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Earth's transmission spectrum from lunar eclipse observations using CRIRES

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Abstract

Using the echelle spectrograph CRIRES at the VLT telescope in Chile, spectra with resolution 100000 were taken during the Moon eclipse of the 21st of December of 2010. The data have been analysed to obtain the Earth's transmission spectrum, the same it is done with an exoplanet in the near-infrarred.

1. Introduction

Observing the Earth's transmitted spectrum is possible by observing a Moon eclipse. During an eclipse, the sunlight goes through the Earth's atmosphere and is reflected back to the night side of the planet by the Moon. Here, the observations of the Moon eclipse of 21st December 2010, visible from Chile, taken with high-resolution spectroscopy are presented.

The observations were taken with the Very Large Telescope (VLT) placed in Cerro Paranal (Chile), using CRyogenic high-resolution IR Echelle Spectrograph (CRIRES) instrument. CRIRES is an infrarred high-resolution spectrograph which covers wavelengths from 1000nm to 5000nm, with a resolving power of 100000 with a 0.2" slit. The eclipse took place the 21st of December of 2010, between 5:29UT and 11:04UT. It was observed 5:41UT- 7:50UT, with a change in air mass between 1.62 and 2.68, as the Moon was setting. According to HORIZONS's NASA database the partial eclipse started at 6:32UT and the total eclipse at 7:40UT, which means that the observational time was enough to cover all the possible lunar illuminations during the eclipse. The range of wavelenght observed covers from 3804nm to 4063nm, using 3 different central wavelength configurations.

The data were reduced and the spectra extracted using standard IRAF tasks. Half of the slit was positioned over the lunar limb and the other half over the sky, allowing us to correct our spectra from the scattered light contribution.

The final spectra were studied looking for possible variations due to changes in the layer of the atmosphere which the sunlight is crossing. Comparing the evolution of the spectra during the eclipse, we can probe the different layers of Earth's atmosphere (with varying pressure and temperatures) that the sunlight crosses in its path towards the Moon.

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References