Optical Instrumentation of an NIR Spectro-Polarimeter for Planetary Atmospheric Studies

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ABSTRACT

Spectro-polarimetry is a novel way of studying the planetary atmosphere as it gives information about not only the chemical composition of the region of observation but also atmospheric density variation and aerosol distribution. By performing these measurements in different modes of observation such as Nadir view, Limb view and Sun occultation, a density/aerosol profile as a function of altitude is possible from which the planetary atmospheric dynamics can be understood. In this paper, an optical configuration design to perform AOTF (Acousto-Optic Tunable Filter) based spectro-polarimetry is presented.

The optical configuration of the instrument is such that it collects light energy within a FOV of +/-0.5^o and spectrally disperses using RF energized AOTF to get diffracted beams polarized in two mutually perpendicular directions. By splitting the incoming beam into two and rotating the AOTF in the second path by 45^o, two more additional polarization angles are also measured.

Fore optics of the instrument is a combination of refractive telescope and collimator which produces a collimated beam of 5 mm dia. The beam is split into two orthogonal paths with equal intensity to spectrally analyse in different polarization angles with AOTF. Aft optics is designed in such a way that the diffracted beam over wide spectral band of interest (0.9 - 1.7 μm) is collimated and focused within the detector area of a large area InGaAs NIR detector. Since the diffracted beams (e and o) from AOTF are 7.5^o to 8.5^o apart from the central un-diffracted beam, separate detector shall be used for each beam. To ensure the diffracted beam spot is always well within the detector area, optical aberrations are minimized through design and field correction by tilting the detector. The un-diffracted beams are completely absorbed by directing towards a beam dump. Optical glass selection and anti-reflection coatings on optical components shall ensure minimum signal loss due to reflection.

This optical instrumentation design is carried out as part of a science payload viz., Venus Atmospheric Spectro-Polarimeter (VASP) development for ISRO's Venus Orbiter Mission.