1. INTRODUCTION

The discussion in Chapter II was concerned primarily with the behavior and properties of individual particles in a partially ionized gas. We wish now to turn our attention to the macroscopic behavior of collections of charged particles. These considerations will lead to the introduction of two related fundamental parameters associated with the electrical properties of a partially ionized gas, namely, the Debye length and the plasma frequency. As noted in Sec. II 8, the collective behavior of neighboring charged particles during a collision between two charged particles plays an essential role in the calculation of the charged particle momentum transfer collision cross section. The notion of shielding involved here also enters the description of the ionized gas region, called a sheath, immediately adjacent to a solid surface.

The last three sections of this chapter are concerned with several topics which involve applications of the fundamental concepts introduced earlier. We discuss first the classical theory of electrostatic probes and their use in making measurements of the properties of low-pressure ionized gases. We then discuss some of the concepts involved in the description of collision-dominated ionized gases adjacent to solid surfaces. Finally, we discuss the elementary theory of the propagation of electromagnetic radiation through an ionized gas and how diagnostic information about ionized gases can be inferred from experiments which employ electromagnetic waves.

2. ELECTRICAL NEUTRALITY—THE DEBYE LENGTH

A basic property of a partially ionized gas is its tendency towards electrical neutrality. If over a macroscopic volume the magnitudes of the charge densities of the negative and positive particles differed just slightly, very large electrostatic forces would exist, for which the potential energy per