Einstein’s Unfinished Symphony: Listening to the Sounds of Space-Time FREE

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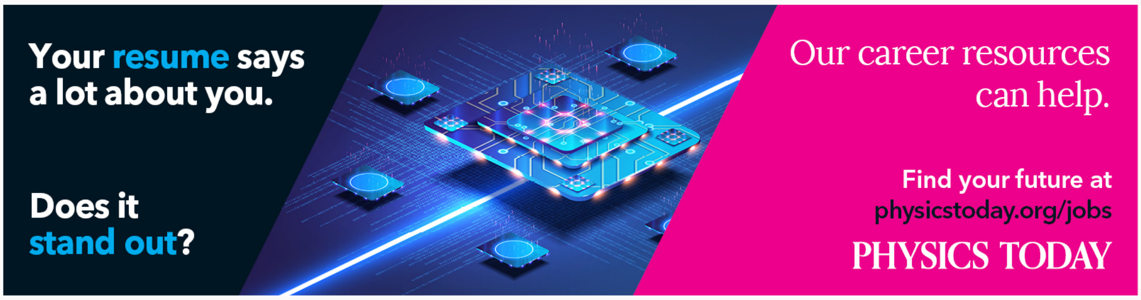

Gravitational-Wave Physics: Testing an Einstein Prediction

Einstein's Unfinished Symphony: Listening to the Sounds of Space-Time

Marcia Bartusiak
Joseph Henry Press, Washington, DC, 2000. $24.95 (249 pp.) ISBN 0-309-06987-4

Reviewed by Lawrence M. Krauss

Gravitational-wave astronomy, as it has now become known, has occupied a lonely corner in the back room of science for more than a generation. Here, individual scientists, sometimes working in small groups, have toiled to build detectors that confront the limits of currently available technology. They have been supported by a steadfast group of theorists who have attempted to make reliable predictions of exactly what a gravitational-wave signal would look like, if one were able to detect it.

With the advent of the Laser Interferometer Gravitational-Wave Observatory (LIGO), comprising three large interferometers, two located in Washington State and one in Louisiana, gravitational-wave detection may have come of age. It is still not at all clear that LIGO, even if it ultimately operates at its exacting design levels, will make a positive detection. Nevertheless, regardless of one's skepticism over the eventual viability of the first round of LIGO detectors, the progress that has been made since LIGO was first proposed more than 30 years ago is staggering. The route to LIGO was long and checkered; it is beautifully recounted by Marcia Bartusiak in her latest book, *Einstein's Unfinished Symphony*.

Bartusiak is a distinguished science journalist with a reputation for detail and accuracy, and her new book is no exception. She has clearly made a great effort to interview all major players in the field, scan the literature, and capture the relevant science. What results is an easy-to-read and clear exposition of a field of physics that has, with minor brief and turbulent exceptions, remained far from the popular and professional limelight during much of its development. Readers of this book will come away with a clear idea of the challenges involved in detecting a signal that will move test masses located several kilometers apart by less than the width of a single atomic nucleus. In addition, they will meet the individuals who have at times single-handedly championed the field during the past three decades.

Bartusiak describes the players, from experimentalists Rainer Weiss, who was one of several individuals who independently came up with the idea for using laser interferometry for gravitational-wave detection, to theorist Kip Thorne, who has been calculating the predicted gravitational-wave signal from a variety of possible astrophysical sources for more than three decades. At the same time, she spares the reader the kind of supermarket-magazine approach to science-writing in which the science plays second-fiddle to personality quirks. Bartusiak describes scientists in terms of their contributions to the science, not in terms of the clothes they wear or the cars they drive.

She handles graciously, for example, the controversies surrounding Joe Weber's ill-fated early claims of detection in 1969, properly crediting him with stirring widespread interest in the field while making it adequately clear that his claims were ill founded. (His subsequent far-fetched claims of neutrino detection are not discussed, although for many of us this puts his earlier claims in a different perspective.) I was particularly glad to see a discussion of the seminal work of Robert Dicke who, I have always felt, has not received the kind of public acclaim that he deserves.

Bartusiak's discussion of the science of gravitational waves, from the earliest predictions of Albert Einstein to the modern exploration of possible sources of gravitational-wave signals is, on the whole, succinct and accurate. There are various minor issues with which I take exception, including her discussion of the absence of gravitational-wave signal from symmetrical collapsing objects, but such issues are few and far between. In addition, while her focus on this issue inevitably leads her to concentrate on its potential importance in the grand scheme of things, the presentation is nevertheless balanced. The uncertainties associated with both LIGO and future proposed detectors are well described, even as the potential scientific payoffs are outlined.

Because the gravitational-wave community has been largely self-contained during the past few decades, physicists from other areas may benefit from Bartusiak's comprehensive history. They and other readers will come away with a far clearer idea of where the field is headed, and how we have come to the present threshold of detection.

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Condensed Matter Physics

Michael P. Marder
Wiley, New York, 2000. $94.95 (895 pp.). ISBN 0-471-17779-2

A satisfactory general-purpose text book for a graduate course on condensed matter physics is difficult to find. The venerable old books that do a great job on the basics fail to capture the excitement and advances of the last quarter-century. The more recent books tend to be rather specialized or emphasize a particular point of view.

The problem is fundamental: The field overlaps classical physics, crystallography, quantum mechanics, statistical mechanics, fluid dynamics, and materials physics. For more advanced topics, one needs quantum field theory and sophisticated mathematics. In recent years, competition has developed between rather simple models that convey the basic principles and more rigorous derivations that allow "first-principles" calculations of properties. How does one pull it all together into a coherent whole?

Michael Marder's new book, *Condensed Matter Physics*, is a valiant attempt to tame the devil. The book's ambition is to cover the basics with a