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**THE DISCOVERY OF TWO NEW DOUBLE-MODE RR LYRAE (RRd)  
VARIABLES IN THE GLOBULAR CLUSTER M3**

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The images used in this study were obtained with the No. 1 0.9-meter telescope at the Kitt Peak National Observatory using “Harris” B and V filters. The field was observed for six nights during May 1992 and again for seven nights in April 1993. The data reported here are the 83 B frames from 1992 and the 100 B frames from 1993. The raw data frames were processed and reduced following standard procedures using ALLSTAR in DAOPHOTX in IRAF.

In the globular cluster M3, V68 and V87 have been known as RRd variables since 1982, V79 was recently discovered as an RRd (Clement et al. 1997), and we identify V99 and V166 as RRd variables in this paper. We determined the primary periods for the RRd variables with a computer program that utilized Stellingwerf’s (1978) phase dispersion minimization (PDM) technique with a (5,2) bin structure. To search for the secondary period, we derived a mean light curve by fitting a cubic spline interpolating function to the bin means, then measured the residuals from this curve and applied the PDM technique to the residuals to determine the secondary period. Next, we corrected the magnitudes by subtracting the mean curve for the secondary period from the raw magnitudes and then, again applied the PDM technique to obtain a final value for the primary period.

This was done for both the combined 1992-1993 data and again for each year separately. There appears to be year-to-year changes (and in some cases, very significant changes) in the properties of the RRd variables in M3. V166 is the most striking in this regard.

For V166 the dominant pulsation mode in 1992 was the fundamental mode with a period of 0.4829 day and an amplitude of 0.75 mag. The 1992 data show a secondary pulsation in the first overtone with a period of 0.3593 day and an amplitude of 0.31 mag. In 1993, just 11 months later, the dominant mode is the first overtone with a period of 0.3566 day and an amplitude that has increased from 0.31 mag to 0.34 mag. The secondary pulsation is the fundamental with a period of 0.4815 day and an amplitude that has decreased from 0.75 mag to 0.23 mag. If the mode shift is an evolutionary effect, this would be additional evidence for blueward evolution for M3 as suggested by Clement et al. (1997) and others.

For V99 the amplitude of the primary, first-overtone oscillation, relative to the secondary, fundamental, increased significantly from 1992 to 1993, again indicating blueward evolution. There seems to have been a similar increase for V68 and V79 but that is not as clear. In both cases the amplitude of the primary appears to have decreased but the

amplitude of the secondary decreased even more. V87 appears to have decreased the amplitude of the primary, first- overtone oscillation relative to the secondary, fundamental, though for both 1992 and 1993, the amplitude of the secondary is very small and difficult to estimate accurately. The properties for the RRd variables in M3 are shown in Table 1.

Table 1. Properties for the RRd Stars in M3

Star	P <sub>1</sub>	P <sub>0</sub>	A <sub>1</sub> /A <sub>0</sub>	A <sub>1</sub> /A <sub>0</sub>	A <sub>1</sub> /A <sub>0</sub> <sup>*</sup>	A <sub>1</sub> /A <sub>0</sub> <sup>*</sup>
			1992	1993	1996	1920-6
V68	0.356	0.479	1.19	1.62	1.12	0.72
V79	0.358	0.480	1.28	1.48	1.73	<0.2
V87	0.357	0.480	3.05	2.34		
V99	0.361	0.485	1.93	3.23		
V166	0.358	0.482	0.41	1.46		

\* from Clement et al. (1997)

#### References:

- Clement, C., Hilditch, R., Kaluzny, J., & Rucinski, S., 1997, *ApJ*, **489**, 55  
 Stellingwerf, R., 1978, *ApJ*, **224**, 953