Today	**Ch 28**	Special Rel. 2nd ½	**HW26Redo; HW 28**
Monday	**Ch 29**	Waves & Particles	**HW27Redo; HW 29**

28.7 The Relativistic Addition of Velocities

- **Motivation Example: Moving Pool game.**

Example1: Speed of light. Say I'm driving my car down a dark highway and a deer stands by the side of the road. Relative to the deer I'm driving at the speed limit, v_m. If light radiates out from my head lights at c, relative to me and my car, how fast does the deer see the light radiating?

Example2: 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?

Example3: 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**

Example4: Fast. How fast must you go for your momentum to be 0.1% of the classical prediction above the classical prediction?

The Equivalence of Mass and Energy

- **Implication**

Example5: If an electron that was orbiting a proton, forming a Hydrogen atom, gets removed, the electric potential energy of the Electron – Proton interaction rises by 27.2 eV. By how much must the combined mass of the electron + proton change?

- **Derivation**
  - **The frame independent space-time metric**
  - **The Energy – Momentum – Mass Relationship**

HW 29

***Read Chapter 1 of The New World of Mr. Tompkins and for each of his strange observations, note which equation applies and whether or not his is the 'proper' ('o' subscripted) measurement.*

18. A jetliner has a mass of 1.2×10^5 kg and flies at a speed of 140 m/s. (a) Find the magnitude of its momentum. (b) If the speed of light in a vacuum had the hypothetical value of 170 m/s, what would be the magnitude of the jetliner's momentum?

24. Suppose tht one gallon of gasoline produces 1.1×10^8J of energy, and this energy is sufficient to operate a car for twenty miles. An aspirin tablet has a mass of 325 mg. If the aspirin could be converted completely into thermal energy, how many miles could the car go on a single tablet?

30. spaceship Y is between spaceship X and spaceship Z. Spaceship Y is moving toward spaceship Z at a speed of 0.68c. Spaceship Z is moving toward spaceship X at a speed of 0.42c. Assuming that all of the spaceships are moving at constant velocities, so they are inertial reference frames, find the speed of spaceship Y with respect to spaceship X.