Bose-Einstein Condensate Cosmology vs. PEMC; Cold plasma

Discussing the problem of replacing all forms of Dark Matter with an interstellar medium: BEC vs PEM/UAF

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December, 2018

ABSTRACT

The failure of the “Dark” Universe to explain observed astrophysical phenomenon has created a vacuum for cosmology. One attempt to fill this involves a radical concept of using Bose-Einstein Condensate (BEC). While it meets some of the limited criteria, it fails on multiple levels of basic physical needs and violates the laws of thermodynamics in a Big Bang Cosmological paradigm. Addressed here in brief are discussions of ultracold plasma, charge sequestration, and the EPEMC paradigm regarding ultracold states, such as superfluidity and superconductivity. BEC can be regarded therefore as a detailed boson-level study of the plasma superfluid interstellar medium, specifically on the retrieval end of the energy-mass cycle, rather than in an active galactic/gravitational side. There is simply no proof that BEC constitutes active “DM”, which is already explained with “charged” DM, that is: local matter, covert matter, hot dust/grains, and condensed matter. Furthermore, with any PEMC, the existence of DM is constrained out of the discussion which leaves BEC within a small category of interesting plasma sciences.

Keywords: *Bose-Einstein Condensate, Condensed Matter, Dark Matter, Charge, Cold Plasma*

Bose-Einstein Condensate

Bose-Einstein Condensates have only recently become mainstreamed in the discussion of cosmology as they were theoretical from 1925-1995. A BEC is defined,

> *"A Bose–Einstein condensate (BEC) is a state of matter of a dilute gas of bosons cooled to temperatures very close to absolute zero* ***(-273.15°C)****. Under such conditions, a large fraction of bosons occupy the lowest quantum state, at which point microscopic quantum phenomena, particularly wavefunction interference, become apparent macroscopically. A BEC is formed by cooling a gas of extremely low density, about one-hundred-thousandth the density of normal air, to ultra-low temperatures."*[1] [emphasis added]

In Das & Bhaduri (2018)[2], the BEC was offered as a solution for the cosmological problems of Dark Matter/Lambda cold Dark Matter simply being absent of all searches thus far for it. Furthermore, it doesn't appear likely at this time that Dark Matter will be found. The "crisis" in physics leads to opportunities for other cosmologies. Unfortunately for MOND, it doesn't appear to be going forward (see Table 2). However, Plasma Cosmology (and in this case we mean PEMC) is surging forward at Harvard, Yale, NASA, and Berkeley. However, BECC is also nudging forward as a possible contender. It is, by definition, composed of bosons, which accounted for roughly half of the found missing matter, while the rest appears to be "local" matter, Condensed Matter, "hot dust" (a form of plasma in Dark Mode), and "covert matter" such as black body planets, stars (again roughly composed of condensed matter such as liquid metallic hydrogen) and exoplanets, etc… (see "References").

Studies have shown this will most probably account for all of the missing matter. However, Das & Bhaduri have stated, *"... we show that when the BEC of ultralight bosons extends over cosmological length scales, it can potentially explain the origins of both dark matter and dark energy."*[3]

Setting aside their insistence on the existence of Dark Matter *apriori* in their Introduction, they go on to provide mathematical frameworks for this BECC - again in support or insistence of the expanding Universe theorem - and say,

> *"We conjecture that there are ultra light bosons that span our universe, their Compton wavelength is comparable to the size of the visible universe, and that a BEC of these bosons constitute DM. We will discuss about the nature of these bosons later. First consider the case where the bosons are their own antiparticles, e.g. for bosons with no charge. To check if these bosons can indeed form a BEC, we first compute their critical temperature Tc and compare it with the ambient temperature of the universe, that of the all pervading cosmic microwave background radiation (CMBR) at any epoch T(a) = (2.7/a) K (we assume a = 1 in the current epoch)"*[4]

They go on to show,

$$T_C = \frac{4.9}{m^{1/3} a} K,\ m < 6\ eV/c^2\ (or\ about\ m < 10E-35\ kg)$$

(1)

> *"In other words, for a gas of bosons which weigh a few electron volts or less, its critical temperature will always exceed the temperature of the universe, it will form a BEC at very early epochs and is a viable DM candidate. Having little or no momentum in the BEC, they will behave as cold dark*

[1] https://en.wikipedia.org/wiki/Bose%E2%80%93Einstein_condensate
[2] https://arxiv.org/pdf/1808.10505.pdf
[3] Ibid. Abstract
[4] P. 3

matter (CDM). Furthermore, $m = 10^{-32}$ eV /c^2 , the boson mass required for its quantum potential to account for the observed cosmological constant is well within the above bound!"[5]

This is all very exciting, however, the average temperature of space is **3 K**[6], while BEC are produced well under 1 K[7]. At a minimum it appears to be 2.7 K[8].

So, the other side may counter, BECC for earlier times in the Universes' lifespan. However, there are a few problems with this. For one the issue of Dark Matter, while observed using very old light, is a present matter. Literally in this Milky Way, it is a problem, and the time scales of observable data within the Milky Way are far removed from early Universe cosmologies.

Secondly, a cosmology should work on all scales. When antimatter was discovered, it was said that this would revolutionize cosmology, but it was later discovered that most of the antimatter was destroyed early on.[9] The Higgs was also supposed to revolutionize cosmology[10], however it turned out to be just another form of regular boson[11]. Rather than solve our **present** cosmological needs, these provided hyped up, temporary solutions. The BEC appears to be just the same, presenting one of two scenarios (yes even for Dark Energy!):

1. A solution to the issue of energy cycling and ever increasing entropy.[12]
2. Only a discussion of the early Universe (if Big Bang is brought forward into the new cosmology being built, which the author predicts it will fail to do in the long run[13]).

The problem gets worse for BECC,

"A Bose-Einstein condensate is a group of atoms cooled to within a hair of absolute zero. When they reach that temperature the atoms are hardly moving relative to each other; they have almost no free energy to do so...

"To make a Bose-Einstein condensate, you start with a cloud of diffuse gas. Many experiments start with atoms of rubidium. ***Then you cool it with lasers, using the beams to take energy away from the atoms****. After that, to cool them further, scientists use evaporative cooling. "With a [Bose-Einstein condensate], you start from a disordered state, where* ***kinetic energy is greater than potential energy****," said Xuedong Hu, a professor of physics at the University at Buffalo. "You cool it down, but it doesn't form a lattice like a solid."*[14] [emphasis added]

In other words, one has to perform work on the system in order to create a BEC. In the early Universe, perhaps atoms can exist at a low temperature, but that seems unlikely in Expansion Theory. Even present temperatures of the interstellar medium are far in excess of 170 nK! But to suggest that present day Dark Matter may be composed of actively cooled BEC would imply a violation of the laws of thermodynamics. It's a

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[5] P. 4

[6] https://sciencing.com/temperatures-outer-space-around-earth-20254.html

[7] *"On June 5, 1995 the first gaseous condensate was produced by Eric Cornell and Carl Wieman at the University of Colorado at Boulder NIST–JILA lab, in a gas of rubidium atoms cooled to* ***170 nanokelvins (nK)****. Shortly thereafter, Wolfgang Ketterle at MIT demonstrated important BEC properties."* Ibid. [emphasis added]

[8] https://www.universetoday.com/77070/how-cold-is-space/

[9] https://home.cern/science/physics/matter-antimatter-asymmetry-problem

[10] https://www.space.com/28181-gravity-higgs-boson-universe-destruction.html

[11] https://en.wikipedia.org/wiki/Higgs_boson and see Table 2

[12] The lack of balance is at clear odds with other known homeostatic behaviors in chemistry and physics which seek balance and equilibrium, on all scales from cellular life cycles to the water cycle to seasons to stellar revolutions. Everything appears rounded and balanced. However there is no proposed mechanism for reabsorption of IR and EMF into the mass-matter (ie "known Universe"). This state of imbalance has led to preposterous hypotheses about the end of the Universe.

[13] In the author's opinion the Universe is time-less, ie: eternal.

[14] https://www.livescience.com/54667-bose-einstein-condensate.html

sexy theory, but behind the math are glaring logical issues which seem insurmountable to the author.

In the next section, however, a discussion of plasma physics and the search for the various filamentary modes of it in space will lead to a startling hypothesis.

Cold Plasma

The issue of energy and attraction, in space, is a primarily charge related matter, not a gravitational one. This has been discussed elsewhere at great length, and demonstrated in laboratories and terrella experimentation. Furthermore, the issue of structure in space, especially in galactic mediums, is defiant of some of the definitions of BEC. Chiefly: it isn't diffuse but organized, it isn't gaseous but electrical, BEC doesn't explain the other phases of matter acting conjointly with plasma (such as solids and liquids), and after all to have a BECC you must violate the laws of thermodynamics to keep the Dark Matter in a condensed state, acting as a single atom. This isn't what is observed in the least!

However, the issue of utilizing extremely low temperatures, caused by energy syphoning out of one part of the system into another part, is possibly vital to the discussion of the age and endurability of the Universe. Could there exist a state of plasma where energy is pulled from the charged bosons into the high temperature space, such that in the long distances between hot bodies and stellar objects?

Actually, yes, although it is not termed "cold" plasma but super cold or ultracold plasma,

> *"A cold plasma is one in which the thermal motion of the ions can be ignored. Consequently there is no pressure force, the magnetic force can be ignored, and only the electric force is considered to act on the particles. Examples of cold plasmas include the Earth's ionosphere (about 1000 K compared to the Earth's ring current temperature of about 10^8 K)., the flow discharge in a fluorescent tube,...*
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> *"An ultracold plasma is one which occurs at temperatures as low as 1K. and may be formed by photoionizing laser-cooled atoms. Ultracold plasmas tend to be rather delicate, experiments being carried out in vacuum."*[15] [16]

> *"Laser-cooled atomic vapors can be photoionized to form plasmas at temperatures as low as 1 K. This may allow the study of very unusual neutral plasmas with liquid and even crystalline properties...*
>
> *"Plasmas, the most common state of matter in the universe, span an incredible range of parameters, from a density of 10^3 cm^{-3} and temperature of a few hundred kelvin in the aurora of earth's ionosphere to a density of $10^{27}cm^{-3}$ and temperature of 10^7 K in the core of the sun. With the tools of atomic physics and the techniques of laser cooling, we can now create **neutral plasmas at temperatures as low as 1K**. Having these kinds of laboratory plasmas may help us to better understand the interiors of large planets and white dwarf stars, and allow us to probe new states of matter and unusual liquidlike and crystalline effects in so-called strongly coupled plasmas."*[17]

Almost assuredly, the existence of ultracold plasmas in liquid, crystal, and obviously gas-like states (being a plasma) is no coincidence at this temperature range or to the behavior of ultracold bosons, which are behaving more fundamentally, and yet with interesting super cold, superfluid, superconductive properties (almost magical

[15] https://www.plasma-universe.com/Plasma_classification_(types_of_plasma)
[16] https://www.sciencedirect.com/science/article/abs/pii/S0370157307001937?via%3Dihub
[17] https://physics.aps.org/articles/v1/2

properties!) This is not a coincidence. BEC are part of PEMC! They are, in fact, a specialty discussion of ultracold plasma behaviors, specific to ultracold plasmas. As HEPP is a subsection of PEMC, and PEM is related to EMF/UAF issues, it can be said that the entirety of High Energy physics is tending towards unification under PEMC.

At first it may appear that this is implausible as a mechanism happening in space because of the use of lasers (as before), but here there are mitigating circumstances. Namely, that in space there is a proposed mechanism of energy and charge sequestration along the filaments which would drain the temperature and charge from an area of concentrated cold plasmas, turning them into ultracold plasmas. As discussed above, BEC is primarily kinetic and not potential energy; so this ultracold state is expected to be quite active, despite being cold. Yet, not nearly as active. It could, at this time, perhaps be considered a method of energy conservation in the Universe. It isn't clear how the energy is being converted from diffuse IR, UV, Radio, etc… back into cold plasma. The most likely mechanism is a form of friction. Much like air syphoning kinetic energy from a bullet, the interstellar medium of bosons etc… would be slowly absorbing IR and other forms of energy, and then carrying that potential energy into charged clumps, which are then syphoned of charge and temperature by highly concentrated "jets" (ie, Birkeland Currents), that then draw mass and energy towards filaments and then via Marklund Convection into nodes, such as stars, quasars, "black holes", AGN, pulsars, etc…

Rather than violating the laws of thermodynamics, the above scenario would prove out if the first portion of the system were considered one system (frictional sequestration), and the second system were thought of in terms of potential gradients and pressure zones. Because the two systems feed each other, but not directly, the recycling "tripartite" motion of the particles and EMF waves are then self-contained but not in violation of thermodynamic properties; rather they feed each other via entropy[18]. Now, this will require a discussion of a separate issue: that of an alternate model for light and photons[19], but that is not for this paper.

The critique of this model may be that the choice between the two is arbitrary. But it isn't. While BEC has only been created in laboratory, plasma pervades the entire Universe. It is reasonable, having found one, two, three, or four modes of plasma, to expect to find all the modes of plasma *in situ*. The author makes the prediction that as the search for "Charged" Dark Matter progresses and BEC is added, becoming a search for neutral bosons, it will lead inexorably to the discovery of various forms of condensed matter and plasma, with a conjoining of the two centered around high pressures with ultracold temperatures. Indeed, the issue will be mostly a matter of charge, as the author stated before that Charge *is* the aether we have been looking for and PEM/EMF is the Unified Aether Field (UAF). When charge states appear neutral, such as in condensed matter and in ultracold plasmas and BEC it is a sure sign of energy sequestration and movement from a lower order *back to a higher order*. Again, these movements must be held in standard (within one system) of thermodynamics. But on the whole, the entire energy of the Universe needs to remain conserved. Because mankind cannot physically see the edge of the Universe (no one can), the entire system is conserved as:

$$\frac{1}{\pm\infty} \rightarrow 0 \qquad (2)$$

While it may seem equation (2) is primarily philosophical, physics it is after all a *Natural Philosophy*, and it should, via EPEMC be possible to apply Occam's Razor and combine physical systems and philosophies into a unified arrangement. The equation is both simple and profound, as it is a re-arrangement of

[18] Ie - entropy rises in both systems, but oppositely. Exactly as yin/yang theory predicts.[9]

[19] Although charge acts as the aether, the polar relationship between the visible (which includes antimatter and quarks etc…) and the invisible (ie, supernatural), must be established. The tripartide rearrangement of these two also needs to be established, and possibly this will be the photon or a general discussion of induction, etc...

the “God equation”[20], and therefore part of the tripartite rearrangement hypothesis. So there is reduction with math, physics, and theology (via numerology).

None of this has any bearing upon the former physics, but flows from a discussion of the placement of ultracold plasma behaviors (and their function or role in the Universe) within EPEMC framework.

[20] In general: 1/0 tends to infinity; and in specific the Dirac Delta equation.

Table 1 :: Proper Physics Chronology[21]

Electricity	Ben Franklin	1751
Gaussian Theory	Carl Gauss	1813
Electromagnetism Unification	Michael Faraday	1831
Maxwell's Equations	James Maxwell	1861-62
Quantized Hypothesis	Ludwig Boltzmann	1877
Photoelectric effect	Heinrich Hertz	1887
Electron Theory	JJ Thomson	1897
Quantum Theory	Max Planck	1900
Relativity theory	Henri Poincare	1900-1904
Mass-energy relation	Henri Poincare	1900
Gravity Waves	Henri Poincare	1905
Special Relativity	Albert Einstein	1905
Photoelectric Effect Explained	Albert Einstein	1905
Birkeland Currents	Kristian Birkeland	1908
Atomic Theory Proved	Ernest Rutherford	1911
Particle-Wave Theory of Atoms and Particles	Niels Bohr	1913
General Relativity	Albert Einstein	1915
Proton discovered	Ernest Rutherford	1919
Quantum Radiation Interaction	Paul Dirac	1920
Quantum Mechanics Codified	Born, Heisenberg, Pauli	1924
Bose-Einstein Condensate	Bose, Einstein	1924
Plasma Cosmology	Irving Langmuir	1927
Big Bang Cosmology	Georges Lemaitre	1927
Missing Matter[22]	Edward Zwicky	1933
Magnetohydrodynamics	Hannes Alfven	1940
QEM/QED	Bethe to Feynman	1947-1960
Electroweak Theory	JC Ward	1959
Quarks	M Gell-Mann & G Zweig	1964
Black Hole Theory	John Wheeler	1967
Dark Matter	Rubin & Ford	1970
Electric Star Theory	Ralph Juergens[23]	1972
QCD	Gross, Wilczek, & Politzer	1973
SUSY	Werner Nahm	1978
MOND	Mordehai Milgrom	1982-83
String Theory	Green & Schwarz	1984
Dark Energy	Friedman[24] or Sivaram[25]	1924 or 1986
M Theory	Edward Witten	1995
Intrinsic Redshift	Halton Arp[26]	1998
MACHOs	unclear	2002?[27]
WIMPs	unclear	2008?[28]

[21] Tables 1 and 2 reproduced from [8]; all references in [8] included, as this paper is a follow-up. Table 1 modified for BEC
[22] Not Dark Matter.
[23] https://www.velikovsky.info/Ralph_Juergens
[24] http://home.fnal.gov/~skent/early.html
[25] https://arxiv.org/ftp/arxiv/papers/0809/0809.3364.pdf
[26] https://www.haltonarp.com/articles/intrinsic_redshifts_in_quasars_and_galaxies.pdf
[27] http://www.astro.caltech.edu/~george/ay20/eaa-wimps-machos.pdf
[28] https://www.astro.umd.edu/~ssm/darkmatter/WIMPexperiments.html

Table 2 :: Falsifications

SUSY	2012[29] - 2017[30]
CDM	2012[31], 2015[32], 2016[33] - 2018[34] [35] [36] [37]
LCDM	2010[38], 2014[39]
WIMPs & MACHOs	2017[40]
MOND	2018[41] [42] [43]
Galaxy Rotation and DM	2017[44] [45]
Standard Redshift	2017[46] [47] [48]
Galaxy Rotation and MOND	2018[49]
Higgs-boson as non-standard Quark	2018[50]
Dark Energy	2018[51]
LDM	2018[52]

Note - this table will likely increase in size and scope due to accelerating results from Gaia DR2 and MMS.

Conclusion

BECC is implausible given the average temperature range of the current and historic Universe. However, fundamental aspects of BEC's will prove valuable study, in the future as a subset of HEPEM and will also prove to be a part of PEMC.

Furthermore, the strange characteristics of ultracold plasmas and cold plasmas demonstrate unique cosmological variations amongst plasmas which will be found in lab and in space, and will give some idea of how generalized energy re-arrangement in an ordered, balanced cosmological framework exists in EPEMC.

[29] http://backreaction.blogspot.com/2016/08/the-lhc-nightmare-scenario-has-come-true.html
[30] https://www.space.com/39001-dark-matter-doesnt-exist-study-suggests.html
[31] https://arxiv.org/abs/1204.2546
[32] http://adsabs.harvard.edu/cgi-bin/bib_query?arXiv:1406.4860
[33] http://adsabs.harvard.edu/abs/2016arXiv161003854K
[34] https://arxiv.org/pdf/1808.09823.pdf
[35] https://academic.oup.com/mnras/article/476/3/3124/4875952
[36] https://arxiv.org/pdf/1807.07113.pdf
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[41] https://www.physicsforums.com/threads/falsifications-and-constraints-due-to-gw-measurements.929254/
[42] https://arxiv.org/pdf/1804.04167.pdf
[43] https://arxiv.org/ftp/arxiv/papers/1809/1809.09019.pdf
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[45] https://arxiv.org/pdf/1811.08843.pdf
[46] https://arxiv.org/pdf/1805.03298.pdf
[47] https://arxiv.org/abs/1807.09409
[48] https://arxiv.org/pdf/1804.03888.pdf
[49] https://arxiv.org/pdf/1801.09304.pdf
[50] https://www.nature.com/articles/d41586-018-06130-9
[51] https://arxiv.org/pdf/1810.05027.pdf
[52] https://arxiv.org/pdf/1810.10543.pdf

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