Schrödinger's Philosophy of Quantum Mechanics

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CHAPTER 6

Complementarity, representation and facts Psycho-physical parallelism and the probability-outcome parallelism in quantum mechanics

Abstract: In the 1950's, Schrödinger's conviction was that the wave-mechanical model has to be considered as more than a symbolic instrument for predicting facts, but less than a description of "nature an-is-is". He thus precluded in advance two opposite reductionist strategies. A strategy of reduction of fact-like appearances to complex features of the wave-mechanical representation, which the popular many-worlds interpretation of quantum mechanics and the strongest version of decoherence theories have tended to endorse; and, conversely, a strategy of reduction of the wave-mechanical model to a meshwork of relations between possible facts which is typical of instrumentalism. According to Schrödinger, no cheap solution could dispense the physicist from accepting a form of parallelism between the w-model of quantum mechanics and the sequence of experimental facts. But how are we to understand this alleged resistance of parallelism to any kind of reduction?

To answer this question, I draw a systematic parallel between two parallelisms: the parallelism which is at stake in quantum mechanics, and another parallelism that concerns human actions (and is connected with the celebrated psycho-physical parallelism). Actions can be described in terms of intentions, beliefs, hopes, desires, and fears, which all involve purpose (namely a view on the fative); and they can also be described, alternatively, in terms of coases and effects, behaviours, physiological events, neurological processes, which generally presuppose knowledge of a series of past events. It is shown that any question about the parallelism between the intentional and the causal accounts of action, can be transposed almost exactly to the case of the parallelism between the ψ-model and the sequence of experimental facts in quantum mechanics.

Before this inquiry starts, I compare Bohr's concept of "complementarity" with Schrödinger's parallelism (which is Schrödinger's counterpart of complementarity).

6- Complementarity, representation and facts

- 6-1 Schrödinger's criticism of Bohr's complementarity
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Schrodingers Philosophy Of Quantum Mechanics

J.T. Blackmore, R. Itagaki, S. Tanaka

Schrodingers Philosophy Of Quantum Mechanics:

Schrödinger's Philosophy of Quantum Mechanics Michael Bitbol, 2012-12-06 This book is the final outcome of two projects My first project was to publish a set of texts written by Schrodinger at the beginning of the 1950 s for his seminars and lectures at the Dublin Institute for Advanced Studies These almost completely forgotten texts contained important insights into the interpretation of quantum mechanics and they provided several ideas which were missing or elusively expressed in SchrOdinger's published papers and books of the same period However they were likely to be misinterpreted out of their context. The problem was that current scholarship could not help very much the reader of these writings to figure out their significance The few available studies about SchrOdinger's interpretation of quantum mechanics are generally excellent but almost entirely restricted to the initial period 1925 1927 Very little work has been done on Schrodinger's late views on the theory he contributed to create and develop The generally accepted view is that he never really recovered from his interpretative failure of 1926 1927 and that his late reflections during the 1950 s are little more than an expression of his rising nostalgia for the lost ideal of picturing the world not to say for some favourite traditional picture But the content and style of Schrodinger's texts of the 1950's do not agree at all with this melancholic appraisal they rather set the stage for a thorough renewal of accepted representations In order to elucidate this paradox I adopted several strategies Metaphysics of Schrödinger's Cat. Bruno del Medico, 2025-03-22 In 1935 Erwin Schr dinger a brilliant Austrian physicist proposed a thought experiment destined to become a cultural icon and a philosophical conundrum At a time when quantum physics was beginning to shake the foundations of scientific thought Schr dinger imagined a cat locked in a box trapped in a situation that was as absurd as it was enlightening alive and dead at the same time at least until an observer opened the lid of the box To those who do not master the details of quantum mechanics the paradox may seem like an absurdity And in fact that is precisely its strength Schr dinger was not trying to define a new physical principle but to point out the strange consequences of a still young theory His cat placed at the boundary between two opposite states has become much more than a conceptual experiment It is a mirror reflecting the paradoxes of nature perception and even our culture The paradox is rooted in the theory of quantum superposition a property described by the Schr dinger equation itself. In the world of the infinitely small particles such as electrons and photons do not are in one state but in a combination of states simultaneously However this bizarre behavior seems to disappear in the macroscopic world a cat does not travel instantaneously to two different places nor does it appear simultaneously alive and dead The paradox then raises an essential question when does the transition from the microcosm to our everyday world occur Is it due to the observer Of our way of interpreting reality Or of the nature of reality itself which is perhaps much more nuanced than we imagine Immanuel Kant centuries before Schr dinger formulated his paradox had argued that reality is never directly accessible. There is always a mediation of our mind which organizes what we perceive according to categories such as space and time But quantum physics seems to push us

beyond Kantian thinking suggesting that reality itself may depend on our act of observing it Schr dinger's cat metaphor has crept in everywhere from science fiction novels to music videos to memes circulating on social media Behind this levity however lies a complex and provocative thought the cat embodies the uncertainty of our knowledge and the fragility of our way of thinking about reality The cat does not belong only to physicists and philosophers In a sense Schr dinger created a tool that invites us to see connections between different disciplines physics philosophy art psychology His box becomes a metaphor for our own universe in which more questions remain than answers For example in the field of modern psychology the cat paradox is sometimes used to explain the concept of cognitive ambiguity. We easily accept the idea that some events can have more than one interpretation but it is much more difficult to accept that something can be two things at once Enclosing Schr dinger's Cat in a single interpretation is impossible but perhaps this is the true meaning that the paradox offers us It is an invitation to think differently An encouragement to push the boundaries of our certainties A reminder that the universe is infinitely complex and that like the cat our worldview is an overlay of assumptions viewpoints and mysteries yet to be explored After all the real protagonist of this story is not just the cat but ourselves How willing are we to accept that the way we look at reality might be only one of many possible versions. This is the legacy of the paradox Not the solution but the question An endless curiosity Epistemology and Probability Arkady Plotnitsky, 2009-10-20 This book offers an exploration of the relationships between epistemology and probability in the work of Niels Bohr Werner Heisenberg and Erwin Schro dinger and in quantum mechanics and in modern physics as a whole It also considers the implications of these relationships and of quantum theory itself for our understanding of the nature of human thinking and knowledge in general or the epistemological lesson of quantum mechanics as Bohr liked 1 to say These implications are radical and controversial While they have been seen as scientifically productive and intellectually liberating to some Bohr and Heisenberg among them they have been troublesome to many others such as Schro dinger and most prominently Albert Einstein Einstein famously refused to believe that God would resort to playing dice or rather to playing with nature in the way quantum mechanics appeared to suggest which is indeed quite different from playing dice According to his later sometime around 1953 remark a lesser known or commented upon but arguably more important one That the Lord should play dice all right but that He should gamble according to definite rules i e according to the rules of quantum mechanics rather than 2 by merely throwing dice that is beyond me Although Einstein's invocation of God is taken literally sometimes he was not talking about God but about the way nature works Bohr s reply on an earlier occasion to Einstein s question 1 Cf Physics. Philosophy and **Psychoanalysis** Robert S. Cohen, R. Laudan, 2012-12-06 To celebrate Adolf Griinbaum's sixtieth birthday by offering him this bouquet of essays written for this purpose was the happy task of an autonomous Editorial Committee Wesley C Salmon Nicholas Rescher Larry Laudan Carl G Hempel and Robert S Cohen To present the book within the Boston Studies in the Philosophy of Science was altogether fitting and natural for Griinbaum has been friend and supporter of philosophy of

science at Boston University for twenty five years and unofficial godfather to the Boston Colloquium To regret that we could not include contributions from all his well wishers critical admirers and admiring critics is only to regret that we did not have an encyclopedic space at the committee's disposal But we and all involved in this book speak for all the others in the philo sophical scientific and personal worlds of Adolf Griinbaum in greeting him on May 15 1983 with our wishes for his health his scholarship his happiness Our gratitude is due to Carolyn Fawcett for her care and accuracy in editing this book and for the preparation of the Index and to Elizabeth McMunn for her help again and again especially in preparation of the Bibliography of the Published Writings of Adolf Griinbaum and to Thelma Griinbaum for encouraging planning and cheering Boston University R S C Center for the Philosophy and History of Science M W W My View of the World Erwin Schrödinger, 2008-11-27 A Nobel prize winner a great man and a great scientist Erwin Schr dinger has made his mark in physics but his eye scans a far wider horizon here are two stimulating and discursive essays which summarize his philosophical views on the nature of the world Schr dinger's world view derived from the Indian writings of the Vedanta is that there is only a single consciousness of which we are all different aspects He admits that this view is mystical and metaphysical and incapable of logical deduction But he also insists that this is true of the belief in an external world capable of influencing the mind and of being influenced by it Schr dinger's world view leads naturally to a philosophy of reverence for Erwin Schrodinger Michel Bitbol, O. DARRIGOL (Ed), 1992 **Quantum Mechanics at the Crossroads** James life Evans, Alan S. Thorndike, 2006-11-02 Quantum mechanics is a beautiful strange and successful theory that originated in the 1920s The theory which Niels Bohr regarded as finished and complete has in the last few decades rapidly developed in unexpected directions An intense new focus on the stranger aspects of the theory including entanglement and nonlocality has resulted in new perceptions of the foundations of quantum mechanics as well as surprising new exploitations of quantum phenomena Historians and philosophers of science have also renewed their attention to quantum mechanics opening up its human dimensions and asking searching questions about its meaning This volume brings together new insights from different vantage points Historians of physics such as J L Heilbron philosophers of science such as Abner Shimony and Michel Bitbol and quantum physicists such as Wolfgang Ketterle and Roland Omn's join forces to tackle essential questions in quantum mechanics and its interpretation All the authors have written for a broad readership and the resulting volume will appeal to everyone wishing to keep abreast of new developments in quantum mechanics as well as its history and philosophy **Ernst** Mach's Vienna 1895-1930 J.T. Blackmore, R. Itagaki, S. Tanaka, 2013-03-14 Section Guide 1 Prolegomena 2 Biographical Sketch 3 Epistemology 4 Textbook Ontology 1 PROLEGOMENA While both philosophers and historians almost always love truth and the search for truth and both often carry out extensive research there can be noticeable differences when historians write about the history of philosophy and when philosophers write about it Philosophers often look at the past with categories and interests taken from the present or at the least from the recent past but many historians especially those who

love research for its own sake will try to look at the past from a perspective either from that period or from even earlier Both camps look for roots but view them with different lenses and presupposi tions This prolegomena has been added to prepare some philosophers for what will hopefully only be the mildest of shocks for seeing the history of philosophy in a way which does not treat what is recent or latest as best but which loves the context of ideas for its own sake a context which can be very foreign to contemporary likes and dislikes To be sure we historians can deceive ourselves as easily as philosophers but Erwin Schrödinger's World View Johann Götschl, 2012-12-06 Erwin Schr dinger is we tend to do so about different things one of the greatest figures of theoretical physics but there is another side to the man not only did his work revolutionize physics it also radiacally changed the foundations of our modern worldview modern biology philosophy of science philosophy of the mind and epistemology This book explores the lesser known aspects of Schr dinger's thought revealing the physicist as a philosopher and polymath whose highly original ideas anticipated the current merging of the natural and the social sciences and the humanities Thirteen renowned scientists and philosophers have contributed to the volume Part I reveals the philosophical importance of Schr dinger's work as a physicist Part II examines his theory of life and of the self organization of matter Part III shows how Schr dinger's ideas have influenced contemporary philosophy of nature and our modern view of the world drawing a fascinating picture of the ongoing synthesis of nature and culture one of the most interesting developments of modern thought The volume also contains the most comprehensive bibliography of Schr dinger's scientific work making it at the same time a book of acute contemporary relevance and a major work of reference Physics Jeremy Butterfield, John Earman, 2007 The ambition of this volume is twofold to provide a comprehensive overview of the field and to serve as an indispensable reference work for anyone who wants to work in it For example any philosopher who hopes to make a contribution to the topic of the classical quantum correspondence will have to begin by consulting Klaas Landsman's chapter The organization of this volume as well as the choice of topics is based on the conviction that the important problems in the philosophy of physics arise from studying the foundations of the fundamental theories of physics It follows that there is no sharp line to be drawn between philosophy of physics and physics itself Some of the best work in the philosophy of physics is being done by physicists as witnessed by the fact that several of the contributors to the volume are theoretical physicists viz Ellis Emch Harvey Landsman Rovelli t Hooft the last of whom is a Nobel laureate Key features Definitive discussions of the philosophical implications of modern physics Masterly expositions of the fundamental theories of modern physics Covers all three main pillars of modern physics relativity theory quantum theory and thermal physics Covers the new sciences grown from these theories for example cosmology from relativity theory and quantum information and quantum computing from quantum theory Contains special Chapters that address crucial topics that arise in several different theories such as symmetry and determinism Written by very distinguished theoretical physicists including a Nobel Laureate as well as by philosophers Definitive discussions of the philosophical implications of modern physics Masterly expositions of

the fundamental theories of modern physics Covers all three main pillars of modern physics relativity theory quantum theory and thermal physics Covers the new sciences that have grown from these theories for example cosmology from relativity theory and quantum information and quantum computing from quantum theory Contains special Chapters that address crucial topics that arise in several different theories such as symmetry and determinism Written by very distinguished theoretical physicists including a Nobel Laureate as well as by philosophers A Bridge between Conceptual Frameworks Raffaele Pisano, 2015-06-30 This book analyzes scientific problems within the history of physics engineering chemistry astronomy and medicine correlated with technological applications in the social context When and how is tension between disciplines explicitly practised What is the conceptual bridge between science researches and the organization of technological researches in the development of industrial applications. The authors explain various ways in which the sciences allowed advanced modelling on the one hand and the development of new technological ideas on the other hand An emphasis on the role played by mechanisms production methods and instruments bestows a benefit on historical and scientific discourse theories institutions universities schools for engineers social implications as well Scholars from different traditions discuss the emergency style of thinking in methodology and in theoretical perspective aim to gather and re evaluate the current thinking on this subject It brings together contributions from leading experts in the field and gives much needed insight into the subject from a historical point of view The volume composition makes for absorbing reading for historians philosophers and scientists **Physics and Philosophy** Werner Heisenberg, 2007-05-08 Presents German physicist Werner Heisenberg s 1958 text in which he discusses the philosophical implications and social consequences of quantum mechanics and other physical theories The Principles of Quantum Theory, From Planck's Quanta to the Higgs Boson Arkady Plotnitsky, 2016-09-26 The book considers foundational thinking in quantum theory focusing on the role the fundamental principles and principle thinking there including thinking that leads to the invention of new principles which is the book contends one of the ultimate achievements of theoretical thinking in physics and beyond The focus on principles prominent during the rise and in the immediate aftermath of quantum theory has been uncommon in more recent discussions and debates concerning it The book argues however that exploring the fundamental principles and principle thinking is exceptionally helpful in addressing the key issues at stake in quantum foundations and the seemingly interminable debates concerning them Principle thinking led to major breakthroughs throughout the history of quantum theory beginning with the old quantum theory and quantum mechanics the first definitive quantum theory which it remains within its proper nonrelativistic scope It has the book also argues been equally important in quantum field theory which has been the frontier of quantum theory for quite a while now and more recently in quantum information theory where principle thinking was given new prominence The approach allows the book to develop a new understanding of both the history and philosophy of quantum theory from Planck's quantum to the Higgs boson and beyond and of the thinking the key founding figures such as

Einstein Bohr Heisenberg Schr dinger and Dirac as well as some among more recent theorists The book also extensively considers the nature of quantum probability and contains a new interpretation of quantum mechanics the statistical Copenhagen interpretation Overall the book's argument is guided by what Heisenberg called the spirit of Copenhagen which is defined by three great divorces from the preceding foundational thinking in physics reality from realism probability from causality and locality from relativity and defined the fundamental principles of quantum theory accordingly Laws, and Structures Dennis Dieks, Wenceslao J. Gonzalez, Stephan Hartmann, Michael Stöltzner, Marcel Weber, 2012-02-02 This volume the third in this Springer series contains selected papers from the four workshops organized by the ESF Research Networking Programme The Philosophy of Science in a European Perspective PSE in 2010 Pluralism in the Foundations of Statistics Points of Contact between the Philosophy of Physics and the Philosophy of Biology The Debate on Mathematical Modeling in the Social Sciences Historical Debates about Logic Probability and Statistics The volume is accordingly divided in four sections each of them containing papers coming from the workshop focusing on one of these themes While the programme s core topic for the year 2010 was probability and statistics the organizers of the workshops embraced the opportunity of building bridges to more or less closely connected issues in general philosophy of science philosophy of physics and philosophy of the special sciences However papers that analyze the concept of probability for various philosophical purposes are clearly a major theme in this volume as it was in the previous volumes of the same series This reflects the impressive productivity of probabilistic approaches in the philosophy of science which form an important part of what has become known as formal epistemology although of course there are non probabilistic approaches in formal epistemology as well It is probably fair to say that Europe has been particularly strong in this area of philosophy in recent Identity in Physics Steven French, Décio Krause, 2006-06-22 Can quantum particles be regarded as individuals vears just like books tables and people According to the received view articulated by several physicists in the immediate aftermath of the quantum revolution quantum physics itself tells us they cannot quantum particles unlike their classical counterparts must be regarded as non individuals in some sense However recent work has indicated that this is not the whole story and that the theory is also consistent with the position that such particles can be taken to be individuals albeit at a metaphysical price Drawing on philosophical accounts of identity and individuality as well as the histories of both classical and quantum physics the authors explore these two alternative metaphysical packages In particular they argue that if quantum particles are regarded as individuals then Leibniz s famous Principle of the Identity of Indiscernibles is in fact violated Recent discussions of this conclusion are analysed in detail and again the costs involved in saving the Principle are carefully considered Taking the alternative package the authors deploy recent work in non standard logic and set theory to indicate how we can make sense of the idea that objects can be non individuals. The concluding chapter suggests how these results might then be extended to quantum field theory Identity in Physics brings together a range of work in this area and further

develops the authors own contributions to the debate Uniquely as the title indicates it situates this work in the appropriate formal historical and philosophical contexts **Niels Bohr and the Philosophy of Physics** Jan Faye, Henry Folse, 2017-10-19 Niels Bohr and Philosophy of Physics Twenty First Century Perspectives examines the philosophical views influences and legacy of the Nobel Prize physicist and philosophical spokesman of the quantum revolution Niels Bohr The sixteen contributions in this collection by some of the best contemporary philosophers and physicists writing on Bohr's philosophy today all carefully distinguish his subtle and unique interpretation of quantum mechanics from views often imputed to him under the banner of the Copenhagen Interpretation With respect to philosophical influences on Bohr s outlook the contributors analyse prominent similarities between his viewpoint and Kantian ways of thinking the views of the Danish philosopher Harald H ffding and themes characteristic of American pragmatism In recognizing the importance of Bohr's epistemological naturalism they examine his defence of the indispensability of classical concepts from a variety of different perspectives This collection shows us that Bohr s interpretation of quantum mechanics now nearly a century old still has the power to shed light on a variety of issues that have arisen only since his lifetime as well as decoherence theory and other non collapse interpretations Balancing historical themes with contemporary discussions Niels Bohr and the Philosophy of Physics establishes Bohr s on going contribution to the philosophy of physics and examines his place in the history of Revolutionary Changes in Understanding Man and Society Johann Götschl, 2012-12-06 JOHANN philosophy GOTSCHL Over the last decades social philosophers economists sociologists utility and game theorists biologists mathematicians moral philosophers and philosophers have created totally new concepts and methods of understanding the function and role of humans in their modern societies. The years between 1953 and 1990 brought drastic changes in the scientific foundations and dynamic of today s society A burst of entirely new revolutionary ideas similar to those which heralded the beginning of the twentieth century in physics dominates the picture This book also discusses the ongoing refutation of old concepts in the social sciences Some of them are the traditional concepts of rationality for example based on maximization of interests the linearity of axiomatic methods methodological individualism and the concept of a static society Today the revolutionary change from a static view of our society to an evolutionary one reverberates through all social sciences and will dominate the twenty first century In an uncertain and risky world where cooperation and teamwork is getting more and more important one cannot any longer call the maximization of one s own expectations of utility or interests rational Constituting Objectivity Michael Bitbol, Pierre Kerszberg, Jean Petitot, 2009-03-29 In recent years many philosophers of modern physics came to the conclusion that the problem of how objectivity is constituted rather than merely given can no longer be avoided and therefore that a transcendental approach in the spirit of Kant is now philosophically relevant The usual excuse for skipping this task is that the historical form given by Kant to transcendental epistemology has been challenged by Relativity and Quantum Physics However the true challenge is not to force modern physics into a rigidly

construed static version of Kant's philosophy but to provide Kant's method with flexibility and generality In this book the top specialists of the field pin down the methodological core of transcendental epistemology that must be used in order to throw light on the foundations of modern physics First the basic tools Kant used for his transcendental reading of Newtonian Mechanics are examined and then early transcendental approaches of Relativistic and Quantum Physics are revisited Transcendental procedures are also applied to contemporary physics and this renewed transcendental interpretation is finally compared with structural realism and constructive empiricism. The book will be of interest to scientists historians and philosophers who are involved in the foundational problems of modern physics 'Nature and the Greeks' and 'Science and Humanism' Erwin Schrödinger, 2014-11-06 The text of two series of lectures given by one of the great philosopher scientists of the twentieth century Foundations and Interpretation of Quantum Mechanics Gennaro Auletta, Giorgio Parisi, 2001 The aim of this book is twofold to provide a comprehensive account of the foundations of the theory and to outline a theoretical and philosophical interpretation suggested from the results of the last twenty years There is a need to provide an account of the foundations of the theory because recent experience has largely confirmed the theory and offered a wealth of new discoveries and possibilities On the other side the following results have generated a new basis for discussing the problem of the interpretation the new developments in measurement theory the experimental generation of Schr dinger cats recent developments which allow for the first time the simultaneous measurement of complementary observables quantum information processing teleportation and computation To accomplish this task the book combines historical systematic and thematic approaches

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Schrodingers Philosophy Of Quantum Mechanics Introduction

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