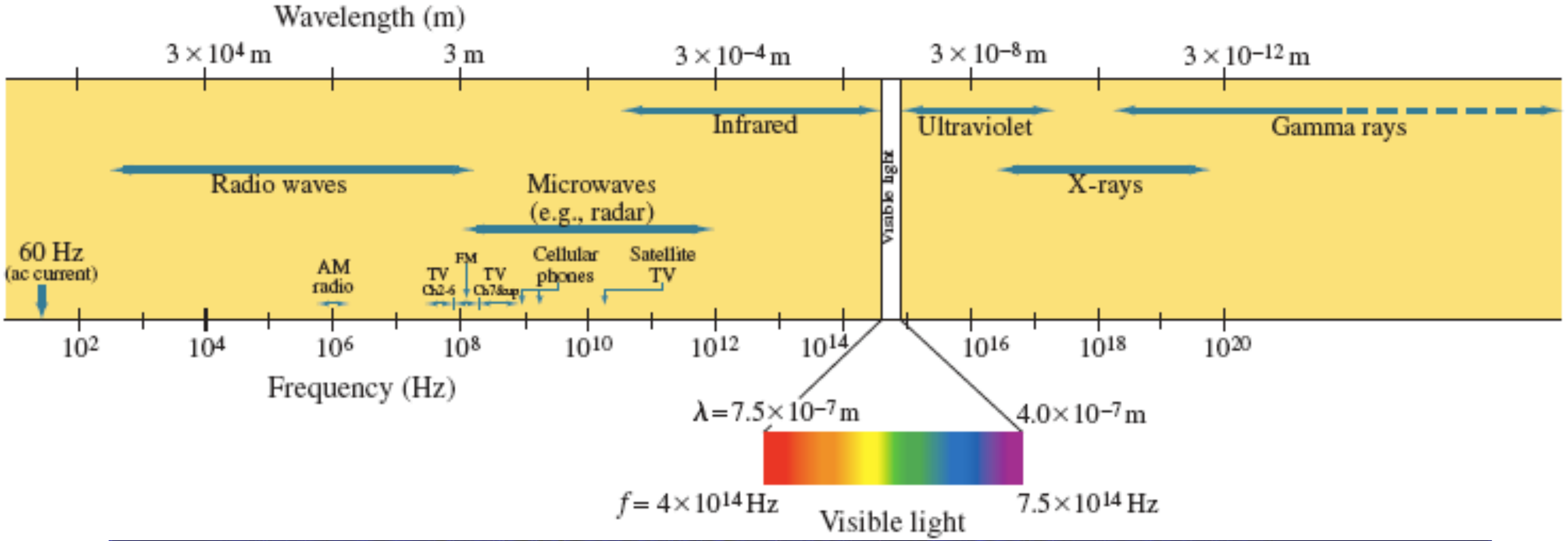
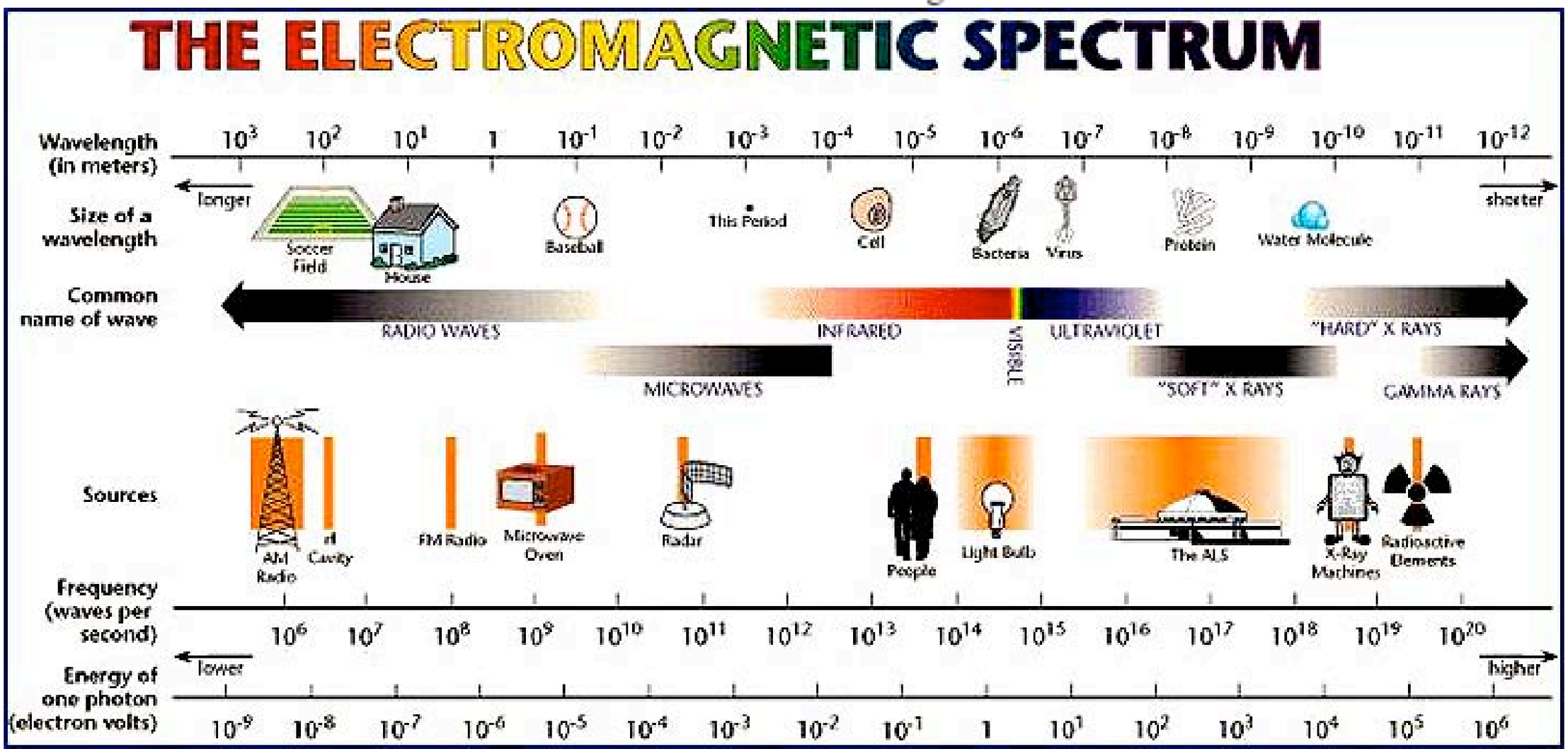

Wavelength (m)
3 × 10^4 m
3 m
3 × 10^−4 m
3 × 10^−8 m
3 × 10^−12 m
Infrared
Ultraviolet
Gamma rays
Radio waves
Microwaves
(e.g., radar)
Visible light
X-rays
60 Hz
(ac current)
AM
radio
TV
Ch2-6
FM
TV
Ch7&up
Cellular
phones
Satellite
TV
10^2
10^4
10^6
10^8
10^10
10^12
10^14
10^16
10^18
10^20
Frequency (Hz)
λ = 7.5 × 10^−7 m
4.0 × 10^−7 m
f = 4 × 10^14 Hz
7.5 × 10^14 Hz
Visible light


THE ELECTROMAGNETIC SPECTRUM
Wavelength (in meters)
10^3 10^2 10^1 1 10^-1 10^-2 10^-3 10^-4 10^-5 10^-6 10^-7 10^-8 10^-9 10^-10 10^-11 10^-12
longer
shorter
Size of a wavelength
Soccer Field
House
Baseball
This Period
Cell
Bacteria
Virus
Protein
Water Molecule
Common name of wave
RADIO WAVES
MICROWAVES
INFRARED
VISIBLE
ULTRAVIOLET
"SOFT" X RAYS
"HARD" X RAYS
GAMMA RAYS
Sources
AM Radio
rf Cavity
FM Radio
Microwave Oven
Radar
People
Light Bulb
The ALS
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
lower
higher
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 10^1 10^2 10^3 10^4 10^5 10^6

(540-1650 KHz) (88-108 MHz) Microwave

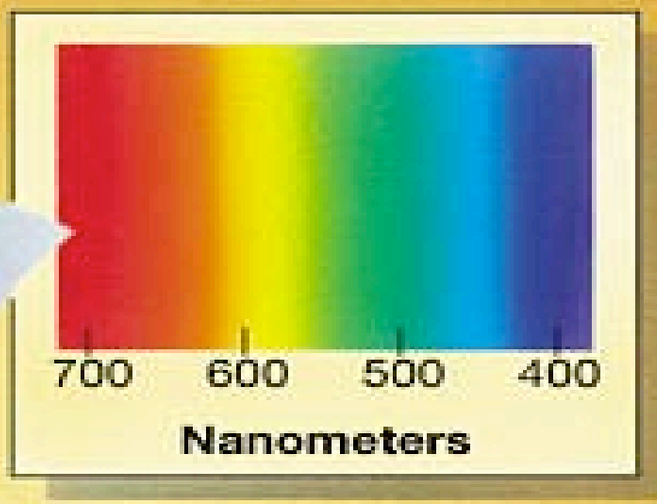
AM Radio FM

1 GHz 100 GHz

Infrared far near

100 1 microns

Visible



Ultraviolet near far

X rays "Soft" "Hard"

Gamma rays

Frequency (Hertz)

10^3 10^5 10^7 10^9 10^{11} 10^{13} 10^{15} 10^{17} 10^{19} 10^{21} 10^{23}

Wavelength (meters)

10^4 10^2 1 10^{-2} 10^{-4} 10^{-6} 10^{-8} 10^{-10} 10^{-12} 10^{-14}

Scale

Mount Everest Sky-scraper Humans Fingernail Pin-head Bacteria Atom Atomic nucleus

Radio window

Optical window

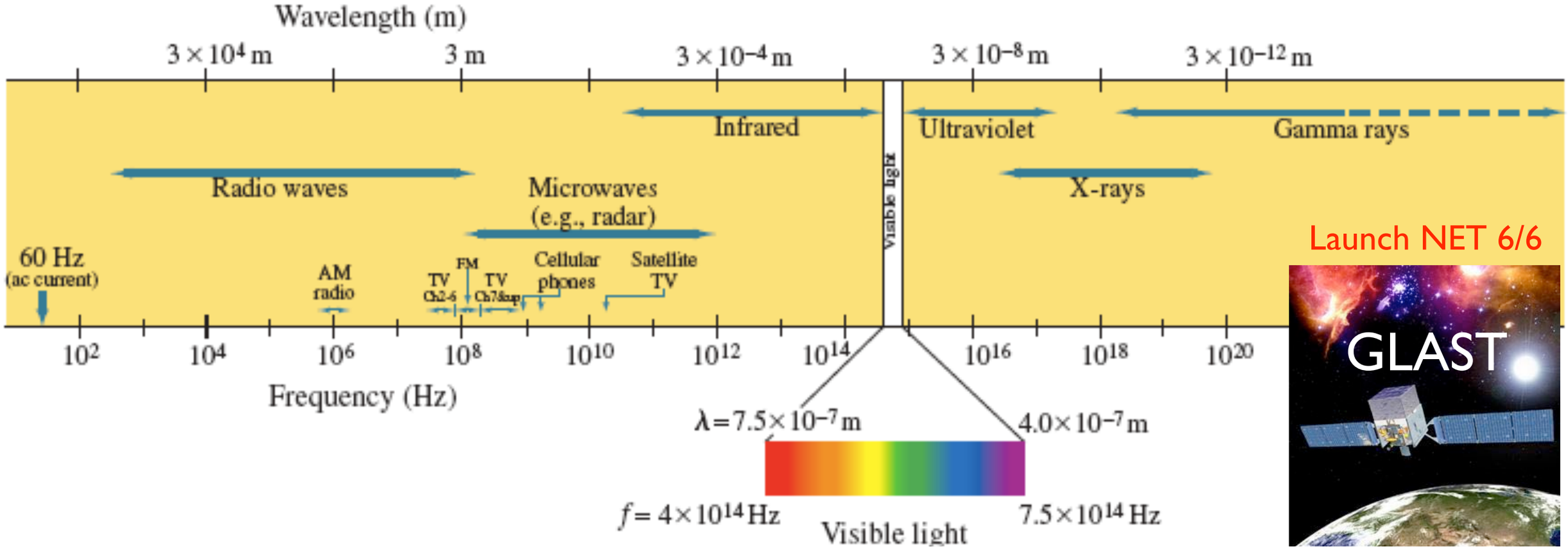
Opacity (percent) 100 50 0

Atmosphere is opaque

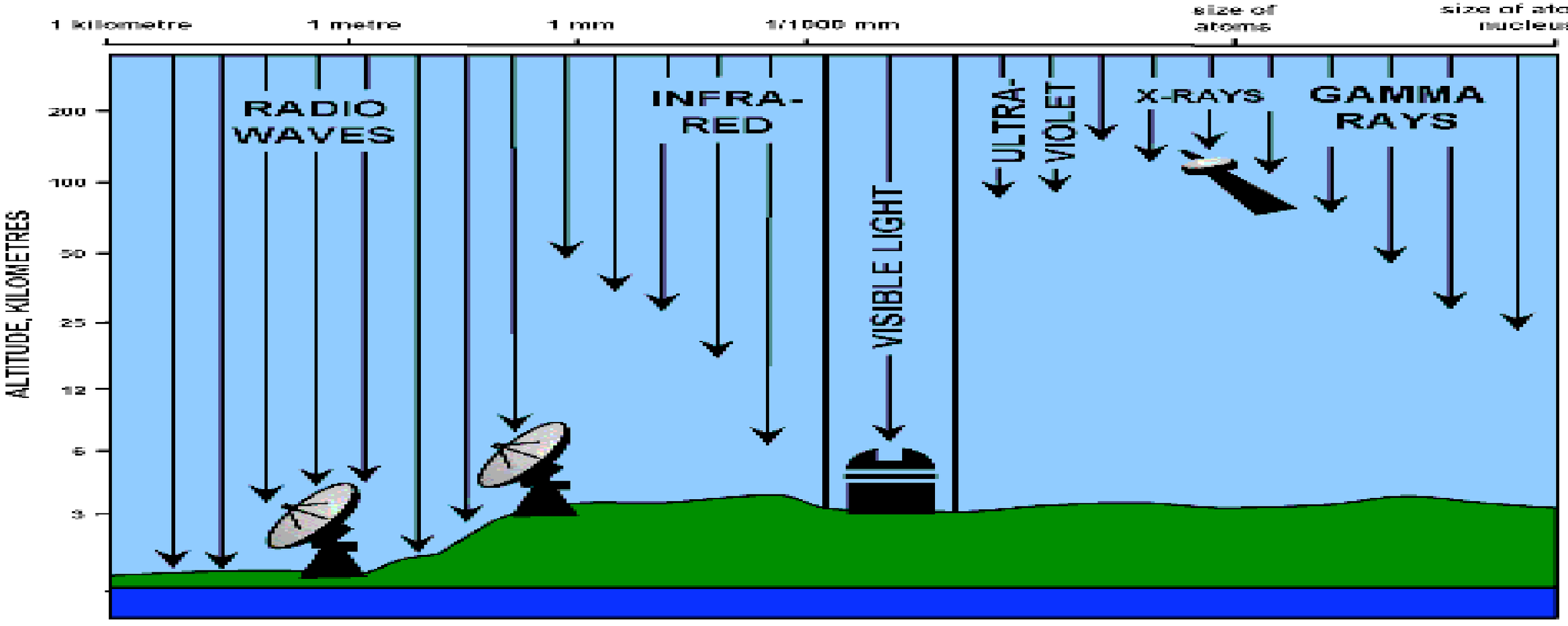
Transparent

Atmosphere is opaque

100 m 10 m 1 m 10 cm 1 cm 100 μm 10 μm 1 μm 100 nm



Launch NET 6/6

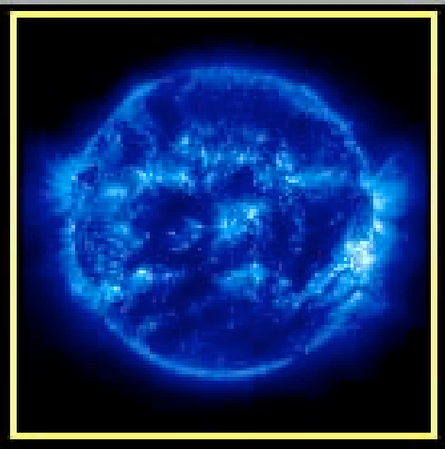


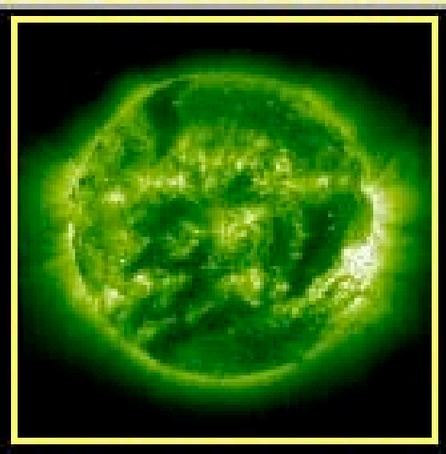
http://www.lmsal.com/YPOP/ProjectionRoom/latest.html

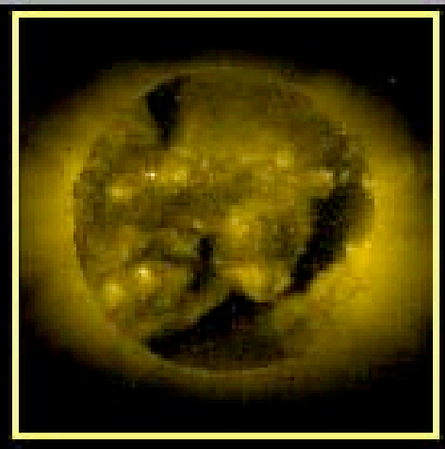
THE SUN FROM SPACE

	X-RAYS	
		
	Soft X-ray Telescope	

EXTREME ULTRAVIOLET

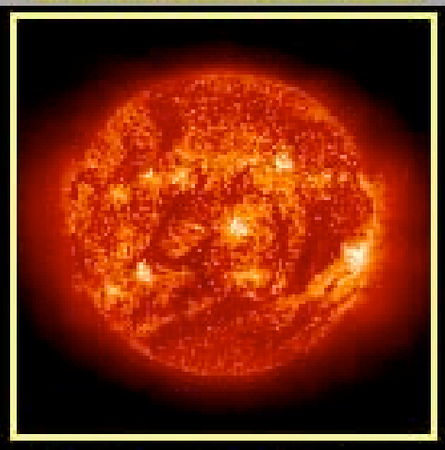


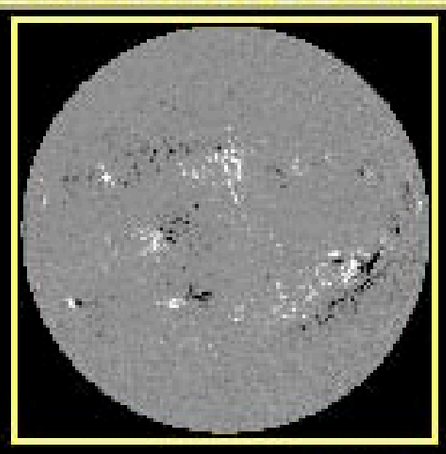


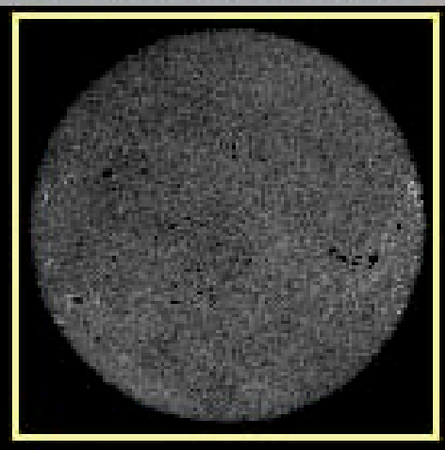


EUV Imaging Telescope

ULTRAVIOLET	MAGNETIC FIELD	WHITE LIGHT



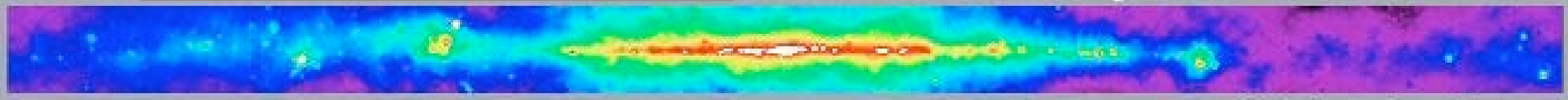




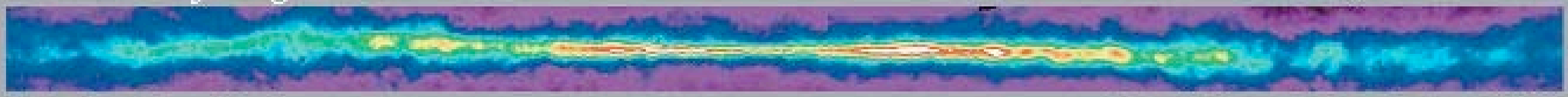
EUV Imaging Telescope	Michelson-Doppler Imager	

THE MILKY WAY IN MANY WAVELENGTHS

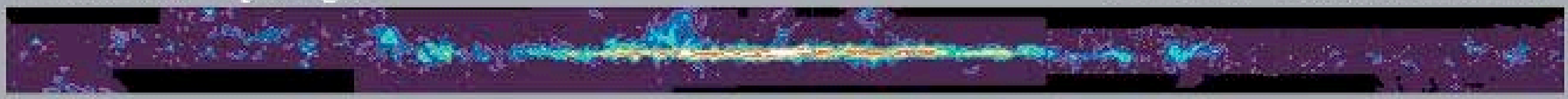
Radio — *408 MHz Bonn, Jodrell Bank, & Parkes*



Atomic Hydrogen — *21 cm Dickey-Lockman*



Molecular Hydrogen — *115 GHz Columbia-GISS*



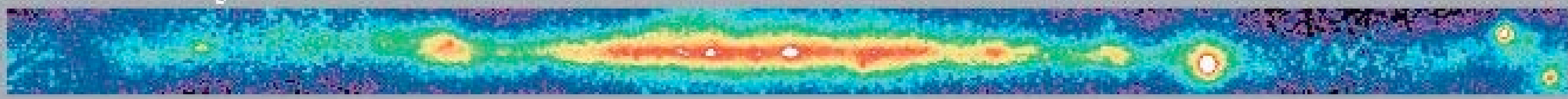
Infrared — *12, 60, 100 μm IRAS*

Near Infrared — *1.25, 2.2, 3.5 μm COBE/DIRBE*

Optical — *Laustsen et al. Photomosaic*

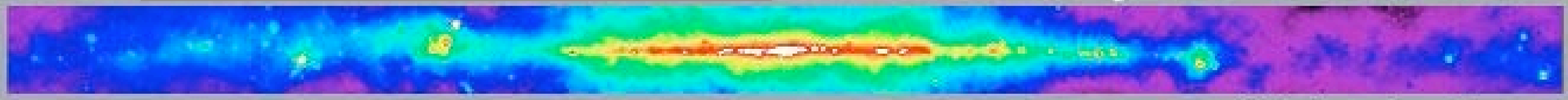
X-Ray — *0.25, 0.75, 1.5 keV ROSAT/PSPC*

Gamma Ray — *>100 MeV CGRO/EGRET*

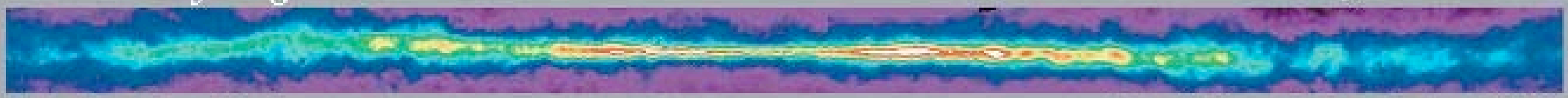


THE MILKY WAY IN MANY WAVELENGTHS

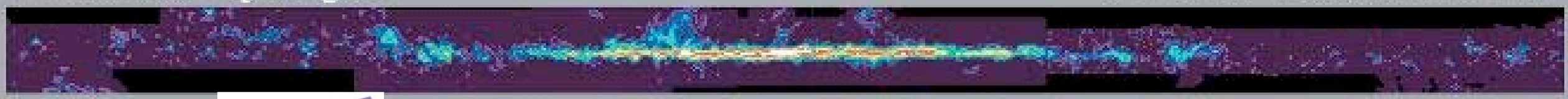
Radio Ground *408 MHz Bonn, Jodrell Bank, & Parkes*



Atomic Hydrogen Ground *21 cm Dickey-Lockman*



Molecular Hydrogen Ground *115 GHz Columbia-GISS*



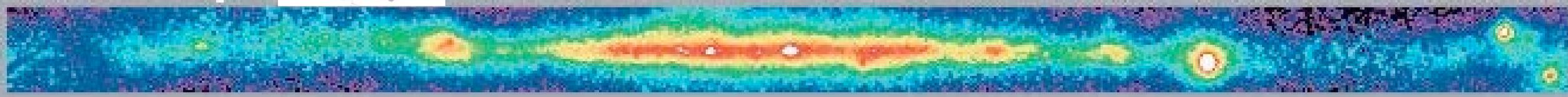
Infrared  *12, 60, 100 μm IRAS*

Near Infrared  *1.25, 2.2, 3.5 μm COBE/DIRBE*

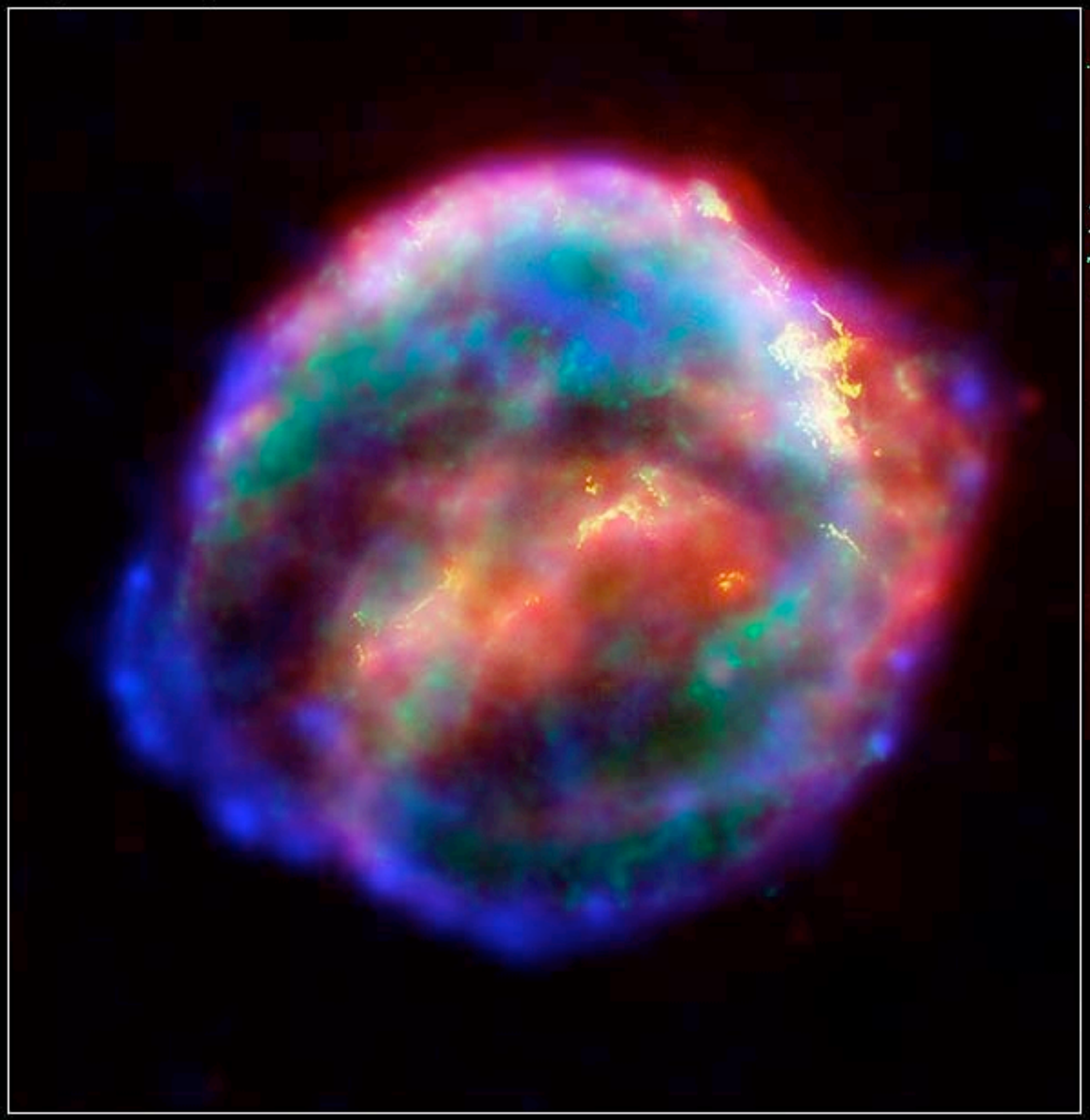
Optical Ground 8  *Laustsen et al. Photomosaic*

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

Gamma Ray  *>100 MeV CGRO/EGRET*

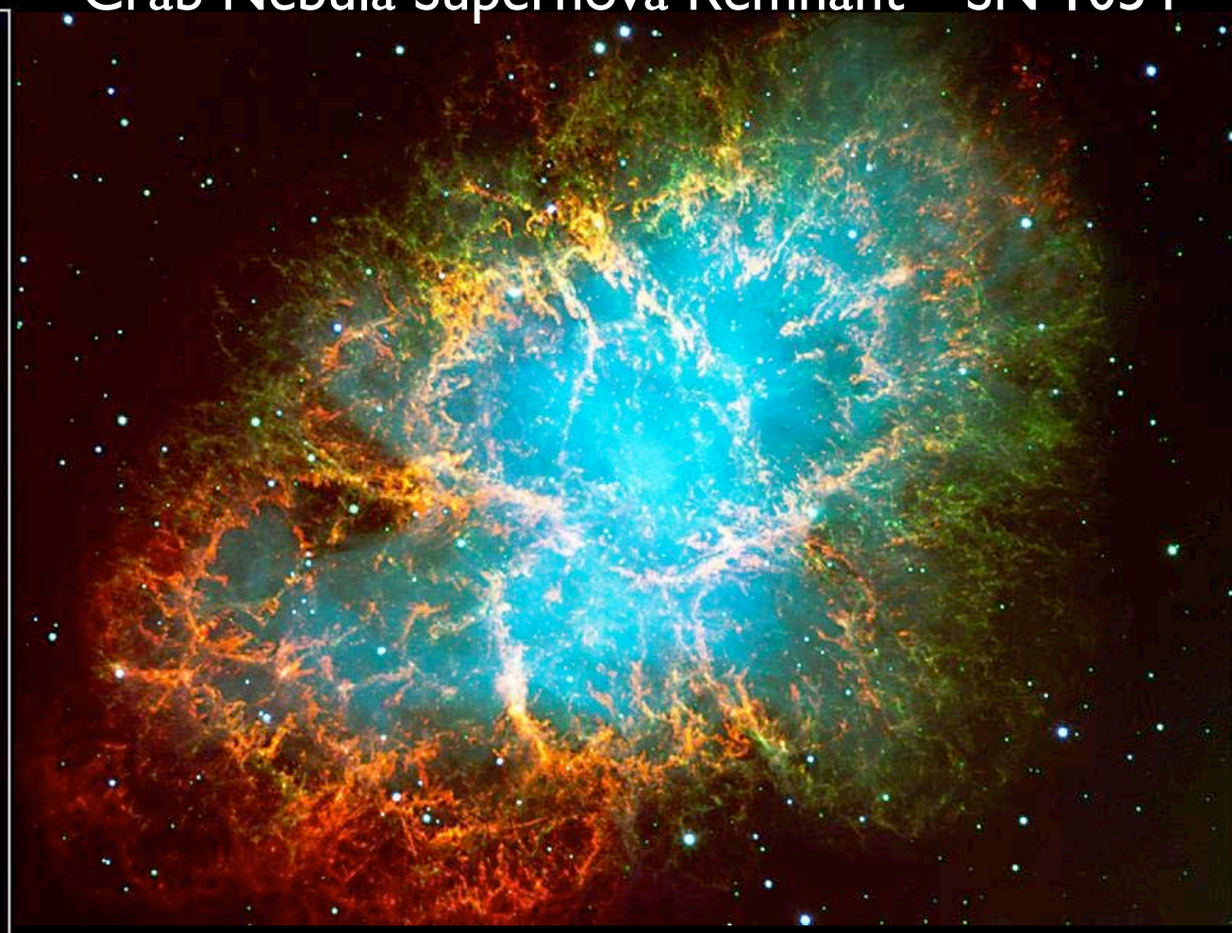


Kepler's Supernova Remnant ▪ SN 1604



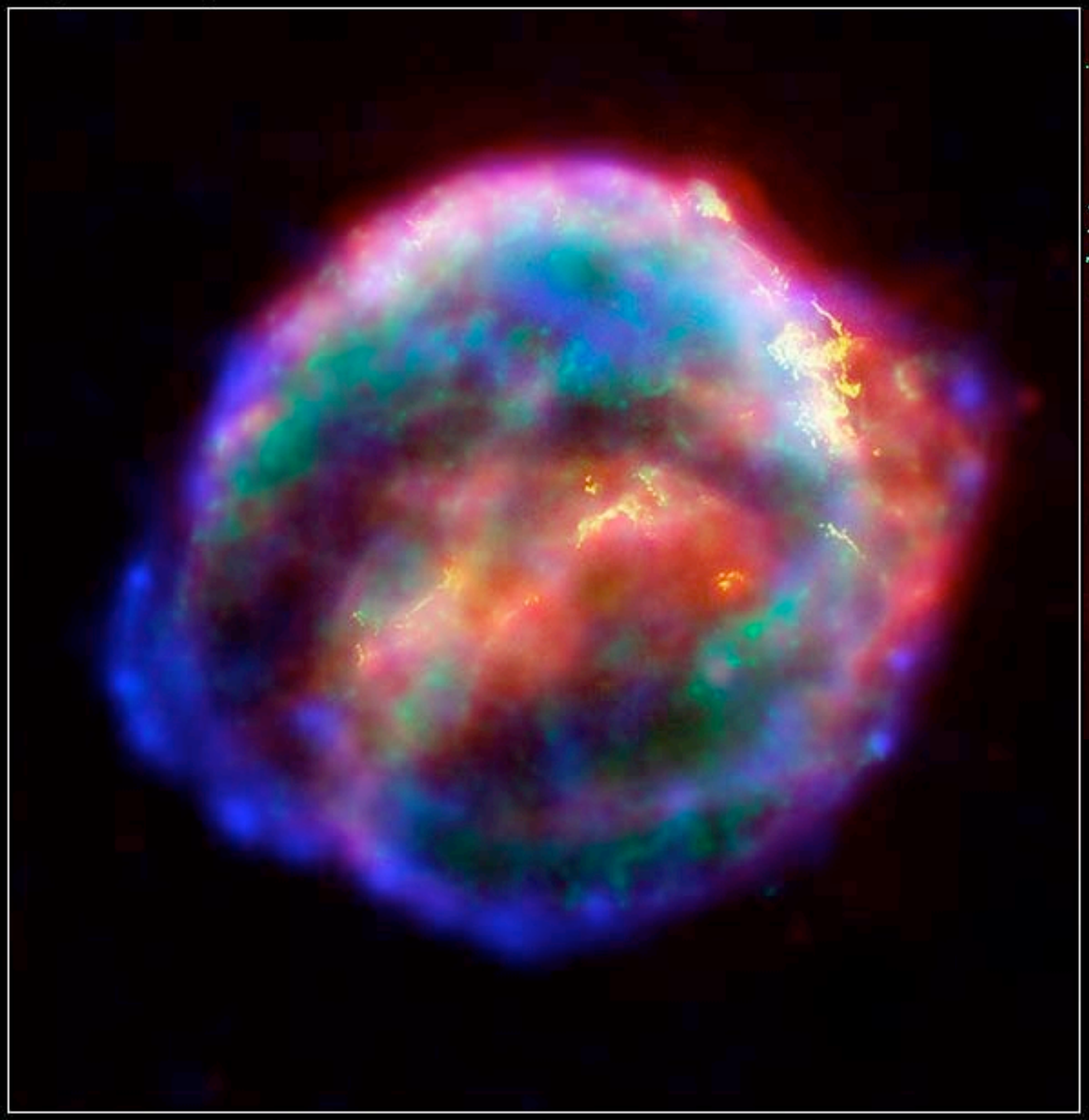
NASA, ESA, R. Sankrit and W. Blair (Johns Hopkins University) STScI-PRC04-29a

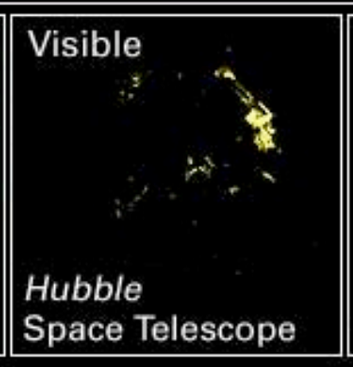
Crab Nebula Supernova Remnant • SN 1054



Making a Composite Image with Vis + IR Light

Kepler's Supernova Remnant ▪ SN 1604

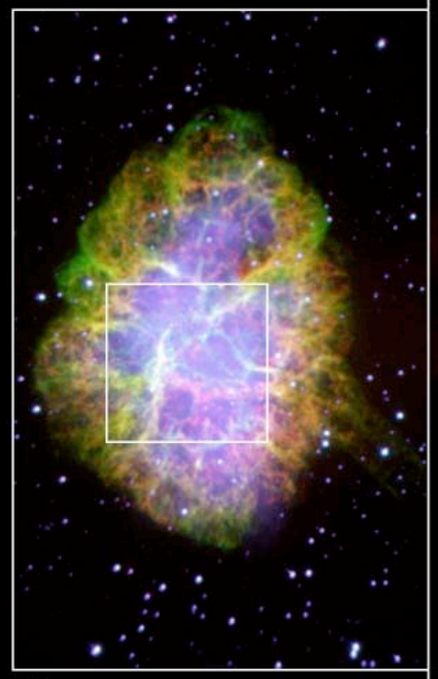




NASA, ESA, R. Sankrit and W. Blair (Johns Hopkins University) STScI-PRC04-29a

Crab Nebula Supernova Remnant • SN 1054

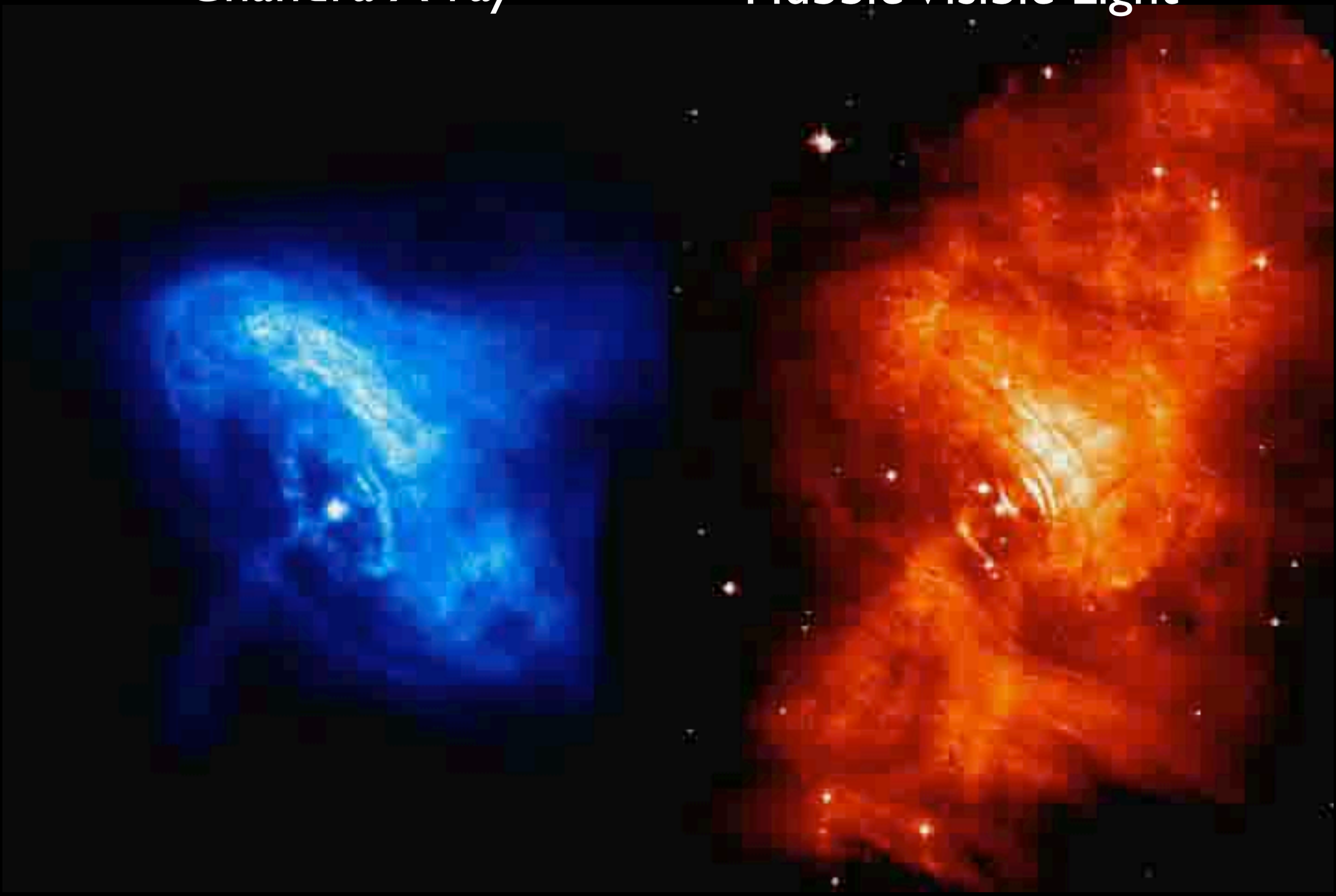
Crab Nebula from Palomar and HST

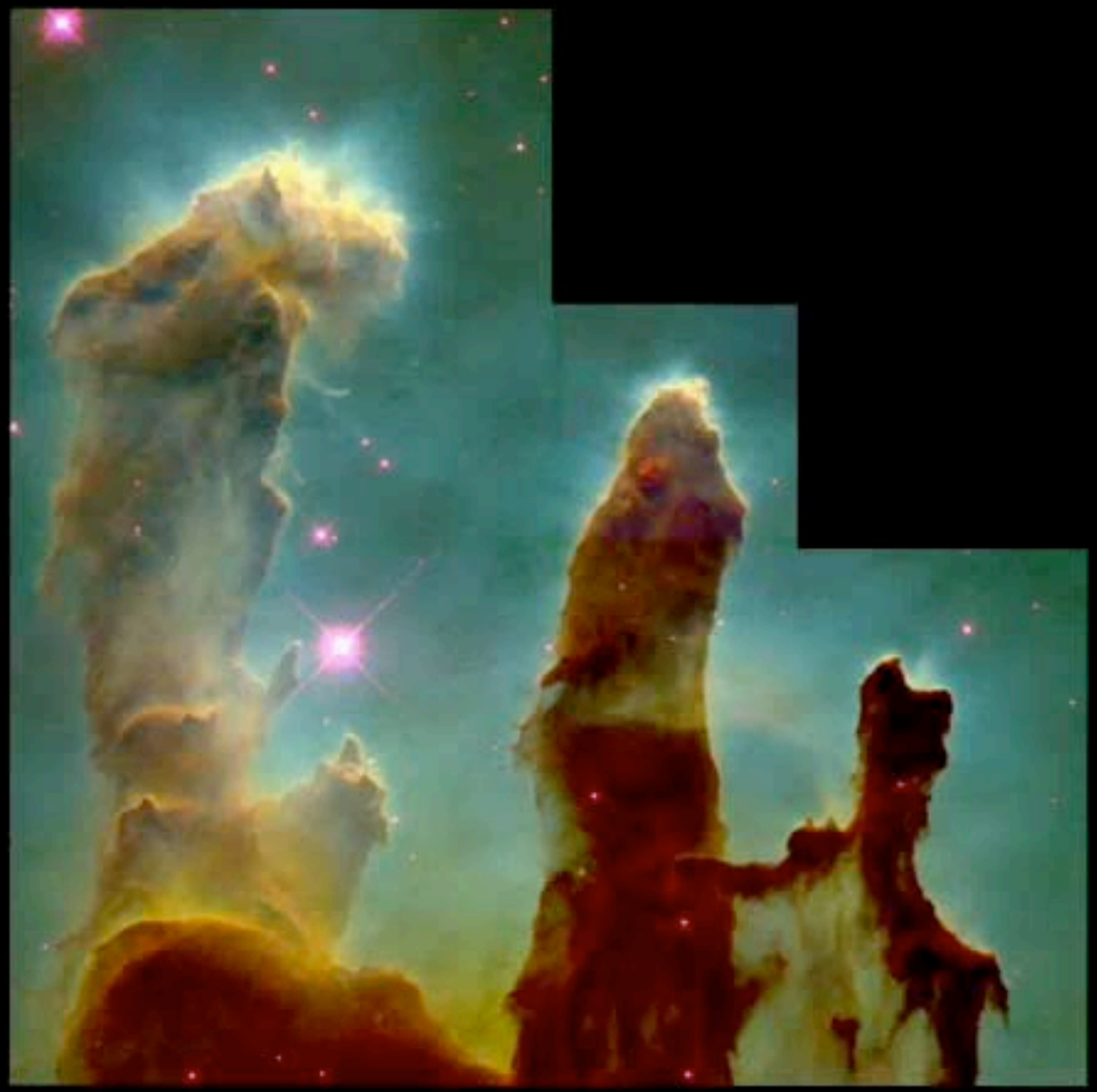


PRC96-22a · ST ScI OPO · May 30, 1996

Chandra X-ray

Hubble Visible Light





http://aegis.ucolick.org/index.html

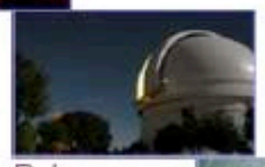
AEGIS

All-wavelength Extended Groth strip International Survey

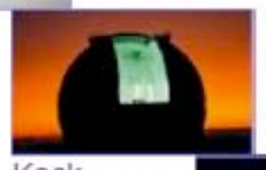
New: AEGIS is in Google Sky! Click here to explore X-ray, ultraviolet, visible, and infrared images.


VLA


Spitzer


Palomar

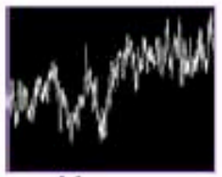

CFHT


Keck

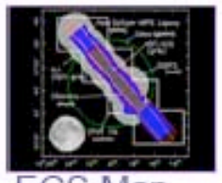

Hubble


GALEX


Chandra


News


Images


EGS Map

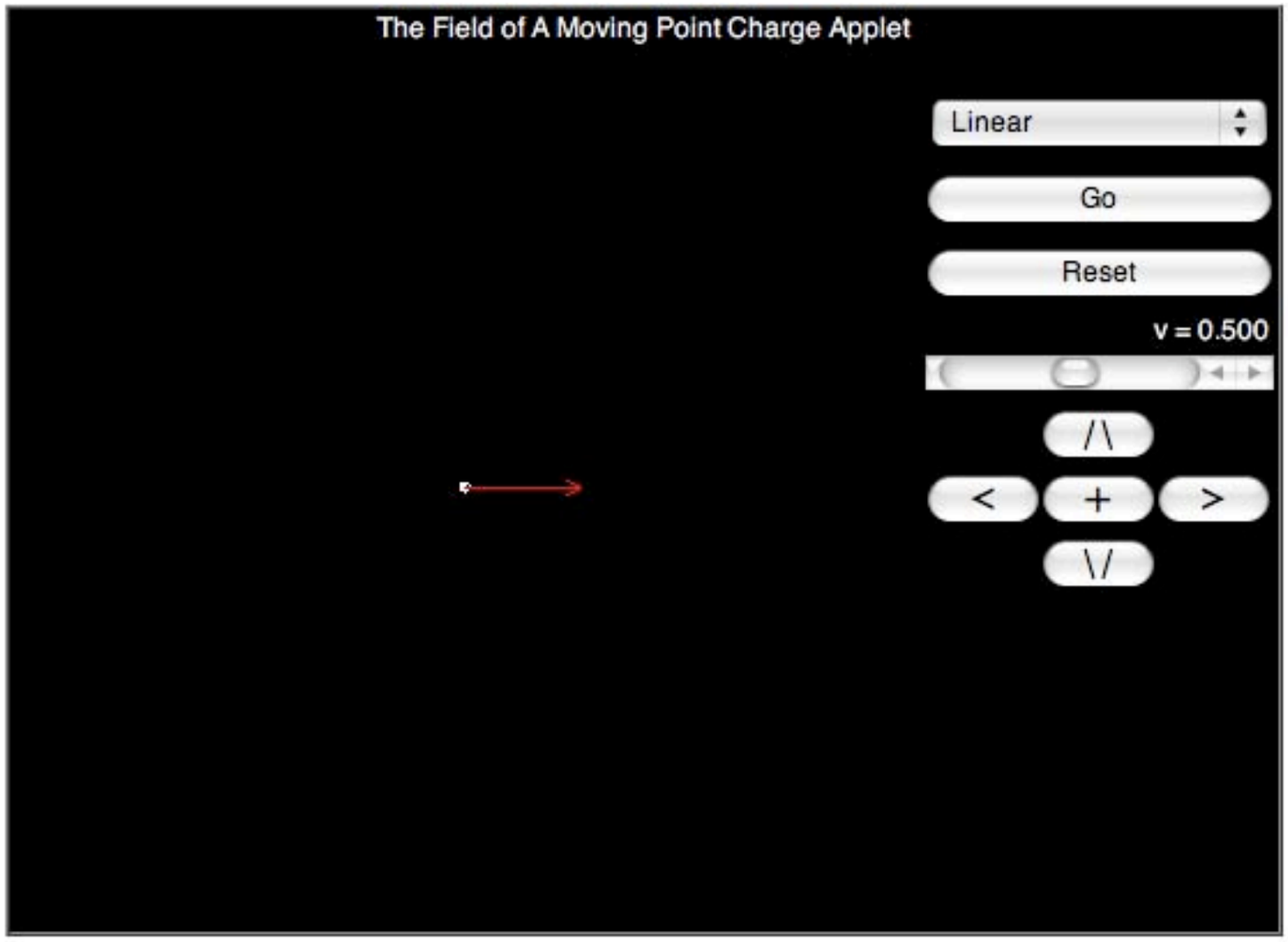
The AEGIS Survey...

...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...

http://www.cco.caltech.edu/~phys1/java/phys1/MovingCharge/MovingCharge.html



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 propogates 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.

http://www.youtube.com/watch?v=agqLEbOFT2A