Detecting the Stochastic Gravitational-Wave Background

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To Camilla, with love and gratitude, and to our uncommon children: Theo, Piero, Noemi and Gabriele.

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Preface

The stochastic gravitational-wave background (SGWB) is the most mysterious source of gravitational radiation. Its detection will be a milestone for science and could dramatically change our knowledge of the Universe. During the writing of this book, gravitational radiation was detected experimentally for the very first time: this detection, announced on 11 February 2016, was hailed as a fantastic achievement for the scientific community. More detections followed and on 16 October 2017 a joint gravitational wave electromagnetic observation was announced: the birth of gravitational wave astronomy has finally become reality. Gravitational wave cosmology could be the most important and most exciting chapter of observations. In this book we review briefly what the SGWB is, its most likely sources and the data analysis techniques required to claim a successful detection.

None of the material presented here is original, everything that is written in this book has already appeared in the literature. The author of this book was a member of the LIGO/Virgo Collaboration for more than ten years and he was involved in the Stochastic Upper Limit Group and contributed to some of the results quoted here. However the way this material is presented is hopefully original and reflects the background of the author, who is not an astrophysicist but rather a theoretical cosmologist with a strong background in high-energy physics.

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Author biography

Carlo Nicola Colacino

Carlo Nicola Colacino studied theoretical physics at the Sapienza University of Rome, working alongside one of the most famous Italian astrophysicists, Remo Ruffini, and one of the most promising high-energy theoreticians, Massimo Bianchi. He then worked on his PhD in Cagliari, under the guidance of Massimo Bianchi and Mariano Cadoni. His research career saw him spend years in Hanover, as a scientist on the project GEO600, Birmingham and Budapest within the framework of the LIGO Scientific Collaboration (LSC) as well as Pisa, within the Virgo project, where he worked specifically on the stochastic gravitational-wave background, detector characterisation and data analysis. He is currently working for the Italian Ministry of Education and Research as a teacher and outreach scientist, bringing the excitement of physics to young children. His main passions are cosmology, high-energy physics, choir music, rugby and probability: because of this, he is one of the leading scientists of a project launched by the Italian Government to inform people, especially young people, about the risks of gambling and games of hazard.