Time-frequency analysis of HD 179436 and HD 179466 using the wavelet transform.

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Abstract

δ Scuti stars are intermediate-mass stars (i.e. between 1.5 and 3 solar masses) pulsators located in the classical Cepheids instability strip, either in their pre-main sequence stage, or already in the main sequence or also moving from the main sequence to the giant branch. Their spectral types range from A to F. Before the era of space telescopes, these stars were thought to have a small number of pulsating frequencies, but with the data coming from space missions like CoRoT, Kepler, TESS, etc., it has been found that there are some δ Scuti stars with hundreds of pulsation frequencies. In the last years, some authors found an amplitude modulation in a few δ Scuti stars but a time-frequency analysis has not yet been performed up to date. In our work we have chosen the wavelet transform as the more appropriate tool to perform such analysis. Unlike the short time Fourier transform, that uses a fixed windows size, the wavelet transform uses short windows at high frequencies and long windows at low frequencies, making it like an adaptive analysis tool. The wavelet analysis relies on the use of a mother wavelet, i.e. a wave-like function of finite energy that can be scaled and shifted in a way that conserves the energy, so it can correlate with the variations on the signal, thus providing a measure of the instantaneous frequencies of the signal. In our work, we analyse the stability of the pulsation frequencies of the δ Scuti stars HD 179436 and HD 179466. The results show that some frequencies are stable, at least within the observation run time, although some others show some kind of variation.

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