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

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June 22, 2020

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 the 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 the Universe will 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 our '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; Anti-Matter; Dark Matter; Ex-Nihilo

1. Introduction

Many creation or origin stories center around the concept of *Ex Nihilo* (from nothing) creation; from the Kono people's Hâ(Holas 1954) to the current Big Bang Theory.(Hartle & Hawking 1983) 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 of our 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 momentous collaborative research, the impacts of which are yet to be truly understood. In 2012, CERN's massive team was able to detect the Higgs-Boson(Collaboration 2012)(the particle thought to be responsible for mass). In 2016, the LIGO/Virgo collaboration published observations of the gravity fluctuations caused by merger GW150914 (Collaboration & Collaboration 2016)and the visualization of the accretion disk(Collaboration 2019) 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; (Scholtz & Unwin 2019)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 the 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(Eddington 1917) and is generally accepted, at the moment, with some slight special case exceptions.(Volonteri et al. 2015) 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 (PBH),(Hawking 1971) formed through unknown mechanisms, increasingly believed to be quite prevalent across the universe. PBHs and more generally Massive Astrophysical Compact Halo Object (MACHO),(Alcock et al. 2000) such as black holes, dwarfs and planets not associated with planetary systems, are the current best candidates to account for the 'dark matter'(Inomata et al. 2017) within our Universe.

Many unexplained phenomena remain, including: Inflation of the 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 the 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,(Inomata et al. 2017) Isaac Newton had The Apple (Nersessian & Malament 2002) and Albert Einstein had The Train(Einstein 1961) 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

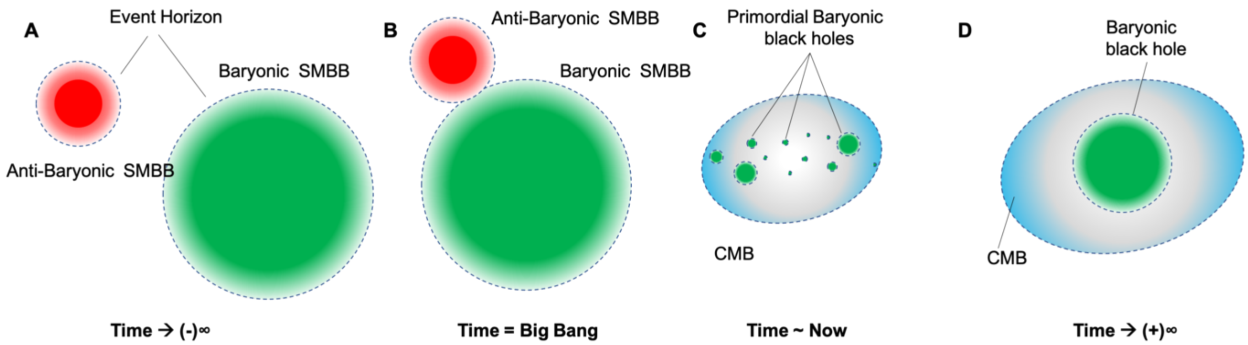
An concept that assisted with my orientation around the concept of black holes was the coalescence of bubbles in a cappuccino foam, enjoyed after a black hole symposium. Energy and agitation are required to mix the air with milk and create the new interfaces present in the micro foam. Each air bubble 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 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 also favorable. With growth of the black hole event horizon there is increased entropy, according to the Berkenstein-Hawking formula(Hawking 1975) $S_{BH} = \frac{k_B A}{4 l_p^2}$; 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 is entropically favored, in line with the second law of thermodynamics.

With enough time, our 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.(Callaway 1996) With this in mind, let us recall the old adage: 'From dust to dust.'(Book of common prayer) Through understanding where the universe may trend towards as time goes to infinity, we may understand something about the 'initial' state and possible perturbations. 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, the universe creation may resemble something closer to the Hirayagarbha,(Ganguli) ('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),(Sukys 1999) one is made of Anti-Matter, obeying the same physics, though opposite in quantum properties(Ahmadi et al. 2016) (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 **??**). The interaction would give rise to massive amounts of energy, production of photons and neutrinos.(Oerter 2006)The energy released should be proportionate to the mass-energy equivalence; $E=mc^2$ (E is Energy, m is mass 2 x $\text{Mass}_{\text{Anti-matter BH}}$, c is the speed of light).



If this thought experiment were to occur at the mass scale of our Universe, an 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 our observable universe, imbalance of matter (baryons) and anti-matter (anti-baryons): if these two black bodies (SMBBs) were unequal in mass there would be a unsymmetrical 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,(Kuzmin et al. 1985)'grand unification epoch,(Georgi & Glashow 1974)or leptogenesis(Fukugita & Yanagida 1986)- 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 real bound of our 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 the 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 universe into a singular black hole, seems to be entropically favored and in line with the second law of thermodynamics. 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 our 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 the 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 our currently observed Universe. Energetic remnants from this annihilation eventually proceeded to form the 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 of beyond the event horizon. This is in addition to understanding if the bounds of our 'Universe' exist as we believe them to. As humans, thinking beyond (or even at) the scale of our current model of the 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 Department of Astrophysics for hosting and providing a welcoming attitude in their symposia.

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