



The Electromagnetic Spectrum—Answer Key

<p>Radio Waves</p> <ul style="list-style-type: none"> • Longest <u>wavelength</u> lowest <u>frequency</u> • wavelength range: 10^6m to 1m • Usually described by their <u>frequency</u> • Different types of radio waves (from high f to low f are: <u>RADAR</u>, <u>CB (Citizen's Band)</u>, <u>FM</u>, <u>Television</u>, <u>AM</u>, <u>Shortwave</u>, <u>Satellite</u>, <u>Communications</u>) • AM stands for <u>amplitude modulation</u> and is given in <u>kHz</u> • FM stands for <u>frequency modulation</u> and is given in <u>MHz</u> • 1st Radio waves were transmitted/detected by <u>Heinrich Hertz</u> • The first “wireless” radio device was invented by: <u>Guglielmo Marconi</u> • Can be <u>reflected</u> or <u>transmitted</u> by Earth's atmosphere <p>Cosmic Connection:</p> <ul style="list-style-type: none"> • SETI: <u>Search for Extra Terrestrial Intelligence</u> • Closely related to <u>x-ray</u> or <u>gamma-ray</u> events 	<div style="text-align: center;">  <p>Guglielmo Marconi (1874-1937) http://en.wikipedia.org/wiki/Guglielmo_Marconi</p> </div>
<p>Microwaves</p> <ul style="list-style-type: none"> • Name means: <u>small radio waves</u> • Wavelength range: 1m to 1cm • Non-ionizing; when absorbed they cause <u>water molecules to vibrate, creating heat.</u> • First developed during <u>WWII</u> and used for <u>communications.</u> • Causes: <u>cataracts</u> <p>Calculating the Speed of Light = _____ x _____</p> <p>c = _____</p> <p>% error = _____</p> <p>Cosmic Connection: <u>Penzias and Wilson</u> detected the <u>Cosmic Microwave Background Radiation (CMBR)</u>. Left over radiation from the <u>Big Bang</u> Uniform to 1 part in 1 <u>billion</u> (Nobel Prize in 1978)</p>	<p style="text-align: center;">Telescope used by Penzias and Wilson at Bell Labs</p> <div style="text-align: center;">  <p>http://www.pbs.org/wgbh/aso/databank/entries/dp65co.html</p> </div>

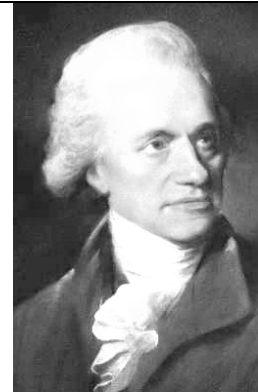
Infrared Rays

- **Name means:** Below red
- **a.k.a.** "heat rays"
- **Wavelength range:**
 - Near:** 1-5 μ m
 - Mid:** 5-40 μ m
 - Far:** 40-350 μ m
- **Uses:** TV remotes, photography, thermal imaging

- **Discovered in 1800 by** William Herschel **using a prism and a thermometer.**
- **Non-ionizing; when absorbed they cause atoms to vibrate**

Cosmic Connection:

Great indicator of star forming regions



Google Image Search

Visible Light

- Small band of frequencies that the retina of the eye responds to.
- Wavelength range: : 400-700 nm
- Color receptors: cones
- Black/white receptors: rods
- Longest wave, lowest frequency: red
- Shortest wave, highest frequency: blue
- First separated into the visible spectrum by: Isaac Newton

Cosmic Connection:

- Identifying atomic spectra
- Lightcurves of extrasolar planets



Biographyonline.net

Ultraviolet Rays

- Wavelength range: 400nm to 10 nm

- Discovered in 1801 by Johann Ritter

Tried to find “cold-rays” past the violet end of the spectrum after hearing about Herschel’s heat rays. White Silver Chloride turned dark when exposed to light past the violet end of the spectrum Named the new wavelength “Ritter Rays,” were later named ultraviolet

- 3 Kinds: UVA: 400-315 nm

UVB: 315-280 nm

UVC: 280-100 nm

- UVB and C destroy DNA at the cellular level

- UVB produces vitamin D in skin up to 1000 IUs per min.

Regulates bone growth, immunity, and blood pressure.

- Uses:

- Forensics, UV curing of finishes, fluorescence, optical brighteners, black lights

- http://en.wikipedia.org/wiki/Johann_Wilhelm_Ritter



X-Rays

- Wavelength range: 0.01nm to 10 nm

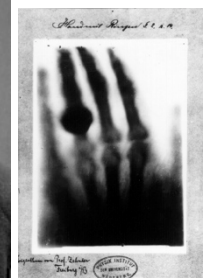
- Discovered in 1895 by Wilhelm Roentgen

- Man-made x-rays are made by a vacuum tube that generates high voltages to accelerate electrons (cathode). The high velocity electrons collide with a metal target usually tungsten (anode) .

- Uses:

- Hard: inspection of bridges, beams, building construction

- Soft: x-ray crystallography, medical diagnosis and treatment



http://nobelprize.org/nobel_prizes/physics/laureates/1901/roentgen-bio.html

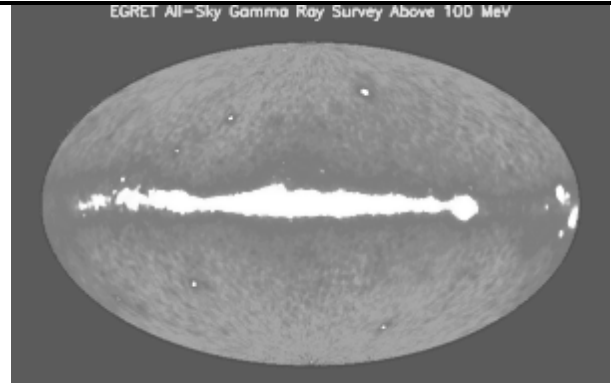
Gamma Rays

- **Wavelength:** 10 pm
- **Discovered in** 1900 by Paul Villard
- **Produced by :** nuclear fission, fusion, and decay

Gamma-ray astronomy: Started in late 1960/early 1970 with the Vela satellite. Was used to detect suspected nuclear bombs detonated from space during the Cold War but instead found large amounts of energy from cosmic sources

Ground-based gamma-ray detection:

Cherenkov radiation occurs when high-energy particles hit the earth's atmosphere. A shower of gamma rays is produced.



Cosmic Rays

*Not technically light, but particles travel close to c .

- Discovered in 1912 by Victor Hess
- Energetic particles originating from space
- May be from:
Supernova, solar flares, gamma-ray bursters, and other high-energy events.



http://en.wikipedia.org/wiki/Victor_Francis_Hess