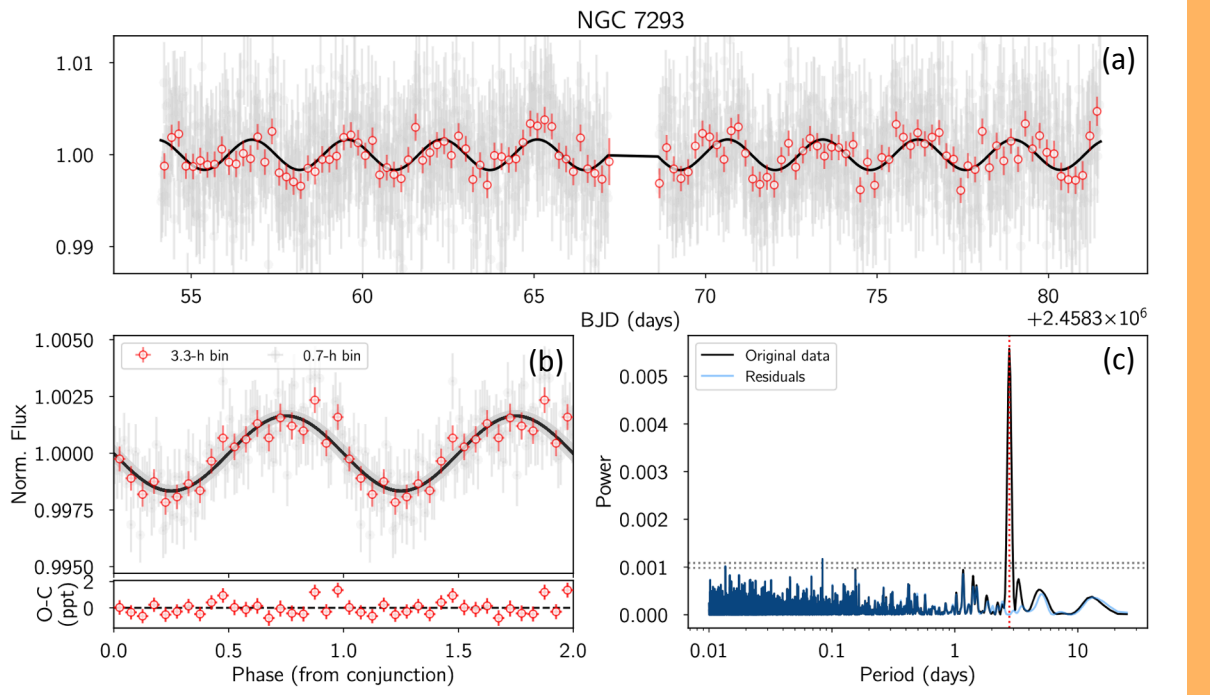
Planetary nebula seen with TESS: Discovery of new binary central star candidates from Cycle 1



Top panel: TESS time-flux light curve (a), phase-folded light curve (b) and periodogram (c) of NGC7293, widely known as Helix nebula. Left panel: HST/CTIO image of Helix Nebula (Credit: NASA, ESA, C.R. O'Dell (Vanderbilt University), y M. Meixner, P. McCullough y G. Bacon (Space Telescope Science Institute)).

It is now clear that **binarity plays a crucial role in many aspects of planetary nebulae** (PNe), particularly with regard to the striking morphologies they exhibit. To date, there are nearly 60 known binary central stars of PNe (CSPNe). However, both theory and observation indicate that this figure represents only the tip of the iceberg.

We have used data from the TESS satellite to search for variability in the eight CSPNe that belong to the two-minute cadence of preselected targets in Cycle 1. We identified strong periodicities and analysed them in the context of the binary scenario. **All the CSPNe but one** (Abell 15) **show clear signs of periodic variability in TESS**. The cause of this variability can be attributed to different effects, some of them requiring the presence of a companion star. We find simple sinusoidal modulations in several of the systems, compatible with irradiation effects. In addition, two of the central stars (PG 1034+001 and NGC 5189) also show photometric variations due to ellipsoidal variations and other signs of variability that are probably caused by star spots or relativistic Doppler-beaming.

The case of the well-studied **Helix Nebula** (NGC 7293) is of particular interest; here we constructed a series of binary models to explain the modulations we see in the light curve, with a periodicity of 2.8 days. We find that the variability constrains the possible companion to be very low-mass main-sequence star or sub-stellar object.

A. Aller, J. Lillo-Box, D. Jones, L.F. Miranda and S. Barceló Forteza, 2020, A&A, Vol. 635, 128