

**THE UNIVERSE EXPANDS**  
**Harry Nussbaumer and Lydia Bieri,**  
"Discovering the Expanding Universe", Cambridge University Press, 2009

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When Einstein published his theory of gravitation in 1915, now known as The General Relativity (GR), cosmology was for the first time in possession of a mathematical formalism which could enable scientists to make it a hard science. Einstein was the first to realize it and soon he formulated his model of our universe (the Universe), now the well known "Einstein static endless cosmos". Many mathematicians, astrophysicists, theoretical physicists, astronomers and others followed the suit and the last century may well be called the century of cosmology.

Einstein's equations of GR are practically impossible to solve in the general case, thus further theoretical investigations made extensive use of various approximate cosmological models, whose number proliferates up to the present. On the other hand, a remarkable advance of the astronomical equipment, first of all telescopes, then the astrophysical science, both theoretical and empirical, have helped our picture of the global structure and dynamics of the Universe to be examined in unprecedented detail and accuracy. Thus the cosmology has become one of the most exciting and fascinating scientific adventures of our time. Last years have witnessed an enormous proliferation of speculative models concerning the early phases of our universe, making the science of Cosmos more a metaphysics than a standard scientific enquiry.

Many books have been written about the history of modern cosmology and the present day state of the art. The monograph by Nussbaumer and Bieri stands apart from these attempts to present

a complex and difficult subject to a broader readership in many respects. Written by an astrophysicist and a cosmologist, the book covers almost all relevant aspects necessary for the general readership to get insight and to appreciate the development of our knowledge of the global features and behaviour of the universe. The monograph has successfully blended the historical account, theoretical investigations and empirical evidence, making the book both self-sufficient and instructive. Theoretical aspects are covered in two layers. In the main text equations are presented and analyzed with the help of figures which explain the nature of various theoretical constructs beyond the usual descriptive level, which allows readers to get a deeper insight into various notions, like the hyperbolic cosmological space, open and closed universe etc. In the mathematical appendix each relevant chapter has been presented at a more scrutinized mathematical level, explaining what really is calculated by the equations which generally stem from the Einstein's original GR. The latter is taken for granted, but very few highly specialized textbooks go further from quoting Einstein's equation. The book is by no means textbook and these elaborations just help to appreciate what the authors (original or of the present book) wanted to say, rather than aiming at real understanding.

The book closely follows main steps in acquiring relevant cosmological empirical evidence, with instructive details concerning exchange and interpretation of the astrophysical data. Many authors are already present in the general outlook of the astrophysical history, but some, like Milton Humason,

Hubble's collaborator, emerge as mainly neglected in the popular accounts of the development of our picture of the universe. The same holds for Tolman, Robertson and other less known but important cosmologists of the last century.

But the principal value of the book is its detailed historical account of the merits of the most prominent figures linked with the last century cosmology. The authors reveal many misconceptions and delusions deeply rooted into minds of those not familiar with cosmological research history. Thus we find that Hubble did not discover the universal expansion, that it was not Hubble who introduced the so-called Hubble constant, etc. The authors do not belittle Hubble achievements, but try to do justice to all those whose contributions should be appreciated. From their account another eminent figure emerges, rev. Georges Lemaitre, who should be considered the most (with Einstein, of course) prolific researcher in the last century's cosmology.

The book is lavishly illustrated by photos, figures, facsimiles of the primary historical sources etc. Some of them are amazing, like the photo of the postcard Einstein sent to Herman Weyl (another author rather neglected in the popular literature), where Einstein discusses some controversial current issues. Another intriguing story appears, that of Einstein's cosmological constant,  $\Lambda$  (originally  $\lambda$ ), which Einstein called his biggest blunder in cosmology and which Lemaitre (and some others) defended vigorously from the majority of the cosmological population (including very Einstein). This cosmological bastard disappears and reappears despite almost universal aversion against it, under many disguises and at present turns out the principal player on the cosmological arena.

With brief but instructive prelude of cosmological (pre)history, and preface by Allan Sandage,

the book appears self-sufficient, easy to read and full of unexpected revelations of importance to everybody engaged in cosmology, both at the research and informational levels. My only remark is the neglect of the so-called hierarchical model, mentioned only in passing (Einstein himself considered the model, but rejected it). The issue of the accelerating universe has not been exploited as much as one might expect, but with good reason. The final message of the book is that scientific enquiry at this level, as illustrated in the monograph, undergoes many changes and one may not expect definite answers, particularly from the cosmologists. (They could be found elsewhere, in the Bible, for instance, anyway). The message (which the authors are cautious not to offer explicitly) appears, paradoxically - we don't know yet for sure that our Universe expands. Or, put it differently, if it does so, why. Though the authors do not insist on the epistemological issues, the book offers a nice illustration of some of the general aspects of the scientific methodology. It demonstrates, for instance, how risky is to assign a particular scientific achievement to a single author. As the case with other scientific activities, important cosmological results are collective products of many contributors.

The target readership are academics with interest in cosmology, but to my estimate those who will benefit most are historians of modern cosmology, many of whom will have to revise their simplistic picture of the development of the discipline, from Antiquity to the present day.

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