**Stephen Hawking:In Memoriam**

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Revd Dr Rodney Holder reflects on the life of Stephen Hawking.

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I was truly sorry to hear of the death of Stephen Hawking. Hawking was a towering figure in physics who made seminal contributions to cosmology. He did this against the backdrop of a terrible physical affliction, having been diagnosed at age 21 with amyotrophic lateral sclerosis and given two years to live. His life should be an inspiration to many, showing what a curious mind, strong will and a famous sense of humour can achieve.

In his early work with Roger Penrose he showed that the universe must have begun at a singularity, a point of infinite density and temperature where the laws of physics break down. He did ground–breaking work on black holes, which are like the inverse of the Big Bang, with matter collapsing to a point rather than expanding from a point. Hawking famously showed that black holes radiate with what has become known as ‘Hawking radiation’. With Jacob Bekenstein he derived a formula for the entropy of a black hole, entropy being a measure of disorder. He said that he wanted this formula to be engraved on his tombstone, in the same way that Austrian physicist Ludwig Boltzmann had his formula for entropy engraved on his tombstone in Vienna. We will see in a few weeks whether this becomes a reality.

Hawking's work in later years concerned the beginning of the universe, and whether it could have been created out of nothing. He made a number of ingenious and stimulating proposals, especially the "no boundary proposal", which makes time "imaginary" (in a mathematical sense) near the beginning, and thereby does away with the need for the universe to begin in real time. He also believed that the universe could arise spontaneously from a "quantum vacuum" acted on by gravity. In these ways Hawking thought that he could do away with the need for God to create the universe.

Hawking also believed that the idea of a multiverse would solve the problem of the universe's astonishing fine tuning. However, none of these ideas are uncontested. In his technical papers, Hawking admits that the no boundary proposal does not do away with the universe having a beginning in time. And, since other universes are unobservable in principle, there is considerable debate as to whether the multiverse idea is scientific at all. In any case, none of these proposals do away with the need for God to create and design the universe. The universe is dependent on God for its existence at all moments of time, including imaginary time – if that makes sense. Creation from the quantum vacuum (certainly something!) is hardly to be equated with the universe creating itself out of nothing; and God can equally well create a multiverse as a single universe.

Hawking's science was always exhilarating, challenging and worthy of serious engagement, even when, as in the ideas above, it remains controversial. He went to his death leaving us to ponder his tantalising question "what is it that breathes fire into the equations and makes a universe for them to describe?". He leaves a legacy in physics and cosmology on which much great progress in human understanding, and indeed human flourishing, have been built. He was an iconic figure, who struggled heroically against a terrible degenerative disease to achieve greatness in his chosen field of cosmology. As a scientist and Christian, I honour his legacy today.

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