

Preface

Chapter 1 discusses the mechanisms of Rydberg state settlement and quenching processes in nonequilibrium two-temperature plasma in the D and E layers of the ionosphere during periods of increased solar activity. The most important of these is the process of I mixing, which leads to the formation of Rydberg particles in orbital degenerated states. Rydberg quasi-molecules are formed from these particles and neutral molecules of the medium. Radiative transitions between states of these quasi-molecules give rise to incoherent additional ultra-high frequency (UHF) radiation over background. The power flux of this radiation is the irregular complicated function of frequency, which depends on plasma parameters. This allows the consideration of such as background noise for satellite-positioning signals. Possible solutions to the elimination of errors in global-positioning satellite systems are discussed.

Chapter 2 is devoted to the analysis of electron ionization and elimination processes at early stages of electric discharges in air at altitudes between 0 at 90 km. In this chapter, ionization processes in an external electric field and background ionization by fast particles, as well as electron attachment and detachment with participation of atomic and molecular oxygen, are considered. Analysis of analytic ionization models allowing simplified approaches to detailed computation models is presented. It is shown that the electric breakdown process in air under the influence of an external electric field represents a complex of several stages that are differently realized with respect to different altitudes over the Earth. In numerical modeling on the basis of the detailed plasma chemical model, it is shown that relaxation processes lead to a nonlinear stage of electric breakdown. The ionization phenomena considered can be realized at natural high-altitude discharges in fields of thunderstorm clouds.

Chapter 3 discusses the physical principles of active and passive methods of remote detection of radioactive substances and toxic agents in the atmosphere as well as the measurement of parameters of regular and/or emergency gas-aerosol emissions and clusters of radioactive and poisoning fragments and microparticles on various surfaces, which provide the means to solve a range of unique problems in environmental monitoring. The analytical possibilities of currently available active

and passive methods of remote control of radioactive and highly toxic substances—which are based on the achievements of infrared (IR) absorption spectroscopy, Raman spectroscopy, fluorescence, laser-induced breakdown spectrometry, THz (sub-THz) spectroscopy, *etc.*—are discussed. Modern trends in the development of active and passive methods of remote detection of radioactive substances and toxic agents for various spectral ranges are analyzed.

Chapters 4 and 5 are devoted to objects that naturally originate in the atmosphere. In Chap. 4, the latest research results on ball lightning (BL) are presented. Descriptions of 46 cases of BL affecting people are presented. Fifty cases of BL occurring inside and near airplanes are described. Cases of BL's interaction with different types of glass (window, mirror) are analyzed, and experimental modeling of BL's influence on different types of glass are presented. Photographic and video data showing traces of natural BL are presented. Theoretical and experimental analysis of a new BL model connected with the oxidation of finely dispersed silicon inside the silicon oxide cover is discussed. The results of experiments on the creation of long-lived fiery spheres on application of erosive capillary discharge at high pressures, in which exploding balls have occurred, is discussed. Computer modeling of "Gatchina" discharge, *i.e.*, discharge above a surface of water, is presented. Chapter 5 considers objects that often appear under the same conditions as BL. These are gelatinous meteors or "star jelly," *i.e.*, Pwdre Ser. Observation data of these natural objects are presented. Hypotheses of their origination is connected with the bacteria blue-green algae and *Pseudomonas* found in clouds.

The Atmosphere and Ionosphere

Elementary Processes, Monitoring, and Ball Lightning

Bychkov, V.L.; Golubkov, G.V.; Nikitin, A.I. (Eds.)

2014, XVIII, 386 p. 136 illus., 70 illus. in color.,

Hardcover

ISBN: 978-3-319-05238-0