The Locating of Hot Spots on Components of Algol System

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The existence of hot spots on components of semi-detached Algol systems has been suspected for a long time, the reason being the distortions observed in many light curves outside of eclipse. However, the question whether such a distortion is caused by absorption or by additional emission and, in the latter case, from which component the emission may come from, could be answered only recently, now that we have a good idea of the trajectories which gas streams follow.

Authors agree that the gas streams start from the subgiant component near the first Lagrange point of equilibrium and, by the effect of Coriolis forces and gravitation, tend to go in a curved path to the following side of the bright component. It may easily happen that the particles hit this component and a hot spot arises on the impact region. For a gas stream of the usual kind and a system of several days period, the supply of kinetic energy by the incoming particles is sufficient to brighten the impact region additionally by a few percent of the whole intensity of the system.

The position of such a hot spot on the primary component may be roughly determined from the light curve outside of eclipse by means of the phases when the additional light is visible. However, I shall not emphasize here the problems concerning the distortions of the light curves outside of eclipse, but proceed to the problems arising within the phases of primary eclipse. If the gas stream is big enough, it is to be expected that, on account of its curved path, during the phases of descending light the intensity of the visible part of the hot component will be reduced by absorption and the primary minimum will become asymmetric. Asymmetries of minima have been observed in many systems and it was always found that the descending branch was the lower one. If there are hot regions on the surface of the primary, the RUSSELL-MERRILL-method to determine the geometric parameters of the eclipse cannot be used in the usual way because the observed values of loss of light no longer mean the same as they do for stellar disks with a symmetrical distribution of intensities. Therefore, it should be preferable to derive the geometrical parameters from the depth of minima (if no third light source is present) and from the phases of second and third contact of total eclipses, as these data are independent of the distribution of light on the stellar disk.

When I was investigating the light curves of SW Cygni obtained some years ago in B and V in Sicily, I did proceed in this way after having made many vain trials to represent the observations by elements derived in the usual way. Finally, by employing the new principles and using the same k and i for both colours, I succeeded in obtaining representations which fit the inner parts of the primary eclipses; but they failed to represent the outer parts. The differences O-C between the observed (rectified) and calculated intensities may be interpreted by the existence of additional light which is eclipsed about at phase -13° and released at $+13^\circ$. As the paper on SW Cygni has appeared recently [Astron. & Astrophys. 13 (1971), 249], I shall proceed right away to another system, RV Ophiuchi. This system was observed intensively by DUGAN about sixty years ago by means of his excellent visual polarization photometer. He found a strongly asymmetric primary eclipse curve. However, my own observations of 1964 showed a symmetric primary eclipse and a conspicuously lower level of distortions between the minima. From this we may suspect that the gas stream was much weaker in 1964 or, at least, that it did not disturb the eclipses so much as before. Therefore, it was assumed that the geometric parameters derived from the observations of 1964 are nearly the real ones, and representations of the normal points of the primary eclipse were calculated by means of these identical elements for the V-observations of 1964 and for the observations of DUGAN. The comparison of the residuals of the two eclipse curves is interesting. The observations of 1964 agree at all phases with the theoretical light curve; but the observations of DUGAN are well represented only for the deep minimum parts; in the

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outer parts of the eclipse curve the intensities are mostly too large. We may infer that additional light of 2 or 3 % of the intensity of the system was frequently present during DUGAN's epoch, and that this light was eclipsed and released around phases $-12°$ and $+12°$. From the fraction of eclipse at these phases, a rough location of the hot spots can be given. For RV Ophiuchi, they lie at mean astrocentric latitudes if one assumes that the axis of rotation of the bright star is perpendicular to the orbital plane. For SW Cygni they were found to lie at high latitudes.

That the hot spots at times prefer mean and high latitudes is a fact which we suspect to be caused by magnetic fields which influence the path of the ionized gas streams.

Investigations of this kind will give us opportunity to study the effects of gas streams approaching stars — magnetic or nonmagnetic — with velocities of some hundred km per s. Observations of some systems have shown that asymmetries of primary eclipses are changing with time. It is suspected that these variations are strongly connected with variable magnetic fields on the bright components of these systems and that the locating of the hot spots is equivalent to the locating of the magnetic fields. I think that this may be improved to provide a concrete way to contribute also to the solution of the general problems of variability of stars.

Discussion to the paper of WALTER

HALL: I have unpublished UBV photoelectric observations of SW Cyg which are very interesting. In V the primary eclipse is total, with a duration of about 2.5 hours, but in U the primary eclipse is partial! This is a very large photometric effect in magnitude units, several tenths of a magnitude, but small in luminosity units, only about 2 % of the total luminosity of the hot star. This would imply that much of the circumstellar material lies far from the hot star, about one stellar radius away. But it is not possible to say whether it is in the equatorial plane or as you would suggest, above the pole of the hot star.

SMAK: Concerning the location of the hot spot: As it can be seen from the published trajectories and angular momentum considerations (see, e. g., KRUSZEWSKI, Acta Astr., Vol. 17, No. 3) a disk *must* be formed when the primary component is small and at least *can* be formed even if the primary is large. Thus the spot must usually be produced in the disk rather than on the star's surface.

WALTER: The observations of the mentioned systems seem to contradict this assumption. They make it probable that also regions in higher latitudes may be met.

Variable Star Observations from outside the Earth's Atmosphere: Review and Prospects

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Abstract

The scientific rationale for variable star observations from outside the Earth's atmosphere will be discussed, followed by a review and discussion of existing observational techniques with reference to their capabilities and limitations. Existing techniques to be discussed will cover aircraft-, balloon-, rocket- and satellite-borne experiments, and observations thus far obtained will also be reviewed. Experiments, planned or under consideration, and also future prospects of obtaining variable star observations from outside the terrestrial atmosphere will be discussed.

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