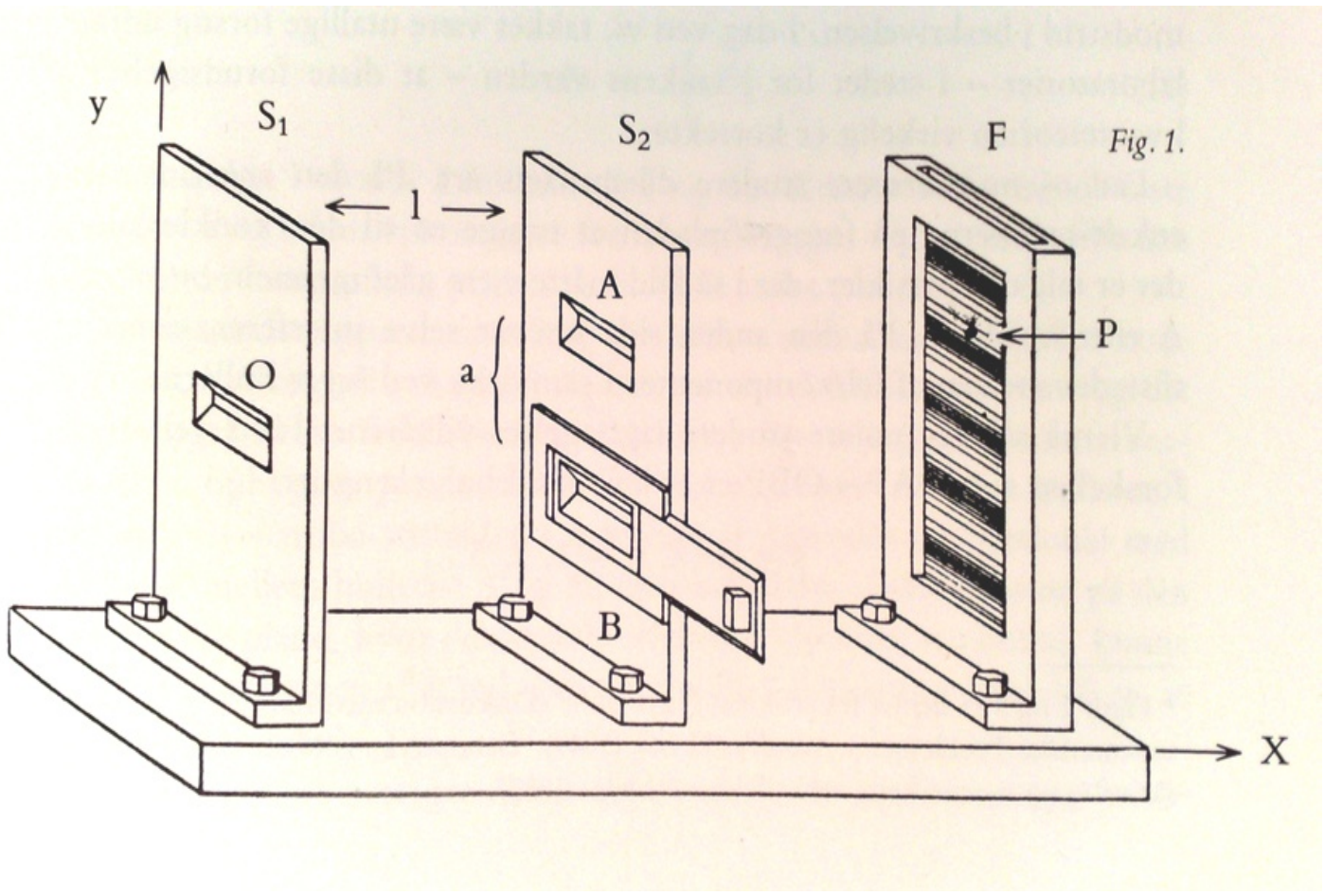
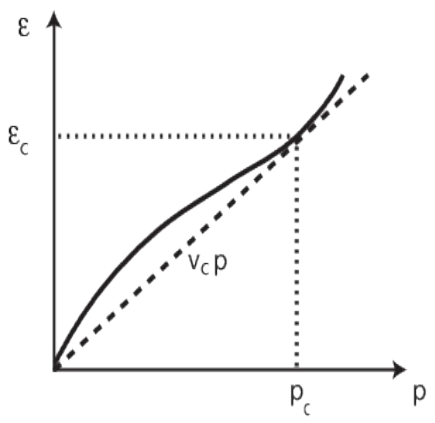
Boston University Physics Colloquium





Two-Slit Diffraction with Highly Charged Particles:

Niels Bohr's Consistency Argument that the Electromagnetic Field Must Be Quantized

Niels Bohr once suggested a very simple two-slit diffraction experiment with highly charged particles to prove that the consistency of elementary quantum mechanics requires the radiation field to be quantized. As this talk will describe in detail, measurement far from the interference apparatus of the electric field of a particle going through the slits yields "which path" information, and thus the diffraction pattern must be destroyed. The key is that as the particle's trajectory is bent in diffraction by the slits it must radiate and the radiation must carry away phase information. Thus the radiation field must be a quantized dynamical degree of freedom. On the other hand, if one similarly tries to determine the path of a massive particle through an interferometer by measuring the Newtonian gravitational potential the particle produces, the interference pattern would have to be finer than the Planck length and thus undiscernable. Unlike for the electromagnetic field, Bohr's argument does not imply that the gravitational field must be quantized.

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October 30, 2012 (Tuesday) at 3:30pm (Refreshments at 3:00pm)
SCI 109, Metcalf Science Center, Boston University

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