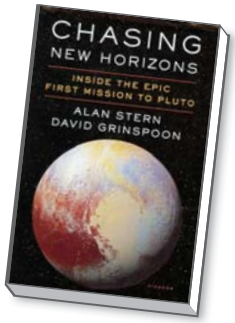
NASA

THE DWARF PLANET PLUTO, photographed by the *New Horizons* spacecraft.

An astounding journey to Pluto and beyond



Chasing New Horizons
Inside the Epic First Mission to Pluto

Alan Stern and David Grinspoon
Picador, 2018. $28.00

On a bitterly cold February night in 1930 at Lowell Observatory in northern Arizona, farm boy turned astronomer Clyde Tombaugh was practicing his newly embraced science. He collected photons on his long-exposure photographic plates from a point of light that would turn out to be Pluto, orbiting just beyond the reach of Neptune. By the end of the 20th century, Pluto would prove to be just the tip of an iceberg, the brightest member of a large population of dwarf planets orbiting in the Kuiper belt. Eighty-five years after Pluto's discovery, a small and speedy robotic probe would turn it from a point of light into a real world, revealing a surprisingly delightful diversity of surface, atmospheric, and ionospheric processes at work.

In *Chasing New Horizons: Inside the Epic First Mission to Pluto*, leading planetary scientists Alan Stern and David Grinspoon tell the insiders' story of that 85-year span from the discovery of Pluto to its initial reconnaissance by the *New Horizons* spacecraft. Stern is the principal investigator on the New Horizons mission and is by any measure the father of that project. His friend and colleague Grinspoon has been helping with public outreach and press interactions during the mission and is an author of previous popular science books. Together, they make a great writing and storytelling team.

And what a story! All of NASA's most famous missions of planetary exploration have, at one point or another, faced existential crises or cancellation, only to be resurrected by political champions, leading scientists, or public pressure. New Horizons was no exception. Plutophiles at NASA endured 26 years of pitching the mission, seeing it approved, and then having it cancelled. They survived that cycle multiple times before New Horizons was finally really approved in 2003. As the authors point out, the key to getting the spacecraft off the launchpad was the rare alignment of a strong scientific case; a lean and nimble spacecraft engineering team and operations plan; support from NASA, congressional leaders, and citizen groups like the Planetary Society; and persistence, persistence, persistence.

Stern, Grinspoon, and colleagues could be forgiven for being bitter about how long it took to make the mission happen, but fortunately any such bitterness was ultimately blown away by the sweet winds of success. After a successful and scientifically rewarding gravitationally assisted flyby of Jupiter in 2007 and then eight more years of cruising to Pluto, the spacecraft finally encountered its target in July 2015. The flyby through the Pluto system produced a spectacular cornucopia of images, spectroscopic data, and information about particles and fields, the most detailed of which was collected during a manic but beautifully orchestrated half-hour sprint close to the planet. It will likely take decades or more to fully understand everything planetary scientists have learned from the New Horizons mission.

Stern and Grinspoon's book is a comprehensive, entertaining, and educational story about the birth, glorious prime of life, and continuing adventures of a unique mission to the farthest realm of our solar system. The spacecraft is on course to fly by another, much smaller Kuiper belt object (KBO) on New Year's Day 2019. The authors do an excellent job of describing New Horizons' results in language appropriate for a general audience. In a nod to the professional scientists

who will also read it, the book includes an appendix describing the major discoveries and surprises of the mission in more technical detail. For me, the biggest surprise is Pluto's internal heat, which drives still-active surface geologic and atmospheric processes. The source of that heat is a puzzle that might only be solvable if we return to Pluto.

Is Pluto a planet, as Tombaugh claimed and schoolkids throughout the 20th century were taught? Stern and Grinspoon make the case that it is, despite the poorly managed decision of the International Astronomical Union's leadership to demote it to dwarf planet status back in 2006. That demotion was based partly on the discovery of so many other Pluto-sized KBOs.

But I agree with the authors that planets should be judged on what they are like, not where they happen to be. I believe that many—perhaps most—planetary scientists would classify the small but supremely interesting and dynamic world of Pluto as a full-fledged planet, and I would include large KBOs beyond Pluto, the large moons of the giant planets, and Pluto's own moon Charon in that category as well. Plutophiles, and the fans of the 40 or so other should-be planets that we know of so far in our solar system, should not give up the fight.

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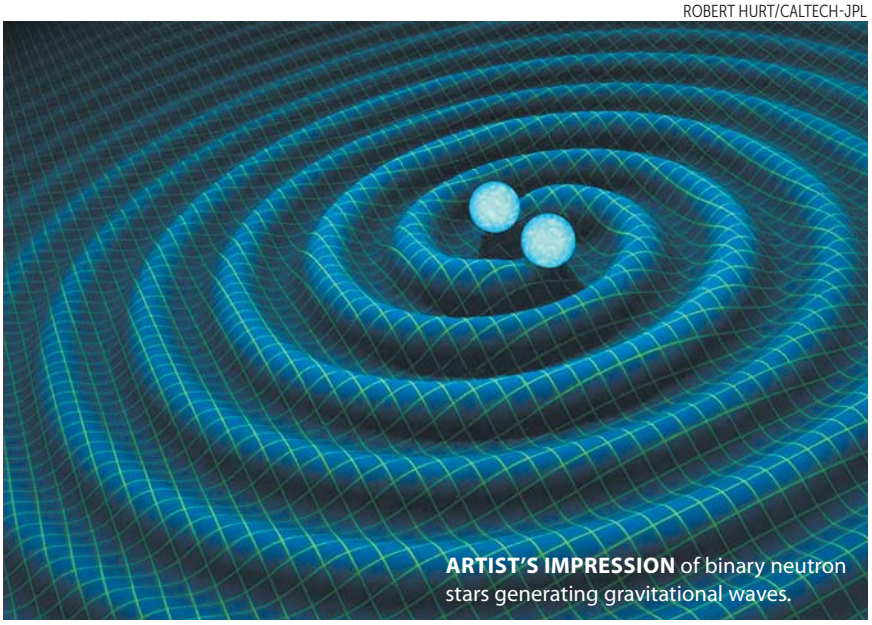
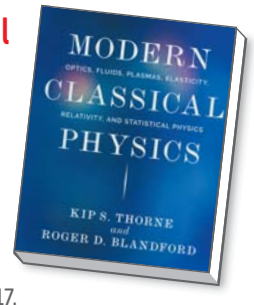


ARTIST'S IMPRESSION of binary neutron stars generating gravitational waves.

A hefty textbook for an ever-changing discipline

Modern Classical Physics
Optics, Fluids, Plasmas, Elasticity, Relativity, and Statistical Physics



Kip S. Thorne and Roger D. Blandford
Princeton U. Press, 2017.
$125.00

Kip Thorne and Roger Blandford's new textbook, *Modern Classical Physics: Optics, Fluids, Plasmas, Elasticity, Relativity, and Statistical Physics*, is a tour through macroscopic physics that features modern treatments of classical topics and insightful treatments of modern ones. If you are looking for a classical mechanics book whose subject matter ranges from nonlinear optics to the difficulties of controlled fusion and the detection of gravitational waves, this is the book for you.

Explaining their rationale and emphasis, the authors write that although the 20th century was largely the century of quantum mechanics, "classical physics has not stood still while the quantum world was being explored. In scope and in practice, it has exploded on many fronts and would now be quite unrecognizable to a Helmholtz, a Rayleigh, or a Gibbs. In this book we have tried to emphasize these contemporary developments and applications at the expense of historical choices, and this is the reason for our seemingly oxymoronic title, *Modern Classical Physics*."

At 1500 oversized pages, *Modern Classical Physics* exceeds in length (by about 20%) even the prior opus of one of the authors, the textbook *Gravitation* (1st ed., 1973), an introduction to general relativity that Thorne wrote with Charles W. Misner and John A. Wheeler. The present work is more straightforward in tone and approach, though in spots you'll see an attenuated version of the flair and exuberance for which *Gravitation* is known.

The presentation in *Modern Classical Physics* demands that readers have considerable prior knowledge. As acknowledged in the preface, they are presumed to have an undergraduate-level command of classical mechanics, electromagnetism, thermodynamics, and applied mathematics. After a rather sophisticated introductory section describing Newtonian kinematics and special relativity, the book moves on to six sections that survey the six areas of physics enumerated in the subtitle.

Readers can learn a lot here, though in places they will have to work hard for the lessons. The breadth of topics challenges what can be fully explained even in 1500 pages, and although many of the explanations are detailed and useful, some are less thorough. Given the scope of the work, though, it seems pointless to quibble over omissions or rare points of disagreement.

As the authors explain in the acknowledgments, the book developed from graduate courses they taught over decades, mostly at Caltech. Their students must have learned a great deal. Certainly graduate students in physics typically do not get such a thorough grounding in most of the topics treated