EUROPEAN SCIENCE FOUNDATION

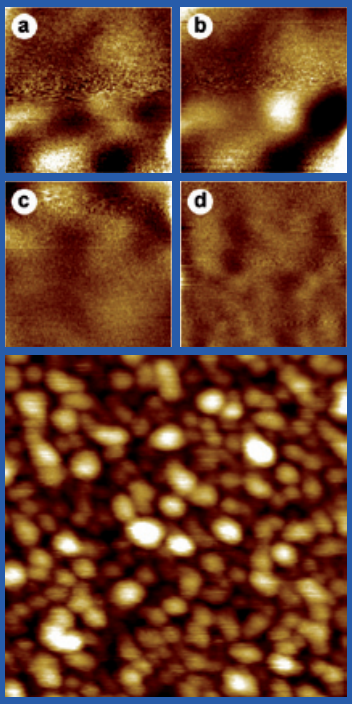
SETTING SCIENCE AGENDAS FOR EUROPE

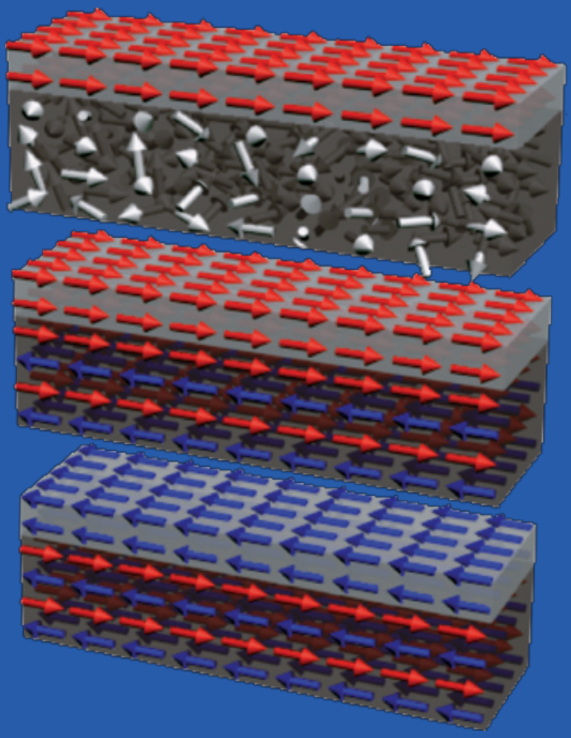
EUROCORES Programme

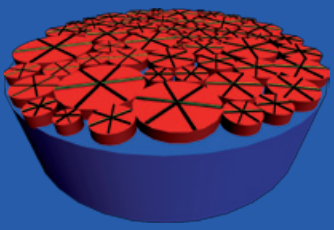
European Collaborative Research

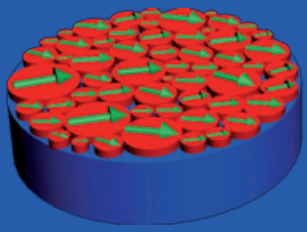
FoNE

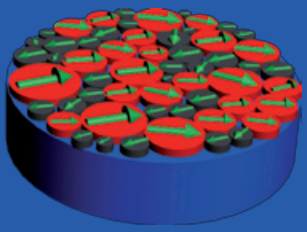
Fundamentals of Nanoelectronics











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The EUROCORES Programme on Fundamentals of Nanoelectronics (FoNE)

The scientific goal of the Fundamentals of NanoElectronics (FoNE) Programme is the development of new concepts necessary to master the operation of nano-scale devices. To realise the potential of nano-scale electronics it is necessary to understand quantum phenomena in semiconductors wires and dots, and control size, interface and proximity effects in a wide variety of hybrid nanostructures.

FoNE is a four-year programme which recognises that understanding the above phenomena is crucial to the development of nanoscale electronics and, thus, advances European research by concentrating and networking the activities of world-leading research groups.

The research in FoNE addresses many areas of nanoelectronics and will create the necessary knowledge for a society in which microelectronics is gradually replaced by nanoelectronics.

FoNE focuses on:
• Nano-spintronic and hybrid devices with integrated superconduction, semiconducting and magnetic functionalities
• Electron-dependent transport in single-molecules and carbon nanotubes (CNTs)
• Quantum transport, noise and related phenomena in quantum dots, wires and other novel structures.

After the Call for Proposals, five Collaborative Research Projects (CRPs) were selected for funding, with a total budget of over 5 Mio Euros.

List of funded Collaborative Research Projects (CRPs)

Intra-Molecular Propagation of Electron Spin States (IMPRESS)

(EPSRC, SNF, FWF)

IMPRESS is concerned with the electron spin states within individual carbon nanotube peapods. Through a variety of characterisation techniques and pioneering synthetic chemistry, it will be possible to engineer spin-spin interactions along a one-dimensional spin chain. Such a structure would have highly remarkable properties. It would be capable of rapidly transferring the spin states, i.e. the information, along the chain purely by virtue of the spin-spin interactions without any externally applied voltage or power dissipation. Thus a molecular device of this kind could constitute a key building block for any technology based on information processing with electron spins.

Project Leader:

Professor George Briggs
Oxford University, Division of Mathematics and Physical Sciences, Department of Materials, Oxford, United Kingdom

Principal Investigators:

Professor Laszlo Forro
École Polytechnique Fédérale de Lausanne, Institute of Physics of Complex Matter, Lausanne, Switzerland

Professor Herwig Peterlik
Universität Wien, Institut für Materialphysik, Vienna, Austria

Domain Walls and Spin-Polarised Currents (SPINCURRENT)

(EPSRC, SNF, Enterprise Ireland, CEA)

SPINCURRENT aims to investigate and exploit the transfer of spin angular momentum from a polarised current to a domain wall in a ferromagnet. As well as involving beautiful and fascinating basic physics, this effect could be useful for writing data to high density non-volatile memories and performing switching operations in domain wall logic schemes.

Project Leader:

Dr. Christopher Marrows
University of Leeds, School of Physics and Astronomy, Leeds, United Kingdom

Principal Investigators:

Dr. Rolf Allenspach
IBM Research Division, Rüschlikon, Switzerland

Professor Michael Coey
Trinity College, School of Physics, Dublin, Ireland

Professor Vladimir Falko
Lancaster University, IENS, Physics Department, United Kingdom

Dr. Michel Viret
CEA Saclay, Gif-sur-Yvette, France

Associated Partner:

Dr. David Williams
Hitachi Cambridge Laboratory, Cambridge, United Kingdom

Co-operating Partner:

Dr. Dafiné Ravelosona
Institut d'Électronique Fondamental, Université de Paris Sud, France

Spin-coherent Transport and Control in Quantum Nanostructures (SpiCo)

(EPSRC, CNR, SNF, GAČR)

SpiCo aims at investigating of spin-related quantum transport phenomena in semiconductor wires and dots of new and recently developed materials in order to identify the relevant physics underlying coherent spin transport and control in low-dimensional systems.

Project Leader:

Professor Vladimir Falko
Lancaster University, IENS, Physics Department, United Kingdom

Principal Investigators:

Dr. Silvano De Franceschi
Laboratorio Nazionale TASC, CNR-INFM, Basovizza, Italy

Professor Klaus Ensslin
Eidgenössische Technische Hochschule Hönggerberg, Laboratorium für Festkörperphysik, Zürich, Switzerland

Professor Tomas Jungwirth
Academy of Sciences of the Czech Republic, Institute of Physics, Department of Surface and Interfaces, Prague, Czech Republic

Professor Daniel Loss
University of Basel, Department of Physics, Basel, Switzerland

Device Electronics Based on Nanowires and Nanotubes (DEWINT)

(CNR, EPSRC, FWF)

The DEWINT project integrates experimental and theoretical investigations of transport and noise in electronic devices based on carbon nanotubes (CNTs) and silicon nanowires (SiNWs). The project aims at acquiring fundamental knowledge of promising building blocks for nanoscale integrated circuits beyond the present technology roadmap for the Semiconductor Industry, evaluating their potential performance as a replacement of current technology.

Project Leader:

Professor Giuseppe Iannaccone
IEIIT-CNR sezione di Pisa, c/o Dipartimento di Ingegneria dell'Informazione, Pisa, Italy

Principal Investigators:

Professor Merlyne De Souza
University of Sheffield, Department of Electronic and Electrical Engineering, United Kingdom

Professor Hans Kosina
Vienna University of Technology, Institute for Microelectronics, Vienna, Austria

Professor Bill Milne
University of Cambridge, Department of Engineering, Cambridge, United Kingdom

Spin-dependent Transport and Electronic Correlations in Nanostructures (SPINTRA)

(MNISW, MEC, GAČR, FWF, CNR, FWO)

SPINTRA research focuses on understanding spin-polarized transport in hybrid-nanostructures, in the design and fabrication of spin filters and detectors which are fundamentals for spintronic devices, and investigation of curren-induced dynamics and switching effects in various magnetic nanostructures.

Project Leader:

Professor Bogdan Bulka
Polish Academy of Sciences, Institute of Molecular Physics, Poznan, Poland

Principal Investigators:

Professor Farkhad Aliev
Universidad Autónoma de Madrid, Facultad de Ciencias, Depto Fisica de la Materia Condensada, C III, Madrid, Spain

Professor Jozef Barnas
Adam Mickiewicz University, Department of Physics, Poznan, Poland

Professor Tomasz Dietl
Polish Academy of Sciences, Institute of Physics and College of Science, Warsaw, Poland

Dr. Vit Novak
Institute of Physics ASČR, Prague, Czech Republic

Professor Gunther Springholz
Johannes Kepler Universität Linz, Institut für Halbleiter- und Festkörperphysik, Linz, Austria

Professor Arturo Tagliacozzo
CNR-INFM Coherentia, c/o Universita' di Napoli Federico II, Facoltà di Scienze, Dipartimento di Scienze Fisiche, Naples, Italy

Professor Chris Van Haesendonck
Katholieke Universiteit Leuven, Laboratory of Solid-State Physics and Magnetism, Department of Physics, Leuven, Belgium

Associated Partners:

Professor Bryan Gallagher
University of Nottingham, School of Physics and Astronomy, Nottingham, United Kingdom

Dr. Joerg Wunderlich
Hitachi Cambridge Laboratory, Cavendish Laboratory, Cambridge, United Kingdom

The aim of the European Collaborative Research (EUROCORES) Scheme is to enable researchers in different European countries to develop collaboration and scientific synergy in areas where European scale and scope are required to reach the critical mass necessary for top class science in a global context.

The scheme provides a flexible framework which allows national basic research funding and performing organisations to join forces to support excellent European research in and across all scientific areas.

The European Science Foundation (ESF) provides scientific coordination and support for networking activities of funded scientists currently through the EC FP6 Programme, under contract no. ERAS-CT-2003-980409. Research funding is provided by participating national organisations.

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Austria

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Research Foundation Flanders,
Belgium

Grantová agentura České republiky (GAČR)
Czech Science Foundation,
Czech Republic

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Institute for Basic Research of the Atomic Energy Commission, France

Enterprise Ireland
Ireland

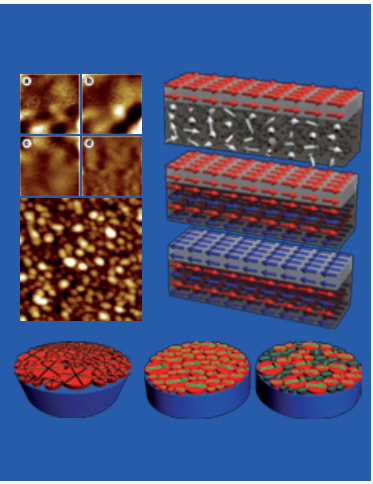
Consiglio Nazionale delle Ricerche (CNR)
National Research Council,
Italy

Ministerstwo Nauki I Szkolnictwa Wyzszego (MNISW)
Ministry of Science and Higher Education,
Poland

Ministerio de Ciencia y Innovacion (MCI)
Ministry of Science and Innovation,
Spain

Schweizerischer Nationalfonds (SNF)
Swiss National Science Foundation,
Switzerland

Engineering and Physical Sciences Research Council (EPSRC)
United Kingdom



Courtesy of Prof. Chris Van Haesendonck,
Katholieke Universiteit Leuven,
Laboratory of Solid-State Physics
and Magnetism, Leuven, Belgium
(SPINTRA Project).

FoNE
Fundamentals of Nanoelectronics

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