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From Quantum to Cosmos

The discovery in the late 1920s that our universe expands led the Belgian astronomer and priest Georges Lemaitre to conjecture it had a quantum origin. I sketch the modern framework on which a quantum approach to cosmology is based. In 1983 Hartle and Hawking implemented Lemaitre's vision and put forward the first concrete model to describe a quantum origin of the universe. Their model predicts our universe emerged with a period of inflation, a phase of rapid expansion which generates the seeds for a complex universe, starting from a natural beginning. However, a fuzzy quantum origin is bound to give rise to a multiverse of possible universes. I discuss some of the challenges associated with the development of a truly predictive multiverse cosmology that is falsifiable to observers within one of its universes. I close by sketching more recent developments aimed at firmly rooting quantum cosmology in fundamental high-energy physics.