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Nota di contenuto	1. Introduction -- 1.1 Historical remarks -- 1.2 Outline of the book -- 1.3 Remarks about notation -- 2. Basic facts and the observational situation -- 2.1 The Schwarzschild lens -- 2.2 The general lens -- 2.3 The magnification factor -- 2.4 Observing gravitational lens systems -- 2.5 Known gravitational lens systems -- 3. Optics in curved spacetime -- 3.1 The vacuum Maxwell equations -- 3.2 Locally approximately plane waves -- 3.3 Fermat’s principle -- 3.4 Geometry of ray bundles -- 3.5 Distances based on light rays. Caustics -- 3.6 Luminosity, flux and intensity -- 4. Derivation of the lens equation -- 4.1 Einstein’s

gravitational field equation -- 4.2 Approximate metrics of isolated, slowly moving, non-compact matter distributions -- 4.3 Light deflection by quasistationary, isolated mass distributions -- 4.4 Summary of Friedmann-Lemaître cosmological models -- 4.5 Light propagation and redshift-distance relations in homogeneous and inhomogeneous model universes -- 4.6 The lens mapping in cosmology -- 4.7 Wave optics in lens theory -- 5. Properties of the lens mapping -- 5.1 Basic equations of the lens theory -- 5.2 Magnification and critical curves -- 5.3 Time delay and Fermat's principle -- 5.4 Two general theorems about gravitational lensing -- 5.5 The topography of time delay (Fermat) surfaces -- 6. Lensing near critical points -- 6.1 The lens mapping near ordinary images -- 6.2 Stable singularities of lens mappings -- 6.3 Stable singularities of one-parameter families of lens mappings; metamorphoses -- 6.4 Magnification of extended sources near folds -- 7. Wave optics in gravitational lensing -- 7.1 Preliminaries; magnification of ordinary images -- 7.2 Magnification near isolated caustic points -- 7.3 Magnification near fold catastrophes -- 8. Simple lens models -- 8.1 Axially symmetric lenses -- 8.2 Lenses with perturbed symmetry (Quadrupole lenses) -- 8.3 The two point-mass lens -- 8.4 Lenses with elliptical symmetry -- 8.5 Marginal lenses -- 8.6 Generic properties of "elliptical lenses" -- 9. Multiple light deflection -- 9.1 The multiple lens-plane theory -- 9.2 Time delay and Fermat's principle -- 9.3 The generalized quadrupole lens -- 10. Numerical methods -- 10.1 Roots of one-dimensional equations -- 10.2 Images of extended sources -- 10.3 Interactive methods for model fitting -- 10.4 Grid search methods -- 10.5 Transport of images -- 10.6 Ray shooting -- 10.7 Constructing lens and source models from resolved images -- 11. Statistical gravitational lensing: General considerations -- 11.1 Cross-sections -- 11.2 The random star field -- 11.3 Probabilities in a clumpy universe -- 11.4 Light propagation in inhomogeneous universes -- 11.5 Maximum probabilities -- 12. Statistical gravitational lensing: Applications -- 12.1 Amplification bias and the luminosity function of QSOs -- 12.2 Statistics of multiply imaged sources -- 12.3 QSO-galaxy associations -- 12.4 Microlensing: Astrophysical discussion -- 12.5 The amplification bias: Detailed discussion -- 12.6 Distortion of images -- 12.7 Lensing of supernovae -- 12.8 Further applications of statistical lensing -- 13. Gravitational lenses as astrophysical tools -- 13.1 Estimation of model parameters -- 13.2 Arcs in clusters of galaxies -- 13.3 Additional applications -- 13.4 Miscellaneous topics -- References -- Index of Individual Objects.

Sommario/riassunto

The theory, observations, and applications ofgravitational lensingconstitute one ofthe most rapidly growing branches ofextragalactic astrophysics. The deflection of light from very distant sources by intervening masses provides a unique possibility for the investigation of both background sources and lens mass distributions. Gravitational lensing manifestsitselfmost distinctly through multiply imaged QSOs and the formation of highly elongated im- ages of distant galaxies ('arcs') and spectacular ring-like images of extra- galactic radio sources. But the effects of gravitational light deflection are not limited to these prominent image configurations; more subtle, since not directly observable, consequences of lensing are the, possibly strong, mag- nification of sources, which may permit observation of intrinsically fainter, or more distant, sources than would be visible without these natural tele- scopes. Such light deflection can also affect the source counts of QSOs and of other compact extragalactic sources, and can lead to flux variability of sources owing to propagation effects. Trying to summarizethe theory and observationalstatus ofgravitational lensing in a monograph turned out to be a bigger problem than any of

the authors anticipated when we started this project at the end of 1987, encour- aged by Martin Harwit, who originally approached us. The development in the field has been very rapid during the last four years, both through the- ory and through observation, and many sections have been rewritten several times, as the previous versions became out of date.