PERIOD CHANGES IN MAGELLANIC CLOUD CEPHEIDS

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It has been found possible to obtain information on period change in data on 115 cepheid variable stars in the Magellanic Clouds (84 LMC cepheids and 31 SMC cepheids). Harvard Observatory data of the period 1910 to 1950 (collated by Payne-Gaposchkin and Gaposchkin) are combined with Dunsink Observatory observations carried out by C.J. Butler in 1966/67 and with South African Astronomical Observatory observations covering the years 1975-1977 by Martin, Thomas, Carter and Davies to derive mean periods for the intervals between the various data sets. Using these new periods in conjunction with the very accurate Harvard periods, seperate estimates of the time averaged fractional change of period per day, d/dt(ln P), with corresponding estimated errors, could be evaluated for two epochs, one around 1950 and the other around 1971. It was found that 70 stars give rates of change of period that are not significantly different from zero, that 20 stars have two values of rate of change of period that are in agreement at the two epochs (indicative of secular period change), while 22 stars give two disparate values of rate of change of period (indicative of irregular period changes).

While neither positive nor negative period changes dominate, it was found that "large" ($>10^{-8}$ $days^{-1}$) significant fractional period changes were largely confined to cepheids with periods greater than about 10 days, which is probably due to the greater instability of the extended envelopes of these stars. The fraction of significant period change estimates which indicate irregular period changes is less for the LMC sample than for the SMC sample, and according to Szabados (1977, 1980, 1981) this fraction is still less for galactic cepheids. Van Genderen (1983) also finds a large fraction of irregular period changes for Magellanic Cloud cepheids. This indicates a possible link between composition and period changes.

The size of the period changes increases with period in good agreement with the trend predicted by evolutionary theory, with most of the data falling around the values associated with the second and third crossings of the instability strip. Indeed, even the irregular period

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changes, whose time averaged rates are greater than the corresponding errors, follow this trend, although it seems likely that these period fluctuations are non-evolutionary in character. Although the binary light-time effect may account for some of the observed period changes, natural constraints on the extent of this effect exclude it as an explanation for the larger period changes. For instance the possibly cyclic variation in the period of HV 900 cannot be due to orbital motion.

References

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