

Preface

One of the most important problems in the interdisciplinary area spanned by Physics, Computing, Engineering, and Nanotechnology is the efficient simulation of the dynamics of quantum many-body systems. Quantum simulators offer a new perspective allowing also for the implementation of quantum computation and the design of new materials with specific properties for technological applications. Initial approaches focused in the use of cold atom in optical lattices and ions in ion traps for mimicking a variety of models from condensed matter. More recent technological developments in the fields of interfacing light and matter, and especially in quantum nonlinear optics, have motivated complementary proposals for quantum simulators based on strongly correlated photons and polaritons. The latter are generated in hybrid light-matter systems ranging from coupled QED resonator arrays in superconducting circuits to slow light setups and semiconductor-based photonic chips. In this edited volume, several world experts in the area review some of the most important works on emulations of phenomena ranging from Mott transitions and Luttinger liquid physics to interacting relativistic theories and gauge fields with photons and polaritons. The aim was to review both the major theory proposals and the ongoing experimental efforts to realize photonic simulators in the laboratory in circuit QED, semiconductor, and integrated photonic lattice structures.

The book should be useful as an introduction to this area for graduate students working in quantum physics, quantum optics, implementations of quantum simulation, and strongly correlated physics. It can also serve as a reference material of the major developments at the time of writing to experts in the field.

We acknowledge the support of Technical University of Crete and the Centre for Quantum Technologies (CQT) Singapore while preparing this volume. We also like to thank CQT Ph.D. student Jirawat Tangpatinanon for his help in processing the latex files and the staff in Springer for their patience while this volume was being prepared.

Crete
October 2016

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Quantum Simulations with Photons and Polaritons
Merging Quantum Optics with Condensed Matter
Physics

Angelakis, D.G. (Ed.)

2017, XIII, 214 p. 86 illus., 77 illus. in color., Hardcover

ISBN: 978-3-319-52023-0