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The CARMENES search for exoplanets around M dwarfs. Guaranteed time observations Data Release 1 (2016-2020)

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Abstract

The CARMENES instrument was conceived to deliver high-accuracy radial velocity (RV) measurements with long-term stability to search for temperate rocky planets around a sample of nearby cool stars. The broad wavelength coverage was designed to provide a range of stellar activity indicators to assess the nature of potential RV signals and to provide valuable spectral information to help characterise the stellar targets. The CARMENES Data Release 1 (DR1) makes public all observations obtained during the CARMENES guaranteed time observations, which ran from 2016 to 2020 and collected 19,633 spectra for a sample of 362 targets. The CARMENES survey target selection was aimed at minimising biases, and about 70% of all known M dwarfs within 10 pc and accessible from Calar Alto were included. The data were pipeline-processed, and high-level data products, including 18,642 precise RVs for 345 targets, were derived. Time series data of spectroscopic activity indicators were also obtained. We discuss the characteristics of the CARMENES data, the statistical properties of the stellar sample, and the spectroscopic measurements. We show examples of the use of CARMENES data and provide a contextual view of the exoplanet population revealed by the survey, including 33 new planets, 17 re-analysed planets, and 26 confirmed planets from transiting candidate follow-up. A subsample of 238 targets was used to derive updated planet occurrence rates, yielding an overall average of 1.44+/-0.20 planets with 1 M_Earth < M sin i < 1000 M_Earth and 1 d < P_orb < 1000 d per star, and indicating that nearly every M dwarf hosts at least one planet. CARMENES data have proven very useful for identifying and measuring planetary companions as well as for additional applications, such as the determination of stellar properties, the characterisation of stellar activity, and the study of exoplanet atmospheres.

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