Introduction

During the 20th century, new windows on the Universe have been opened by the advent of radio astronomy and X-ray astronomy and these, together with the great advances in optical astronomy (both from the Earth’s surface and from space), have revolutionized our understanding of the Universe and the way in which it works. Now, as we enter the twenty-first century, we await the opening of another new window – that provided by gravitational waves – which will allow us a closer “view” of black holes and neutron stars, as well as providing a new probe of processes in the very early Universe. This is an exciting prospect but one which poses a serious challenge to theoretical astrophysics. The new generation of detectors (both laser interferometers and resonant detectors) require input from theoreticians regarding the possible mechanisms for generation of gravitational waves by astronomical sources and predictions of the waveforms produced. This input is essential in order both to tune the parameters of the detectors and to provide templates for use in extracting the tiny gravitational-wave signals from the ambient noise. Also, we need to understand how gravitational wave data, when it arrives, could be used in order to obtain information about the nature of the sources and about their dynamical evolution as well as, perhaps, giving deeper insights into some questions of fundamental physics by means of probing the state of matter under the extreme conditions of energy and pressure found in the interior of neutron stars and in the very early universe. This can provide opportunities beyond the capabilities of experiments carried out in terrestrial laboratories.

For a week at the beginning of June 2000, 106 scientists from 28 countries came to Trieste for a meeting whose aim was to present a survey of the current status of the response of theoreticians to the challenge described above, as well as including progress reports on the different types of detector. The meeting was a special occasion in that it provided a forum for people working on the physics of the various potential sources of gravitational waves to discuss in depth the many different aspects of the problems involved. The papers in this volume are the written versions of most of the talks given during that week and the order in which they appear is the same as that in which the talks were given. We hope that they will provide a useful resource for people interested in this growing area of research.

As organisers, we would like to thank all of those who contributed to making this meeting such a successful one. Firstly, it is a pleasure to thank Professor Miguel Virasoro, the Director of ICTP, for giving us the possibility
of holding this meeting at the ICTP premises in beautiful surroundings by the Bay of Grignano. The facilities were excellent and we are especially grateful to the ICTP staff who were involved with all of the different aspects of the organisation, among whom we here particularly mention Dilys Grilli who was responsible for putting together this proceedings book. Next, we thank the sponsoring institutions for their support: in addition to the ICTP itself, we also received funding from the INFN and SISSA. Then, we thank the other members of the Scientific Organising Committee (Marek Abramowicz, Fernando de Felice, Francesco Fucito, Antonio Lanza and Sabino Matarrese) who helped us in working out the format of the meeting and fixing the programme. Last, but definitely not least, we thank all of the speakers and other participants for creating such a memorable spirit of lively discussion and good companionship. In the autumn and winter months which followed, we often found ourselves thinking back to that week in June!

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April, 2001