Special and General Relativity (PHZ 4601/5606) Fall 2018 Solutions

Set 12

30. Negative energy density due to the cosmological constant.

The modified Poisson [Rindler equation (14.20), p.304] can be re-written as

$$\sum_i \Phi_{ii} = 4\pi\, G \left(\rho_o - \frac{\Lambda\, c^2}{4\pi\, G} \right) .$$

The absolut volue of the energy density due to the cosmological constant is therefore

$$\rho_L = \frac{\Lambda\, c^2}{4\pi\, G} .$$

Using the numbers given in the problem we obtain

$$\rho_o = 2.8 \times 10^{-31}\, [g/cm^3] \quad \text{and} \quad \rho_L = 1.2 \times 10^{-29}\, [g/cm^3] .$$

In percent the relative values are then given by

$$p_o = 100\, \frac{\rho_o}{\rho_o + \rho_L} = 2.3\% \quad \text{and} \quad p_L = 100\, \frac{\rho_o}{\rho_o + \rho_L} = 97.7\% .$$

Our present consideration does not include dark matter. Besides, there is something wrong with the input numbers.