Operationalizing Black-Hole Cosmology Through Iterative Computer Simulations

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Abstract

Operationalizing Black-Hole Cosmology (BHC) through iterative computer simulations will provide data regarding the Cosmic Microwave Background (CMB) temperature fluctuations. These fluctuations provide the most useful data currently being used by cosmologists studying the early universe. The results of these simulations will either substantialize hypothesized BHC predictions or indicate that further research is required. Substantiated predictions would suggest that the universe did, in fact, originate from a black hole existing within a parent universe.

1. Background

In 1927 a scientist by the name of Lematre proposed that our universe was initially extremely dense and hot. He further proposed that the universe then experience a period of rapid expansion. The essence of this belief is what constitutes the Big-Bang theory. Two years later Hubble discovered that the universe is expanding. In 1948 another scientist by the name of Alpher discovered that the theory matches observational data from the lightest particles in the universe. Later on Penzias and Wilson discovered cosmic microwave background (CMB) radiation which came from all directions in the universe. The radiation is remnants left over from the early universe and gives scientists clues as to the origin of the universe. The CMB, however, did not explain why the universe looked so uniform. It was from this dilemma that physicists developed the inflation theory. This theory proposes that the universes uniform appearance can be attributed to its rapid and symmetric expansion shortly following the big bang. This theory accurately predicted the CMB temperature slightly changes with the direction of the sky.

Although Big-Bang cosmology answers many questions it does not accurately explain how the universe was created. Big-Bang cosmology predicts that the universe began as a point of infinite density. This prediction does not make physical sense and consequently indicates that we have an incomplete understanding of the physics of the early universe. Moreover, inflation theorists had to introduce hypothetical types of matter which has never been observed. These theorists also relied on models which were frequently adjusted in order to match their predictions. Furthermore, Big-Bang cosmology does not predict what existed before the big bang.

The answer to this fundamental problem might come from Black-Hole cosmology (BHC). BHC purposes that the universe was created by a black hole which exists within a parent universe. If a star is large enough it can collapse into a black hole due to the the weight of its own gravity. Matter can not escape from a black hole because the escape velocity of a black hole is faster than the speed of light and anything with mass can not travel as fast as the speed of light. Consequently, not even light can escape the black hole hence the name. Matter inside of a black hole collapses until it reaches a certain point of extremely high density. It is at this point that the black hole can cannot collapse any further and, in fact, bounces outwards (but still can not leave the black hole). After this bounce the black hole would expand into a new region of space which becomes a universe (Pathria 1972, Popawski 2010).

Although BHC may explain the origin of the universe it has yet to generate specific predictions about the observed CMB temperature fluctuations. These fluctuations provide the most important data currently being used by cosmologists studying the early universe.

2. Hypothesis

A universe which exists according to BHC theory should never collapse to a point. Furthermore, this universe may undergo multiple bounces between which it expands and contracts. Moreover, the scalar spectral index obtained from the computer program should be consistent with the observed value of our universes scalar spectral index.

A universe should never collapse to a point because torsion will prevent matter from collapsing beyond a density in the order of magnitude of 10E57 kilograms per meters cubed. Therefore such a world would collapse to a finite size and consequently expand for a period of time.

This universe may also undergo several bounces before expanding to infinity. This is because the quantum particle production coefficient directly affects the size and density of the world undergoing the bounces. A smaller coefficient would require more bounces (each of which produces matter from particle production) in order to reach the same mass another universe which has fewer bounces but a greater particle production coefficient.

This universe should also have a scalar spectral index with that of our world. This value describes the quantum fluctuations in the early universe and how these fluctuations were amplified through the rapid inflation of the universe. Therefore consistent values would indicate that the physical characteristics of a BHC universe and our universe may be indistinguishable (one of the same).

3. Methodology

In order to operationalize and test the BHC theory the research will be split into two parts. The first part involves writing a computer program the Fortran programming language which will numerically solve a system of two coupled, ordinary, first-order differential equations which describe the dynamics of a closed universe in a black hole (NP, arXiv:1410.3881). These equations are the Einstein-Cartan equations of general relativity with spin and torsion (Sciama 1964) are also modified by quantum particle production from the vacuum of strong gravitational fields near the bounce (Popawski 2014). These equations give the size (scale factor) a and temperature T of the universe as functions of time t (see Fig. 1). Quantum particle production should greatly increase the mass inside of a black hole. The universe may undergo several bounces, but it will eventually have enough mass to expand to infinity.

The second part in operationalizing this theory involves evaluating whether or not hypothesized predictions match the results generated by the computer program. Since the rapid recoil of the bounce could the the cause of universal expansion, the results of the recoil should match observations of the universes size and mass as functions of time, its geometry, and several variables which describe the fluctuations in the CMB temperature. The results obtained from a graphical representation of the data should match the predicted values of the scalar spectral index ns (see Fig. 2).

4. Results

Results The data generated from the computer simulations has validated all three hypotheses. Firstly, one of the computer simulations tasks was to calculate the size of the universe with respect to time. The graphical representation of this data indicates that black holes collapse they will always collapse to a finite size and never to a point. The smallest possible size of a black hole derived solely from the amount of matter it contains. Since torsion prevents matter from collapsing beyond a certain density, this critical density may be multiplied by the amount of matter a black hole contains in order to determine the smallest possible size of that black hole. Since each bounce produces matter, the smallest possible size of a black hole is transient and will increase with each bounce due to the particle production of each bounce.

Secondly, more simulations were done In which only the quantum particle production coefficient was changed. Since this value is not yet known it was evaluated by finding a coefficient value which causes inflation at the same magnitude and rate as our world does. The data from these simulations showed that a smaller coefficient results in each bounce producing less matter than universe with a larger coefficient undergoing bounces. Furthermore, it was discovered that a small enough coefficient may require a nearly infinite number of bounces before it could expand to infinity (instead of continuing bouncing) and likewise, a large enough coefficient would result in a universe that would undergo one bounce and consequently generate too much mass and grow too rapidly to resemble our universe. It just so happened that the coefficient which accurately models the growth of our universe is very close to the critical coefficient value that would generate an infinite amount of matter and expand infinitely fast.

Finally, the simulated values of ns in our model are consistent with the observed CMB value ns for a small range of and a wide range of a0 (m) (See Fig. 3).

5. Discussion

The discovery of consistent CMB observations implies that our current understanding of gravity and high-energy physics may need to be modified (Kibble 1961). There may be new forms of undiscovered energy which could revolutionize energy production and even space travel. If these new forms of energy exist they could open up new possibilities for propulsions systems which currently have too great of an energy requirement.

6. Conclusion

Through this research BHC has been substantiated through three separate predictions which proved to be true. Furthermore, the research has yet to make any discoveries which refute BHC. From this we can make several conclusions.

The first conclusion is that the dynamics of the early universe formed in a black hole depend on the quantum-gravitational particle production rate , but is not too sensitive to the initial scale factor a0. This is establish by comparing the graphs of universes which 1) have the same initial size, but different quantum-gravitational particle production rates and 2) have different initial sizes, but the same quantum-gravitational particle production rate.

Next, inflation (exponential expansion) can be caused by particle production with torsion if is near some critical value cr. When the simulation uses this value it produces a universe which mirrors the inflation rate of our universe.

Third, since our results for ns are consistent with the 2015 CMB data we can further support our assertion that our Universe may have been formed in a black hole.

Dr. Poplawskis mathematical framework only contains one free parameter (particle production rate) which is predicted through graphical data (see Fig. ????). Only having one free parameter makes this theory more stable than inflation theory which has two. On top of that BHC expands rather than refutes inflation theory (which was developed to describe what scientists have observed). Therefore BHC does not have to prove Inflation theory wrong in order to be true, it merely needs to substantiate its further explanation (refuting inflation theory could possibly suggest that we are refuting important and widely accepted observational data).

Finally, if, and when quantum gravity is solved, we will know what the particle production rate is. This rate should match the rate which we have already predicted This will either support BHC or indicated that major changes are needed within the mathematical framework.

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