

Principles of Astrophysics and Cosmology

Problem Set 11

JC-31) Chapter 8, Problem 1 from your textbook

JC-32) Einstein's Static Universe, Part 1

As we discussed in class, Einstein introduced the cosmological constant in order to create a static universe. Consider Einstein's static universe, in which the attractive force of the matter density ρ is exactly balanced by the repulsive force of the cosmological constant, $\Lambda = 4\pi G\rho$. Suppose that some of the matter is converted into radiation (by stars, for instance). Will the universe start to expand or contract? Justify your answer using the Friedmann Equation(s).

JC-33) Einstein's Static Universe, Part II

- What geometry (positive curvature, flat or negative curvature) must Einstein's static universe have? Be sure to justify your answer for full credit.
- If $\rho = 3 \times 10^{-27} \text{ kg m}^{-3}$, what is the radius of curvature R_0 of Einstein's static universe?
- How long would it take a photon to circumnavigate such a universe?