**PhD Physics course at Bari University (XXXIII Cycle)**

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| **Title** | Atom-photon interactions |
| **Proponent** | Dr. Francesco Vincenzo Pepe (INFN) |
| **# CFU**  **(1 CFU = 8 hours)** | 2 |
| **Schedule** | 8 class lectures in February and March |
| **Brief Summary of the course** | The course will provide the basic concepts, results and mathematical tools of low-energy Quantum Electrodynamics. The first part will be devoted to a review of QED and its elementary processes. In the second part, non-perturbative analysis methods will be introduced, and a fully quantum theory of atom-laser interaction will be presented, also focusing on its relevance for optical trapping and atom manipulation. |
| **Programme** | 1. Electrodynamics in Coulomb gauge.  Constants of motion. Transverse and longitudinal fields. Quantization. Gauge invariance and minimal coupling. Dipolar approximation.  2. Processes.  Review of the basic processes of atom-photon interactions. Feynman diagrams. Perturbative estimate of transition rates.  3. Non-perturbative methods.  Properties of the resolvent. Self energy and partial resummation. Lifetimes and energy shifts. The Lamb transition.  4. The dressed atom approach.  Quantum treatment of the atom-laser interaction. Dressed states. Fluorescence triplet. Master equation for the dressed atom. Dipolar forces. |
| **Recommended texts** | C. Cohen-Tannoudji, J. Dupont-Roc, G. Grynberg  “Atom-Photon Interaction: Basic Processes and Applications” WILEY-VCH Verlag GmbH & Co (2004) |
| **Assessment methods** | Final seminar |