Preface

This book presents an account of the NATO Advanced Study Institute on "Nano-Optics for Enhancing Light-Matter Interactions on a Molecular Scale: Plasmonics, Photonic Crystals, Metamaterials and Sub-Wavelength Resolution," held in Erice, Sicily, Italy, from 3 to 18 July 2011. This meeting was organized by the International School of Atomic and Molecular Spectroscopy of the "Ettore Majorana" Center for Scientific Culture.

Quoting one of our lecturers (L. Novotny): "Nano-optics is the study of optical phenomena and techniques on the nanometer scale, that is, near or beyond the diffraction limit of light. It is an emerging field of study, motivated by the rapid advance of nanoscience and nanotechnology which require adequate tools and strategies for fabrication, manipulation and characterization at this scale."

The Institute provided a comprehensive overview of the rapidly expanding field of nano-optics, and outlined the current state of the art both in terms of the theory and applications to various technologies. The topics presented covered a broad range of subjects within the field of nano-optics, and included both the fundamental and advanced treatments of the following topics: plasmonics, photonic crystals, metamaterials, imaging with sub-wavelength resolution, ultrafast spectroscopy for coherent control of biomolecules, fluorescence resonant energy transfer, photovoltaics, photonic structures for information delivery and processing, non-linear phenomena, luminescence of nanostructures, waveguide arrays of nanostructrures, and terahertz spectroscopy for imaging at the nanoscale. The applications of nano-optics presented included: bio-imaging with subwavelength resolution, plasmonics for cell manipulation and materials processing at the nanoscale, transfection and nano-surgical techniques using ultrafast lasers, the enhancement of fluorescence for bioimaging, sensors based on plasmonics and various nano-structured materials, photovoltaics using nano-materials, photonic crystals for fiber communication, and ultrasensitive techniques (optical microcavities and waveguide arrays) for detection of chemical and biological molecules and explosives in the field.

Each lecturer started at a fundamental level, ultimately reaching the frontier of knowledge in a systematic and didactic fashion. The participants were encouraged to ask questions both during and after the lectures, which often led to lively

interactions. The formal lectures were complemented by additional seminars and discussions. The Institute gave the participants an opportunity to present their research work in the form of short seminars or poster presentations. In all, 10 short seminars and 42 posters were presented.

The participants came from 21 different countries: United States, England, Germany, Italy, Canada, France, Spain, The Netherlands, Finland, Denmark, Norway, Poland, Switzerland, Russia, Ukraine, Czech Republic, Uzbekistan, Belarus, Estonia, Croatia, and Egypt. Over the 2 weeks of the course, participants were given numerous opportunities to interact with one another, at both formal (poster sessions, seminars) and informal (e.g. dinners, excursions) events. The goal was to allow the participants to learn from one another about their scientific work and to expose them to others researchers from various cultures.

Two roundtable discussions were conducted during the course. The first discussion, conducted early in the course, allowed for the organizers and lectures to get immediate feedback from the participants regarding the organizational aspects of the course. The second roundtable meeting, held on the last day of the course, assessed the overall effectiveness of the course from the view of the participants. All participants filled out an evaluation form for the course and were given the opportunity to express their views at the meeting. The discussion and the evaluation forms indicated that the participants overwhelmingly felt that the course was a success. They appreciated the didactic nature of the course and found some of the lecturers very inspiring. They felt that the scientific level of the course was very high, and that both the breadth and balance of the subjects covered were appropriate. They believed the atmosphere of the course helped to promote interaction between all participants, especially between students and lecturers, and that these interactions often led to creative discussions. They also appreciated that the lectures were made available to all the participants online.

The evaluations provided many helpful suggestions that we will implement in the next course. Several participants suggested that additional information be made available online regarding some practical aspects of coming to Erice (accommodations, food, climate, etc.). They indicated a desire to have an online form on the web site to submit abstracts for posters and short seminars. Generally, they believed that a greater online presence would help in disseminating information about the course. Many participants also expressed a desire for additional events with a non-scientific focus, such as the special session given by one lecturer on his recent climb of Mt. Kilimanjaro.

Overall, it seemed that all the students enjoyed meeting and discussing their work not only with the lecturers, but also with one another. They appreciated the opportunity to meet with fellow graduate students and post-doctoral researchers from other countries who are working in the same field, or in related fields that could enhance their own work. They generated friendships and contacts that will very likely lead to new collaborations and opportunities for the enhancement of their research work.

The evaluations allowed us to gather new ideas on how to further improve the course, and revealed a consensus that the course will benefit their research work.

The following quotes from the evaluation forms give insights into how the students viewed their experience at the Institute.

"Very useful and interesting. The atmosphere is very special and very creative. The lineup of the speakers is fantastic . . . . A great service to the community."

"The most valuable thing I got out of the conference was meeting the other people who are involved in my field . . . . This was especially true for those of us from a small group, who maybe don't have as many people to bounce ideas off of."

"Very nice atmosphere among participants. Professors available for questions and willing to answer was highly important."

Summaries of the lectures, seminars, and posters are presented in this report.

I wish to acknowledge the sponsorship of the meeting by the NATO Organization, the Karlsruhe School of Optics, Boston College, the Italian Ministry of Scientific Research and Technology, and the Sicilian Regional Government.

I am looking forward to our activities at the Ettore Majorana Center in years to come, including the next 2013 meeting of the International School of Atomic and Molecular Spectroscopy.

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