Didactic Program – PhD course

QUANTUM PHYSICS OF LOW DIMENSIONAL STRUCTURES

QPLDS-PhD

Duration: One semester, 2h/week=30h/semester

The aim: To Introduce to quantum formalism and to phenomena in low dimensional structures at the mesoscopic level and the presentation of the possible applications in **quantum computations**

Main issues:

1. INTRODUCTION TO QUANTUM MECHANICS – PRINCIPLES
2. INTRODUCTION TO QUANTUM MECHANICS – ADVANCED EXAMPLES
3. 2^{ND} QUANTIZATION FORMALISM. INTRODUCTION
4. 2^{ND} QUANTIZATION FORMALISM. QUANTUM OPTICS AND COHERENT STATES
5. 2^{ND} QUANTIZATION FORMALISM. GREEN FUNCTIONS
6. QUANTUM COMPUTATIONS. INTRODUCTION
7. QUANTUM ALGORITHMS. CODING, TRANSORMING, READING AND SEARCHING
8. QUANTUM ALGORITHMS. MRI IN QUANTUM COMPUTATIONS
9. QUANTUM ALGORITHMS. OPTICAL REALIZATION OF QUANTUM COMPUTATIONS
10. PHYSICS OF QUANTUM DOTS I
11. PHYSICS OF QUANTUM DOTS II
12. QUANTUM-POINT CONTACTS
13. MESOSCOPIC TRANSPORT AND MAGNETOTRANSPORT
14. TRANSPORT OF AN ELECTRON SPIN
15. DEVELOPMENT AND PERSPECTIVES FOR QUANTUM COMPUTATIONS USING QUANTUM DOTS

Suggested, preliminary literature-list:

1. L. I. Schiff, MECHANIKA KWANTOWA, PWN, Warszawa, 1987.
2. S. Węgrzyn, J. Graja, S. Bugajski, M. Gibas, R. Winiarczyk, L. Znamirowski, J. A. Miszczak, S. Nowak, NANO I KWANTOWE SYSTEMY INFORMATYKI, Wyd. Pol. Śl., Gliwice 2003.
3. M. Hirvensalo, ALGORYTMY KWANTOWE, WSiP, Warszawa 2004.
4. M. P. Das et al., QUANTUM POINT CONTACTS AND BEYOND: NEW RESULTS ON MESOSCOPIC CONDUCTANCE AND FLUCTUATIONS, arXiv: cond-mat/0404412 (http://lanl.arxiv.org).
5. H. A. Engel et al., CONTROLLING SPIN QUBITS IN QUANTUM DOTS, arXiv: cond-mat/0409294 (http://lanl.arxiv.org).