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Astroparticle Physics (Physics 711)

Exercise 1

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General comments

This and future problem sheets can be obtained at the web site:
`http://www.astroteilchen.uni-bonn.de//teaching/lectures/astro_winter201011/`

Most relevant particle- and astrophysical constants can be obtained from the Particle Physics Booklet (PDG) (`http://pdg.lbl.gov/`).

Problem 1: Units and distances (5P)

Lets get familiar with astronomical distance measures. The parsec ('parallax of one arcsecond', symbol: pc) is defined as the length of the adjacent side of an imaginary right triangle in space, where one angle of the triangle is the parallax angle (defined as 1 arcsecond) and the opposite side is defined as 1 astronomical unit (AU), the distance from the Earth to the Sun (AU=1.49578 $\cdot 10^{11}$ m).

a) Express the distance of 1 pc in meters and light years.

b) What is the distance to a redshift $z = 0.1$ object, assuming that it is still in the linear Hubble flow?

c) A Supernova Type Ia was observed with an apparent magnitude of 17. Such objects have an absolute magnitude (defined as the apparent magnitude of an object with 10 pc distance) of -19.3. What is the luminosity distance of the object?

Problem 2: Cosmological Redshifts (5P)

a) Light from distant extragalactic sources will be redshifted. Assume a star such as the sun to be located at a redshift of 0.3 and 1.0, respectively. Assume the spectral shape of the radiated light is that of a black body. At what wavelengths will an astronomer on earth measure the peak intensity of the emitted light? What observational difficulties may arise due to the redshift?

b) The photons of the cosmic microwave background (CMB) that we measure today, have a temperature of 2.725 Kelvin. What is their temperature given in eV? The CMB photons decoupled from the primordial plasma at a redshift of $z \approx 1090$ - what was their temperature at that time (in Kelvin and eV)?