Tuesday Oct 24

Agenda

• Announce:
  – Test on Thursday
  – Lunar Observations due
  – Online quizzes/tutorial due by Thursday
  – Need to schedule extra credit talks
  – Read Ch. 7 for next week
• Review Special Relativity
• Review Physics
• Review Labs
• “Einstein’s Big Idea”

Trivia:

• Guitarist who used to be a doctoral student in astronomy

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• Guitarist who used to be a doctoral student in astronomy
• British rock group of the 70s
• On the “Wayne’s World” soundtrack…

“I think there’s a sort of purity about both of them,” he said recently, according to The Guardian newspaper. “Because you can immerse yourself in thoughts of the universe, or in music, and you’re really abstracted. You’re a million miles away from all your worries and personal problems and the dust and smoke of where you are.”

Review Relativity
• Laws of physics/nature same for all observers
• Speed of light is same for all observers

Why? How do we know?

Consequences/Implications of Theory
• Quantities dependent just on space or just on time will, in general, depend on the observer:
  – Time runs slower for moving frames (w/r/t us)
  – Length contracts for moving frames (w/r/t us)
  – No agreement on simultaneity
• Special quantities constructed from time and space (spacetime) are invariant with respect to observer…not everything is relative

Length Contraction
• Only lengths in direction of relative motion are contracted
Effects on Space Travel

Experimental Tests of Relativity

- Constancy of speed of light
- Time dilation:
  - Particles
  - Flights / satellites
- Various consistency checks
- $E=mc^2$

Suppose you are in a plane flying completely smoothly at 900 km/s. Without making reference to outside the plane could you tell what your motion was?

- Yes
- No
- Only by making careful experiments

Suppose you are traveling at 500 km/hr. You shine a flashlight in the direction you are going. Someone not moving with you will see the light pass them:

- At a speed 500 km/hr faster than someone who is moving with you
- At the same speed as you see the light move
- Neither of the above

Suppose you are traveling at 500 km/hr. You shine a flashlight in the direction you are going. Someone not moving with you will see the light pass them:

- At a speed 500 km/hr faster than someone who is moving with you
- At the same speed as you see the light move
- Neither of the above
Why do we think the speed of light is the same for all observers?

- This makes the laws of physics simpler
- Einstein thought of this, and everything he thought has proven to be correct
- Experiments showed this to be true
- It isn’t, really, this is just an approximation that we use
- None of the above

If someone were to pass you at 90% the speed of light

- Time would appear to be running slower for them, and they would think that time is running slower for you
- Time would appear to be running slower for them, but they will think time is running faster for you.
- Time will appear to be running slower for them but they will see your time unchanged
- None of the above

Time dilation – the slowing down of time for objects moving at nearly the speed of light

- Is Einstein’s wildest idea but has not been tested
- Happens in science fiction, but not in reality
- Has been observed for subatomic particles that decay after a certain time. Their lifetime actually increases as they speed up.
- None of the above
Review Labs: Uncertainty

- Every lab experiment has uncertainty no matter how good the equipment
- Has little/nothing to do with error
- Dishonest/Unscientific to report with unc
- See a recent paper pulled completely at random from the web
Review Labs: Significant Digits

- Bad to report too many:
  - Dishonest/misrepresentation
  - Messy/silly/unprofessional
- Would it make sense for me to give someone with a final grade of 90 an A- and someone with an 89.99999 a B+?
- Want to buy some knives for $19.99

Review: Significant Figures

- Let’s measure the speed of a ball:
  - Length of room: 1334.3 cm
  - Time: 3.5 s
- Speed:
  - \( V = \frac{d}{t} = \)

Review: Significant Figures

- Let’s measure the speed of a ball:
  - Length of room: 1334.3 cm
  - Time: 3.5 s
- Speed:
  - \( V = \frac{d}{t} = \) 1334.3 cm / 3.5 s = 381.22857142857142857142857142857 cm/s
  - \( V = 3.8 \times 10^2 \) cm/s
  - \( V = 1334.3 / 3.4 = 370.638888888888888888889 \) cm/s
  - \( V = 1334.3 / 3.6 = 392.4411764705823529411764705882 \) cm/s