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A Langmuir probe is a device used to determine the electron temperature, electron density, and electric potential of a plasma. It works by inserting one or more electrodes into a plasma, with a constant or time-varying electric potential between the various electrodes or between them and the surrounding vessel. The measured currents and potentials in this system allow the determination of the physical properties of the plasma.

[Langmuir probe - Wikipedia](#)

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Langmuir probe theory and applications have also become a significant part of contemporary Langmuir probe diagnostics. The author of the present book apologizes if he does not mention in this short essay all the scientists who participated in building the probe diagnostics methods to their contemporary form.

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The Langmuir probe was the first diagnostic tool used for studying plasmas in detail and it is still widely used today. Langmuir probes, in principle, provide a simple and relatively inexpensive diagnostic for measuring the plasma parameters. However, there are a number of issues in the design and interpretation of Langmuir probe characteristics which have led in the past to a wide disparity in measured parameters obtained under similar conditions.

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The Langmuir Probe is the key plasma diagnostic used by scientists interested in plasma characterisation to measure the internal parameters of the bulk of the plasma. Among the key parameters measured are electron density, ion density, electron temperature, plasma potential, floating potential and the electron energy distribution function (EEDF).

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On the other hand, the most widespread use of Langmuir probes at present is in the semiconductor industry, where radiofrequency (rf) sources are used to produce plasmas for etching and deposition. These partially ion- ized plasmas require special techniques in probe construction and theory.

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The Langmuir probe is a small electrode which is submerged in plasma in order to measure the probe current-voltage characteristic. The same characteristic is processed further to derive the electron and ion concentration, the electron distribution function, and the plasma potential at the probe location.

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Langmuir probe diagnostics afford rapid measurements of the electron distribution function and plasma potential at a good time resolution, 10⁻⁸ seconds in a wide range of plasma densities 10⁺³ - 10⁺¹⁴ cm⁻³, and the electron energy from the room temperature to hundreds of electron-volts - qualities which are essential for researchers.

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The collected current by spherical and cylindrical Langmuir probes immersed in an unmagnetized and collisionless non-Maxwellian plasma at rest are theoretically studied, and analytical expressions for the currents of attracted and repelled plasma particles are presented.

[Theory and simulations of spherical and cylindrical ...](#)

The Langmuir probe, a small electrode immersed in the plasma, provides such measurements. However, designing of a Langmuir probe system in a dusty plasma environment demands special consideration. First, the probe has to be miniaturized enough so that its perturbation on the ambient dust structure is minimal.

[Langmuir probe in collisionless and collisional plasma ...](#)

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From flat-panel televisions to thermonuclear fusion for energy production, plasmas currently have numerous and wide applications in sciences and industry. A diversity of plasma diagnostics is available to physicists and engineers to measure and control plasma parameters. Among them, the Langmuir probe is the most inexpensive and most popular instrument and method. The Langmuir probe is a small electrode which is submerged in plasma in order to measure the probe current-voltage characteristic. The same characteristic is processed further to derive the electron and ion concentration, the electron distribution function, and the plasma potential at the probe location. Langmuir probe diagnostics afford rapid measurements of the electron distribution function and plasma potential at a good time resolution, 10⁻⁸ seconds in a wide range of plasma densities 10⁺³ - 10⁺¹⁴ cm⁻³, and the electron energy from the room temperature to hundreds of electron-volts - qualities which are essential for researchers. In view of these facts, Langmuir probe diagnostics are applied very frequently to measuring plasma parameters. This book will be useful in teaching plasma diagnostics to undergraduate and graduate students in plasma physics courses. And it will also serve as a practical reference manual for physicists and engineers working in the growing area of plasma physics. The reader of this book will learn what kind of plasma parameters the Langmuir probe can measure, how to develop the probe diagnostics for specific cases, and how the probe data obtained should be processed to deduce reliable plasma parameters. In this book, the reader can find not only the basic physics information important to understanding the principles of probe operation, but also how the

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"real" probe disturbs plasma, and how it is possible to reconstruct undisturbed plasma parameters with available probe data.

This report develops a unified theoretical representation of the spherical Langmuir probe in a collision dominated weakly ionized gas. The analysis is performed by numerically integrating Poisson's equation and a set of moment equations, derived from the Boltzmann equation, that conserve mass, momentum and energy for electrons and ions. The theory provides for the continuous description of Langmuir probes from collisionless through collision dominated conditions. Numerical techniques are developed to carry out the analysis. The numerical results show that the theoretical model satisfies all known theoretical limits for collisionless and collision dominated operating conditions. A new model for Langmuir probe data analysis is developed. The model provides for the description of sheaths of finite thickness and is found to meet all known theoretical limits in the collisionless and collision dominated extremes and provides a continuous description of operating conditions between these extremes. Systematic data analysis procedures employing the new data analysis model are developed. The feasibility of performing a Langmuir probe experiment in a thermodynamic equilibrium cesium plasma for the purpose of validating theoretical probe models under experimental conditions where plasma properties are known from thermodynamic relations is investigated.

A method was developed and used to obtain theoretical predictions of the current collected from a collisionless, fully Maxwellian plasma at rest by an electrically conducting Langmuir probe having spherical or cylindrical symmetry. The probe characteristic, or functional relation between current and probe potential, was determined for both geometries for probe radii up to 100 times the

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Debye shielding distance of the hotter species of charged particle, for a complete range of ion-to-electron temperature ratios and for probe potentials from -25 to +25 times the thermal energy of the hotter species. Each current collection result is computed to a relative accuracy of 0.002 or better in an average time of approximately two minutes on the IBM 7094. Explicit comparison is made between the results for a completely Maxwellian plasma and those for a plasma mono-energetic in attracted particles, as treated by Bernstein and Rabinowitz, Lam, and Chen. It is shown that in certain cases, the mono-energetic plasma does not adequately simulate the Maxwellian plasma.

This book provides the reader with an introduction to the physics of complex plasmas, a discussion of the specific scientific and technical challenges they present and an overview of their potential technological applications. Complex plasmas differ from conventional high-temperature plasmas in several ways: they may contain additional species, including nano meter- to micrometer-sized particles, negative ions, molecules and radicals and they may exhibit strong correlations or quantum effects. This book introduces the classical and quantum mechanical approaches used to describe and simulate complex plasmas. It also covers some key experimental techniques used in the analysis of these plasmas, including calorimetric probe methods, IR absorption techniques and X-ray absorption spectroscopy. The final part of the book reviews the emerging applications of microcavity and microchannel plasmas, the synthesis and assembly of nanomaterials through plasma electrochemistry, the large-scale generation of ozone using microplasmas and novel applications of atmospheric-pressure non-thermal plasmas in dentistry. Going beyond the scope of traditional plasma texts, the presentation is very well suited for senior undergraduate, graduate students and postdoctoral researchers specializing in plasma physics.

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This unified introduction provides the tools and techniques needed to analyze plasmas and connects plasma phenomena to other fields of study. Combining mathematical rigor with qualitative explanations, and linking theory to practice with example problems, this is a perfect textbook for senior undergraduate and graduate students taking one-semester introductory plasma physics courses. For the first time, material is presented in the context of unifying principles, illustrated using organizational charts, and structured in a successive progression from single particle motion, to kinetic theory and average values, through to collective phenomena of waves in plasma. This provides students with a stronger understanding of the topics covered, their interconnections, and when different types of plasma models are applicable. Furthermore, mathematical derivations are rigorous, yet concise, so physical understanding is not lost in lengthy mathematical treatments. Worked examples illustrate practical applications of theory and students can test their new knowledge with 90 end-of-chapter problems.

Plasma Diagnostics, Volume 1: Discharge Parameters and Chemistry covers seven chapters on the important diagnostic techniques for plasmas and details their use in particular applications. The book discusses optical diagnostic techniques for low pressure plasmas and plasma processing; plasma diagnostics for electrical discharge light sources; as well as Langmuir probes. The text also describes the mass spectroscopy of plasmas, microwave diagnostics, paramagnetic resonance diagnostics, and diagnostics in thermal plasma processing. Electrical engineers, nuclear engineers, microwave engineers, chemists, and technical personnel in universities, industry, and national laboratories will find the book invaluable.

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THE SUMMER SCHOOL IN SPACE PHYSICS HELD IN ALPBACH, AUSTRIA, JULY 1S-AUGUST 10,1963 AND ORGANIZED BY THE EUROPEAN PREPARATORY COMMISSION FOR SPACE RESEARCH (COPERS) Edited by J. ORTNER European Space Research Organisation. Paris and H. MAS ELAND Sterrewacht ' Sonnenborgh' □ Utrecht D. REIDEL PUBLISHING COMPANY DORDRECHT-HOLLAND e-ISBN-13:978-94-010-3590-3 IS8N-13:978-94-0 10-3592-7 00110. 1007/978-94-010-3590-3 '96' Softcover reprint of the hardcover 1st edition 1965 All rights reserved No part of this book may be reproduced in any fonn. by print, photoprint, microfilm, or any other means without permission from the publisher FOREWORD The textbook presented in the following is composed of the proceedings of the Summer School in Space Physics held during the summer months of 1963. This Summer School was organized by the Preparatory Commission (COPERS) of the European Space Research Organisation (ESRO). It was the first time that such a summer course was held in Europe on a subject of space physics. Thanks to an invitation from the Austrian Government these lectures were given in the College House of Alpbach, Tyrol. Eight outstanding European scientists each presented five two-hour lectures on topics covering the region between the Sun and the Earth. The courses contained the physics of the Sun, the Interplanetary Medium and Trapped Radiation, the Ionosphere and High Latitude Phenomena. Furthermore, a course on space instrumentation was given. Sixty students were selected to attend the courses.

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