BOWLING GREEN DAILY NEWS

Make time for Muller's book 'Now'

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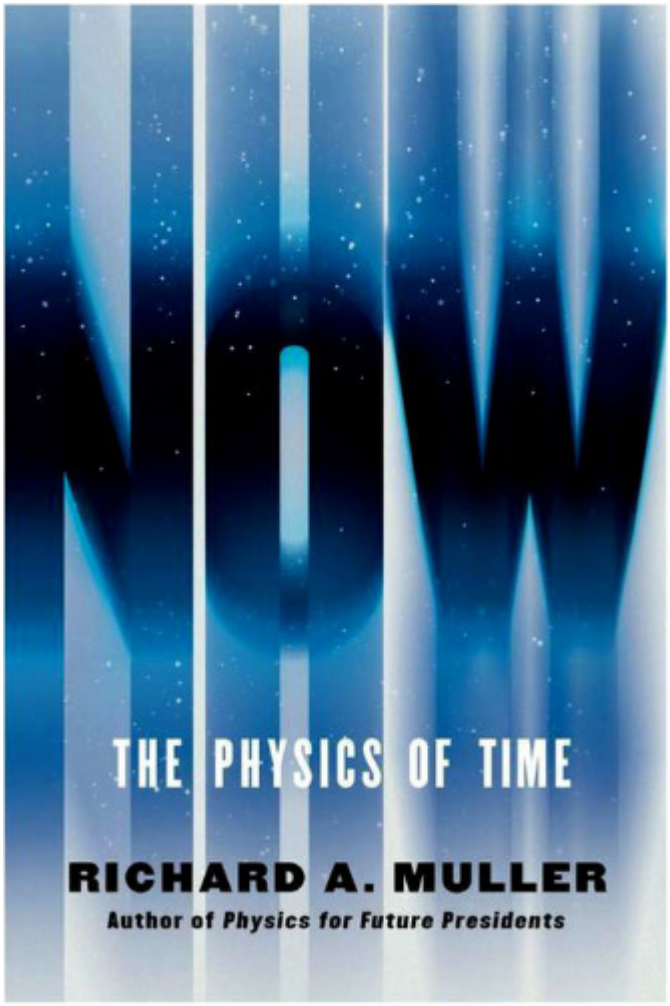
"Now: The Physics of Time" by Richard A. Muller. New York, NY: W.W. Norton & Company, 2016, 352 pages, $27.95.



"Coming to grips with the concept of 'now' sets us on a journey through abstract and amazing physics, the physics of time, the meaning of reality and an updated examination of free will," Richard A. Muller explains near the beginning of "Now: The Physics of Time," his latest attempt to enlighten the general public on a topic that ultimately affects us all in one way or another. "We start by discussing the wonderful and weird behavior of time that borders on the unbelievable but is nevertheless solidly established. The greatest breakthroughs date back to the early 1900s, when Albert Einstein discovered that the rate of time depends on both velocity and gravity. Time is flexible, stretchable and even reversible. These effects are so substantial that they are built into the current GPS satellites. If GPS didn't adjust for Einstein's discoveries, they would mislocate us by miles. Have a cellphone? Then you are carrying a device that uses relativity right in your pocket."

I am a huge fan of science fiction, regardless of whether it comes in the form of novels, short stories, magazine articles, movies or television series. And based on personal conversations with a variety of acquaintances, I am pretty sure my fascination is shared by a large proportion of the population. When it comes to science fiction, few themes are more prevalent or provocative than those that deal with some aspect of time. On a side note, if you have not seen "Arrival," the new film by Denis Villeneuve starring Amy Adams, Jeremy Renner and Forest Whitaker, I strongly suggest you check it out. After viewing it – and this is one you may want to see more than once – you may find yourself wanting to pick up a copy of "The Physics of Time." The line, it seems, between reality and fantasy is becoming more blurred as we gain a greater and more cogent understanding of the nature of time.

Structurally, the book consists of an introduction and 25 chapters arranged in five major sections: "Amazing Time," "Broken Arrow," "Spooky Physics," "Physics and Reality" and "Now." The manuscript includes several illustrations (primarily pictures, diagrams, drawings and even a few cartoons) strategically placed throughout the volume to help make the material even more

accessible to those interested in his primary thesis. Even though the author is obviously dealing with some fairly technical ideas and concepts, I found I was able to follow the discussion with minimal interruptions to consult with Google or Wikipedia. It did help that my schooling included an emphasis in mathematics as understanding some of the arguments articulated requires at least a rudimentary background in basic algebra.

Muller is a physics professor at the University of California, Berkeley as well as a faculty senior scientist at the Lawrence Berkeley National Laboratory. He has degrees from Columbia University and the University of California, Berkeley. He has received several prestigious honors and awards, including a MacArthur "Genius" Fellowship in 1982 and a share of the 2015 Breakthrough Prize in Fundamental Physics for the discovery of dark energy. His previous books include the best-selling "Energy for Future Presidents: The Science Behind the Headlines" "The Instant Physicist: An Illustrated Guide" and "The Sins of Jesus" – a historical novel.

One of the chapters I found especially intriguing was "Einstein Is Spooked," which deals with the famous scientist's discomfort with the notion of entanglement, a process that seems to indicate there are some wave functions capable of changing at a rate faster than the speed of light. In other words, when two particles are entangled, measuring one of them could instantaneously affect the other one – even though they could potentially be light years apart. Obviously, if you are not somewhat familiar with the physics underlying this line of reasoning, you will probably be challenged to appreciate the true significance of the phenomenon as well as its implications for our understanding of what time truly is and how it manifests itself in our lives on a daily basis. In a very real sense, Muller is simply trying to get us to consider the possibility that how we view time may be rather naïve. Believe it or not, and as the author suggests below, the practical applications of this emerging view of time could be enormous.

"The essence of quantum computing is that you can store and manipulate information in wave functions," Muller notes. "There is a vast advantage to avoiding using ordinary bits, with their limited ones and zeros, and instead using 'qubits,' each consisting of a quantum amplitude. A qubit can be manipulated and used in a computation. In an important sense, a qubit contains far more information than does an ordinary bit. Quantum computing could enable enormously complex computations to be done in parallel. They could be done without generating heat. Every time a bit is flipped in an ordinary computer, a minimum of heat is generated. But with quantum computing, you (in principle) generate heat only when you finally measure the qubit at the end."

It should be noted Muller is doubtful quantum computing will ultimately be successful; however, he is the first to admit he could be wrong, which is one of the endearing qualities of the author's prose. Throughout the narrative, he provides several examples of theories and predictions that were, in the final analysis, proved to be incorrect or in the very least insufficient to account for the available empirical evidence. As usual, I found the impact being "proved wrong" had on many of the physicists profiled in the book to be very insightful. In many instances, they simply acknowledged they were wrong and forged ahead to tackle the problem from a different vantage point. In other cases, their egos were so bruised they never fully recovered.

Like most scientific endeavors, the quest to fully comprehend the intricacies associated with time is a never-ending proposition. If you want to know more about the subject at hand, you would probably find Muller's perspective to be an interesting read. If you have time, that is.

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