

① WHAT CAN WE LEARN FROM THE SPECTRUM OF A STAR?

- (1) The temperature of the star can be gleaned from its color. Bluer stars are hotter than redder stars.
- (2) The composition of the star can be determined by matching lines in the stellar spectrum to the known spectral fingerprints of atoms.
- (3) The speed of the star relative to the observer can be determined by observing the Doppler shift of spectral lines.

② OBSERVATIONAL EVIDENCE OF THE BIG BANG

- (1) NUCLEOSYNTHESIS. Big Bang calculations for the amount of light elements (hydrogen mostly) matches very closely to the observed abundances.
- (2) COSMIC MICROWAVE BACKGROUND. We see the nearly uniform CMB in every direction, giving evidence for RECOMBINATION and DECOUPLING, predicted to occur $\sim 300,000$ yrs after the Big Bang.

③ WHAT IS THE ANGULAR RESOLUTION OF SHANE'S TELESCOPE?

The smallest object a telescope can theoretically see has size:

$$L = R \frac{\lambda}{D}$$

sol/ $R = \text{distance to moon} = 3.84 \times 10^8 \text{ m}$

$\lambda = \text{wavelength of light} = 5.00 \times 10^{-7} \text{ m}$

$D = \text{telescope diameter} = 0.32 \text{ m}$

sol/

$$L = \frac{(3.84 \times 10^8 \text{ m})(5.00 \times 10^{-7} \text{ m})}{(0.32 \text{ m})} = 600 \text{ m}$$

So Equinox can see anything on the Moon which is 600m or larger. Aloha Crater has a diameter of 3km = 3000m, so Equinox should easily be able to resolve it.

④ LOST AT SEA, NAVIGATING BY THE STARS.

The altitude of Polaris above your N horizon is equivalent to your latitude, in this case 32.75° .

This would make landfall near CHARLESTON, SC.

Other nearby cities include SAVANNAH GA ($32^\circ \text{N } 3'$)

MYRTLE BEACH, SC ($32^\circ \text{N } 43'$) and

WILMINGTON, NC ($34^\circ \text{N } 13'$)

⑤ WHAT'S IN THE VOIDS BETWEEN GALAXIES?

There is a large amount of hydrogen. This hydrogen is detected by looking at the spectra of distant quasars and galaxies. The hydrogen absorbs light from these distant objects making a lot of absorption lines — this is known as the Lyman Alpha forest.

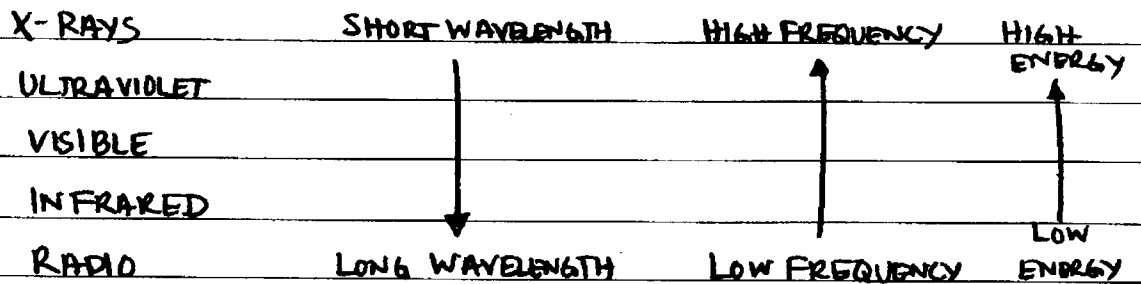
As many of my brilliant astronomy students pointed out there is dark matter between the galaxies which manifests itself through gravitational effects (lensing etc).

⑥ WHAT EVIDENCE IS THERE FOR DARK MATTER?

(1) Far from the centers of galaxies we can measure the rotation speed of stars, and apply KEPLER'S LAWS to determine the mass of the galaxy. Comparing this mass to the amount of matter we can see (i.e. the amount of luminous matter that emits light) we find there is a lot of missing matter that doesn't shine — DARK MATTER.

(2) Some clusters of galaxies can lens the images of distant galaxies. The strength of the lensing is a measure of the cluster mass, which found to be larger than the luminous matter — DARK MATTER.

⑦ LIST 3 KINDS OF ELECTROMAGNETIC RADIATION



All forms of EM radiation travel at the SAME SPEED—the speed of light, $c = 3.0 \times 10^8 \text{ m/s}$.

⑧ EXPLAIN OLBER'S PARADOX.

Olber's Paradox is the sky is dark, when it was believed it should have been bright. The assumption was that if the Universe were infinite, there were an infinite number of stars. In any direction you looked, your eye should eventually see the surface of a star, making the sky always bright.

One resolution to Olber's Paradox is a FINITE UNIVERSE. If the Universe is finite in size, there are not an infinite number of stars and so the sky is not filled with light.

A second resolution is the Universe has a finite age, and so the light from distant stars has not had the time to reach Earth.

⑨ How DOES THE EXPANDING UNIVERSE LOOK FROM DIFFERENT PLACES?

Every observer thinks the universe is expanding from a point centered where they are standing. From the point of view of Zorgitron 7 the Universe is expanding away from the planet in EVERY direction, and the farther away from Zorgitron you are the faster you are moving away. From you on Earth, you think the expansion is centered on Earth and expanding away from YOU in every direction!

⑩ What is the difference between ALTITUDE, LATITUDE and DECLINATION?

LATITUDE is an angle which defines where you are on the Earth in terms of an angle measured due North or South of the EQUATOR.

DECLINATION is the celestial equivalent of latitude. If you project the Earth's latitude lines onto the sky, they lie directly on top of the declination lines. Declination then is an angle which defines a location on the sky in terms of an angle measured due North or South of the Celestial Equator.

ALTITUDE is an observer dependent sky location angle, expressed as an angle measured from horizontal (the horizon) upwards to the object, such that the altitude line is \perp to the horizon.