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Optical Design of Bifurcated Light Coronagraph and Ultrafast Raman Spectrometer

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Optical design tools are challenging but a cornerstone for optimal and high-quality constructions of optical systems. This work presents a design of a Bifurcated Light Optical Coronograph for interferometry applications in a large-scale telescope and the design and construction of an Ultrafast Raman spectrometer. The novel telescope was designed to detect exoplanets both, indirectly (with radial velocity and astrometry techniques) and directly with advanced spectroscopy, using a HOE as a primary objective, with a bandpass function. The Coronograph is the major part of the exoplanet telescope designed by using ZEMAX software, where two optical paths are directed from the slit located between the primary and secondary dispersers. By two configurations, a half-wave path difference is established at the host star position and diameter causing phase cancellation at a unique spectral band. The spectral interferometer can be fiber-fed from the near field and far-field due to the implementation of spherical mirrors. Additionally, a reconstruction of a high-resolution double-grating Raman spectrometer was made. In order to capture the Raman spectrum, a CCD camera was implemented and configured using a program built based on C# programming language. It allows recording the intensity of radiation in every pixel of the array and converting this mapping into a spectrum. The spectrometer was designed for ultrafast Raman spectroscopy applications to measure phonons dynamics of iron-based superconductors and vanadium oxides.

Topics

Session A. Physics of condensed matter and spectroscopy

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