Today	**Ch 28**	Special Relativity 1st 1/2	**HW25Redo; HW 27**
Friday	**Ch 28**	Special Rel. 2nd ½	**HW26Redo; HW 28**

Chapter 28: Special Relativity

Introduction.

- **Intuition, proes and cons.**
- **Modern Questions**
  - **Blackbody radiation**
  - **Atomic Spectra**
  - **Relativity**

- **Einstein's Relativity**
- **Relativity**
  - **The Concept:**
    - **Postulate 1**
      - **"Special"**
  - **The (old) Math: Galilean Relativity**

- **The Observation: Light Speed in different reference frames**
  - **Speed of Sound & a medium.**
  - **Speed of light & no medium.**
  - **Postulate 2: Constancy of the Speed of light.**

28.3The Relativity of Time: Time Dilation

- **Rest Frame**
- **Relative Frame**

Example1: Fast motion

Say you hop an intergalactic liner, rev. up to a speed of ¾ c, and take off for some distant solar system. In order for this to satisfy certain 'multicultural experience' requirements of your school, you've got to keep a daily journal through out your trip. If you write in your journal once a day, as *you* measure it, how often would that be as the *school* measured it?

- **Time Dilation:**
- **Life time:**
- **Reality Check:**

Example2: Slow motion. The fastest any of us are likely to ever go, relative to anyone else, is about the speed of sound, 344m/s. If you're aboard a supersonic jet, going 344m/s. If your friend on ground measures 2 hrs, how much shorter a time do you measure?

  - **Doesn't contradict everyday experience.**
  - **Confirmable.**
- **Sub-atomic particle lifetime**
  - **Muons**
- **Speed Limit**
- **Warning: Rest frame**

28.4The Relativity of Length: Length Contraction

Example3: Fast

The distance from here to the center of the galaxy is 23,000 ly or 2.18×10^{20}m as measured by an Earth based telescope. If a space ship traveled there at 0.9990 c, A) how far would passengers measure the journey B) how much time would they measure its taking?

28.7 The Relativistic Addition of Velocities

- **Relativity**

- **Motivation Example: Moving Pool game.**
  - **Example: Speed of light**

Example4: Fast

Upon our development of warp drive; the Vulcans come to visit and welcome us into the Federation. The Vulcan ship approaches the Earth at 0.50 c, then it launches a smaller landing pod which approaches us at 0.70 c. How fast does the ship see the pod moving?

Example5: Slow

Back to the pool game on the train. Say I'm in a 'Bullet train' moving forward at about 90 m/s (200 mph) relative to the ground. I hit the cue ball forward at 7 m/s, relative to me. How fast do you, on the ground, measure the cue ball moving? How does it compare with what you'd classically expect?

28.5 Relativistic Momentum

- **Classical Momentum:**
- **Special Relativistic Momentum:**
  - **Classical Momentum doesn't withstand special relativistic transformation.**
- **The practical problem with going near or at light speed**

Example6: Fast

How fast must you go for your momentum to be 0.1% of the classical prediction above the classical prediction?

HW 28

4. Suppose that you are traveling on board a spacecraft that is moving with respect to the earth at a speed of 0.975 c. You are breathing at a rate of 8.0 breaths per minute. As monitored on earth, what is your breathing rate? (notes: You are stationary relative to the person breathing, *yourself*; the book's equation transforms *time* not frequency so it may be convenient to find out what your minute looks like from earth).

6. An astronaut travels at a speed of 7800 m/s relative to the earth, a speed that is very small compared to c. According to a clock on earth, the trip lasts 15 days. Determine the *difference* (in seconds) between the time recorded by the earth clock and the astronaut's clock [Hing: when v<<c, the following approximation is valid: $\sqrt{1-\left(\frac{v}{c}\right)^2} \approx 1-\frac{1}{2}\left(\frac{v}{c}\right)^2$)

12. Suppose you are traveling in space and pass a rectangular landing pad on a planet. Your spacecraft has a speed of 0.85c relative to the planet and moves in a direction *parallel to the length* of the pad. *While moving*, you measure the length to be 1800 m and the width to be 1500 m. What are the dimensions of the landing pad according to the engineer who built it (i.e. someone stationary relative to the pad)? Note: 2nd Pay special attention to the last two sentences on pg. 872 of the 5th Edition of the text.