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BOOK REVIEW

Robert E. Kennedy: A student's guide to Einstein's major papers

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The "Student's Guide to Einstein's Major Papers" by Robert E. Kennedy is a true gift for students who are interested to better understand the revolutionary change of physics during the early twentieth century under the dominant influence of Albert Einstein. This is much more exciting and illuminating than working through the dry accounts of most textbooks. Einstein published his breathtaking insights in a beautifully clear and simple style, never hiding dark points. It was obviously a pleasure for him to tell the world of physics what he had discovered.

Over decades of teaching theoretical physics, I often asked myself whether the largely standardized way of presenting the polished basic courses is really satisfactory. Clearly, it would be too time-consuming to always follow the historical development. Teachers should however—I think—try to give at least from time to time an impression of how fundamental achievements have been reached along meandering paths with confusing forks. Einstein's early papers during his *annus mirabilis* 1905 are probably the best examples for this. Therefore, I warmly recommend Robert Kennedy's book also to teachers, who often hold incorrect views on the historical developments of physics, that are passed—with further simplifications—to the next generation.

Here are a few indications about the contents and the presentation of the present book. In an opening chapter the author gives an impression of the state of physics at the time when Einstein was a student at ETH in Zurich, and briefly describes his papers before 1905. For what followed afterwards, the three papers from 1903 and 1904 on the foundations of statistical mechanics turned out to be decisive.

Chapter 2 is devoted to Einstein's first paper from 1905 with the title "On a Heuristic Point of View Concerning the Production and Transformation of Light". The author begins with a historical background on thermodynamics, Boltzmann's statistical

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interpretation of entropy, black-body radiation, and Planck's attempt in December 1900 to understand the empirically successful black-body distribution he had guessed two months before. After this a detailed account of Einstein's truly revolutionary paper is presented. (Einstein himself used the adjective "revolutionary" only for this paper on the light quantum, and—as far as I know—only in a famous letter to his friend Conrad Habicht.) Contrary to a still widespread understanding, Kennedy stresses that this paper was not written to explain the photoelectric effect. The primary focus was to explain the black-body radiation, with the conclusion that in the Wien regime the entropy of radiation agrees with that of an ideal gas of non-interacting particles—the light quanta. Only at the end of the paper used Einstein the photoelectric effect as but one of three possible consequences of his light quantum hypothesis. With this conception of the free electromagnetic field, Einstein remained almost completely isolated for about two decades. Kennedy provides lots of helpful explanations, especially in well-organized appendices. With this help the student should be able to fully understand Einstein's paper. This chapter might serve as a stimulating opening of a course on quantum theory.

The other 1905 papers of Einstein are presented in the same mode. We add some remarks on chapter 5, which centres on Einstein's first review paper on the general theory of relativity, entitled "The Foundations of the General Theory of Relativity". After a concise description of the path from 1905 to 1916, Einstein's account, written soon after he had completed his grand theory of space, time and gravitation, is presented and supplemented with many detailed intermediate calculations, mostly collected in an extended appendix of about 30 pages. Without this help, students would have great difficulties to fill the gaps in Einstein's original paper.

After this landmark, the presentation of general relativity was soon considerably transformed in influential texts by H. Weyl, W. Pauli and others, but working through this great 1916 paper is really revealing. It shows, in particular, how Einstein found the definite field equations—without knowing the Bianchi identities.

The present book ends with a chapter on Einstein's later contributions to quantum theory and a brief epilogue.

As a student, I would have studied such a guide to Einstein's major papers with devotion.