

## **Causal and Classical Concepts in Science: II International Workshop**

## **Conceptos Clásicos y Causales en la Ciencia: II Encuentro Internacional**

### **PROBABILITIES, CAUSALITY AND PROPENSITIES IN PHYSICS / PROBABILIDAD, CAUSALIDAD Y PROPENSIONES EN LA FÍSICA**

Salón de Grados, Facultad de Filosofía, Universidad Complutense de Madrid

6 y 7 de Octubre de 2006

Contact / Información: Mauricio Suárez, Dept. of Logic and Philosophy of Science / Departamento Lógica y Filosofía de la Ciencia ([msuarez@filos.ucm.es](mailto:msuarez@filos.ucm.es), 650 577847)

Funding / Patrocinador: Ministerio de Educación y Ciencia (Proyecto de Investigación HUM2005-07187-C03).

Tentative Programme / Programa provisional:

#### **Friday 6th October / Viernes 6 de Octubre 2006**

12:00 Introduction / Presentación

12:15 – 13:30 STEPHAN HARTMANN (London School of Economics)

13:30 – 15:00 COMIDA / LUNCH

15 :00 – 16:15 SORIN BANGU (University of Toronto)

16 :15 – 17 :30 MARIA CRUZ BOSCA (Universidad de Granada)

17 :30 – 18 :00 DESCANSO / BREAK

18 :00 – 19 :15 ROMAN FRIGG (London School of Economics)

#### **Saturday 7th October / Sábado 7 de Octubre 2006**

10 :00 – 10:30 IÑAKI SAN PEDRO (Universidad Complutense)

10 :30 – 11 :45 JACQUES DUBUCS (IHPST, Paris I / CNRS /ENS)

11:45 – 12:15 DESCANSO / BREAK

12:15 – 13:30 MAURO DORATO (Universit  degli Studi Roma III)

***RES MENES Y BIOGRAF AS /  
ABSTRACTS AND BIOSKETCHES***

**Sorin Bangu**

University of Toronto

*Physical Symmetries and Probability Assignments*

Abstract

In this paper I analyze a special kind of inference, the assignment of probabilities on the basis of symmetries. This kind of inference involves (versions of) the Principle of Indifference, which prescribes to assign two outcomes equal probability when presented with symmetrically-balanced evidence in favor of each. While the history of physics features episodes in which its application led to important successes (the prediction of the viscosity of a gas within the kinetic theory, the transition from Boltzmann statistics to Bose-Einstein statistics, etc.), the principle is subject to serious objections from Bertrand-type paradoxes. The paper examines the possible ways to reconcile the apparent logical inconsistency of the principle with its effectiveness in physics.

Biography

Sorin Bangu holds a PhD in Philosophy from the University of Toronto and is at present a Post-doctoral Fellow at the same university. His main work is in philosophy of science, philosophy of mathematics and metaphysics. He published a couple of papers in these areas, dealing mainly with issues related to the applicability of mathematics to physics. *Physical Symmetries and Probability Assignments*

**Mari Cruz Bosc **

Universidad de Granada

*La dualidad onda-corp sculo frente a la  ptica cu ntica*

Abstract

El prop sito de la charla que presentamos es analizar el concepto de la dualidad onda –corp sculo a la luz de determinados experimentos realizados en  ptica cu ntica. Para ello comenzaremos por discutir el significado de dicha dualidad, distinguiendo entre su concepci n est ndar, la de Bohr, y la menos conocida de Heisenberg. Esta inicial distinci n nos permitir  pasar a establecer las

diferencias entre los conceptos de dualidad onda-corpúsculo y complementariedad, estableciendo como errónea la identificación muchas veces mantenida entre ambos, cuya raíz es la extendida confusión entre las ideas de Bohr y la denominada interpretación de Copenhague. Finalmente, a través de la exposición de varios experimentos realizados a partir de los 90 en óptica cuántica, concluiremos que algunas de las ideas de Bohr al respecto no pueden ya mantenerse, sugiriendo que pudiera haber llegado el momento de abordar un cambio radical en la terminología relacionada.

### Biography

María Cruz Boscá es actualmente Profesora Titular de Física Atómica, Molecular y Nuclear en la Universidad de Granada, España. Tras realizar estudios de Física y Filosofía y doctorarse en Física Nuclear, trabajó extensamente en teoría de muchos cuerpos, tema en el que ha publicado numerosos artículos. En los últimos años ha iniciado investigaciones en filosofía de la ciencia, centrándose en los fundamentos filosóficos de la física cuántica.

### **Mauro Dorato**

Università degli Studi "Roma 3"

*Do dispositions and propensities have a role in the ontology of quantum mechanics?*

### Abstract

In order to tackle this question – notoriously answered in the positive, among others, by Heisenberg, Margenau, Popper and Redhead – I start by trying to relate the puzzling metaphysical distinction between dispositional and non-dispositional properties to the formalism of the theory. Since any answer posed by the title must be interpretation-dependent, I review some of the main interpretations of QM in order to argue that the ontology of theories regarding “wave collapse” as a genuine physical process must be *irreducibly* dispositional. In particular, this poses the question whether it is just the manifestation of a property that is dispositional or the ascription of the property itself. While in the case of Bohmian mechanics the reducibility of dispositional properties is guaranteed by the fact that the positions of particles play the role of the “categorical basis” of dispositions, in Everett-type interpretations dispositionalism really turns into a form of a perspectival relationism.

### Biography

Mauro Dorato earned a Ph.D in philosophy at the Johns Hopkins University and is presently professor of philosophy of science at the

University of Rome Three. He is interested in the philosophy of space and time, in the relationship between the physical image and the experiential image of the world, and in the history and philosophy of laws of nature. In his various publications, he has defended scientific realism in its various forms (entity realism and to a certain extent, theory realism) and has attempted to claim that there is no irresolvable conflict between the physical image of time and the image of time emerging from our experience.

## **Jacques Dubucs**

Institut d'Histoire et de Philosophie des Sciences et des Techniques,  
(Paris I / CNRS / ENS - UMR 8590)

### Abstract

The propensity interpretation of probability has been originally conceived by reference to physical dispositional properties of the kind illustrated by the decay of radio-activity : propensities *are* physical properties that have virtual causal power. My paper tries to evaluate the explanatory virtue of that ultra-objectivist interpretation of probability by contrasting it with the competing interpretations that conceive probability as a mere effect of observable frequencies on the mind.

### Biography :

Jacques Dubucs, Directeur de Recherches at the CNRS, leads the Institut d'Histoire et de Philosophie des Sciences et des Techniques (CNRS/Université Paris I/Ecole Normale Supérieure). His general research and teaching areas are in logic, philosophy of science and cognitive science. While his current area of specialization is in philosophy of mathematics, he has a long-term interest in philosophy of probability since the book he published in 1995 on that topic (Kluwer, Philosophical Studies Series).

## **Roman Frigg**

London School of Economics (LSE)

*The interpretation of probability in Boltzmann's approach to statistical mechanics*

### Abstract

Over the last decade a remarkable consensus has emerged that Boltzmann's approach to statistical mechanics supplemented with the Past Hypothesis provides conclusive answers to the puzzles of statistical mechanics. However, the question of how to interpret probabilities in this approach has not been much discussed. I will first argue that the time-average, frequency, propensity and 'no-theory-theory' interpretations are impossible in this context and then turn to a discussion of Barry Loewer's proposal that Boltzmann probabilities should be understood within David Lewis' Humean Best Systems framework. I point out that there are three fundamental problems with this proposal and conclude that Boltzmann probabilities cannot be interpreted in this way without giving up the very aim of statistical mechanics, namely to explain how the behaviour of macroscopic bodies emerges from the behaviour of its microscopic constituents. I then examine Sheldon Goldstein's proposal that the notion of probability should be given up altogether and replaced by the notion of typicality, which I also dismiss as untenable. The sobering conclusion is that there is, at present, no acceptable interpretation of Boltzmann probabilities.

#### Biography:

Roman Frigg is lecturer in philosophy at the London School of Economics and Political Science. He received a PhD in philosophy from the University of London and an MPhil. in theoretical physics from the University of Basel, Switzerland. His main research interests lie within general philosophy of science and philosophy of physics.

### **Stephan Hartmann with Patrick Suppes**

London School of Economics (LSE) and Stanford University

#### *Probability and Decoherence*

#### Abstract

Decoherence is the process by which a quantum superposition state decays into a classical, statistical mixture of states, resulting from entangling interactions between the system and its environment. One aspect of this transition from the quantum to the classical is the emergence of a joint probability distribution over random variables whose expectation values are taken in the corresponding quantum state. Suppes and Zanotti (1981) have derived a necessary and sufficient condition for the existence of a joint probability distribution for three random variables. Using a master equation approach, we study the time evolution of a GHZ state and examine its decay into a classical state under the influence of decoherence. To do so, a new group theoretical superoperator method is developed, which can be applied to a large class of problems in quantum optics and quantum information theory. We show that a joint probability

distribution emerges after about 20% of the half time of the system and discuss the implications of this result.

### Biography

Stephan Hartmann has held positions at Konstanz, Pittsburgh and Irvine and is at present Professor in the Department of Philosophy, Logic and Scientific Method at the London School of Economics. From 2002-2005, he directed the research group Philosophy, Probability and Modeling at the University of Konstanz and from 2004-2006 he directed LSE's Centre for Philosophy of Natural and Social Science. His primary research and teaching areas are in general philosophy of science, formal epistemology, philosophy of physics, and social choice theory. Most of the research he has been doing over the last couple of years is contained in the book *Bayesian Epistemology* (with Luc Bovens) that appeared in 2003 with Oxford University Press. He is currently writing a textbook on Bayesianism and has a research interests in subjective probabilities in quantum mechanics, the development of a Bayesian account of inter-theoretic relations, scientific modelling, and voting theory.

## **Iñaki San Pedro and Mauricio Suárez**

Universidad Complutense de Madrid (UCM) Universidad del País Vasco (UPV)

### *New Perspectives on Causal Inference and EPR*

#### Abstract

It is still a matter of controversy whether the Principle of the Common Cause can be used as a basis for sound causal inference. Recent debate has moved to consider the virtues of a generalised PCC-inspired condition, the so-called Causal Markov Condition. It is thus to be expected that whether or not these conditions may be used to ground causal explanations in quantum mechanics in particular should be a correspondingly controversial issue. Indeed the early 90's saw a flurry of papers addressing just these issues in connection with the EPR correlations. Yet, that debate does not seem to have caught up with the most recent literature on causal inference generally. In this paper we aim to do just this: we will analyse the issue of causal explanations for EPR correlations in light of the recent debate on the Causal Markov Condition, and the Principle of Common Cause more generally.

#### Biography

Iñaki San Pedro graduated in Theoretical Physics from University of London (Royal Holloway College). He is currently enrolled in the final year of his PhD at Complutense University and UPV. His research interests mainly focus on the characterisation of the concept of causation in physics, particularly in quantum mechanics,

and how it may related to the idea of locality. In particular, for the last four years he has been investigating to what extent Reichenbach's Common Cause Principle may be taken to ground causal explanations of the EPR correlations in quantum mechanics.

Mauricio Suárez has held positions at Oxford, St. Andrews, Northwestern and Bristol Universities and is at present Associate Professor in Logic and Philosophy of Science at Complutense University. His main research interests lie in the philosophical foundations of physics (particularly quantum mechanics) and general epistemology of science, and he has published widely in both areas. He defends a broad kind of pragmatism that does not skew but rather aims to assimilate and appropriate for itself traditional realist notions such as representation, explanation, warrant, causation, disposition or propensity.