

eral. Conversely, at times the text pursues tangents at the expense of the main message. A cursory, few-page excursion into control theory, for example, ends up being more jarring than illuminating. But such misfires are the exception.

I can envision at least two ways Fieguth's book could be used in a classroom setting. On its own, it would be a fine primary text for an interdisciplinary course at the intermediate undergraduate level. For a more specialized course tailored to advanced physics majors, the book would naturally complement a more mathematical text in dynamical systems,

chaos, or network science. For those texts I can recommend Steven Strogatz's *Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering* (2014), *Chaotic Dynamics: An Introduction Based on Classical Mechanics* by Tamás Tél and Márton Gruiz (2006), and Albert-László Barabási's *Network Science* (2016). But regardless of how Fieguth's text is used, students of all stripes will find at the end of each chapter a wealth of appropriately challenging exercises ranging from the conceptual to the analytical and computational.

An Introduction to Complex Systems

largely accomplishes what it sets out to do. Its application-forward approach is likely to appeal to readers in fields like environmental science and economics, in which complex systems are typically underemphasized but no less important. And if even a specialist like me can read about climate change, lake eutrophication, or any of the panoply of other case studies in this book and exclaim "I never thought about it that way!" then the book should be regarded as a success.

Sean P. Cornelius
Northeastern University
Boston, Massachusetts

Anomaly!

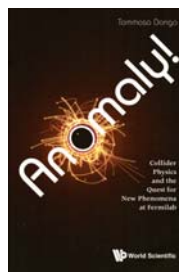
Collider Physics and the Quest for New Phenomena at Fermilab

Tommaso Dorigo

World Scientific, 2016. \$110.00 (304 pp.). ISBN 978-1-78634-110-5

The desire to discover something new is a powerful driver of the research process. In particle physics, the potential for discovery is especially great at the laboratories with the highest-energy particle accelerators, where particle col-

lisions have the best chance of producing novel states and processes. The Tevatron collider at Fermilab constituted that "high-energy frontier" from 1989 until 2010; two collaborations, the Collider



Detector at Fermilab (CDF) and DZero, each collected data from the collisions at the Tevatron during this period. They stopped roughly 18 months after data collection began at CERN's more powerful Large Hadron Collider.

In *Anomaly! Collider Physics and the Quest for New Phenomena at Fermilab*, Tommaso Dorigo provides an engaging and insightful perspective on the pursuit of physics discoveries at CDF. The book, written for a nonspecialist but scientifically literate audience, begins with

THE ESSENTIAL TOOLS FOR OPTICAL SIMULATION

Now you can accurately predict the outcome of your experiment and get to your final results quickly with FRED – Photon Engineering's leading optical engineering software.

FRED – the most versatile software tool in your optical physics toolkit

Photon
ENGINEERING
Illuminating Ideas

20
YEARS

520.733.9557 | 310 S. Williams Blvd., Suite 222 | Tucson, AZ 85711 | www.photonengr.com

BOOKS

informal explanations of the physics of the standard model and colliding-beam experiments. Dorigo takes a breezy approach with that introductory material and deftly employs analogies so that he can get to the real business at hand: Fermilab's work in the 1990s and 2000s. Much of the narrative centers on the process of discovery, including that of the top quark, long predicted in the standard model. CDF claimed to have found evidence of the top quark in 1994 but ultimately shared credit with DZero for discovering it in 1995.

Dorigo arrived at CDF as an undergraduate student in 1992 as the collaboration began its first serious data run, which culminated in the discovery of the top quark. He draws on conversations with many of his CDF colleagues to detail the fascinating and sometimes contentious episodes that led to the discovery. Observing and confirming evidence for the top quark required the scientists to make hard choices about both detector technology and approaches to data analysis. Dorigo succeeds in maintaining the lively character of their sometimes arcane disagreements. He explains the scientific aspects of the disputes suc-

cinctly and clearly while also bringing their human dimensions to life.

Anomaly! reveals the ways in which individual scientists' personalities, loyalties, and enthusiasms shape their contributions to the labors of the collaboration. One of the most poignant passages concerns Japanese physicist Kunitaka Kondo's attempts to gain approval of a novel likelihood-based approach to identifying the top-quark signal. Kondo's approach was not adopted at the time, although physicists use it frequently now. Dorigo acknowledges that the obstacles to implementing Kondo's ideas lay not so much in the method itself as in the way Kondo presented it; part of the difficulty was cultural differences that created "a barrier between him and his collaborators."

Dorigo's point is not to undermine the results that were published but to make clear the human aspects of the process by which physicists decide how to present their results. He proclaims, "The enormous wealth of the collaboration was the competence, the knowledge, and the experience of its members; and the best way to use such assets was through a free communication." But as the Kondo anecdote

teaches, the best approach is not always an easy one.

The most dramatic part of the book, and the part in which Dorigo seems to have the most personal involvement, comes last, as he discusses disputes over anomalies in CDF's data that seemed—for a time, at least—to point to physics beyond the standard model. In the aftermath of their 1995 discovery of the top quark, some CDF members noticed an apparent excess of events involving a W boson and two energetic jets. The quest to understand that anomaly led to what is sometimes called the "superjets affair," a contentious internal dispute over the existence, size, and interpretation of the effect in question, which, some argued, indicated a supersymmetric partner to the bottom quark.

Dorigo skillfully conveys the drama of the debate within CDF. Physicist Paolo Giromini was determined to publish the anomaly but was furiously opposed on the grounds that it could be the result of an unspecified detector effect, among other things. In a contentious collaboration meeting, Melissa Franklin argued that even if the result were an error, the interest of the broader physics commu-

charge preamplifiers

detect femtoJoule light pulses and *shaping amplifiers*



all product specifications can be found online at:

<http://cremat.com>

Cremat's low noise charge sensitive preamplifiers (CSPs) can be used to read out pulse signals from **p-i-n photodiodes**, **avalanche photodiodes (APDs)**, **SiPM photodiodes**, semiconductor radiation detectors (e.g. Si, CdTe, CZT), ionization chambers, proportional counters, surface barrier/PIPS detectors and **PMTs**.

When used with shaping amplifiers, you can detect visible light pulses of a couple femto-joules using common p-i-n photodiodes. Our amplifiers are small plug-in modules. Evaluation boards are available.

cremat

950 Watertown St
West Newton, MA
02465 USA
+1(617)527-6590
info@cremat.com

SPIE. PHOTONICS WEST

The Moscone Center, San Francisco
www.spie.org/pw2018

Register Today
Photonics West
2018

Attend the premier event for
the photonics and laser industries

27 January – 1 February 2018

nity would be better served by publishing a result that might point to important new physics. Passages such as those exemplify the difficulty of balancing the scientific interest in avoiding error with the desire to facilitate discovery. Eventually, CDF did publish the 13 anomalous events, but without any discussion of them in terms of new physics. A subsequent run with a much larger data set did not yield a similar effect.

Scholars will be shocked to learn that Dorigo's book does not include a single citation of any published work or source. He acknowledges a long list of colleagues and other interlocutors who helped him piece together his narrative, but he provides no means for determining the basis for any particular claim. Dorigo's defense of that peculiarity is that he aims "to teach some physics in an entertaining way" rather than "to contribute to the history of science." However, to my knowledge, the only comparable monograph on CDF's history and the top quark's discovery is my own book, *The Evidence for the Top Quark: Objectivity and Bias in Collaborative Experimentation* (2004), which pursues a different agenda and emphasizes different aspects. Dorigo's book is thus almost certainly going to be an important source for anyone interested in the history of CDF, whether or not that was his intent.

Scholars who manage to set aside their usual reading habits, and readers who do not care about scholarly documentation, will be rewarded. *Anomaly!* is a personal yet highly informative story of discovery and almost-discovery from the perspective of someone who saw the events firsthand.

Kent Staley
Saint Louis University
Saint Louis, Missouri

Astrophysics for People in a Hurry

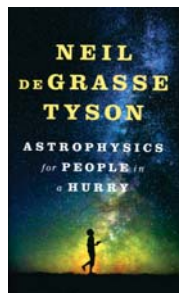
Neil deGrasse Tyson

W. W. Norton, 2017. \$18.95 (224 pp.).
ISBN 978-0-393-60939-4

If anyone has the knowledge to popularize science, it's Neil deGrasse Tyson. The Harvard- and Columbia-educated astrophysicist has published more than 10 books, hosted the TV series *Cosmos: A Spacetime Odyssey* in 2014, and continues

to host *StarTalk*. The latest addition to his outreach career is his new book, *Astrophysics for People in a Hurry*.

As its title suggests, this small hardcover book offers curious laypeople a quick, easy-to-read overview of the world of astrophysics. Tyson keeps the reader engaged by combining scientific facts with historical anecdotes, etymological discussions, and stories of his own experiences in science, such as



when he learned of an asteroid being named in his honor. He also offers some of his own opinions as an astrophysicist and demonstrates his wit with a suggestion that aliens from Jupiter's moon Europa might be called Europeans.

Astrophysics for People in a Hurry covers a broad selection of topics: from the largest scales of the universe and its main components, such as dark matter, to the smaller scales of the

AC Resistance Bridge

... for low-temperature experiments



- Accurate millikelvin thermometry
- Sub-femtowatt excitation
- Measures 1 mΩ to 100 MΩ
- 2 Hz to 60 Hz variable frequency
- Displays resistance, temperature & phase

SIM921... \$2495 (U.S. list)

The most demanding low-temperature measurements are within easy reach of the SIM921 AC Resistance Bridge. With constant RMS current, voltage, or power modes and variable frequency sinusoidal excitation, the SIM921 gives you more control than competing bridges costing several times as much.

The SIM900 Mainframe provides power and communication to the SIM921 and up to 6 other modules. See our web site for details on the SIM product line.



Stanford Research Systems

Tel: (408) 744-9040
www.thinkSRS.com