COMMENTS ON AN ASSOCIATION IN VELA

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I was aware of Dr. Upton's excellent work on O- and B-Associations, since he was my thesis advisor on a quite different topic. However, I did not know he had worked on this specific region.

In November, 1970, when I became aware of the Brandt et al. (1971) suggestion of an association in the Vela pulsar region, I went to the catalogs to see what evidence was available on motions, distances, and so on. This work has been submitted for publication.

I found that the proper motions do not correlate very well with the suggestion of an association. Of the 10 stars looked at by Brandt et al., 5 seem to be moving together, and the other 5 in widely scattered directions. The radial velocities do not correlate with the proper motions or the distances found by Brandt et al.

I then looked at all O and B stars in a 10° radius region around γ Vel, about 500 in all. Again the proper motions do not correlate. Few radial velocities are available. However, most of the proper motions are of the order of the errors of measurement.

I next looked at the H-R diagram of the 500 stars. Here a strong suggestion of an association appears. There is a definite bunching in the diagram around the mean line. The indicated distance is about 500 parsecs, in good agreement with the pulsar distance and with the Brandt et al. stars, and also in agreement with Upton. The sample will clearly include background stars. I therefore tried several ways of eliminating the non-member stars. The first method was a selection by proper motion to match γ^2 Vel. As mentioned earlier, this also eliminates half the Brandt et al. stars. The second method was to eliminate those stars at each spectral type which were more than 1 rms deviation away from the mean apparent magnitude. At each spectral type, the rms spread is about ± 1 mag. The third method involved eliminating only those stars more than 1 rms deviation fainter than the mean apparent magnitude at each spectral type. None of these methods of elimination altered the diagram in shape significantly, although elimination of the faint stars produced a mean magnitude for the remaining stars at each spectral type about 1/2 mag. brighter for the B8 and B9 stars, but much less for the earlier types.

The mean line lies close to a main sequence up to about B2 or B3. Then earlier types (mostly the Brandt et al. stars) tend upward from a zero age main sequence. Upton's Region A corresponds closely to my selected stars, and his color-magnitude diagram is in agreement. He does not, however, include all of the Brandt et al. stars and thus finds no definite turnoff from the main sequence.

The evidence, then, for the association near the Vela pulsar rests on the H-R diagram, and is not supported by the motions. But the H-R diagram, both as done by Upton and by me is strongly suggestive.

It is interesting to note that, if the Vela pulsar is a member of this association, a rather large mass is implied. Some of the Brandt et al. stars are quite massive, notably γ^2 Vel at 46 and 16 solar masses for the two components. A coeval hypothesis would call for a pre-supernova mass for the pulsar of more than 30 solar masses. If we take a spread in formation times of 10^8 or so years, as suggested by Iben and Talbot, we can get down to about 10 solar masses. This agrees with the suggestion made by Gott on a dynamical basis, although I know that Professor Cameron is quite unhappy with such a large mass.

References

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