

Determinação do Centro galáctico mediante a distribuição dos aglomerados Globulares: Experiência de Shapley

A Tabela em anexo, tem os seguintes dados, Nome (do globular), Ascensão Reta (RA), Declinação (D), Longitude Galáctica (L) e Latitude Galáctica (B), distancia ao Sol (R_{sun}), distancia ao centro galáctico (R_{gc}), e as Coordenadas Heliocêntricas Z,Y,X, em kpc, dos Aglomerados Globulares Galácticos. A figura ilustra o Aglomerado 47 Tucane. Para alguns dos aglomerados da Tabela, esta faltando ou a distancia ao (Sol R_{sol}) ou as coordenadas Heliocentricas (ZYX). Complete os dados da Tabela com a ajuda das seguintes equações

$$Z = R_{\text{sun}} \sin B$$

$$Y = R_{\text{sun}} \cos B \sin L$$

$$X = R_{\text{sun}} \cos B \cos L$$

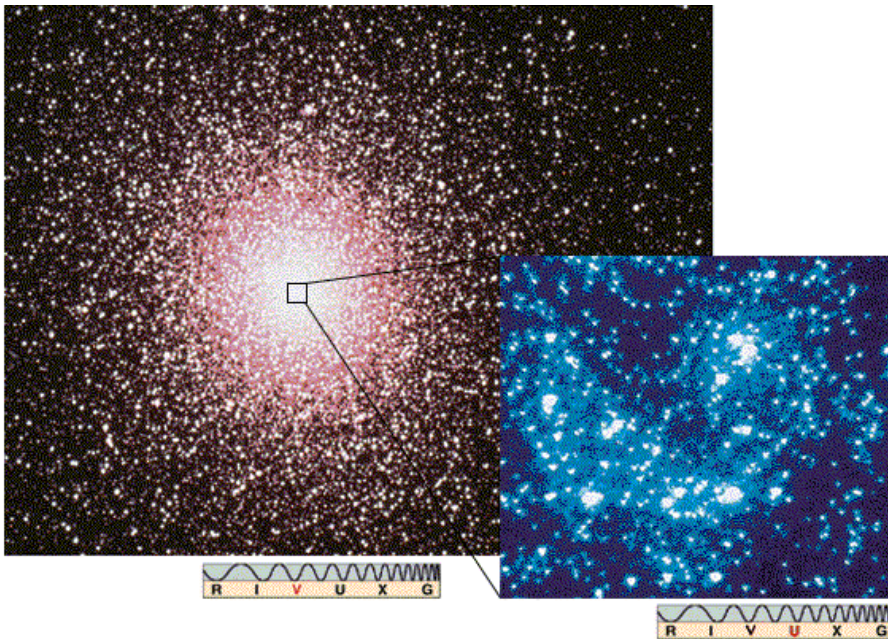


Tabela 1

- 1) Cluster identification number
- (2) Other commonly used cluster name
- (3,4) Right ascension and declination (epoch J2000)
- (5,6) Galactic longitude and latitude (degrees)
- (7) Distance from Sun (kiloparsecs)
- (8) Distance from Galactic center (kpc), assuming $R_0=8.0$ kpc
- (9-11) Distance components X,Y,Z in kiloparsecs, in a Sun-centered coordinate system;
X points toward Galactic center, Y in direction of Galactic rotation, Z toward North Galactic Pole

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
D	Name	RA (2000)	DEC	L	B	R_Sun	R_gc	X	Y	Z
NGC 104	47 Tuc	00 24 05.2	-72 04 51	305.90	-44.89	4.5	7.4	()		
NGC 288		00 52 47.5	-26 35 24	152.28	-89.38	8.8	12.0	()		
NGC 362		01 03 14.3	-70 50 54	301.53	-46.25	8.5	9.4	()		
NGC 1261		03 12 15.3	-55 13 01	270.54	-52.13	16.4	18.2	()		
Pal 1		03 33 23.0	+79 34 50	130.07	19.03	10.9	17.0	-6.6	7.9	3.6
AM 1	E 1	03 55 02.7	-49 36 52	258.36	-48.47	121.9	123.2	-16.3	-79.2	-91.3
Eridanus		04 24 44.5	-21 11 13	218.11	-41.33	90.2	95.2	-53.3	-41.8	-59.6
Pal 2		04 46 05.9	+31 22 51	170.53	-9.07	()		-26.8	4.5	-4.3
NGC 1851		05 14 06.3	-40 02 50	244.51	-35.04	12.1	16.7	-4.3	-8.9	-6.9
NGC 1904	M 79	05 24 10.6	-24 31 27	227.23	-29.35	12.9	18.8	-7.6	-8.3	-6.3
NGC 2298		06 48 59.2	-36 00 19	245.63	-16.01	10.7	15.7	-4.3	-9.4	-3.0
NGC 2419		07 38 08.5	+38 52 55	180.37	25.24	84.2	91.5	-76.2	-0.5	35.9
Pyxis		09 07 57.8	-37 13 17	261.32	7.00	39.7	41.7	()		
NGC 2808		09 12 02.6	-64 51 47	282.19	-11.25	9.6	11.1	2.0	-9.2	-1.9
E 3		09 20 59.3	-77 16 57	292.27	-19.02	4.3	7.6	1.6	-3.8	-1.4
Pal 3		10 05 31.4	+00 04 17	240.14	41.86	92.7	95.9	-34.4	-59.9	61.8
NGC 3201		10 17 36.8	-46 24 40	277.23	8.64	5.0	8.9			
Pal 4		11 29 16.8	+28 58 25	202.31	71.80	109.2	111.8	-31.6	-12.9	103.7
NGC 4147		12 10 06.2	+18 32 31	252.85	77.19	19.3	21.3	-1.3	-4.1	18.8
NGC 4372		12 25 45.4	-72 39 33	300.99	-9.88	()		2.9	-4.9	-1.0
Rup 106		12 38 40.2	-51 09 01	300.89	11.67	21.2	18.5	10.7	-17.8	4.3
NGC 4590	M 68	12 39 28.0	-26 44 34	299.63	36.05	10.2	10.1	4.1	-7.1	6.0
NGC 4833		12 59 35.0	-70 52 29	303.61	-8.01	6.5	7.0	()		
NGC 5024	M 53	13 12 55.3	+18 10 09	332.96	79.76	17.8	18.3	2.8	-1.4	17.5
NGC 5053		13 16 27.0	+17 41 53	335.69	78.94	16.4	16.9	2.9	-1.3	16.1
NGC 5139	ome	13 26 45.9	-47 28 37	309.10	14.97	5.3	6.4	3.2	-3.9	1.4
NGC 5272	M 3	13 42 11.2	+28 22 32	42.21	78.71	10.4	12.2	()		
NGC 5286		13 46 26.5	-51 22 24	311.61	10.57	11.0	8.4	7.2	-8.1	2.0
AM 4		13 55 50.1	-27 10 22	320.15	33.54	29.9	25.5	19.1	-16.0	16.5
NGC 5466		14 05 27.3	+28 32 04	42.15	73.59	15.9	16.2	()		
NGC 5634		14 29 37.3	-05 58 35	342.21	49.26	25.2	21.2	15.7	-5.0	19.1

NGC 5694	14 39 36.5	-26 32 18	331.06	30.36	34.7	29.1	26.2	-14.5	17.5	
IC 4499	15 00 18.5	-82 12 49	307.35	-20.47	()		10.7	-14.0	-6.6	
NGC 5824	15 03 58.5	-33 04 04	332.55	22.07	32.0	25.8	26.3	-13.7	12.0	
Pal 5	15 16 05.3	-00 06 41	0.85	45.86	23.2	18.6	16.2	0.2	16.7	
NGC 5897	15 17 24.5	-21 00 37	342.95	30.29	12.4	7.3	()			
NGC 5904 M 5	15 18 33.8	+02 04 58	3.86	46.80	()		5.1	0.3	5.4	
NGC 5927	15 28 00.5	-50 40 22	326.60	4.86	7.6	4.5	6.3	-4.2	0.6	
NGC 5946	15 35 28.5	-50 39 34	327.58	4.19	10.6	5.8	9.0	-5.7	0.8	
BH 176	15 39 07.3	-50 03 02	328.41	4.34	15.6	9.7	13.2	-8.1	1.2	
NGC 5986	15 46 03.5	-37 47 10	337.02	13.27	10.4	4.8	9.3	-4.0	2.4	
Lynge 7	16 11 03.0	-55 18 52	328.77	-2.79	7.2	4.2	()			
Pal 14 AvdB	16 11 04.9	+14 57 29	28.75	42.18	73.9	69.0	48.0	26.3	49.6	
NGC 6093 M 80	16 17 02.5	-22 58 30	352.67	19.46	10.0	3.8	9.4	-1.2	3.3	
NGC 6121 M 4	16 23 35.5	-26 31 31	350.97	15.97	2.2	5.9	2.1	-0.3	0.6	
NGC 6101	16 25 48.6	-72 12 06	317.75	-15.82	15.3	11.1	10.9	-9.9	-4.2	
NGC 6144	16 27 14.1	-26 01 29	351.93	15.70	8.5	2.6	()			
NGC 6139	16 27 40.4	-38 50 56	342.37	6.94	10.1	3.6	9.6	-3.0	1.2	
Terzan 3	16 28 40.1	-35 21 13	345.08	9.19	7.5	2.4	7.2	-1.9	1.2	
NGC 6171 M 107	16 32 31.9	-13 03 13	3.37	23.01	()		5.9	0.3	2.5	
1636-283 ES	16 39 25.5	-28 23 52	351.91	12.10	7.8	2.0	7.5	-1.1	1.6	
NGC 6205 M 13	16 41 41.5	+36 27 37	59.01	40.91	7.7	8.7	3.0	5.0	5.0	
NGC 6229	16 46 58.9	+47 31 40	73.64	40.31	30.4	29.7	()			
NGC 6218 M 12	16 47 14.5	-01 56 52	15.72	26.31	4.9	4.5	4.2	1.2	2.2	
NGC 6235	16 53 25.4	-22 10 38	358.92	13.52	11.4	4.1	11.1	-0.2	2.7	
NGC 6254 M 10	16 57 08.9	-04 05 58	15.14	23.08	()		3.9	1.1	1.7	
NGC 6256	16 59 32.6	-37 07 17	347.79	3.31	8.4	1.8	8.2	-1.8	0.5	
Pal 15	17 00 02.4	-00 32 31	18.87	24.30	44.6	37.9	38.4	13.1	18.3	
NGC 6266 M 62	17 01 12.8	-30 06 49	353.57	7.32	6.9		1.7	6.8	-0.8	0.9
NGC 6273 M 19	17 02 37.8	-26 16 05	356.87	9.38	8.6		1.6	8.5	-0.5	1.4
NGC 6284	17 04 28.8	-24 45 53	358.35	9.94	15.3	7.6	()			
NGC 6287	17 05 09.4	-22 42 29	0.13	11.02	9.3	2.1	9.1	0.0	1.8	
NGC 6293	17 10 10.2	-26 34 55	357.62	7.83	8.8	1.4	8.7	-0.4	1.2	
NGC 6304	17 14 32.1	-29 27 44	355.83	5.38	6.0	2.2	6.0	-0.4	0.6	
NGC 6316	17 16 37.3	-28 08 24	357.18	5.76	11.0	3.2	10.9	-0.5	1.1	
NGC 6341 M 92	17 17 07.3	+43 08 11	68.34	34.86	8.2	9.6	2.5	6.3	4.7	
NGC 6325	17 17 59.2	-23 45 57	0.97	8.00	()		7.9	0.1	1.1	
NGC 6333 M 9	17 19 11.8	-18 30 59	5.54	10.70	7.9	1.7	7.7	0.7	1.5	
NGC 6342	17 21 10.2	-19 35 14	4.90	9.73	8.6	1.7	8.4	0.7	1.5	
NGC 6356	17 23 35.0	-17 48 47	6.72	10.22	15.2	7.6	14.8	1.7	2.7	
NGC 6355	17 23 58.6	-26 21 13	359.58	5.43	9.5	1.8	9.5	-0.1	0.9	
NGC 6352	17 25 29.2	-48 25 22	341.42	-7.17	5.7	3.3	5.4	-1.8	-0.7	
IC 1257	17 27 08.5	-07 05 35	16.53	15.15	25.0	17.9	()			
Terzan 2 HP 3	17 27 33.1	-30 48 08	356.32	2.30	8.7	0.9	8.7	-0.6	0.3	
NGC 6366	17 27 44.3	-05 04 36	18.41	16.04	3.6	5.0	3.3	1.1	1.0	
Terzan 4 HP 4	17 30 39.0	-31 35 44	356.02	1.31	9.1	1.3	9.1	-0.6	0.2	
HP 1 BH 229	17 31 05.2	-29 58 54	357.42	2.12	14.1	6.1	()			
NGC 6362	17 31 54.8	-67 02 53	325.55	-17.57	7.6	5.1	5.9	-4.1	-2.3	
Liller 1	17 33 24.5	-33 23 20	354.84	-0.16	9.6	1.8	9.6	-0.9	0.0	
NGC 6380 Ton 1	17 34 28.0	-39 04 09	350.18	-3.42	10.7	3.2	10.5	-1.8	-0.6	
Terzan 1 HP 2	17 35 47.2	-30 28 54	357.56	0.99	5.6	2.5	5.6	-0.2	0.1	
Ton 2 Pismis 26	17 36 10.5	-38 33 12	350.80	-3.42	8.1	1.4	()			
NGC 6388	17 36 17.0	-44 44 06	345.56	-6.74	10.0	3.2	9.6	-2.5	-1.2	
NGC 6402 M 14	17 37 36.1	-03 14 45	21.32	14.81	9.3	4.1	8.4	3.3	2.4	
NGC 6401	17 38 36.6	-23 54 34	3.45	3.98	10.5	2.7	10.5	0.6	0.7	
NGC 6397	17 40 41.3	-53 40 25	338.17	-11.96	2.3	6.0	()			

Pal 6	17 43 42.2 -26 13 21	2.09	1.78	5.9	2.2			5.8	0.2	0.2
NGC 6426	17 44 54.7 +03 10 13	28.09	16.23	20.7	14.6			17.6	9.4	5.8
Djorg 1	17 47 28.3 -33 03 56	356.67	-2.48	()				12.0	-0.7	-0.5
Terzan 5 Terzan	17 48 04.9 -24 46 45	3.84	1.69	10.3	2.4			10.2	0.7	0.3
NGC 6440	17 48 52.7 -20 21 37	7.73	3.80	8.4	1.3			8.4	1.1	0.6
NGC 6441	17 50 12.9 -37 03 05	353.53	-5.01	11.7	3.9			11.5	-1.3	-1.0
Terzan 6 HP 5	17 50 46.4 -31 16 31	358.57	-2.16	9.5	1.6			9.5	-0.2	-0.4
NGC 6453	17 50 51.7 -34 35 57	355.72	-3.87	9.6	1.8			9.6	-0.7	-0.6
UKS 1	17 54 27.2 -24 08 43	5.12	0.76	8.3	0.8			8.3	0.7	0.1
NGC 6496	17 59 02.0 -44 15 54	348.02	-10.01	11.5	4.3			11.1	-2.3	-2.0
Terzan 9	18 01 38.8 -26 50 23	3.60	-1.99	6.5	1.6			6.4	0.4	-0.2
Djorg 2 ESO45	18 01 49.1 -27 49 33	2.76	-2.51	6.7	1.4			6.6	0.3	-0.3
NGC 6517	18 01 50.6 -08 57 32	19.23	6.76	10.8	4.3			10.1	3.5	1.3
Terzan10	18 02 57.4 -26 04 00	4.42	-1.86	5.7	2.4			5.6	0.4	-0.2
NGC 6522	18 03 34.1 -30 02 02	1.02	-3.93	7.8	0.6			7.7	0.1	-0.5
NGC 6535	18 03 50.7 -00 17 49	27.18	10.44	6.8	3.9			6.0	3.1	1.2
NGC 6528	18 04 49.6 -30 03 21	1.14	-4.17	7.9	0.6			7.9	0.2	-0.6
NGC 6539	18 04 49.8 -07 35 09	20.80	6.78	8.4	3.1			7.8	3.0	1.0
NGC 6540 Djo	18 06 08.6 -27 45 55	3.29	-3.31	3.7	4.4			()		
NGC 6544	18 07 20.6 -24 59 51	5.84	-2.20	2.7	5.3			2.7	0.3	-0.1
NGC 6541	18 08 02.2 -43 30 00	349.48	-11.09	7.0	2.2			6.8	-1.3	-1.4
2MS-GC01 2	18 08 21.8 -19 49 47	10.47	0.10	3.6	4.5			3.6	0.7	0.0
ESO-SC06 ES	18 09 06.0 -46 25 23	346.90	-12.57	21.7	14.3			20.6	-4.8	-4.7
NGC 6553	18 09 17.6 -25 54 31	5.25	-3.03	6.0	2.2			5.9	0.5	-0.3
2MS-GC02 2MA	18 09 36.5 -20 46 44	9.78	-0.62	4.0	4.1			()		
NGC 6558	18 10 17.6 -31 45 50	0.20	-6.02	7.4	1.0			7.4	0.0	-0.8
IC 1276 Pal 7	18 10 44.2 -07 12 27	21.83	5.67	5.4	3.7			5.0	2.0	0.5
Terzan12	18 12 15.8 -22 44 31	8.36	-2.10	4.8	3.4			4.7	0.7	-0.2
NGC 6569	18 13 38.8 -31 49 37	0.48	-6.68	10.7	2.9			10.6	0.1	-1.2
NGC 6584	18 18 37.7 -52 12 54	342.14	-16.41	13.4	7.0			12.3	-4.0	-3.8
NGC 6624	18 23 40.5 -30 21 40	2.79	-7.91	7.9	1.2			7.8	0.4	-1.1
NGC 6626 M 28	18 24 32.9 -24 52 12	7.80	-5.58	5.6	2.7			5.5	0.8	-0.5
NGC 6638	18 30 56.1 -25 29 51	7.90	-7.15	9.6	2.3			9.4	1.3	-1.2
NGC 6637 M 69	18 31 23.2 -32 20 53	1.72	-10.27	()				8.9	0.3	-1.6
NGC 6642	18 31 54.1 -23 28 31	9.81	-6.44	8.4	1.7			8.3	1.4	-0.9
NGC 6652	18 35 45.7 -32 59 25	1.53	-11.38	10.1	2.8			9.9	0.3	-2.0
NGC 6656 M 22	18 36 24.2 -23 54 12	9.89	-7.55	3.2	4.9			3.1	0.5	-0.4
Pal 8	18 41 29.9 -19 49 33	14.10	-6.80	12.9	5.6			12.4	3.1	-1.5
NGC 6681 M 70	18 43 12.7 -32 17 31	2.85	-12.51	9.0	2.1			8.7	0.4	-1.9
NGC 6712	18 53 04.3 -08 42 22	25.35	-4.32	6.9	3.5			6.3	3.0	-0.5
NGC 6715 M 54	18 55 03.3 -30 28 42	5.61	-14.09	26.8	19.2			()		
NGC 6717 Pal 9	18 55 06.2 -22 42 03	12.88	-10.90	7.1	2.4			6.8	1.6	-1.3
NGC 6723	18 59 33.2 -36 37 54	0.07	-17.30	8.7	2.6			8.3	0.0	-2.6
NGC 6749	19 05 15.3 +01 54 03	36.20	-2.20	7.9	5.0			6.4	4.7	-0.3
NGC 6752	19 10 52.0 -59 59 05	336.49	-25.63	4.0	5.2			()		
NGC 6760	19 11 12.1 +01 01 50	36.11	-3.92	7.4	4.8			6.0	4.4	-0.5
NGC 6779 M 56	19 16 35.5 +30 11 05	62.66	8.34	10.1	9.7			4.6	8.9	1.5
Terzan 7	19 17 43.7 -34 39 27	3.39	-20.07	23.2	16.0			21.8	1.3	-8.0
Pal 10	19 18 02.1 +18 34 18	52.44	2.72	5.9	6.4			()		
Arp 2	19 28 44.1 -30 21 14	8.55	-20.78	28.6	21.4			26.5	4.0	-10.2
NGC 6809 M 55	19 39 59.4 -30 57 44	8.80	-23.27	5.3	3.9			4.8	0.7	-2.1
Terzan 8	19 41 45.0 -34 00 01	5.76	-24.56	26.0	19.1			23.6	2.4	-10.8
Pal 11	19 45 14.4 -08 00 26	31.81	-15.58	13.0	7.9			()		
NGC 6838 M 71	19 53 46.1 +18 46 42	56.74	-4.56	4.0	6.7			2.2	3.3	-0.3
NGC 6864 M 75	20 06 04.8 -21 55 17	20.30	-25.75	20.7	14.6			17.5	6.5	-9.0

NGC 6934	20 34 11.6	+07 24 15	52.10	-18.89	15.7	12.8	9.1	11.7	-5.1
NGC 6981 M 72	20 53 27.9	-12 32 13	35.16	-32.68	17.0	12.9	11.7	8.3	-9.2
NGC 7006	21 01 29.5	+16 11 15	63.77	-19.41	41.5	38.8	()	
NGC 7078 M 15	21 29 58.3	+12 10 01	65.01	-27.31	10.3	10.4	3.9	8.3	-4.7
NGC 7089 M 2	21 33 29.3	-00 49 23	53.38	-35.78	11.5	10.4	5.6	7.5	-6.7
NGC 7099 M 3	21 40 22.0	-23 10 45	27.18	-46.83	8.0	7.1	4.9	2.5	-5.9
Pal 12	21 46 38.8	-21 15 03	30.51	-47.68	19.1	15.9	11.1	6.5	-14.1
Pal 13	23 06 44.4	+12 46 19	87.10	-42.70	25.8	26.7	1.0	18.9	-17.5
NGC 7492	23 08 26.7	-15 36 41	53.39	-63.48	25.8	24.9	6.9	9.2	-23.1

Os dados da tabela lhe permitirão determinar a distribuição espacial dos aglomerados globulares e a distancia do Sol ao Centro da Galáxia, assumindo que este coincida com o centro da distribuição dos Aglomerados.

a) Construa os seguintes gráficos:

i) a distribuição dos aglomerados globulares nos planos X versus Z e X versus Y.

b) determine as coordenadas (Z_c , X_c) e (Y_c , X_c) do ponto de maior concentração de aglomerados em ambos os planos.

c) Com estes valores determine a distancia do Sol ao centro de concentração dos aglomerados.