PNAS
Proceedings of the National Academy of Sciences of the United States of America www.pnas.org

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PNAS 1924;10;253-256
doi:10.1073/pnas.10.6.253

periodic (cf. Poisson's theorem). In the theory of the Trojan group, it was shown[6] that the only direction in which instability was threatened appeared in the eccentricities, being due to a perturbation caused by Saturn. I was not able to obtain any definite result owing to the high order of the approximation needed. But these results indicate that one should search for instabilities, not primarily in the equation for the mean distances, but rather in those for the eccentricities.

There is no information at present as to what happens when the eccentricities are large. We can then no longer assume that their squares and higher powers may be neglected in a first approximation. But there is a challenge in the distribution of the short period comets. In the list given by Professor H. N. Russell,[7] there are nine comets with periods between 5.42 and 5.90 years, 15 with periods between 6.35 and 6.70 years and none with periods between 5.90 and 6.35 years. The half period of Jupiter is 5.93 years, so that for observational reasons instability due to resonance is not unlikely.

[1] *Science*, **33**, 86 (1911).
[2] *Phil. Trans. R. S.*, **222A**, 101–130 (1921).
[3] *Mon. Not. R. A. S.*, **82**, 356–360 (1922).
[4] *Les Nouv. Méth. de la Méc. Cél*, **1**, 101.
[5] *Mon. Not. R. A. S.*, **72**, 609–630 (1912).
[6] *Astron. J.*, **35**, 78 (1923).
[7] *Astron. J.*, **33**, 52 (1920).

NOTE ON THE DIFFERENCE IN VELOCITY BETWEEN ABSOLUTELY BRIGHT AND FAINT STARS

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Communicated, April 28, 1924

It is a well known fact that the average velocity of the so-called "dwarf" stars is considerably higher than that of the "giants" of the same spectral class. The following note is intended to show that the stars of high velocity (which are distinguished from the other stars by the peculiarly systematic character of their motions) are responsible for the major part of this difference, greater percentages of these stars occurring among the fainter stars than among the brighter ones.

The material used for the comparison consists of all F, G, K and M stars with Mt. Wilson spectroscopic parallaxes for which radial velocities have been published; for these stars I computed the transverse velocity 4.74 μ/π and corrected the radial velocities for the solar motion (assumed to be 20 km.).

As the stars with velocities smaller than about 65 km. show very little of the characteristics of the high velocity stars, it may be expected that in excluding all total motions higher than 65 km. we should get rid of the great majority of this class of systematically moving stars. In computing the total motion for this purpose the transverse velocity was not corrected for solar motion. This course was followed for convenience, but it has another advantage: as the apex of the sun's motion nearly coincides with the center of the hemisphere toward which the high velocity stars are moving this procedure will exclude more completely the stars moving in that general direction.

In order to effect the comparison between stars of different absolute magnitude, they were divided into strictly homogeneous groups according to the value of μ/π, and the comparison of the average radial velocities was made for each group independently. For the groups with high transverse velocities the comparison would have little meaning because all total velocities higher than 65 km. had been excluded. Accordingly only stars of transverse velocity less than 45 km. have been used.

In this preliminary note only the differences between "giants" and "dwarfs" considered as a class will be given, the division-point being taken at $+2^{M}.5$ for the F-type and at $+3^{M}.0$ for the other types. It looks as though there were a conspicuous increase in velocity for the K stars from —1.0 to +2.0 spectroscopic magnitude, but the average for the "giants" is not perceptibly smaller than that for the "dwarfs." The G-type "giants" do *not* show a distinct progression of velocity with absolute magnitude and for the M stars the progression is in a direction opposite that for the K stars.

The ratios of the average radial velocity of the "dwarfs" to that of the "giants" are given in the following table. Besides the division into homogeneous groups with respect to transverse velocity the computation has been made separately for three areas, area I comprising all stars more than 70° from either stream vertex, area II those between 45° and 70° from both, and area III those less than 45° distant. The weights used to combine the average velocities from the different areas and spectra have been taken in inverse proportion to the squares of these average velocities. The last column in the table gives the ratios found by Adams, Strömberg and Joy.[1]

SPECTRUM	RATIO OF AVERAGE VELOCITIES					RATIO FROM MT. WILSON CONTR. 210
	AREA I	AREA II	AREA III	WEIGHTED MEAN	PROBABLE ERROR	
F0 to *F9*	0.92	0.87	1.30	0.99	±0.09	1.33
G0 to *G9*	0.81	1.25	1.65	1.18	±0.09	1.48
K0 to *K9*	1.12	0.94	1.24	1.08	±0.10	1.48
M	..	..	..	0.70	±0.19	1.77

The average ratio for all types comes out *1.04 ± 0.05* (p. e.), indicating an increase of about 0.12 ± 0.15 km. per magnitude, whereas the corresponding increase found in Mt. Wilson Contributions No. 210 is about 1.5 km. The value found here rests on a comparison of 305 "giants" with 222 "dwarfs."

The difference between the two ratios is perhaps most pronounced among the M stars. Because of the small number of "dwarfs" available I included stars with transverse velocities up to 50 km. in this type. After excluding the high velocities 11 "dwarfs" remain for the comparison showing an average radial velocity of 14 km. These stars are nearly 10 magnitudes fainter than the "giants" in this class having an average velocity of 18 km. In comparing the results for the three areas it appears that the ratio of the velocities is larger in area III than in the other areas, the average being 0.93 for area I, 0.98 for area II, and 1.39 for area III. The difference is probably real and indicates a stronger preferential motion among the "dwarf" stars, conforming with the results found by B. Boss[2] and Strömberg.[3]

Every exclusion of high velocities tends to diminish differences in average velocity previously found; however, in the case of an approximately Gaussian distribution and a limit of exclusion of the radial velocities at 59 km. (the average limit in the present comparison) the decrease is easily found to be small. That not all differences in velocity have disappeared is also illustrated by the fact that stars near the stream vertices and far from them still differ in their radial velocities. The ratio of the average radial velocity in area III to that in area I is found to be 1.44, which is only slightly smaller than the ratio we should expect without excluding high velocities. We can effect the same general diminution of the factors without the exclusion of any star on account of its high radial velocity, by repeating the comparison for stars moving toward the hemisphere from which the high velocity stars seem to come. A preliminary computation gave practically the same results as were found above.

The result of the present investigation is, therefore, that for stars with total velocities less than 65 km., or also for stars moving in a direction opposite to that in which the motions of the high velocity stars occur, the average velocities of "giant" and "dwarf" stars are nearly equal, the weighted mean ratio found being 1.04 ± 0.05 (p. e.). There is an indication, however, that the preferential motion is stronger for the "dwarfs" than for the "giants."

Neither the low velocity of the M-"dwarfs," nor the equality of the velocities of "giant" and "dwarf" stars for the later types,[4] nor any of the indications obtained from a comparison of double and single stars,[5] seem to support the hypothesis of a general increase of velocity with decreasing mass.

[1] *Mt. Wilson Contr.*, **10**, 1921 (181–198), from the corrected radial velocities in table VI.

[2] *Astron. J.*, **31**, 1918 (130–131).

[3] *Mt. Wilson Contr.*, **11**, 1922 (322).

[4] Russell, Adams and Joy, *Publ. Astr. Soc. Pacific*, **35**, 1923 (193), give values for the mean masses that would make the "giants" nearly twice as massive as the "dwarfs" of these spectral types.

[5] *Astron. J.*, **35**, 1923 (141–144).

ON A POSSIBLE RELATION BETWEEN GLOBULAR CLUSTERS AND STARS OF HIGH VELOCITY

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Communicated, April 28, 1924

Several facts are known that might suggest a connection between globular clusters and stars of high velocity. The ten clusters for which radial velocities have been published by Slipher[1] give an average velocity of 140 km., well comparable with the higher star-velocities. The motions of the high velocity stars are known to be directed toward one hemisphere of the sky,[2] the center of which lies in the galactic equator at about 230° longitude; the directions of the radial velocities of these ten clusters lie between 123° and 334° galactic longitude and therefore fall practically within the same hemisphere.[3] Strömberg has remarked that a recent computation by Lundmark, with the aid of seven unpublished radial velocities gives a systematic motion of the clusters which nearly coincides with that of the stars of highest velocity.[4] It may be of significance that the mean antapex of the high velocity stars has been found to shift with decreasing average velocity towards lower galactic longitude[3]; that is, in the direction of the hemisphere in which nearly all the globular clusters are situated.

It has also been shown that the short-period Cepheids which are the typical variables in globular clusters generally have high velocities with the same characteristics as the other high velocity stars.

One of the most striking peculiarities of the globular clusters is their general avoidance of mid-galactic regions,[5,11] only one globular cluster being found within 5° of the galactic equator. Figure 1 shows the distribution according to the sine of the galactic latitude for the 88 clusters known to be globular.[6] Part of this avoidance may be explained by the existence of dark absorbing matter in the Milky Way[7]; Shapley however, has pointed out that there are several indications which favor the hypothe-