Minicourse on

Non-equilibrium Josephson Dynamics and Superconducting Devices

Prof. Dr. Claudio Guarcello (Erasmus guest lecturer)

This minicourse will cover selected topics in non-equilibrium Josephson dynamics, ranging from the basic Josephson effect and the RCSJ model to fluctuations, switching phenomena, and SQUID dynamics. It is primarily intended for graduate students, but may also be of interest to advanced Master's students and researchers.

Each lecture is designed to be self-contained and can therefore also be attended independently. In this spirit, every lecture will begin with a short recap of the key concepts and results introduced in the previous ones. The course of three lectures will be round up by a theory colloquium talk.

Lecture 1 – Josephson effect and RCSJ dynamics

Monday, June 22, 12:15-13:45 in MG 367

Macroscopic wave functions, DC/AC Josephson effect, short junctions, Josephson energy, washboard potential, and the RCSJ model.

Lecture 2 – Fluctuations, switching, and nonlinear dynamics in Josephson junctions

Tuesday, June 23, 12:15-13:45 in MG 367

Time scales, damping regimes, AC response, chaotic dynamics, noise effects, switching-current distributions, thermal activation, macroscopic quantum tunnelling, and brief remarks on long Josephson junctions and sine-Gordon dynamics.

Lecture 3 – SQUID dynamics and Josephson devices

Thursday, June 25, 10:15-11:45 in MG 367

Flux quantization, dc-SQUIDs, the RCSJ model for dc-SQUIDs, interference patterns, voltage response, asymmetry effects, and rf-SQUID configurations and readout.

Theory Colloquium – Unconventional Josephson signatures and diode effects in oxide nanojunctions

Friday, June 26, 14:00-15:30 in MC 351

Short bio – Claudio Guarcello

Claudio Guarcello is Associate Professor at the Department of Physics, University of Salerno, Italy. Before his current appointment, he held a tenure-track position at the University of Salerno and worked as a postdoctoral researcher at the NEST laboratories of the Scuola Normale Superiore in Pisa and at the CFM-MPC (CSIC-UPV/EHU) in Donostia–San Sebastián, Spain. He received his PhD in Applied Physics and his Master's degree in Physics from the University of Palermo, Italy.

His research focuses on Josephson physics, superconducting devices, and transport in superconducting systems, with broader interests in non-equilibrium statistical mechanics, complex systems, and noise-induced phenomena. He has authored more than 80 scientific publications in these areas.