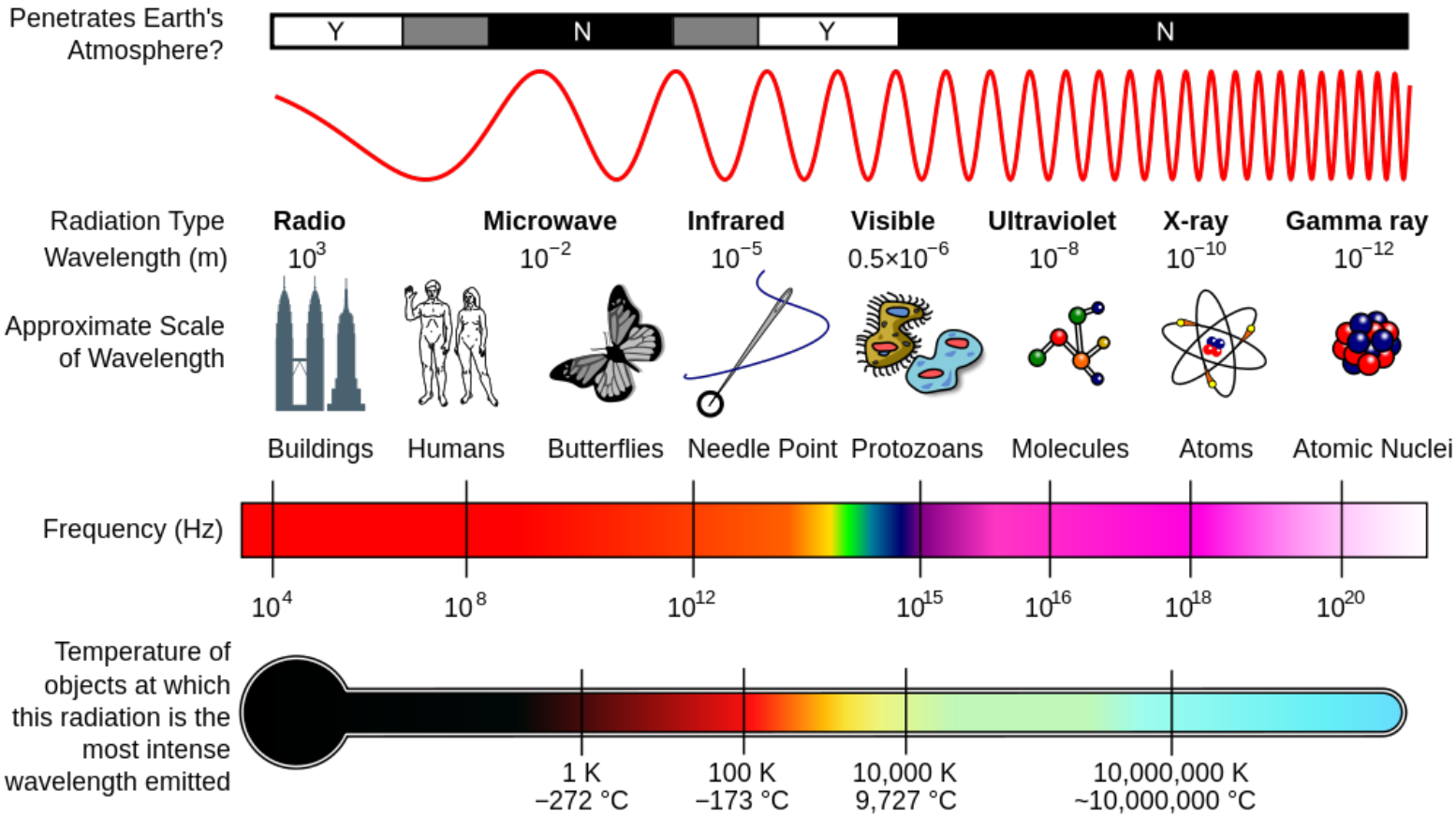
X Ray Telescopes

What gives off X-rays?

Hot and highly energetic objects....

black holes
exploded stars
galaxy clusters

False colour image


Penetrates Earth's Atmosphere?
Y
N
Y
N
Radiation Type
Wavelength (m)
Approximate Scale of Wavelength
Radio
10^{3}
Microwave
10^{-2}
Infrared
10^{-5}
Visible
0.5×10^{-6}
Ultraviolet
10^{-8}
X-ray
10^{-10}
Gamma ray
10^{-12}
Buildings
Humans
Butterflies
Needle Point
Protozoans
Molecules
Atoms
Atomic Nuclei
Frequency (Hz)
10^{4}
10^{8}
10^{12}
10^{15}
10^{16}
10^{18}
10^{20}
Temperature of objects at which this radiation is the most intense wavelength emitted
1 K
−272 °C
100 K
−173 °C
10,000 K
9,727 °C
10,000,000 K
~10,000,000 °C

X

False colours

Colours are used as a 'code'.

Colours can be associated with the intensity or brightness of the radiation from different regions of the image, or with the energy of the emission.

How it works.

X Rays are focused by mirrors.

X-rays that strike a 'regular' mirror would be absorbed.

to focus X-rays onto a detector the mirrors have to be shaped so that the X-rays hit them at grazing angles.

Animation

Where are they?

Because of atmospheric absorption, X-ray telescopes must be carried to high altitudes.

This is done with rockets and balloons or by launching the telescope into orbit outside the atmosphere.

Balloon-borne telescopes can detect the more penetrating X-rays.

Telescopes carried by rockets or in satellites are used to detect softer radiation.

Orbit

200x higher than the Hubble Space Telescope*.

*The Chandra X-ray Observatory which captures X-ray images and measures spectra of high-energy cosmic phenomena.

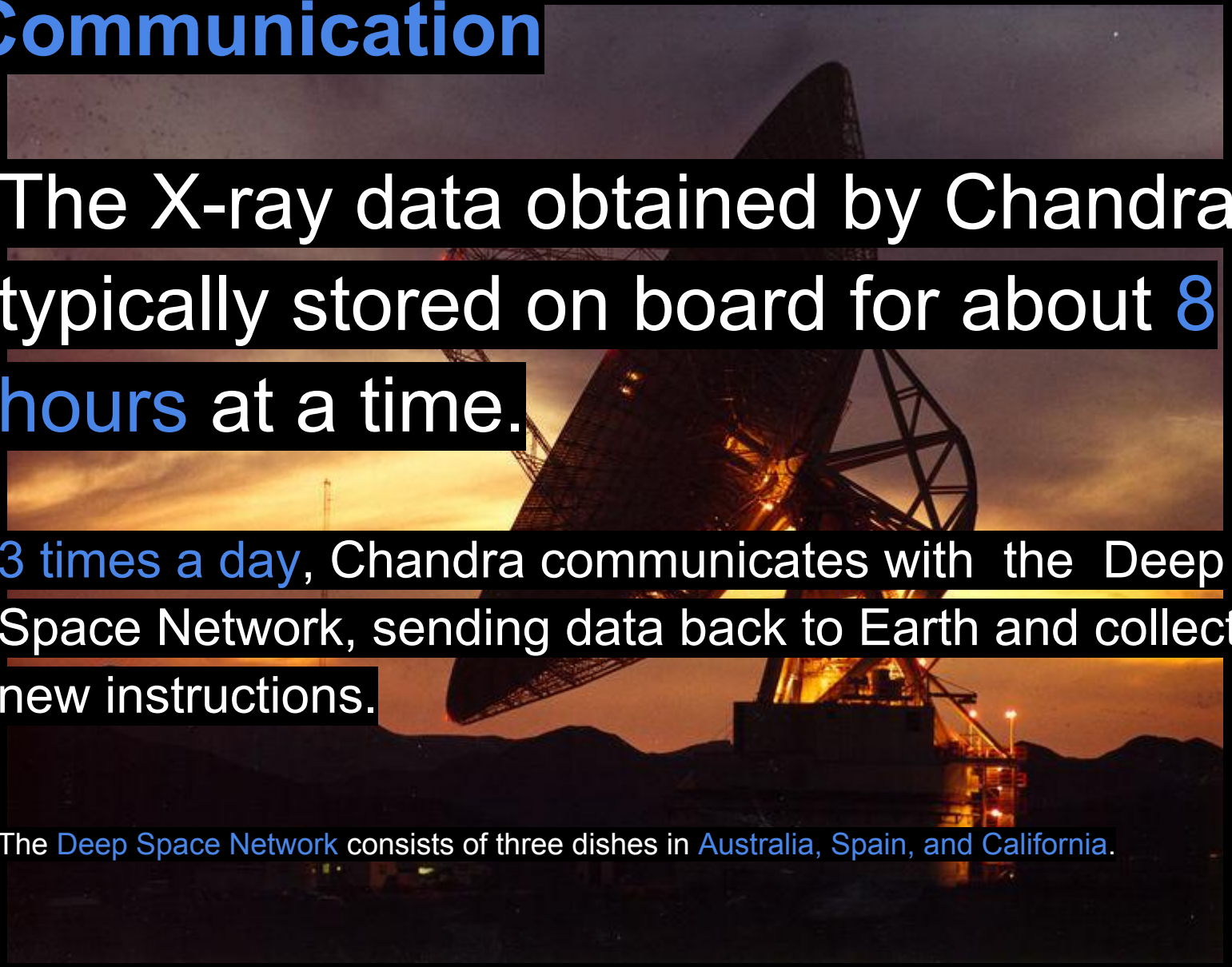
It also has an elliptical orbit that takes it 1/3 of the way to the Moon. Allowing continuous observation for hours at a time.

Note: It is unreachable by the Space Shuttle, which was used to launch it in 1999.

Communication

The X-ray data obtained by Chandra is typically stored on board for about 8 hours at a time.

3 times a day, Chandra communicates with the Deep Space Network, sending data back to Earth and collecting new instructions.



The Deep Space Network consists of three dishes in Australia, Spain, and California.

Resolving Power

"Resolving power is the ability of an imaging device to separate points of an object that are located at a small angular distance."

0.5 arc-seconds

2.42×10^-6 radians

=letters of a stop sign at a distance of 12 miles

=1cm headline at the distance of a half-mile.

Use

X Ray telescopes are used in:

Spectroscopy,

(the study of which atoms absorb and emit light)

They can show the chemical composition of cosmic objects.
They can show the temperature and velocity of cosmic objects.

X Ray Telescopes

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