Kepler sheds new and unprecedented light on the variability of a blue supergiant: gravity waves in the O9.5Iab star HD 188209

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Stellar evolution models are most uncertain for evolved massive stars. Asteroseismology based on high-precision uninterrupted space photometry has become a new way to test the outcome of stellar evolution theory and was recently applied to a multitude of stars, but not yet to massive evolved supergiants.Our aim is to detect, analyse and interpret the photospheric and wind variability of the O9.5Iab star HD 188209 from Kepler space photometry and long-term high-resolution spectroscopy. We used Kepler scattered-light photometry obtained by the nominal mission during 1460d to deduce the photometric variability of this O-type supergiant. In addition, we assembled and analysed high-resolution high signal-to-noise spectroscopy taken with four spectrographs during some 1800d to interpret the temporal spectroscopic variability of the star. The variability of this blue supergiant derived from the scattered-light space photometry is in full in agreement with the one found in the ground-based spectroscopy. We find significant low-frequency variability that is consistently detected in all spectral lines of HD 188209. The photospheric variability propagates into the wind, where it has similar frequencies but slightly higher amplitudes. The morphology of the frequency spectra derived from the long-term photometry and spectroscopy points towards a spectrum of travelling waves with frequency values in the range expected for an evolved O-type star. Convectively-driven internal gravity waves excited in the stellar interior offer the most plausible explanation of the detected variability.

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