Re: where does newtons laws fail

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- *From*: markwh04@xxxxxxxxx
- *Date*: Wed, 21 Sep 2005 20:54:10 +0000 (UTC)

jaan wrote:
> iam really searching for the answer where does newtons laws fail.

The infrastructure underlying Newton's Laws fails −− that is: the structure of its spacetime.

Use the word "event" in the following to denote that which is characterized by a position and time −− a point−instant.

Newton's laws presume a spacetime amongst whose features includes the following ones of significance:

* Spacetime has the form of a sequence of 3−dimensional snapshots, each representing "space" at a given "time"

* The past of any event is ALL of space on all the snapshots preceding that which the event lies on

* The future of any event is ALL of space on all the snapshots preceding that which the event lies on

* A hypothetical object travelling at an infinite speed in one frame of reference would be doing so in all frames of reference. Infinity is an invariant speed. All finite speeds are relative.

* To say the same thing another way: two events simultaneous in one frame of reference are simultaneous in all frames of reference.

* To say the same thing a third way: for a given event, the neither−past−nor−future of the event comprises a 3−dimensional space −− namely, the snapshot the event lies on.

* To say the same thing a fourth way: if A, B, C are events and A is neither past nor future of B, B is neither past nor future of C, then A is neither past nor future of C.

The contrast to Relativity is this:
* The past of any event is a sphere (and its inside) that contracts down at light speed to the event, itself −− the past light cone of the

event.

* The future of the event is a sphere (and its inside) that expands at
light speed from the event, itself −− the future light cone of the
event.

* The invariant speed is FINITE. Not all finite speeds are relative,
which makes the name "Relativity" of the theory entirely inappropriate,
as Einstein pointed out early on.

* Infinity is NOT an invariant speed, it's relative.

* The neither−past−nor−future of a given event is a FOUR dimensional
continuum −− namely the outside of the past and future light cones of
the event.

* It is possible for A, B, C to be events with A neither before nor
after
B, B neither before nor after C, but A before C. (Example: A = the
Earth at a specific time, C = the Earth 1 second later; B = the Moon at
one of a specific range of times within the approximate 2 second window
of its existence that lies outside the light cones of A and C).

The two spacetimes are known, respectively, as Galilean and Minkowski
spacetime.

In the process of trying to retrofit Newton's Laws to Minkowski
spacetime, this forces the concepts of energy and momentum to be
unified into a single entity −− the 4−momentum. The law of inertia has
to be suitably modified and extended; with the additional condition
that a quantity, U, of energy must be associated with a mass equal to
U/c^2, where c is light speed.

In Newtonian spacetime, the two separate concepts of kinetic energy
(Lagrangian and Hamiltonian) for a body are equal, the equivalence
expressed by $L = H$; where L and H are related by the Legendre transform
$H = pv - L$, and the momentum and velocity by the relation $p = mv$.

This implies that $L = mv^2/2$; $H = p^2/2m$.

In Relativity, these two concepts split. The Hamiltonian is larger
than the Lagrangian, since it also includes the contribution provided
by the mass equivalent of the total energy of the Hamiltonian, itself.
So, they lie in a ratio, $H/(m + H/c^2) = L/m$, where m is the rest mass
of the body.

Likewise, the momentum carries this additional contribution: $p = (m + H/c^2) v$.

Since L and H are related by the Legendre transform, $H = pv - L$, this
implies that

H/(m + H/c^2) = L/m; L = (m + H/c^2)v^2 − H
whose solution is
L = mv^2/(1 + (1 − (v/c)^2)^{1/2})
= mc^2 − mc^2 (1 − (v/c)^2)^{1/2}

H = p^2/((p/c)^2 + m^2)^{1/2} + m)
= mc^2/(1 − (v/c)^2)^{1/2} − mc^2.
So, it's natural to identify mc^2 as the rest energy of the body and
equate the total kinetic energy to H + mc^2, which is
E = H + mc^2 = mc^2/(1 − (v/c)^2)^{1/2}.
The momentum is thus
p = mv/(1 − (v/c)^2)^{1/2}
and (E, p) form the components of the momentum 4−vector.

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- ***Follow−Ups***:
  - ***Re: where does newtons laws fail***
    - *From:* Harry

- ***References***:
  - ***where does newtons laws fail***
    - *From:* jaan

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