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Article *in* Proceedings of the International Astronomical Union · August 2018

DOI: 10.1017/S1743921318007998

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KIC 5110739: A new Red Giant in NGC 6819

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Abstract. The *Kepler* Input Catalogue (KIC) misclassified a number of red giant stars as sub giants. This could have resulted from the large uncertainties in the KIC surface gravities. This resulted in 1523 stars which were recently classified as red giant stars. The cluster membership of the 1523 red giant stars was determined using age, distance modulus, and variation of colour magnitude with large frequency separation. We found that one star, KIC 5110739, is a member of NGC 6819.

Keywords. stars: fundamental parameters, stars: mass loss, stars: general

1. Introduction

The *Kepler* input catalog (KIC) misclassified some red giant stars as sub giants (Molenda-Zakowicz et al., 2011) as a result of incorrect KIC surface gravities (Yu et al. 2016). This implies that the KIC stellar parameters of sub giant stars could be significantly biased (Thygesen et al., 2012). This motivated Yu et al. (2016) to analyze 4758 solar-like oscillating sub giant stars in the *Kepler* field, coming up with 1523 red giants. Increase in number of red giants in a cluster may influence the cluster parameters, i.e, distance modulus, age and rate of mass loss. Since stars in the same cluster are formed from a common cloud, they are expected to possess approximately similar properties such as distance modulus and age.

2. Methods and Results

The coordinates, R.A. (J2000) and Dec (J2000), colour magnitudes and continuous photometric *Kepler* data for the 1523 red giant stars were obtained from Multi-mission Archive at Space Telescope (MAST) website†. The stellar coordinates for the sample were compared with the cluster coordinates. Stars that lie in the regions that correspond to the cluster sizes were considered to be probable members of the clusters, respectively. Using this criterion, 21 candidate members of *Kepler* open cluster were obtained.

However, there is a possibility of some stars lying in the field of view (FOV) of a given *Kepler* but when they are actually, relative to the observer, either farther or nearer than the cluster. The distance modulus for each of the 21 red giant stars was determined using Equation (12) of Wu et al., 2014a.

Comparisons were made between the values of distance modulus for the 21 candidate members and the available confirmed members of the respective *Kepler* clusters. The stars with distance modulus within the range of the confirmed members were considered to be members of those clusters. This resulted into KIC: 2303304, 2438069 and 2439420 as the only candidate members of NGC 6791 (8.0 ± 0.4 Gyr) (Wu et al., 2014b) and 5110739 and 5113985 for NGC 6819 (2.5 ± 0.05 Gyr) (Balona et al., 2013).

† *https://archive.stsci.edu/kepler/data_search/search.php*

The 5 stars were over-plotted with the well known red giants on a colour magnitude-large frequency separation diagram. This technique eliminated KIC 2439420 from the group. In addition, using isochrone fitting, the ages of KIC: 2303304, 2438069, 5110739 and 5113985 were found to be 0.60, 0.77, 2.45 and 2.90 Gyr, respectively. This confirmed KIC 5110739, the only star from the RG catalog by Yu et al. (2016), as a member of the *Kepler* open cluster NGC 6819.

With high quality continuous photometric *Kepler* data, we observed that KIC 5110739 pulsates stochastically and the solar-like oscillation are clearly manifested in its power density spectrum represented in Figure 1.

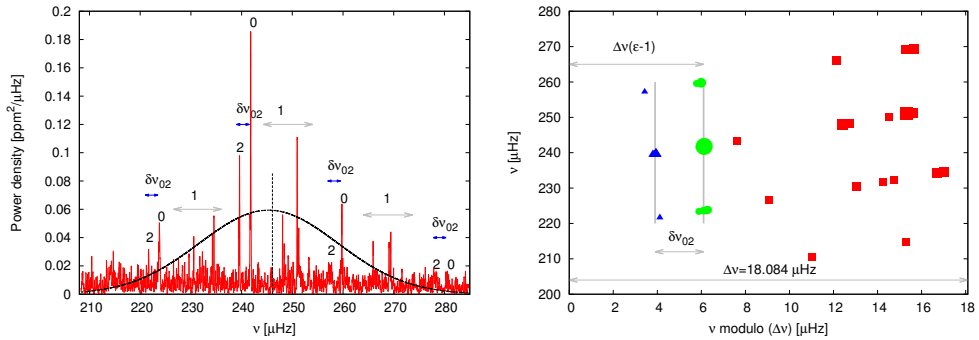

Figure 1. Left: the power density spectrum of KIC 5110739 indicating oscillations. The black dashed curve shows a heavily smoothed power spectrum indicating the power excess envelope of the solar-like oscillations. The black dashed vertical line represents $\nu_{\rm max}$ = 246.08 νHz. The numbers indicate the degree, l, of the modes and $\delta\nu_{02}$ represent the small frequency separation ($\sim$ 2.4 νHz). Right: Echelle diagram of KIC 5110739 showing the frequencies (red squares, green points and blue triangles) as determined from the power spectrum: modes with $l = 0$, $l = 1$, and $l = 2$ are represented with circles, squares and triangles, respectively.

With an intention of knowing whether KIC 5110739 is on the RGB or RGC, its echelle diagram was drawn (Figure 1). Using frequencies with $l = 1$ the period spacing (ΔP=2.42 s) was calculated which confirms KIC 5110739 to be on the RGB (Balona, 2010).

3. Conclusions

KIC 5110739 is the only star confirmed as a cluster member (NGC 6819) by all the three criteria. Being the only star of the 1523 previously misclassified red giant stars, we think that its effect on the cluster parameters could be insignificant.

Acknowledgments

The International Science Program (ISP) from Uppsala University in Sweden for funding the study. The *Kepler* team for generously making data publicly available.

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