

SEMICLASSICAL COULOMB APPROXIMATION  
WITH APPLICATION TO SINGLE AND DOUBLE  
K-SHELL IONIZATION IN ION-ATOM COLLISIONS

by

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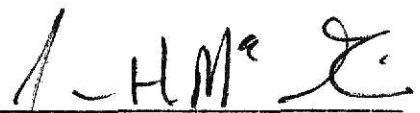
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## CHAPTER 1

### INTRODUCTION

Full understanding of the collision mechanisms of ions and atoms has not been accomplished, neither in atomic physics nor in the application of related fields to atomic physics. The three body collision problem has not been fully solved in atomic physics. Furthermore, much of the research currently conducted in atomic physics deals with collisions between atomic many-particle systems which are inherently more complex than the three body problem.

Atomic ionization, induced by ion-atom collisions, is important in many physical phenomena. For example, an ion-atom collision can result in the ejection of an inner shell electron of a target atom. This results in higher energy electrons of the target atom cascading down to fill the vacancy and the subsequent release of energy in the form of x-rays. This process has broad applications, viz., trace element analysis<sup>1</sup>, x-ray astronomy<sup>2</sup>, and laser technology<sup>3</sup>. Also, ion-atom collisions will result in some energy loss of the projectile by collisional energy loss or by bremsstrahlung<sup>4</sup>. This process adversely affects some fusion reactions for generating energy.

One central, basic question of atomic theory concerns the yet unsolved problem of three charged particles. A systematic method of addressing this problem has yet to be realized, due in part to the obscurity of the features of the collision process in a full quantum treatment. This is analogous to the gravitational three-body problem, as yet unsolved analytically but approximated numerically. Thus, many techniques (perturbation theory, variation methods, asymptotic forms, effective potential, close coupling equations, series expansions, etc.) are required to build the physical picture.