ESF Short Visit Grant
Arrays of Quantum Dots and Josephson Junctions
Cooper-pair Solitons in Josephson Juction Arrays
Final Report

Timothy L. Duty

Microtechnology and Nanoscience, MC2,
Chalmers University of Technology, S-412 96 Göteborg, Sweden

The purpose of the visit was to further elaborate the understanding of the charge-phase duality between Cooper-pair solitons and fluxons, and investigate the experimental possibilities afforded by such a comparison.

During the visit, I first presented our recent experimental results concerning the observations in real-time of the correlated tunnelling of both single-electron and Cooper-pair solitons in a $1D$ array. This was followed by extensive discussions aimed at achieving and observing truly ballistic Cooper-pair solitons in high-charging-energy Josephson junction arrays. This is an exciting prospect since it is possible that Cooper-pair solitions may be more in the quantum limit than fluxons. Eventually, the focus became the choice of sample design for future experiments. It was realized that the design of our previous samples was the dual to the "inline" geometry of long Josephson junctions and that a considerable improvement would be to create the dual of the "overlap" geometry. This can be done by capacitively coupling the array to a constant voltage bias along the array (the dual to a constant current bias in long junctions), instead of the customary ground-plane capacitances used before.

The main result of the visit was the generation of several ideas for experiments based upon this new type of sample design.

Future collaboration with Ustinov's group in Erlangen is quite likely and will consist of further numerical calculations and exeriments.

On the basis of this visit, we expect to co-author a paper that presents the idea of using this new array circuit and sample design, along with some numerical calculations on Cooper-pair and single-electron solitons in such a geometry.