

Quantum modeling: The real and the mathematical

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ABSTRACT

The records of mathematical modeling doors physics have been ruled via way of means of using classical mathematical fashions, C-fashions, usually the ones of a probabilistic or statistical nature. More recently, however, quantum mathematical fashions, Q-fashions, primarily based totally withinside the mathematical formalism of quantum principle have grown to be extra outstanding in psychology, economics, and selection technological know-how. The use of Q-fashions in those fields stays controversial, in element as it isn't always totally clear whether or not Q-fashions are important for handling the phenomena in the query or whether or not C-fashions could nonetheless suffice. My aim, however, isn't always to evaluate the need for Q-fashions in those fields, but alternatively to mirror what the feasible applicability of Q-fashions may also inform us approximately the corresponding phenomena there, vis-à-vis quantum phenomena in physics. To do so, I shall first speak about the important thing motives for using Q-fashions in physics. In particular, I shall look at the essential concepts that caused the improvement of quantum mechanics. Then I shall don't forget a likely function of comparable concepts in the use of Q-fashions doors physics.

Psychology, economics, and selection technological know-how borrow already to be had Q-fashions from quantum principle, instead of deriving them from their inner concepts, whilst quantum mechanics changed into derived from such concepts, due to the fact there has been no quite simply to be had mathematical version to deal with quantum phenomena, even though the arithmetic at the end utilized in quantum did in truth exist then. I shall argue, however, that the precept angle on mathematical modeling doors physics would possibly assist us to recognize higher the function of Q-fashions in those fields and likely to examine new fashions, conceptually analogous to however mathematically distinct from the ones of quantum principle, that can be useful or may be important there or in physics itself. I shall, in closing, endorse one feasible form of such fashions, singularized probabilistic fashions, SP-fashions, several of which can be time-dependent, TDSP-fashions. The necessity of the use of such fashions may also extrude the character of mathematical modeling in technological know-how and, thus, the character of technological know-how, because it passed off withinside the case of Q-fashions, which now no longer simplest caused an innovative transformation of physics however additionally opened new opportunities for clinical wondering and mathematical modeling past beyond physics.

INTRODUCTION

The records of mathematical modeling outdoor physics have been ruled through classical mathematical fashions, C-fashions, primarily based totally on mathematical fashions evolved in classical physics, especially probabilistic or statistical fashions, borrowed from classical statistical physics or chaos and complexity theories. More recently, fashions are primarily based totally withinside the mathematical formalism of quantum concept, Q-fashions, in general, are borrowed from quantum mechanics however on occasion additionally quantum discipline concepts, have become extra modern outdoor physics, mainly in psychology, economics, and choice technological know-how, the fields (past physics). My abbreviations follow P. Dirac's difference between c-numbers (classical numbers) and q-numbers (quantum numbers), due to the fact the variables uti-

zed in Q-fashions are in truth q-numbers. Quantum mechanics and Q-fashions are primarily based totally withinside the arithmetic of Hilbert areas over-complicated numbers, C, with Hilbert-area operators used as bodily variables withinside the equations of quantum mechanics, as in opposition to capabilities of actual (mathematical) variables, c-numbers, that function bodily variables in classical physics. The use of Q-fashions in those fields stays controversial, as it isn't always completely clear whether or not they're essential for handling the phenomena in the query or whether or not C-fashions might suffice. It is authentic that debates and every so often controversies have additionally followed quantum mechanics when you consider that it's beginning in 1925. These debates, initiated through the well-known disagreement among N. Bohr and A. Einstein on, in Bohr's words, "epistemological issues in atomic ph-

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ysics,” used withinside the name of his account of this disagreement. However, as Bohr's word indicates, the motives for those controversies had been in general philosophical. The effectiveness of quantum mechanics or higher-degree quantum theories, together with quantum discipline concepts, has now no longer been in query: they're a few of the best-showed theories in physics. The state of affairs is exceptional in psychology, economics, and choice technological know-how, in which it's miles the medical effectiveness or at the least necessity of Q-fashions this is doubted. My goal here, however, isn't always to evaluate this effectiveness or necessity, however as an alternative to mirror what the feasible applicability of Q-fashions may also inform us approximately the corresponding phenomena in those fields vis-à-vis quantum phenomena in physics. To do so, I shall first recall the important thing motives for using Q-fashions in physics. In particular, I shall take a look at the essential concepts that grounded and certainly brought about the improvement of the quantum concept. Then I shall recall a probable position of comparable concepts in the usage of Q-fashions past quantum concepts. My emphases are because of the truth that psychology, economics, and choice technological know-how borrow already to be had Q-fashions from quantum concept, as opposed to deriving them from their very own essential concepts, at the same time as quantum mechanics after which quantum discipline concept had been derived from such concepts. This isn't always unexpected due to the fact there has been on the time no to be had mathematical version or (an extra preferred

concept, which incorporates an interpretation of the version used) concept to efficaciously deal with quantum phenomena. The “vintage quantum concept” of M. Planck, A. Einstein, N. Bohr, and A. Sommerfeld, which ushered with inside the quantum revolution, have become glaringly insufficient by the point W. Heisenberg started his paintings on quantum mechanics that he found in 1925. For the motives defined below (ordinarily a look for an extra rigorous derivation of the formalism), the studies in quantum foundations remain involved with deriving quantum concepts from such concepts, a task in component influenced through the upward thrust of quantum facts concept. That does now no longer appear like a widespread issue in outdoor physics in which using Q-fashions is influenced in general through their predictive capacity, that's of the route essential attention in physics as well. It may also, however, be useful to recall the deeper motives for the feasible use of Q-fashions in those fields, or, in phrases of my name, the actual that offers an upward thrust to the mathematical of Q-fashions there. The precept angle on mathematical modeling past physics would possibly assist us to do that and probable to examine new, post-quantum, fashions there or maybe in physics. I shall, in closing, advocate one feasible sort of such fashions, singularized probabilistic fashions, SP-fashions, several which might be time-dependent, TDSP-fashions, and recall their implications for mathematical modeling in technological know-howand our knowledge of the character of science.