The role of TESS in the search for binary central stars of planetary nebulae

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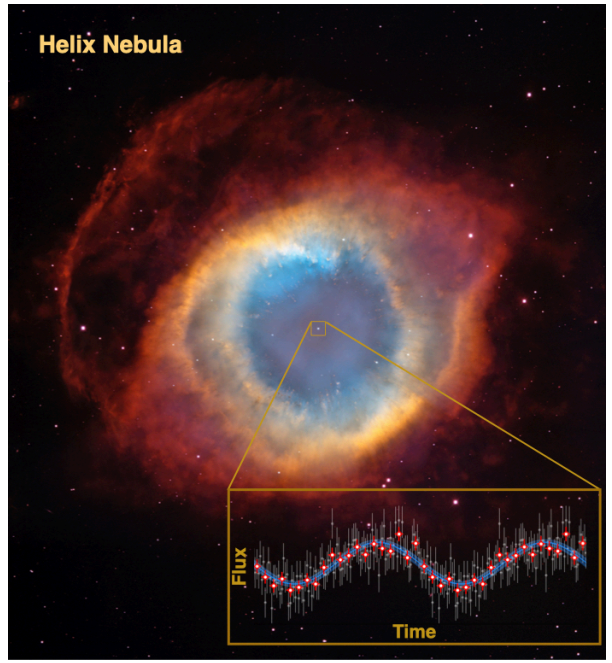
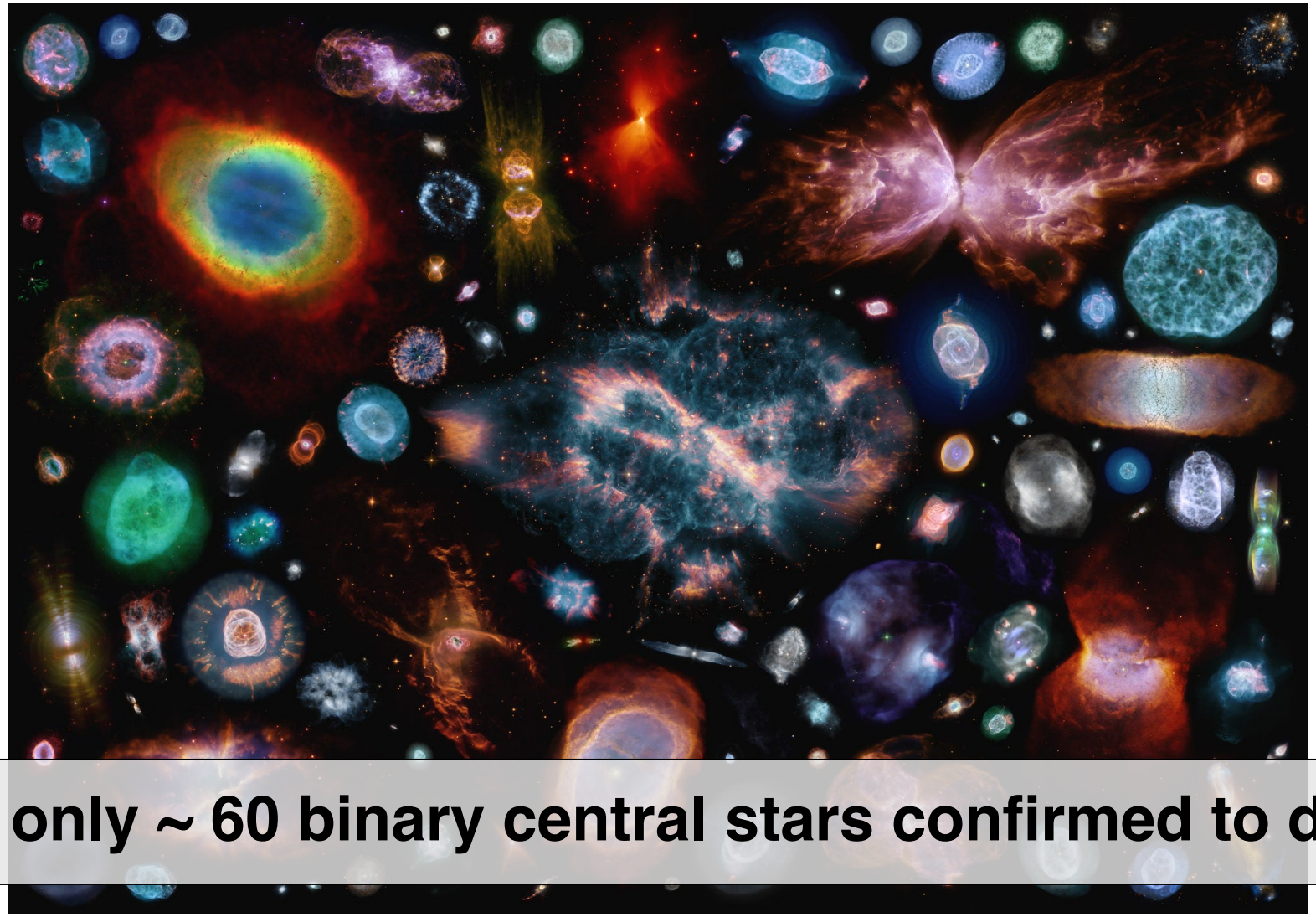


Abstract: *It is now clear that binarity plays a crucial role in many aspects of planetary nebulae (PNe), particularly the striking morphologies that they show. To date, there are about 60 binary central stars of PN (bCSPN) known, among the more than 3000 PN in our Galaxy. However, both theory and observation indicates that this represents only the tip of the iceberg. Search for new bCSPNe is essential to enhance the statistical validation of the key role of binarity in the formation and shaping of PNe. In this work, we used data from the TESS satellite to search for variability in the eight CSPNe that belong to the two-minute cadence preselected targets in Cycle 1. All the CSPNe but one show clear signs of periodic variability in TESS that can be attributed to different effects, some of them requiring the presence of a companion star. The case of the well-known Helix Nebula is of particular interest, since we find that the variability constrains the possible companion to be very low-mass main-sequence star or sub-stellar object.*

More details: A. Aller et. al, 2020, A&A, Vol. 635, 128

80% of PNe in our Galaxy are assymetrical! —> Binaries?

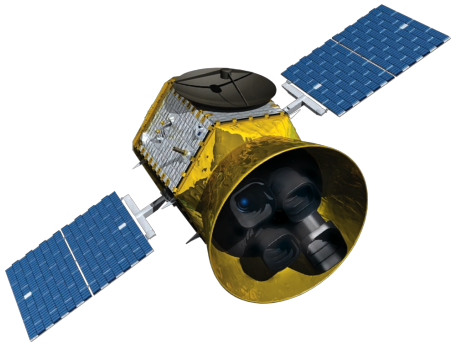


But only ~ 60 binary central stars confirmed to date

Image credit: Judy Schmidt/NASA

Goal: To detect new binary central stars

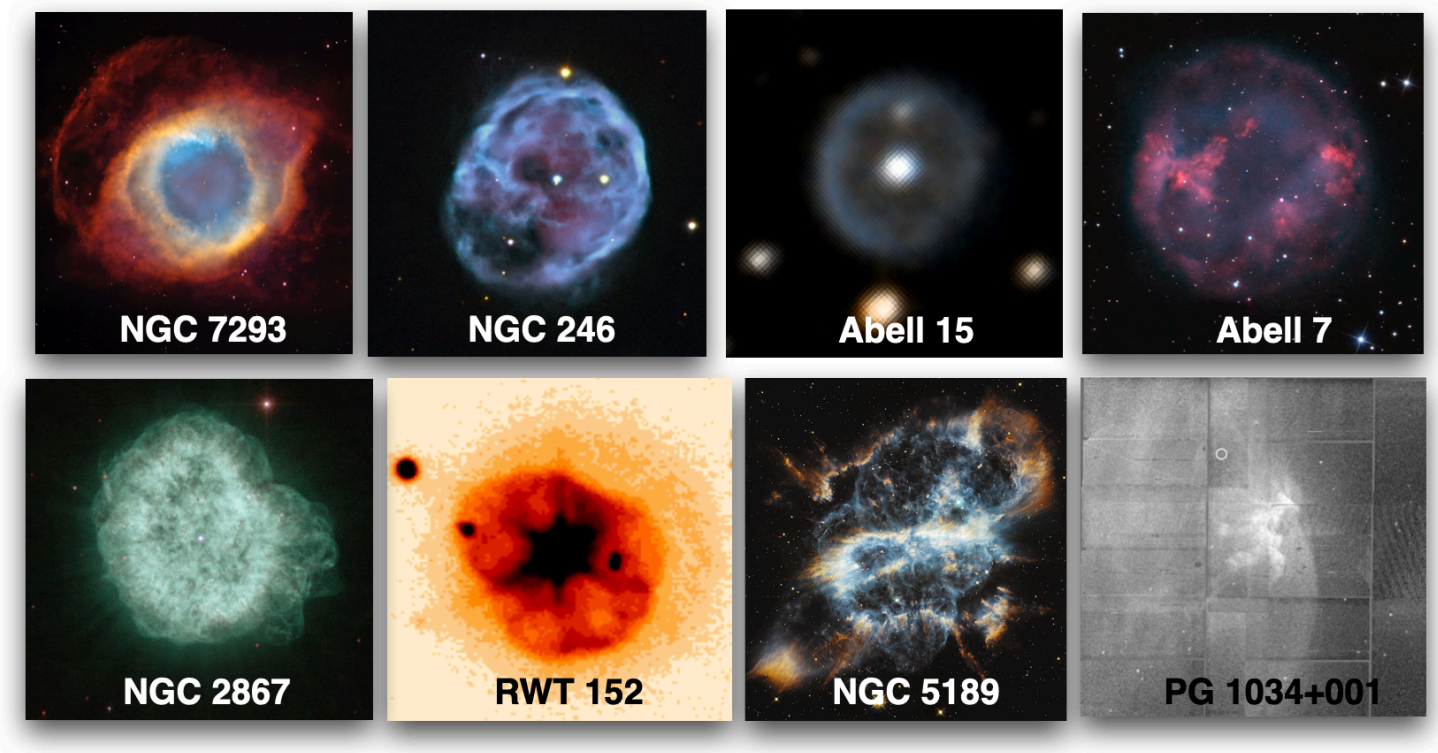
How?:



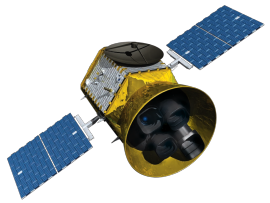
With the
Transiting
Exoplanet
Survey
Satellite

- All-sky mission
- 2-year/2-cycle (with extension)
- High-precision photometry
- ~ 200,000 stars with 2-min cadence

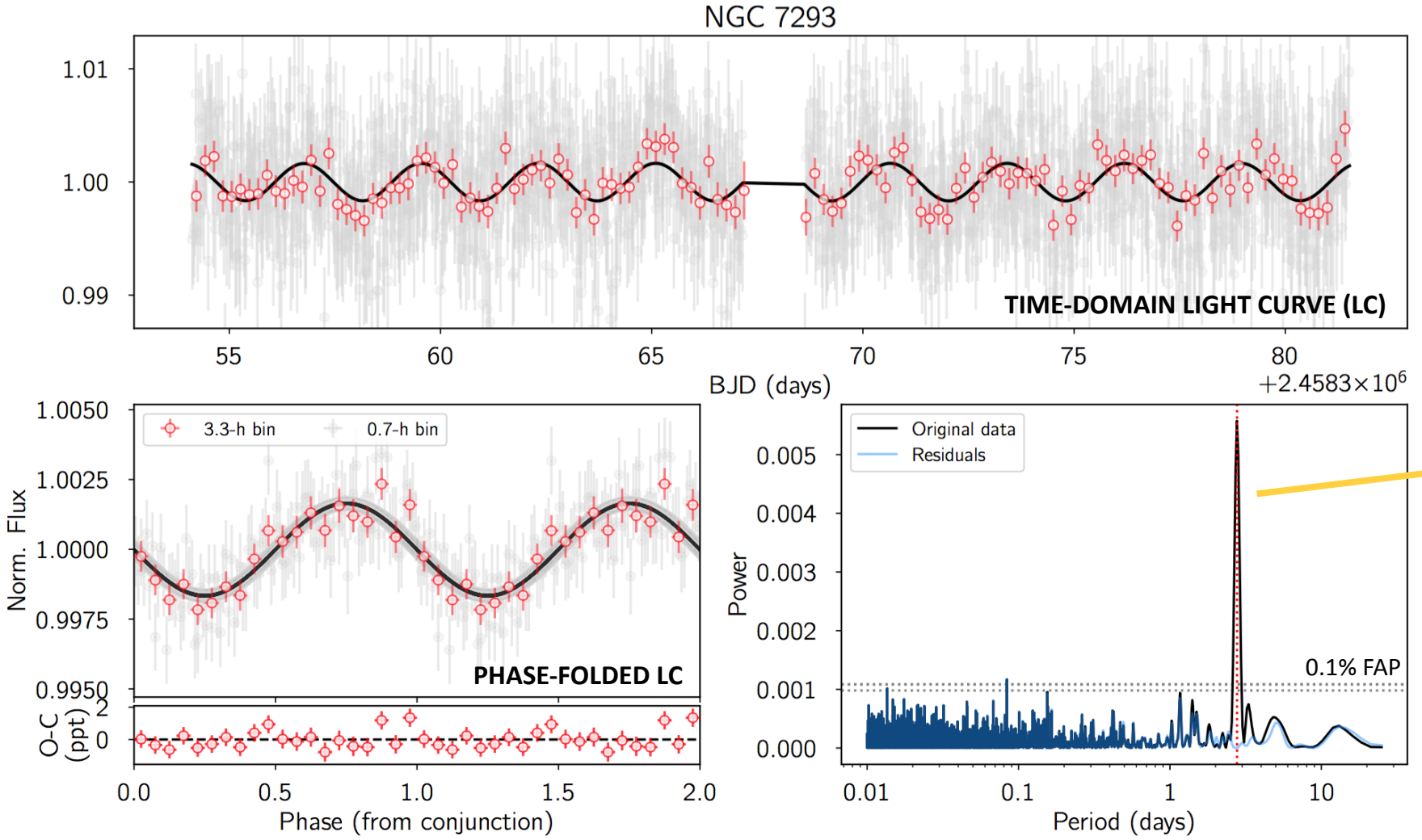
The PN sample (cycle 1):



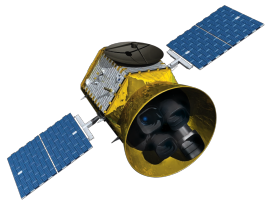
Credits: NGC 7293: NASA, ESA, C.R. O'Dell (Vanderbilt University), y M. Meixner, P. McCullough y G. Bacon (STScI); NGC 246, Abell 7: D. Goldman (Astrodon Imaging); Abell 15: DSS2 color image; NGC 2867: H. Bond (STScI) and NASA/ESA; RWT 152: Aller et. al (2015); NGC5189: NASA, ESA, Hubble Heritage Team (STScI/AURA); PG1034+001: Hewett et. al (2003).



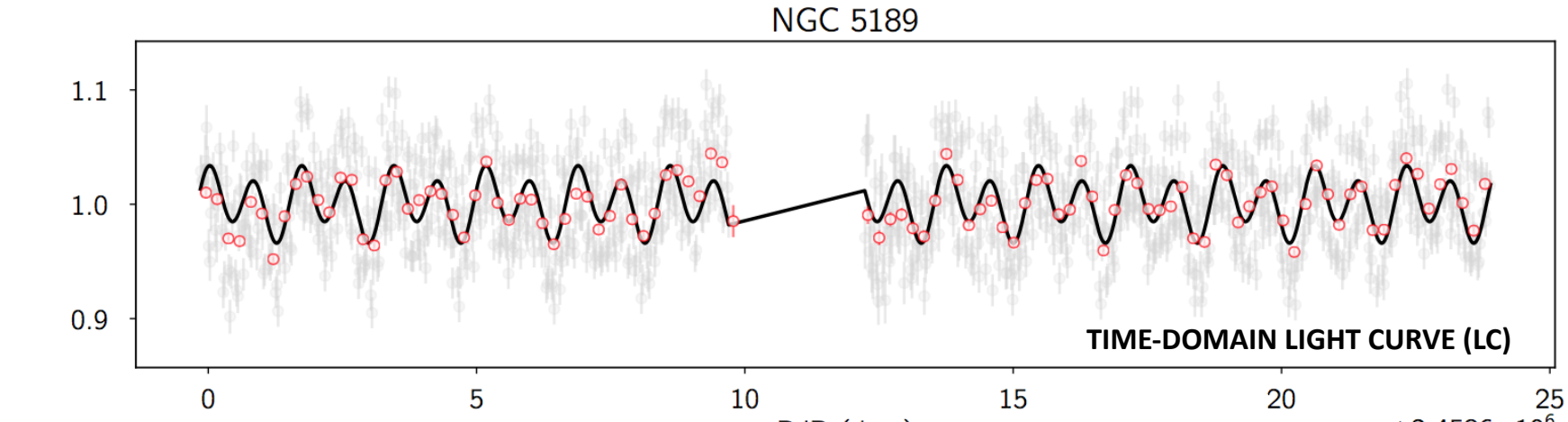
Results cycle 1: Variability analysis **NGC 7293**

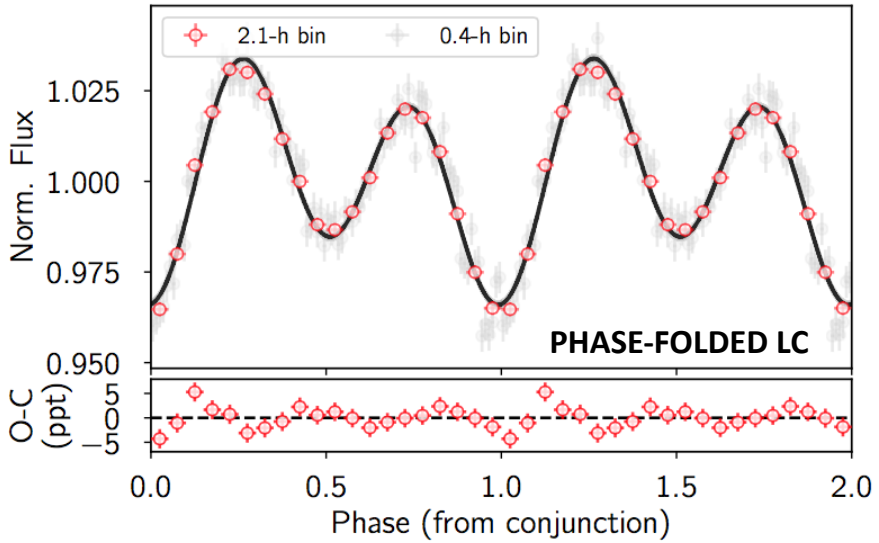


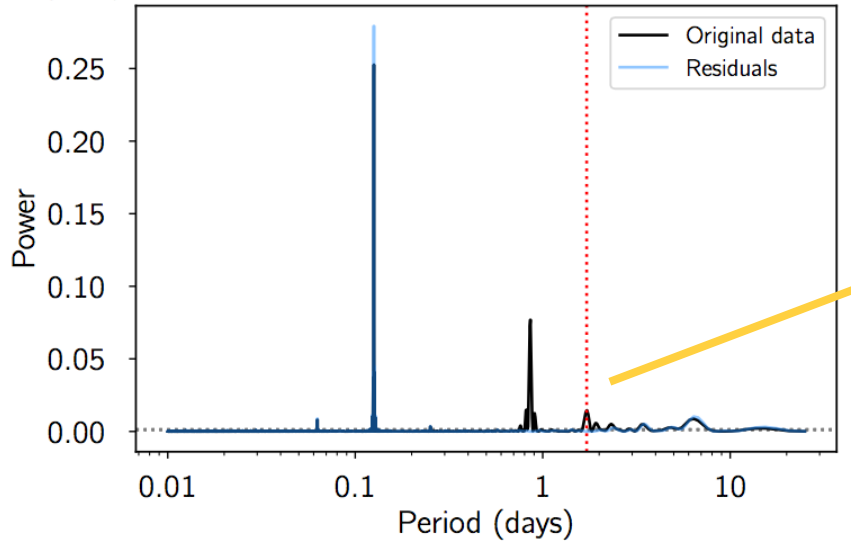
P ~ 2.8 days



Results cycle 1: Variability analysis **NGC 5189**







P ~ 1.7 days

So… what we have:

Results from Cycle 1:

7/8 central stars show clear variability: Possibly binaries!

To be confirmed by photometry and/ or radial velocity

And for the close future:

Cycle 2 is coming…

+ Analysis of the Full Frame Images (FFIs)

Waiting for many more binary central stars!