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BOOK REVIEW

Valerio Bozza

Silvia Mollerach, Esteban Roulet: Gravitational Lensing and Microlensing

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Ten years after the publication of "Gravitational Lenses" by Schneider, Ehlers and Falco [1], the fascinating and spectacular world of gravitational lensing has been finally revisited in a completely new and updated publication. Along with the book by Petters, Levine and Wambsganss [2], this fills a gap in the literature that was opening more and more, after a decennium of new developments and discoveries that have involved gravitational lensing on the frontiers of modern cosmology.

One may think that this book is just an extension of the microlensing review by the same authors that appeared five years before [3], but I do not share this impression, since the topics are now reorganized in a widely different way. However, the main focus of the book remains on microlensing and other applications of gravitational lensing are only partially touched.

After a short introduction clarifying the historical background of gravitational lensing, Chapter 2 intends to provide the reader with all the necessary theoretical tools to understand the physics of gravitational lensing. Tensor notation and the basics of geometry in curved spacetimes are introduced in a very quick but nevertheless complete way. In the same chapter, the Schwarzschild metric is explicitly derived and the deflection of light is calculated by the geodesic equations in the weak field limit. At the time when this book was written, the interest in gravitational lensing in strong gravitational fields was about to be renewed, so its treatment is still missing.

Chapter 3 contains the full theory of gravitational lensing. Starting from the lens equation, the authors particularly stress the surface brightness conservation (which is sometimes overlooked by non-experts) and introduce critical curves and caustics. A nice intuitive representation of the lens mapping is provided by what the authors call "the folded sky". Finally they explain the general features of

V. Bozza (✉)
Theory Department, CERN, Meyrin (GE) CH-1211, Switzerland
E-mail: valboz@sa.infn.it

caustic points. Some classical topics have been excluded from the book, e.g. the Chang and Refsdal lens, which is only briefly mentioned in Chapter 6.

Chapter 4 is a summary of macrolensing. With this term the authors indicate anything that is not microlensing. This includes lensing of quasars with the estimates of the Hubble constant H_0, statistical lensing, strong and weak lensing by clusters, cosmic shear and lensing of the cosmic microwave background. In order to understand all the cosmological applications of gravitational lensing, the authors provide a very useful appendix at the end of the book. Within a book that is mainly focused on microlensing, this chapter represents an exhaustive and synthetic overview. So, by reading it, one cannot expect to acquire all the necessary tools for the applications discussed therein, but the interested reader is refered to some suggested readings listed at the end of the chapter.

The final two chapters are devoted to microlensing. Chapter 5 explains the basic idea and its use in the search for baryonic dark matter in the galactic halo. The statistic quantities are well explained and the main results of the existing microlensing surveys (by 2002) are reported. The scientific community is now widely convinced that MACHOs only contribute a negligible fraction to the halo. The authors discuss various interpretations for the microlensing results and the perspectives opened by new possible observational facilities.

Chapter 6 examines in detail all the categories of microlensing events which deviate from the simplest one. The accent is posed on the possible exploitation of the additional information in order to break the degeneracies among mass, distance and velocity of the lens. The discussion of these degeneracies and their possible breakings is carried in a really clear and enjoyable way. Astrometric microlensing finds its place in this chapter, together with binary events, extended sources and parallax measures. Certainly, microlensing searches still have very much to say on the distributions of stellar and sub-stellar populations in our Galaxy and hopefully also on the occurrence of planetary systems. A short notice is finally devoted to quasar microlensing.

Summing up, as one can expect from the number of pages, this book cannot replace the much deeper and extended treatment of [1] or the mathematical insight of [2]. Indeed, in any course on gravitational lensing, the older book should still be present. However, here one can find a complete overview of all the recent revolutionary developments of gravitational lensing, with a fully self-consistent treatment of microlensing. The quality and number of didactic illustrations is high and only very few typos can be found, though the reading is sometimes slowed by the fact that many statements are given without adequate comments. In conclusion, I think that this book should not be missing in scientific libraries that are to be updated on gravitational lensing. It also provides a useful support tool for basic gravitational lensing courses. Finally it can be recommended to researchers who want a rapid overview of the field, without getting swamped into too many details.

References

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