books

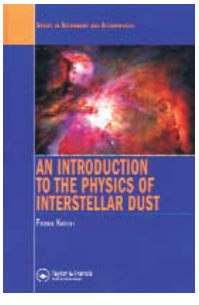
Clarifying the role of the universe's particulate matter

An Introduction to the Physics of Interstellar Dust

Endrik Krügel
Taylor & Francis, New York, 2008. $79.95 (387 pp.). ISBN 978-1-58488-707-2

Reviewed by Angela Speck

Interstellar dust used to be considered an annoyance. It dims and reddens visible light from distant objects, making some regions of the sky almost impossible to observe. But with the emergence of IR astronomy in the late 1960s, the importance of dust particles in the universe began to be revealed. Dust is a vital ingredient in understanding many astrophysical environments; it is essential in star formation and contributes to several aspects of interstellar processes such as gas heating and the formation of molecules. In addition, mass loss from evolved stars is radiation driven and thus intimately linked to the precise nature of the circumstellar dust, which affects the coupling between stellar radiation and circumstellar material.



Dust needs to be well understood in its own right if we are to comprehend how it influences many aspects of astrophysics. To educate students in the delights and pitfalls of cosmic dust, many astronomy and astrophysics departments offer courses, either at the advanced-undergraduate or graduate level, on the interstellar medium (ISM).

Angela Speck is an associate professor of physics in the department of physics and astronomy at the University of Missouri–Columbia. She is an IR astronomer whose interests include stellar evolution, astromineralogy and dust around evolved stars, galactic chemical evolution, meteoritics, and the optical properties of materials.

Endrik Krügel's *An Introduction to the Physics of Interstellar Dust* offers the perfect foundation for studying dust in the ISM and the physics of interactions of dust with light, as well as with its surroundings.

Krügel, a researcher at the Max Planck Institute for Radio Astronomy in Bonn, Germany, has taken his previous encyclopedic tome, *The Physics of Interstellar Dust* (Institute of Physics, 2003), and produced a slimmer volume that still covers the foundations. Krügel's new book is designed for advanced-undergraduate and graduate courses and is tremendously appealing because it requires no prior knowledge of astronomy. It can be used as a textbook, a self-study guide for graduate students or more senior academics, or a general reference for active researchers to delve into as needed.

A major problem in investigating cosmic dust is that a proper study incorporates so many aspects of the physical sciences, and current texts rarely bring those topics together in such a coherent and concise form as Krügel does. He starts with undergraduate-level electricity and magnetism and builds up to a complete picture of how we understand dust in space merely by observing light. Krügel starts at a level that is accessible, but he does not oversimplify. He moves from scattering and absorption by a single particle to the importance of radiative transfer modeling for a collection of particles and on to the effect of dust on hydrodynamics. The book does not attempt to address all aspects of the interaction of cosmic dust with space and, particularly, magnetohydrodynamic interactions. But it provides the tools that a student, or researcher whose main expertise lies elsewhere in astrophysics, will need to further his or her studies and delve into more specialized texts.

The book does fall down in a few places. First, the sources of dust injected into the ISM, especially the asymptotic giant-branch stars and planetary nebulae, are given short shrift. That approach is to some extent necessary to keep the book concise; however, the treatment of pre-solar grains is woefully inadequate. The mere existence of pre-solar grains shows that some stardust survives not only the traverse of the ISM but also the process of star and planet formation. The short subsection on the topic is out of date and fails to give the reader a true picture of the importance and results of the study of those grains. Furthermore, it suggests that those grains are processed in the ISM, which is misleading. Second, and a more minor issue, is the shoddy editing. It is a shame that such a valuable resource is marred by numerous, avoidable spelling mistakes and typographical errors. Third, students and researchers who are comfortable with the physics side of cosmic-dust studies but who want to learn more about the geological, mineralogical, and chemical aspects of dust will be disappointed.

That last point is not meant to be a serious criticism of Krügel's book, which cannot be all things to all people. However, the book's goal is to bring together the various aspects of physical science needed to understand dust in space. And researchers in the field who want to fully understand the processes involved in determining the nature of dust in astrophysical environments need to know many aspects of geology and chemistry in addition to the physics. *An Introduction to the Physics of Interstellar Dust* would be the perfect companion to Charles Cowley's *An Introduction to Cosmochemistry* (Cambridge University Press, 1995), which treats the geology and chemistry of cosmic-dust studies. But Cowley's book lacks the detailed physics presented in Krügel's latest text.

Yoshio Nishina

Father of Modern Physics in Japan

Dong-Won Kim
Taylor & Francis, New York, 2007. $69.95 (195 pp.). ISBN 978-0-7503-0755-0

The history of physics in Japan might be one of the most important under-