

Class problems #2

1. Introduce the balloon model of Hubble expansion, see sec.1.1 in [1].
2. Assume that an observer A sees two observers B and C according to the Hubble law:

$$\vec{v}_{B(A)} = H\vec{r}_{BA} \quad \vec{v}_{C(A)} = H\vec{r}_{CA}$$

Show that the observer B sees the velocity of C also in agreement with the Hubble law, see sec.1.1 in [1].

3. In order for a general expansion law $\vec{v} = \vec{f}(\vec{r}, t)$ be the same for all observers, the function f must satisfy the relation (to be proven as well)

$$\vec{f}(\vec{r}_{CA}, t) - \vec{f}(\vec{r}_{BA}, t) = \vec{f}(\vec{r}_{CA} - \vec{r}_{BA}, t).$$

Show that the Hubble law is the only solution. I don't quite see how to prove it.

4. Using only a given value of H_0 , find a rough value for the age of the Universe, express your answer in years, up to 2 significant digits.

References

- [1] Viatcheslav Mukhanov, "Physical Foundation of Cosmology".