

**SCHOOL OF PHYSICS**  
**UNIVERSITY OF NEW SOUTH WALES**



# COLLOQUIUM

*4-5 p.m., Monday, 27 April 2009*

School of Physics Common Room

Room 64, Old Main Building

**Dr Michele Governale**

**Universität Duisburg-Essen, Germany**

## **“Hybrid Normal-Superconducting Systems Comprising Interacting Quantum Dots”**

We present a real-time diagrammatic theory for transport through interacting quantum dots, tunnel coupled to normal and superconducting leads. These systems are interesting due to the presence of superconducting correlations, quantum fluctuations, electron-electron interaction, and non-equilibrium. Our formulation describes both the equilibrium and non-equilibrium superconducting proximity effect in the quantum dot. In the limit of large superconducting gaps in the leads, we describe the formation of Andreev bound states within an exact resummation of all orders in the tunnel coupling to the superconducting leads. We apply this theory to two different three-terminal setups:

The first setup consists of a single-level quantum dot, tunnel coupled to two phase-biased superconducting leads and one voltage-biased normal lead. The normal lead is used to drive the dot out of equilibrium. We compute both the Josephson current between the two superconductors and the Andreev current in the normal lead, and analyze their switching on and off as well as transitions between 0- and  $\pi$ -states as a function of gate and bias voltage.

The second setup is suitable to investigate non-local Andreev transport and it comprises a single-level quantum dot, tunnel coupled to one superconducting and two normal-conducting leads, which can be either ferromagnetic or non-magnetic.

The audience is invited to meet the speaker beforehand at 3.45 p.m. over coffee and biscuits in the Common Room.

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**\* Dr Governale is a candidate for the School's new Condensed Matter theory position**