K2 photometry of bright Pleiades and Hyades Stars

Timothy R. White, Georg-August-Universität Göttingen

We propose a pilot study to perform K2 photometry on bright ($Kp < 5.5$) targets using a small number of unsaturated pixels. The test will be performed on nine 3–5 mag B-stars and red giants in the Pleiades and Hyades open clusters, at a pixel cost equivalent to ~48 12th mag stars. If successful, this technique will open an unprecedented window for K2 to study the interiors of bright stars with exceptionally well determined fundamental properties.

Science Justification

The naked-eye Pleiades and Hyades members are some of the most well-studied stars in the night sky. However, time series data have so far been subject to the limitations impososed by ground-based observing. K2 observations of these stars provides a unique opportunity to address two key science goals:

- Red-giant asteroseismology relies on empirical relations to infer radii, masses, and hence ages. The Hyades giants have measured angular diameters and parallaxes to ~1%, making them exceptional benchmark stars to test these relation. This is particular important for galactic archeology studies, one of the key science components of the K2 mission.
- Pulsating B-type stars on the Main Sequence are keys to the calibration of stellar structure and evolution models of massive stars. Their lifetime is strongly influenced by internal mixing processes, such as core overshooting and internal differential rotation. These processes are poorly understood, but asteroseismic modelling of the B stars in the Pleiades can provide the much needed observational input to refine theory.

If the technique is proven successful, it can be applied to other bright targets in later campaigns.

Technical approach and methodology

With magnitudes ranging from Kp 3–5, capturing the entirety of the flux from these stars is either extremely pixel expensive or impossible owing to very extended bleed column. We propose an alternative, low-cost method for measuring oscillations in these stars using 40 x 20 (width x height) pixel masks centered on each star. The total pixel cost is equivalent to only ~48 12th magnitude stars. The method works by measuring the stellar oscillations from unsaturated pixels within the mask. Saturated pixels are discarded, with the remainder included in a weighted sum. The weights are varied to minimize instrumental effects, particularly telescope drifts. Figure 1 shows this method successfully applied to a classically pulsating star observed during K2 Campaign 0, with a similar power spectrum to what could be expected for the Pleiades B stars.

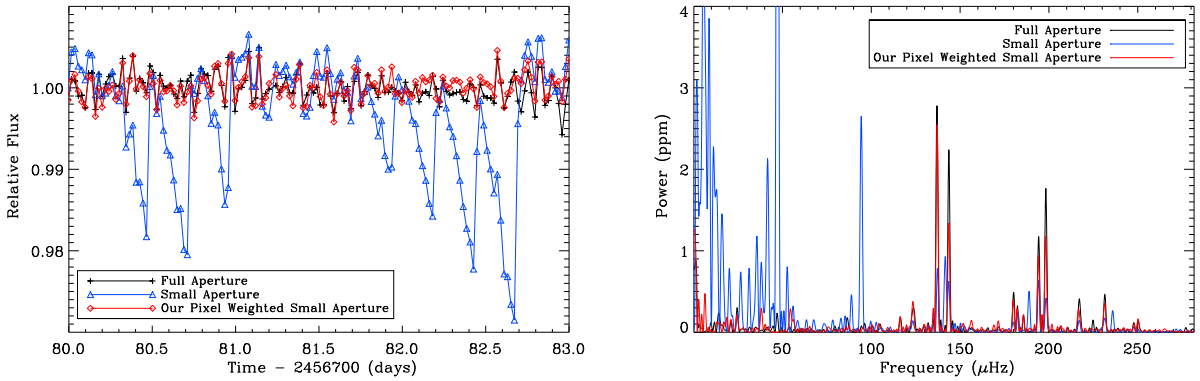

Figure 1: *Left:* Time series of a $Kp = 12.6$ classical pulsator, EPIC 202065874, observed during K2 Campaign 0. The black light curve is from an aperture large enough to capture all the stellar flux, while the blue light curve is from a smaller aperture that exhibits instrumental drifts as the star moves in and out of the aperture. The red light curve shows a correction made to the blue light curve by appropriately weighting the contribution from each pixel to the sum. *Right:* Power spectra corresponding to the time series on the left. Differences between black and red power spectra are minor. The red power spectrum is a significant improvement over the blue power spectrum, particularly with respect to removing the signal from the telescope drift at 46.3 μHz, and its harmonics.

Targets

EPIC	Name	Kp (mag)	Cluster
210513001	γ Tau	3.474	Hyades
210640801	δ^1 Tau	3.585	Hyades
211070770	Alcyone (η Tau)	2.986	Pleiades
211067718	Atlas (27 Tau)	3.763	Pleiades
211071265	Electra (17 Tau)	3.851	Pleiades
211061086	Maia (20 Tau)	4.305	Pleiades
211061086	Merope (23 Tau)	4.305	Pleiades
211093973	Taygeta (19 Tau)	4.448	Pleiades
211072686	Pleione (28 Tau)	5.192	Pleiades