PRE-U REVISION NOTES MECHANICS AF/3118

COSMOLOGY: DISTANCE MEASUREMENT, RADIAL VELOCITY MEASUREMENT USING DOPPLER, COSMOLOGICAL MODELS, HUBBLE LAW

THE COSMOS "is all that is or ever was or ever will be" (Carl Sagan 1934–1996 Cosmos pp20)

↳ The universe on the largest scales, ie
Planets → Stars → Galaxies → Clusters → Universe

Key questions for Science:

1. How big is the universe? How many stars?
2. How far away are the stars?
3. How fast are the stars moving?
4. How old is the universe? Did it have a 'beginning'? Will it have an 'end'?
5. What are the physical properties of the cosmos? ie average density, temperature, matter/radiation composition.

And importantly: How can we measure these things? →

ASTRONOMICAL DISTANCES (and times and speeds)

"planetary" units →

$1\,AU = 1.496 \times 10^{11}\ m$ — Average Earth–Sun separation.

$1\,Yr = 365 \times 24 \times 3600\,s \simeq \pi \times 10^7\,s$ — orbital period of Earth–Sun system

$v_\oplus = \frac{2\pi \times 1\,AU}{1\,Yr} = 29.8\ km/s$ — Earth orbital speed about the Sun

Distance to nearest star beyond solar system (Proxima Centauri) $\simeq$ 4 light years

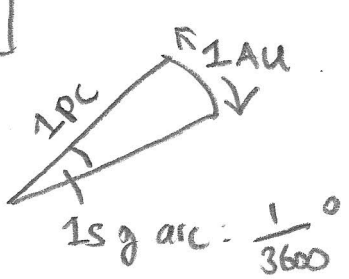
$1\,ly = 2.998 \times 10^8\ m/s \times 365 \times 24 \times 3600\,s = 9.461 \times 10^{15}\ m$

Distance of Sun to centre of galaxy $\simeq 25{,}000\ ly$

Distance to nearest galaxy $\simeq 2 \times 10^6\ ly$

" " distant quasars $\simeq 10 \times 10^9\ ly$

Most measurements from telescopes involve angles, so a **Parsec** (pc) is useful:



$\therefore 1\,pc = \frac{1.496 \times 10^{11}\,m}{\pi/180 \times 3600} = 3.086 \times 10^{16}\,m = 3.26\,ly$