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HIGH-FREQUENCY STELLAR OSCILLATIONS. III. A BRIEF REPORT

Our program, which is an extension of one begun at the Princeton University Observatory by Lawrence, Ostriker and Hesser (and Reported in ApJ.148, L161, 1967; 153, L151, 1968; and 155, 919, 1969), consists of acquiring long (~7200 sec), continuous, digitized records of the apparent luminosity of various stars in the lower left-hand portion of the HR diagram. These records are searched for low-amplitude, periodic variability using modern autocorrelation and power spectrum techniques; various noise statistics are also derived which help to distinguish objects possessing intrinsic but non-coherent variability from either quiet objects or objects exhibiting periodic behaviour superimposed upon an otherwise quiescent radiation field. During a two-month run on Cerro Tololo in early 1969 we surveyed a large number of central stars of planetary nebulae (CSPN), white dwarfs, old novae, U-Geminorum stars, optical candidates for X-ray sources and pulsars, and peculiar blue stars. We were able to take advantage of the experience gained at Princeton and,in so doing, we feel our techniques have been measureably improved over what we reported at the scientific meeting of Commission 27 at Prague.

A partial summary of our results to date would include:

1) Discovery of a new, blue, short-period variable star, G44-32, whose proper motion, magnitude and colors led Eggen and Greenstein (ApJ 141, 83, 1965) to include it in their catalogue of white dwarfs (EG 72). The star is variable with amplitudes of about 2 % and periods in the range from 10 to 27 minutes. Our results have been described in detail elsewhere (ApJ 158, L171, 1969). Spectroscopy and further photometry are needed to clarify its nature and relationship to other short period blue variable stars such as HZ 29.Should other investigators be interested in acquiring substantial blocks of photometric data on G44-32 during the forthcoming season in a form suitable for time series analysis (in particular, equi-spaced data points), we would be pleased to consult with them concerning the possibilities of analysing their data with our computer programs.

2) A comparative study of the power spectra of white dwarfs and CSPN in the period range from 4 to ~ 720 sec has been made in which we have found that the CSPN are extremely quiet with regards to both intrinsic flickering and

coherent, low amplitude variability. For many objects observed, individual Fourier amplitudes in the relevant period range were much less than 0.001 mag. Thus, in constrast to tentative results previously reported and based upon data taken under conditions of poor seeing, at Princeton, we find that the power spectra of the CSPN more nearly resemble those of the white dwarfs than they do the old novae: we are, however, presently attempting to appropriately characterize the mean continuous power spectra of the various types of objects observed in order to learn if more subtle differences exist which are difficult to isolate in the high resolution spectra.

3) Observations were obtained of old novae, U-Geminorum stars and optical candidate for X-ray sources and pulsars. In particular, extensive data on WX Cen were obtained in the period range of $\sim$ 900 sec > period > 4 sec and some exploratory data were obtained which extend this range to 0.2 sec. We find that in the more common frequency range WX Cen is only marginally noisier than comparison objects and that it exhibits no coherent noise. Its general noise level was significantly less on the nights of observation than corresponding noise levels determined for Sco X-1 by ourselves and other investigators. The dissimilarities between the optical power spectra of Sco X-1 and WX Cen suggests that the latter's identification with Cen X-2 (Eggen, Freeman and Sandage, ApJ 154, L27, 1968) remains tentative.

4) For Sco X-1 the power spectrum was computed from a data set 44 min long recorded at the 60-inch telescope with 0.1 sec. time-resolution. This spectrum shows no periodic activity with amplitude greater than 0.002 mag for 120 > period > 0.2 sec. Combining this result with that of Hiltner and Mook (ApJ 150, 851, 1967), we note that Sco X-1 is aperiodic for the range, 3600 > P > 0.2 sec, where P is the period. We can interpret the continouous power spectrum for 205 > P > 0.2 sec to consist of two parts: a flat component due to the photon statistics of observing, and a decaying part with power spectrum proportional to f^{-2} for P > 45 sec. For P < 45 sec, the decaying part of the spectrum cannot be seen over the flat component. Data from more active phases of Sco X-1 are needed to extend the analysis to smaller periods.

5) An attempt to identify optically the pulsar, PSR 0833-45, gave a null result (see Nature 223, 485, 1969).

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