

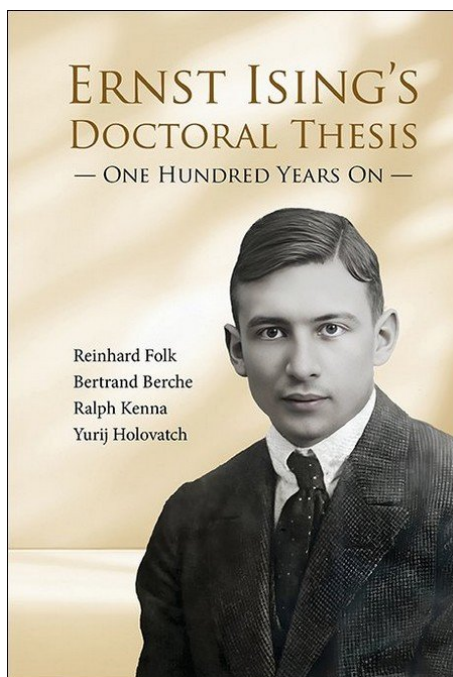
Book review

Ernst Ising's Doctoral Thesis — One Hundred Years On by Reinhard Folk, Bertrand Berche, Ralph Kenna, and Yurij Holovatch*

S. Kobe

Institut für Theoretische Physik, Technische Universität Dresden, Dresden, Germany

Received 8 July, 2026; accepted 18 September 2026; published 28 September 2026



World Scientific, London, 216 pages. ISBN: 978-981-98-2264-5

The Ising model plays an important role in describing a wide variety of cooperative phenomena. Its roots can be traced back to the 1920s at the University of Hamburg, where Wilhelm Lenz held the full professorship in theoretical physics. Among the young people that he gathered around him were Wolfgang Pauli, who served as his assistant, as well as Lucy Mensing and Ernst Ising. The latter two earned their doctorates under Lenz with their final theses and published their respective results in 1925 in “*Zeitschrift für Physik*”. Ising’s publication, “*Beitrag zur Theorie des Ferromagnetismus* (Contribution to the Theory of Ferromagnetism)”, marks the starting point for what is perhaps the most widely used model in statistical physics. Since then, however, myths have arisen regarding its origins and the role of

*World Scientific Publishing, London, 2026, 216, doi:10.1142/14565.

its namesake, whose list of publications contains only two entries.

The authors of the book, whose own research is closely linked to the Ising model, contribute to clarifying the historical context of this scientific development. To this end, they first present the doctoral dissertation, which exists in its original form as a typewritten manuscript. An English translation is presented alongside the German text. Copies of the related illustrations, drawn by Ising himself, are included. The supervisor's evaluation conveys the assessment from the perspective of that time. Lenz was convinced that, in contrast to Weiss's theory, an atomistic explanation of ferromagnetic behavior had to be found, and he attested to the candidate's considerable skill in his efforts to achieve this goal with the help of probability considerations.

The following chapter deserves special attention, as the authors impressively succeed in linking individual passages of the thesis with the results of current physical research. This reflection provides the reader with surprising insights that allow them to contextualize the connections and gain an understanding of Ising's approach in writing his dissertation. For example, it contains considerations that are later found in the introduction of the transfer matrix method to statistical mechanics. Also little known are Ising's approaches to extending the original model, which ultimately led to further important insights into the nature of phase transitions. These include the use of three states instead of two, the addition of interactions with next-nearest neighbors in a linear chain, and interactions between two chains.

Ernst Ising was born in Cologne in 1900 and grew up in Bochum as part of a Jewish merchant family. His life spanned nearly the entire 20th century. The social upheavals of that era had a lasting impact on his fate and that of his family. Drawing on authentic sources, this account paints an emotional picture of his life. The subsequent description of the historical development of the model spans the spectrum from the main result of his doctoral dissertation — that there is no phase transition at finite temperatures for the one-dimensional model — to modern applications in complex systems, even beyond the realm of physics. Thus, the modelling of neural networks laid the foundations for artificial intelligence.

Many interesting details are woven into the narrative, which, in their historical context, also suggest mutual influences with the parallel development of the formalism of quantum theory. For example, the Hamiltonian function used today for the Ising model was first introduced in 1930 by Wolfgang Pauli, who coined the term “semiclassical spin” for the variable it contains. Those in the field of scientific research know that insights often mature through circuitous paths and that the associated processes take time. These processes can influence and even change an initial opinion. The fact that this is also reflected in the hundred-year history of the Ising model is what makes reading this book so fascinating. For example, in March 1996, when asked by the reviewer what Pauli had thought of the model back then in Hamburg, Ising replied that Pauli had viewed it with great skepticism and had shaken his head.