AGPhil 1: "Condensed Metaphysics" I: Reduction and Emergence

The Metaphysics of Condensed Matter and Complex Systems. Brigitte Falkenburg & Margaret Morrison

Time: Monday 9:30–13:00 Location: E 020

Invited Talk AGPhil 1.1 Mon 9:30 E 020
On the Success and Limitations of Reductionism in Physics — •Hildegard Meyer-Ortmanns — School of Engineering and Science, Jacobs University Bremen

Methodological reductionism has proved to be an extremely successful approach in physics. It led to the very construction of the standard model as the theory of three of the four fundamental interactions. It allows bridging the scales from the microscopic to mesoscopic and sometimes even to macroscopic scales in the spirit of the renormalization group. It enables to predict emergent phenomena like phase transitions or self-organized pattern formation in space and time. We shall study the question of how far one can push the reductionistic approach and, along with that, we point on its limitations when it is pushed to extremes. The price then may be not only a lack of understanding in simple terms, but also a miss of emergent traits and new interactions between composed objects which arise when these composed objects are formed out of more elementary ones, and when they afterwards are considered as the new elementary units on the coarse-grained scale, on which their compositeness may be safely ignored. The very choice of what is declared as new elementary units is a matter of convention, and if phenomena on different scales should be related to each other, it is often the art in the game to find a really convenient choice. We shall illustrate the success and limitations of the reductionistic approach, in particular in view of emergent features, with a number of examples, ranging from particle physics to complex systems in biological applications.

Invited Talk AGPhil 1.2 Mon 10:15 E 020
Why is More Different? — •Margaret Morrison — University of Toronto

Emergent phenomena are typically described as those that cannot be reduced, explained nor predicted from their microphysical base. However, this characterization can be fully satisfied on purely epistemological grounds, leaving open the possibility that emergence may simply point to a gap in our knowledge of these phenomena. By contrast, Anderson's (1972) claim that the whole is not only greater than but very "different from" its parts implies a strong ontological dimension to emergence, one that requires us to explain how, for example, superconductivity can be ontologically distinct from its micro-ontology of Cooper pairing. This is partly explained by using RG methods to show how the 'universal' characteristics of emergent phenomena are insensitive to the Hamiltonian(s) governing the microphysics. But this is not wholly sufficient since it is possible to claim that the independence simply reflects the fact that different 'levels' are appropriate when explaining physical behavior, e.g. we needn't appeal to micro properties in explaining fluid behavior. The paper attempts a resolution to the problem of ontological independence by highlighting the role of spontaneous symmetry breaking in the emergence of universal properties like infinite conductivity. If we focus on the dynamical aspects of symmetry breaking rather than interpreting it as an organizing principle (Laughlin and Pines, 2000) we are able to see how it, together with the RG arguments, illustrates both how and why emergent phenomena can be considered different from their micro-constituents.

Coffee break

Invited Talk AGPhil 1.3 Mon 11:30 E 020
Parts, Wholes and Emergence — •Andreas Hüttemann — Philoosphisches Seminar, Universität zu Köln, Albertus Magnus Platz, 50923 Köln

Emergence has been defined or explicated in a number of different ways. Typically the definiens contains terms such as "novelty", "irreducibility", "unpredictability", "holism", etc. For at least two reasons these attempts appear not to be particularly fruitful. First, there is no consensus on how to understand the terms that are invoked in the definitions or explications in question. Second, intuitions about whether certain phenomena should count as examples of emergent phenomena tend to diverge. There seem to be hardly any clear-cut cases against which a definition or explication of emergence could be tested.

In this paper I want to take a different approach towards an explication of concepts of emergence. I will look at certain influential reductionist projects. It is in the contexts of these projects that concepts of emergence have been formed. If we understand the aims of the reductionist projects we get a better hold on certain concepts of emergence, because they are usually conceived of as failures or limitations of reductionist projects.

More particularly I will look at a philosophical tradition of ontological reductionism and at a methodological reductionist project that has been discussed by physicists. Keeping these two sense of reductionism separate will help to disambiguate two different concepts of emergence. Critical phenomena provide a useful case study in this context because the case illustrates how a phenomenon can be a emergent in one sense but fail to be emergent in another sense.

Invited Talk AGPhil 1.4 Mon 12:15 E 020
Functional Reduction and Emergence — •Sorin Bangu — Univ. of Illinois, 801 S Wright St., Urbana, IL 61801, USA

The clarification of the concept of emergence has long been on the agenda of the metaphysics of science; notions such as 'novelty', 'unpredictability' and, most specifically, 'irreducibility' have been invoked in an attempt to elucidate this notoriously elusive idea. This paper aims to join this effort, by discussing a class of familiar phenomena, such as boiling and freezing - generically called 'phase transitions'. Recent work on this topic takes these processes as uncontroversial examples of emergent, or irreducible phenomena. I am broadly sympathetic to this view, but I argue that a better understanding of the emergence claim can be gained by clarifying how one of the best models of reduction on offer - Kim's 'functional' model - deals with these phenomena.