Problems Week 6

1. The timelike unit vectors $\hat{u}$, $\hat{v}$ and $\hat{w}$ lie in a 2-plane in spacetime. Assume $\hat{u} \cdot \hat{v}$ and $\hat{v} \cdot \hat{w}$ are known.

  a) Calculate $\hat{u} \cdot \hat{w}$.

  b) Write $-\hat{u} \cdot \hat{v} = \cosh \zeta$, $-\hat{v} \cdot \hat{w} = \cosh \eta$ and $-\hat{u} \cdot \hat{w} = \cosh \xi$. Express ξ in terms of ζ, η.

2. Two galaxies have four-velocities $\hat{u}$ and $\hat{v}$ respectively. A light signal is emitted from one of them (event R_1) which is absorbed by the other (event R_2). Calculate the Doppler shift.

3. Two unaccelerated spaceships are about to meet. A light signal is sent from ship A to ship B and the Doppler shift is given by $\omega_B/\omega_A = d$. Ship A measures proper time τ_A from emission to meeting and B measures time τ_B from receiving the signal to meeting. Calculate τ_A/τ_B.