In the name of God

Department of Physics
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ADVANCED TOPICS IN MODER COSMOLOGY

Exercise Set 2

(Date Due: 1393/01/30)

1. Calculate the energy of a massive non-relativistic particle as a function of scale factor, $a(t)$, in an expanding universe.

2. Suppose that in the FLRW metric, the Ricci scalar is independent of spatial part of metric. So in this case find $f(r)$.

3. Suppose that according to the following map: $x = u + v$, $y = u - v$ and $z = uv + w$:

A : Find the contravariant and covariant vectors of (u, v, w).

B : Calculate the norm of u, v and w.

4. Suppose the general form of spherical symmetry metric, $c^2 d\tau^2 = A(r)dt^2 - B(r)dr^2 - r^2 d\Omega^2$. Find the $A(r)$ and $B(r)$ in empty universe. Using comparison of your results with weak field approximation, determine the unknown constant in function of $A(r)$ and $B(r)$.

5. Find the area and volume of a 3D circle as a function of the curvature parameter, K.

6. Solve exercises of chapter 2 (Book: Modern Cosmology, By: Dodelson, page 53) Exercise 2, Exercise 3, Exercise 7, Exercise 11, Exercise 13.

Good luck, Movahed