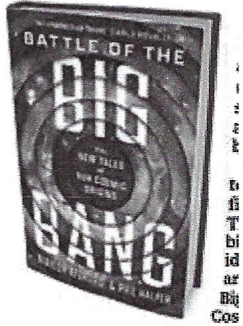


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The big bang ought to have spread energy homogeneously. What explains clumps of galaxies with vast spaces between them?



A Question Of Origins

BOOKSHELF

By Steven Poole

Battle of the Big Bang

By Niayesh Afshordi and Phil Halper

Chicago, 360 pages, \$32.50

In the 1920s, scientists discovered that the universe was not static in size, as had previously been assumed, but was expanding in all directions. Galaxies were rushing away from one another as the very space between them was stretching. It was tempting, therefore, to imagine running the film backward into the past. The expansion, it seemed, must have started somewhere: at an infinitely hot, infinitely small and infinitely dense point from which everything exploded some 13.8 billion years ago.

This origin became known as the big bang, and that infinitely small point at which it all began was called a singularity: a place where all the known laws of physics break down. Time was purportedly created only at the moment of banging, so it made no sense to ask what came before the big bang, just as it makes no sense to ask what is north of the North Pole. Why it happened at all remained an awkward question, but the existence of such an inscrutable singularity at the birth of all things became the mainstream view. It might be surprising, then, to learn that few experts in the field hold this view anymore. The traditional picture of the big bang is actually two separate ideas, explain Niayesh Afshordi and Phil Halper in "Battle of the Big Bang: The New Tales of Our Cosmic Origins." Researchers continue to endorse the hot big bang, the idea of a primordial explosion of energy, but most do not think it goes back to "a state of infinite density where time stands still and the answers to all our origin questions meet their demise." Mr. Afshordi is a professor of physics and astronomy at the University of Waterloo in Canada; Mr. Halper is a fellow of the Royal Astronomical Society and the creator of the YouTube series "Before the Big Bang." Their excellent book promises to map the "quiet revolution" of 21st-century cosmology and introduce us to the revolutionaries.

In very different ways, these rebels are all addressing questions left unanswered by the old theory. One is the origin-of-structure problem: The big bang ought to have spread energy homogeneously throughout space, but we observe clumps of galaxies with vast spaces between them, and measurements of the cosmic microwave background—the fossil radiation from when the universe was only 380,000 years old—reveal an unpredictable pattern of warm and cold spots. Nor have we ever seen an inflaton, a hypothetical particle that is supposed to have driven a period of enormous growth in the size of the early universe.

The range of proposed solutions to such problems is mind boggling. Among them is “string-gas cosmology,” according to which the big bang began as the very hot gas of vibrating strings; “tunneling from nothing,” in which our universe appeared as a quantum fluctuation in something that was not space as we know it; “eternal inflation,” in which our universe is one bubble in an endless champagne froth of universes; “cosmological natural selection,” in which a new universe is birthed inside every black hole, with slightly different laws of physics each time; and the “Janus universe,” which—like the god after which it is named—looks both ways: the big bang is the point at which the arrow of time is reversed, and a whole other universe stretches in the opposite direction beyond it.

Mr. Afshordi’s own preference, he admits, is for a hypothesis in which the speed of light in the early universe was infinite. What distinguishes this book from others on the subject—such as Laura Mersini-Houghton’s “Before the Big

Bang” (2022)—however, is that he and Mr. Halper are generously curious about alternatives and warn against the excessive skepticism of other scientists toward rival theories. Messrs. Afshordi and Halper readily admit that we don’t know enough to rule out much at all. Maybe there are two dimensions of time. Maybe the whole universe is a hologram. Maybe “geometry is an illusion.”

“Battle of the Big Bang” brilliantly humanizes such abstract speculations by highlighting the powerplays and publicity struggles of competing scientific teams. “Science is a messy business that involves more politics than meets the eye,” the authors warn. One scientist describes inflation theorists as “religious zealots” who “feel offended if someone doubts their idea.” Some researchers are described as “insurgent”; others are “much better at marketing” than their competitors. Another says of a paper that poses a challenge to his view: “This is serious. We have to destroy it.” (“As we say in Persian,” Mr. Afshordi remarks, “two beggars can sleep on a rug, but two kings can’t fit in a land.”) The upshot is a reminder that science is, after all, a social practice pursued by fallible apes. That it should ever get close to the truth is itself a miracle.

It might be, at last, that old truths were waiting all along to be rediscovered. Ancient notions of cyclical universes, similar to those proposed by the ancient Stoics and Hindu philosophers, have returned: Some cosmologists believe the universe has always existed, or that the big bang was really a bounce after a previous contraction, or even that the universe, by means of a cunning time-travel loop, created itself. One model posits that the universe repeats its own history indefinitely, rather as Friedrich Nietzsche dreamed of as an “eternal recurrence.” According to another, “an invisible reality exists in which all is one,” which would have pleased Baruch Spinoza.

The old view of the big bang as originating in a mysterious singularity might be outdated, but how shall we choose a winner from among all the new candidates? There may yet be evidentiary clues to be found in the cosmic microwave background, or in future particle accelerators, or in the tiny perturbations of gravity waves left over from the big bang itself. To detect the last, we’d need a solar-system-spanning set of spacecraft firing laser beams at one another. That notional project is called the Big Bang Observer, and one of its supporters happily describes it as “stupidly expensive.” So, the authors ask, “should we dare to discover how our expanding cosmos was born?” The truth may be out there, but it won’t come cheap.

Mr. Poole is the author of “Rethink: The Surprising History of New Ideas.”

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