

## PREFACE

The ADVANCED SUMMER SCHOOL 2005 (*EAV05*) was held at Centro de Investigación y de Estudios Avanzados (Cinvestav), Mexico City, on July 11-22, 2005. The aim of this School was to bring together graduate and advanced undergraduate students, postdocs and researchers from the five different areas of research developed at the Physics Department of Cinvestav. At the School a general overview was presented of the current state of the art on topics related to mathematical physics and gravitation, high energy physics, statistical, medical, and solid state physics. The courses consisted of an introductory general session plus a series of lectures at increasing levels to reach applications and special topics. The School was attended by about 170 participants from different countries: Mexico, Guatemala, Spain, U.S.A., Israel, Germany, Italy, and Brazil.

During the two weeks of the School, fourteen advanced level courses were presented by internationally recognized experts from U.S.A., Italy, Israel, Spain, Brazil, and Mexico. It is a pleasure to express to all lecturers our gratitude for their stimulating, sound courses at the School. In addition to the lecture courses, there were thirteen invited plenary talks as well as seminars in which also students and postdocs were given the opportunity to present the results of their research. Thank you to all who contributed to the School in such a manner.

The first week embraced topics on neutrino physics, group theory, field theory and medical imaging. Francis Halzen opened the School sessions by lecturing on cosmic rays, gamma rays and neutrinos. David Cline delivered his lectures on a hot subject in astrophysics: the search for dark matter and the nature of the dark energy. Both Halzen and Cline, discussed detectors, telescopes and laboratories which are of help in order to explain the origin of the Universe. The theoretical aspects involved were discussed by José Valle and Abdel Pérez-Lorenzana. An overview on the fundamentals of quantum field theory was delivered by José Gracia-Bondía while Hugo García-Compeán lectured on Lie Groups and Lie Algebras. In his turn, Luciano Ramello discussed the use of semiconductor solid-state detectors in medical imaging; the relevance of looking for better image quality and reduced dosage to the patients with respect to conventional methods became clear. Ramello also presented the details of angiographic and mammographic dual energy techniques. Finally, the first week came to an end with the course of Joel Stavans on biomolecular physics.

The second week dealt mainly with mathematical, statistical and solid state physics. The School opened with Tatiana Rappoport lecturing on the fundamentals of spintronics in semiconductors. Rappoport discussed production, injection, manipulation, and detection of spin-polarized carriers. She also presented some of the applications of quantum dots in spin filtering and quantum computation. Mónica Olvera delivered her lectures on the methods used to compute correlations in blends of linear chains and in melts of heterogeneous chains. Charles Tu discussed III-N-V compound semiconductors, explaining that their basic properties produce a variety of electronic and optoelectronic device applications. Guillermo Morales-Luna lectured on parallel computing based on exterior algebra as an introductory subject to quantum computation from the mathemat-

ical point of view. In his turn, Luis Miguel Nieto taught coherent and supercoherent states. His course, lectured in a clear and nice manner, was an example of the beauty of mathematical physics. We are certain the students who attended this course were positively impressed by its quality and the news after the School as well. Last October 4, the Royal Swedish Academy of Sciences announced the decision to award the Nobel Prize in Physics for 2005 to Roy J. Glauber, for his contribution to the quantum theory of optical coherence. Hence, our School not only was added to the celebration of the Year of Physics, it was also lucky to have included this hot subject in the courses. Finally, Rafael Baquero closed the School by lecturing on relevant aspects of superconductors nowadays.

The present volume of the AIP Conference Proceedings includes the lecture notes of eleven of the courses taught as well as the positively refereed contributions of the EAV05. We have to say that most of the contributors sent us original results to be considered for publication in this volume. Fortunately, almost all the contributions were accepted in agreement with the decision of the anonymous referees. The proceedings are organized in five chapters according to our Physics Department's groups of research: Mathematical Physics and Gravitation, High Energy Physics, Statistical, Medical, and Solid State Physics. In all cases, the chapter starts with the lecture notes of the courses while contributions are arranged according to similarity of subject.

It would not have been possible to organize this School without the generous support of our institution, Cinvestav. The support of the Mexican funding agency CONACyT is also acknowledged. Professors Cline and Halzen were also partially supported by The United States-Mexico Foundation for Science and the Academia Mexicana de Ciencias. We are indebted to Gerardo Herrera, Chair of the Physics Department, and Professor Arnulfo Zepeda, whose advice helped us to solve some organizational and financial difficulties.

The participation of Miriam Lomelí was essential; she worked on many aspects of the organization, starting with the design of posters and the distribution of announcements. She was also in charge of all the hotel reservations and many flight reservations, as well as the scheduling of the event. In general, the administrative duties were very easy with Miriam's help. Thank you very much Miriam.

Patricia Guadarrama participated in the printing of the preliminary lecture notes and their distribution during the School. Beatriz Garrido helped us with some administrative and broadcasting tasks. Our special thanks go to the support team: Juan Carlos Arteaga, Juan Barranco, Argelia Bernal, Luz del Carmen Cortés, Nicolas Fernández and Israel Lomelí. They as well as Sara Cruz y Cruz, Elvia Lomelí and Patricia Pliego, dedicated many hours of their time and a great part of their energy to many organizational tasks of EAV05. Finally, we extend our thanks to everybody who has helped to make this School a success.

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