

Re: What causes time dilation?

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From: Old Man (nomail_at_nomail.net)

Date: 08/30/04

Date: Sun, 29 Aug 2004 20:08:25 -0500

"Edward Green" <spamspamspam3@netzero.com> wrote in message
news:eca320d0.0408290353.6b821f59@posting.google.com...
> "Old Man" <nomail@nomail.net> wrote in message
news:<FuGdnVs954KCCrPcRVn-pw@prairiewave.com>...
> > "hunkahunkaburninluv" <some@where.come> wrote in message
> > news:2p75lgFhs9v9U1@uni-berlin.de...
> > > First, I am not a physicist. I do desktop publishing as a profession,
but
> > am
> > > an avid sci-fi reader.
> > >
> > > Two related questions. What causes time to slow down as a ship
approaches
> > > the speed of light? Is there any possibility that we could create the
> > effect
> > > on a stationary object? Imagine a room in which time was slowed down
to
> > say
> > > 1% normal. One year might in it might equal 100 years.
> > >
> > > Sure you can do that by modification of the space-time
> > metric, that is, by increasing the curvature of space, for
> > some limited region of space. For, example, see to it
> > that the gravitational field is increased in that special
> > room of yours.
> > >
> > > Actually, a field isn't required. All you need is a huge
> > amount of gradient-free, negative gravitational potential.
> > > You can do that by constructing a massive spherical
> > shell about yourself. Then, through peepholes in the
> > shell, you can watch time fly by on the shell's outer
> > surface, all in weightless comfort.
> > >
> > > That's a very cute idea, Old Man.
> > >
> > > You could use that as a refrigerator: Say your peach is ripe. You
> > just pop it in your massive spherical shell, and, a week later, when

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- > you want to eat it, you take it out, a few minutes older. Better than
- > a refrigerator.
- >
- > I wonder somewhat about the physics of watching time fly by, though.
- > If a some light at frequency f came down your peephole, would its
- > frequency on receipt be slowed by the same factor?
- >
- > No, I guess that's not so: light climbing out of a gravity well is
- > red-shifted -- i.e., *_not_* speeded up to the frequencies we would
- > expect for its particular spectral transmission. It carries the
- > stigmata of its slow birth. So I guess the reverse is true, and light
- > falling in would be blue shifted to the internal observer. Which does
- > solve a queueing problem for all the light which would otherwise be
- > waiting around to fall in your peephole. Not to mention the even more
- > significant precognition problem for light climbing out.
- >
- >> However, for a large factor in time-rates between you
- >> and those on the surface, the people on the surface
- >> would be living (?) in a huge gravitational field. So, lets
- >> put them out in space, almost an infinite distance away.
- >> Then the ratio in time rates between you and them is
- >> given by
- >>
- >> $\Delta t(\text{you}) / \Delta t(\text{them}) = \sqrt{1 - 2M / R c^2}$
- >>
- >> where M and R are the mass and radius of the shell,
- >> and G is the universal gravitational constant. Note that
- >> your time approaches zero (their time approaches infinity)
- >> as the mass of the shell, M , approaches that of a black-
- >> hole of radius, R , but everyone lives in free-fall comfort.
- >>
- >> See: "Gravity: An Introduction to ..." by J.B. Hartle
- >> ISBN 0-8053-8662-9
- >
- > Should be banned by the GR technicians, of that is an example of its
- > teachings: it was clearly comprehensible! :-)
- >
- > (P.S. He asked about kinematic time dilation, not gravitational. But
- > yours was a lovely answer anyway ;-).

Hartle's book is pretty neat. Rather than plowing through the GTR formalism, he provides conceptual shortcuts via the space-time metric and 4-vector length invariance.

[Old Man]