Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

A quantum delayed-choice *gedanken* experiment[1] RADU IONICIOIU, Institute for Quantum Computing, University of Waterloo, DANIEL TERNO, Department of Physics & Astronomy, Macquarie University, Sydney — *Gedanken* experiments are important conceptual tools in the quest to reconcile our classical intuition with quantum mechanics and nowadays are routinely performed in the laboratory. An important open question is the quantum behaviour of the controlling devices in such experiments. We propose a framework to analyse quantum-controlled experiments and illustrate the implications by discussing a quantum version of Wheeler's delayed-choice experiment. The introduction of a quantum-controlled device (i.e., quantum beamsplitter) has several consequences. First, it implies that we can measure complementary phenomena with a single experimental setup, thus pointing to a redefinition of complementarity principle. Second, a quantum control allows us to prove there are no consistent hidden-variable theories in which "particle" and "wave" are realistic properties. Finally, it shows that a photon can have a morphing behaviour between "particle" and "wave"; this further supports the conclusion that "particle" and "wave" are not realistic properties but merely reflect how we "look" at the photon. The framework developed here can be extended to other experiments, particularly to Bell-inequality tests.

[1]Work supported by ARC Centre for Quantum Computer Technology, Macquarie University and EC Project QUANTIP 244026

Radu Ionicioiu
Institute for Quantum Computing, University of Waterloo

Date submitted: 03 Nov 2011 Electronic form version 1.4