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Influence of D and E atmospheric layers on the propagation of radio waves and satellite signals

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The impact of solar activity on the atmosphere has been intensively studied in the United States, Japan, India, China, Australia, Brazil and the leading European countries. It is caused by continuing attempts to establish the nature of sporadic disorders of the global satellite positioning system work. In the N N Semenov Institute of Chemical Physics (Moscow, Russia) on the basis of a detailed analysis of series of experiments conducted at the Cornell University (USA) and in other research centers, has been found a direct link between the UHF incoherent radiation power of the D and E layers of the atmosphere in the decimeter range with the positioning errors. This radiation is due to transitions between the split reactions with a neutral medium characterized by the orbital degenerate Rydberg states, living in a two-temperature recombination plasma. A large number of experimental data on S/N ratio of power and delay of the received GPS signals enabled to create a theory of the ultrahigh-frequency (UHF) signal propagation through the upper atmosphere. This theoretical problem is reduced to the study of the process dynamics and the calculation of intensity and shape of the emission lines. The data are put into the general kinetic scheme establishing a time dependence of the Rydberg particle concentration distribution on height as functions from density, flow of electrons and temperature, composition and temperature of the atmosphere. The obtained results compose an essential component of radio-chemical physics of the Earth's atmosphere as a science on interaction of electromagnetic waves with the resonance quantum medium containing Rydberg molecular complexes that occur in the upper atmosphere (at altitudes of 80-110 km) and are responsible for the delay of satellite constellation signals. The radiative transitions between their states form the additional background incoherent UHF and longwave infrared (IR) radiation that plays an important role in basic research and uses independently in many scientific and technical applications. These studies will allow determining the plasma parameters and the characteristic times of the satellite signals propagation delay at different carrier frequencies simultaneously, i.e. in the same physical conditions. Such data are necessary for effective employment of positioning system as measurement devices.

Biography

Gennady Valentinovich Golubkov is a Professor and Doctor of Physical and Mathematical Science and a Leading scientist of Semenov Institute of Chemical Physics at Russian Academy of Sciences. He is also a specialist in the quantum scattering theory, the theory of atom-molecular processes and elementary chemical reactions, chemical physics of atmosphere and low temperature plasma.

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