Preface

The International Association for Relativistic Dynamics was organized in February 1998 in Houston, Texas, with John R. Fanchi as president.

Although the subject of relativistic dynamics has been explored, from both classical and quantum mechanical points of view, since the work of Einstein and Dirac, its most striking development has been in the framework of quantum field theory. The very accurate calculations of spectral and scattering properties, for example, of the anomalous magnetic moment of the electron and the Lamb shift in quantum electrodynamics, and many qualitative features of the strong and electroweak interactions, demonstrate the very great power of description achieved in this framework. Yet, many fundamental questions remain to be clarified, such as the structure of classical relativistic dynamical theories on the level of Hamilton and Lagrange in Minkowski space as well as on the curved manifolds of general relativity. There, moreover, remained the important questions of the covariant classical description of systems at high energy for which particle production effects are not large, such as discussed in Synge’s book, The Relativistic Gas, and in Balescu’s book on relativistic statistical mechanics, and the development of a consistent single and many body relativistic quantum theory.

In recent years, the very high accuracy of telescopes and advanced facilities for computation have brought a high level of interest in cosmological problems such as the structure of galaxies (dark matter) and the apparently anomalous expansion of the universe (dark energy). Some of the papers reported here deal with these problems, as well as other fundamental related issues.

It was for this purpose, to bring together researchers from a wide variety of fields, such as particle physics, astrophysics, cosmology, foundations of relativity theory, and mathematical physics, with a common interest in relativistic dynamics, to investigate fundamental questions of this type, that this Association was founded.

The second meeting took place, in 2000, at Bar Ilan University in Ramat Gan, Israel, the third, in 2002, at Howard University in Washington, D.C., and the fourth, on June 12-19, 2004, in Saas Fee, Switzerland. In 2006, the fifth meeting took place at the University of Connecticut campus in Storrs, Connecticut, and the sixth meeting, in Thessaloniki, Greece, in 2008, with the significant guidance of Professor Ioannis Antoniou, the help of the Aristotle University of Thessaloniki, at the Teleglion Foundation. The seventh meeting took place in Hualien, Taiwan, 2010,and the eighth at the Galileo Galilei Institute for Theoretical Physics (GIG) in Florence (Firenze), Italy, in 2012. The ninth meeting took place again at the University of Connecticut in Storrs, Connecticut (2014), and the tenth, in 2016, in Ljubljana, Slovenia, with the help and guidance of Professor Matej Pavšič. The eleventh meeting took place in Mérida, Yucatán, Mexico, under the sponsorship of the Instituto Politécnico Nacional with the help and guidance of Professor Gonzálo Ares de Parga. This meeting forms the basis for the Proceedings that are recorded in this issue of the Journal of Physics: Conference Series.
Along with the work of some of the founding and newer but already much engaged members of the Association, we were fortunate to have lecturers from application areas that provided strong challenges for further developments in quantum field theory, cosmological problems, and in the dynamics of systems subject to accelerations and the effects of general relativity.

Topics treated in this issue include studies in relativistic statistical mechanics and radiation, including mass radiation in an off shell theory. A new approach to understanding the observed rotation curves of galaxies is discussed, based on retardation, consistent with the recent observation of gravitational waves. There is also a discussion of an elementary approach, following Einstein’s original development, of the embedding of the relativistic dynamics of Stueckelberg, Horwitz and Piron into a canonical (with a complete phase space) classical and quantum theory of a particle moving in a gravitational field subject to additional forces, extended to many body systems with electromagnetic interaction. A geometrization of Newtonian mechanics is also studied, and the effect of vacuum fluctuations on the properties of the vacuum are also discussed. An important and timely study is given of the effect of critical scaling on the Higgs phenomenon is given. The spinorial formulation of relativistic wave equations is discussed, and the notion of measurement is rigorously studied. The EPR problem is also rigorously analyzed.

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The organizers express their gratitude to the Instituto Politécnico Nacional for its support in arranging excellent facilities in the charming city of Mérida.

We thank the participants who contributed through their lectures, personal discussions, and these papers, to the advancement of the subject and our understanding.

For the Editors and Organizing Committee,

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