# AGPhil 4: Quantum Foundations 1

Time: Wednesday 11:00–12:30 Location: JAN/0027

AGPhil 4.1 Wed 11:00 JAN/0027

**Supervaluationism, Determinacy, and the Completeness of Quantum Mechanics** — •Samuel Fletcher and David Taylor — University of Minnesota, Twin Cities

Putative instances of quantum indeterminacy provide important test cases for theories of metaphysical indeterminacy such as metaphysical supervaluationism (MS). A theory that cannot faithfully model these types of cases is arguably inadequate. While MS has had notable success in modeling run-of-the-mill examples of indeterminacy, such as those which accompany vagueness, it faces a challenge in modeling the peculiar behavior of quantum systems. The challenge goes roughly as follows: (i) MS models indeterminacy via quantification over possible worlds; (ii) those possible worlds require a classically complete assignment of properties to individuals; (iii) there is no consistent, classically complete way of assigning properties to quantum systems; therefore (iv) MS cannot model indeterminacy in quantum systems.

We believe that this challenge has not yet been sufficiently understood and that, as a result, there is considerable confusion regarding its strength and scope. Accordingly, our aims are to: (i) present a version of the challenge that is stronger, more general, and more refined than those currently in the literature; (ii) clarify the role that EEL plays in the challenge, as this is a persistent source of confusion; and (iii) show that the primary disagreement between proponents of the challenge and its critics reduces to a disagreement regarding the (in)completeness of quantum mechanics.

AGPhil 4.2 Wed 11:30 JAN/0027

**Classicality and Bell's Theorem** — •Márton Gömöri[1] and Carl Hoefer[2] — [1]Eötvös Loránd University, Budapest, Hungary — [2]University of Barcelona, Spain

A widespread view among physicists is that Bell's theorem rests on an implicit assumption of "classicality," in addition to locality. According to this understanding, the violation of Bell's inequalities poses no challenge to locality, but simply reinforces the fact that quantum mechanics is not classical. The paper provides a critical analysis of this view. First we characterize the notion of classicality in probabilistic terms. We argue that classicality thus construed is not a mark of the validity of classical physics, nor of classical probability theory, contrary to what many believe. At the same time, we show that the probabilistic notion of classicality is not an additional premise of Bell's theorem, but a mathematical corollary of locality in conjunction with the standard auxiliary assumptions of Bell. Accordingly, any theory that claims to get around the derivation of Bell's inequalities by giving up classicality, in fact has to give up one of those standard assumptions. As an illustration of this, we look at two recent interpretations of quantum mechanics, Reinhard Werner's operational quantum mechanics and Robert Griffiths' consistent histories approach, that are claimed to be local and non-classical, and identify which of the standard assumptions of Bell's theorem each of them is forced to give up. We claim that while in operational quantum mechanics the Common Cause Principle is violated, the consistent histories approach is conspiratorial.

AGPhil 4.3 Wed 12:00 JAN/0027

**On the Bell Notion of Beable: from Bohr to Primitive Ontology** — •Federico Laudisa — Department of Humanities and Philosophy, University of Trento, Via Tommaso Gar 14, 38122, Trento (Italy)

There have been in more recent times comprehensive accounts of the Bell scientific developments, but in my talk I would like to focus on a rather specific point. I refer here to the Bell notion of beable, a term first introduced in his 1973 paper entitled *Subject and object*. The aim of my talk is to show that there are at least two different readings of the notion of beable in the development of Bell*s foundational analyses. First, the concept of beable emerges as the consequence of a Bohr-like view of the status of measurement in QM: Bell, across the succession of his papers devoted to the foundations of QM, refers to Bohr in different places and with different senses, often instrumental to supporting claims that in fact appear to be only partially consistent with a Bohrian view of quantum mechanics. Only later the notion of beable acquired the meaning which in retrospect motivated the so-called primitive ontology approach. It will also be shown that in neither of the two readings the use of the notion of beable commits Bell to assume any form of naive *realism*, especially with respect to the so-called *local realism* that, according to a widespread opinion, would be the alleged target of the Bell theorem.