

Complex Plasmas and Colloidal Dispersions: Particle-Resolved Studies of Classical Liquids and Solids is the fifth and latest volume in a soft-condensed-matter series started by Pierre-Gilles de Gennes. Of the authors, Alexei Ivlev and Gregor Morfill are leaders in the study of complex plasmas, Patrick Royall is a colloid experimentalist specializing in imaging, and Hartmut Löwen is a theorist who covers a broad range of soft-matter topics.

The book emphasizes the use of plasmas and colloids to study fundamental phenomena, particularly nonequilibrium processes such as crystallization and glass formation, and the effects of external forces including gravity, electric and magnetic fields, and shear. Another motivation, which the book does not explicitly address, for studying the two systems is their practical importance. Dusty plasmas occur widely in the atmosphere and in space and are important in industrial processes such as computer-chip production. Colloidal dispersions are ubiquitous in everyday life, in such products as foods, paints, glues, cosmetics, and medicines.

After an introduction, chapters 2 and 3 deal with the basic properties of complex plasmas and colloidal dispersions: how the particles become charged and the nature of their interactions, including how external fields affect the interactions and other properties. Chapter 4 compares the two systems. For similar interactions, the structural arrangements of the particles in the two are the same, but the dynamics—that is, the particles' thermal motion—are fundamentally different. In the dilute ionized gas of plasma, the particle motions are underdamped and obey simple Newtonian dynamics; in a dense liquid, the motions of colloidal particles are overdamped and are well described in terms of Langevin dynamics (or Brownian motion). These important differences are emphasized later in the book. Chapter 5 contains a description of the equipment used to study plasmas, a brief section on the preparation of colloids, and a survey of video microscopy and particle tracking.

The remaining two-thirds of the book covers various phenomena associated with both systems, under the headings Simple Liquids, Liquid-Solid Phase Transitions, Binary Mixtures, Slow Dynamics, Driven Systems, and Anisotropic Interactions. As is inevitable when covering a developing field, the narrative is not smooth. Some topics are treated in detail; in other cases

the text simply notes the absence of a desirable experiment. The authors naturally emphasize their own interests and include some intensive theory sections.

The book convincingly makes the case that particle-resolved studies can provide information not obtainable in other ways. One example is the nature of the two-dimensional liquid-crystal freezing transition. Particle-resolved studies in both colloidal and plasma systems have elucidated the conditions under which freezing is a simple first-order transition, as in three dimensions, and those for which a more complex scenario applies—involving the appearance of an intermediate hexatic phase. Another complex and still not fully understood phenomenon that may be elucidated with particle-resolved studies is “laning”: Like pedestrians on a busy sidewalk, two species of particles pushed in opposite directions tend to form lanes from an initially disordered state.

The stated aim of the book series is to address “graduate students and junior researchers as an introduction to new fields, but it should also be useful to experienced people who want to obtain a general idea on a certain topic or may consider a change of their field of research.” In those aims I think the authors have been successful. *Complex Plasmas and Colloidal Dispersions* is not a textbook, although if supplemented by background reading, it could provide topics for an interesting graduate course. It is also not among the growing number of books that provide broad surveys of soft matter—the text is more focused than that. But, in part because of the extensive list of references, this book will certainly find a place on the shelves of experienced researchers as an up-to-date snapshot of a fast-developing area.

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Astrophysical Jets and Beams

Michael D. Smith
Cambridge U. Press, New York, 2012.
\$105.00 (228 pp.).
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In recent years the astrophysics community has made rapid progress in understanding the physics of cosmic jets, including those associated with active galaxies, young stars, x-ray binaries,



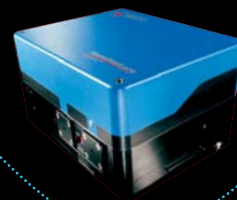
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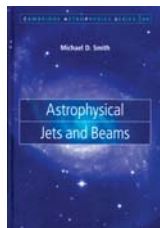
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planetary and pulsar-wind nebulae, gamma-ray bursts, comets, and the solar magnetosphere. It is commendable (and unique) that the goal of Michael Smith's *Astrophysical Jets and Beams* is to assimilate the current knowledge and present astronomy students and other newcomers to the field with a timely introduction to the essentials.

The book can best be described as a collection of brief reviews accompanied by two compact chapters on radiation mechanisms and fluid dynamics, the most important common threads binding the diverse phenomena. With those two chapters in particular, Smith seems to be attempting to make the book self-contained. But given the field's rapid developments, the diversity of jets, and the complexity of the involved physics, including molecular interactions and general-relativistic magnetohydrodynamics, the task seems almost impossible for one person to achieve, and in less than 230 pages.

Smith is a well-known astrophysicist who since the 1980s has been associated with theoretical and observational stud-

ies of cosmic jets. Early in his career he focused on jets of active galaxies. Later he turned to jets from young stars and protostars. Research on both systems enjoys the lion's share of the coverage in the book, and observational data for them is in abundance in the literature and archives. Other types of jets are not sufficiently discussed. For example, only three pages are devoted to jets of x-ray binaries and gamma rays and only one page to jets from pulsars. As a result, their descriptions lack detail, and key results, particularly recent ones, are not even mentioned. As the author himself admits, the reviews are incomplete and serve best as a springboard to a more detailed literature search.

Perhaps a more suitable strategy to attract young researchers to the field would be to focus on the observational discoveries of the past, when different ideas on the nature of cosmic jets were in conflict and evolving in response to observational and theoretical investigations. Such a historical approach would certainly make for a more entertaining read and would prolong the book's shelf life.

Another way to increase such an introductory book's value would be to focus more broadly and deeply on the

underpinning physical processes, which are bound to remain relevant and provide a solid foundation for many years to come. That approach is implemented successfully in *Accretion Power in Astrophysics* (3rd edition, Cambridge University Press, 2002) by Juhan Frank, Andrew King, and Derek Raine. In *Astrophysical Jets and Beams*, the attention given to gas dynamics and magnetohydrodynamics is mainly limited to basic equations and rudimentary applications.

To truly develop readers' physical intuition and enhance their understanding of the background physics, one needs to provide derivations of solutions concerning jet dynamics and discuss them in quantitative detail. Unfortunately, the author does not do that. Even with the shock-wave solutions, which he describes as most important for understanding jet dynamics, he does not properly explain them.

On the whole, the theoretical part of the book is rather disappointing and is mostly limited to qualitative descriptions. The discussions, especially on the role of magnetic fields and relativistic models, tend to be brief and uninformative. Some important topics are completely ignored; those include the acceleration of nonthermal particles and

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magnetic dissipation, which is beginning to be recognized as a main mode of dissipation, and emission, in magnetized relativistic jets.

No other recent book claims to cover the whole “zoo” of cosmic jets. Instead, each tends to concentrate on some particular type of object and address it with as much rigor and detail as possible. Sophisticated readers with a particular interest would do better to consult specialized books than to work through *Astrophysical Jets and Beams*. Those interested in jets of active galaxies, for example, should have a look at *Relativistic Jets from Active Galactic Nuclei* (Wiley-VCH, 2012)—to which I contributed a chapter. That book, edited by Markus Böttcher, Daniel Harris, and Henric Krawczynski, offers a good combination of breadth and depth. Equally successful is the series of lectures on stellar jets published as several volumes under the common title *Jets from Young Stars* (Springer, 2007–10). I admire the author’s goal to make *Astrophysical Jets and Beams* a broad-based, student-friendly work. But I cannot enthusiastically recommend it as an introductory text.

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Solid Biomechanics

Roland Ennos
Princeton U. Press, Princeton,
NJ, 2012. \$60.00 (250 pp.).
ISBN 978-0-691-13550-2

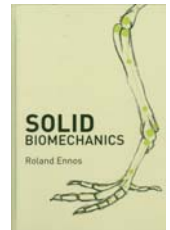
If you’re looking for an engaging and insightful introduction to the mechanical world of living organisms, Roland Ennos’s *Solid Biomechanics* may be the book for you. As the title suggests, Ennos restricts himself to introducing and exploring the mechanics of solid bodies. Still, he is able to cover a wealth of biological contexts and organisms.

Ennos is a biologist at the University of Manchester in the UK and a widely published educator, with particular expertise in the structure and design of plants and animals. His prolific research ranges over such diverse subjects as the structure and mechanical design of trees, statistical analysis in biology, adaptive origins of fingerprints in humans, and silica in grasses as a defense mechanism against herbivores.

Solid Biomechanics seamlessly links physics and biology. The basic engineering theory it covers is clearly laid out and supplemented by effectively pedagogical graphs and diagrams. The

discussions of stress, strain, and torsion provide an excellent introduction to the relevant concepts; the commentary on properties of biological materials is particularly accessible. Ennos links the basic engineering theory to practical problems in the natural world by uncovering structures that provide an interesting context for the theory—an approach that will be useful in introductory courses.

The book is divided into five sections. The first is a well-constructed introduction to the properties of materials and underlying mechanical concepts. The second looks at shapes and compositions of such biological structures as polymers and human connective tissues. The third section considers the mechanical properties of structures under bending, compression, and torsion, with a significant application to bone and muscle design and behavior under stress. The fourth looks at mechanical interactions, including the anchoring of plants, a major area of the author’s own research. The brief fifth section discusses the future and limitations of research in structural biomechanics.



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