Dark Origins: Departure from an *Ex-Nihilo* Big Bang

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Abstract

With the growing body of research on black holes, it is becoming increasingly apparent that these celestial objects may have a stronger part to play in our Universe than previously thought, shaping galaxies and influencing star formation. In this manuscript, I take these findings a step further, proposing a new set of boundary conditions to both the early and late Universe, extrapolating from thermodynamics. I propose that our Universe may collapse into a massive black hole and that the Big Bang is a result of a collision or interaction between Supra Massive Black Bodies (SMBBs, black holes at the mass scale of the known Universe) of opposite matter type (baryonic and anti-baryonic) and disproportionate masses a stark departure from the classical *Ex-Nihilo* creation (from nothing) approach. Such a collision, between a matter and anti-matter SMBB, with disproportionate masses could account for both the explosion referenced as the Big Bang, as well as the drastic baryonic asymmetry that we observe. Expulsion of black body material from the interaction could also account for Primordial Seed black holes.

Keywords: Black Hole; Big Bang; Early Universe; Dark Matter; Ex-Nihilo; Baryonic Asymmetry

Original Draft- June 22nd, 2020

Revision- July 11th, 2020

1. Introduction

Many creation or origin stories center around the concept of *Ex Nihilo* (from nothing) creation; from the Kono people's Hâ [1] to the current Big Bang Theory. [2] Prior to the key 'creation' event, it is commonly theorized that there had been a void of sorts, free from the 'real' time and physical laws we know. While not materially influential to our lives, how we think about the origins and bounds of the Universe has direct implications on our approaches to understanding the world around us, and how we utilize our limited scientific resources. While we continue to understand more and more, we should humbly acknowledge our collective scientific history, as there is often something beyond that which we can see- both in the direction of the very small and very large.

The past decade (2010-2019) has played host to monumental collaborative research, the impacts of which are yet to be truly understood. In 2012, CERN's team was able to detect the Higgs-Boson [3] the particle thought to be responsible for mass. In 2016, the LIGO/Virgo collaboration published observations of the gravity fluctuations caused by merger GW150914 [4] and the visualization of the accretion disk [5] around the super massive black hole in Galaxy M87. In addition, last year a proposal emerged that there may be a 'basketball-sized' black hole, in our solar system- as a Trans-Neptunian Object; [6] accounting for the missing mass in our solar system. We are learning that black holes, likely at the center of every galaxy, may be playing a larger role in our Universe than we think.

Black holes can be formed through the supernova of a massive star, or the implosion of a neutron star- both relying on the compression of a critical mass under immense forces. These routes to formation have size/mass restrictions that are linked to the stability of the previous form. Accretion-based growth rate limitations can be described by the Eddington limit [7] and is generally accepted, at the moment, with some slight special case exceptions. [8] In all cases, other than merger, the growth rates are limited by both the available 'food' and accretion dynamics (*i.e.* maximum luminosity a body can achieve; balance of radiative and gravitational forces). These models and assumptions can account for observed black holes such as ones in the center of our own Milky Way, but they cannot explain so-called Primordial Black Holes (PBHs), [9] formed through unknown mechanisms, increasingly believed to be quite prevalent across our Universe. PBHs and more generally Massive Astrophysical Compact Halo Objects (MACHO), [10] such as black holes, dwarfs and planets not associated with planetary systems, are the current best candidates to account for the 'dark matter' [11] within our Universe.

So many open question remain, a few of them include: Dynamics of inflation of our Universe (shortly after the Big Bang), what are the bounds of our Universe, and perhaps the most fundamental question- 'Where did all of this come from?' The Big Bang is accepted to be the 'what' in our Universe coming into existence, but how and why that 'Big Bang' occurred is something entirely different. Extrapolating from the accumulated knowledge, we may begin to understand the more generalized nature of black holes.

Inspiration and analogies can come in many forms; J.J. Thompson had plums in pudding, [12] Isaac Newton had The Apple [13] and Albert Einstein had The Train. [14] Simple objects in the world around us can be used to orient how we think about the complex Universe, acting all around us. With so much unknown and currently untestable, this paper orients away from the contents of a black hole and towards the more generalized behavior and what we can learn from it.

2. Discussion

A concept that assisted with my orientation around the concept of black holes was the coalescence of bubbles in a cappuccino foam, enjoyed after a black hole symposium. Energy and agitation are required to mix the air with milk and create the new interfaces present in the micro foam. Each air bubble within the foam is temporarily stabilized by the surrounding milk matrix. Given time, the air bubbles are driven towards merger; the smaller the foam bubbles the longer it will take the merging bubbles to reach a given size. What can we learn from the foam and how can these holes help us complete the picture?

From observations of black hole mergers, we can see that black hole merger is favorable. The growth of a black hole event horizon there is a theorized increase in entropy, according to the Berkenstein-Hawking formula [15] $S_{BH} = \frac{k_B A}{4 l_p^2}$; where S_{BH} is the entropy of the black hole event horizon, k_B is the Boltzmann constant, A is the area of the event horizon and l_p is the Plank length. The merger and growth of black holes should be entropically favored, in line with the second law of thermodynamics.

Through understanding where our Universe may trend towards as time goes towards infinity, we may understand something about the 'initial' state and possible perturbations. With enough time, the known

Universe may move towards black body material, through absorption and coalescence similar to that seen in droplet growth dynamics; large droplets ‘eating’ smaller ones driven through surface tension. Likewise, in the case of black holes, surface energetics that occur at the event horizon are entropically driven. [16] With this in mind, let us recall the old adage: ‘From dust to dust.’ [17] I theorize that the Big Bang, and the formation of our Universe, were caused by the interaction of black-holes far more massive than our Universe. Rather than ex-Nihilo, our Universe creation may resemble something closer to the Hirayagarbha, [18] (’Golden Egg’) from which all emerged in Vedic philosophy.

2.1 Supra Massive Black Body Annihilation

A thought experiment: Imagine the merger of two black holes, except instead of them both being made up of baryonic or koinomatter (‘Ordinary’ matter), [19] one is made of Anti-Matter, obeying the same physics, though opposite in quantum properties [20] (momentum, charge, etc.). Both of the black holes contain very concentrated masses that would attract one another, however instead of merging, there would be a spectacular annihilation (**Figure 1**). The interaction would give rise to massive amounts of energy, production of photons and neutrinos.[21] The energy released should be proportional to the mass-energy equivalence; E=mc^2 (E is Energy, m is mass 2 x Mass$_{\text{Anti-matter BH}}$, c is the speed of light).

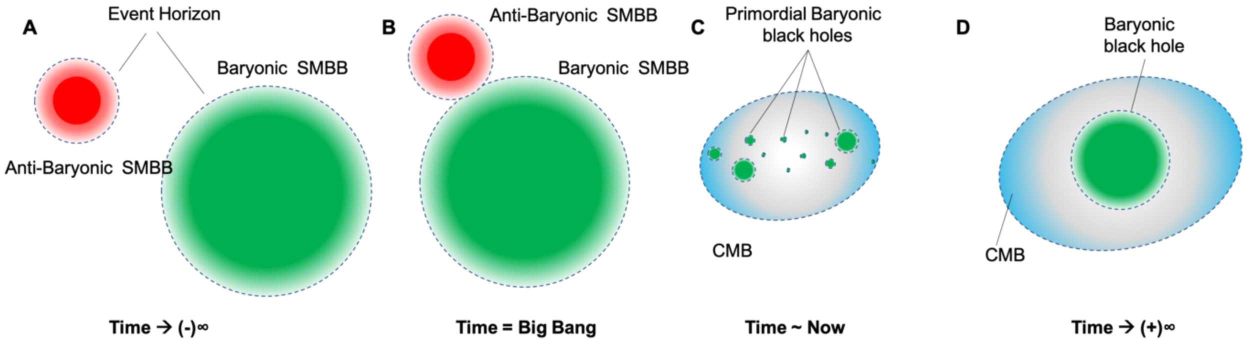

Figure 1. Proposed schematic of the Big Bang event and production of primordial black holes; A) attraction of baryonic /Anti-Baryonic SMBBs of asymmetric masses, B) Partial annihilation of baryonic SMBB, C) post inflation Universe with Cosmic Background radiation from annihilation and ‘atomization’ of SMBB to form primordial black holes, D) entropically driven merger of remaining universal mass into barionic black hole as time goes to infinity.

If this thought experiment were to occur at the mass scale of our Universe, a interaction with an anti-matter black hole could result in what we refer to as the Big Bang. The Eddington limit, might point to why once mutual annihilation occurred with SMBB, that there was no immediate re-consolidation allowing for a sufficiently long cooling period to reach the ‘Matter Dominated Era’ (est. 47,000 yrs. post-Big Bang).

To explain the baryonic asymmetry in the observable Universe, imbalance of matter (baryons) and anti-matter (anti-baryons): if these two black bodies (SMBBs) were unequal in mass there would be an asymmetrical distribution of matter type remaining. In this framework, I postulate that the baryonic black body was far more massive than the anti-matter black body resulting in a large explosion, expelling large baryonic black bodies that form what we observe as PBH sprinkled around the observable Universe. Other approaches to explain the asymmetric distribution of matter types lean on the quantum mechanical mechanisms occurring during electroweak epoch, [22] grand unification epoch, [23] or leptogenesis [24]- all occurring after the Big Bang. The framework proposed has to do more with proportions of matter type pre-Big Bang rather than more complicated quantum conversions of matter type.

One result of the above scenario, the CMB may be the residual outwardly propagating photons from the energetic annihilation, similar to what we observe in super nova, however it does not represent the real bound of the Universe but rather a shock wave of sorts. Beyond that more empty space, containing more SMBBs and temporary, low-density matter systems, like our own.

A second result from the above conjecture: the energies released via annihilation of asymmetric masses could cause *'atomization'* or divisions of black bodies from the massive SMBB. This could cause a narrow distribution of black hole masses which gradually grew and opportunistically merged during our early Universe. Revisiting the foam analogy, this would be something of an inverse of our traditional image of foam; a dense spherified phase surrounded by a low density matrix. These dense spherified objects could be what we refer to as primordial black holes and could have been key shapers of early nebulas and galaxies.

A third results is that if a similar SMBB pair interaction occurred with opposite mass proportions (possibly with other SMBB-black bodies) a 'Universe'/system, like ours, would exist and be made of 'anti-matter'. Such systems may co-exist presently but are spaced sufficiently far from our own making observation/detection beyond the CMB difficult.

3. Conclusion

Unification of our part of the Universe into a singular black hole, seems to be entropically favored and in line with the second law of thermodynamics, though kinetics of such a "Big Crunch" are not taken into account here. If this is the case, the end of our Universe would look similar to the beginning- considering the Big Bang theory currently starts off as a 'singularity' which is also what lays beyond an event horizon.

With more tools to observe black hole behavior we can continue to understand the Universe around us. The deeper we dig, the more questions we answer but also the more that are unearthed. There is much evidence supporting the Big Bang, and particle physicists are continually searching for theoretical particles to explain the observable Universe. Leptogenesis is the current testable hypothesis to explain the asymmetry of matter and anti-matter, requiring stripping of the Higgs-field that gives mass and conversions of anti-matter to matter in our early Universe. As a counter to leptogenesis, I propose that the asymmetry of matter and anti-matter existed before the big-bang. Furthermore, the Big Bang itself was caused by the proportional annihilation of anti-matter and matter black bodies with masses larger than the scale of the currently observed Universe. Energetic remnants from this annihilation eventually proceeded to form our matter dominated Universe that we exist in currently, along with formation of a distribution of ‘seed’ black holes, at ‘time=0’ after the Big Bang, acting as particle concentrators and shaping the structures of our Universe.

Research in the following areas will continue to evolve/develop and should be used to interrogate this theory: definitive evidence of leptogenesis, starting with neutrino particle physics, understandings around black hole stability and of course the composition beyond the event horizon. This is in addition to understanding if the bounds of the Universe exist as we believe them to. As humans, thinking beyond (or even at) the scale of our current model of our Universe is almost too abstract to fathom.

Acknowledgements

The author wishes to thank Anna Shneidman for constructive comments and review assistance, in addition to Nima Dinyari and Sarah Schlotter for fruitful discussions and/or ramblings. The author would like to acknowledge Harvard University’s Center for Astrophysics for their symposia and providing a welcoming attitude.

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