Re: Time dilation and expanding space

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- *From*: "Robert Karl Stonjek" <stonjek@xxxxxxxxxxxxxx>
- *Date*: Thu, 08 Mar 2007 07:59:38 GMT

"N:dlzc D:aol T:com (dlzc)" <dlzc@xxxxxxx> wrote in message
news:_KrHh.13536$Xk.1217@xxxxxxxxxxxxxxx

> Dear Robert Karl Stonjek:
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> "Robert Karl Stonjek" <stonjek@xxxxxxxxxxxxxx> wrote in message
> news:pjqHh.8145$8U4.4892@xxxxxxxxxxxxxxxxxxxxxxxxxxxxx
>
> > > > GR Specifically models the effect that gravity has on the motion of objects as they pass through a gravitational field − the curvature of spacetime. That is where GR is in its element. But if we just want to know about how a Black Hole is different from, say, a planet then there are several ways of modelling that.
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> > > > No discipline can model the evolution of a black hole from a star than quantum mechanics. Special relativity plays a secondary role and general relativity a tertiary role in the QM description of the evolution of Black Holes.
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> > > Since there is no gravitation, time, or space in QM... I'd be fascinated in how you think QM describes any such "evolution".
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> > As a star collapses it goes through a phase where it becomes a neutron star − well described in QM. Further collapse is also a quantum phenomena.

> Actually no. There is no quantum state (short of the magic singularity) that can withstand additional pressure, which is then no longer quantum.

I'll deal with this issue separately. Here is a quote from John Wheeler:−

"Others had thought about these questions before me. Back in the 1930s, Fritz Zwicky of Caltech had postulated neutron stars; Subrahmanyan Chan−drasekhar, then at Cambridge University, had calculated the largest mass of a white dwarf that could withstand the crushing imperative of gravity; and Robert Oppenheimer with George Volkoff and Hartland Snyder at Berkeley had discussed the collapse of heavy stars. But much more remained to be learned about the ultimate fate of stars of all sizes. What they do depends on whether they are small, medium, large, or extra large. I set some of my good students to work on questions of stellar death, and they came up with answers. By 1958, Kent Harrison, Masami Wakano, and I had learned something about three conceivable ultimate fates of burned−out stars. A star like our own Sun, we reckoned, would shrink to become a white dwarf. There is nothing extreme about a white dwarf. It is small, but not terribly small; dense, but not terribly dense. Spacetime is "flat" within it (that is, relativity plays no special role), and the atoms in its core remain atoms.
A second fate awaits more massive stars. Stirling Colgate, an energetic weapons scientist turned astrophysicist, used the increasingly powerful computers becoming available in the late 1950s at Livermore Laboratory to trace the final stages of a star appreciably more massive than the Sun. His calculations showed that such a star becomes a supernova. Its calculated properties matched observed properties of supernovas that astronomers had seen from time to time in other galaxies. (In July 1054, Chinese astronomers had seen an outburst that was, in fact, a supernova in our own galaxy. Its residue, the Crab Nebula, remains an object of great interest.)

A supernova is a star that both collapses and explodes. The energy released by its collapse powers the explosion of its outer layers. Left behind, according to theory, is an object far smaller and denser than a white dwarf. It is called a neutron star because it is literally one giant nucleus made up of neutrons. Its atoms have been crushed out of existence, with their electrons and protons forced by the extreme gravity to unite, becoming neutrons. What Wakano's calculations showed is that the neutron star, within a certain range of size and density, is a stable object. Like the much larger white dwarf, it is a possible end state of a burned−out star. The white dwarf and the neutron star last indefinitely, unable to release more energy and not inclined to shrink further. A stable neutron star, we calculated, would have a diameter of only about 15 miles and a density a million billion times that of our Sun. Its mass would be comparable to that of the Sun, at most about 2 solar masses.

When we reported this work in 1958, the neutron star was still a theoretical object. It would be another decade before Antony Hewish and Jocelyn Bell in England would report the discovery of pulsars −quickly identified as rotating neutron stars. Then we could bolster our belief in these astronomical oddities with real observational evidence. Today we know that at the center of the Crab Nebula, exactly where the sky brightened so dramatically in July 1054, sits a neutron star, blinking at us 30 times per second as it spins on its axis.

The third possible fate of a dead star is the most dramatic. We are convinced now that if a star is massive enough, it will neither contract gently to a final state as a white dwarf nor transform itself into a neutron−star nugget after exploding as a supernova. It will collapse to a point of infinite or near−infinite density from which neither light nor anything else can escape. Only its gravitational aura will remain.

For some years this idea of collapse to what we now call a black hole went against my grain. I just didn't like it. I tried my hardest to find a way out, to avoid compulsory implosion of great masses. At first I thought that a collapsing star might radiate so much light and throw off so much matter in the early stages of its contraction that its mass would shrink below the value needed to keep the collapse going. It would stop contracting as it became a white dwarf or neutron star. Before long we learned that this mechanism won't save the day for a star of great mass. So I looked to elementary−particle interactions for salvation. Is it possible, I asked, that repulsive forces between particles can prevent the particles from being squeezed to densities much greater than the density of an atomic nucleus? In due course we learned that this mechanism won't save the day either. The enormous pressure that builds within collapsing matter actually adds to the mass of the material and contributes more to the gravity that is driving the collapse inward than to the outward forces that would stop the collapse.

At this point in the evolution of my thinking (the early 1960s), I realized that nothing could prevent a large−enough chunk of cold matter from collapsing to a dimension smaller than the "Schwarzschild radius." Within a sphere of this radius, everything, including light, is trapped. The surface of this sphere defines what we call the "horizon," the boundary of a black hole. Yet I could still entertain the idea that within the black hole, "new physics" stops the collapse short of a mathematical point of infinite density. In 1964, Roger Penrose offered a powerful theorem showing that such new physics would have to be new indeed, for his theorem establishes that, for just about any description of matter that anyone has imagined, a singularity must sit at the center of a black hole.

Where I stand now is to imagine that the yet−to−be−discovered true blending of the quantum with general relativity will indeed provide that new physics, operating at the "Planck scale," the incredibly small dimension where quantum foam makes its appearance, and that the core of a black hole will prove to have some structure, albeit tiny beyond all imagining."

From 'Geons, Black Holes & Quantum Foam', P293~295.

I have read the about the quantum mechanical processes that force the electon into the proton to form neurtons. There are process with names like 'confinement principle' (I don't recall exactly) and there are several steps, described by quantum mechanics. Wheeler, a virtuouso General Relativity scientist, blieves that Quantum mechanics is needed to describe the singularity and I concur with his view. Of course there is currently no such description beyond the neutron star stage (I think).

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Kind Regards
Robert Karl Stonjek

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