OPEN AND SOLVED ELEMENTARY QUESTIONS IN ASTRONOMY

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Student:
1) Let's consider a tunnel getting from a side to the other side of the Earth, and passing through the center of the Earth.

a) If one drops an object in the tunnel, will the object stop at the center of the Earth, or will oscillate like a pendulum about the center, up and down, and after a while will stop?
Will then the object float in the center?

Instructor:
Yes, we solved this problem in school using methods of Classical Mechanics.

Student:
b) If an elevator is freely left down in the tunnel, how much force would be necessary to push it up (especially from the Earth center) to the second side of the Earth?
Isn't any inertial force, from the falling force that might push the elevator beyond the Earth center towards the other side?

Instructor:
No. It is school problem too. Inertial forces will act on a body if only this body will be linked to this inertial field. Not this case.

Student:
c) Suppose the second side of the tunnel gets in the bottom of an ocean. Will the water flow down into the tunnel only up to the center of the Earth, or even lower near to the first side (to compensate/equilibrate somehow, about the Earth center, the water masses from both sides of the Earth center), or even will flood out the first side?

Instructor:
The water will oscillate like a pendulum in the first question.
Then the water will fill only ½ of the tunnel, so that part which is between the Earth centre and the ocean. If ocean is located at both sides of the tunnel, the tunnel will be highly full.

Student:
d) The above three questions for the case when the tunnel gets from a side to another side of the Earth, but doesn't pass through the Earth center. Would the midpoint of the tunnel play a similar role as the Earth center in the above three questions?

Instructor:
Yes, of course.

Student:
e) How will Coriolis force influence this?

Instructor:
Very little. The force of gravity is greater.

Student:
2) Is it possible to accelerate a photon (or another particle traveling at, say, 0.99c) and thus to get speed greater than c?

Instructor:
This is "double-question", linked to "no-speed-barrier" thesis. I mean it follows. General Relativity is the theory on **observable quantities**. **Absolute quantities** are also presented there - **absolute rotation** and **the deformation of the space**. This is well-known fact.
So, I think, you can accelerate a particle at 0.99c (where c = speed of light) and then more and more, but its observable motion
will asymptotically close to the light velocity anyway. The below is citation from Rabounski-Borissova's book "Particles here and beyond the mirror", for understanding this problem. They called it the **Blind Pilot Principle**:

"…We can outline a few types of frames of reference which may exist in General Relativity space-time. Particles (including the observer themselves), which travel at sub-light speed ("inside" the light cone), bear real relativistic mass. In other words, the particles, the body of reference and the observer are in the state of matter commonly referred to as "substance". Therefore any observer whose frame of reference is described by such monad will be referred to as *sub-light speed* (substantional) *observer*."

Particles and the observer that travel at the speed of light (i.e. over the surface of light hyper-cone) bear $m_0=0$ but their relativistic mass (mass of motion) $m \neq 0$. They are in light-like state of matter. Hence we will call an observer whose frame of reference is characterized by such monad a *light-like observer*.

Accordingly, we will call particles and the observer that travel at super-light speed *super-light particles and observer*. They are in the state of matter for which $m_0 \neq 0$ but their relativistic mass is imaginary.

It is intuitively clear who a sub-light speed observer is, the term requires no further explanations. Same more or less applies to light-like observer.

From the point of view of light-like observer, the world around looks like colorful system of light waves. But who is a super-light observer? To understand this let us give an example.

Imagine a new supersonic jet plane to be commissioned into operation. All members of the commission are inborn blind. And so is the pilot. Thus we may assume that all information about the surrounding world the pilot and the members of the commission gain from sound that is from transversal waves in air. It is sound waves that build a picture that those people will perceive as their “real world".

Now the plane took off and began to accelerate. As long as its speed is less than the speed of sound, the blind members of the commission will match its ``heard" position in the sky to the one we can see. But once the sound barrier is overcome, everything changes. Blind members of the commission will still perceive the speed of the plane equal to the speed of sound regardless to its real speed. For the speed of propagation of sound waves in the air will be the *maximum speed of propagation of information* while the real supersonic jet plane will be beyond their ``real world" in the world of ``imaginary objects" and all its properties will be imaginary too.
The blind pilot will hear nothing as well. Not a single sound will reach him from the past reality and only local sounds from the cockpit (which also travels at the supersonic speed) will break the silence. Once the speed of sound is overcome, the blind pilot leaves the subsonic world for a new supersonic one. From his new viewpoint (supersonic frame of reference) the old subsonic fixed world tat contains the airport and the members of the commission will simply disappear to become an area of “imaginary values".

What is light? Transversal waves that run across a certain medium at a constant speed. We perceive the world around through sight, receiving light waves from other objects. It is waves of light that build our picture of the “true real world".

Now imagine a spaceship that accelerates faster and faster to eventually overcome the light barrier at still growing speed. From pure mathematical viewpoint this is quite possible in the space-time of General Relativity.
For us the speed of the spaceship will be still equal to the speed of light whatever its real speed is. For us the speed of light will be the maximum speed of propagation of information and the real spaceship for us will stay in another “unreal" world of super-light speeds where all properties are imaginary. The same is true for the spaceship's pilot. From his viewpoint having the light barrier overcome brings him into a new super-light world that becomes his “true reality". And the old world of sub-light speeds is gone to the area of “imaginary reality".

Student:
3) Would ever be possible to construct a flexible bridge between two planets and thus have "terrestrial" traffic between them? I mean what about gravity field of each planet (how to smoothly escape from one field and smoothly enter into the other filed)?
Another difficulty would be that planets are moving…

Instructor:
Yes, of course. Similar projects were developed from 1960’s. I mean Space Bridge or Space Lift, which will link the Earth surface and a satellite in a geostationary orbit (which is located over the

same point of the terrestrial equator) A cabin in such lift, moving upstairs, will be partially moved by inertial force, partially by a machine. The problem was a cable.
Geostationary satellites can be located in stable state in very high orbits, about 20,000 km minimum. Steel cable, linking the satellite and the terrestrial surface must be about 3metre in diameter. Then, in 60's, such projects had been stopped. Now it started again, because the recent developments of carbon cables give possibility to make such cable of necessary properties only centimeter width. I heard numerous commercial corporations started such projects the last year. They think to begin use the 1st Space Bridge in 2015.

Student:
4) Suppose we are able to dig around and cut our planet into two separated parts. In the first case, suppose the two parts are equal, while in the second case one part is much bigger than the second one. Will these parts mutually attract back to re-form a single planet, or will they separate each other?

Instructor:
It depends on those conditions in which they will be after the divorce. If they will be in relative rotation at a velocity, necessary for that they would be in stable condition - inertial forces will put the gravity force in equilibrium, then they will not form a unitary plane.
If they will not rotate, then they will join into a single planet.

Student:
5) Why from the Earth the Moon is seeing up, and from the Moon the Earth is seeing up too?
(Let's consider a fixed point on the Earth; we are able to see the Moon from that point only when it is above the Earth, because when the Moon is diametrically opposed it cannot be seeing from that Earth point.
{Similarly when we consider a fixed point on the Moon where the Earth is visible from.}

Instructor:
I don't understand exactly…