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On the determination of the Sun's motion from radial velocities

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Finally the two determinations give according to weight the following definitive ephemeris:

Min. at J. D. hel. M. T. Grw.

$$2418573^d.2912 + ^d.16035647. E \\ \pm .0012 \pm .00000008 \text{ (m. e.)}$$

The observations do not reveal any appreciable difference between odd and even minima. Nevertheless the star must be considered as an eclipsing variable with a period of $^d.3207$. This is the shortest period known among stars of this kind, the period of the very similar variation of *W Ursae Majoris* being a little longer, viz: $.3336$. In the latter case the explanation of the variability as being of eclipsing character

with both minima shown was first suggested by the discoverers MÜLLER and KEMPF (*Sitzungsber. d. preuss. Akad. d. Wiss.* 7, 182; 1903) and has later been verified spectroscopically by ADAMS and JOY (*Ap. J.* 49, 189; 1919). — The next following star of similar nature is *U Pegasi* with a period of $^d.3748$.

As these stars, in comparison with the majority of known eclipsing variables, have great densities and probably are of relatively low luminosity, we may expect their number to increase considerably, when stars apparently still fainter are examined. Down to the apparent magnitude 15 there may be several hundreds — perhaps even a few thousands — short period eclipsing variables of this type waiting for discovery.

On the determination of the sun's motion from radial velocities, by *Ejnar Hertzsprung*.

If we leave out of consideration the existence of systematic errors in the determination of radial velocities, the main difficulty in deriving the sun's motion from these data is caused by the fact that many more very large motions in the line of sight have been observed than would be expected from a Maxwellian distribution of velocities.

When numerous observations of a single quantity are available the well known remedy is to use the median instead of the mean value. The determination of the sun's motion from radial velocities is more complicated, because here three unknown quantities (the projection of the sun's motion on three axes) are required.

The equations of condition have the form

$$V = Ax + By + Cz,$$

where V is the radial velocity, A , B and C are the projections of the sun's motion on the three axes and

$$x = \sin \delta, \quad y = \cos \delta \cos \alpha \quad \text{and} \quad z = \cos \delta \sin \alpha.$$

The normal equations then are

$$A \sum x^2 + B \sum xy + C \sum xz = \sum Vx \\ A \sum xy + B \sum y^2 + C \sum yz = \sum Vy \\ A \sum xz + B \sum yz + C \sum z^2 = \sum Vz.$$

When the stars considered and their counterpoints taken together are evenly distributed in the sky, we have $\sum xy = \sum xz = \sum yz = 0$. If not, it is easy to indicate in which region of the sky we will have to omit a certain number N of stars in order to make

$$\sum xy = \sum xz = \sum yz = 0.$$

Putting

$$\sum xy = a, \quad \sum xz = b, \quad \sum yz = c,$$

the coordinates of that region are determined by

$$Nxy = a, \quad Nxz = b, \quad Nyz = c, \\ x^2 + y^2 + z^2 = 1,$$

from which

$$N = ab|c + ac|b + bc|a, \\ x^2 = ab|Nc, \quad y^2 = ac|Nb, \quad z^2 = bc|Na.$$

If N is found to be negative, then N more radial velocities have to be observed in the region in question. In the latter case the same effect will be reached by omitting N/n stars in $2n$ regions forming pairs 90° apart from each other and from the region, where N radial velocities should be added.

To decide which stars should be omitted, all the stars in the region in question are arranged in order of their observed radial velocities, and then equal numbers of the largest positive and the largest negative ones are obliterated, until the required number is reached.

The condition $\sum xy = \sum xz = \sum yz = 0$ thus being satisfied, the normal equations become of the simple form

$$A \sum x^2 = \sum Vx, \text{ etc.}$$

$\sum Vx$ may be written $\sum (V/x) \cdot x^2$: That is to say that the constant A is the weighted mean of the values V/x , each taken with the weight x^2 . We may therefore now apply the method of the medians in the following way: For each star the 6 quantities

$$V/x, \quad x^2, \quad V/y, \quad y^2, \quad V/z, \quad z^2$$