

More is Different Emergence of Gravity and Dark Energy/Matter

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NASA WMAP

- This new data shows the existence of exotic cosmic torsion vacuum fields that account for $\sim 95\%$ of the “stuff” of the universe.
- Local control of these exotic vacuum torsion fields are of profound importance to the immediate future and survival of life in the universe.



Is Dark Matter Real?

- “Dark wind” suggests, maybe, a gas of massive real (i.e., on mass shell) neutral particles at rest in the Hubble flow.
- Nevertheless, I predict that the bulk of dark matter is not any kind of real missing on mass shell particle, but is an exotic gravitating phase of vacuum from the same zero point torsion field as anti-gravitating dark energy.



Micro-Quantize Gravity?

- V. Ambegoakar: “Is it not a rather large extrapolation to apply quantum mechanics to the universe as a whole? Is there some evidence that this is a justified or prudent assumption?”
- P.W. Anderson: “No, there is no evidence. So far [1986] there is, in fact, a disturbing absence of evidence ... It is hard to know whether the phenomenon of inflation, is to be considered as a confirmation or a further puzzle and ... there is the strange question of the cosmological constant.”



Physics Today

- The standard particle model is not as parsimonious as anyone would like with perhaps 18 “effective field” fudge factors like Ptolemy’s epicycles. They can only be explained by the *selection* effect of the *Weak Anthropic Principle* in an infinity of dynamic Hubble sphere parallel universes out of causal contact with each other on a single post-inflation bubble in an infinity of bubbles. (Max Tegmark, 2002) It is the worst theory we have except for every other! :-)



String Theory?

- Not immune from the objection of too many adhoc “epicycles”.
- Too soon to tell compared to standard gauge model of point particles, which, as shown by Frank Wilczek here at APS at low energy $\sim 10^{12}$ ev is battle-tested experimentally.



Action Principle

- Physicists can always be counted upon to do the right thing after they have exhausted every other alternative.



Darwin's Super Cosmos

- "Barring conspiracy theories where the universe is designed to fool us, the observations thus speak loud and clear: space as we know it continues far beyond the edge of our universe, teeming with galaxies, stars and planets."
- "Because of this selection effect, the answer to the question 'what is it that breathes fire into the equations and makes a universe for them to describe?' (Hawking, 1993) would then be 'you', the SAS." (Self-Aware Substructure, Max Tegmark, astro-ph/0302131 v1)



Macro-Quantum Vacuum Condensate as World Stuff

- “very direct demonstrations which seem to bring the quantum particle field almost into the ordinary tangible, macroscopic realm ... very similar to the roles ... of the classical fields, the electromagnetic and gravitational fields in our ordinary macroscopic experience” P.W. Anderson “Coherent Matter Field Phenomena in Superfluids”



“Physics is simple when it is local.” John A. Wheeler

- Micro-quantum physics is
- IT FROM BIT (Action Without Reaction)
- Nonlocal with signal locality (no cloning).
- Macro-quantum \square (zpf) vacuum physics is
- IT FROM BIT + BIT FROM IT
- Is our post-inflation accelerating universe local, but with signal nonlocality in “sub-quantal nonequilibrium” ?
- (Antony Valentini <http://arxiv.org/abs/quant-ph/0203049>)



SUBQUANTUM INFORMATION AND COMPUTATION Antony Valentini

- “It is argued that immense resources - for nonlocal communication, espionage, and parallel computation - are hidden from us by a veil of quantum noise that is not fundamental, but merely reflects the statistical properties of an equilibrium state in which the universe happens to be at the present time. It is suggested that "non-quantum" or nonequilibrium matter might exist today in the form of relic particles from the early universe. We describe how such matter could be detected and put to practical use, for superluminal signaling, for eavesdropping on quantum key distribution, and for reading all the results of a parallel quantum computation.”
<http://users.ox.ac.uk/~quee0776/valentiniabs.html>
- Change “matter” to \square (zpf).



Superconductor & World Crystal

- $\mathbf{v}_s = [(\hbar/m)\mathbf{grad} \arg\langle g|e^{-i\mathbf{g}}\rangle - (e/mc)\mathbf{A}]$
- Velocity of a Cooper pair
- $d_{\square}(x) = L_p^2[\arg\langle 0|e^{+}(x)e^{-}(x)|0\rangle - 2(e/hc)\int A_{\square}dx_{\square}],_{\square}$
- Distortion field of World Crystal.



Isn't the Dirac electron vacuum “BCS” unstable? If not, why not?

- Imagine large numbers of virtual electron-positron pairs at the edge of the Fermi sphere binding under their mutual Coulomb attraction to form the vacuum condensate $\langle 0 | e^+(x) e^-(x) | 0 \rangle$.
- The effective field action for the vacuum condensate has inflation Landau-Ginzburg “Mexican Hat” Goldstone-Higgs potential and covariant “generalized phase rigidity”.
- (P.W. Anderson’s “More is different.” in “A Career in Theoretical Physics”, World Scientific)



Goldstone Phase -> Gravity

IR $U(1)_{em}$ Toy Model

- ODLRO c-number emergent metric $\langle g_{\alpha\beta}(x) \rangle = \delta_{\alpha\beta} + (L_p^2/2) \{D_{\alpha,\beta} + D_{\beta,\alpha}\} [\arg \langle 0 | e^+(x) e^-(x) | 0 \rangle - (2e/hc) \int A_\alpha dx^\alpha]$
- = strain tensor of Hagen Kleinert's "world crystal" precipitate
<http://www.physik.fu-berlin.de/~kleinert/>
- $L_p^2 = hG/c^3 =$ Bekenstein BIT (IT FROM BIT)
- $L_p \rightarrow L_p^* = L_p^{2/3} L^{1/3}$ at scale L if Susskind's "World Hologram", $L_p^* \sim 1$ fermi if $L \sim c/H \sim 10^{28}$ cm
- $D_\mu = \partial_\mu - (2e/hc)A_\mu$ is $U(1)_{em}$ Josephson gauge covariant derivative for IR limit of model. Note that $D_{u,v}$ is ordinary partial derivative followed by a gauge covariant derivative.



Exotic Macro QM Vacuum

- $\rho + 3p$ is source of gravity in Einstein's GR
- $\rho(\text{zpf}) + p(\text{zpf}) = 0$
- $\rho(\text{zpf}) = \rho(\text{zpf}) > 0$ spin 1 virtual photons
- $\rho(\text{zpf}) < 0$ spin 1/2 virtual electron-positron pairs
- When $\langle 0 | e^+(x) e^-(x) | 0 \rangle = 0$
- $|\rho(\text{zpf})| \sim 1/L_p^2 \gg |\rho(\text{obs})| \sim (H/c)^2$
- “zpf” here is from spin 1/2 and spin 1 quantum fields.



Two Fluid Model

$$\rho(zpf) = L_p^{-2} [1 - L_p^3 | \langle 0 | e^+(x) e^-(x) | 0 \rangle |^2]$$

- G.E. Volovik (Landau Institute, gr-qc/0302069) argues from condensed matter physics analogy of phonons in a real 3D crystal that the equilibrium vacuum of Kleinert's 4D "world crystal" has $\rho(zpf) = 0$ from "trans-Planckian" physics inside the unit cell, i.e. $p(zpf)_{\text{equil}} = 0$



Dark Energy/Matter

- □(zpf)_{eq} = 0 non-gravitating vacuum
- □(zpf) > 0 is anti-gravitating “dark energy”
~ 66% of stuff of the world
- □(zpf) < 0 is gravitating “dark matter” ~ 30%
of stuff of the world.



Einstein's Local Field Equation

- $\langle G_{\mu\nu} \rangle + \lambda(\text{zpf}) \langle g_{\mu\nu} \rangle = -(8\pi G/c^4) \langle T_{\mu\nu} \rangle$
- $\langle G_{\mu\nu} \rangle_{; \rho} + \lambda(\text{zpf})_{; \rho} \langle g_{\mu\nu} \rangle = -(8\pi G/c^4) \langle T_{\mu\nu} \rangle_{; \rho}$
- $\langle G_{\mu\nu} \rangle_{; \rho} = 0$ *zero torsion* Bianchi identities
- $\lambda(\text{zpf})$ is constant and uniform in vacuum defined as $\langle T_{\mu\nu} \rangle = 0$.
- $\langle G_{\mu\nu} \rangle_{; \rho} \neq 0$ non-zero torsion allows variable $\lambda(\text{zpf})$ in vacuum as now observed in NASA WMAP.



Curvature and Torsion

- Curvature and torsion are physically *anholonomic* “vortex line” singularities in the *local* macro-quantum vacuum Goldstone phase field $\langle 0 | e^{+i\phi(x)} e^{-i\phi(x)} | 0 \rangle$ of *disclination* and *dislocation* respectively in the Kleinert world elastic-plastic 4D crystal lattice.
- Torsion formally is the antisymmetric Diff(4) third rank tensor $S^{\alpha\beta\gamma}$ added to the symmetric connection parallel transport field $\Gamma^{\alpha}_{\beta\gamma}$ in Einstein's GR.



Dark Energy/Matter Λ (zpf) is the Torsion Field Potential

- $S_{\mu\nu} = \int_{\mu\nu} S_{\mu\nu}$
- $S^{\mu\nu} = L_p^2 \Lambda(\text{zpf})_{\mu\nu} \langle g_{\mu\nu} \rangle$
- $\int_{\mu\nu} = L_p^2 (D_{\mu,\nu} - D_{\nu,\mu}) \{ \arg \langle 0 | e^{+(x)} e^{-(x)} | 0 \rangle - (2e/hc) \int A_{\mu} dx^{\mu} \}$
- $S^{\mu\nu} = (\delta^{\mu\nu} - (2e/hc) A^{\mu}) \int_{\mu\nu} ?$
- Note the electromagnetic field-torsion field coupling via the 4-potential.



Metric Engineering the Vacuum?

- Set $\langle T_{\mu\nu}(x) \rangle = 0$ in “vacuum”
- Assume torsion $\neq 0$ as now observed in WMAP.
- $\langle G_{\mu\nu} \rangle + \square(zpf) \langle g_{\mu\nu} \rangle = 0$
- Control *variable local* $\square(zpf)$ via Bohm-Aharonov and Berry phase modulation in Josephson weak link of real superconductor $\langle g | e^{-\int dx e^+(x) e^-(x)} | g \rangle$ with macro-quantum vacuum $\langle 0 | e^+(x) e^-(x) | 0 \rangle$ in covariant nonlinear Landau-Ginzburg partial differential equation?



Landau-Ginzburg Equation

- $\{ (\partial_\mu - (2e/hc)A^\mu) (\partial_\mu - (2e/hc)A_\mu) + M^2 + \lambda |\langle 0|e^+e^-|0\rangle|^2 \} \langle 0|e^+e^-|0\rangle = 0$
- $M^2 < 0, \lambda > 0$ is “More is different” spontaneous broken ground state symmetry in the generic Goldstone-Higgs condensate Mexican Hat Potential
- ∂_μ is Diff(4) covariant derivative
- L-G eq is BIT FROM IT



Macro-QM Vacuum Weak Link?

- $$\{(\hbar^2 - (2e/\hbar c)A^\mu)(\hbar^2 - (2e/\hbar c)A_\mu) + M^2 + \hbar^2 [\langle 0|e^+e^-|0\rangle + \langle g|e^-e^-|g\rangle^2]\} [\langle 0|e^+e^-|0\rangle + \langle g|e^-e^-|g\rangle] = 0$$
- C3 warp drive* modulation cross term is
- $$\sim | \langle 0|e^+e^-|0\rangle | | \langle g|e^-e^-|g\rangle | \cos[\arg \langle 0|e^+e^-|0\rangle - \arg \langle g|e^-e^-|g\rangle] + \hbar^2_{\text{magnetic}} + \hbar^2_{\text{Berry}} + \hbar^2_{\text{Lense-Thirring}} + ?]$$



In the Heart of Dark Matter Apocalypse Now?

- “Why not go to a lower vacuum here and now? ... It was a very frightening experience which I had when I first thought about these bubbles ... I really shivered ... I told Andrei Sakharov about these bubbles. I vividly remember his reaction. He said: ‘Such theoretical work should be forbidden. It’s too dangerous.’”
- Lev. B. Okun hep-ph/0112032



This lecture is online

- <http://qedcorp.com/APS/Austin.pdf>
- My books “Destiny Matrix” and “Space-Time and Beyond II” are at
- <http://www.1stbooks.com>
- Website is at <http://stardrive.org>

