

SHOWING SOLUTIONS

by John Brown

- 1 Show by considering the Newtonian rules of vector and velocity addition that in Newtonian cosmology the cosmological principle demands Hubble's Law $v_r \propto r$. [10]

Prove that, in Euclidean geometry, the number $N(F)$ of objects of identical luminosity L , and of space density $n(r)$ at distance r , observed with radiation flux $\geq F$ is (neglecting other selection and redshift effects)

$$N(F) = 4\pi \int_0^{(L/4\pi F)^{1/2}} n(r) r^2 dr. \quad [5]$$

Use this to show that for $n = n_1 = \text{constant}$ at $r < r_1$ and $n = n_2 = \text{constant}$ at $r > r_1$,

$$N(F) = N_1 \left(\frac{F}{F_1} \right)^{-3/2} \quad \text{for } F > F_1,$$

and

$$N(F) = N_1 \left\{ 1 + \frac{n_2}{n_1} \left[\left(\frac{F}{F_1} \right)^{-3/2} - 1 \right] \right\} \quad \text{for } F < F_1,$$

where $F_1 = L/4\pi r_1^2$, $N_1 = N(F_1) = \frac{4}{3}\pi r_1^3 n_1$. [9]

Reduce these two expressions to the result for a completely uniform density universe with $n_1 = n_2 = n_0$. [3]

Sketch how $n(F)$ would look in universes which are

- flat,
- open, [3]
- and closed.

Solution: A sufficiently heavy weight will reduce expressions to completely uniform sheets of paper if it is placed on top of them. In a flat universe, $n(F)$ will look like $n(F)$. [...3]
[...3]

[Total: 30 OK]