



ble introduction to quantum transport and nanoscience and to meet the demand for an updated text for graduate and advanced undergraduate courses. Both authors are well-known authorities in the field, and rumors

about their book project had spread for several years, creating substantial anticipation. Could Nazarov and Blanter meet such lofty expectations?

In my view, they have done so: *Quantum Transport* presents a comprehensive and almost complete overview of nanoscale electronic transport theory. The book is organized according to the authors' areas of expertise. The titles of the six chapters indicate the topic coverage: "Scattering," "Classical and Semiclassical Transport," "Coulomb Blockade," "Randomness and Interference," "Qubits and Quantum Dots," and "Interaction, Relaxation, and Decoherence." Some subjects, such as one-dimensional systems, superconducting heterostructures, and quantum pumping, are integrated into those chapters. Others, including quantum Hall effects and numerical approaches, are not treated. I understand why: Recent monographs exist for those two topics, and with almost 600 pages, *Quantum Transport* is already quite long.

Nazarov and Blanter's general approach is to develop theoretical methods and apply them to various examples in experimentally accessible limits, so as to demonstrate the close connection between experiment and theory in nanoscience. For instance, the scattering approach to transport through a quantum point contact is used to explain the complex physics of so-called multiple Andreev reflections between biased superconducting contacts. Experimentalists have employed that effect to determine the PIN code of atomic break junctions, which allows them to characterize the detailed chemical environment of the contact and determine transport properties such as the shot noise and even the full counting statistics.

Their presentation of the theory is surprisingly comprehensible and should be accessible to advanced undergraduate students. However, being theorists, they do not attempt to address advanced experimental methods. Readers interested in sample fabrication and measurement techniques will have to consult the original literature. Nevertheless, I think experimentalists will find value in the book

because it successfully relates the theoretical concepts and results to physical examples.

I warmly recommend *Quantum Transport* to lecturers and students interested in the subject. It contains a lot of illustrations and exercises that make it suitable for a one- or two-semester course. Additionally, the text facilitates self-study through integrated questions that allow readers to check their understanding of the material. In view of its comprehensive coverage of numerous topics and its accessible style, Nazarov and Blanter's text has the potential to

become a standard reference in the field.

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Granular Patterns

**Igor S. Aranson and
Lev S. Tsimring**
Oxford U. Press, New York, 2009.
\$110.00 (343 pp.).
ISBN 978-0-19-953441-8

After water, the most frequently handled materials in industry are sand, grains, and other large conglomerations



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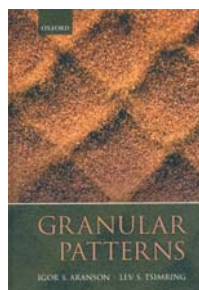


of discrete macroscopic particles. Not only are granular materials ubiquitous, they also display an incredibly rich set of behaviors. Whenever the particles are set in motion, nontrivial patterns are created. For example, shaken granular layers display surface patterns, gravity-driven flows yield avalanches and vortices, shaken or flowing granular mixtures show various types of segregation patterns, and a freely cooling granular gas forms clusters.

Over the past two decades, such phenomena have attracted the interest of physicists whose findings have been consolidated in review articles and monographs on granular media (see, for example, the article by Heinrich Jaeger, Sidney Nagel, and Robert Behringer in *PHYSICS TODAY*, April 1996, page 32). Of the few of those works that focus on pattern formation, the most notable are Gerald Ristow's *Pattern Formation in Granular Materials* (Springer, 2000), Igor Aranson and Lev Tsimring's article in *Reviews of Modern Physics* (April–June 2006, page 641), and Aranson and Tsimring's new book *Granular Patterns*. Ristow's book is, unfortunately, somewhat outdated and is narrower in scope and lacking the theoretical richness offered in *Granular Patterns*.

Aranson and Tsimring, highly esteemed in their field, are well placed to write about the subject. In *Granular Patterns*, they offer an informative and detailed overview of the field. As it stands, granular physics is missing a comprehensive theoretical foundation. The nonequilibrium nature of granular media and the lack of separation of scales lead to difficulties in developing an overarching theory akin to the kinetic theory of gases or the Navier–Stokes equations for Newtonian fluids. At present, we have a set of approaches covering different regimes of granular physics; those include the Boltzmann equation with a dissipative collision term, conservation equations (à la Navier–Stokes) completed with phenomenological constitutive equations, the Edwards theory, Ginzburg–Landau and phase-field descriptions, and many more. The techniques vary in breadth of applicability, and some are more phenomenological than others; *Granular Patterns* gives a good overview of how the techniques can be used to interpret different pattern formations.

An interesting—and for a book on granular media, unique—feature of the text is that it includes examples in biol-



ogy. Pattern formation in biological systems is a personal interest of the authors and an increasingly popular pursuit of other practitioners in the field. Although biological dynamics are generally considered complex, the interactions between organisms (modeled as particles) in a number of pattern-forming systems are simple—for example, they are often short-range interactions—and the resulting patterns can be understood with the same tools used for “dead” granular matter. The growth of bacterial colonies, self-organization of cellular microtubules by molecular motors, flocking, and collective swimming of bacteria are all relevant examples.

Included with the book is a CD-ROM containing about 70 movies contributed by various research groups of experiments and simulations. Although the quality and utility of those movies is uneven, some of them—particularly a number of experimental ones—are truly spectacular. Somewhat less spectacular is the style of writing: *Granular Patterns* reads in places like a review article, which makes sense given it is based in part on the authors' 2006 publication in *Reviews of Modern Physics*. Despite generally careful editing, a number of typos and even minor inconsistencies have remained, which I hope are weeded out before subsequent printings. Also, some of the figures are not print quality, which I find surprising from a reputable publisher such as Oxford University Press.

Those minor issues notwithstanding, I enthusiastically recommend *Granular Patterns* to graduate students and researchers working on pattern formation or with granular media. The book is very useful, and having it at hand will foster appreciation of granular patterns and help researchers push the boundaries of that truly rich and fascinating subject.

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