

## Thanks to Bekenstein Bound Holographic Phenomena Collapse of E8 Symmetry Cyclic Universes Can be Prevented

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**Abstract:** The Bekenstein bound energy limit of the universe has a value determined by the universe's radius and  $mc^2$  energy content at a given time. The bound energy cannot be exceeded and controls the maximum size and final age of each succeeding cyclic universe.

The next part of my theory of the universe concerns the importance of Bekenstein holographic phenomena<sup>1</sup>. According to this work, the sphere enclosing the universe at any stage of its growth has a radius,  $R$ , enclosing a  $mc^2$  energy  $E$  no greater than  $(2 \times \pi \times R \times E)/(h^{\text{bar}} \times c)$ . This dimensionless equation arises from holographic considerations:  $\frac{1}{4}$  the surface area of the universe's sphere must be equal to, or less than, this number. For the present radius of the universe,  $R = 4.29611 \times 10^{26} \text{ M}$ , and with  $(2 \times \pi)/(h^{\text{bar}} \times c) = (6.28318)/(1.6896113 \times 10^{-44} \text{ (GeV-s)} \times 2.99792458 \times 10^8) = (4.29611 \times 6.28318 \times 10^{26} \text{ M})/(5.0653271 \times 10^{-36} \text{ (M}^2/\text{sec. holographic units)}) = 5.3290252 \times 10^{62} \text{ GeV}$ . We next find  $E$  This<sup>2</sup> is universe matter density =  $6.3600743 \times 10^{-27} \text{ (Kg/M}^3) \times 0.0186408 \text{ (GeV)} = 0.1185568 \times 10^{-53} \times (\text{volume of our present universe} = 80 \text{ M}^3)$ . This gives for the dimensionless equation  $63.17921 \times 10^{86} \text{ (holographic units)}$ . To convert this to GeV, we proceed as follows<sup>3</sup>:  $1.501/1.19 \times \text{sq. rt. } (63.179) = 7.9485 \times 1.26134 = 10.0257 \times 10^{43} \text{ GeV}$ . This is the Bekenstein bound energy limit BBE for the universe at the present time.

We next compare the  $\text{BBE} = 10.0257 \times 10^{43} \text{ GeV}$  Bekenstein bound energy limit with the value<sup>4</sup> of the  $mc^2$  energy entering the universe via E8 supersymmetry (E8SE). This is

1350.56 GeV per second, or for the  $13.8 \times 10^9$  year age of the universe =  $4.354948 \times 10^{13}$  sec.  $\times$  1350.56 GeV =  $5.8816185 \times 10^{16}$  GeV per active galaxy. We must multiply this by the number<sup>5</sup> of active galaxies to get E8SE. This number is  $10^{27}$ , which gives a total for E8SE =  $5.8816185 \times 10^{43}$  GeV. Thus BBE is not exceeded at this time.

We notice an interesting pattern here. Our present universe has a galaxy cube  $10^9$  M on a side and is slightly more than  $13.5 \times 10^9$  years old. If our previous universe had a galaxy cube  $10^8$  M on a side and an age of 12 billion years with galaxy total of  $10^{24}$ , and the BBE and the E8SE were recalculated, etc., we would have after 8 such universe cycles a universe with an age of 1.5 billion years and a galaxy cube  $10^1$  M on a side with a galaxy total of 1000. It would take only 8 such cycles (there's that eight-fold symmetry of life again!) and 54 billion years (not including unbroken E8 symmetry time) to reach our prior universe's ending size starting from zero volume! The 8 universe age sequence would be 12, 10.5, 9, 7.5, 6, 4.5, 3,  $1.5 \times 10^9$  years with galaxy side sequence  $10^8$ , 7, 6, 5, 4, 3, 2,  $1 \times$  M. For all of these cyclic universes the BBE was exceeded and the universes collapsed (see the Appendix for the calculations). Only for the 9<sup>th</sup> universe (our own) was the BBE not exceeded and our universe did not collapse (at the scheduled age of  $13.5 \times 10^9$  yrs.) and has gone on<sup>6</sup> for another 0.3 billion years unchanged.

Bekenstein has made a contribution to cosmology and cyclic universe E8 symmetry theory in particular of very great importance. Unfortunately my realization of this importance will not benefit him at the present time.

Appendix: Calculation of ending BBE/E8SE ratios for several prior universes.

For universe no. 8 (the universe just prior to our own),  $R$  was reduced by 0.1 and  $E$  by  $12/13.5 \times 10^3 = 0.88888 \times 10^{-4}$ . The Bekenstein Bound BBE was thus reduced to  $10.0257 \times 0.88888 = 8.91172 \times 10^{39}$ . E8SE was reduced by a lesser fraction,  $0.88888 \times 10^3 = 5.228053 \times 10^{40}$ . This number exceeds BBE (but not by much!), so the 8th universe collapsed. For universe no. 7, the numbers are  $10.5/12 = 0.875 \times 10^{-4}$ . The BBE now is  $8.91172 \times 0.875 = 7.797755 \times 10^{35}$ . E8SE was reduced by  $0.875 \times 10^3 = 5.228053 \times 0.875 = 4.5745463 \times 10^{37}$ . Again the BBE is beaten (more) by the E8SE, and universe no. 7 collapsed. For universe no. 6 we have  $9/10.5 = 0.8571428 \times 10^{-4}$ . The BBE is  $7.797755 \times 0.8571428 = 6.6837895 \times 10^{32}$ . E8SE is reduced by  $0.8571428 \times 10^3 = 4.5745463 \times 0.8571428 = 3.9210394 \times 10^{34}$ . Again the BBE is beaten by the E8SE and universe no. 6 collapsed, etc. (I leave the remaining universe calculations to the reader).

1. "Bekenstein Bound", Wikipedia, (2017)
2. George R. Briggs, "The latest value of the Hubble constant indicates a universe matter density higher than one hydrogen atom per cubic meter", viXra 1704.0404, (2017)
3. "Cosmological constant", Wikipedia, (2017)
4. George R. Briggs, "The significance of the holographic and non-holographic versions of the cosmological constant", viXra 1705.0477, (2017)
5. See Ref. 4
6. John D. Barrow, Chandrima Ganguly, "The shape of bouncing universes", ArXiv 1705.06647v1 (gr -qc) May 2017