Study on the Apparent Multiple Nature of Ferrero 32

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Abstract: Ferrero 32 is a visual asterism in Cygnus with the appearance of a quadruple star system, especially in online survey images such as the Digitalized Sky Survey (DSS). With the use of survey data (including the Gaia DR2), the author shows that only two of the stars could possibly be bound gravitationally, while the two others lie much further away.

Ferrero 32 is a visual asterism discovered by French amateur astronomer Laurent Ferrero when scanning the Digitalized Sky Survey (DSS) plates in 2006. Note that Laurent is also the discoverer of double star LFR 1 in Hydra. Ferrero 32 is a compact group of four stars ranging from a visual magnitude of +11 to +13 (magnitudes based on the author's analysis, see Table 1). Not only are the stars brighter than the average background star field, but they have strikingly bluer colors, giving them the impression of a quadruple star system. Despite such an appearance, no previous study had been made (to the author's knowledge) regarding the actual nature of this group.

In this work I designate each star a letter alphabetically correlated to their brightness (see Figure 1 and Table 1). Their actual designations are TYC 2669-1092 -1 (A), TYC 2669-5021-1 (B), UCAC4 609-094210 (C) and UCAC4 609-094194 (D).

The colors and visual magnitudes of each component are shown in Table 1. For both A and B these values were directly extracted from UCAC4 (Zacharias, 2012). In the case of C, the visual magnitude of C was extracted from NOMAD1 (Zacharias, 2005) while the B-V magnitude was indirectly determined using the 2MASS J and K magnitudes (Cutri et al. 2003).

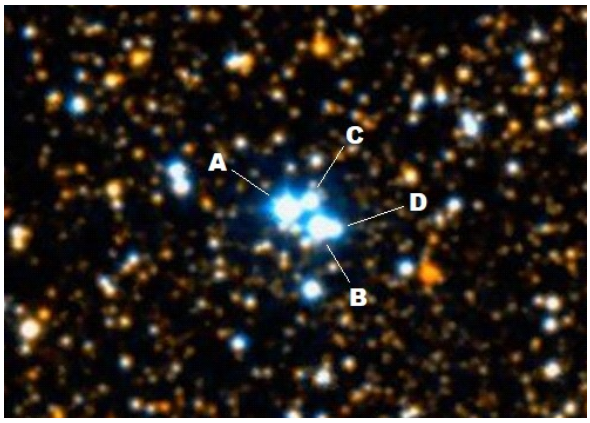

Figure 1. Coloured DSS image extract showing Ferrero 32. Notice how their brightness and colours clearly stick out in comparison the background star field. Blue plate taken B1989.5082. Red plate taken B1992.4843. Image credit: Skymap.org

In the case of D, not much photometric data is available. Like for C, the B-V index is based on 2MASS magnitude data. The g magnitude from Pan-STARRS1 (Chambers, 2016) was considered to be the

Table 1. Summary Data

Star	RA + DEC	PM (RA)	PM (DEC)	Plx (mas)	PA	Sep	B-V	Mag
A	298.580+31.765	-2.39	-4.59	1.983	--	--	0.40	10.7
B	298.575+31.762	-2.43	-4.89	1.923	239°	17.4	0.41	11.2
C	298.577+32.304	-2.85	-0.38	0.855	290°	11.5	0.46	12.4
D	298.573+31.762	3.39	9.18	0.805	246°	24.0	0.49	13.2

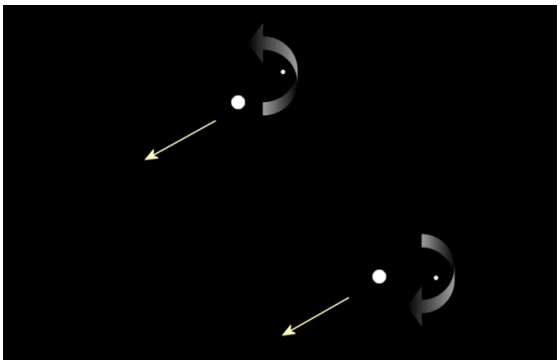

Figure 2: *Possible interpretation of Ferrero 32 according to Laurent Ferrero if it was indeed to be a multiple star system. Image credit: Laurent Ferrero.*

best approximation to the B magnitude. The V magnitude is based on the B mag and B-V index.

With the data from Gaia DR2 (Gaia Collaboration, 2018), one can see that only A and B share similar proper motions and parallax (see Table 1). The measured proper motion of C is slightly similar to that of A and B, but it is located much further away (~3800 ly) hence proving that it is not bound gravitationally to any of these two stars. D differs significantly in proper motion and distance (~4000 ly) in comparison to A, B and C, hence not bound to any of these stars.

Using the separation listed in Table 1 (based on UCAC4 coordinates) and the distance of A and B (~1670 ly), one finds a physical separation of about 2.0 ly. Knowing that both A and B are likely to be more massive than the Sun, this physical separation would be sufficiently small to gravitationally bound A and B.

To sum up, Ferrero 32 is a nice visual asterism, which might resemble a quadruple star system at first glance (as first noted by its discoverer). The Gaia DR2 shows however that only the two brightest components of this system are likely to be gravitational bound, forming a wide binary system with both components separated by about 2 ly. The two fainter stars making up this asterism are likely to be 2000 ly more distant than the binary system.

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