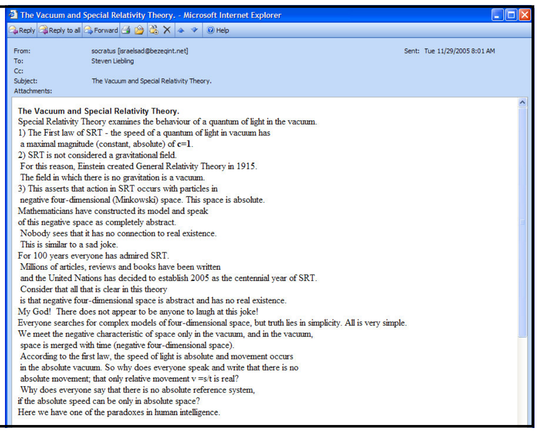
Jan. 31—Special Relativity

Agenda

- Announce:
  - Read Ch. S3 for Thursday
- An example of Relativity crackpot
- Another way Earth could be destroyed…or what I read this weekend
- Why does one need relativity for astronomy?
- Review S2:
  - Length contraction
  - Reality of length, duration, mass
  - More tests of special relativity --Let's unify electric/magnetic
- Lab 2
  - Error bars
  - Do we have to measure in a specific spot?
  - How do we get altitude
  - How do we get confidence interval (and why do so)



The Vacuum and Special Relativity Theory. - Microsoft Internet Explorer

From: socratus [israelsad@bezeqint.net] Sent: Tue 11/29/2005 8:01 AM
To: Steven Liebling
Cc:
Subject: The Vacuum and Special Relativity Theory.
Attachments:

The Vacuum and Special Relativity Theory.
Special Relativity Theory examines the behaviour of a quantum of light in the vacuum.
1) The First law of SRT - the speed of a quantum of light in vacuum has
a maximal magnitude (constant, absolute) of **c=1**.
2) SRT is not considered a gravitational field.
For this reason, Einstein created General Relativity Theory in 1915.
The field in which there is no gravitation is a vacuum.
3) This asserts that action in SRT occurs with particles in
negative four-dimensional (Minkowski) space. This space is absolute.
Mathematicians have constructed its model and speak
of this negative space as completely abstract.
Nobody sees that it has no connection to real existence.
This is similar to a sad joke.
For 100 years everyone has admired SRT.
Millions of articles, reviews and books have been written
and the United Nations has decided to establish 2005 as the centennial year of SRT.
Consider that all that is clear in this theory
is that negative four-dimensional space is abstract and has no real existence.
My God! There does not appear to be anyone to laugh at this joke!
Everyone searches for complex models of four-dimensional space, but truth lies in simplicity. All is very simple.
We meet the negative characteristic of space only in the vacuum, and in the vacuum,
space is merged with time (negative four-dimensional space).
According to the first law, the speed of light is absolute and movement occurs
in the absolute vacuum. So why does everyone speak and write that there is no
absolute movement; that only relative movement v =s/t is real?
Why does everyone say that there is no absolute reference system,
if the absolute speed can be only in absolute space?
Here we have one of the paradoxes in human intelligence.

I ran across an interesting paper this weekend…

- *Phantom Energy and Cosmic Doomsday*
- Authors: Robert R. Caldwell, Marc Kamionkowski, Nevin N. Weinberg
- http://arxiv.org/abs/astro-ph/0302506

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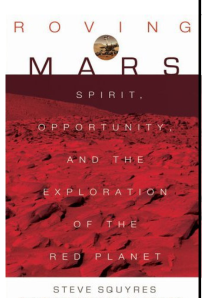
- Size: about 5 times the mass of Earth!
- Why is relativity important for this?
- Planet found by gravitational microlensing

Added a cool new book to list

- Life of a planetary scientist
- Passion
- Mars' surface very old
- Contrasts w/ Earth's



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- Effects important for observations:
  - Transverse Doppler effect
  - Gravitational red shift
  - Frame dragging effects observing (rotating) stars
- Plays big role in death of stars
- GR is only relevant force for cosmology (large scale structure)

Understanding Length Contraction

- Measurement of length requires locating begin and end points *at the same time*
- length can be measured w/ a ruler in your (the observer's reference frame)
- Already, should be able to see that different observers will measure different lengths because no common concept of simultaneity

Length Contraction

- Use “laser ranging” method….time how long it takes for laser to bounce off reflector
  - Stationary frame:
    - Measure the “normal length” : $\ell_0 = \dfrac{c}{2t_0}$
  - Moving frame: $\ell = \dfrac{c}{2t}$
- If time dilates, then length contracts

Further Thoughts on Relativity

- If you want a unique, right answer can think of
  - Proper time – time measured by a stationary observer
  - Rest length – length measured in stationary frame
  - Rest mass
- Instead of unique values for space and time, it’s a matter of perspective…
- But if that makes you uncomfortable, you can take comfort in an *invariant spacetime interval*

Further Thoughts on Relativity

- Special Relativity is so accepted now, that any good evidence against would upset nearly all theories
- One could say it’s taken for granted that these effects are there…here’s an example

Let’s Unify Electric and Magnetic Forces

- Consider a wire with a current running through it
- Let a charged particle fly at constant speed parallel to the wire
- We see the wire as neutral (no net charge) and the moving particle experiences a **magnetic** force to the wire

Let’s Unify Electric and Magnetic Forces

- That’s what **we** see!
- What does the moving particle see?
  - It sees the distance between positively charged particles in the wire as length contracted
  - Hence, the wire has a net charge
  - So it experiences an **electric force**!

Questions

- You construct a pole that is the precise length of Jackie’s (transparent) spaceship as it fuels up in port. You give it to your friend Jackie who boards her ship and flies off at constant speed. As you see her fly off, you see Jackie arrange the pole horizontally so that you can observe it. What do you see?

1. The pole is now longer than the spaceship
2. The pole is now shorter than the spaceship
3. The pole is the same length as the spaceship

Questions

- Which of the following are the essential assumptions which lead to the various conclusions of special relativity?
  1. Observers may disagree about simultaneity.
  2. E=mc^2
  3. The laws of physics are the same for all observers.
  4. Time dilation occurs.
  5. Length contraction occurs.
  6. The speed of light is constant in vacuum for all observers.
  7. No material object can travel faster than the speed of light in vacuum.

Questions

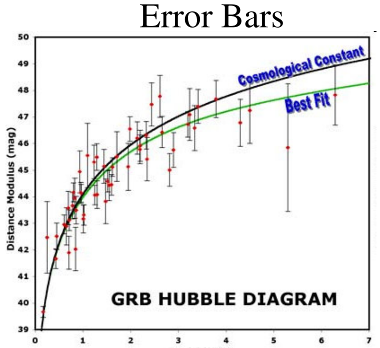
- JimBob and SallyMae are each in identical spaceships with windows to look at each other. However, they cannot see stars or anything else. SallyMae sees JimBob moving and vice-a-versa for JimBob. How can we tell who is really moving?

Questions

- Larry, Moe and Curly buy identical, very accurate watches. As Larry stands still, Moe flies off westward while Curly flies off eastward, both at the same speed (relative to the ground). Moe and Curly flash their flashlights at you every minute according to their watches. Whose flashes arrive first? How often do you receive flashes?

Lab 2 Continued

Error Bars

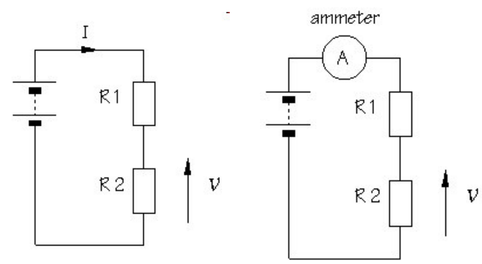


Lab 3—Electric Circuits

- What are Voltage, Current, Resistance
- How to measure voltage and current
- How are voltage and current related
- Ohm's Law

- Ok, let's test
- Due next Tuesday (but bring what you've got Thursday)

Measuring Current



Measuring Voltage