

INS Physics Workshop, May 11: due on May 12

1. The last episode of *Acquaintances* is broadcast live from Los Angeles. Studio microphones are about 1.5 m from the performers. The studio audience is about 8 m from the stage. New York is about 3939 km from LA. If the show is broadcast directly from the studio (beamed via satellite), who will hear the performances first: an audience member in LA or a technician in the NY affiliate studio wearing headphones? Speed of sound is 343 m/s.
2. Match the wavelengths of electromagnetic radiation with the likely application.
0.07 nm, 120 nm, 320 nm, 1.3 mm, 0.3 km
tanning booth, Rush Limbaugh, microwave, heat lamp, full dental exam
3.
 - a. Galileo concluded that the speed of light was infinite. Galileo was wrong, but his conclusion was not bad. Explain.
 - b. When Earth and Jupiter are on the same side of the sun (in conjunction) they are two Earth orbits closer than when they are on opposite sides of the sun (in opposition). Sketch this. Explain how Roemer used this and Io's eclipses to calculate the speed of light.
 - c. Roemer reported a 22 minute delay in Io's eclipse. Use the modern value for Earth's orbit to calculate the speed of light as Roemer might have. How does his value compare to the currently accepted one?
4. Suppose an Earth colony is established in the absolute immediate galactic neighborhood, say, 5 light years away.
 - a. Convert 5 light years to kilometers and miles.
 - b. What communication difficulties does the colony face?
5. Assume that the radius of an electron's orbit in a hydrogen atom is 0.529×10^{-10} m. (This is the Bohr radius.)
 - a. Further assume that the centripetal force keeping the electron in orbit about the proton is the electrostatic force between them. Calculate the electron's velocity around the proton.
 - b. Calculate the electron's period (time for one orbit).
 - c. Calculate the electron's frequency.
 - d. Since an electron is charged and moving charge generates electromagnetic radiation, what wavelength of radiation should hydrogen gas emit spontaneously? What kind of radiation is this?