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Bi-chromatic scintillation observed by GOMOS on ENVISAT: Results from statistical analyses

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The scintillations of stars observed through the Earth atmosphere are generated by random irregularities of air density. In this talk, we propose the qualitative theory for description of the coherency spectra of optical scintillations measured at two wavelengths.

The main reason of coherency reduction is the dependence of the refractive index on wavelength. The theoretical approach is based on two-component model of the air density irregularities. The one of the components is generated by locally isotropic turbulence. The second, anisotropic one is a consequence of the internal gravity waves activity. The main conclusion of the developed theory is that chromatic aberration results in low coherency of isotropic scintillations

The scintillations measured by GOMOS fast photometers on board the ENVISAT satellite have confirmed the theoretical conclusions. Synchronous observations at wavelength 675 and 495 nm have allowed detecting the layers with small coherence. They are located generally between altitudes 30- 40 km. The thickness of the layers and their altitude distribution depend on observation location. It is expected that the locally isotropic turbulence is well developed within these layers.

The coherency spectra visualize the regions of high coherency where the anisotropic irregularities dominate. The intensity of the isotropic turbulence is not sufficient for breaking the structures generated by internal waves. The altitude dependence of the characteristic wave numbers corresponding to buoyancy scales and to outer scale is seen within these highly coherent layers.

We show that the low values of the maximum of the cross-correlation function of two-

wavelength scintillations can be used as a qualitative indicator of presence of layers with prevailed isotropic turbulence.

The obtained results showed that the analysis of two-wavelength coherency spectra is a sensitive approach which allows studying separately the locally isotropic and the stretched along the Earth surface air density irregularities in the stratosphere. Further analysis of the GOMOS scintillation data will give information about global distribution and power of the stratospheric layers with high intensity of the isotropic turbulence.