

Summary of Mike Horne's Talk

Anton has asked us "What exists in quantum physics?" If existence means physical objects, there are many candidates: particles, fields, charges, currents, etc, etc. But most of the objects in such long lists existed prior to quantum mechanics, that is, the object is not inherently quantum mechanical. Is there an object whose existence is uniquely quantum mechanical, an object that exists only because of quantum mechanical behavior? In a 1965 lecture, Feynman noted that single-particle two-slit interference fully captures the essence, "the only mystery," of quantum mechanics. To demonstrate this interference in the laboratory one must exhibit the fringes that develop after many particles fall on an area detector behind the slits. These fringes are real objects – you can look at them – and they exist only because of quantum mechanics. Earlier, in 1935, Schrödinger had stated that entanglement is the essential characteristic of quantum behavior. To demonstrate two-particle entanglement in the laboratory one must again exhibit fringes, only now they are conditional fringes. That is, if the first particle of each pair lands on a specific small portion of an area detector, the ensemble of second particles form fringes on another area detector. Thus, to paraphrase Schrödinger, I would say that fringes are not one but the object that exists in quantum mechanics.