On the use of the Fourier Transform to determine the projected rotational velocity of line-profile variable B stars

C. Aerts, S. Simon-Diaz, P. G. Groot, P. Degroote

Institute of Astronomy, KULeuven, Belgium

Dept. of Astrophysics, IMAPP, Radboud University Nijmegen, the Netherlands

Instituto de Astrofisica de Canarias, 38200, La Laguna, Tenerife, Spain

Departamento de Astrofisica, Universidad de La Laguna, 38205, La Laguna, Tenerife, Spain

The Fourier Transform method is a popular tool to derive the rotational velocities of stars from their spectral line profiles. However, its domain of validity does not include line-profile variables with time-dependent profiles. We investigate the performance of the method for such cases, by interpreting the line-profile variations of spotted B stars, and of pulsating B stars, as if their spectral lines were caused by uniform surface rotation along with macroturbulence. We perform time-series analysis and harmonic least-squares fitting of various line diagnostics and of the outcome of several implementations of the Fourier Transform method. We find that the projected rotational velocities derived from the Fourier Transform vary appreciably during the pulsation cycle whenever the pulsational and rotational velocity fields are of similar magnitude. The macroturbulent velocities derived while ignoring the pulsations can vary with tens of km/s during the pulsation cycle. The temporal behaviour of the deduced rotational and macroturbulent velocities are in antiphase with each other. The rotational velocity is in phase with the second moment of the line profiles. The application of the Fourier method to stars with considerable pulsational line broadening may lead to an appreciable spread in the values of the rotation velocity, and, by implication, of the deduced value of the macroturbulence. These two quantities should therefore not be derived from single snapshot spectra if the aim is to use them as a solid diagnostic for the evaluation of stellar evolution models of slow to moderate rotators.

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Comments:

Email: conny.aerts@ster.kuleuven.be