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Book Review: *Kinetic Theory of Granular Gases*

Kinetic Theory of Granular Gases. Nikolai V. Brilliantov and Thorsten Pöschel, Price: £45.00 (Hardback), 340 pages, Oxford Graduate Texts.

This appears to be the first introductory text in the rapidly growing field of the kinetic theory of granular materials, a subject with wide ranging applications in physics, astronomy, engineering, and chemistry. The basic equation of the standard kinetic theory of molecular gases, the Boltzmann equation, can be easily extended to the particles of granular gases, such as a cloud of dust, a landslide, the grains in a silos, the planetary rings, etc. At variance with the former the latter particles lose part of their kinetic energy when they collide. This gives rise to many unexpected physical properties. The book provides a self-contained introduction to the theory of granular gases for advanced undergraduates and beginning graduates. No mathematical knowledge is required beyond standard undergraduate level and the book is well adapted for use in graduate courses on kinetic theory, since it includes a broad range of exercises throughout the book.

The first chapter is devoted to the mechanics of particle collisions and includes a good discussion of the coefficients of restitution in an inelastic collision. The second chapter, devoted to the velocity distribution function for granular gases, starts with a discussion of the cooling process in a granular gas and of the Haff law. The Boltzmann equation is then introduced and the Sonine polynomial expansion of the distribution function is discussed. Further topics of this chapter are the case of a constant inelasticity, the case of viscoelastic particles, the high-energy tail of the velocity distribution function, and the case of two-dimensional granular gases. The third chapter deals with single-particle transport, self-diffusion and Brownian motion. The fourth chapter is devoted to transport processes and kinetic coefficients, and starts with a discussion of a granular gas modelled as a continuum, via hydrodynamic equations. It includes a description of a Chapman–Enskog approach for non-uniform granular gases. Finally, the fifth chapter deals with the interesting phenomena of structure formation, arising from the instability of the homogeneous cooling state.

Although the book has mainly a didactical purpose, people engaged in research in the area may find the book interesting, because it discusses many concepts in an accurate fashion and may suggest interesting topics for further research.

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