

## Expanded 3rd Draft

# An Astounding Not-So-Simple Retro-Causal Hologram Universe Simultaneous Solution to the Cosmological Constant & Arrow of Time Enigmas?

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## Abstract

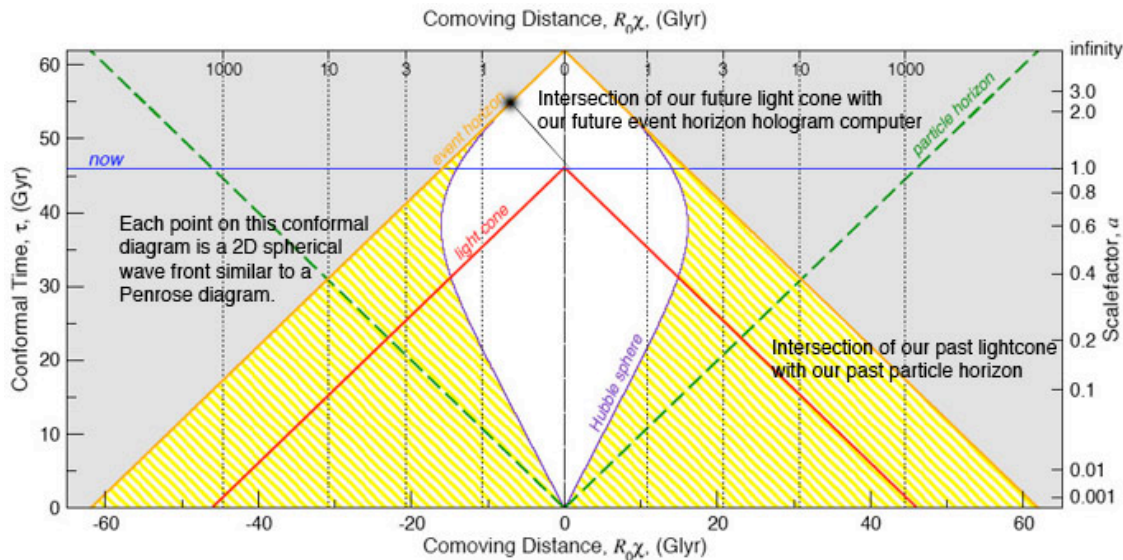
The bias against Wheeler-Feynman retro-causal advanced waves from a future absorber, a general lack of understanding of *when* the asymptotically constant de Sitter horizon *is* in our subjective observable causal diamond piece of the multiverse, Hawking's chronology protection conjecture, and the lack of comprehension of the strange implications of the t'Hooft-Susskind hologram principle<sup>i</sup> have not allowed us to see what is in front of our eyes since the discovery of dark energy accelerating the expansion rate of 3D space ten years or so ago. Bernard Carr<sup>ii</sup> has already published a brief account of my idea that retrocausality is the key to understanding the biggest problem in physics today – why the dark energy density is so small. My paper with Creon Levit (NASA AMES)<sup>iii</sup> based on my brief talk at DICE 2008 further developed that idea. This paper, is still a simpler explanation of why the virtual boson dark energy density is so small and how it is intimately connected to the Arrow of Time of the Second Law of Thermodynamics.<sup>iv</sup> The basic idea is so simple that any bright curious schoolboy or girl can grasp it without too much difficulty. Our universe grows from one qubit at the moment of inflation to an asymptotically constant de Sitter horizon hologram screen  $\sim 10^{123}$  qubits that is also the upper limit to the total thermodynamic entropy of our observable universe in the precise sense of Tamara Davis's 2004 Ph.D. dissertation at the University of New South Wales. The early universe is obviously not de Sitter, therefore, we have already there an obvious temporal asymmetry explaining the Arrow of Time. The dark energy density we see in our past light cone is proportional to the inverse area of our future de Sitter horizon at its intersection with our future light cone in accord with the Wheeler-Feynman retrocausal absorber principle.<sup>v</sup> Our future de Sitter null horizon is the Wheeler-Feynman "total future absorber" of last resort giving us "retrocausality without retrocausality" similar to the "nonlocality without nonlocality" of the "no cloning a quantum" or "passion at a distance" of orthodox quantum theory's "signal locality." The link between our future and our past is a globally self-consistent time loop in the sense of Igor Novikov. Indeed, this is a bootstrap of self-creation from future to past. The past dark energy density is indeed the Planck density at the moment of inflation, but Tamara Davis's Fig 5.1 shows that this density quickly drops to the small constant value that has been dominant in the past few billion years – bearing in mind that what matters, is not the spacelike intersection at a constant conformal time, but, rather, the intersection of the observer's future light cone with his future dark energy horizon. However, although **I have not yet proved** that the dark energy seen in our past light cone is really advanced Hawking radiation from our future observer-dependent de Sitter cosmic horizon that is, in addition, likely to be a holographic (post) quantum computer not in

sub-quantal equilibrium. I have given a plausible argument that this may turn out to be true.

**We are all agreed that your theory is crazy. The question that divides us is whether it is crazy enough to have a chance of being correct.**

Said by Niels Bohr to Wolfgang Pauli after his presentation of Heisenberg's and Pauli's nonlinear field theory of elementary particles, at Columbia University (1958), as quoted in *Symposium on Basic Research* (1959) by Dael Lee Wolfe, p. 66<sup>vi</sup>

Tamara Davis has plotted the large-scale history of our observable universe based on the best data from precision cosmology circa 2004. Her basic results relevant to this paper are show below adapted from her Ph.D. dissertation.



The above picture is adapted from Fig 1.1 of Tamara Davis's Ph.D.<sup>1</sup> Our **past particle horizon** is the future light cone of our past moment of the creation (aka **Alpha Point**) of our observable finite piece of the total material multiverse of parallel "Level 1" worlds on the same inflation bubble.<sup>2</sup> Retarded light waves coming from our past particle horizon along our past light cone are infinitely redshifted – we will not see them or anything beyond it. Our **future event horizon** is the past light cone of our future **Omega Point** "End Time" that is finite on the Penrose conformal scale but infinite on our proper time clock scale. For the subtle details read Tamara Davis's Ph.D. Even eminent cosmologists have gotten these details wrong. The time evolution of the area/entropy of our future horizon is shown in the thin solid middle line of Davis's (adapted) Fig 5.1 below. According to my retrocausal version of the hologram principle, the dark energy density  $\rho$  we measure

<sup>1</sup> [http://www.physics.uq.edu.au/download/tamarad/papers/thesis\\_complete.pdf](http://www.physics.uq.edu.au/download/tamarad/papers/thesis_complete.pdf)

<sup>2</sup> <http://space.mit.edu/home/tegmark/crazy.html>

along our past light cone now is proportional to the reciprocal area  $\Lambda$  of the intersection of our future light cone with our future event horizon forming a Novikov loop in time.<sup>3</sup>

$$\rho \equiv \rho_{Dark\_Energy} = \frac{8\pi G}{c^4} \Lambda_{virtual\_boson}$$

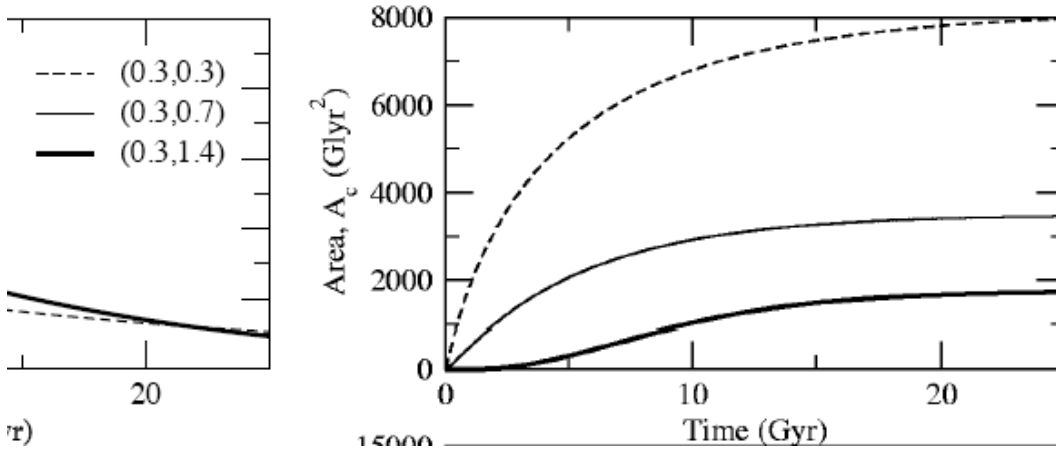
$$\Lambda_{virtual\_boson} = \frac{1}{Area_{future\_horizon}} \equiv \Lambda$$
(1.1)

The maximal upper bound to the total entropy of our observable universe sandwiched between our past and future thermal horizons in the causal diamond is

$$S(t) = \frac{k_B}{4L_p^2 \Lambda(t)}$$

$$= \frac{k_B c^3}{4\hbar G \Lambda(t)} \xrightarrow{t \rightarrow \infty} \frac{k_B c^3 R_{Hubble}^2}{4\hbar G}$$
(1.2)

The maximal upper bound of the thermodynamic entropy  $S$  of our universe, therefore, has the Planck value at the Alpha Point prior to the hot thermal Big Bang but relatively quickly approaches the small constant de Sitter value we actually observe today.



The ordinate area in the above piece of Tamara Davis's Fig 5.1 is  $\Lambda(t)^{-1}$  where  $t$  is a convenient measure of time from the Alpha Point. See the original Ph.D. for those details. The important qualitative idea here is to imagine a plot of the reciprocal of the middle thin solid line plot showing how the dark energy density accelerating the rate of expansion of 3D space quickly drops from the large Planck value of  $\hbar c/L_p^4$  approaches the asymptotic constant de Sitter value of  $\hbar c/NL_p^4 \sim 10^{-23} \hbar c/NL_p^4$  on the cosmic landscape<sup>4</sup> of chaotic eternal inflation of Max Tegmark's Levels 1 and 2 material parallel universes.

<sup>3</sup> [http://en.wikipedia.org/wiki/Novikov\\_self-consistency\\_principle](http://en.wikipedia.org/wiki/Novikov_self-consistency_principle)

<sup>4</sup> [http://en.wikipedia.org/wiki/String\\_theory\\_landscape](http://en.wikipedia.org/wiki/String_theory_landscape)

Imagine both intersections of our future and past light cones with our future and past event and particle horizons respectively. Both are 2D spherical shell walls of light a Planck length thick in which we are always at the center. We can also imagine these two spherical walls of light on the co-moving now line of the above Fig 1.1 spacelike separated from us. We are always closer to our future sphere horizon than our past sphere horizon, though it takes us an infinite amount of proper clock metric time to reach our final Omega Point that is finite in Roger Penrose's "conformal time" measure.

Each sphere is pixelated with one Planck area per Bekenstein BIT, but only our future sphere is the hologram quantum computer retrocausally projecting advanced Wheeler-Feynman metric gravity 3D hologram images volume quanta of size

$$\Delta L(t) = \left( \frac{L_p^2}{\sqrt{\Lambda(t)}} \right)^{1/3} \quad (1.3)$$

In other words, the number of volume quanta  $N(t)$  in our observable universe now equals the number of pixels on our future horizon's intersection with our future light cone. I am only using the Penrose-Hawking classical causal signal rules here neglecting effects of post-quantum signal nonlocality from Bohmian sub-quantal non-equilibrium developed by Antony Valentini.<sup>5</sup>

Our future horizon radiates advanced thermal Hawking radiation back from our future along our future light cone that we detect as the dark energy zero point vacuum fluctuations primarily of virtual photons. This is the Unruh effect<sup>6</sup> of unitarily non-equivalent quantum vacua seen by locally coincident inertial and accelerating detectors. Virtual off-shell zero point boson quanta for the inertial observer are real on-shell thermal black body quanta for the accelerating static non-inertial observer. The two are connected by the Bogoliubov transformation.<sup>7</sup> Thus, for static LNIF detectors clamped to constant  $r$  with no orbital angular momentum relative to us at  $r = 0$ , our future universe is approximated by the representation of the de Sitter geometrodynamical field

$$ds^2 = \left( 1 - \frac{\Lambda r^2}{2} \right) (ct)^2 - \frac{dr^2}{\left( 1 - \frac{\Lambda r^2}{2} \right)} - r^2 d\Omega^2 \quad (1.4)$$

Each hovering static LNIF detector has covariant proper radial acceleration pointed away from us equal to<sup>vii</sup>

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<sup>5</sup> <http://eprintweb.org/S/authors/All/va/Valentini>

<sup>6</sup> [http://en.wikipedia.org/wiki/Unruh\\_effect](http://en.wikipedia.org/wiki/Unruh_effect)

<sup>7</sup> [http://en.wikipedia.org/wiki/Bogoliubov\\_transformation](http://en.wikipedia.org/wiki/Bogoliubov_transformation)

$$g(r) = \frac{c^2 \Lambda r}{\sqrt{1 - \frac{\Lambda r^2}{2}}} + c^2 \sqrt{\Lambda}$$

$$\xrightarrow{r \rightarrow 0} c^2 \sqrt{\Lambda} \sim \frac{10^{21}}{10^{28}} \sim 10^{-7} \frac{cm}{sec^2}$$

$$\xrightarrow{r \rightarrow \sqrt{\frac{2}{\Lambda}}} \infty$$
(1.5)

Note that we are not quite inertial, but are covariantly accelerating in this idealized large-scale de Sitter future to past retrocausal metric field. The advanced Wheeler-Feynman radiation we see has an absolute Kelvin temperature of

$$T_{DE} \sim \frac{\hbar c}{k_B} \sqrt{\Lambda}$$
(1.6)

Note that the black body irradiance<sup>8</sup> goes as  $T_{DE}^4$ . Here is where I stumble. I will now give an intuitive argument that is far from a rigorous one using the full machinery of Einstein's GR. The total power in advanced Wheeler-Feynman EM radiation from the spherical shell horizon focused on us at its center, in a suitable cosmic time measure is

$$\frac{dE}{dt} = \sigma \left( \frac{\hbar c}{k_B} \right)^4 \Lambda$$
(1.7)

$$\sigma = \frac{2\pi^5 k^4}{15c^2 h^3} = 5.670400 \times 10^{-8} \text{ J s}^{-1} \text{ m}^{-2} \text{ K}^{-4}$$

$$\sigma \left( \frac{\hbar c}{k_B} \right)^4 \sim c^2 \hbar \Lambda \sim \frac{10^{21} 10^{-27}}{10^{56}} \sim 10^{-62} \frac{ergs}{sec}$$
(1.8)

Is the total advanced Wheeler-Feynman real thermal photon wave field power flux impinging on us from our entire future hologram screen – *too tiny to be directly measured it seems*. Remember all of that is focused there is no spreading out since these are advanced converging Wheeler-Feynman waves back along our future light cone. The **advanced wave curved spacetime redshift** is presumably already included. In other words, a static LNIF detector, relative to us, near the intersection of our future light cone with our future spherical wall of light would see **a retarded wave curved spacetime infinite blue shift** of any retarded real photons arriving from us. Therefore, any Wheeler-

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<sup>8</sup> [http://en.wikipedia.org/wiki/Stefan-Boltzmann\\_law](http://en.wikipedia.org/wiki/Stefan-Boltzmann_law)

Feynman-Cramer transaction has no net curved spacetime frequency shift at all in a globally self-consistent Novikov loop in time. This simple consideration makes one wonder if there is not a flaw in the argument for the chronology protection conjecture that the infinite looping around a closed null geodesic gives an infinite blue shift at the moment that time travel to the past through a traversable wormhole star gate becomes possible. It seems, on general grounds, that the two half loops in any closed full loop should cancel out. I am perhaps mistaken. I am simply raising the question.

However, the Hologram Principle tells us that N Planck areas tile around our future spherical null geodesic thermal horizon membrane hologram screen. Therefore,

$$\Lambda \sim \frac{1}{NL_p^2} \sim \frac{1}{R_{Hubble}^2} \quad (1.9)$$

Einstein's gravity field equation tells us how to convert the vacuum curvature to the dark energy density using the G-string tension  $\hbar c / L_p^2$ . We therefore, get essentially the correct value of the dark energy density agreeing with Type 1a supernovae data

$$\rho_{DE} \sim \frac{\hbar c}{L_p^2 R_{Hubble}^2} \sim \frac{10^{-27} 10^{10}}{10^{-66} 10^{56}} \sim 10^{-7} \frac{ergs}{cc} \quad (1.10)$$

There is a Korean paper<sup>9</sup> also claiming that the dark energy density is Hawking radiation from the cosmic horizon. However, I am not able to follow the details of their paper and they do not seem to say that the relevant horizon is in our future not in our past.

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<sup>i</sup> [http://en.wikipedia.org/wiki/Holographic\\_principle](http://en.wikipedia.org/wiki/Holographic_principle)

<sup>ii</sup> "Can Psychological Research Bridge the Gulf Between Matter and Mind?" Bernard Carr *Proceedings of the Society for Psychical Research*, Vol 59 Part 221 June 2008

<sup>iii</sup> Sarfatti, Jack & Creon Levit (NASA AMES) 2009. "The emergence of gravity as a retro-causal post-inflation macro-quantum-coherent holographic vacuum Higgs-Goldstone field" <http://arxiv.org/pdf/0902.0032v1> "Official IOP publication list with free downloads of all the DICE 2009 papers" <http://www.iop.org/EJ/toc/1742-6596/174/1>

<sup>iv</sup> See Roger Penrose, "The Road to Reality", Sean Carroll "From Eternity to Here" and the book reviews in "None Dare Call It Reason" on <http://fourmilab.ch> by John Walker who also discusses the idea that the material universe is computed and that all objects in it including us are essentially avatars.

<sup>v</sup> [http://en.wikipedia.org/wiki/Wheeler-Feynman\\_absorber\\_theory](http://en.wikipedia.org/wiki/Wheeler-Feynman_absorber_theory)

<sup>vi</sup> [http://en.wikiquote.org/wiki/Niels\\_Bohr](http://en.wikiquote.org/wiki/Niels_Bohr)

<sup>vii</sup> This is analogous to hovering static LNIF observers outside the event horizon of a black hole. However, we are always at the dead center of our spherical cosmic future event horizon inside it not outside it. The residual acceleration  $c^2 \sqrt{\Lambda} \sim 10^{-7} cm / sec^2$  is a

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<sup>9</sup> <http://arxiv.org/pdf/0803.1987v5>

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future hologram surface effect. This number is same order as that of the NASA Pioneer Anomaly but it points in wrong direction. A small scale AdS solution, centered at Sun, rather than the large-scale future dS cosmological model of this paper would perhaps point to a cosmic hologram explanation of this local effect as well. Dark matter would correspond to exotic vacuum with more virtual fermion-antifermion loops than virtual bosons opposite to dark energy. This vacuum dark matter would clump like  $w = 0$  CDM even though the real  $w = -1$ . The LHC and other deep mine detectors would not find real dark matter particles as a matter of principle like the null aether motion result of Michelson and Morley's interferometer for the Earth.