EPS Young Minds Group Messina

4th March, 2011
Conference Room (Start at 9.45am)
CNR-IPCF, Istituto per i Processi Chimico–Fisici
Messina

Symposium on
"QUANTUM INTERFERENCE"

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(Dipartimento di Fisica "E. Fermi", Università di Pisa)

Alessandro Ridolfo
(Dip. di Fisica della Materia e Ingegneria Elettronica, Università di Messina)

Alessia Irrera & Barbara Fazio
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Acknowledgements:

Appunti di Fisica
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Dottorato di Ricerca in Fisica & Dottorato di Ricerca in Tecnologie Avanzate per l'Optoelettronica e la Fotonica e Modellizzazione Elettromagnetica – Uni. Messina
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Program & Abstracts

9.45: Welcome & Introduction: the EPS "Young Minds" Project

10.00: Ennio Arimondo, *Dipartimento di Fisica "E. Fermi", Università di Pisa*

Ettore Majorana and the Birth of Autoionization

In some of the first applications of modern quantum mechanics to the spectroscopy of many-electron atoms, Ettore Majorana in 1931 solved several outstanding problems by developing the theory of autoionization. Later literature makes only sporadic references to this accomplishment. After reviewing his work in its contemporary context, we describe subsequent developments in understanding the spectra treated by Majorana, and extensions of his theory to other areas of physics. We find several puzzles concerning the treatment of Majorana's work in the subsequent literature and the way in which the modern theory of autoionization was developed.
The relevant papers are those numbered 3 and 5 in the convenient collection, *Ettore Majorana Scientific Papers: On the occasion of the centenary of his birth*, ed. G. F. Bassani *et al.* (SIF, Bologna 2006), where they are accompanied by English translations and commentary. The originals are, respectively, ``I presunti termini anomali dell'elio,"E. Majorana, *Il Nuovo Cimento*, **8**, 78 (1931) and ``Teoria dei tripletti *P*' incompleti," E. Majorana, *Il Nuovo Cimento,* **8**, 107 (1931).

11.00: Coffee Break

11.20: Alessandro Ridolfo, *Dip. di Fisica della Materia e Ing. Elettronica, Università di Messina*

Playing with Quantum Coherence in Nanophotonics

The principle of complementarity refers to the ability of quantum entities to behave as particles or waves under different experimental conditions. For example, in the famous double-slit experiment, a single electron can apparently pass through both apertures simultaneously, forming an interference pattern. But if a "which-path" detector is employed to determine the particle's path, the interference pattern is destroyed. We propose a device enabling the ultrafast all optical control of the wave-particle duality of light. It is constituted by a three-level quantum emitter

strongly coupled to a microcavity and can be realized by exploiting a great variety of systems ranging from atomic physics and semiconductor quantum dots to intersubband polaritons and cooper pair boxes. We show that control pulses with specific arrival times, performing which-path and quantum-eraser operations, are able to destroy and recover interference almost instantaneously.
I also discuss quantum interference in hybrid molecules composed of an individual quantum emitter and a metallic nanoparticle. The coupling between the two systems give rise to a Majorana-Fano interference effect which strongly affects the quantum statistical properties of the scattered photons. This effect can be exploited for the realization of ultra-compact single-photon switches.

11.50: Alessia Irrera & Barbara Fazio, *CNR-IPCF, Istituto per i Processi Chimico-Fisici, Messina*

Fano Resonances in Si and Si Nanostructures

Silicon is the most important semiconductor since the Si-based devices have dominated integrated circuits for many decades. Si nanostructures exhibit both electrical and optical properties dramatically modified with respect to the bulk material. This makes them ideally suited to become basic building blocks for photonic components, including optically- and electrically-pumped lasers, polarization-sensitive detectors, electro-optic modulators and solar cells. However, one of the main limitation for their applications is to obtain uniform doping during their growth and measure the doping level with good accuracy. It has been demonstrated that laser induced Fano resonances in strongly doped Si and Si nanostructures affect the shape of their Raman peak. Here we discuss prospects for the correlation of the known doping level of Si nanowires, obtained via chemical etching of a Silicon substrate, with the asymmetry parameter of the Fano line shape of the Raman peak. This calibration plot can be a simple and versatile method based on standard Raman spectroscopy to access the doping level of Si nanowires, where unknown.

12.20: Conclusive Remarks

The EPS "Young Minds" Project

International networking, young researchers involvement with the scientific community, promotion of science among local communities; these should be goals of every young researcher in Europe. Of course, these highly-rewarding activities are time-consuming and hence the focus of most young minds is on getting their research task done, be it in the lab or in front of a computer. A strong institutional support is therefore deeply needed. And this is the kind of support is now available in the framework of the EPS Young Minds Project.

Young scientists -- from undergraduates to postdoctoral researchers -- are encouraged to organize EPS Young Minds Sections that collaborate to develop scientific, networking and outreach activities. These Sections are composed of at least four members: a president, a vice-president, a secretary and a treasurer. A local senior scientist acts as advisor to the local Section, providing advice and assistance. These Sections offer many benefits to their members and the local communities: seminars and colloquia can help broaden the knowledge of the members outside their special field of interest; visits to local industries and research labs can boost the integration between industry and research, while providing an outlook on the possible employment possibilities for recent graduates; educational outreach programs to local schools and communities can provide a stimulus for new generations of scientists and increase the awareness for the importance of scientific research amongst the widest public. EPS and the affiliated national societies will provide financial support for such activities though a specific granting scheme.

Local Sections are strongly encouraged to interact amongst them and build an international network. This can be organized at various levels: one-to-one exchanges between local Sections; European-level student conferences; and interaction with the student organizations of other organizations, e.g. OSA Student Chapters or SPIE Student Chapters. In particular, the established student network IONS, is a great way to connect to other leading scientists from all over Europe -- and EPS will provide financial support though specific grants.

Boosting the creativity of young minds, setting up a bright, brave, creative, determined, passionate and focused initiative -- this is the essence of the EPS Young Minds Project. As this project is open to all enthusiastic young researchers in Europe, be sure to be part of the next generation of leaders in science. Get this stimulus and join the EPS Young Minds Project today!

Webpage: http://epsyoungminds.org/

Organized by the "Young Minds" Group Messina

Cristiano D'Andrea, Antonino Foti, Marco Antonio Monaca, Alessandro Ridolfo, Lilla Schirò, Sebastiano Vasi, Rocco Vilardi.

Onofrio M. Maragò (Advisor)

New Members are Very Welcome!!!