Preface

In this book we present the recent advances in the theory of Polarizational Bremsstrahlung (PBrS) of structural particles (atoms, ions, clusters, etc.) as well as of the related phenomena occurring in collisional processes. The first theoretical predictions and experimental evidence of the PBrS phenomenon were made in the 1970–1980s. More reliable quantitative description of this type of radiation has become possible in the last two decades due to the rapid development of computational facilities. Within this period a number of theoretical, numerical, and experimental studies have been performed aimed at better understanding of the process. In this book we review the results of this research as well as of the earlier works in which the key ideas were formulated.

The subject is highly relevant since the phenomena considered in the book have a number of possible applications. Thus, the study of various radiative mechanisms can lead to creation of novel light sources operating in various parts of the electromagnetic spectrum. Analyzing spectral and angular distribution of the photon emission, one can extract information on the interaction of the colliding particles, and on their structure and dynamic internal properties. Accurate quantitative description of the radiative mechanisms allows one to determine radiative energy losses of particles in various media, which is needed, for example, for the plasma diagnostics, astrophysical applications, and medical applications which involve radiation therapy, etc.

The phenomena considered are of fundamental character and of general physical interest.

The material is arranged as follows. In the introductory chapter we describe qualitatively the typical features of PBrS, introduce main concepts and terminology, and present a review of the theoretical and experimental activity in the field. In Chap. 2 we outline the general quantum formalism which is used for theoretical quantitative analysis of the BrS radiation emitted in non-relativistic collisions of charged projectiles with many-electron targets. Specific features of PBrS in collisions with atomic hydrogen (or a hydrogen-like ion) are discussed in Chap. 3. In Chap. 4 we present the results of numerical calculation of spectral and angular distribution of BrS in electron collisions with many-electron atoms. The comparison is carried out on various approximations used for the calculations. BrS emitted in non-relativistic collisions of structural particles (atoms, ions) is discussed in detail in Chap. 5. The peculiarities in the BrS process due to relativistic motion of the projectile particle and/or atomic electrons are analyzed in Chap. 6. Chapter 7 is devoted to PBrS and the related phenomena in electron collisions with metallic clusters and fullerenes.

The atomic system of units, Inline Equation $\hbar = m_e = e = 1$, is used through the book except for Sects. 6.3 and 6.5, where the relativistic system $\hbar = c = 1$ is applied.

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