PREFACE

In 1975 the Marcel Grossmann Meetings were established by Remo Ruffini and Abdus Salam to provide a forum that would meet every three years to discuss recent advances in gravitation, general relativity and relativistic field theories, emphasizing their mathematical foundations, physical predictions and experimental tests. These meetings aim to facilitate the exchange of ideas among scientists, to deepen our understanding of space-time structures and to review the status of ongoing experiments and observations testing Einstein's theory of gravitation either from ground or space-based experiments.

The first two Marcel Grossmann Meetings MG1 and MG2 were held in Trieste (1975, 1979). The meetings have since grown under the guidance of its International Organizing Committee and eventually of a large International Coordinating Committee. MG3 (1982) took place in Shanghai and distinguished itself as the first truly international scientific meeting to take place in China after the so-called cultural revolution. The range of topics presented at these meetings has gradually broadened to accomodate issues of major scientific interest. For example, the birth of "astroparticle physics" was testified to in the inaugural lecture of Abdus Salam at MG4 in Rome (1985), which saw entire sessions dedicated to this new topic. The proceedings of these first four meetings were published by North Holland in Amsterdam. Starting with MG5 held in Perth (1988), they have been published by World Scientific in Singapore.

General relativistic theories have become more and more the theoretical foundation for a very broad new area of research encompassing experiments and observations which make use of techniques from space missions in the optical, X- and gamma-ray wavelengths to large radio and optical ground-based observatories as well as underground laboratories. The enormous momentum gained following very large investments in observational techniques, having no precedent in other areas of science, has gradually led to the maturing of a new field of research: relativistic astrophysics. Paradoxically Einstein's theory, born as a purely theoretical and mathematical conceptual revolution with extremely feeble supporting experimental evidence, has become the driving force in the theoretical understanding of possibly the largest observational and experimental scientific effort in the history of mankind. The Marcel Grossmann meetings have followed these developments at MG6 (Kyoto, 1991), MG7 (Stanford, 1994), MG8 (Jerusalem, 1997) and MG9, or 'MG IX MM' to emphasize the millennium change (Rome 2000), which has become an important point of reference for this field.

The Tenth Marcel Grossmann Meeting (MG10) was held from July 20–26, 2003 in Rio de Janeiro. MG10 was organized by the International Organizing Committee composed of D. Blair, Y. Choquet-Bruhat, D. Christodoulou, T. Damour, J. Ehlers, F. Everitt, Fang Li Zhi, S. Hawking, Y. Ne'eman, R. Ruffini (chair), H. Sato, R. Sunyaev, and S. Weinberg. Essential to its planning was the International

Coordinating Committee of 160 members from scientific institutions of 57 countries and the work of the Local Program Committee. The morning plenary sessions took place in the auditorium of the Military Institute of Engineering (IME), located on a beautiful spot just below the famous Sugar Loaf mountain in the Urca neighborhood of Rio. The afternoon parallel sessions took place at the Brazilian Center of Physical Research (CBPF) and at the University of Rio de Janeiro (UNIRIO).

The opening ceremony was held the morning of July 21. The importance of the conference attracted the attention of the Brazilian government. During this opening ceremony Professor Roberto Amaral, the Minister of Science and Technology of Brazil, announced the creation of a new institute in Rio de Janeiro devoted to cosmology, relativity and astrophysics: the ICRA-BR, which will be a member of ICRANet. His speech is reproduced in these proceedings. Other welcoming addresses were given by Remo Ruffini (Chairman of the International Organizing Committee) followed by Mario Novello, Fernando Peregrino, Luis Pinguelli Rosa, Marco Vales, and Enio Candiotti.

Following tradition, the Marcel Grossmann Awards were also announced in this opening session. The institutional award was given to the CBPF (Brazilian Center for Research in Physics) for its role as a teaching and research institution and as a place originating fundamental physics ideas in the exploration of the universe, and was presented to CBPF founders Cesar Lattes, José Leite Lopez and Jayme Tiomno (see photos on page xi). Unfortunately Professor Lattes was not present at the ceremony due to health problems and was represented by Alfredo Marques. The individual award was shared by Yvonne Choquet-Bruhat and James W. York, Jr. (see photos on page xiii), for separate as well as joint work in establishing the mathematical framework for proving the existence and uniqueness of solutions to Einstein's gravitational field equations. Professor York received his award in Rio and presented a lecture at the meeting, while Professor Choquet-Bruhat received her award at a later ceremony at the Institut Hautes Etudes Scientifiques in Paris. The other individual award went to Yuval Ne'eman for his contributions to science, epistemology, mathematics and physics from subnuclear to space sciences (see photo on page xiii). Each of them received a silver replica of the TEST (Traction of Events in Space-Time) sculpture by Attilio Pierelli.

After the opening ceremony, the meeting began with a talk by Yuval Ne'eman entitled "Mathematics, Physics and Ping-Pong". The scientific program included 29 morning plenary talks during 6 days, and 57 parallel sessions over five afternoons, during which roughly 500 papers were presented.

The 500 scientists and their families from 52 countries present at the meeting had the opportunity to enjoy the beauty of the city of Rio de Janeiro, along with summer-like clear-sky weather, which enhanced the views of the city. During the afternoon of June 23, some of the partipants visited the Corcovado mountain with its world famous statue, while others took a jeep tour to the Tijuca forest, the greatest urban forest in the world. The closing banquet took place on the evening

of June 25 at a typical Brazilian restaurant with a breathtaking view of the Sugar Loaf and the Botafogo Bay, and participants enjoyed traditional Brazilian music after the meal.

In the closing speech on June 26, Remo Ruffini and Mario Novello thanked the members of the Organizing and Coordinating Committees for their continuing efforts and CNPq, MCT, FAPERJ, FINEP, IUPAP, UNESCO, and ICTP for the financial support which led to the success of a forum on such a grand scale.

The three volumes of these proceedings represent an authoritative view of relativistic astrophysics, a field which is now becoming one of the priorities in the scientific endeavour. The first volume includes the plenary talks and parallel session review talks, while the last two volumes include the remaining contributions to the parallel sessions. The papers that appear in these volumes cover all aspects of gravitation, from mathematical issues to recent observations and experiments, summarizing a complete picture of our current understanding of gravitational theories.