

KARMENES Short Cadence (Fields 2 & 3):

M dwarfs as hosts of close-in planets and pulsations

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Summary

We propose short cadence observations of a selection of 13 M dwarfs (5 for Field 2 and 8 for Field 3) from the CARMENES spectrograph input catalog (CARMENCITA) and the Exoplanets database (<http://exoplanet.eu/>) with the aim of detecting close-in planets with orbital periods of only a few hours, and pulsations predicted to be in the 20 minutes to 3 hours range.

Scientific Justification

In the last few years, M dwarfs have been the objects of desire regarding the search of exoplanets resembling as much as possible our own Earth. The reasons behind it are the more favorable planet-star mass ratio to detect the gravitational pull via Doppler shifts and the increase in transit probability, due to planets being closer to the small host M dwarf. This increase in transit probability is emphasized for close-in planets with orbital periods of only a few hours and corresponding shorter semi major axis. Nowadays, there are six confirmed exoplanets with periods shorter than half a day and 0.5 to 1.5 Earth radii (*Sanchís-Ojeda et al. 2013, ApJ, 775, 54; Batalha et al. 2011, ApJ, 729, 27; Charpinet et al. 2011, Nature, 480, 496*), two of which orbit M dwarfs: KOI-1843b (*Ofir and Dreizler 2013, A&A, 555, A58*) and Kepler-42c (*Muirhead et al. 2012, ApJ, 747, 144*). The physical nature of these newly discovered objects, suspected to be common, is a matter of debate and finding more objects to test the class and its role in the planet formation scenarios is crucial, and the object of this proposal.

The traditional sampling long cadences of exoplanets searches are inadequate for the detection of short period signals, as the one we aim here. Therefore, we request 1 minute cadence observations of 13 targets selected to be the brightest in the field: 8 from the CARMENES spectrograph input catalog (CARMENCITA; *Caballero et al. 2013, Protostars and Planets VI, Heidelberg*) and 5 from the Exoplanets database.

The short cadence observations required have a twofold objective as they naturally combine synergies with the search for pulsations around M dwarfs. The theoretical instability strip of M dwarfs has been predicted (*Rodríguez-López et al. 2014, MNRAS, 438, 2371*) for M dwarfs in the main sequence with $T_{\text{eff}} [3300, 4300]\text{K}$ and $\log g [4.5, 5.1]$, where most of the proposed targets lie, to show periods in the 20 minutes to 3 hours range. Amplitudes are unknown but expected to be in the ppm regime. Therefore, short cadence observations with a large baseline are essential to be able to detect the shortest periods and low amplitudes. The discovery of the first pulsating M dwarf would be a breakthrough, allowing the independent precise determination of critical parameters of the star and of the possible planets.

Target Sample

All targets have an EPIC identification as given in the attached .xls tables. Their Kepler magnitudes span the 6.6 - 13.2 range. From our previous Fourier time-series analysis of Kepler M dwarfs in short cadence (*Rodríguez-López et al. in preparation*), a detection limit of 20ppm is already attained for a $K_p \text{ mag}=13.8$ with 1 month of observations. All the selected targets are bright enough in the optical red and nIR to allow RV follow up with enough precision.

Should null results in planets discovery or pulsations be obtained, the data would still produce very useful science to be exploited within CARMENES consortium through the characterization of photometric variability due to flares and magnetic activity modulated by stellar rotation.