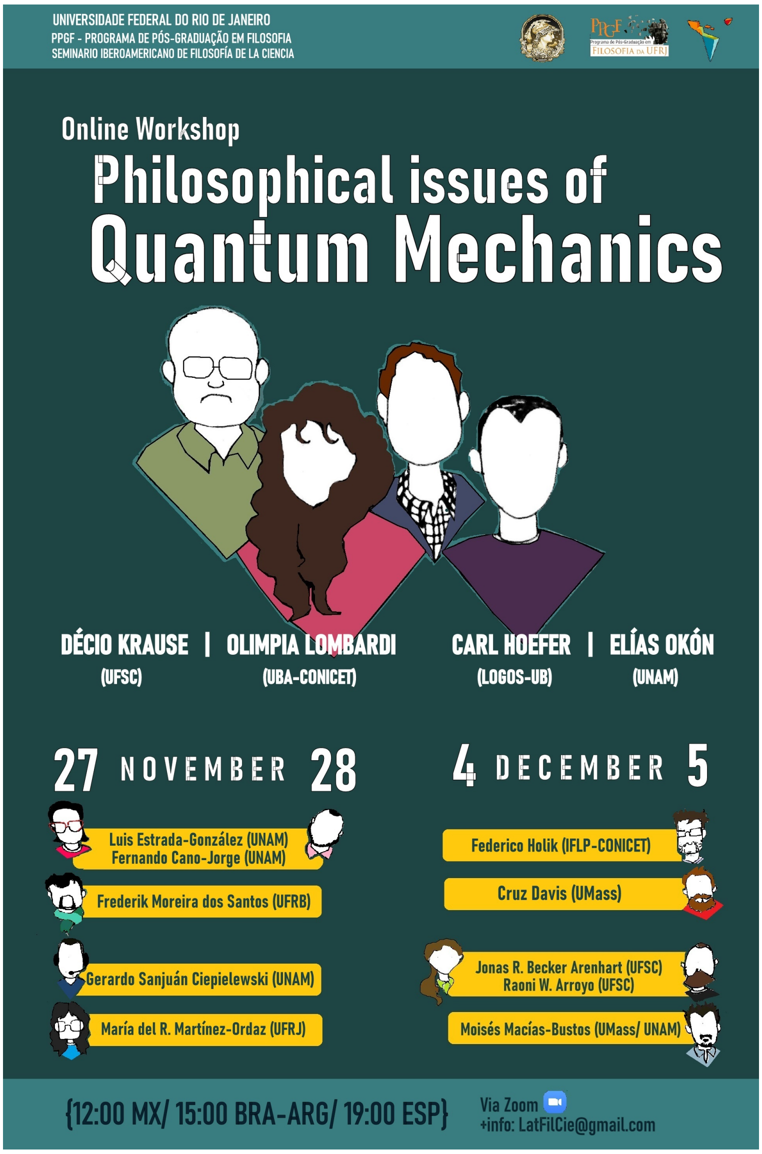
PROGRAM & ABSTRACTS



P R O G R A M

Philosophical Issues of Quantum Mechanics

Universidade Federal do Rio de Janeiro

12:00 MX/ 15:00 BRA-ARG/ 19:00 ESP
Zoom Meeting ID: 829 5473 2274
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27-11-2020

Décio Krause (UFSC)

(35 min) "Identity and Individuality in Quantum Physics"
(20 min) Q &A

Luis Estrada González (UNAM) & Fernando Cano Jorge (UNAM)

(20 min) "Principios de expansión en teoremas de imposibilidad: el caso de CHSH"
(15 min) Q&A

Frederik Moreira dos Santos (UFRB)

(20 min) "Would decoherence be considered a well would-be to be a type?"
(15 min) Q&A

28-11-2020

Olimpia Lombardi (UBA-CONICET)

(35 min) "The Modal-Hamiltonian interpretation of quantum mechanics"
(20 min) Q&A

Carlos Gerardo Sanjuán Ciepielewski (UNAM)

(20 min) ""Superdeterminismo y Toy Models""
(15 min) Q&A

María del Rosario Martínez Ordaz (UFRJ)

(20 min) "Can we use a contradictions right from the start methodology?"
(15 min) Q&A

04-12-2020

Carl Hoefer (LOGOS-UB)

(35 min) "Quantum non-locality and Realism (Scientific and Metaphysical)"
(20 min) Q&A

Federico Holik (IFLP-CONICET)

(20 min) "Acerca de los presupuestos del teorema de Kochen-Specker"
(15 min) Q&A

Cruz Davis (UMass-Amherst)

(20 min) "Many One Identity and Particle Non-Individuality"
(15 min) Q&A

05-12-2020

Elias Okon (UNAM)

(35 min) "Bell's theorem, non-locality and superdeterminism"
(20 min) Q&A

Jonas R. Becker Arenhart (UFSC) & Raoni W. Arroyo (UFSC)

(20 min) "How not to connect non-individuality and quantum mechanics"
(15 min) Q&A

Moisés Macías Bustos (UMass-Amherst/UNAM)

(20 min) "From simplicity to scientific realism The case of Standard Quantum Mechanics"
(15 min) Q&A

A B S T R A C T S

Philosophical Issues of Quantum Mechanics

Universidade Federal do Rio de Janeiro

Novembro 27, 28 & Decembro 04,05. 2020.

Identity and Individuality in Quantum Mechanics

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"Physical theories are about things."

Sunny Auyang [1, p.152]

By rejecting the instrumentalistic view, we accept that quantum mechanics (QM) speaks of something, and let us call these things quantum objects (particles and waves in orthodox QM and quantum fields in QFTs – quantum field theories; but here we shall be restricted to orthodox QM). According to most formulations of QM, these entities are to be taken as non-individuals [3, 12, 13], as entities devoid of identity conditions, although they can be isolated and satisfy some metaphysical individuality principle. This leads us to consider the concept of identity, and to the distinction between these three notions, usually taken as implying one each other: identity, individuality, and individuation (isolation) [12]; in particular, we need to consider the question: of what identity are we speaking about, which by hypothesis quantum objects supposedly lack? There is an intuitive notion of identity, let us call it the metaphysical identity, usually associated to numerical identity: two things are numerically (or metaphysically) identical if and only if (iff) they are the same thing, that is, there are no two things but just one. As is known, we cannot formalize or define this notion in first-order languages. Higher-order languages also present problems, for it is impossible to distinguish identity (defined by Leibniz law) and indistinguishability (agreement with respect to all properties) by syntactical means. Thus in a formal discourse (essential for precision and for foundational issues), all we can do is to keep with the 'identity' we can define (either by axioms or by standard definitions), and this notion is not suitable for QM. Really, QM (I will not consider Bohm's QM in this talk), quantum objects may be indiscernible without being (metaphysically) identical, so the notion of identity grasped by classical logic is not proper, for it equals these concepts. We need a different mathematics, and it exists, grounded on non-reflexive logics [3, Chap.8] and quasi-set theory [3, Chap.7], [6]. As it has been put up in several works, we can reconstruct QM and QFTs (the Fock space formalism) [2, 4] within such a framework with lots of philosophical consequences.

In the talk, I shall speak of these notions and motivate the study of further philosophical questions in QM, mainly in what concerns the three notions mentioned above and their formal considerations.

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Principios de expansión en teoremas de imposibilidad: el caso de CHSH

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It is widely known that some concepts and propositions are defective only relative to a specific background logic —standard or "classical" logic in most cases— and that they make (more) sense under another logic. Nonetheless, all those examples belong to the so-called "formal realm". The natural question then is whether there are any prospects of finding similar cases in other areas of scientific inquiry. In this paper, we examine Routley/Sylvan's suggestion that the logic to be employed in quantum mechanics is a relevance logic, and how that would affect the plausibility of certain ideas in the scope of no-go theorems like Bell's.

Would decoherence be considered a well would-be to be a type?

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In this presentation I build a historical-conceptual narrative comparing the discussions about the nature of time present in Bergson reflections (inspired on Zeno's paradox) and the discussion about the nature of quantum entities, such as, the collapse of the wave function in the measurement process. Firstly, I argue that despite of physicists did not deal with this controversy, they use several tokens to instance a type in a problematic way. The approaching between the pragmatic use of the type "time" well fixed in ordinary language and the use of concepts like synchronicity and variation of time are crucial to practical goals in measurement processes and theoretical claims, allowed physicist to take different tokens to represent this physical entity. Quantum theory has a worse situation because there is no would-be entity or type to set theoretical or empirical processes or tokens in the double split experiment outcomes, however in classical and ordinary experiences they share a same type, such as, a wave. In this presentation I wonder if decoherence process would be a possible would-be to be considered as a type. I will present reasons that demonstrate why I believe this is not the case.

The Modal-Hamiltonian interpretation of quantum mechanics

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As it is well-known in the philosophy of physics community, traditional modal interpretations do not pick out the right properties for the apparatus in non-ideal measurements, that is, in measurements that do not introduce a perfect correlation between the possible states of the measured system and the possible states of the measuring apparatus. Since ideal measurement is a situation that can never be achieved in practice, this shortcoming was considered a “silver bullet” for killing modal interpretations. Perhaps these problems explain the decline of the interest in modal interpretations since the end of the 90’s. Jeffrey Bub’s preference for Bohmian mechanics in those days can be understood in this context: given the difficulties of those traditional modal interpretations whose preferred context depends on the state of the system, the natural alternative for a realist is Bohmian mechanics, which can be conceived as a member of the modal family whose preferred context is a priori defined by the position observable. But position is not the only observable that can be appealed to in order to define the state-independent preferred context of a modal interpretation.
The purpose of this talk is to introduce the Modal-Hamiltonian Interpretation (MHI) of quantum mechanics, which belongs to the “modal family” and endows the Hamiltonian of the system with a central role in the identification of the preferred context. This makes the MHI immune to the non-ideal measurement’s “silver bullet”, since it accounts for ideal and non-ideal measurements. Furthermore, the MHI also supplies a criterion to distinguish between reliable and non-reliable measurements in the non-ideal case. Moreover, the MHI can be reformulated under an explicitly Galilean-invariant form in terms of the Casimir operators of the Galilean group. Such a reformulation not only leads to results that agree with usual assumptions in the practice of physics, but also suggests the extrapolation of the interpretation to quantum field theory by changing accordingly the symmetry group, in this case, the Poincaré group. Finally, the MHI provides a “global” solution to the ontological problems of quantum mechanics in terms of a quantum ontology of properties.

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Superdeterminismo y Toy Models

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En años recientes, el interés por la posibilidad de evadir la no-localidad del teorema de Bell a partir de negar una de sus suposiciones conocida como independencia de ajustes (IA) (settings independence) (también conocida como measurement independence o freedom of choice) ha crecido. IA mantiene que la distribución de probabilidad del estado a medir es independiente de los ajustes de los aparatos de medición de Alice y Bob.

El hecho de que el teorema de Bell asume IA no es algo nuevo. Clauser y Horne notaron la presencia implícita de esta suposición en el teorema (Clauser and Horne, 1974) y Bell mismo la discutió de forma explícita en (Bell, 1977). La novedad está—al menos parcialmente |en la aparición de varios "modelos" superdeterministas (modelos que postulan que la violación de IA se debe al pasado común entre los ajustes de aparatos de medición y el estado λ a medir) que supuestamente ofrecen evidencia a favor de la posibilidad del superdeterminismo (Brans, 1988; Hall, 2010a, 2011, 2010b; Pütz et al., 2014; Pütz and Gisin, 2016; Vervoort, 2013; Weinstein, 2009; Friedman et al., 2019).

En este trabajo evaluaré la relevancia de estos modelos para el debate general sobre la no-localidad y la posibilidad del superdeterminismo. Argumentaré que los modelos, contrario a lo que sus defensores mantienen, nos dicen poco sobre la viabilidad del superdeterminismo. Primero, mostraré que el posibilidad de derivar violaciones de las desigualdades de Bell a partir de violar IA es algo que ya se habia hecho desde los 70 en [Shimony *et al*. (1976)]. Segundo, argumentaré que es trivial mostrar que una teoría de variables ocultas superdeterminista puede hacer las mismas predicciones que la mecánica cuántica. Por último, argumentaré que la parte más divulgada de los modelos superdeterministas −su capacidad de cuantificar la cantidad de violación de IA necesaria para conseguir violaciones de las desigualdades de Bell −no ofrece ninguna razón para creer en el superdeterminismo.

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Can we use a *contradictions right from the start* methodology?

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Here we tackle the question under which circumstances, if any, should physicists adopt a methodology that accepts a contradictions right from the start in order to achieve better understanding of the quantum phenomena?

Da Costa and de Ronde (2013) have argued in favor of developing an interpretation of superposition which, 'right from the start', takes contradictions to be a privileged element of the structured of Quantum Mechanics. According to them, a contradictions right from the start methodology can help physicists to take seriously the features which the theory seems to show, and with it, to explain out some of the alleged anomalies of the theory and its interpretations. If they are in the right, there would be two important outcomes associated to their proposal: on the one hand, to adopt a methodology of this kind would help physicists to achieve better understanding of the quantum realm. On the other hand, philosophers would have helped physicists do develop a novel approach to their object of study, and this would reinforce the idea that philosophy has an important impact in the development of the sciences. The combination of these facts leaves us with the impression that the study of proposals such as the contradictions right from the start methodology deserve significant attention. Hence the importance of addressing this issue here.

In what follows, we describe in detail what a contradictions right from the start methodology should be and we provide a general guide for adopting such a methodological approach in quantum physics.

In order to do so, we proceed as follows: First we introduce the contradictions right from the start methodology as it was presented by da Costa and de Ronde, then we extend it into a more cohesive proposal of what this methodology should be in order to be relevant for the physicists' practice. Second, we challenge the scope of this methodology by using it to tackle one of the most important problems of the GRW dynamical-collapse theory, namely, the 'problem of tails' (Albert and Loewer 1990, Wallace 2014). We reconstruct in terms of contradictions the problem of tails (in the form of both the problem of bare tails and the problem of structured tails). Third, we evaluate this methodology's usefulness for explanation of this problem and contend that while the approach promises to enhance our explanatory power it's not straightforward how it applies to these cases and whether it succeeds. Finally, we draw some remarks on the contexts in which physicists could (and should) adopt this methodology in order to achieve better understanding of the quantum phenomena.

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Quantum non-locality and Realism (Scientific and Metaphysical)

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Acerca de los presupuestos del teorema de Kochen-Specker

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El teorema de Kochen-Specker (KS) juega un rol fundamental en muchas interpretaciones del formalismo cuántico (ver por ejemplo, [2] y [3]). Por otro lado, el problema de la indistinguibilidad cuántica, ha despertado un acalorado debate en la literatura de la filosofía de la física acerca del estatus de los sistemas cuánticos en tanto individuos [4]. En esta charla, luego de presentar una rápida revisión del teorema de KS y de sus versiones más populares, nos enfocaremos en el rol que juega la noción de individualidad en las hipótesis que llevan a la contradicción. Discutiremos también las consecuencias de nuestro análisis para el problema de la contextualidad cuántica.

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Many One Identity and Particle Non-Individuality

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Several arguments from quantum theory lead to the conclusion that particles are entities which lack identities. The fundamental particles that make up the objects in the physical world are non-individuals. I explore what consequences the non-individual conception of sub-atomic particles has on the nature of the composition relation. In particular, I argue that if particles are non-individuals, then the composition relation cannot be the identity relation. I will briefly argue that similar considerations undercut other important principles often thought to govern the composition relation.

Bell’s theorem, non-locality and superdeterminism

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Relying on some auxiliary assumptions, usually considered mild, Bell’s theorem proves that no local theory can reproduce all the predictions of quantum mechanics. In this talk, I will introduce a fully local, superdeterministic model that, by explicitly violating settings independence—one of these auxiliary assumptions, requiring statistical independence between measurement settings and systems to be measured—is able to reproduce all the predictions of quantum mechanics. Moreover, I will show that, contrary to widespread expectations, the proposed model can break settings independence without an initial state that is too complex to handle, without visibly losing all explanatory power and without outright nullifying all of experimental science. Still, I will argue that the model is unnecessarily complicated and does not offer true advantages over its non-local competitors. I will conclude that, while the introduced model does not appear to be a strong contender to their non-local counterparts, it provides the ideal framework to advance the debate over violations of statistical independence via the superdeterministic route.

How not to connect non-individuality and quantum mechanics

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Ever since its beginnings, standard quantum mechanics has been associated with a metaphysical view according to which the theory deals with non-individual objects, i.e. objects deprived of individuality in some sense of the term. Many of the

founding fathers of the theory suggested that a metaphysics of non-individuals generates a radical contrast between quantum and classical objects, tying very closely quantum mechanics and non-individuality. We shall examine the grounds of the claim according to which quantum mechanics advances such a metaphysics of non-individuals. We discuss the attempts to learn 'metaphysical lesson' from physics in three directions: from the formalism of the theory including the underlying logic; from the ontology of the theory, understood as the furniture of the world according to the theory; and, at last, we analyze whether a metaphysics of non-individuals is indispensable from a purely metaphysical point of view, by evaluating arguments to the effect that the theory forces this view on us. We argue that non-individuality is not to be found imposed on us in any of these levels, so it should be seen as a metaphysical addition to the theory, rather than as a lesson from it.

From simplicity to scientific realism The case of Standard Quantum Mechanics

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Here we contend that, contrary to what our intuition might dictate, the most important downside of the fulfillment of simplicity associated to empirical success is that it leaves some of our most successful empirical theories in such a position in which they cannot be considered to be full-fledged theories of the physical world –being Quantum Mechanics (QM) the best example of this. We argue that QM importantly fulfills the simplicity requirement; however, the QM basic algorithm posits laws of evolution and while its ontology is simple in application: its simplicity is only apparent.

Organizadores

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