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Hunting for binary central stars of planetary nebulae: exploiting archival data

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Abstract. The detection of new binary central stars of planetary nebulae is crucial to definitively determine the importance of binary interactions in the nebular morphology. In this context, we are working on a project that aims to increase the low number of binary central stars detected so far. For that, we are first analyzing public archival data in order to discover potential candidates of binary central stars. These candidates will be subsequently followed-up in order to confirm and characterize them. Here we present our ongoing search and some preliminary results.

Keywords. binaries: general, planetary nebulae: general, astronomical data bases: miscellaneous

1. Overview

While binary interactions have been proposed as the main mechanism to explain the complex and amazing morphologies seen in planetary nebulae (PNe), only less than 2% of the central stars (CSs) have been found to be close binaries. This is a very small fraction among the ∼3500 known PNe in the Milky Way (Parker, Bojičić & Frew 2016), specially taking into account that only about 20% of PNe are spherical! Since the sample is too big to obtain new data of all of them, archival data offer a great opportunity to search for new binary CSs candidates. For example, photometric public surveys provide light curves of a large number of objects in a long timespan which allows us to look for periodic variability in the CSs. Also, the large amount of photometric catalogues, that provide data in a very wide range of wavelengths, allow us to detect infrared excess in the spectral energy distributions (SEDs) of the stars. We are exploiting all of these archival data to search for new candidates that will be subsequently followed-up by means of multi-epoch photometric and spectroscopic observations.

2. The search for new binaries: preliminary results

In order to obtain good results, an efficient selection of the central stars is crucial. For that reason, we have carefully inspected the available photometric data of our sample of around ∼3000 CSs. In the following, we briefly explain the two different approaches that have been followed to find new binary CSs candidates:

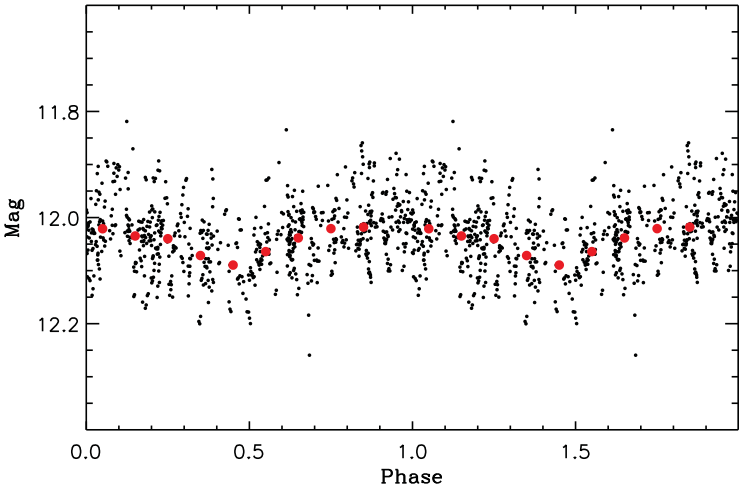

Figure 1. Phase-folded light curve of one of our candidates from the OMC-Integral archive. The red dots show the binned data with 0.1 in phase.

(*a*) Search in photometric surveys: Most of the known binary CSPNe have been detected through modulations in the light curve. With this method, Miszalski *et al.* (2009) found, by using the OGLE survey, a total of 21 binaries, more than doubling the known sample at that time. As a continuation of this working line, we have inspected the photometric surveys ASAS, Catalina Sky Surveys, OMC and SuperWasp to search for new binary CSs. We have analyzed the light curves available in these surveys for our sample looking for periodic variability. We have not only recovered all known binaries present in the surveys data but also we have found a significant number of CSs that show significant variability. Figure 1 shows an example of one of our candidates.

(*b*) Search for infrared excess: CSPNe are very hot stars and the detection of any excess flux at infrared wavelengths would indicate the presence of a cooler companion. This method has been successfully used by De Marco *et al.* (2013) and Douchin *et al.* (2015) for some individual objects. We are extending this infrared excess search to our whole sample of CSPNe in an automatic way. For that purpose, we are using VOSA (Bayo *et al.* 2008), the Virtual Observatory SED Analyzer, which provides the photometry available in the accesible catalogues and constructs the SED for the queried objects.

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