AGPhil 3: Philosophie der Physik III

Time: Thursday 12:45–14:45 Location: H 2033

AGPhil 3.1 Thu 12:45 H 2033

Explaining Universality: Infinite Limit Systems in the Renormalization Group Method — •Jingyi Wu — Munich Center for Mathematical Philosophy

I analyze the role of infinite idealizations used in the renormalization group (RG hereafter) method in explaining universality across microscopically different physical systems in critical phenomena. I argue that despite the reference to infinite limit systems such as systems with infinite correlation lengths during the RG process, the key to explaining universality in critical phenomena need not involve infinite limit systems. Following Norton (2012), we can properly demote the use of limits in RG explanations as a case of approximations. I develop my argument by emphasizing what I regard as the crux of RG explanations: linearization* around the nontrivial fixed point; I then present both heuristic evidence, provided by Wilson and Kogut (1974), and technical evidence, made possible by recent mathematical advancement in Yin (2011), regarding the topology around the nontrivial fixed point, to show that the properties purportedly only infinite limit systems possess can also be retrieved using finite systems.

AGPhil 3.2 Thu 13:15 H 2033

Connecting structuralism with the paradox of phase transitions — •Johannes Mierau — Technische Universität Dortmund

Reductions and emergence in physics are frequently discussed in case of phase transitions. The inhering paradox of phase transitions is mostly resolved by applying a topology onto the space of physical systems. The question of which topology is ought to be used is still at issue. In my text I am going to connect this problem to the structuralism of physical theories in order to find a justified topology.

Günther Ludwig introduced uniform structures to blur theoretic relations, which never match experimental data exactly. This concept was adopted by other structuralists. Erhard Scheibe, in particular, used uniform structures to express the experimental inaccuracy of measurements.

In this vein, every physical theory carries a topology induced by its empirical uniform structure. A theoretic model in the thermodynamic limit can represent an actual physical system, if all measurable magnitudes in regard to the specific theory conform to the finite system up to the accuracy of the uniform structure. In this way phase transitions can be defined theoretically as a concept for infinite systems, but be applied to certain real systems. Additionally, no new topology has to be introduced, since, from the structuralists point of view, uniform structures are core parts of physical theories.

AGPhil 3.3 Thu 13:45 H 2033

The dilemma of the observer and the second law of thermodynamics — •Matteo Polettini — Physics and Materials Science Research Unit, University of Luxembourg, Campus Limpertsberg, 162a avenue de la Faiencerie, L-1511 Luxembourg (Luxembourg)

The statistical description of irreversible phenomena and the information-theoretic interpretation of entropy introduce the dilemma of the observer in thermodynamics. If entropy is a measure of missing information, will the second law of thermodynamics depend on whether the observer has a Ph.D. in physics? While many would take a materialistic approach to this hurdle, arguing that the analogy between Shannon's informational entropy and Gibbs's statistical entropy is just incidental, we argue that a dependency on the observer can and should be included without making physical laws less "objective". Furthermore, this approach is actually more prudent and secular than the materialistic one, as we show that this latter surreptitiously introduces a preferential observer and "sweeps the dirt under the carpet". In technical terms, we show that the choice of prior probabilities in statistical physics is a gauge symmetry of the second law.

AGPhil 3.4 Thu 14:15 H 2033

More Talk About Toy Models — •Joshua Luczak — Leibniz Universität Hannover, Hannover, Germany

Scientists frequently use toy models to reason about physical theories and actual systems. This may seem strange because toy models do not perform a representational function. That is, they do not represent actual systems or collections of systems. In fact, they do not represent anything. Despite their frequent and important use in scientific reasoning, discussions of toy models are scarcely found in the philosophical literature on scientific modelling. This paper intends to elevate the status of these models by highlighting and justifying some of the ways they are used to reason about actual systems and physical theories. This will be achieved by highlighting and justifying some of the ways Paul and Tatyana Ehrenfests' urn (dog-flea) model—a model originally introduced so as to reason about the kinetic theory of gases and Ludwig Boltzmann's original attempts to account for irreversible thermal phenomena and the Second Law of Thermodynamics—is used within statistical mechanics.