

**Poster Submission to the 4th European QIPC Workshop**

## Modelling One and Two Qubit Interactions at the Wave Function Level

Suguru Furuta, Chris Doran and Cripsin Barnes

*Cavendish Laboratory and Centre for Quantum Computation, University of Cambridge*

### **Abstract**

We model the behaviour of bipartite systems of identical particles in the presence of external electromagnetic fields, with special attention to the spin dynamics of entangled systems. We consider first a non-relativistic model for implementing single-particle quantum operations on trapped electrons using external magnetic fields. Simulations have analysed the feasibility of obtaining spin read-out in the Surface Acoustic Wave implementation of quantum computing. Simulations for single and two qubit gates are in progress. Next we consider a relativistic model of a non-local spin-measurement process, involving two identical particles in a maximally entangled state. By studying the covariant Dirac current of the system in configuration space, we find that the spin vectors evolve unitarily but non-locally, respecting the quantum correlations present in the entangled state. By working at the wave function level, we are able to give a novel definition for the notion of simultaneity within the covariant multiparticle quantum theory.