Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Path detection and interference tradeoff in the double-slit experiment JULIO GEA-BANACLOCHE, University of Arkansas, MASANAO OZAWA, Tohoku University, Japan — We study how the acquisition of "which-path" information leads to a loss of contrast in the double-slit interference setup. We show that neither the conventional uncertainty principle nor the recently-derived universal uncertainty principle place any restriction on the minimum root-mean-square momentum disturbance, once it is recognized that the which-path determination does not require one to measure x, but only an appropriate two-valued function of x. We then develop a description of the problem in terms of only two-valued variables, and consider a completely general measurement model, which allows us to distinguish between the measurement error and what we call the "preparational error." We show that error-free which-path measurements are possible in this model that do not destroy the fringe visibility. On the other hand, we also show that there is a general tradeoff relation between preparational error and fringe visibility, which, for measurements obeying the "non- destruction" condition, reduces to Englert's inequality.

Julio Gea-Banacloche
University of Arkansas

Date submitted: 27 Nov 2007 Electronic form version 1.4