Book of abstracts of the workshop "Identity in science and philosophy"

July 29th – 30th 2019 - Paris - France

Fortin, Sebastian; Catrén, Gabriel and Lombardi, Olimpia
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On phi-entropies derived from inverse MaxEnt problems

STEEVE ZOZOR

GIPSA-Lab, CNRS, Grenoble, France & J.-F. Bercher, LIGM, ESIEE, Paris, France

This presentation focus on maximum entropy problems under moment constraints. Contrary to the usual problem of finding the maximizer of a given entropy, or of selecting constraints such that a given distribution is a maximizer of the considered entropy, we consider here the problem of the determination of an entropy such that a given distribution is its maximizer. Our goal is to adapt the entropy to its maximizer, with potential application in entropy-based goodness-of-fit tests for instance. It allows us to consider distributions outside the exponential family – to which the maximizers of the Shannon entropy belong -, and also to consider simple moment constraints, estimated from the observed sample. Out approach also yields entropic functionals that are function of both probability density and state, allowing us to include skew-symmetric or multimodal distributions in the setting. Finally, extended informational quantities are introduced, such that generalized moments and generalized Fisher informations. With these extended quantities, we propose extended version of the Crame´r-Rao inequality and of the de Bruijn identity, valid or saturated for the maximal entropy distribution corresponding to the generalized entropy previsouly studied.

Symmetry constraints and MaxEnt estimation

MARCELO LOSADA

CONICET – Universidad de Buenos Aires (Argentina)

The maximum entropy principle is a useful technique for estimating states of probabilistic models. This principle states that the most suitable probability distribution compatible with the known data is the one with largest entropy. In this talk I explain how the MaxEnt principle can be applied to quantum physical systems with symmetry constraints. I present an explicit solution for the problem of estimating the state of a quantum system that satisfies additional constraints given by a group of symmetries. Moreover, I discuss two simple examples in order to illustrate how this approach works, a qubit and a qutrit system.

Degrees of Freedom

PIETER THYSSEN
KU Leuven (Belgium)

This talk makes four contributions to the debate on the tension between (in)determinism and human freedom. First, it contains a proposal for a classification of scientific theories based on how much freedom they allow, taking into account that indeterminism comes in different degrees and that both the laws and the boundary conditions can place constraints. Second, inspired by Hoefer, it gives a specific interpretation to the boundary conditions: an interval of boundary conditions corresponds to a region in phase space and to a bundle of block universes. Third, it combines crucial elements from the work of Hoefer (2002) and List (2014; 2015; 2019) and attempted to give a libertarian reading of this combination. On our proposal, throughout spacetime, there is a certain amount of freedom (equivalent to setting the initial, intermediate or final conditions) that can be interpreted as the result of agential choices. Fourth, it focuses on the principle of alternative possibilities throughout and proposes three ways of strengthening it.

Galois perspectives about the identity of indiscernible

JULIEN PAGE
Université Paris Diderot (France)

We study the identity of indiscernibles in the framework of Galois theories. We prove 3 thesis :

1) There are different mathematical interpretations of indiscernability.

2) Galois indiscernability is relative and not absolute.

3) The identity of indiscernibles is usually false in Galois theories.

Observers, ensembles, and typicality in finite multiverse theories

SYLVIA WENMACKERS

KU Leuven (Belgium)

This paper compares observer selection effects in single-universe and multiverse theories. It starts by identifying two key ingredients of multiverse theories that occur in current cosmology, with the inflationary multiverse theory as the prime example. This study is informed by the treatment of ensembles in the foundations of probability and of typicality in other branches of physics. An underlying question is: when is it justified to reify a theoretical ensemble? To clarify the discussion, a template sample space is introduced that can be used to assess the difference between single-universe and multiverse theories.

Fibrations identity equality (according to Jean Benabou)

JEAN-JACQUES SZCZECINIARZ
Université Paris Diderot (France)

I would like to present you a thinking of on the philosophy and mathematics and over all elements to a revival of the philosophy of mathematics. Here, the center of the (my) thinking about is the equality, the point of view is not foundationalist, the setting is CT, in a very deep reflection , I will sequel Jean Benabou. His paper is Fibred categories and the foundations of naive category theory J of Symbolic Logic Volume 50, Number 1. March 1985.

The question we want to deal with in this talk is the question of the equality. This is the most subtle and strange notion. We will analyze this question in terms of the sets and classes defined above, but try to get answers adaptable to the abstract situation of "categories".

I can keep the followings facts.

What about equality of objects?

i) There is no categorical way to detect, for two objects X and Y of an abstract category C, if they are equal.

ii) Moreover we do not care about question, which should in general be meaningless, if no other information is given about C

There is no reason to assume, for an arbitrary category C, any of the following properties

i) Pairs of equal objects are definable in all pairs of objects

ii) Identity maps are definable in all maps

iii) Pairs of equal maps are definable in all pairs of maps.

Suppose we know that two objects X and Y are "equal". Unless this equality is some "god-given" identity, by performing very trivial constructions, say X x Y and Y x X we get two objects defined up to a unique isomorphism, for which we can no longer be sure that they are still equal. There is no significant construction in CT which forces objects to become equal. However, there is two major notions of congruencies in CT.

Equality of objects should be an extra structure, which a "category" p may or may not admit, such a structure, if any need not be unique. A pair consisting of p and one structure shall be called a "category" with equality of objects.

The "functors" between categories with equality of objects need not preserve this equality. We may have to select those which do, called equality preserving "functors". There is no reason to suppose that our "category" of "sets" p(B) when it exists should admit such a structure.

Even in the restricted context of set theories based on membership we are confronted with two types of equalities for sets : T = S and the external equality T = S in U. The second is the only one meaningful for classes, yet is not definable in Ens The last remark: according to JB, the idea of a "category" without equality of objects can have some mathematical significance.

The key concept that will allow to answer question of equality is the concept of a fibration that will be enriched with the concept of splitting of the fibration. Jean Benabou developed the concept of fibration on the line of Grothendieck' conception in SGA IV..

Criteria of Elementhood: Debates on Vanadium, Niobium and Tantalum in 19th-century chemistry

SARAH HIJMANS
Université Paris Diderot (France)

One feature of the chemical revolution is the widespread acceptance by most chemists of Lavoisier's definition of chemical elements as indecomposable by analysis. This change in conception of the element as an isolable substance rather than an immaterial principle was followed by the rapid discovery of new elements: their numbers rose from 33 in 1789 to 70 in 1869. Yet, in many cases the criterion of indivisibility wasn't decisive in the determination of whether or not a newly found substance could be considered an element. In this paper, I analyse the debates surrounding the discoveries of the elements belonging to group 5 of the current-day periodic table. Vanadium, Tantalum and Niobium were discovered in the early 19th-century, but all three were retracted from the list of elements, rediscovered and renamed up to 50 years later. During these debates, empirical results and their interpretations were provided in an attempt to prove the elemental nature of the three substances (as well as three others, which today are no longer considered to be elements). I will show that chemists referred to the chemical behaviour of the substances and its analogy to that of other elements, rather than to Lavoisier's definition of the element. Furthermore, I will make a comparison to the controversy surrounding the elemental nature of the halogens and I will suggest that in the early 19th century, operational indivisibility was a necessary but non-sufficient criterion for elementhood. In doing so, this paper will shed a new light on the role of analogies in scientific reasoning.

On the ontology of entities in quantum chemistry

SEBASTIAN FORTIN, JESUS ALBERTO JAIMES ARRIAGA AND HERNAN ACCORINTI

CONICET-Universidad de Buenos Aires (Argentina)

From the successes achieved in physics by applying Quantum Mechanics (MC) to chemical systems in the early twentieth century, the idea that chemistry can be completely reduced to physics, both epistemologically and ontologically, has been disseminated. Although in recent decades, and together with the emergence of the philosophy of chemistry, this fact has been questioned, it remains the predominant position in the scientific-philosophical field. In this work we will analyze in detail the methods used by those who positively apply quantum mechanics to chemical systems.

On the one hand, the Born-Oppenheimer approach assumes that since the mass of the atomic nuclei is much greater than that of electrons, then the nuclei can be considered to be still. On the other hand, the orbital approach establishes that in an atom with many electrons the quantum entanglement between them is not important. Based on this assumption, a separate wave function is assigned to each electron.

The two approaches mentioned contradict the principles of quantum mechanics. On the one hand, Heisenberg's principle of indeterminacy, together with the Kochen-Specker theorem, states that it is not possible to simultaneously assign defined values ??to the position and velocity of a quantum particle. However, the Born-Oppenheimer approach establishes that the atomic nuclei are still, that is, they have a well defined position and velocity. On the other hand, according to quantum mechanics, a physical system of N particles has a wave function of 3N dimensions associated with it. Since traditional physical space has only 3 dimensions, the space that inhabits the wave function has been the subject of intense debates within the philosophy of physics. However, the orbital approach disregards the holistic multidimensional space of quantum mechanics and states that each of the electrons that form an atom has a three-dimensional wave function and separated from the rest.

From this analysis, and from the review of the philosophical literature about approximations, we will argue that the methods used by quantum chemists are not true approximations. We will also develop the idea that the entities that populate the universe of this discipline are ontologically very different from those considered by quantum physics. And for this reason we will move towards our own ontology for quantum chemistry.