G-G

From Geometry to God via Light

We connect with God via prayer

God is the Supreme Architect of the Universe

We seek to understand His Universe via Physics, particularly with Light and Relativity

God must be very pleased that we ae seeking this understanding

Physics is based on Mathematics, particularly **vectors**, which is a **geometric** concept.

- **MASONS USED GEOMETRY TO DESIGN AND BUILD BUILDINGS**

- **SCIENTISTS USE GEOMETRY TO FORMULATE AND USE THE TOOLS OF PHYSICS IN ORDER TO UNDERSTAND NATURE**

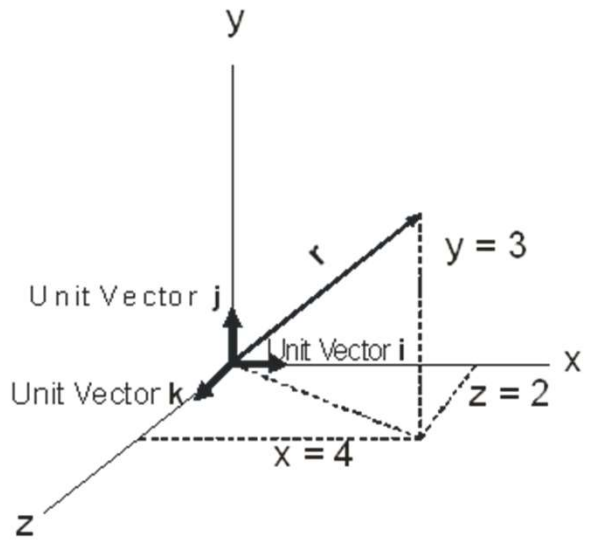
VECTORS & SCALARS

- A scalar is a quantity without direction, such as the speed of a car of 60 mph.
- A vector is a scalar with direction, such as a velocity of a car with a speed of 60 mph travelling northwest.
- Vectors can be added, subtracted and multiplied.

EXAMPLE OF VECTORS

X could be East, Z south and Y up. -X would then be West, -Y down and –Z north
The scalars would the the 4, 3 and 2in mph.

VECTOR IN 3 DIMENSIONS



Vector: $\mathbf{r} = \mathbf{i}\,4 + \mathbf{j}\,3 + \mathbf{k}\,2$

Scalar: $r = \sqrt{(4^2 + 3^2 + 2^2)} = 5.385$

Rotate the 4 fingers of your right hand from x axis to y axis. Notice that your thumb will project forward on the z axis. This coordinate system therefore follows the *right hand rule*.

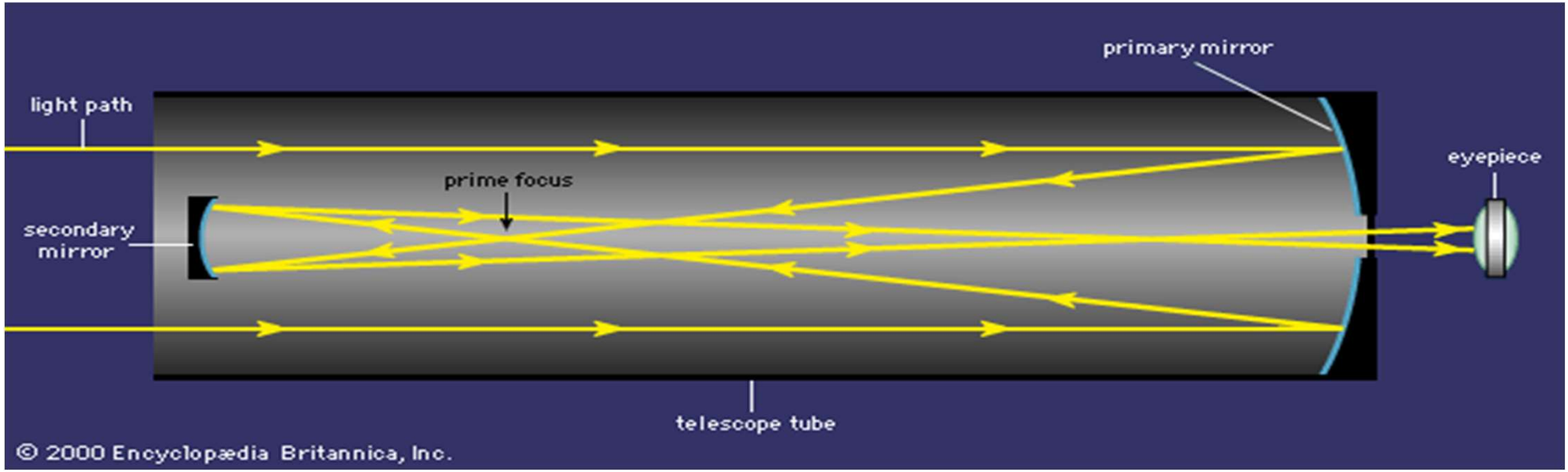
HOW LIGHT GIVES US KNOWLEDGE OF THE UNIVERSE - ASTRONOMY

- We can observe the PROPERTIES of a heavenly body via **telescopes**
- We can determine the COMPOSITION of a heavenly body from the **spectral lines** of the light it emits and absorbs
- We can determine the VELOCITY of a heavenly body relative to ourselves by the **doppler effect** (wavelength shift) of the spectral lines it emits and or absorbs
- We can determine the TEMPERATURE of a heavenly body by **shape of the continuous spectrum** of light it emits.

LIGHT

- Light is electromagnetic radiation
- The physics of Electricity & Magnetism is totally expressed by the four Maxwell equations, which are vector based.
- The equation for the propagation of light is derived from Maxwell's equations

TELESCOPES

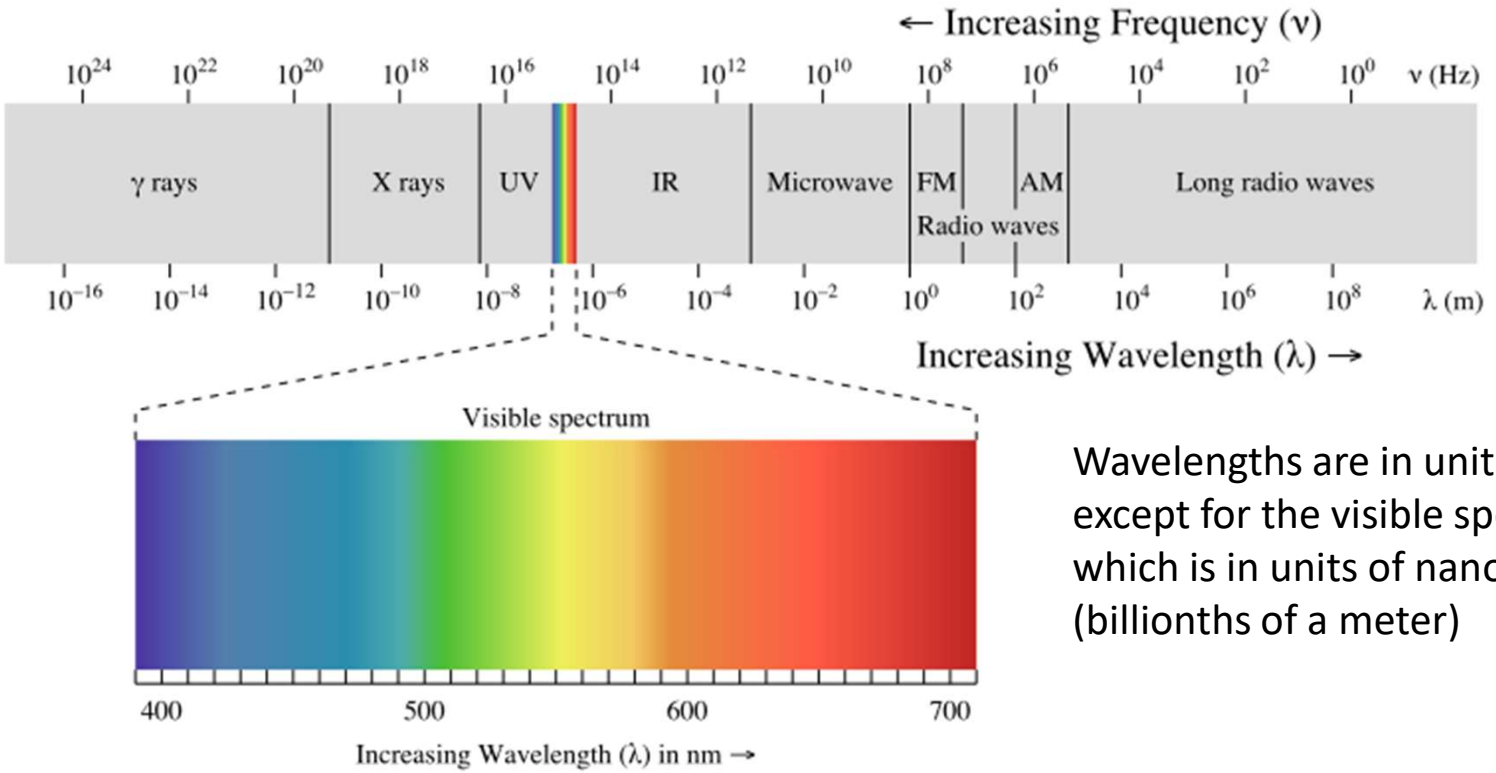


Large telescopes like that in the figure use mirrors, smaller ones can use lenses or mirrors. The principle of the astronomical telescope is to gather weak light by a large primary mirror and redirect the light to a small receptor, being the eye, a camera or a spectrometer. The larger the primary mirror, the more powerful the telescope. ***Please note the geometry involved in telescopy.***

SPECTRA

- Properties of light are intensity, velocity and frequency (or usually wavelength)
- The wavelength of light ranges from infintesimaly small (gamma rays) to infinitely large (longwave radio transmission)
- The speed of light is constant at 186,000 miles per second in a vacuum, in any direction.

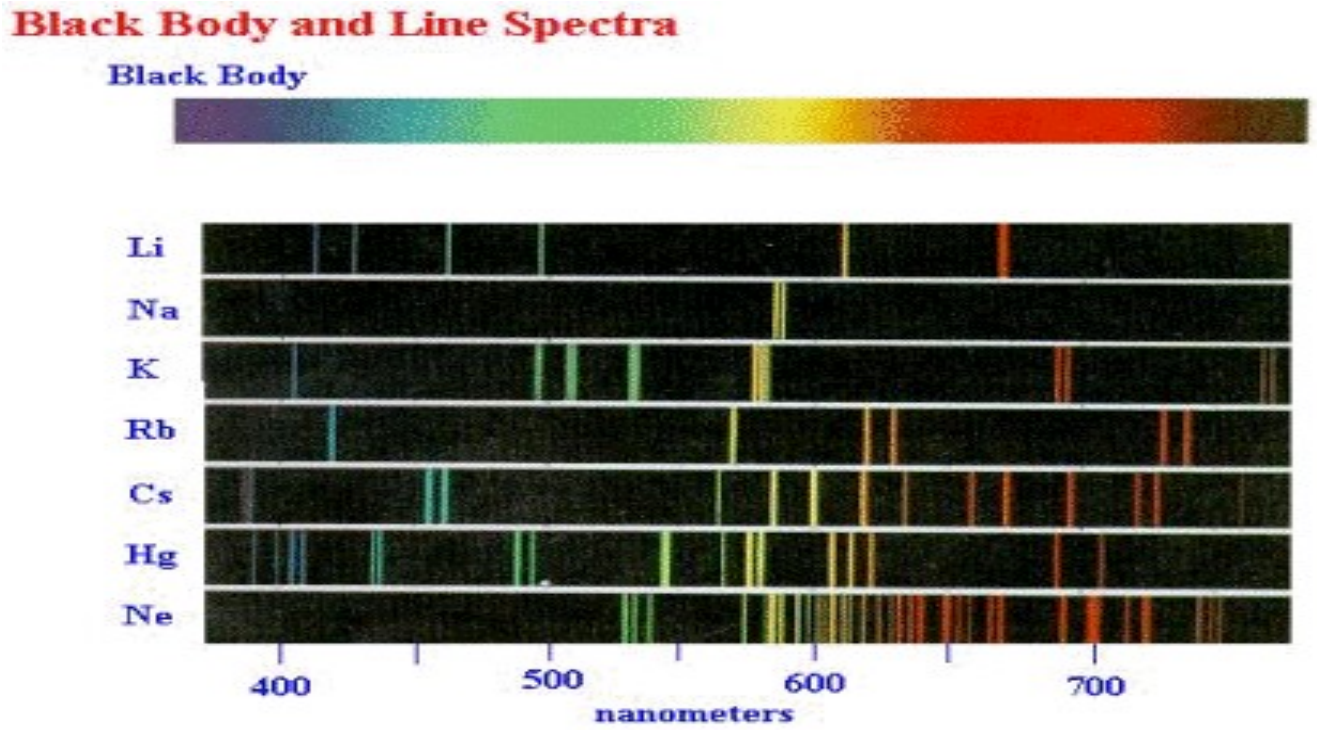
SPECTRA continued



Wavelengths are in units of meters, except for the visible spectrum which is in units of nanometers (billionths of a meter)

SPECTRA OF ATOMS & MOLECULES

- Atoms & molecules absorb and emit light at unique frequency series



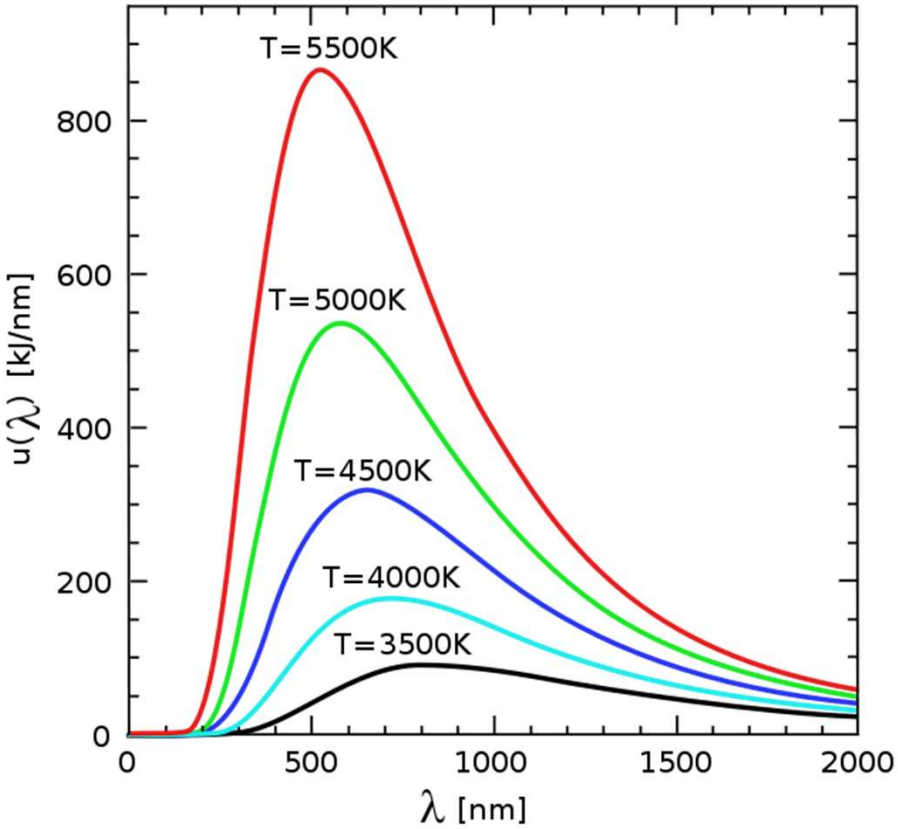
THE DOPPLER EFFECT

- The Doppler effect is the change in frequency (or inversely the wavelength) that is perceived of a wave travelling to or from the observer.
- Example is the change in pitch of a siren travelling toward you (higher) or away from you (lower).
- The greater the velocity of the sound or light emitter, the greater the Doppler effect

CONTINUOUS SPECTRA – Black Body Radiation

An ideal black body radiates light depending on its temperature according to a specific formula developed by Max Planck. By measurement of the spectrum of a heavenly body its temperature can be approximated. The vertical line in the graph is proportional to the intensity of the emitted light.

The temperature of a heavenly body can be determined by the wavelength of the peak of its spectrum λ per Wien's equation **T = 0.0051 mK/λ, m in meters, K in degrees Kelvin**

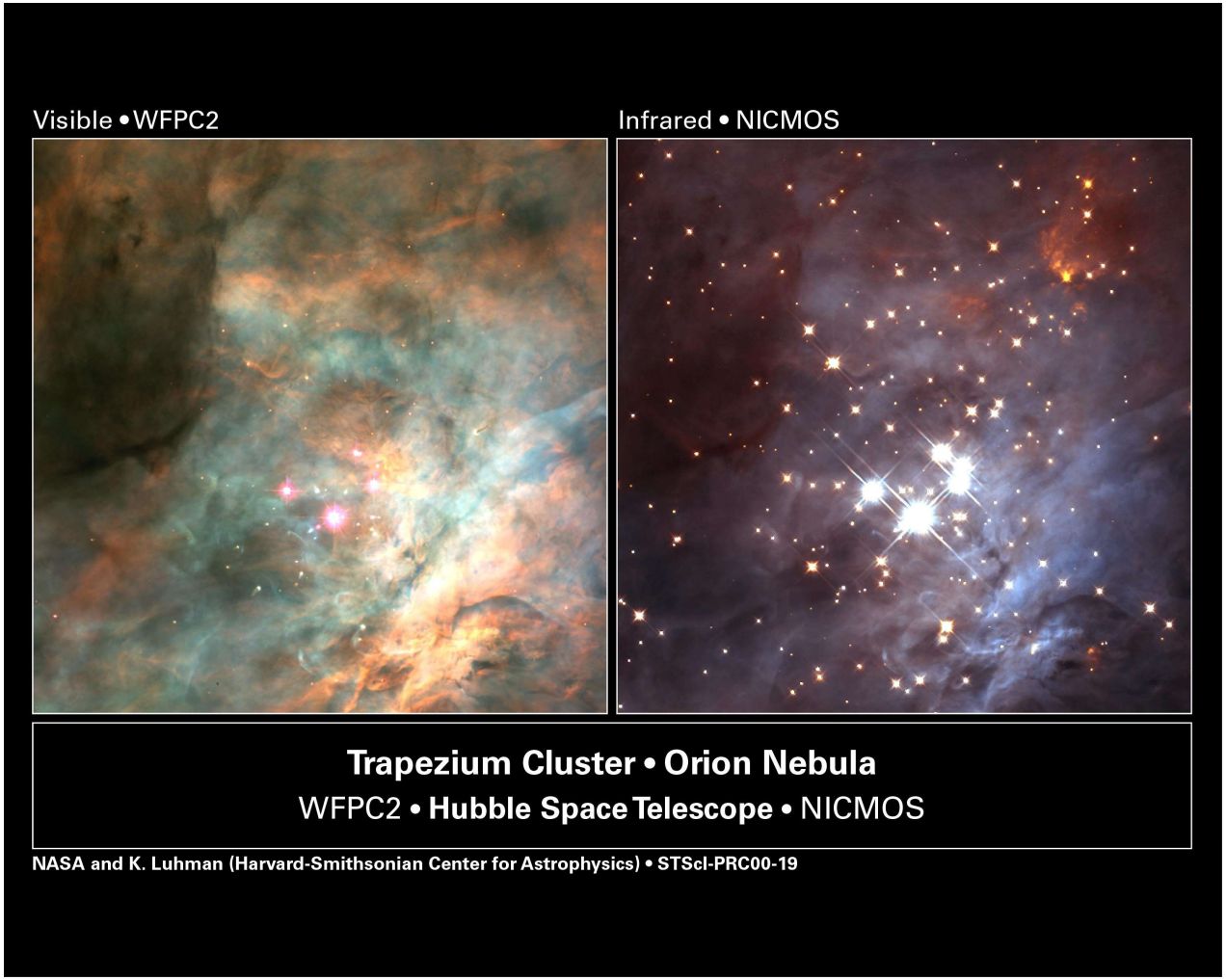


THE PROBLEM OF SPACE DUST

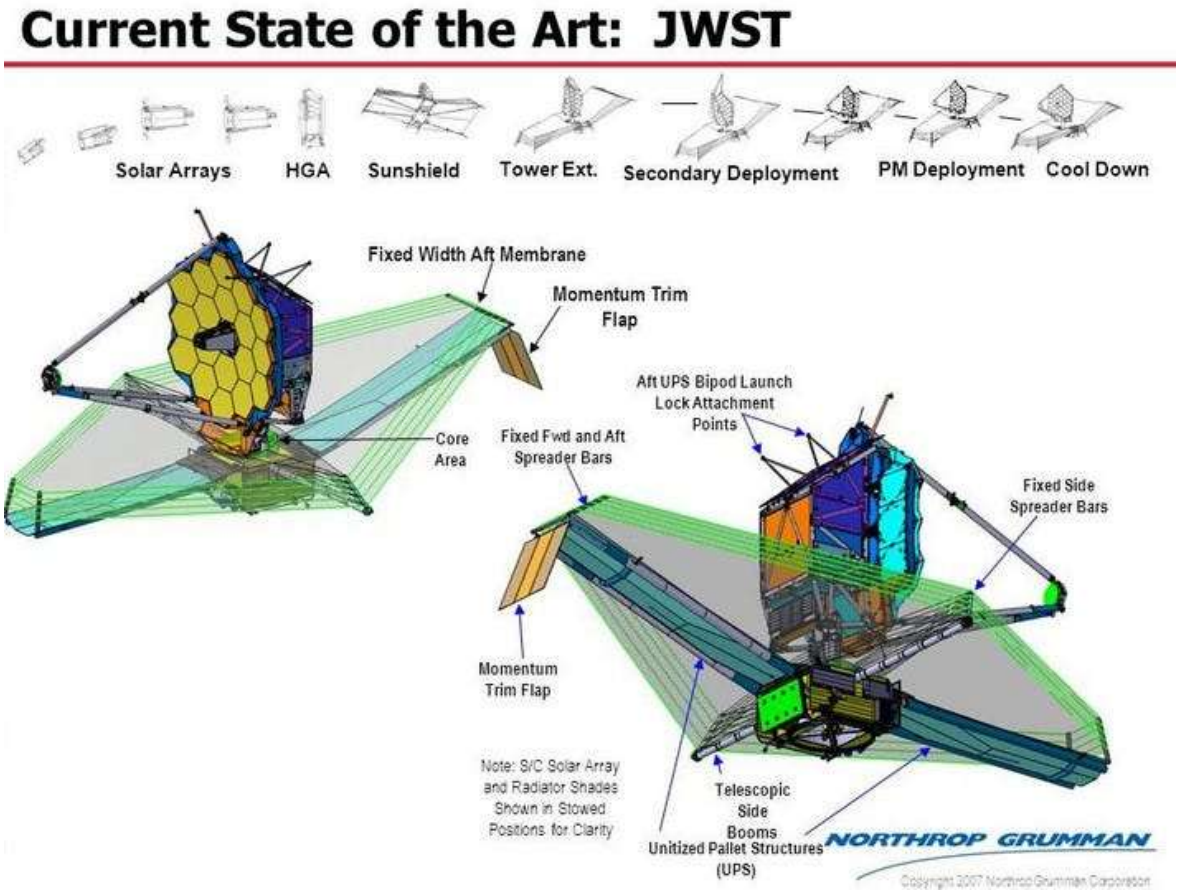
- Space dust makes the observation of weak or very distant heavenly bodies difficult because of the light it scatters.
- Light scattering by very small objects increases as the wavelength decreases, to the fourth power; the Tyndall Effect or Rayleigh Scattering
- Scattering = k/λ^4 , k is a constant λ is wavelength
- The blue part of the spectrum is around 700 nm wavelength, the red around 450 nm, therefor blue light is scattered $(700/550)^4$ = 6 times more than the red. Therefor the sky is blue.
- To minimize the effect of scattering, telescopes should view light at long wavelengths, such as the near infrared (780 to 2,500 nm) and middle infrared (2,500 to 25,000 nm)
- 1nm is 1 nanometer = one billionth (10^{-9}) of a meter

SPACE DUST, VISIBLE vs INFRARED VIEW

See how space dust scatters visible light to obscure an object but has little effect on infrared light.



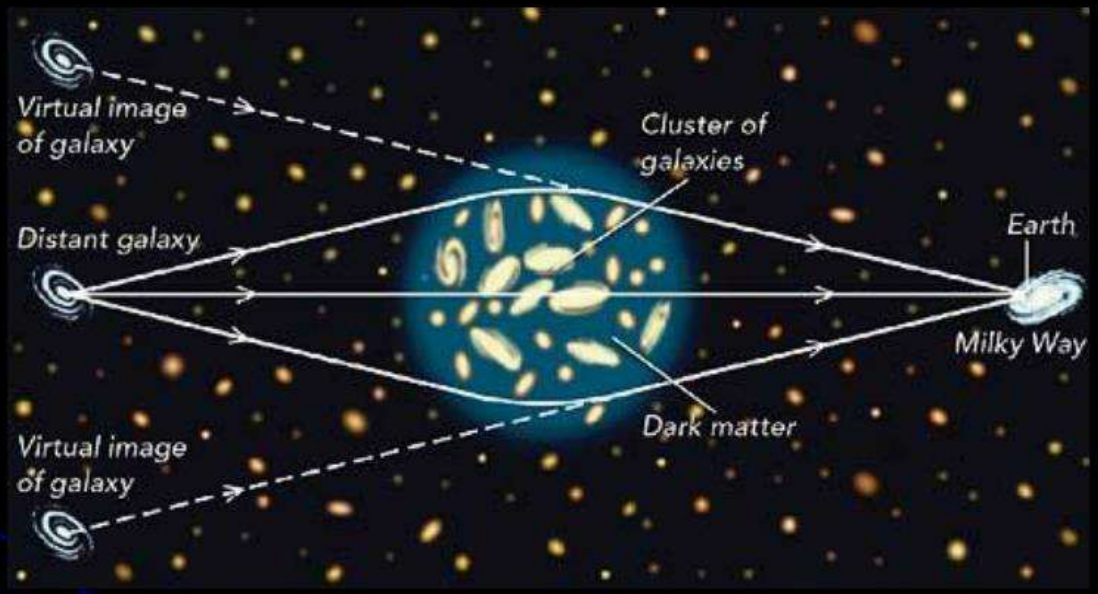
THE WEBB SPACE TELESCOPE



ADVANTAGES OF THE WEBB TELESCOPE

- Very large mirror 21.3 feet vs 7.8 feet of the Hubble. Light gathering power is proportional to the square of the width, being 7.5 times greater than the Hubble
- Capable of obtaining spectra in the visible, near infrared and far infrared.
- Uses gravitational lensing to observe very distant galaxies
- **Those very distant galaxies are near the edge of the universe, nearly 13 billion light years away**.
- ***The data we get on those very distant galaxies is how they were NEARLY 13 billion years ago.***

What is Gravitational Lensing?



Gravitational lensing is a visual effect caused by the distortion of space-time caused by large masses. The paths that light follow no longer remain straight.

GRAVITATIONAL LENSING CAUSED BY GENERAL RELATIVITY

- General Relativity shows that Gravity warps Space
- Since light travels through space its path is also warped
- Extremely massive bodies warp space so much that light is trapped: ***black holes***
- General Relativity is based on Non-Euclidean **Geometry**, which pertains to non-planar surfaces, as opposed to Euclidean Geometry with which we are all familiar and is limited planar (flat) surfaces

Here again is the necessity of geometry to understand the architecture of God's universe.