

The last third of this book is devoted to some conventional appendices, plus appendix D, an introduction to basic physics concepts as applied to particle physics. This section is less inhibited in its use of equations and quantitative concepts. It contains exercises for the reader and is clearly intended as a supplement to an introductory physics course.

The book is recommended as a supplementary text for introductory college courses or for advanced high-school courses; science teachers will find it useful for updating their knowledge in an ever-expanding field of physics research.

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Waves in Dusty Space Plasmas

Frank Verheest

*Kluwer Academic, Norwell, Mass.,
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Particulate matter in the universe exists in sizes ranging from macromolecules to micron-sized grains to even larger pebbles and boulders. When such particles are present in a plasma, they become charged (usually negatively because of the greater mobility of electrons) and thus contribute to the plasma dynamics as a separate "species." These particles have much larger masses and usually larger charges than those of the plasma ions, but much smaller charge-to-mass ratios. This so-called dusty plasma contains a highly diverse range of collective modes of oscillation, unstable behavior, and linear and nonlinear waves.

The grains of a dusty plasma also have a range of sizes and shapes, and the charge can fluctuate in time, leading to highly complex behavior. Over the years, dusty plasmas have been studied mostly as a theoretical construct, due to a lack of direct observations of dust in space. In the past two decades, however, the situation has changed dramatically: First Voyager mission's observations revealed new planetary rings and intricate structure ("spokes") in the rings themselves; more recently, the Galileo and Ulysses missions made measurements of dust streams from Jupiter, and rocket flights collected data through noctilucent clouds high in Earth's atmosphere.

Dusty plasmas are also now easily made in the laboratory, will be subjects of some experiments on the International Space Station, and, because of self-grown contaminants, occur in plasma-processing devices. Theory and simulations have managed to keep up with this explosion of data, leading to a new and exciting subfield of plasma physics.

In *Waves in Dusty Space Plasmas*, Frank Verheest has captured the diversity of phenomena, the excitement, and the challenges of studying waves in dusty plasmas in space. Verheest has contributed in many significant ways to the understanding of these plasmas over the years and has written an oft-cited review of waves (*Space Science Reviews*, volume 77, page 267, 1996). This book is no rewrite of the review article, but a new, major compilation and summation of this rapidly evolving subject, with its own wide range of topics.

The book naturally divides into three parts. The first part introduces basic concepts, such as charging of dust grains, and provides the observational evidence in space for dusty plasmas. The second part develops the formalism for treating dust as a separate plasma species and describes the basic electrostatic and electromagnetic wave modes in a dusty plasma; unlike many plasma textbooks, the emphasis here is on nonlinear waves as much as linear modes. The final third of the book discusses more complex processes, such as dust grains with fluctuating charges or a distribution of sizes, as well as the astrophysically important issue of dust in self-gravitating systems.

Verheest has written a book that is both highly informative and engagingly readable. His use of the first person throughout the text and his honest discussion of controversial points contribute to the personal style of this book. He assumes the reader has basic background in plasma physics but is not an expert in dusty plasmas or space plasmas. He is quick to point out that, in this still emerging field, a proper mechanism to introduce dust into the plasma equations in a mathematically rigorous manner does not yet exist; instead he extends the standard formalism in a natural way.

His approach is based on a fluid treatment of the plasma, which is almost always valid here, given the mass of grains relative to those of the usual plasma components and resulting behavior at frequencies much lower than those typically found in plasmas. He gives an excellent description of the basic physics, and the

reference list he includes is complete and by itself well worth the price of the book.

Most of the treatment of waves (linear and nonlinear) is analytical. Personally, I think some numerical solutions of these complex plasma equations displayed graphically, such as are found in S. Peter Gary's noteworthy monograph on plasmas without dust (*Theory of Space Plasma Microinstabilities*, Cambridge U. Press, 1993) would add further insight. Overall, Verheest's treatment is excellent and is highly recommended, both for those who are just starting out in the field and for more established researchers.

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Chernobyl Record: The Definitive History of the Chernobyl Catastrophe

Richard F. Mould

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My problems with Richard F. Mould's *Chernobyl Record* start with the words "definitive history" in the title. The book is decidedly not a history of events that resulted in the catastrophe. It is rather a mixture of chronicle, traveler's journal, summaries of some aspects of nuclear civilization, and a great deal of statistics. The tone of the narrative varies from emotional eyewitness account to overly dry technical description. Along with authoritative, official information, there are bits with less-than-evident significance, such as pictures of the author's Soviet visa or a camel in the Kazakh steppe. While the comparison of the Chernobyl explosion to the nuclear accidents at Three Mile Island and Tokaimura seems to be too laconic, the comparisons to the Hiroshima and Nagasaki atomic explosions and to nuclear weapons test sites seems out of place.

The 1986 Chernobyl catastrophe was indeed a multidimensional phenomenon, and it may still be too soon to attempt a "definitive" history. But what is striking is that Mould has not even tried to address the very basic historical question: whether Chernobyl was just one of quite a few (even though the worst) accidents of the nuclear era, or whether the Soviet regime was mainly responsible for this misfortune. The question is much