A preliminary study of the RR Lyrae stars observed in *K2* Campaign 3

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Abstract. We have started a comprehensive analysis of the *Kepler K2* Field 3 data set. Our goals are to assess the statistics of the sample, and to search for peculiar stars. We found a candidate triple-mode RRab star, where the first and ninth overtones also seem to be excited.

1. The data sets of *K2* Field 3

The *Kepler K2* mission observed 79 fundamental and 1 first overtone RR Lyrae variables in Field 3 for 69.2 days. Our goals are to investigate the Blazhko periods and examine the properties and occurrences of the various additional modes.

The large number of stars in this sample gives us the opportunity to describe the abundance of each pulsation mode. To do this we need to investigate the reliability of the Field 3 data sets, especially the light curves of faint stars and stars close to the edge of the field of view. We summarize the first results in this paper.

At the release of *K2* Field 3 data, NASA published two kinds of automatically generated light curves for long cadence targets. The first type was created with single aperture photometry. The second type used the same aperture, but the light curves underwent an optimizing and noise reducing method (PDCSAP). In the first part of the investigation we used these latter data.

Within Field 3 there are many PDCSAP light curves which frequently contain large and sudden jumps. The most determinative parameter is the distance of the star from the center of the field of view. The movement of the star’s photocenter position is only 0.2-0.3 pixel near the center, but this could be more than 2 pixels at the edge. Therefore in many cases the simple pixel photometry was impractical, because the PSF can move out from the mask or another star could contaminate it (especially in dense fields). This was the reason why we did our own photometry on the stars in many cases, occasionally using more than one aperture. Because of the large number of stars in this sample we hoped for finding some peculiar targets as well. Here we present one such case.
2. The possible FM-O1-O9 triple mode star EPIC 206280713

The Fourier spectrum of the PDCSAP light curve shows one peak slightly above $1.5f_0$. The original light curve does not show Blazhko modulation. We created our own tailor-made pixel photometry for the star with PyKE (Still & Barclay 2012), which suggests that this star is in fact a Blazhko star with a low-amplitude and long-period modulation.

The frequency spectrum of the light curve confirms the peak at $1.5f_0$ and clearly shows peaks on $0.5f_0$ and $2.5f_0$, the signs of period doubling. The most important discovery is the low-amplitude first overtone signal ($f_0/f_1 = 0.7370$; $P_0 = 0.48146$ day, $P_1 = 0.35486$ day) and its linear combinations with the fundamental mode. The frequency spectrum of EPIC 206280713 closely resembles that of RR Lyr itself, and provides another opportunity for comparison with triple-mode non-linear hydrodynamic model calculations (Molnár et al. 2012). These periods put the star in the same region in the Petersen diagram where the modulated double-mode stars are also located (Jurcsik et al. 2015; Smolec et al. 2015).

![Figure 1. Fourier-spectrum of the tailor-made photometry. Black arrow: the possible first overtone. Red arrows: peaks at $0.5f_0$, $1.5f_0$, $2.5f_0$. Blue arrows: the linear combinations of $f_0$ and $f_1$.](image)

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