AN ASPECT OF STAR FISSION

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Abstract. Parameters are derived for two massive, unevolved, contact binaries.

Most people would agree that fission is the most probable way to form binary systems, especially the close systems. The angular momentum must be the deciding factor as to whether a gas cloud becomes a single star or a binary system. In the case of critical angular momentum it may become a contact system. There has been a debate as to whether zero age contact systems exist, and this is particularly true for massive systems with a common radiative envelope and a mass ratio different from unity. We seem to have found convincing evidence for two such massive zero-age systems by studies of the light curves of V701 Sco and V1010 Oph with the aid of the Wilson-Devinney (1971) binary model.

V701 Sco (Leung, 1974a) is a member of the galactic cluster NGC 6383 (Eggen, 1961), which is similar to NGC 2264, whose age is 4 to 5×10^6 yr. The location of V701 Sco in the HR diagram and the age of the cluster indicate that the system is very young and unevolved. The photometric solution indicates strong over-contact, as shown by the computer-generated picture in Figure 1. We have found the absolute radii and masses by

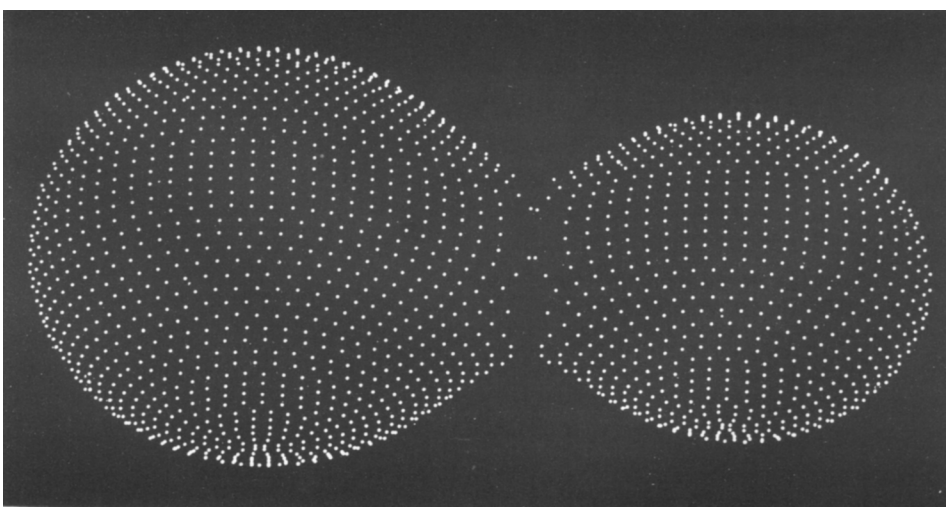

Fig. 1. Computer generated picture of V701 Sco.

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combining the photometric solution with the absolute magnitude (from cluster membership) and temperature by means of the laws of Kepler and of Stefan-Boltzmann. The masses are 13 and $8\,M_\odot$, while the radii are 4.5 and $3.6\,R_\odot$, for the primary and secondary components, respectively. Comparison with the tables of zero-age parameters by Stothers (1967) shows that the radii are normal for unevolved stars. Therefore, V701 Sco provides strong evidence that massive zero-age contact systems exist and can have unequal masses.

A similar analysis was carried out for V1010 Oph. The observations were by Leung (1974b). Here the absolute magnitude was derived from Stromgren photometry. The photometric solution indicates that this is also an overcontact system, although by a modest margin, as shown by Figure 2. Here, the masses are 2 and $1\,M_\odot$ while the radii are 2.1 and $1.5\,R_\odot$. The location in the HR diagram suggests that they are zero-age stars, as do the radii (Kippenhahn *et al.*, 1967), thus supporting the conclusion derived for V701 Sco.

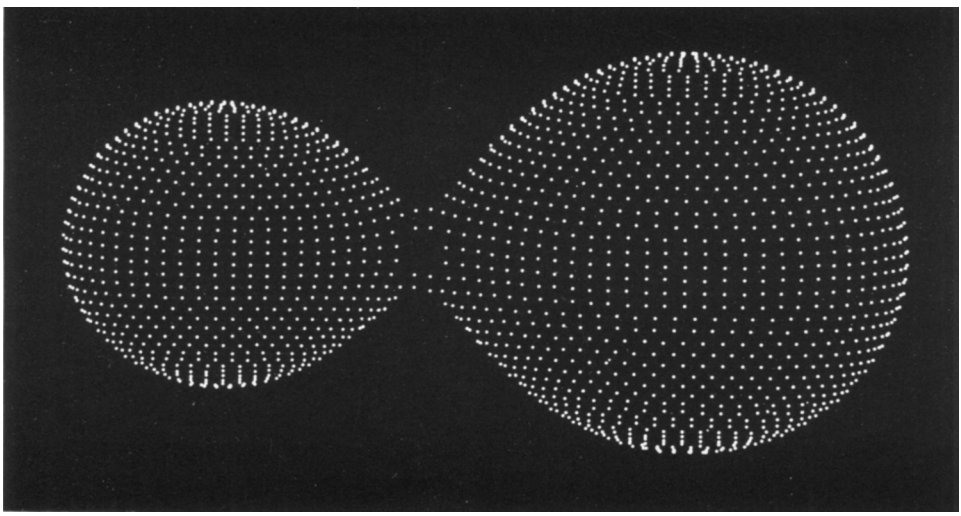

Fig. 2. Computer generated picture of V1010 Oph.

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DISCUSSION

Van't Veer: I think that it becomes more and more clear now that we can only have thick envelopes in systems without convection in the outer layers.

Leung: No.

Rucinski: SV Cen might belong to the similar systems as yours; I found a contact model to work

in that case with the outer critical envelope only slightly under-filled (by about 15%). I would like to stress the importance of this system because of its very high period-change rate (time-scale about 50 000 yr).

Leung: What are the radii in this system? Is the system a zero-age system?

Rucinski: The radial velocities are poor, so the radii would not be dependable.

Whelan: There is a difference between your systems and that of Rucinski (SV Cen) since in yours you know L via cluster membership whereas in SV Cen you don't and thus need spectroscopy for the latter.

Flannery: Is there any evidence of period changes in these systems?

Leung: For V701 Sco there was some photographic evidence, but it is not strong. For V1010 Oph, again the evidence for the period change is not strong.

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