AT THE CONFLUENCE: PARTICLE PHYSICS AND COSMOLOGY

Particle Physics and Inflationary Cosmology

Andrei Linde

Gordon and Breach, New York, 1990. 362 pp. $36.00 hc ISBN 3-7186-0489-2; $29.00 ISBN 3-7186-0490-6

Reviewed by Edward Kolb

An indication that the interdisciplinary field of particle cosmology has come of age is the appearance of textbooks on the subject. *Particle Physics and Inflationary Cosmology* by Andrei Linde is unique among recent books in that it does not attempt to cover all current topics in the field, but rather concentrates on the single subfield of inflation.

Much of the work in particle cosmology is speculative and still awaits the final verdict, to be provided by observation. It is impossible to say which, if any, current ideas—such as cosmic phase transitions, quantum cosmology, particle dark matter, inflation and so on—will remain as part of the ultimate picture of the evolution of the universe. What is certain is that the ideas resulting from the confluence of particle physics and cosmology are bold, imaginative and perhaps profound: Most conspicuous in this genre are the ideas of inflation.

Linde's foremost message is that inflation is not a single theory or a model, but rather an idea—an idea that at some early time there was a very rapid expansion of the volume of the universe. This basic idea has far-reaching implications for the subsequent development of the universe. While inflation is simple and beautiful, the implementation of the idea within a framework of particle physics has yet to produce a unique model. In fact Linde discusses many particle physics models that can lead to successful inflation. Given the unsettled state of affairs, one might think a book like this is premature. However, Linde takes the approach that the important point is developing the concept rather than concentrating on the details of any particular model. The idea of inflation is likely to outlive any of the models described.

While the title suggests a book devoted solely to inflation, it is much more. The first six chapters contain the most complete discussion to date of phase transitions in scalar field theories driven by high temperature or high density. In fact the development of the subject goes far beyond what is required to understand inflation. My only criticism of the book is that occasionally the author strays from inflation into related areas of his research.

Linde was one of the early pioneers in the field and continues to make important contributions. His landmark paper with David Kirzhnits on high-temperature symmetry restoration led to the idea that the energy density of the vacuum could change in a phase transition. This discovery was later exploited by Alan Guth in the scenario where the vacuum energy density dominates the universe during a phase transition, causing inflation. When it was realized that Guth's original model would not work, many "improved" versions of inflation emerged, some of which still survive as viable (if not compelling) models. No one has contributed more to the collection of inflationary models than Andrei Linde. The creativity, enthusiasm and imagination characteristic of his scientific career is evident throughout the book.

The book is addressed to the professional physicist and to the advanced graduate student. The level of presentation is demanding for those without a background in field theory, cosmology and general relativity. However, in the tradition of the great Russian texts of Landau and Lifshitz, Linde usually provides the reader with physical insights as a guide through the sometimes difficult and technical subject matter. Anyone who has had the pleasure of hearing one of Linde's lectures will be pleased to discover that he brings the same panache to his often amusing book.

Many reviews end with the traditional statement that the book is a must for all serious students of the subject. *Particle Physics and Inflationary Cosmology* should be read by a wider audience. The section on the possibility of a self-regenerating inflationary universe (in which parts are inflating even today), and the discussion of the creation of the universe from "nothing," are sure to excite the imagination of any reader curious about the origin of our universe and interested in the most exciting ideas in cosmology over the last decade.

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Technological Risk

H. W. Lewis

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This turned out to be a better book than I thought when I first started the book. Perhaps I was put off by Harold Lewis's too-frequently exercised and apparently incorrigible habit of using cute phrases and clever wording. Early on in my reading of the book, I considered recommending he rewrite the book, omitting two-thirds of the cleverness—still letting the whimsy show but sparing us the distraction of his (unnecessary) parenthetical remarks. But then I realized that Hal Lewis is incapable of not repeating every pun and unusual turn of phrase that pops into his brilliantly composed mind. And a person who would give us a controlled flow (as opposed to an incessant flow) of distracting (but clever!) anecdotes and phrases would