Welcome to a new era in astronomy

Ripples in Spacetime

By Govert Schilling

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Credit: LIGO/T. Pyle

The acronym GW was first used in astronomy in the 1990s as shorthand for 'galactic worms' — worm-shaped structures of neutral hydrogen found in the Milky Way. However, GW turns out to also be the initials for gravitational waves, the elusive spacetime ripples (a magnified artist's impression is pictured) that were directly detected for the first time in September 2015: the measured signal became famous with the name GW150914. *Ripples in Spacetime* by Govert Schilling sets out to describe the discovery of gravitational waves and the efforts that led to this breakthrough, putting special emphasis on the process and the scientists who contributed to it. The book also provides simple explanations of the science behind this scientific feat and some historical perspective, necessary to understand the discovery's huge impact on astronomy and on our insight into gravity. Schilling — a popular-science writer and astronomy journalist from the Netherlands who has an asteroid (10986 Govert) named after him — has authored several well-received books, including *The Hunt for Planet X*, *Flash! The Hunt for the Biggest Explosions in the Universe*, *Tweeting the Universe* (with Marcus Chown) and *Deep Space*.

The book's foreword, a magnificent summary of the most important aspects of the quest to find this elusive prediction of Einstein's theories, is written by the well-known astrophysicist Martin Rees — University of Cambridge emeritus professor, former President of the Royal Society and current Astronomer Royal, who also has an asteroid (4587 Rees)

named after him. The short introduction follows two parallel threads: on one side is the story of the emission of the gravitational wave signal GW150914 and its journey towards us while on the other unfolds the development of life on Earth and the history of humankind. The two storylines connect at the time and location of the discovery, inspirationally putting our existence in the Universe in perspective. The first 10 of the 16 chapters lay the groundwork for the discovery: they cover topics ranging from Einstein's theory of general relativity and how its predictions have been proved so far, to the life (and death) of stars and the evolution of the Universe.

The author spends some time on the experimental aspects of the discovery, including a description of the Laser Interferometer Gravitational-wave Observatory (LIGO) interferometers that detected gravitational waves and how they came into existence, thanks to the efforts and persistence of numerous scientists and generous funding. A whole chapter is devoted to the events surrounding the discovery itself: from the first phone calls and e-mails exchanged after the alert to the announcement at the press conference in February 2016 — gravitational waves (or 'Einstein waves', as the author calls them) are unsurprisingly the star of the show. The rest of the book covers important topics associated with the LIGO gravitational waves detection such as black holes, the hunt for electromagnetic counterparts to gravitational wave signals and the plans for future gravitational wave detectors, both on the ground and in space. There are plenty of references to previous chapters, creating a cohesive picture of interrelated scientific research fronts. Several pages of notes at the back of the book include links to videos, references to scientific articles (including the original detection paper), and details about the more than 20 interviews used in the book. The writing is dynamic and seasoned with personal stories and interesting anecdotes, from the film *Interstellar* to 'bar fights' and Carl Sagan's apple pie. The scientific explanations, expressed in accessible terms but sufficient to provide a

complete understanding, are interspaced with historical interludes that span more than a century. The combination results in a more relaxed read.

I would recommend this book to non-experts in the field: enthusiasts who are willing to look up a few concepts or more technical terms (for instance, the meaning of 'degenerate matter' or the function of a Geiger counter are not explained) or interested scientists with a different area of expertise. From my point of view as a member of the LIGO collaboration, what I found most interesting was to learn more about the impact that this discovery had on the scientific community, as well as becoming more familiar with the history of the pursuit of gravitational waves and other related physics projects farther away from my field of expertise. For readers interested in the discovery itself, from a social point of view, the book *Gravity's Kiss* by sociologist Harry Collins is probably a more in-depth option. Unlike the present work, most existing books on the chase for gravitational waves were written before the detection, like Collins's *Gravity's Shadow*, which very extensively covers 40 years of gravitational wave hunting, and Janna Levin's *Black Hole Blues*, a shorter chronicle that focuses mainly on the people behind the discovery. *Einstein's Unfinished Symphony* by Marcia Bartusiak has been recently updated to cover the detection.

Ripples in Spacetime does a great job of providing an accessible and enjoyable way for readers to understand the discovery of gravitational waves, and the new and intriguing window to the cosmos that this discovery has opened. Now we can not only observe the Universe with telescopes, but also listen to it with gravitational interferometers. A new era in astronomy has started — welcome! □

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