Mormon Cosmology

Can It Survive the Big Bang?

By Keith E. Norman

Cosmology is a subject of vital interest to both science and religion. Simply stated, cosmology is the study of the totality of things, the ordered whole, the universe. Both physicists and metaphysicists seek answers to the same ultimate puzzles of existence; e.g., Why is there something instead of nothing? How did the universe come to be? Will it last forever, or is there to be an end to the cosmos? However, the two disciplines take very different approaches to these questions. The scientific cosmologist analyzes data from astronomical observations and high-energy particle experiments with abstract mathematical formulations, while the theologian contemplates the heavens, moon, and stars as the handiwork of God and analyzes them in light of revealed concepts.

Mormons tend to be optimistic about reconciling the outcomes of these two approaches, believing that all truth can be circumscribed into one great whole. Discoursing on the Mormon doctrine of creation, Brigham Young asserted that "we differ from the Christian world, for our religion will not clash with or contradict the facts of science in any particular" (*Journal of Discourses*, 14:116). But though we may fantasize about hieing to Kolob faster than the speed of light, few of us have the training in theoretical physics and mathematics needed to achieve such a synthesis. Astronomy has always held a fascination for me, but my mathematical abilities are awaiting the Millennium for development. Nevertheless the startling advances in theoretical physics and cosmology in this century have accelerated in recent years and have been widely publicized in the media. I believe this "new physics" holds exciting challenges and opportunities related to the Mormon view of reality.

MORMON COSMOLOGY AND NEWTONIAN PHYSICS

Mormon cosmology is readily understood in terms of a nineteenth-century scientific milieu. It arose and developed in the post-Enlightenment challenge to Christian orthodoxy, when Copernicus, Galileo, and Newton were no longer questioned. When we read Mormon's exposition on the power of God to make the sun stand still, his pointed editorial aside that "surely it is the earth that moveth and not the sun" (Hel. 12:15) looks suspiciously like an explanatory gloss by the modern translator. Later Joseph Smith and his followers developed a remarkably naturalistic view of reality in which God, himself a physical rather than a strictly supernatural being, works according to natural laws. God is omniscient in the sense of being the all-knowing scientist, and as Creator he is the ultimate technician.

Rejecting the orthodox view of creation *ex nihilo*, Joseph Smith asserted that the elements are eternal (D&C 99:33). They cannot be created or destroyed, just as the scientific principle of the conservation of matter states (*History of the Church*, 6:308-9). Rather than existing apart from and independent of the material universe, God operates within time and space according to inviolable laws; otherwise, he would cease to be God (Alma 42:13, 22, 25). Mormonism's opposition to the long Christian tradition of spirit-matter dualism parallels Newton's rejection of Descartes' mind-body dualism: in Newton's system, not even mind can be separated from mechanism, while for Mormons, ultimately spirit is a purified form of matter (D&C 131:7-8). Likewise, speculation about "worlds without number" inhabited by people was a favorite pastime of Newton's adherents (cf. Moses 1:33, 35). The Prophet Joseph also abandoned the traditional and literalistic interpretation of the Genesis creation account. His closest disciple and successor, Brigham Young, scoffed at the notion of man's creation from the dust like adobe as a "baby story" (*JD*, 2:6; 3:319; 7:285-86), and the temple ceremony reminds us that the acount is "figurative."

In general, Mormon cosmology is quite consistent with Newtonian physics: the universe is a rationally ordered system consisting of matter which obeys inviolable physical laws. For Mormons, God did not create natural laws, nor does he stand above them. He became God by

learning the laws and obeying or using them for his purposes. Mormonism largely sidestepped the struggle to come to terms with the rationalistic world view which threatened proponents of a more traditional Christian mythology. Although never systematized, Mormon cosmology has been accounted one of its chief glories.

But this harmony was doomed to a short life. Scientific theories are by nature impermanent; the "laws" they prescribe are valid precisely because they are capable of being disproven by contradictory evidence. Revealed truth, by contrast, claims immunity from challenge by human authority. Even though Mormons have a provision for progressive revelation to accommodate increased capacity for human enlightenment, this feature is not geared to keeping up with *Scientific American*. Scientific cosmology began its leap forward just when Mormon doctrine was becoming stabilized.

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The revolution in twentieth-century physics precipitated by Einstein dethroned Newtonian physics as the ultimate explanation of the way the universe works. Relativity theory and quantum mechanics, combined with advances in astronomy, have established a vastly different picture of how the universe began, how it is structured and operates, and the nature of matter and energy. Not only does this new scientific cosmology pose a serious challenge to the Mormon version of the universe, but some of its main features seem remarkably congruent to the orthodox Christian doctrine of creation opposed by Mormonism.

THE QUANTUM LEAP

To understand the conflict between the scientific and Mormon versions of cosmology requires at least a superficial knowledge of what has been going on in theoretical physics in this century. I can presume to offer no more than that, as I am still struggling with books on the subject written for the layman. Although they can be esoteric and often at odds with our sense of reality, the important features of the new physics are now supported by a large body of experimental evidence.

Einstein's famous equation, $E=mc^2$, means that matter and energy are interchangeable. Under the right conditions, matter can be created out of pure energy, or it can be reduced to nothing but heat and light. Furthermore, our perception of material substance as solid and quiescent is an illusion. At the atomic level, the relatively compact nucleus is separated by a vast empty space from a whirling cloud of tiny electrons. If we were to project the atom to a scale the size of the largest dome in the world, St. Peter's in the Vatican, the nucleus would be like a grain of salt in the center, and the electrons would be microscopic specks of dust around the shell. The illusion of solidity we experience is a function of the electrical charge of those particles combined with the speed of the electrons' orbits.

This general model of the atom like a miniature solar system was demonstrated three quarters of a century ago by Rutherford, but more recently quantum theory has destroyed the notion of even the subatomic particles as solid objects. Despite their relative imperviousness, protons and neutrons are now described as consisting of combinations of elementary particles known as quarks, interacting with an array of other subatomic particles, such as mesons, muons, gluons, and neutrinos, with properties as bizarre as their names. To call them "particles" is itself misleading, since they behave sometimes like particles and at other times like waves, or fluctuations in energy. Their momentum and position cannot be measured simultaneously, and individual particles can appear and disappear for fleeting instants. Electrons do not follow orbital paths; they jump around and appear unpredictably within boundaries analogous to orbits. The so-called physical laws, which describe the regularity of objects and forces on the level of our perception, are valid only as statistical probabilities pertaining to large numbers of elementary particles.

"To the naive realist," writes Paul Davies about most of us, "the universe is a collection of objects. To the quantum physicist it is an inseparable web of vibrating energy patterns. . . . The world, it seems, can be built out of structured nothingness." (*Superforce*, pp. 48, 7.) As Fritjof Capra puts it, "particles must not be pictured as three-dimensional objects like billiard balls or grains of sand, but rather . . . [as] a continuous dance of energy" (*Tao of Physics*, p. 188).

RELATIVITY

Equally startling is the concept of space and time described by Einstein in his relativity theories. The three dimensions of space as we perceive it, as well as the passage of time, are not absolute, but can stretch or shrink relative to the motion of the observer. This means that someone moving close to the speed of light would appear to a stationary observer to be flattened along the direction of motion, to be heavier, and to be aging more slowly than if he were at rest. The discrepancies are no illusions but are quite measurable. A space traveler would return younger than his twin on earth, for instance. This effect has been observed thousands of times in particle accelerators and confirmed by other experiments as well. Einstein showed that space and time cannot be separated; four dimensions of space-time must be considered in any description of reality. More recent theories posit up to eleven dimensions of space-time as the minimum number necessary to explain the structure of reality. Although such extra dimensions are beyond our imagination, they are verifiable mathematically and may be manifested to our senses as forces. For example, the electromagnetic force may simply be one (or more) of these unseen dimensions at work.

Related to these hypothetical extra dimensions is the concept of gravity, which has changed radically in this century. Rather than Newton's "force," Einstein showed that gravity could be better explained as a distortion of the fabric of space-time itself, caused by the presence of matter. The moon is not pulled by the earth's gravity into a circular path; it is following a straight line in the geometry of curved space. The idea that space can be "curved" or distorted implies that there is more to space than simply empty void or nothingness. What is it that is being warped? Another way to understand Einstein's concept of space and matter is to consider space to be a quantum electromagnetic field, with matter as local regions of intense concentration of that field—disturbances or blemishes in space-time. Such a field does not fill space and "curve" it; the field *is* curved space.

THE BIG BANG VERSION OF CREATION

Quantum mechanics and relativity are essential to understanding the Big Bang theory of the beginning of the universe. But the impetus for that theory came from astronomy. In the 1920s Edwin Hubble, having just discovered galaxies beyond our own, noticed that light from those galaxies is "red-shifted" on the spectrum, indicating that they are rushing away from us at tremendous speeds. The recession is evident in every direction, and the more distant the galaxy the greater its speed, by fifteen kilometers per second for every million light years.

The realization that the universe is expanding did not accord with the long-held assumption that the starry heavens are largely fixed and unchanging. Two theories were proposed to explain the new data, known as "Big Bang" and "Steady State." The first version mentally reverses the movement of the stars, thereby deducing that at some point in the distant past the stellar materials must have been compacted together. The present observed expansion is the result of an initial cosmic explosion—the "Big Bang"—and the galaxies and stars are the scattered debris from that event. Space is increasing as the galaxies recede from each other, although gravity is slowing down the rate of recession.

The alternative scientific version of creation, the steady-state theory, postulates a perpetually self-renewing universe. In this scenario matter is continually being created spontaneously at one or more localities so that, despite the apparent expansion, the average density of matter in the universe remains constant.

Confirmation of the Big Bang theory came in the 1960s, when astronomers discovered a background radiation or temperature of three degrees above absolute zero throughout the universe. This is in fact the "after-glow" or the intense heat generated by the Big Bang and had been predicted some years before. Virtually all astronomers and theoretical physicists now accept the Big Bang version of creation.

A comprehensive picture of the beginning of the universe has recently become available, thanks to data obtained in high-energy particle accelerators, which replicate the conditions in the first milliseconds of time. About fifteen billion years ago, all of the matter we now observe in the universe started out in a condition of infinite compression and heat, known as a "singularity." As this unimaginably dense matter exploded, first particles and then nuclei formed, and after several hundreds of thousands of years, atoms "congealed" out of the heat. Although the earlier plasma was virtually uniform, tiny irregularities in the density gradually led to the formation of stars clustered in galaxies. Stars eventually burn out or explode, but the creation of new stars and planets out of leftover materials continues. Our own solar system is about five billion years old.

This description of creation could be elaborated in much greater detail and sophistication, but one crucial question remains. What was there before the Big Bang—what happened to cause it? Scientists remain divided over the question of their ability to discover the ultimate reasons for existence without recourse to the supernatural. Strictly speaking, however, to fall back on a theistic explanation—"God made it"—is a cop-out for the scientist and the last gasp of a "God of the gaps" mentality for the theologian (Hans Kung, *Does God Exist?*, p. 638). Surprisingly, both the theoretical physicist and the Christian philosopher give the same answer to the question of what preceded the universe: "Nothing." Before creation, there was no matter and no universe, not even space or time. For the scientific cosmologist, space does not exist apart from matter, and time cannot exist independently of objects moving in space. Modern physics pictures the expansion of the universe not as bodies moving apart from each other in the void of space, but as space itself expanding between matter. Quite apart from the inability to validate experimentally any theory about what preceded the Big Bang, scientists balk at the question on theoretical grounds: "prior to the beginning" has no meaning in the absence of space and time. The universe, therefore, was created "out of literally nothing." (Davies, *Superforce*, p. 8.)

Surprisingly, both the theoretical physicist and the Christian philosopher give the same answer to the question of what preceded the universe: "Nothing."

It is remarkable how much this sounds like the orthodox doctrine of creation *ex nihilo*. Although theologians require an agent or First Cause of that creation (God), the divine creator exists outside time and space; he created those dimensions along with matter. Augustine, perhaps the most profound of all Christian philosophers, established once and for all the *ex nihilo* creation as Church doctrine. His argument against an eternal and infinite cosmos almost could have come from a modern physicist: "It is silly to imagine infinite space since there is no such thing as space beyond the cosmos. . . . It is [also] silly . . . to

excogitate a past time during which God was unoccupied, for the simple reason that there was no such thing as time before the universe was made." (*City of God*, 11.5.)

Augustine also established the traditional Christian view on the ephemeral reality of the universe of matter, having only contingent being, since it was created out of nothing. Similarly, quantum physics describes the "rational, orderly, commonsense world of experience [as] a sham. Behind it lies a murky and paradoxical world of shadowy existence and shifting perspectives." (Davies, *Superforce*, p. 37.)

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IS MORMON COSMOLOGY AT ODDS WITH MODERN SCIENCE?

In contrast to the apparent harmony between modern physics and traditional Christianity on the subject of creation and the substantiality of material being, Mormon doctrine now seems to be a relic of the nineteenth century. It is still conceivable that the Mormon Deity became God at some time after the Big Bang and so did indeed direct the creation or organization of our world and others out of previously existing material. After all, fifteen billion years is a long time. But what about the infinite regression of gods alluded to by Joseph Smith (*HC*, 6:476)? As the song asks us,

D'ye think that you could ever,
Through all eternity,
Find out the generation
Where Gods began to be?
Or view the last creation
Where Gods and matter end? . . .
Methinks the Spirit whispers,
"No man has found 'pure space'."
Nor seen the outside curtains,
Where nothing has a place. . . .
There is no end to matter;
There is no end to space. . . .
There is no end to being. . . .
There is no end to race.
("If You Could Hie to Kolob," *Hymns*, no. 257.)

Mormonism's insistence that matter, not to mention intelligence, is eternally existent, without beginning or end, would be met with considerable skepticism in the scientific community today. And while modern physics may describe space as without boundaries, this does not mean the universe is infinite as the Mormon hymn suggests. Rather, it exists as a finite three-dimensional curve defined by the gravitational field. A simple analogy is the surface of the earth, a finite two-dimensional plane without edge or boundary, because it is curved to form a sphere in three dimensions. One cannot leave that plane by traveling in any direction on the surface; the only escape is movement into another dimension; e.g., up. The inability of a space-traveling tourist to reach the end of matter and find "pure space" is not because the universe goes on forever, but is due to the fact that a straight-line journey in any direction would eventually lead back to the starting point, just as it would on earth. Although there is a limited amount of matter in a finite (though expanding) space, there is no geographical center or edge to the cosmos. The only way to escape the universe would be to jump into another dimension, if that were possible.

Mormon cosmology's problems with modern science do not stop with Big-Bang creation and the structure of the universe. Turning our gaze forward in time, science paints a bleak picture of the ultimate fate of the cosmos, in contrast to the optimistic Mormon doctrine of eternal progression. The future holds one of two possibilities, depending on the total amount of matter in existence.

The first scenario is that the expanding matter in the universe will eventually escape its own gravity and continue to recede and cool forever. A college student in the back row of his astronomy class was suddenly jolted to attention when the implications of this were being explained. "What did you say?" he frantically asked the professor. "I said the sun will burn itself out in fifty billion years." The student slumped back into his chair. "Thank goodness," he sighed, "I thought you said *fifteen* billion!" In fact, the ability of the sun to sustain life on earth is expected to end only about five billion years hence, when it will expand into a red giant and engulf the inner planets, vaporizing the earth. After shrinking back to a white dwarf, by the fifty billion year mark it should be entirely spent—cold and dark. Eventually, all the stars will burn out, and the entropy of the universe, its natural tendency to disorder and heat dissipation, will increase to its maximum state. There will be no more possibility of light or life.

The alternative to eternal expansion and cooling is a cyclic universe, which would stretch things out a bit longer. If the total matter in the universe exceeds a critical value, its gravity will eventually reverse the expansion and an equally long contraction will begin. Whether this would finally result in another big bang and start the cycle over is uncertain. But even this would not really accommodate the Mormon concept of eternal matter, since the second law of thermodynamics still requires a steady overall increase in entropy, and thus precludes the possibility that such a macro-cosmic fluctuation in size and density has been going on without beginning or can continue indefinitely. However, at present the bulk of evidence points to a total mass in the universe that is much less than is needed to reverse the expansion. Slowly but relentlessly, the universe is running down.

Either scenario poses a serious challenge for Mormon theology. Particle physicist Steven Weinberg represents a large body of current thought when he comments, "The more the universe seems comprehensible, the more pointless

it also seems." (*The First Three Minutes*, p. 154.) Even if we take comfort in Hoyle's dissenting vision of the universe as a "put-up job," it hardly appears able to accommodate Mormonism's eternal progression. Where is there room or time for a limitless series of exalted beings to organize and people new worlds by natural means, presumably without end? How will such gods operate, let alone exist, in a dead and cold universe, or even a violently expanding and contracting one? Mormons cannot appeal to God to get them out of this fix. God also is a natural being and exists within the universe of time and space, not outside or above it. We even know the name of the celestial body adjacent to his residence.

HOPE FOR THE FUTURE

At this point it would probably be wise to stop speculating about mysteries. But before I can slump back into my chair, I must attempt to complete the folly. I am not ready to desert the God of my Mormon fathers for the greener pastures of Infinite Being. Whether or not it can be reconciled with science, Mormon cosmology encompasses a powerful religious myth that should not be dismissed lightly. In fact, it is this very concept of a God who has limitations that points to a possible resolution of the cosmological dilemma.

Precisely because Mormons believe in a plurality of gods, we are logically led to speculate as to their locations or spheres of dominion. The astronomical assertions in the Pearl of Great Price may indicate that God rules within our own galaxy, the Milky Way: "Kolob is set nigh unto the throne of God, to govern all those planets which belong to the same order as that upon which thou standest" (Abr. 3:9; cf. facsimile 2, esp. fig. 5). Does each God have his and her own galaxy or cluster of galaxies? The Milky Way galaxy alone has over 100 billion stars, quite enough to accommodate the phrase "worlds without number." And ours is just average-sized as galaxies go, one of 100 billion. In other words, there are as many galaxies in the universe as there are stars in our galaxy.

But perhaps we are being too parochial to think of our universe as really all there is. We know from science that it is finite, and we may even entertain the thought of other dimensions. Are there alternate universes existing in those other dimensions of reality?

In fact theoretical physics already speculates along these lines. In addition to the eleven-dimensional hypothesis to explain our own universe mathematically, some versions of quantum physics entertain the possibility of an infinite number of universes. Other theories speculate that black holes, regions where matter becomes so dense that it virtually collapses in on itself so that not even light can escape, may constitute passageways or singularities into alternate dimensions or universes. The matter that disappears from our universe into a black hole could then explode into existence in another one. Such a scenario has even been used to explain the Big Bang: our universe may have begun as an enormous black hole in a different universe.

Such ideas are highly speculative, bordering on science fiction if not fantasy, although they are taken seriously by some (Davies, *Superforce*, p. 102). A view of black holes as singularities connecting alternate dimensions could relieve Mormons of trying to deal with the Big Bang on *ex nihilo* terms. Infinite universes could also allow for an endless regression of gods, as well as the creation or at least availability of new universes for celestialized beings. Whether such alternate realities would be recognizable or enticing to exalted children of earth is another question altogether.

The view of natural laws as immutable, even self-existent, points to a further intriguing aspect of Mormon theology's limited deity. In the dispute among scientists over whether supernatural agency is needed to ignite the Big Bang, or whether the laws of physics alone suffice, ironically Mormonism could come down on the side of the "atheists," since the Mormon position is that God creates neither matter nor the laws that govern its behavior.

Rather than trying to explain away or simply ignore the implications of a Big Bang cosmology, perhaps Mormons should recognize the need to update their theology. It is unreasonable, on both practical and theoretical grounds, to expect Joseph Smith to have given us an account of creation based on late twentieth-century physics. Certainly science cannot guarantee us ultimate answers, despite the current quest for Grand Unification Theories, or GUTs, which propose to do just that. It is fair, however, to assume that science is closer to the truth about the cosmos than it was 150 years ago.

Mormonism's unique cosmology may be described as theistic materialism or "naturalism" (Sterling McMurrin, *The Theological Foundations of the Mormon Religion*, p. 2). If we are to persist in the claim that our theology encompasses natural and not just mythical truth, then we are obliged to come to terms with a science devoted to material reality. It is no longer possible to pretend there is no conflict. Given the dynamic nature of Mormon theology, and the mechanism of progressive revelation in accordance with our capacity to receive, such a reconciliation is by no means farfetched. The danger is that we might abandon more valuable symbolic truths in a short-sighted attempt to keep up with hard facts. However, we have been told already that God has not yet given us a complete account of creation (D&C 101:32-34). He may be trying to bring us a step closer to understanding our universe now through science. Do we have ears to hear?

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