MULTIPLE STELLAR SYSTEMS

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A spectroscopic survey of visual binaries with known orbital elements has been carried out with the radial velocity scanner CORAVEL at the Haute-Provence Observatory, since 1977, (Baranne, Mayor, Poncet, 1979). This survey of more than 100 visual systems, selected from Dommanget's catalogue (1967) (see also a new edition 1982) was first devoted to the determination of stellar masses. Several multiple systems were detected and have permitted also a study of the structure of triple systems. We have detected and measured in particular a class of triple systems with radial velocity variations of small amplitude. Taking advantage of the high resolution and high signal-to-noise ratio accessible with the cross-correlation technique, such small amplitude radial velocity curves are sometimes derived only through the change of width and shape of the cross-correlation function. Let us recall that the cc-function of a SB2 (or SB3) system is only the weighted sum of the individual cc-functions (Mayor, 1985). This property of the cross-correlation combined with the linearity of the detector allow a very simple analysis of blended dips. The full width at half depth of the cross-correlation dip is about FWHD = 16 km/s (in absence of noticeable rotation). Analysis of blended systems allows a good determination of the two individual velocities if the difference $|V_{r_1} - V_{r_2}|$ is equal or larger than about 0.15 *FWHD (about 2 km/s).

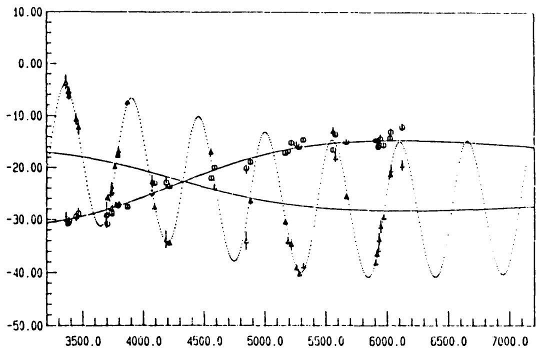

Fig.1 : HD 214608 a triple system with frequent small velocity differences between the two components.
A : G3V + K3V:
B : F8V
P_{Aa-Ab} = 1.5 year = P_{short}
P_{A-B} = 30 years = P_{long}

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A 1-meter telescope, dedicated only to radial velocity measurements, gave us favorable conditions to discover and measure such systems with multiple periods ranging from days to years and sometimes very eccentric orbits. HD 214608 is a good example of a triple system with $|V_{r_1}-V_{r_2}|$ almost always less than FWHD (see fig.1). The long period (visual) is 30.0 years and the short period (spectroscopic) 1.5 years.

Considering the position of representative values for triple systems in a log P_{long}-log P_{short} plane figure 2, we are inclined to see a bimodal distribution. If most triple systems have a highly-hierarchical structure with spectroscopic period (P_{short}) much smaller than visual period (P_{long}), a non-negligible number of systems show only a factor of 10 to 100, between the two periods. Selecting a domain of P_{long} (for example 17y < P_{long} < 170y) we can clearly see the bimodal distribution of P_{short}. (A bimodal distribution also exists for P_{long} > 170 years, the two periods in such systems only being determined by visual observations). The gap between the two modes (fig.3) of the distribution cannot be explained by observational bias. Such a bimodal distribution describing the geometry of triple systems can result from initial conditions or dynamical evolution.

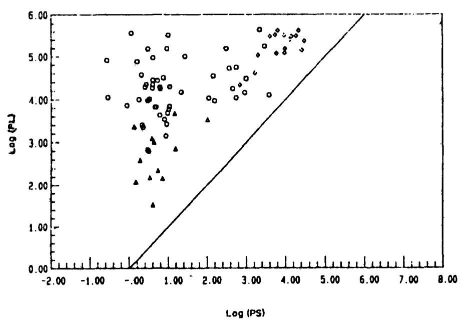

Fig.2 : Distribution of multiple stellar systems in a log P_{long} - log P_{short} plane. Δ=spectroscopic systems, O=spectroscopic-visual systems, ◇=visual systems.

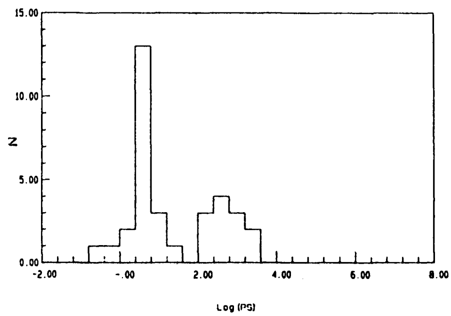

Fig.3 : In triple stellar systems having 17y<P_{long}<170y, the distribution of short periods is bimodal.

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