Il Dr.

Giuseppe Calajò

ICFO The Institute of Photonic Sciences

MARIE CURIE ACTIONS

in the framework of the PhD program in Physics and Chemistry will deliver a **series of 4 lectures** titled

Modern platforms for quantum nonlinear optics

on **24, 25, 26 e 27 Jan 2022, 11.00 am**
at **aula B**, DiFC, via Archirafi 36. Team code: **qh5xiih**

Studenti e **dottorandi** sono invitati a partecipare.

Abstract

Nonlinear optical processes constitute the basis of many applications in modern science and engineering, where an effective interaction between electromagnetic signals inside some medium is required. These processes usually occur at high light intensities, but over the years, many efforts have been made to progressively reduce the minimum required input power. The ultimate goal is to achieve the realm of Quantum Nonlinear Optics (QNLO) where nonlinear effects occur at the level of individual photons. In this short course we aim to give a an intuition on the basic mechanisms to obtain such quantum optical nonlinearities and we will provide an overview on the main platforms used in the field.

Program

Lecture 1. General introduction to the course. Short review on light quantization, light matter interaction in rotating wave approximation and photon-photon correlations. Light-matter interaction in free space. Introduction to cavity QED and Jaynes Cumming model.

Lecture 2. Photon blockade in cavity QED. Introduction to waveguide QED and current experimental platforms. Single-photon scattering. Two-photon scattering: Bethe ansatz. Photon bound states and non linear frequency mixing.

Lecture 3. Review on electromagnetic induced transparency (EIT). Introduction to Rydberg atoms. Rydberg EIT: effective theories, Rydberg blockade and photon bound states.

Lecture 4. Introduction to atomic arrays. Spin model and collective effects. Overview of the emerging many-body physics with light and modern numerical techniques (e.g. Matrix Product States). Short introduction to quantum nonlinear optical processes in graphene.