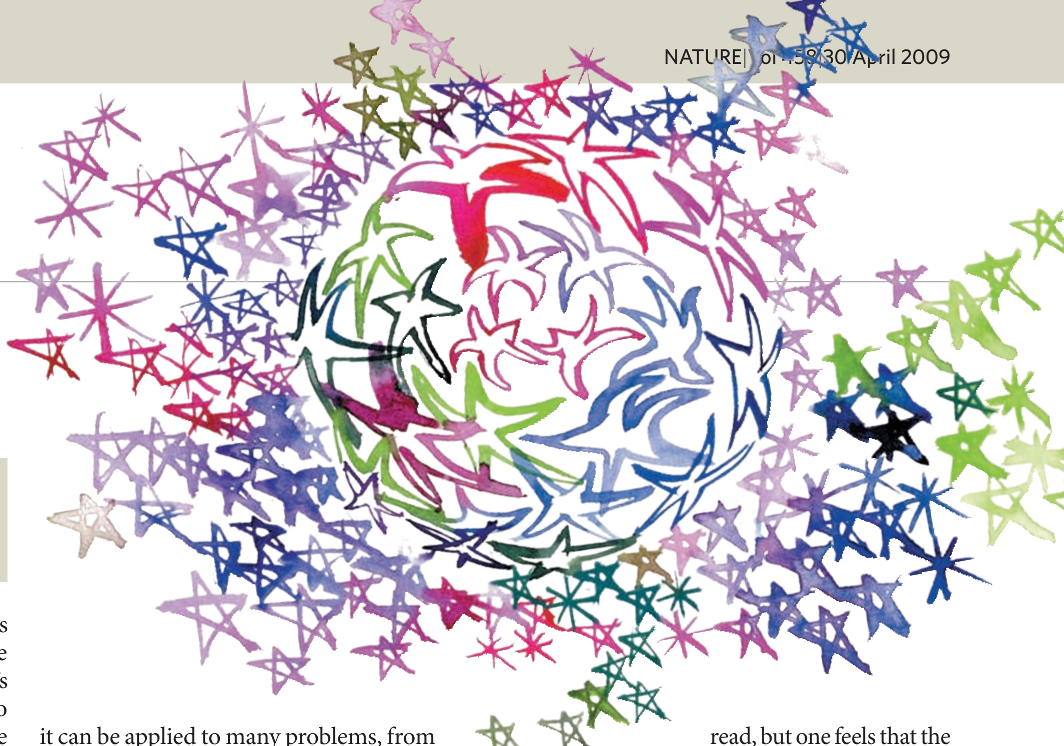

An eye on the Universe

Einstein's Telescope: The Hunt for Dark Matter and Dark Energy in the Universe
by Evalyn Gates
W. W. Norton: 2009. 320 pp. £18.99, $25.95

Gravitational lenses — heavenly bodies that bend light rays by their gravity — have emerged as powerful tools in the astronomer's repertoire. Yet their usefulness was difficult to foresee. In the 1930s, Albert Einstein wrote sceptically that "there is no great chance of observing this phenomenon". Astronomer Henry Norris Russell titled them 'Perfect Tests of General Relativity that are Unavailable'. Only the optimistic Fritz Zwicky predicted that "the probability that … gravitational lenses will be found becomes practically a certainty", although he did not live to see it.

Einstein's Telescope opens up this new view of the Universe. Originally proposed as a semi-crazy thought experiment by Johann Soldner in 1801, gravitational lensing was ignored for more than a century until Einstein addressed it in a paper in 1911. Gravitational light deflection made headlines when astronomers Arthur Eddington and Frank Dyson measured offsets in the positions of stars viewed near the Sun's edge during the solar eclipse of 29 May 1919, confirming a prediction of Einstein's general theory of relativity. But it was another 60 years before the first double image of a lensed quasar was discovered in 1979, and the technique's use in cosmology began.

Conceptually simple, gravitational lensing occurs when a light ray is attracted by a cosmic body, its path becoming bent as if being focused by a lens. The amount by which the ray is deflected is proportional to the mass of the 'lens', and inversely proportional to the closest distance by which the ray passes the lens. Lensing is seen in astrophysical systems over a huge range of scales: from nearby stars and planets to distant and massive clusters of galaxies. And it can be applied to many problems, from the detection of invisible dark matter and the magnification of very distant galaxies to the search for Earth-like planets around other stars. Given the method's power, one wonders why it has taken so long for a book to be written about it.

Author Evalyn Gates is an active scientist with a background in particle physics, cosmology and public outreach. This combination gives her the ideal tools to describe gravitational lensing. She addresses the book to the scientifically curious layperson — and delivers. Gates does an excellent job of directing readers through diverse astrophysical scenarios, including the 'strong' and 'weak' variants of lensing. She comprehensibly describes observations such as the distortion of background galaxies seen through a giant galaxy cluster and the surge in the brightness of stars caused by compact lenses moving in front of them.

Gates uses the search for dark matter and dark energy — the two greatest mysteries in modern physics and astronomy — as her main driver. With this in mind, she explores fields from galaxy clusters to the searches for weakly interacting particles and from distant supernovae to the cosmic microwave background. But she also touches on many other issues, such as star and planet formation and galaxy evolution. She wants the reader to understand the underlying physics questions. Some of these are complex, so the book is not always an easy read, but one feels that the author knows what she is writing about. Guiding the reader through multiverses, accelerated cosmic expansion or the physics of exploding stars, Gates clearly explains the problems and challenges that physicists face today. She uses apt analogies and original comparisons, many of which I had not heard before. They are so appropriately chosen that I found myself eagerly awaiting the next good metaphor.

Gates discusses the major challenges in cosmology. Not all of these questions will be solved with gravitational lensing, but in many cases it will contribute to the answer. Some of the topics appear to be slightly out of focus; but then, we learn, a gravitational lens does not have a single focal point.

Einstein's Telescope is comprehensive, including a glossary and a good index, referencing original literature and websites as well as offering detailed explanations of physical mechanisms. It provides food for thought for both expert and general readers. Through Gates's ambitious book, everyone will appreciate the puzzles of the dark Universe — and the power and beauty of gravitational lensing. ■

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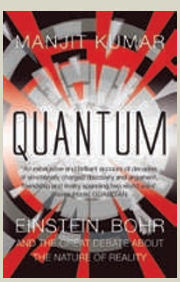
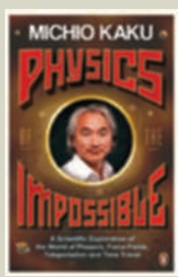


Quantum: Einstein, Bohr, and the Great Debate about the Nature of Reality
by Manjit Kumar (Icon Books, £9.99)
In this popular history of quantum mechanics, Manjit Kumar focuses "on the long-running debate between Niels Bohr and Albert Einstein, which took place from the mid-1920s through to the mid-1950s, over the adequacy of the quantum theory as a framework for fundamental physics", explained reviewer Don Howard (*Nature* **456,** 706–707; 2008).



Physics of the Impossible: A Scientific Exploration of the World of Phasers, Force Fields, Teleportation and Time Travel
by Michio Kaku (Penguin, £9.99)
Theoretical physicist Michio Kaku looks at various 'impossibilities' drawn from science fiction. He asks how new technology might help us achieve currently impossible phenomena, such as invisibility, and explains why others, such as precognition, would break the laws of physics.