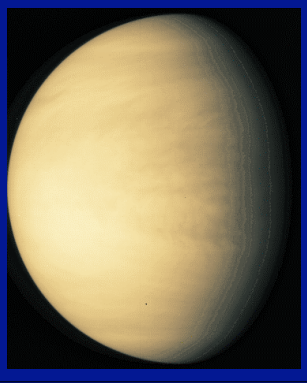
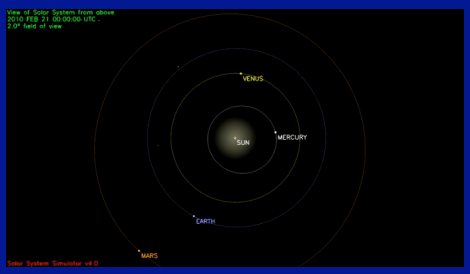
Venus…Earth's twin



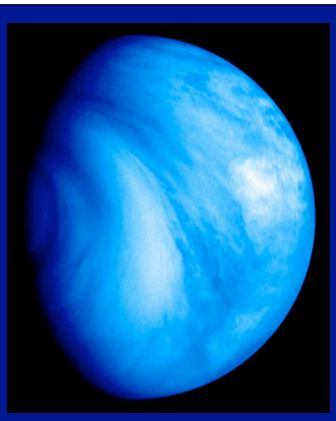
Reminder: where is Venus in the solar system right now



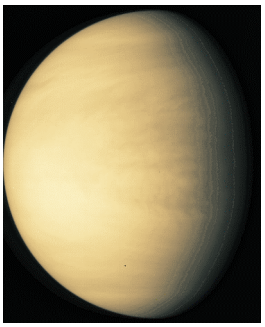
Did anybody see it in the night sky the last two night?

Venus in ultraviolet light

What is under
The clouds?



The planet Venus: the Earth's twin (in a limited sense)



A comparison of Earth and Venus

- Semimajor axis of orbit: 0.7233 (V) 1.000 (E)
- Orbital eccentricity: 0.007 (V), 0.017 (E)
- Diameter: 12104 km (V) 12756 (E) !
- Mass: 0.815 Earth masses (V) 1.00 Earth masses (E) !!
- As spheres, Venus and Earth are very similar

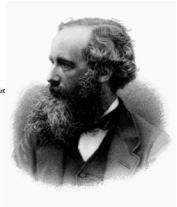
⇨ demo

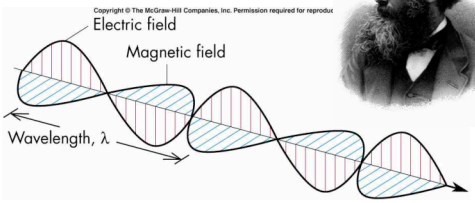
Seeing through the clouds of Venus with **Radio Astronomy!**

The Goldstone (California) tracking station and planetary radar

So what does radio astronomy or radar astronomy do for you?

First result: light is a wave (electromagnetic wave)





Wave characterized by wavelength, amplitude
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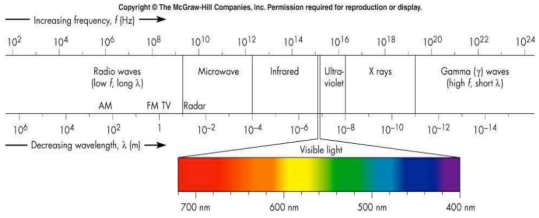
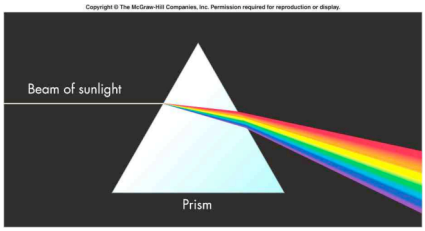
Amazing fact of nature: wide range of wavelengths of electromagnetic waves



EM radiation includes gamma rays, x-rays, ultraviolet, Light, infrared, microwave, radio

Concept from physics crucial for astronomy: the spectrum of light



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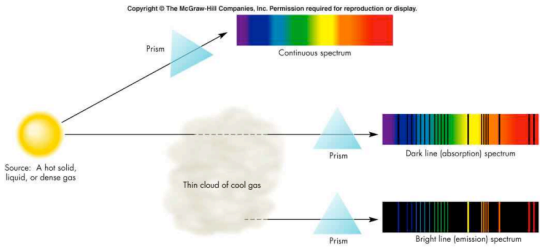
The Physics of Spectrum Formation, Kirchoff's Laws and Wien's Law

- Hot opaque solid or liquid produces a continuous spectrum
- Hot, tenuous gas observed against dark background produces emission line spectrum
- Cold, tenuous gas observed against bright background produces absorption spectrum
- See Figure 16.6

Kirchoff's Laws of Radiation



Kirchoff's First Law + Wien's Law

- Hot, opaque objects produce *continuous spectrum*
- The hotter the object, the bluer it is
- Wien's Law w_{max} = 2.9E-03/T
- The hotter an object, the brighter it is

Radio astronomy and application of Kirchoff's Laws and Wien's Law allow us to measure the surface temperature of Venus (done first in the late 1950s)

- Surface temperature is 730K
- That corresponds to 855 degrees Fahrenheit
- What is responsible for this sort of temperature?
- The answer also lies in Kirchoff's Laws