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A P-brane Solution to Three Cosmological Puzzles

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Abstract: I will show that P-brane model, first employed by Hawking and others to explain blackhole Hawking radiation, may, when applied to the Zero Point Frame explain three cosmological puzzles at the same time.
Keywords: P-brane, blackhole, general relativity, clock simultaneity.

Introduction

In general relativity black holes are classical solutions with a region of space-time which is causally disconnected from the asymptotic region. The boundary of such a region is called the event horizon. No physical signal can travel from a point inside the event horizon to a point outside. An observer who is sitting outside can never 'see'' the interior of the horizon. According to her clocks, an inwardly falling object takes an infinite amount of time to reach the horizon; as it approaches the horizon, it slows down and never quite makes it to the horizon. This is because of an effect called the gravitational red shift. Clocks stationed at different points in a gravitational field run at different rates: Generally a clock will appear to run slower as observed by someone who is at a location where the metric components are weaker than that at the location of the clock. As a result, if some physical process emits light at some frequency, it will appear to have a much lower frequency when detected at a position with much smaller metric components, so that there is a redshift. At the horizon, this redshift is infinitely large.

The infinite redshift might give the impression that the gravitational fields at the horizon must be infinitely large. This is not true. For a very massive black hole, local gravitational fields are very weak at the horizon. In fact for a neutral spherically symmetric black hole of mass M in four space-time dimensions, the magnitude of the space-time curvature, $|R|$ (which is the measure of the strength of the gravitational field) at a distance r from the center scales as

$$|R| \sim \frac{M}{r^3}. \tag{1.1}$$

For such a black hole, the radius of the horizon is proportional to M, so that the curvature at the horizon scales as $1/M^2$ and can become arbitrarily small for large M.

At the zero point we encounter a similar effect. At this scale we have a loss of our ability to measure events. Again, referring to the clock idea. Outside of the zero point we have motion of time as determined by our clock. At the zero point we have no information forthcoming from our clock. It's as if the clock has ceased to exist at this scale, irrespective of where the particle-wave we are measuring moves to next. From this we deduce that these particle-waves are broken into quanta.

In 1974 Hawking[1] made a remarkable discovery, he showed that due to quantum effects a black hole is not really black. Rather, it emits a steady stream of particles of all kinds, with a spectrum which is approximately thermal at late times. There is a heuristic way of understanding this process. Due to quantum fluctuations, pairs of particles are always created in a vacuum. Normally they would annihilate quickly. Consider, however, such a process occurring near the horizon of a black hole: in this case, one member of the pair can go inside the black hole – never to come out again; the other member can fly off to infinity. Since the actual state of the particle which went in cannot be measured by an observer sitting far away, he/she would average over these states and this would result in a mixed state. The nontrivial fact being, essentially due to the large redshift at the horizon, that the resulting spectrum is thermal. This radiation is called Hawking radiation.

Because of its thermal nature, one can associate standard thermodynamic properties to a black hole. Remarkably, these properties are rather universal in nature and related to geometric properties of the black hole space-time. The black hole entropy – called Beckenstein-Hawking entropy, S_{BH} – has a leading contribution given, in units h = c = 1, by

$$S_{\mathrm{BH}} = \frac{A_{\mathrm{H}}}{4G}, \tag{1.2}$$

where A_{H} is the area of the horizon and G is the Newton's gravitational constant. This gave a rationale for an earlier conjecture by Beckenstein[2] that one should assign an entropy to a black hole to avoid violations of the second law of thermodynamics, and that entropy should be the horizon area. For all kinds of black holes in all possible number of space-time dimensions, this is the leading result for large black holes.

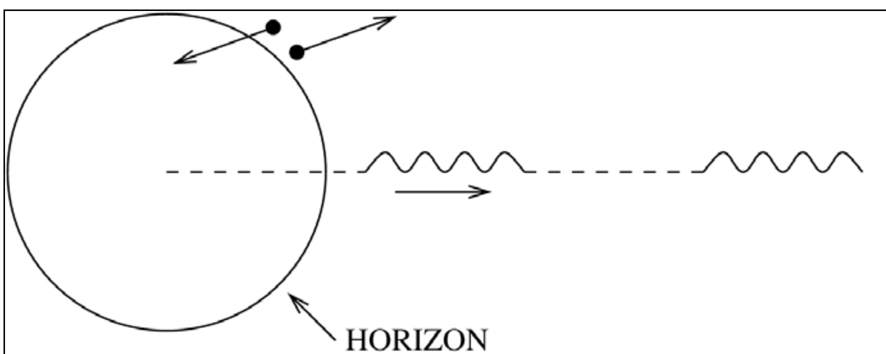

Fig 1 : Redshift and Hawking radiation by pair creation at horizon

The Zero Point Frame Solution

(Particle used in this example is a photon. Actual local motion of ZPF is always double the particles own velocity.)

Hawking's solution to how information going into a blackhole can come out may well apply to the zero point as well. Basically, the particle is considered an open string intersecting the P-brane in the M-Theory model of blackhole states.   As that particle intersects it creates a vibration along the P-brane itself.   This vibration becomes strong enough that it causes a section of the P-brane to break off.   That broken off bit of the P-brane becomes a closed string and, thus, carries the information away that was stored on the P-brane.   If we consider the zero point as the p-brane of this universe then as our particle-wave collapses between cycles upon hitting the zero point it would cause a similar effect on this world brane.   We get information being carried forward from a state we cannot measure in the form of a broken off bit of the world brane. The break off point would be nearly that of the entry position minus the gap in time involved in the zero state itself. If we consider that gap, one Plank unit, then the exist point will be one plank unit removed.

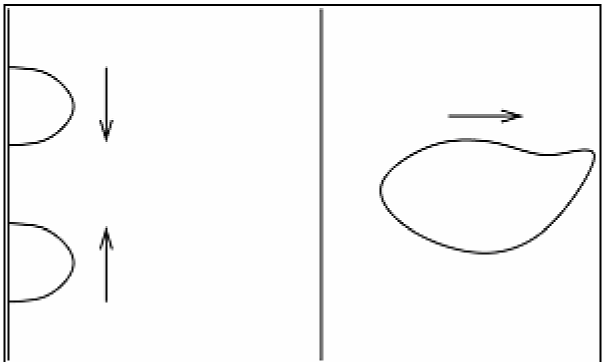

Fig 2 : Hawking radiation mechanism

Now since particles are in motion in all directions this would imply that our background reference frame is in motion itself in all directions irrespective of the particle involved own motion. That being the case, then there is no way to pinpoint our own motion against this backdrop field. However, if we consider for a model, that this field is moving outward 1 plank unit ahead of any motion in our world volume space-time, which would make the field moving no less than 2C, then we can begin to pin its motion down.   That motion would be 2C in all directions at the same time irrespective of our relative motion through that field.   Everything then, as far as motion in our world volume would appear Lorentz Invariant following the model set forth in SR. But motion at the zero point, though still obeying a modified version of Lorentz Invariance would appear to our world volume to be near infinite. The reason for this is the lack of our ability to properly measure time there.

Answer to Some Cosmological Problems

But this brings up two important questions. One relates to Inflation during the start of creation and the other to the accelerated expansion issue. The basic idea behind inflation, especially in conjunction with the mass mechanism of the Higg's field, is that some symmetry is broken wherever a given scalar field ϕ has a non-vanishing value, so the dimensionality of the corresponding topological defect depends on the number of components of the scalar field: for a single-component real scalar field, $\phi(\vec{r}) = 0$ defines a two-dimensional surface in three-dimensional space, a *domain wall*; for a complex scalar field, the real and imaginary parts of $\phi(\vec{r}) = 0$ define a one-dimensional locus, a *cosmic string*; for a three-component (e.g., isovector) field, $\phi_i(\vec{r}) = 0$ for $i = 1, 2, 3$ is satisfied at isolated points, *monopoles*; for more than three components, one gets *textures* that are not topologically stable but which can seed structure in the universe as they unwind.

To see how this works in more detail, consider a cosmic string. For the underlying field theory to permit cosmic strings, we need to couple a complex scalar field ϕ to a single-component (i.e., $U(1)$) gauge field A_α, like the electromagnetic field, in the usual way via the substitution $\partial_\alpha \to D_\alpha = (\partial_\alpha - ie A_\alpha)$, so that the scalar field derivative term in the Lagrangian becomes $\mathscr{L}_D\phi = |D_\alpha \phi|^2$. Then if the scalar field ϕ gets a non-zero value by the usual Higgs ``spontaneous symmetry breaking" mechanism, the gauge symmetry is broken because the field has a definite complex phase. But along a string where $\phi = 0$ the symmetry is restored. As one circles around the string at any point on it, the complex phase of $\phi(\vec{r})$ in general makes one, or possibly $n > 1$, complete circles $0 \to 2n\pi$. But since such a phase rotation can be removed at large distance from the string by a gauge transformation of ϕ and A_α, the energy density associated with this behavior of $\phi \mathscr{L}_D\phi \to 0$ at large distances, and therefore the energy μ per unit length of string is finite. Since it would require an infinite amount of energy to unwind the phase of ϕ at infinity, however, the string is topologically stable. If the field theory describing the early universe includes a $U(1)$ gauge field and associated complex Higgs field ϕ, a rather high density of such cosmic strings will form when the string field ϕ acquires its nonzero value and breaks the $U(1)$ symmetry. This happens because there is no way for the phase of ϕ to be aligned in causally disconnected regions, and it is geometrically fairly likely that the phases will actually wrap around as required for a string to go through a given region(1).

But what if the local shifting ahead of the ZPF provided that mechanism so that the phase of ϕ would be aligned in causally disconnected regions. Its step ahead motion and the fact that entanglement exists at this level would go a long way to explaining why we have so few cosmic strings. Thus, this moving background zero point frame could be the reason why we find just enough of the parameter μ, usually quoted in the dimensionless form $G\mu$ (where G is Newton's constant), as the key parameter of the theory of cosmic strings. The value required for the COBE normalization is $G\mu_6 = G\mu \times 10^6 = 1\text{-}2$ (recent determinations include $G\mu_6 = 1.7 \pm 0.7$(2), and ($1.05_{-0.20}^{+0.35}$), putting this so fine tuned, that it is close enough to the value required for structure formation, $G\mu = (2.2\text{-}2.8)\, b_8^{-1} \times 10^{-6}$(3).

But even if this mechanism might provide an answer there we still have to answer how the accelerated expansion comes about. For this we need to examine the evolution of the Cosmos over time.

In the early stages of its evolution the universe had clusters of matter far closer together. The local energy excitation of the ZPF would have been higher then, than now. Going back to the P-brane derived model of our world volume the local ZPF would have had more natural movement of particles through it that tend to wash out the overall movement of the frame and would have displayed a higher count of virtual particles and P-branes breaking off from it. The result is the Stress Energy Tensor locally should have been higher during this period. As the Universe expanded the reverse would have become true. This would have resulted in a lowering of the ZPF field's natural energy baseline over time. In the larger voids of intergalactic space the local ZPF would begin to go below the vacuum baseline as we judge it locally, and with the induction of naturally occurring negative energy we'd have the workings of an inflation driving mechanism. The result would be that these void areas begin to expand and grow in size with the end effect being an overall accelerated expansion.

One side effect of this, one that may show up in observations is that the value of C should alter over intergalactic distances. Granted, we look back in time so to speak as we make observations. But somewhere between the past and the present we'd detect what amounts to a change in the velocity of light. Any change in that velocity, even if its caused by a region closer to our present era would be detected and we'd be unable to determine if its coming from the far past or the near present. We'd just have an odd reading to account for which is exactly what our observations have detected at the present(4).

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