisations of the Roche formula (32.153.031, 87.47663) but the tide is time-dependent, and the effect of this is still poorly understood (29.151.034, 30.151.030, 87.42505).

Many of these theoretical investigaytions require the use of numerical methods. Several significant new techniques have been devised for the solution of both collisional and collisonless problems (32.151.016, 33.151.067, 34.151.063), and there has been some development of Larson's fluid dynamical method (33.151.084).

Much of this review has been concerned with dynamical evolution, but for some purposes there is a need for equilibrium cluster models which are justified more by their simplicity than on dynamical grounds. There are some new models of single component clusters (30.151.089, 33.154.036, 87.72992), and models containing two components (32.151.015) or a binary (30.154.039).

It remains to mention a number of isolated investigations which cannot be grouped conveniently with any of those described above. These include a numerical investigation of small systems immersed in a uniform medium (34.151.079) and theoretical studies of stellar orbits in clusters (33.153.041), the effect on anisotropy of accretion at the centre of a system

(87.58488), and a modification of the virial theorem due to pair correlations (32.151.089).

To summarise, the review period has seen some excellent work on the dynamics of binaries within clusters, and the realisation of the importance of tidally formed pairs. A fresh start has been made in the attempt to understand post-collapse evolution, while the attention paid to clusters containing a black hole has declined sharply. In the next few years it is possible that more attention will be paid to the effects of mass segregation, to the dynamics of the halo and the tidal boundary, and to the role of rotation, important topics which have recently been rather neglected.

8. Some Trends in Cluster Research

Major advances have been realized during the last three years in star cluster research, and new techniques and detectors are quickly being applied to the study of star clusters. We can anticipate further advances in several areas in the next few years.

Progress in our understanding of the detailed physics of stellar evolution has, until recently, been limited by the uncertainties in the available observational data. The precision of photometric measurements for stars on cluster main sequences and at the main sequence turnoffs has been too poor to offer theoreticians much guidance in constraining their stellar evolution calculations. The effects of many parameters in stellar evolution have been too subtle to distinguish from the observations. The application of CCD detectors to the problem of measurement of cluster H-R diagrams has brought substantial improvement to this situation. Examples of this work are the H-R diagrams of 47 Tucanae recently obtained by Hesser and W. Harris and the H-R diagram of NGC 6752 by Penny and Dickens. For the first time it may be possible to compare the ages of globular clusters to an accuracy better than 10%, to determine if they were formed over an extended period in the early history of the galaxy, or if they formed suddenly in a short time. From the improved theoretical models, the actual ages of clusters may be determined, and the controversy between the globular cluster ages and the age of the Universe determined from H_o may be resolved. We can anticipate significant improvements in the quality and quantity of cluster color-magnitude diagrams during the next several years.

During the last several years, we have also seen much progress in the study of star clusters very distant from the disk of the Milky Way, allowing us to explore very remote regions of the galactic halo. Examples of this work include studies of AM-1 by Aaronson et al, and of the Eridanus cluster by Da Costa.

Investigations of star clusters in other galaxies have also been moving forward quickly during the last three years. Buonanno and his colleagues have surveyed, catalogued, and measured many clusters in M31, and we can anticipate a much more detailed understanding of cluster systems in that galaxy and in our own. Searches for clusters in more distant galaxies have received much attention, and we can expect to begin to understand the formation of cluster systems in galaxies of different morphological types.

A third area in which we can look forward to important progress is the study of stellar rotation and binarism on the main sequences of star clusters. The work of Stauffer has already lead to interesting results on the duration of star formation in open clusters. The combination of the availability of new instrumentation with a renewed interest in solar/stellar cycles and variability has lead us again to use star clusters as laboratories for investigating these

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phenomena. Similarly, R. Peterson's work on rotational velocities of horizontal branch stars in globular clusters may lead to a solution of the "second parameter" problem in globular cluster research.

The period from 1981 to 1984 has seen continued efforts to resolve the controversy surrounding the metal rich calibration of the globular cluster metallicity scale. Although the question is still not fully resolved, many investigations are consistent with the adoption of metallicities near [Fe/H] = -0.8 for the clusters M71 and 47 Tucanae. The application of new instrumental techniques to the problem may lead finally to a solution.

The primary thrust in studies of cluster abundances has been a detailed examination of star-to-star variations within clusters. Norris, G. Smith, Suntzeff, Kraft and their colleagues have made extensive investigations of molecules and abundances of carbon and nitrogen in star clusters. Their results may lead to a better understanding of mixing and nucleosynthetic processes in stellar evolution.

The ability now to measure accurate radial velocities for relatively faint stars has produced a revolution in observational dynamics of star clusters. In particular, kinematical studies of open clusters and star forming regions are now possible. Recent work in this rapidly expanding area was summarised at IAU Colloquium 88 "Stellar Radial Velocities", in Schenectady. Also, it is now possible to measure velocity dispersions as low as about 4 km/s from the integrated light of globular clusters: Elson recently made a direct measurement of the mass of NGC 1835, in the LMC, with this technique.

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