On the way!
Modelling sky polarization patterns

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RAYLEIGH MODEL

This model takes in consideration that the light is scattered by a small homogeneous, isotropic, spherical particle whose radious is much smaller than the wavelength of the incidente radiation. The degree off polarization, the fraction of light that is polarized, is given by [1]:

$$\delta = \delta_{max} \frac{\sin^2 \gamma}{1 + \cos^2 \gamma} \, .$$

The term δ_{max} is the maximum value for the Expression which corresponds to 100%. Considering the stokes parameters: I, Q, U and V. This expression for linear degree off polarization is given by [2]:

$$\delta = \frac{\sqrt{Q^2 + U^2}}{I} \, .$$

$\gamma \equiv$ Scattering angle

$$\cos\gamma = \cos\theta_s \cos\theta + \sin\theta_s \sin\theta \cos(\phi_s - \phi)$$

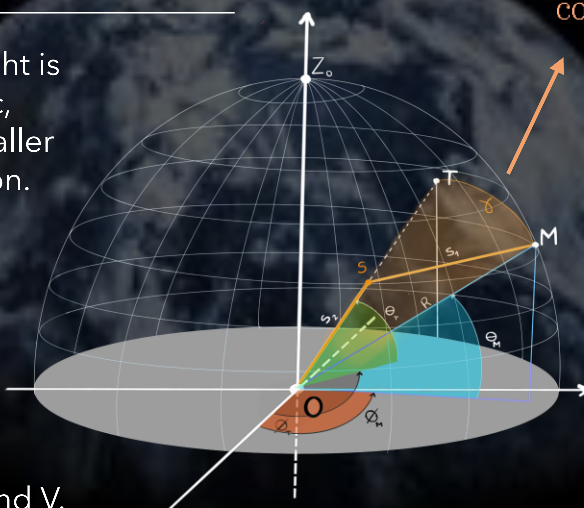

Figure 1 – Scheme for the single scattering in the Earth's Atmosphere.

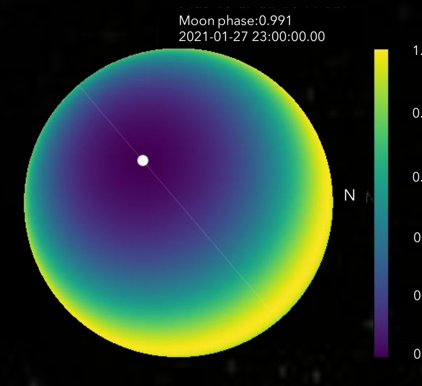

Figure 2 – Simulation based on the Rayleigh Model, with the observer at Paranal. The white dot represents the position

OBSERVATIONS

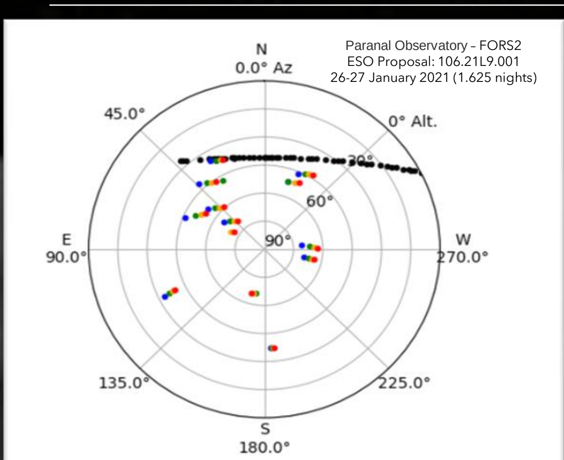

Figure 3 – Resume of the observations. The coloured points represent the position of the fields when observed (blue – B band; green – V band; yellow – R band and red – I band) and in black its represented the Moon position.

Our team performed some polarimetric observation on some blank fields in four bands, which are resumed in the plot on the left. In the first stages of the study, we compare the observations data with the Rayleigh model.
The simple plots bellow, show that the data have some affinity with the model. Although there is **a difference in magnitude** in the degree of polarization compared to the model, a **wavelength dependency** in the scattering intensity is observed. That, in part, can be explained by the wavelength dependency on the **Moon's albedo**.
There is also a need to add a term due to the time of data acquisition. It is essential to consider that different conditions of observations can alter the data behaviour.

Increasing the wavelenght

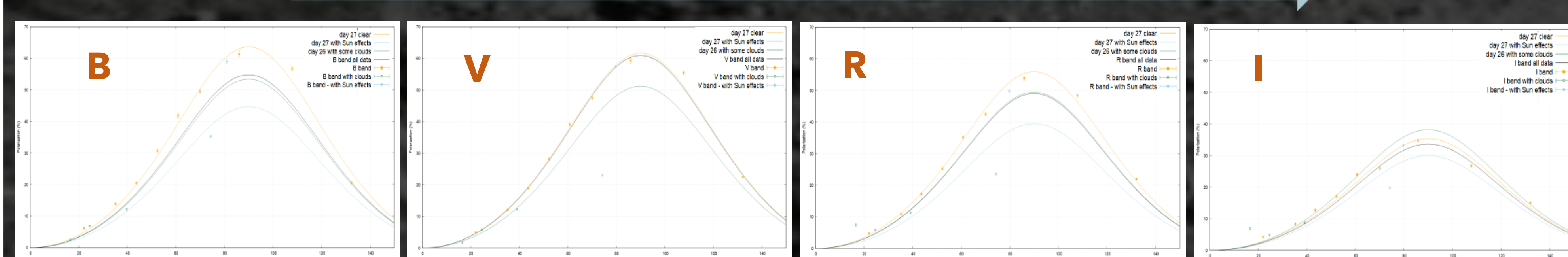

Figure 4 – Set of plots containing fits for the Rayleigh model for the respective band.

NEXT CHAPTER

Observations, such as the work of Horváth in 2004 [3], show more than two singularities or points where light is not polarized. The implementation of a multiple scattering model is done assuming that the total intensity scattered will be the sum of all the single scattering phenomenons' contributions in the light's path [4].
Some years after an empirical model for polarization was constructed, as in Berry's work. The degree of polarization is the module of *w* given by the following equation [5]:

$$w(\xi) = \frac{(\xi - \xi_+)(\xi - \xi_-)\left(\xi + \frac{1}{\xi_+^*}\right)\left(\xi + \frac{1}{\xi_-^*}\right)}{(1 + r^2)^2 \left|\xi_+ + \frac{1}{\xi_+^*}\right| \left|\xi_- + \frac{1}{\xi_-^*}\right|} \, .$$

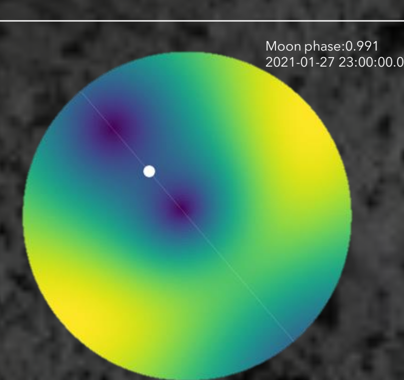

Figure 5 – Simulation based on the multiple scattering, with the observer at Paranal. The white dot represents the Moon's position.

Where we can describe the arbitrary points of observation with the coordinates of the light's source :

$$\xi_- = \frac{x_s - Lcos(\varphi_s)}{1 + Lcos(\varphi_s)x_s} + \frac{y_s - Lsin(\varphi_s)}{1 + Lsin(\varphi_s)y_s} i \, , \quad \xi_+ = \frac{x_s + Lcos(\varphi_s)}{1 - Lcos(\varphi_s)x_s} + \frac{y_s + Lsin(\varphi_s)}{1 - Lsin(\varphi_s)y_s} i \, .$$

The determination of L, the parameter that describes the degeneration of two singularities is leading us to understand how the the atmosphere and Sun can influence the scattering

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