Theory redraws formation of early universe

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This is the "South Pillar" region of the star-forming region called the Carina Nebula. Like cracking open a watermelon and finding its seeds, the infrared telescope "busted open" this murky cloud to reveal star embryos tucked inside finger-like pillars of thick dust. Credit: NASA

Scientists have provided a solid foundation for an alternative theory to help explain how the early universe took shape.

This theory, first devised two decades ago, proposes that the dominant expansion in the early universe some 14 billion years ago, known as cosmological inflation, took place in a warm environment.

The idea differs from existing theories which state that this time of change took place during a cold period.

Physical model

A group of physicists, including Professor Arjun Berera from the University, who first devised the theory, has now created the first compelling physical model of events that took place at this point in time, based on fundamental physical principles.

This work contradicts prevailing beliefs in the field that if would be near impossible to devise a compelling model, based on first principles, for this theory.

Their idea takes into account a scientific process known as the Little Higgs mechanism, which stabilises the mass of sub-atomic particles known as Higgs bosons.

Their theory combines this mechanism with the concept that energy produced in the early universe allows for a continuous warm temperature.

Their idea showed very good agreement with satellite measurements of temperature fluctuations in the early universe.

Alternative theory

The latest research, published in *Physical Review Letters*, contradicts an alternative theory known as standard inflation theory, which suggests that early expansion of the universe took place in a cold phase. In that theory, as the universe took shape, the temperature plummeted before getting reheated again. Their paper was highlighted by the journal as an

Editors' Suggestion, which recognises its important contribution to the field.

"We are pleased to have formed a theoretical model for this phase of the universe, which is based on first principles. This could be a valuable theory for improving our understanding of how the early universe took shape," says Professor Arjun Berera of the School of Physics and Astronomy.

More information: Mar Bastero-Gil et al. Warm Little Inflaton, *Physical Review Letters* (2016). DOI: 10.1103/PhysRevLett.117.151301

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