GEOS – Groupe Europeen d'Observations Stellaires

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GEOS was formed in 1973 from several European groups (French, Italian, Spanish and Belgian). All the members of GEOS have the same aims: to observe variable stars and to analyse their observations themselves.

Other objects are also observed by GEOS: artifical satellites and minor planets, in particular minor-planet occultations. Observations are treated statistically and the procedures allow accidental, and – if there are several observers of the same star – systematic, errors to be corrected, thus improving the accuracy of the results and the light-curves.

Initially, therefore, GEOS encouraged members to accumulate a large number of observations with a view to their later reduction. Up to 1980, the methods were visual, using the Argelander method. GEOS receives about 100 000 observations every year and their analysis was quickly decentralised. After 14 years, more than 500 papers have been published.

Although GEOS members observe a wide range of stars, certain categories have emerged as being particularly important:

1) Pulsating variables, where the aim is to obtain the mean light-curve, to confirm the ephemeris or to determine the O–C, an indication of a slight change in period. The short-period, RR Lyrae stars are well observed, especially the Blazhko effect, which indicates a double period.

2) Eclipsing variables are observed in the same way. In addition one tries to directly determine the times of minima, and to calculate the orbital elements from the light-curve.

3) Favourite among GEOS members, however, are little-known stars, where there is a possibility of quickly discovering something new. These stars are essentially of two types, low-amplitude variables and variables that are always faint, with maxima below magnitude 10. These stars need a telescope of more than 20 cm to be properly studied.

When an amplitude is greater than 2.5 magnitudes, observational errors can be considered as negligible in comparison with the observed variation. Between 1 and 2 magnitudes, particular care must be taken in making estimates and the detection of errors becomes useful. Below one magnitude, not only should the estimates be made with the utmost care, but statistical treatment of the observations becomes essential. Such reduction allows spurious points to be eliminated and a smooth light-curve to be drawn. When several observers have carefully followed the same star, systematic errors can be eliminated. Correction of systematic errors must always be made before calculation of the final mean of observations by several observers.

Statistical treatment has allowed the range of visual observations to be extended, and for their potential to be established. Variation of one magnitude is still detectable, and if the variable is periodic, visual estimates allow the variation to be detected if the amplitude is more than 0.2 magnitude. If the variations are not periodic it is difficult to draw any conclusion about them below 0.4 magnitude.

The procedure for studying new objects is that they are chosen, often from the NSV, and usually for showing rapid variations. A visual observational campaign follows, in particular monitoring the star through the night and over several nights. Each observer obtains a set of points to which he tries to fit a periodic curve. The best algorithm is to produce a periodogram, which will show the probable period. From the light-curve and period an attempt is made to determine the type of variation and a preliminary ephemeris. Any new results obtained by visual methods should be confirmed. GEOS therefore organises photoelectric observing runs at an observatory (Pic du Midi, Jungfraujoch, etc.). The results are published either in the GEOS *Circular* or in the *IBVS*.

M. Roland Boninsegna will describe GEOS results for a specific star.