

Decoherence and the Quantum-to-Classical Transition (The Frontiers Collection)

By Maximilian A. Schlosshauer

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This detailed, accessible introduction to the field of quantum decoherence reviews the basics and then explains the essential consequences of the phenomenon for our understanding of the world. The discussion includes, among other things: How the classical world of our experience can emerge from quantum mechanics; the implications of decoherence for various interpretations of quantum mechanics; recent experiments confirming the puzzling consequences of the quantum superposition principle and making decoherence processes directly observable.

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Editorial Review

Review

From the reviews:

"A thorough and readable representation of today's understanding of the topic ... An excellent overview of the various theoretical approaches to the physics that leads to decoherence. A particular strength is that it includes accounts of several experiments demonstrating the decoherence mechanism in detail ... An important resource for anyone interested in decoherence. It is very well written and it will contribute to further conceptual and theoretical development and to new experiments."

Review by Anton Zeilinger, published in Nature **451**, 18 (2008)

"An excellent monograph about what the best current thoughts are on the link between quantum and classical physics. … rewarding reading for physicists who do not have the time or the mathematical preparation to delve into all the details. For such readers, the book includes interesting and accessible discussions of recent experiments … . a welcome contribution. The index is well organized to help readers find their way around. And the more than 500 up-to-date references are a bonus for the more interested, persistent reader." (Eugen Merzbacher, Physics Today, September, 2008)

"A very fine tour of the decoherence program in all its facets. ... Schlosshauer's book is highly recommended. ... [He] has written an excellent survey of a field that is of the greatest possible interest for the foundations of quantum physics." (N. P. Landsman, Studies in History and Philosophy of Modern Physics, Vol. 40, 2009)

From the Back Cover

The ultimate introduction, textbook, and reference on decoherence and the quantum-to-classical transition. This detailed but accessible text describes the concepts, formalism, interpretation, and experimental observation of decoherence and explains how decoherence is responsible for the emergence, from the realm of quantum mechanics, of the classical world of our experience.

Topics include:

• Foundational problems at the quantum–classical border;

• The role of the environment and entanglement;

• Environment-induced loss of coherence and superselection;

• Scattering-induced decoherence and spatial localization;

• Master equations;

• Decoherence models;

• Experimental realization of "Schrödinger kittens" and their decoherence;

• Quantum computing, quantum error correction, and decoherence-free subspaces;

• Implications of decoherence for interpretations of quantum mechanics and for the

"measurement problem";

• Decoherence in the brain.

Written in a lucid and concise style that is accessible to all readers with a basic knowledge of quantum mechanics, this stimulating book tells the "classical from quantum" story in a comprehensive and coherent manner that brings together the foundational, technical, and experimental aspects of decoherence. It will be an indispensable resource for newcomers and experts alike.

"Reads like a bestseller. An engaging and intuitive treatment of a very important subject, combining the scope of a monograph with the clarity of a textbook and the intellectual excitement of a Sherlock Holmes adventure."

Wojciech Zurek, Los Alamos

"Everyone who works in the borderlands between quantum and classical physics, from philosophers of physics to quantum-computer technologists, will find much here to stimulate and inspire."

Gerard Milburn, University of Queensland

"A thorough, readable, and very useful account of decoherence theory and its diverse applications. Valuable as a text and as a reference work, both for graduate students and for active researchers in the field."

Steve Adler, IAS, Princeton

About the Author

Maximilian Schlosshauer is an internationally recognized researcher in the foundations of quantum mechanics in general and in quantum decoherence in particular. After completing his undergraduate education at Freiburg University, Germany, he graduated from Lund University, Sweden, with a Master of Science degree in 2001. He received a Ph.D. degree in Physics from the University of Washington in Seattle in 2005. His postgraduate research (with Arthur Fine) was focused on decoherence and the quantum-to-classical transition. He is currently an Australian Research Council Postdoctoral Fellow in the Department of Physics at the University of Melbourne, Australia. Besides his interest in decoherence and the foundations of quantum mechanics, he has also contributed important research in theoretical biophysics.

Users Review

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