Today's discussion is about the interplay between pressure, gravity, and cosmological evolution. The key equation is \( G_{ab} = 8\pi G T_{ab} \), where \( G \) is the gravitational constant, \( 8\pi G \) is a dimensionless constant, \( T_{ab} \) is the stress-energy tensor.

Tidal forces are given by \( \ddot{v} = \frac{\ddot{v}}{v} = N^a \dot{v}_a = -R_{ab} U^a U^b \), where \( R_{ab} \) is the Ricci tensor and \( U^a \) is the four-velocity.

To make the right analogy, \( R_{ab} \) is responsible for tidal forces, not \( R \).

So, \( R_{ab} = 8\pi G (T_{ab} - \frac{1}{2} T g_{ab}) \)

and \( \frac{\ddot{v}}{v} = -R_{ab} U^a U^b = -4\pi G (2T + T) \)

\( T = T^{\text{eff}} \)

**Examples:**

- **Dust:** \( T_{ab} = \rho U_a U_b \), \( T = \rho \)

  \( \Rightarrow T^{\text{eff}} = 2\rho - \rho = \rho \) (only energy density contributes)

- **Fluid with isotropic pressure:** \( T_{ab} = \rho U_a U_b + P (g_{ab} + U_a U_b) \)

  \( = (\rho + P) U_a U_b + P g_{ab} \)

  \( T = -\rho - P + 4P = 3P - \rho \)

  \( \Rightarrow T^{\text{eff}} = 2\rho + T = \rho + 3P \)

  \( P \) doesn't contribute for non-relativistic fluids.

- **Radiation fluid:**

  For EM (Maxwell), \( T^a_b = 0 \) \( \Rightarrow P = \frac{1}{3} \rho \)

  \( \Rightarrow T^{\text{eff}} = 2\rho \)