
A Photometric Survey of Central Stars of PNe for Close Binaries

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Summary. We have recently begun a photometric survey of a large sample of central stars of PNe to search for photometric variability indicating a close binary companion. The survey consists of a re-evaluation of previous surveys to search for lower amplitude variability as well as a list of previously unmonitored objects. The goal is an improved binary fraction for close binary central stars. The improved binary fraction, combined with existing radial velocity and imaging surveys will provide limits for binary star models of PN shaping. Here we discuss the reasoning behind a new survey, specific goals of the study, and early data gathering.

1 The Target List

The role of binary stars in the shaping of PNe is still an active topic of debate (note the scientific program for this meeting). One important goal in the study of binary central stars (CSs) is determining an accurate binary fraction. Prior studies have produced our current list of known close binary CSs [2] and have determined a binary fraction of 10–15% for these systems. The largest study of CSs was a photometric campaign by Bond & Ciardullo (hereafter B–C), the results of which were presented in a few papers and summarized (from the standpoint of binarity) in [1]. The B–C campaign covered over 100 CSs and even now represents the majority of CSs which have undergone photometric monitoring capable of detecting forms of variability due to close binary companions (see [3] for two examples). We have begun a long-term photometric monitoring campaign of a large number of CSs. The campaign is designed to both re-evaluate the B–C sample and introduce new targets. The majority of the B–C data was collected in the 1980s and early 1990s with a fairly broad range of sensitivities and time-resolutions. Our re-evaluation is based on the potential for higher signal-to-noise ratio data with modern equipment and a more uniform approach. Our new target list was compiled based on very specific, and

limited, criteria in an attempt to remove as many selection effects as possible. Only two major criteria were involved: CS magnitude ($15 < V < 17$) and nebular diameter (> 25 arcsec). The magnitude criterion is necessarily related to the combination of instrumentation (how faint can we go) and required time-resolution (limiting the maximum exposure time). The combination of the two criteria result in targets which are typically older PNe and therefore have CSs less prone to photometric variability due to strong winds (Wolf-Rayet-type CSs). The criteria also have the effect of providing a larger percentage of targets for which the inner nebulosity is sufficiently faint to allow accurate photometry of the CS. One difficulty is that our target list is more likely to contain pulsating CSs. However because pulsations are periodic, yet distinct from variability due to binaries, they are more easily accounted for than wind variability. We have made no effort to adjust our target list for known binaries, favored targets, or unlikely binaries. We have also only listed our target list by their PN G designations. In this respect we are attempting to produce a double-blind sample, thereby giving a binary fraction as free from bias as possible.

1.1 The Current Data

Our monitoring campaign is making use of the SARA 0.9-meter telescope and MDM observatory, both at Kitt Peak, the SMARTS telescopes at Cerro Tololo, and soon the SARA-south 24-inch telescope at Cerro Tololo (scheduled to come online by January 2008). A first-order analysis of the current data produced typical errors between 0.007 and 0.030 magnitudes. The expected errors with more detailed analysis are expected to improve by a factor of five or better. The observations are spaced such that maximum coverage of the frequency spectrum is obtained. Once the higher frequency ranges have been searched for periodicities, the data can be binned to further decrease the errors. Figure 1 shows an example of our current data for one potential variable CS.

References

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