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REVIEWS

General Post-Newtonian Orbital Effects. From Earth's Satellites to the Galactic Centre, by Lorenzo Iorio (Cambridge University Press), 2025. Pp. 282, 25 × 17·5 cm. Price £125/$160 (hardbound; ISBN 978 1 009 56287 4).

The title of this book neatly summarizes both it and many of the author's numerous papers, which have made his name well known. The book deals with many subtle issues which can, in principle, be examined by careful perturbative analysis of two-body motions in the Universe. Thus it is packed with formulae providing the effects on orbital elements (mainly) of perturbations from a wide variety of sources. Actually, while 'post-Newtonian' might to many readers mean 'relativistic' or, more widely, non-classical, the book actually also includes quite classical topics, such as the J2 perturbation of an oblate body, though these are often included as nuisance terms which, if omitted, might mimic the non-Newtonian effects of interest. Little is said of the effects of gravitational waves.

The kinds of effects under discussion are divided into about eight chapters, dealing separately with first- and second-order effects, gravitoelectric and gravitomagnetic relativistic effects, perturbations in non-standard dynamical theories, and so on. Each one of these chapters begins with a short introduction to the physical context of the effects covered, and, having only a nodding acquaintance with some of them myself, I found these interesting. That apart, the text is full of formulae, usually with no more than outline derivations, which the reader has to fill out from the cited literature or provide for himself. The references to the literature are apparently very comprehensive, and the citations and the formulae themselves are presented with a lot of care; the longest ones are hived off to separate appendices.

The author's main application of such results is observational, but almost nothing is said of the statistical methods which such work requires. He does, however, point out the danger of searching for an effect by fitting the residuals from an existing incomplete theory, if one does not repeat the entire fitting with the augmented theory. And when no natural binary motion exists for examining some effect, it can sometimes be done with a suitably designed probe. Some of these are described in a separate chapter at the end, and include proposals with amusingly quirky names, including IORIO (In-Orbit Relativity Iupiter [*sic*] Observatory). The entire text is lightened with etymological and other notes. — Douglas C. Heggie.

Hidden in the Heavens. How the Kepler Mission's Quest For New Planets Changed How We View Our Own, by Jason Steffen (Princeton University Press), 2024. Pp. 253, 24·5 × 16·5 cm. Price £25/$29·95 (hardbound; ISBN 978 0 691 24248 4).

This fascinating book tells the story of *Kepler*, one of the most significant space-science missions ever launched. It is a tale of imagination, innovation, perseverance, technological wizardry, and human ingenuity, described in graphic detail by one of the members of the science team who made the mission such a resounding success.

Until the 1990s, the only family of planets available for astronomers to study was our own Solar System, populated by nine planets (now eight, after the demotion of Pluto), hundreds of satellites, and countless chunks of icy or rocky debris. There seemed little reason to expect any other planetary systems — if they existed — to be very different. Then, in 1992, the first planets confirmed to exist beyond our Solar System were discovered in orbit around a dense, dying star — a pulsar. Three years later, a planet (51 Peg b) was found in orbit around a distant, Sun-like star for the first time. Furthermore, 51 Peg b turned out to be something most unexpected — a searingly hot gas giant that circled its star once every four days, the first example of what came to be known as a 'hot Jupiter'. According to the theories of the time, such a world should not exist. In the years that followed, a steady stream of exoplanet discoveries was recorded, but progress was very slow. However, a group of scientists, led by William Borucki of NASA's Ames Research Center, envisaged a revolutionary space observatory, equipped with a highly sensitive photometer, that would be able to study minute changes in brightness caused by planets transiting in front of distant stars. After years of trying to convince NASA that such a mission was viable, the *Kepler* planet-finding mission was given the go-ahead in 2001 December.

Kepler's primary objective was to spend up to four years staring at more than 100 000 pre-selected stars in order to detect variations in light with an accuracy of 20 parts per million. So much data came pouring in that the science analysts were in danger of being swamped, but the introduction of computer simulations