

CANDIDATE FOR PERIOD DOUBLING EFFECT IN BLAZHKO MODULATED RRC CANDIDATE FROM OGLE-IV SURVEY

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INTRODUCTION

Classical pulsators such as RR Lyrae stars are known to exhibit quasi-periodic modulation of pulsation amplitude and phase known as Blazhko effect, discovered in 1907. A century has passed after its discovery but its cause still remains to be a mystery. In recent years, another dynamical effect known as period doubling was observationally established in Blazhko modulated fundamental mode RR Lyrae (RRab) stars. In the light curves, it is manifested by alternating maxima over cycles and in the frequency domain as peaks at half-integer frequencies of the radial mode. So is there a connection between the Blazhko effect and the period doubling phenomenon? Yes, quite intimately connected, as an analysis of amplitude equations and current hydrodynamical models propose a 9:2 resonance between the fundamental mode and the 9th overtone mode (Buchler Kollath (2011)) as the cause of both phenomena: period doubling and Blazhko modulation. May a similar mechanism operate in modulated first overtone (RRC) stars?

Here, we report a detection of period doubling signature in a Blazhko RRC star from the OGLE-IV survey of the Galactic bulge sample by Netzel et al. (2018). The candidate has a pulsation period (P_{10}) of ~ 0.254 d and a modulation period (P_B) of ~ 12.446 d. Successive pre-whitening analysis results in a frequency peak at half integer of the radial mode, indicating period doubling. However, it is a low amplitude signal to observe any manifestation directly in the light curve. We also present frequency analysis of *Kepler* observations of KIC 4484128, which is a well established modulated fundamental mode RR Lyrae star with period doubling effect, to show the correspondence with our candidate.

LIGHT CURVE AND FOURIER PARAMETERS

The photometry data consists of 8 seasons of observation spanning ~ 3000 days (see Fig. 1). Frequency analysis gives the first overtone mode with period 0.25388 days. We compare the fourier parameters $R_{21}, \phi_{21}, R_{31}$ and ϕ_{31} with literature Magellanic and Galactic fields (Soszynski et al. (2014, 2019)) and find them consistent with the bulge classification (see Fig. 2). So we move on with frequency analysis and the pre-whitening analysis shows already confirmed Blazhko modulation of 12.44562 days. The frequency solution obtained is listed in the table provided. After adding radial mode and its harmonics along with modulation peaks, we detect frequency peaks around half-integer of the first overtone radial mode (see Fig. 4).

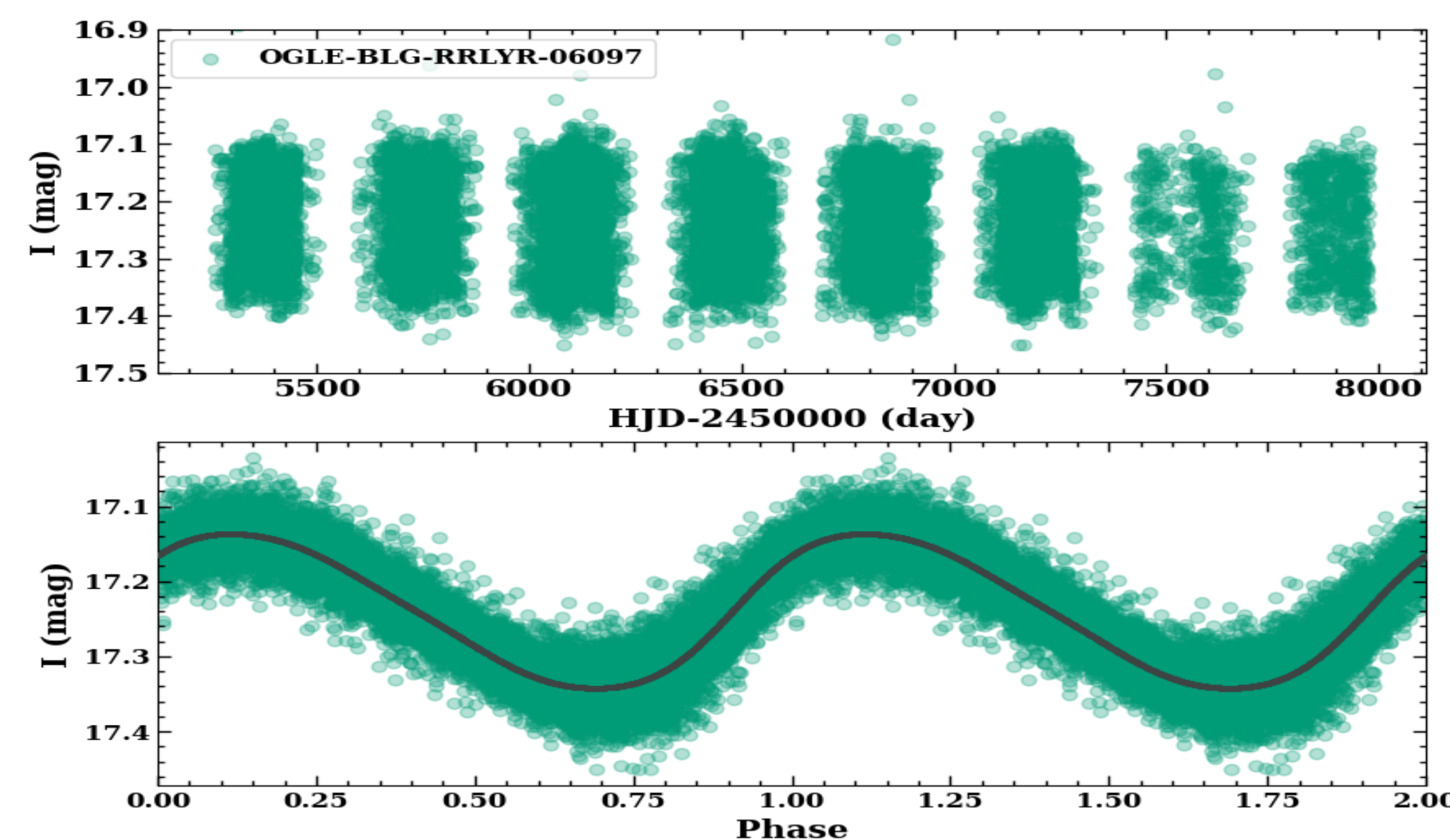


Fig. 1: Photometry data and phased light curve for OGLE-BLG-RRLYR-06097.

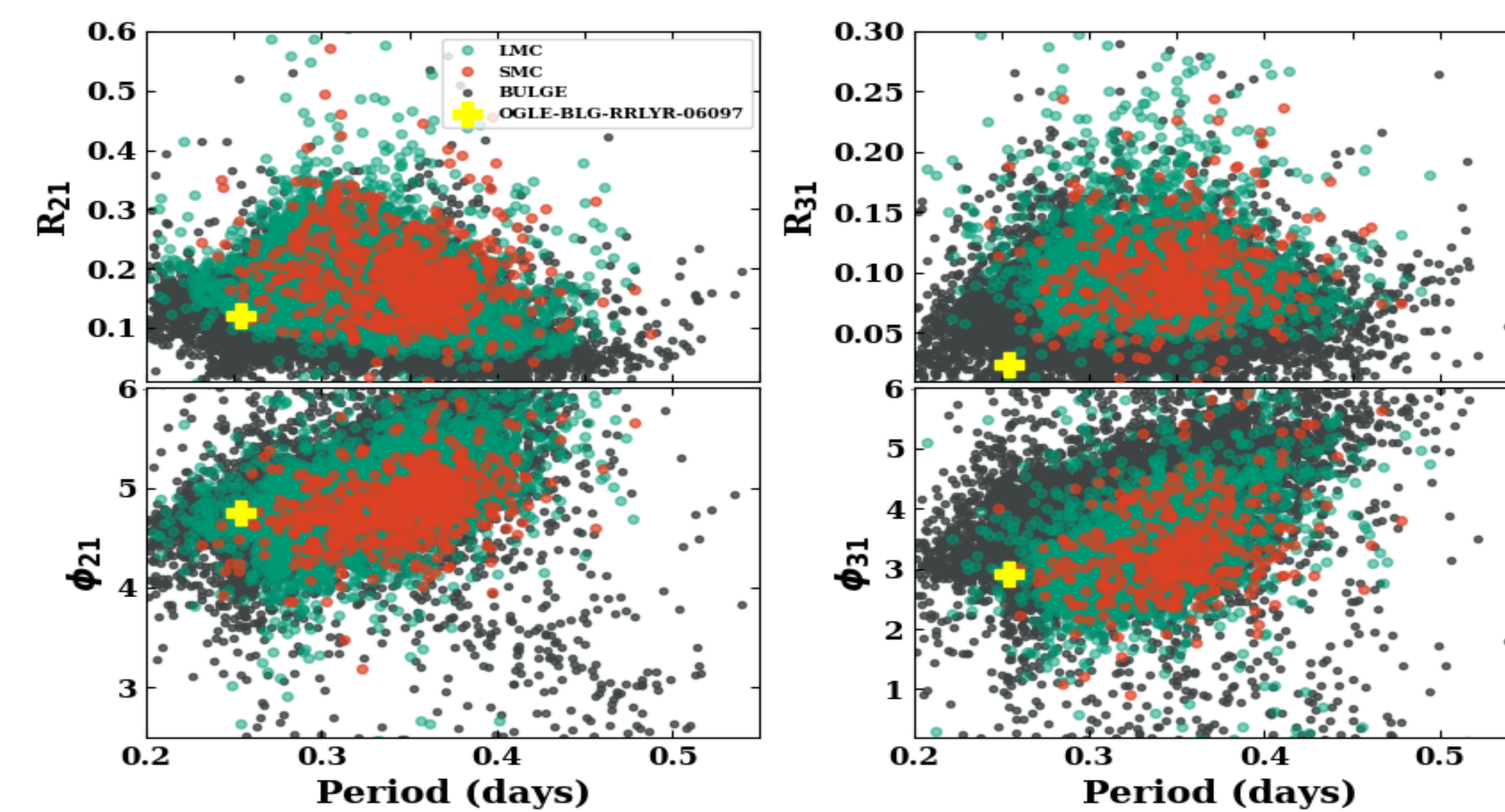


Fig. 2: Comparison of Fourier parameters of OGLE-BLG-RRLYR-06097 with literature RRC stars

FREQUENCY ANALYSIS

After pre-whitening the peaks corresponding to radial mode and its harmonics, revealed side-peaks around the radial modes corresponding to Blazhko modulation. After pre-whitening them, couple of peaks appear which neither have any radial interpretation nor any Blazhko modulation. Some of the low frequency peaks had slightly higher S/N compared to the half-integer peak, but none of them corresponded any alias of the subharmonic peak, hence indicating it is likely real. We show its correspondence with *Kepler* star KIC 4484128 as shown in Fig. 3.

Frequency (d^{-1})	Amplitude (mag)	Interpretation
3.93888876	0.1036	ν_{10}
4.01923832	0.0162	$\nu_{10} + \nu_m$
3.85853919	0.0115	$\nu_{10} - \nu_m$
7.87777752	0.0131	$2\nu_{10}$
7.95812708	0.0043	$2\nu_{10} + \nu_m$
7.79742795	0.0026	$2\nu_{10} - \nu_m$
11.81666628	0.0027	$3\nu_{10}$
11.89701584	0.0013	$3\nu_{10} + \nu_m$

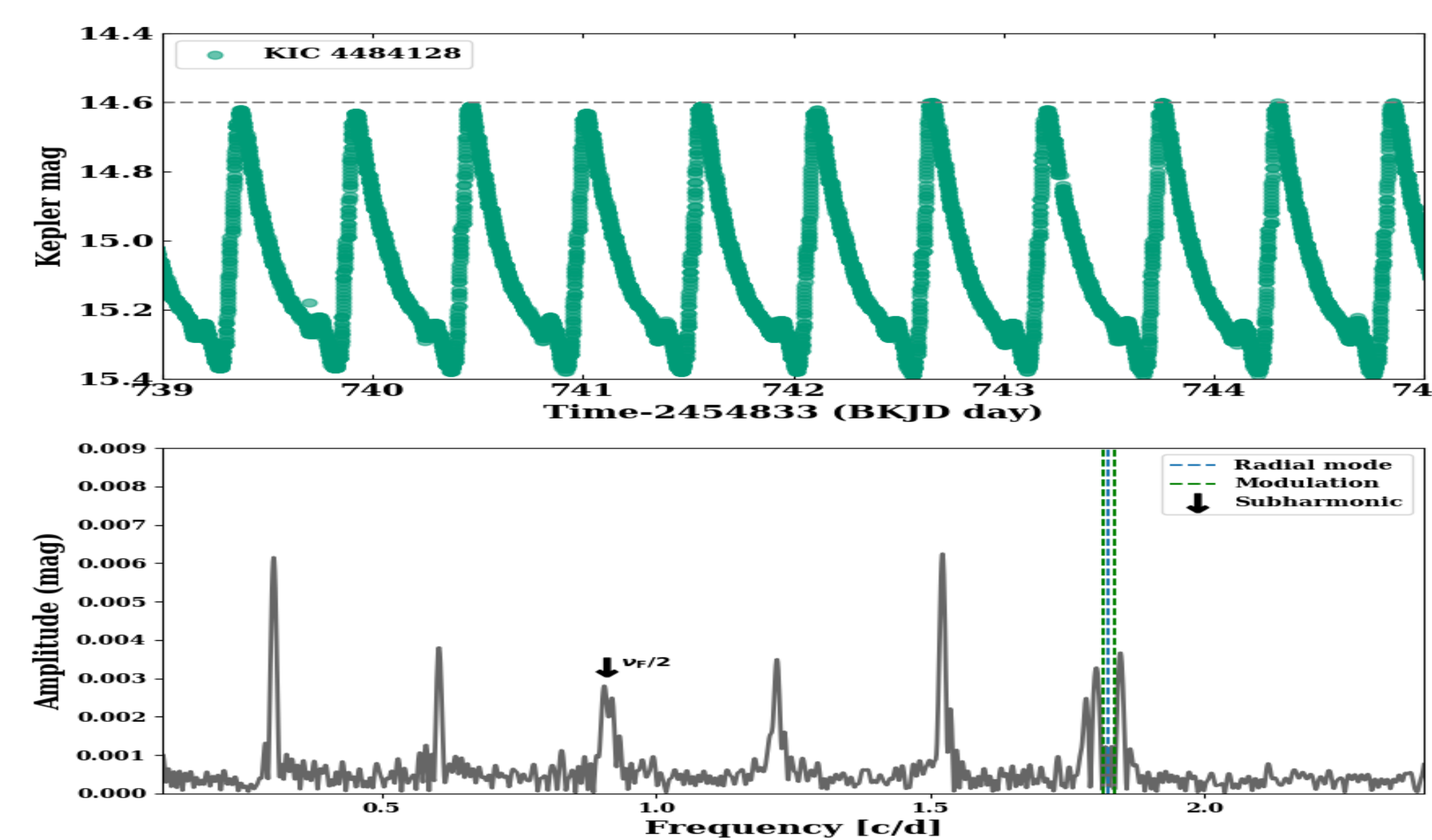


Fig. 3: Comparison star KIC 4484128 show alternating maxima in the light curve (top panel) and subharmonic peak in the frequency spectra (bottom panel).

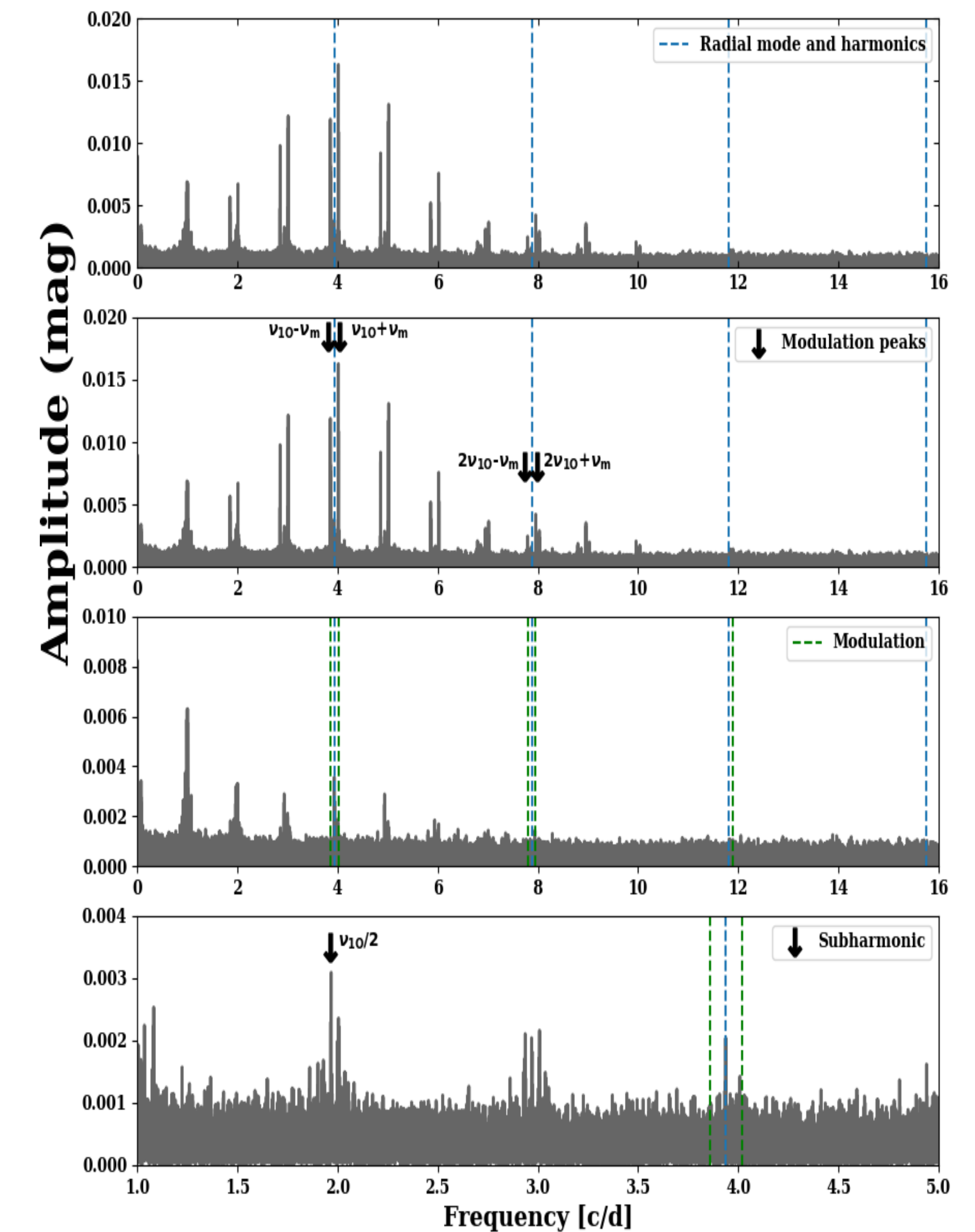


Fig. 4: Frequency spectra of OGLE-BLG-RRLYR-06097 showing pre-whitening steps.

CONCLUSION

We present a case for period doubling RRC candidate, OGLE-BLG-RRLYR-06097. To show the correspondence, we compare it with a confirmed fundamental mode, period doubling *Kepler* star KIC 4484128. As a consequence, a period doubled modulated RRC star finding may indicate that a similar mechanism may be responsible for Blazhko modulation, namely half-integer resonance, as in fundamental mode (RRab) stars.

ACKNOWLEDGEMENT and REFERENCES

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