PH3930 (Particle Astrophysics)
Problem sheet 4
To be turned in by Friday 14 February, 2003, 17:00.

1 Find the home page of the Alpha Magnetic Spectrometer (AMS) experiment at `ams.cern.ch/AMS/`.

(a) Follow the 'General Public' link and browse through the material. Briefly describe how AMS will indentify antimatter in cosmic rays. No technical details please – just mention the main physical principles involved.

(b) A prototype of the AMS detector took data in 1998 on board the space shuttle Discovery. The results of their search for antihelium are published in *Search for Antihelium in Cosmic Rays*, Phys. Lett. B461 (1999) 387-396. The preprint can be found in the Los Alamos archives as hep-ex/0002048. To retrieve this paper from the archives, go to

`xxx.lanl.gov/abs/hep-ex/0002048`

From there you can read the abstract and you can get the full-text document in various formats. From the paper cited above find:

(i) How many helium nuclei were observed?

(ii) How many antihelium nuclei were found?

(iii) What is the upper limit on the flux ratio of antihelium to helium in cosmic rays?

Tip: save a tree – you don't need to print out the paper.

2 The baryon to photon ratio has been determined to be

$$\eta = \frac{n_B - n_{\overline{B}}}{n_\gamma} \approx 5 \times 10^{-10} \; . \tag{1}$$

Using this and $H_0 = 70$ km/s/Mpc for the Hubble constant, find the current value of $\Omega_B = \rho_B/\rho_c$.

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6 February, 2002