The Electromagnetic Spectrum:

- **Wavelength (m)**
  - $3 \times 10^4 \text{ m}$
  - $3 \text{ m}$
  - $3 \times 10^{-4} \text{ m}$
  - $3 \times 10^{-8} \text{ m}$
  - $3 \times 10^{-12} \text{ m}$

- **Frequency (Hz)**
  - $10^2$
  - $10^4$
  - $10^6$
  - $10^8$
  - $10^{10}$
  - $10^{12}$
  - $10^{14}$
  - $10^{16}$
  - $10^{18}$
  - $10^{20}$

- **Units of Measurement**
  - $\lambda = 7.5 \times 10^{-7} \text{ m}$
  - $f = 4 \times 10^{14} \text{ Hz}$
  - Visible light: $7.5 \times 10^{14} \text{ Hz}$

- **Size of a Wavelength**
  - Longer:
    - Soccer Field
    - House
    - Baseball
    - This Period
    - Cell
  - Shorter:
    - Bacteria
    - Virus
    - Protein
    - Water Molecule

- **Common Name of Wave**
  - **RADIO WAVES**
  - **INFRARED**
  - **ULTRAVIOLET**
  - **“SOFT” X-RAYS**
  - **“HARD” X-RAYS**
  - **MICROWAVES**

- **Sources**
  - AM Radio, FM Radio, Microwave Oven, Radar, People, Light Bulb, The A.S, X-Ray Machines, Radioactive Elements

- **Frequency (waves per second)**
  - $10^6$
  - $10^7$
  - $10^8$
  - $10^9$
  - $10^{10}$
  - $10^{11}$
  - $10^{12}$
  - $10^{13}$
  - $10^{14}$
  - $10^{15}$
  - $10^{16}$
  - $10^{17}$
  - $10^{18}$
  - $10^{19}$
  - $10^{20}$

- **Energy of one photon (electron volts)**
  - $10^{-9}$
  - $10^{-8}$
  - $10^{-7}$
  - $10^{-6}$
  - $10^{-5}$
  - $10^{-4}$
  - $10^{-3}$
  - $10^{-2}$
  - $10^{-1}$
  - $1$
## The Sun From Space

<table>
<thead>
<tr>
<th>X-Rays</th>
<th>Soft X-ray Telescope</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="http://www.lmsal.com/YPOP/ProjectionRoom/latest.html" alt="image" /></td>
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</tbody>
</table>

### Extreme Ultraviolet

<table>
<thead>
<tr>
<th>EUV Imaging Telescope</th>
<th>Magnetic Field</th>
<th>White Light</th>
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</thead>
<tbody>
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### Ultraviolet

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<tr>
<th>EUV Imaging Telescope</th>
<th>Michelson-Doppler Imager</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>
THE MILKY WAY IN MANY WAVELENGTHS

Radio
408 MHz Bonn, Jodrell Bank, & Parkes

Atomic Hydrogen
21 cm Dickey-Lockman

Molecular Hydrogen
115 GHz Columbia-GISS

Infrared
12, 60, 100 μm IRAS

Near Infrared
1.25, 2.2, 3.5 μm COBE/DIRBE

Optical
Laustsen et al. Photomosaic

X-Ray
0.25, 0.75, 1.5 keV ROSAT/PSPC

Gamma Ray
>100 MeV CGRO/EGRET
Crab Nebula Supernova Remnant • SN 1054

Crab Nebula from Palomar and HST

Kepler’s Supernova Remnant • SN 1604

X-ray
Chandra X-ray Observatory
NASA, ESA, R. Sankrit and W. Blair (Johns Hopkins University)

X-ray
Chandra X-ray Observatory

Visible
Hubble Space Telescope

Infrared
Spitzer Space Telescope

Crab Nebula

STScI-PRC04-29a

HST • WFPC2

PRC6-22a • ST ScI OPO • May 30, 1996

Palomar

NASA and ESA
New: AEGIS is in Google Sky! Click here to explore X-ray, ultraviolet, visible, and infrared images.

The AEGIS Survey...

...is unlocking the secrets of galaxy and large-scale structure formation over the last 9 billion years.

AEGIS is targeted on a special area of the sky, called the Extended Groth Strip (EGS), that has been observed with the world's most powerful telescopes on the ground and in space, from X-rays to radio waves.

Each telescope contributes its own key information to create a complete portrait of every galaxy. By looking out far into space and back in time, AEGIS literally shows us galaxies in all their glory that are emerging from infancy into adulthood. More...
Welcome to the Moving Charge Applet

This applet shows the field of a moving charge, and how it is concentrated directions perpendicular to the motion. It also shows how information only propagates at the speed of light, and shows how the accelerating charge emits radiation by the compression of electric field lines, which produces an electromagnetic wave.

Instructions:
- Select Your Mode From the pull down menu and press go.
- Use the scrollbar to accelerate the charge.
Merging Spiral Galaxies - simulating visual appearance

Dust absorption is particularly important during the final coalescence of the two galaxies, when the rapidly forming stars are heavily enshrouded in dust and gas. At this time, over 90% of the starlight is absorbed.

To illustrate this effect, we will now fade between still images that do not include dust to images that do.