RaPTIR: Radio-wave Propagation Through Ionosphere Regions CubeSat Mission

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The ionosphere plays an important role in radio-wave propagation. Lower frequency waves are deflected, and higher frequency waves are degraded in terms of amplitude, phase and polarization. The characteristics of this layer are due largely to solar conditions. The varying solar conditions cause great variability at different daily times, seasons, position and altitudes. Different techniques have been used to measure the ionosphere in the past, but they are limited in spatial coverage and resolution.

This paper presents a mission concept for a CubeSat constellation which collects simultaneous measurements from different spatial positions. With this detailed information it will be possible to better understand ionospheric physics and improve associated models.

RaPTIR will collect LF and HF radio waves transmitted from ground stations like CODAR, AM radios or WWV signals, in the range from 1 to 20 MHz. These signals will be acquired by a 2-meter long STEM antenna, and a High Impedance Amplifier receiver to acquire these high wavelength signals efficiently.

These signals will be processed and compressed on-board, and downlinked. With the foreseen technique it is expected to obtain a daily average of 2 overpasses of 20 minutes each.

The satellites will also incorporate a propulsion system, allowing a variable and controllable separation. A simple maneuver has been studied requiring very low delta-V. Propulsion will be used to characterize the ionosphere spatial variability in a range from 10 to 100 km. It will also be used to extend the orbit lifetime at low altitudes, providing measurements below the hmF2.

The paper includes more details on the most challenging subsystems here summarized, as well as the other subsystems, like communications, data handling, etc. All the mission design supports the very challenging and motivating scientific requirements, in a scalar range not measured until now.