North PHASE observations of the young cluster Tr37

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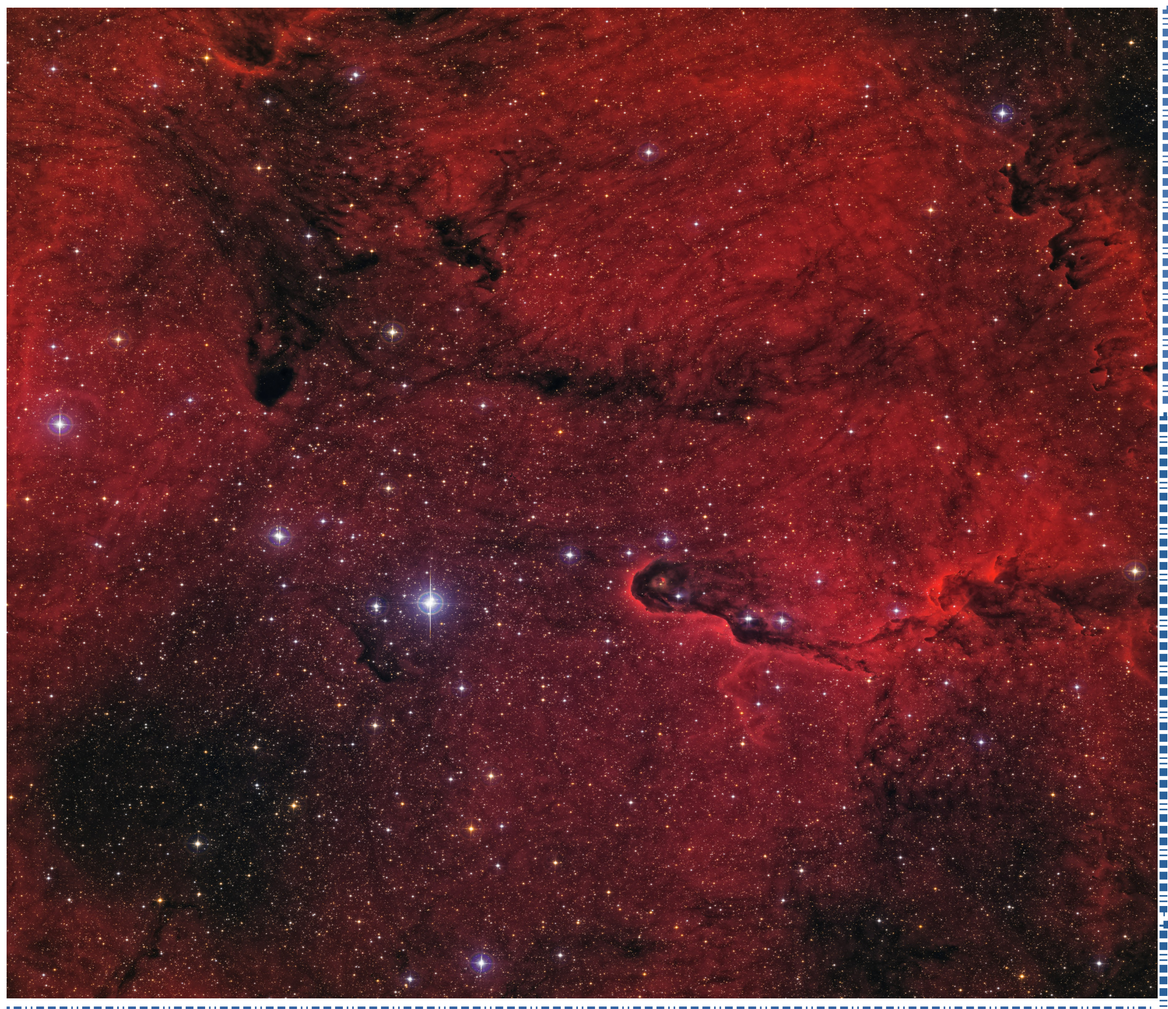

Fig 1. A deep RGB image of Tr37 by José Luis Lamadrid. In the image, blue is gSDSS, green is rSDSS-J0660, and red is J0660 (Hα).

ABSTRACT

The North-PHASE Legacy Survey is using the T80 telescope from the Javalambre Observatory (Spain) to study variability in several young clusters in the northern hemisphere. It produces time-resolved observations that enable us to 'use time to map space', identifying young variable stars and the processes that cause their variability, such as stellar spots, accretion variations, and occultations by circumstellar material. I will present the initial results for the cluster Tr37, which will be the subject of my PhD, having started in January 2024.

NORTH PHASE (Periodicity,Hot spots,Accretion Stability and Early evolution in young stellar clusters in the Northern Hemisphere) LEGACY SURVEY

A 5 year survey that will “use time to map out space”. The use of variability becomes very helpful when structures are too small to be resolved by direct imaging techniques. This survey is carried out using the 80 cm JAST80 telescope with a mounted T80cam camera at the Javalambre Observatory in Spain. With a Field of view (FOV) diameter of 2 deg (130 mm), the whole Tr37 cluster can be observed at once. The observations will be carried out in 6 filters : uJava(Ultraviolet), J0660(Hα), gSDSS , rSDSS, iSDSS, zSDSS.

Trumpler 37 (Tr37)

A 4 Myrs cluster found in the ionised IC1396 H II region,part of the Cepheus bubble. This cluster is 925 +- 73 pc away according to the revised Gaia EDR3 [1]. This cluster hosts different types of young stars, Classical T Tauri stars which have optically thick circumstellar disks and show strong evidence of accretion, Weak Line T Tauri stars weak/lower accretion rates with optically thin disks. There are also disk- depleted stars that show no accretion[3].

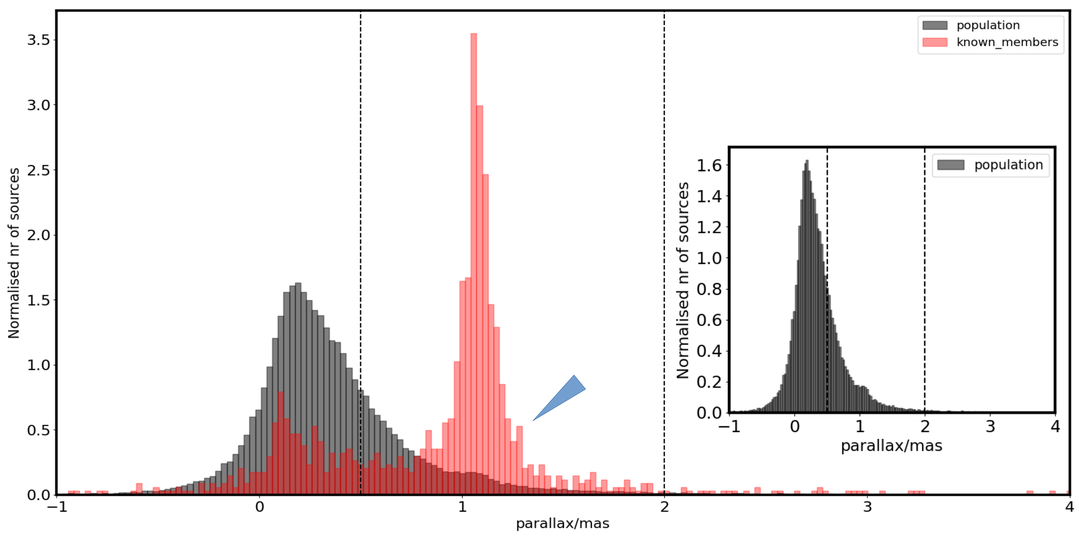

Fig 2. A parallax histogram of the objects reveal the presence of a cluster within expected Tr37 parallax range. The known members were obtained from [1].

Light curves of variable objects

From the 1st year of data 2226 objects are found variable. Different objects such as young stars, eclipsing binaries and giants have been found. The light curves below are some examples.

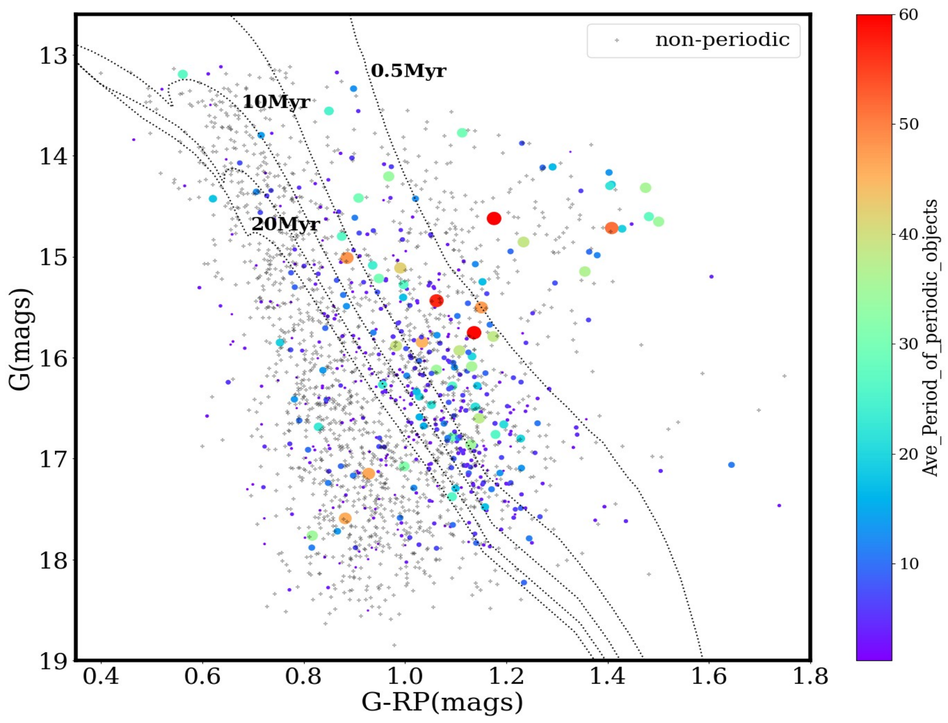

Fig 3. Shows the distribution of periodic and non-periodic variable objects. Size and colour represents increasing periods. We expect the young objects to have lower periods compared to giants and for objects approaching the main sequence to have low or no periodicity. On the colour-magnitude young stars will be between the 0.5-20 Myr boundary and the giants above 0.5 Myr isochrone limit.

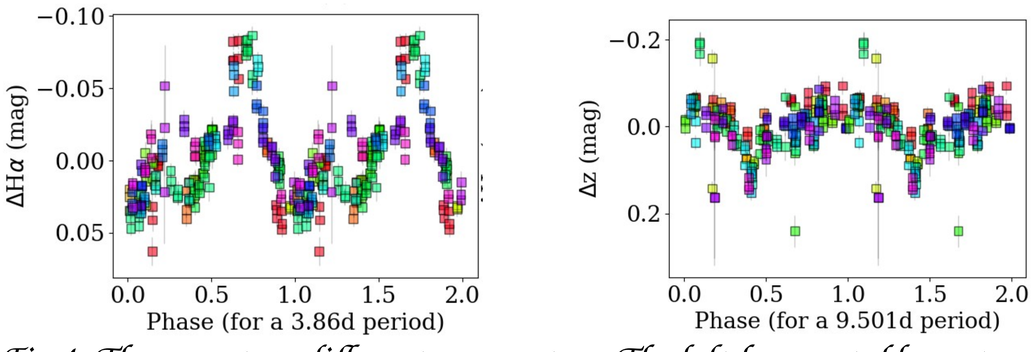

Fig 4. These are two different young stars. The left has unstable spots with different temperatures . Right shows dips in magnitude and the spots are stable.

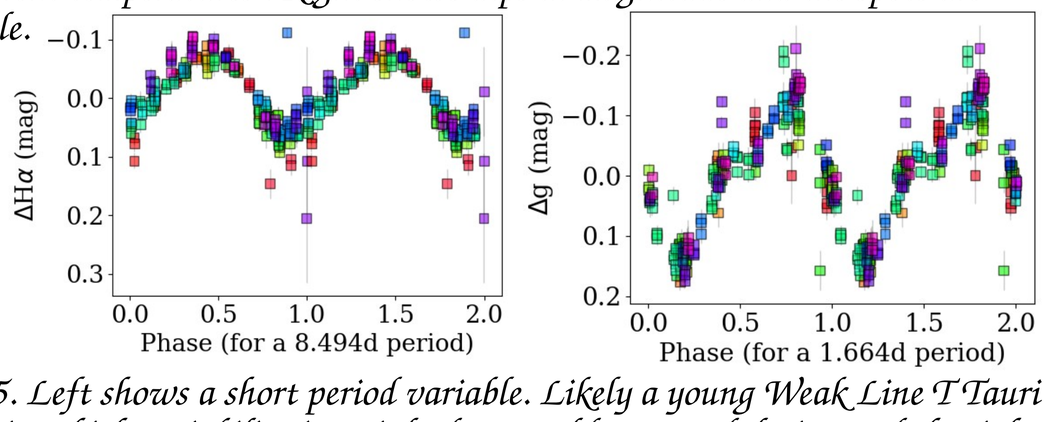

Fig 5. Left shows a short period variable. Likely a young Weak Line T Tauri star, in which variability is mainly due to cold spot modulation and the right seems to show variability due to both hot and cold spots at the same time.

Below are not young objects but were detected by the survey.

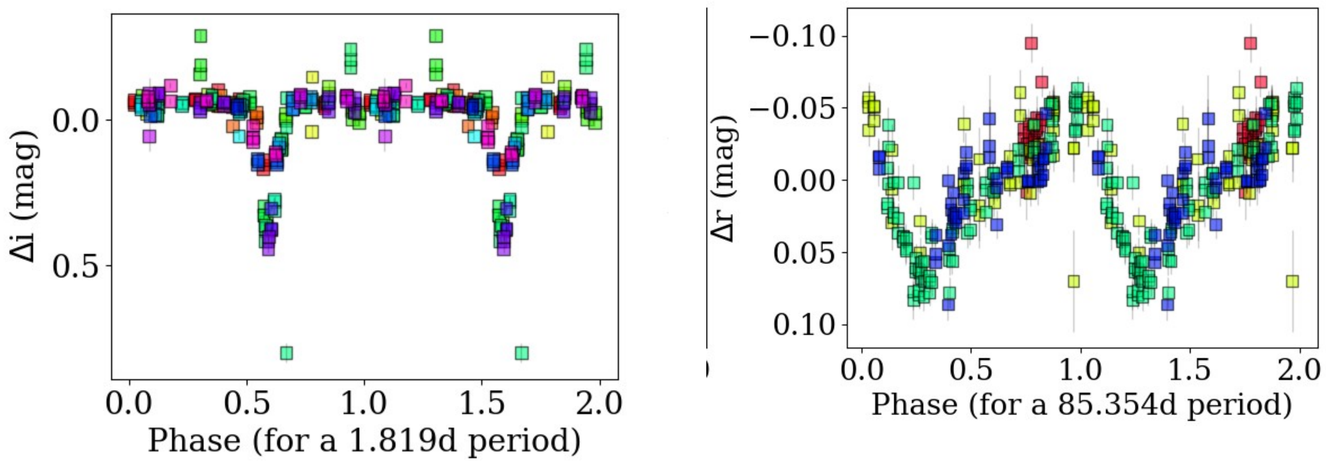

Fig 5. Left shows an eclipsing binary with its sequential dips in magnitude and the right Left shows a long period variable likely to be a giant star.

RESULTS

- Considering the 1st year of data; a total of **2226 variable objects** were obtained and **23% are periodic variables of which 65% are young**.
- The work aims to explore variability of the young stars in Tr37, from accretion variability to rotational variability.
- To explore the causes of variability in these stars and how variability evolves with increase in both age and mass.

References

[1] Pelayo-Baldarrago M. E et al. 2023 ,MNRAS 669,A22
[2] Sicilia-Aguilar et al. 2024, MNRAS 532.2108S
[3] Herbig. 1962, doi = {10.1016/B978-1-4831-9919-1.50006-6},1962AdA&A...1...47H