ASTR 680 Practice questions for lecture 17: Sunyaev-Zeldovich Effect

1. Derive the photon energy at the "null point" where the S-Z effect goes from a decrement to an increment. That is, assume that prior to scattering the spectrum is a perfect Planck spectrum of temperature T_0. Scattering boosts a fraction τ (the optical depth; $\tau \ll 1$) of the photons by a factor that is independent of the energy of the photon (look up Compton scattering to determine this factor). Photon number is conserved, so this results in an overall shift in the spectrum to higher energies. At low energies there are thus fewer photons than there were, but at higher energies there are more photons. What is the crossover point?

2. Go through and derive some of the effects mentioned in the lecture regarding how a measurement of H_0 is affected by different complexities. For example, what if the cluster is not spherical, or if the gas is clumpy or if the cosmology (e.g., the balance between Ω_m and Ω_Λ) is different than you assumed?