On a New Ontology of the Quantum-Mechanical Wavefunction

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Classical physics tells us that the world consists of objects in three spatial dimensions which are specified by absolute, deterministic states. According to quantum mechanics, however, the classical physics encountered in our everyday lives is false. One of the ways that quantum mechanics has revolutionized our view of the world is by introducing the radical hypothesis that configurations of particles live in a 3N-dimensional space, as opposed to the 3 or 4 dimensional spacetime we appear to encounter everyday. Theoretically, quantum mechanical phenomena are described most elegantly in 3N dimensions through the Schrödinger wave equation:

$$i\hbar\frac{\partial\Psi}{\partial t} = \hat{H}\Psi$$

However, the majority of the empirical evidence for quantum mechanics is via observations of the behavior of objects in a three dimensional space (i.e., the photoelectric effect, the Young-Fresnel double-slit experiment, etc.). Hence, if objects do not inhabit a classical, 3D space, then there is little reason to believe in quantum mechanics in the first place. This is a topic of intense worry to contemporary philosophers of physics, and is a serious obstruction to a physics-based metaphysics.

I tackle this issue by focusing on the dichotomy between the 3N-dimensional wavefunction Ψ and our 3D view of the everyday world. The wavefunction, as John Bell has put it, "lives in configuration space"–it is a function that describes the motion of particles in a quantum system in much the same way a classical wave function describes a mode on a string. Though philosophers such as Maudlin (2007) have argued that the configuration space of the wavefunction has little to do with our macroscopic world, contemporary discoveries in physics have given numerous examples of macroscopic phenomena governed by the Schrödinger wavefunction. In this paper, I attempt to reconcile the 3N dimensions of the quantum mechanical wave function with our common sense 3D view of the world by proposing a new ontology of the wave function. This ontology describes, not one particle in configuration space, but an array of entangled quasiparticles in 3D space. These quasiparticles, though not real in the sense that an electron or proton might be said to be real, allow the wavefunction to be defined in three dimensions. This new ontology is then reconciled with the major realistic interpretations of quantum mechanics present today.