Astronomy beyond the visible

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International Astronomical Union Comm 46
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Goals

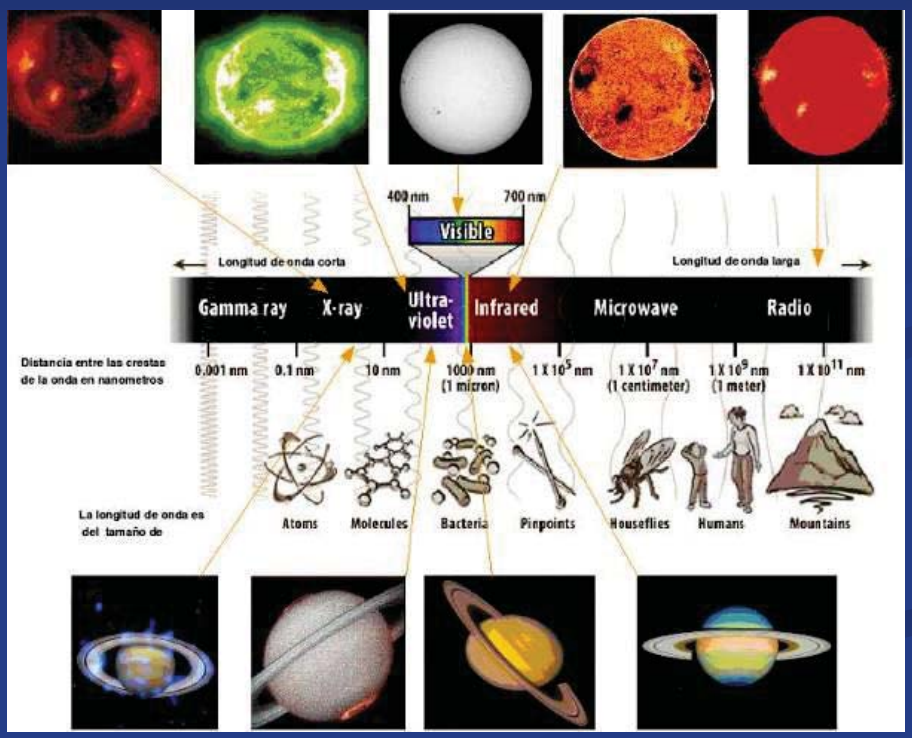
- Show phenomena beyond the observable, e.g., beyond the visible, the electromagnetic energy emitted by celestial bodies, but undetectable by the human eye.
- Perform several simple experiments for determining the existence of emission in the wavelength regions of radio waves, infrared, ultraviolet, microwave and X-ray.

Presentation

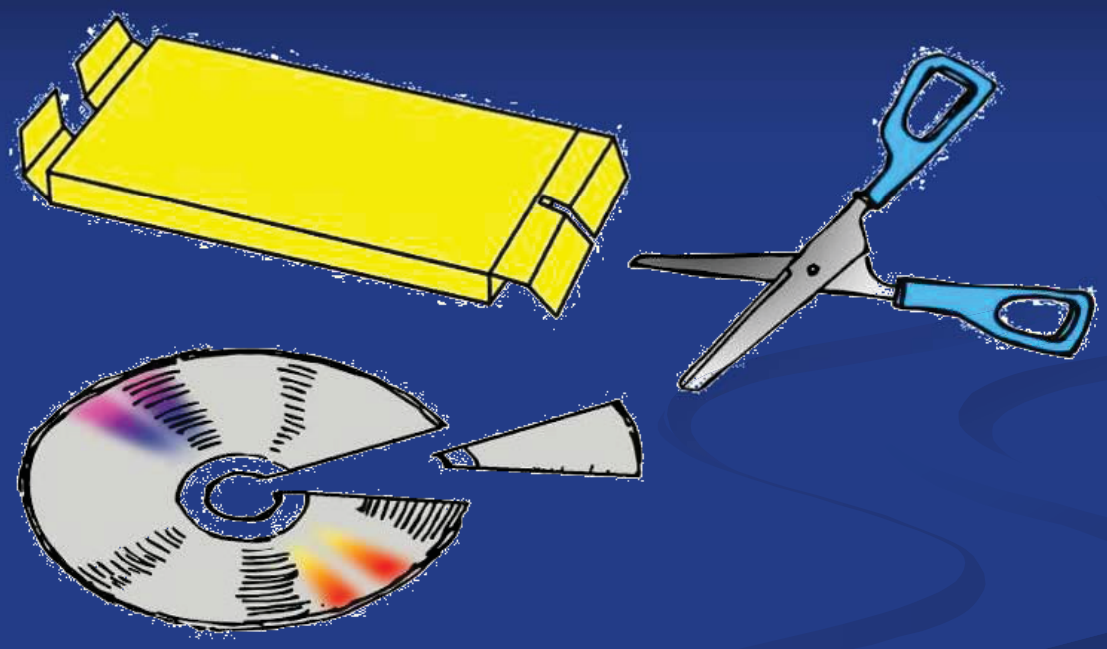
- For centuries, the universe had been studied only with the light detected by the human eye.
- There is information that comes from other wavelengths that our eyes can not see.
- Astronomers observe today in the infrared, ultraviolet, radio, microwave, X-rays and gamma rays as well as visible.

Electromagnetic Spectrum

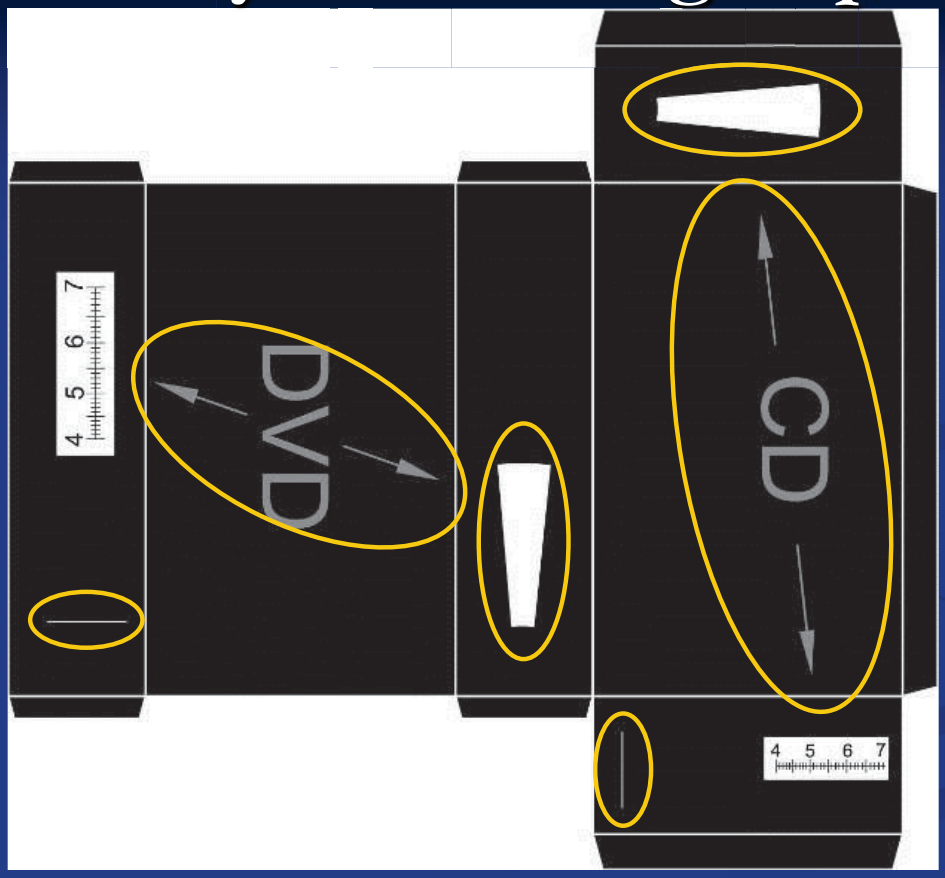
all wavelengths of electromagnetic radiation.



Activity 1: Building a spectrometer



Activity 1: Building a spectrometer



Depending what you use DVD or CD, you should cut one or the other portion of the template

Activity 1: Building a spectrometer

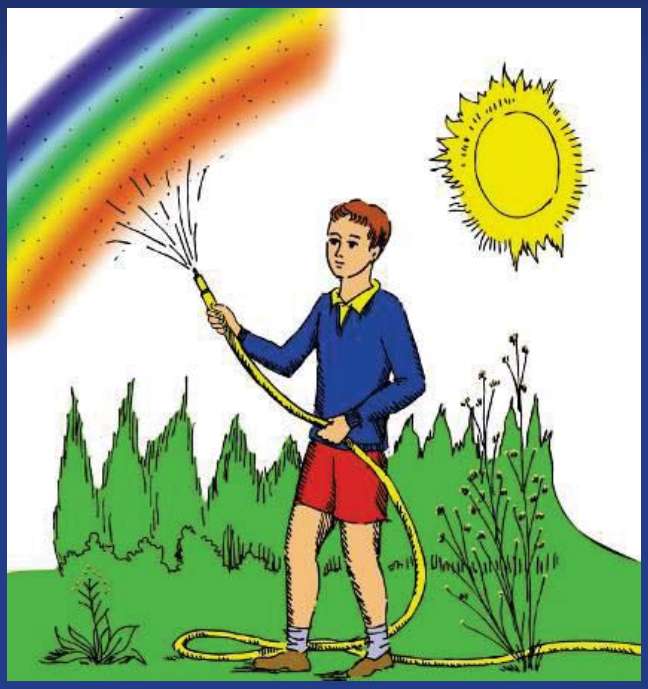
Remove the metal layer of the CD (white CDs can not be used) scratching it and using the tape.

Activity 1: Building a spectrometer

The black portion should be inside

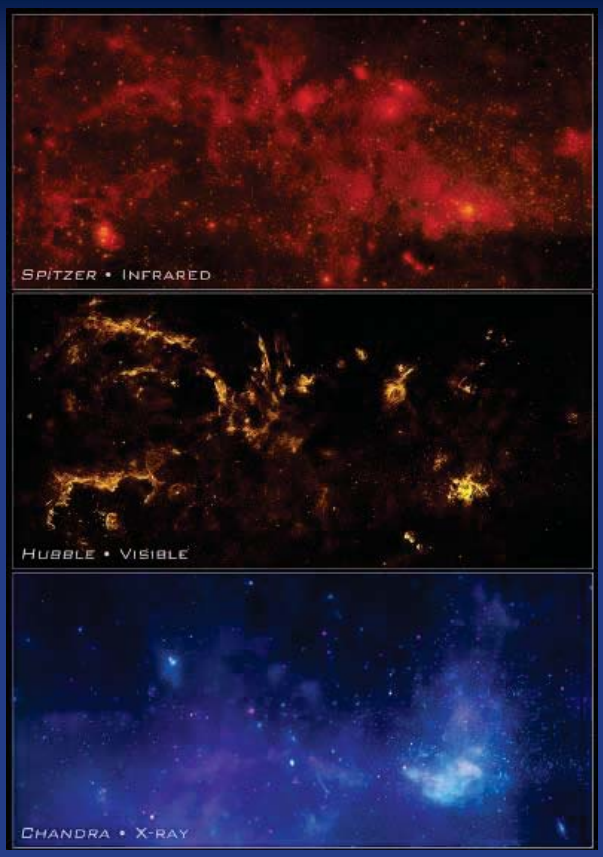
Look at the light of a non-fluorescent bulb, such as street lamps ...

Activity 2: Decomposing sunlight? With raindrops



Children can split the light and make a rainbow. They need a hose with a diffuser, and to have the Sun at their back

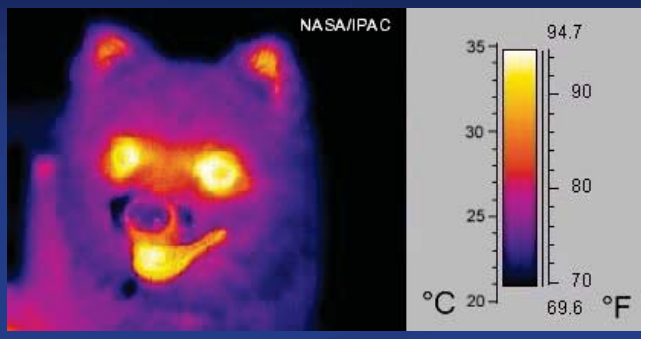
Another regions of the spectrum



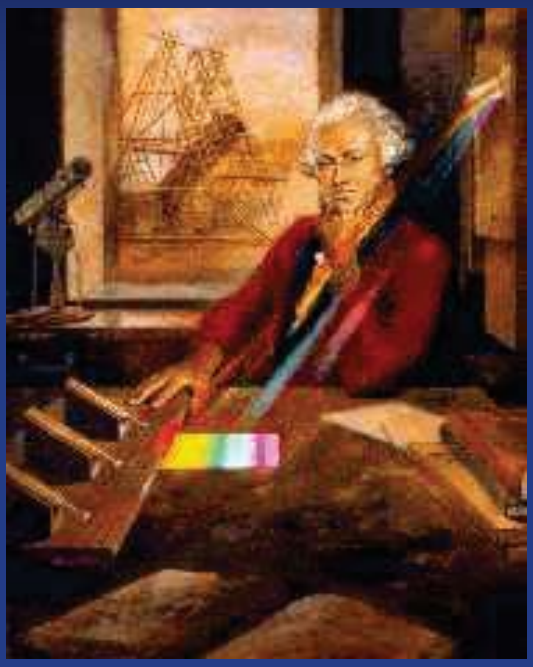
- There is a matter with temperatures much lower than that of the stars, for example, clouds of interstellar matter.
- They do not emit visible radiation, but emit infrared radiation, microwaves and radio waves.
- The type of radiation is associated with the processes that are occurring inside the matter. E.g., details in the center of our galaxy ...

The infrared

- William Herschel discovered it using the prism and thermometers.
- It is a property of warm bodies, even those not hot enough to emit visible light.
- To help visualize it, we normally establish an equivalence between temperature and color.

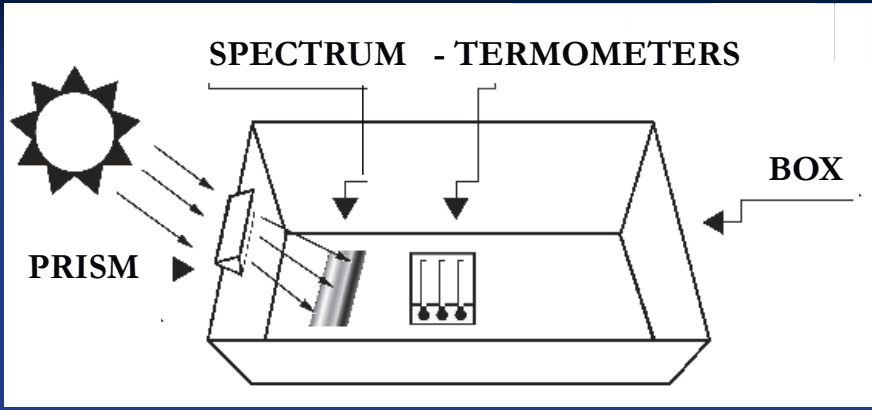


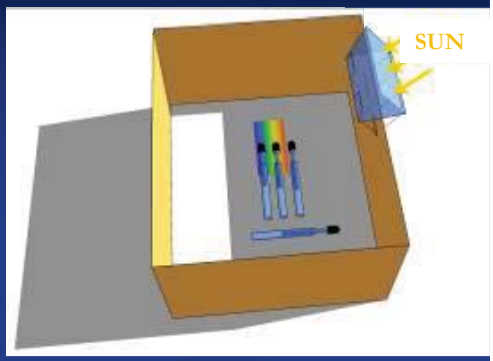
Activity 3: Herschel Experiment

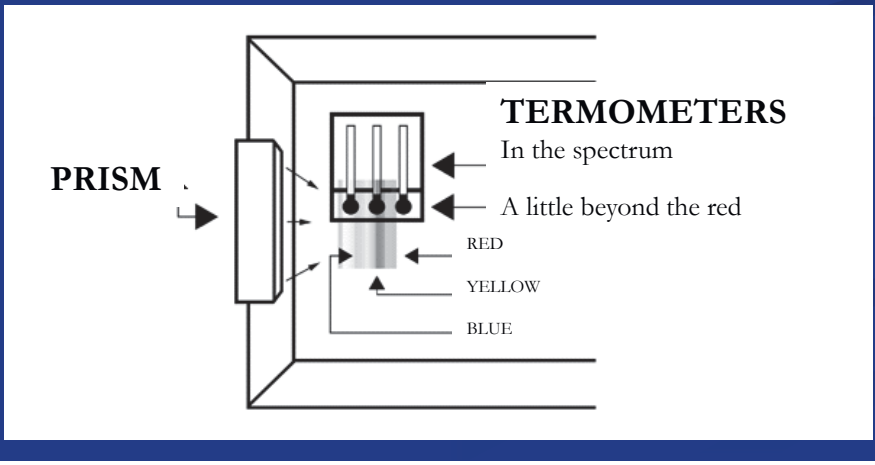


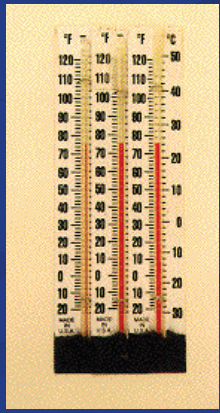
- In 1800, Herschel dicovered the infrared.

Actividad 3: Herschel Experiment









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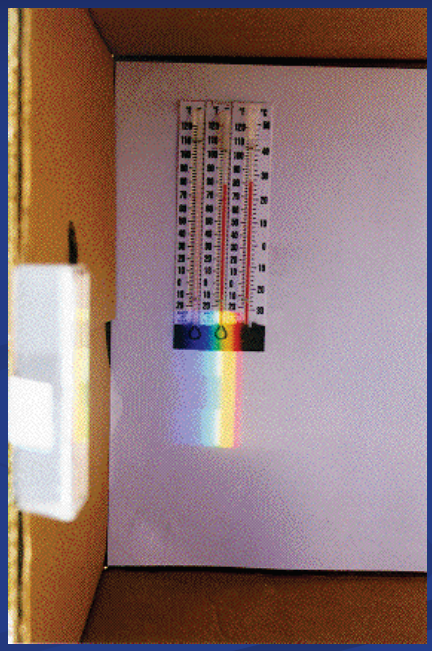

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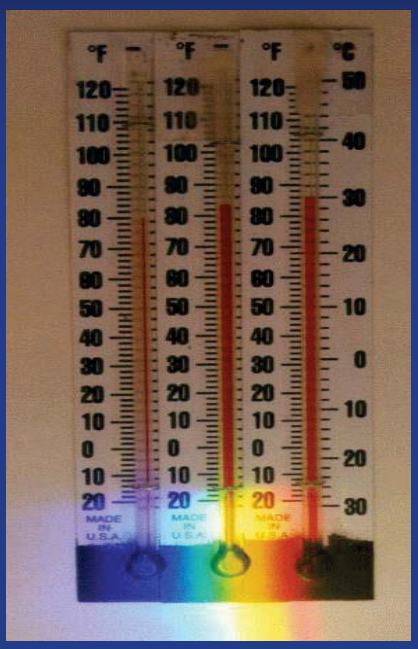


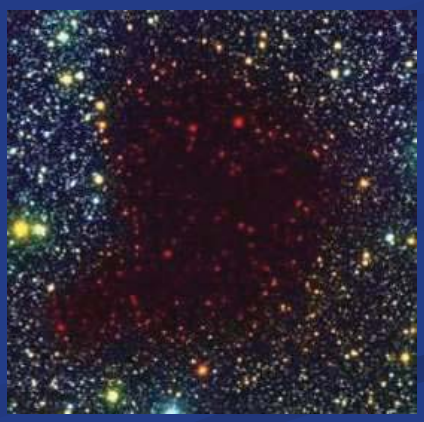
TABLE OF DATA COLLECTION				
	Thermometer No. 1 in the blue	Thermometer No. 2 in the yellow	Thermometer No. 3 beyond the red	Thermometer No. 4 in the shadow
After 1 minute				
After 2 minute				
After 3 minute				
After 4 minute				
After 5 minute				

Activity 4: IR detection with a phone

- Remote controls emit infrared that our eyes can not see.
- Many mobile phone cameras are sensitive to IR.

The power of the infrared

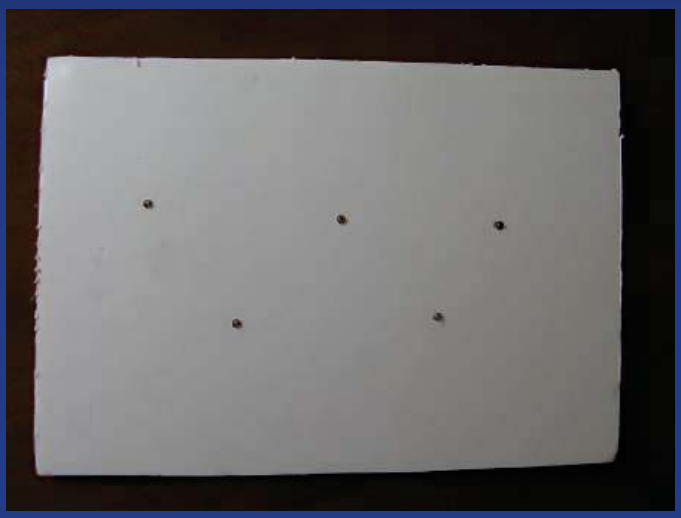
- The intergalactic dust absorbs the visible light but not infrared.

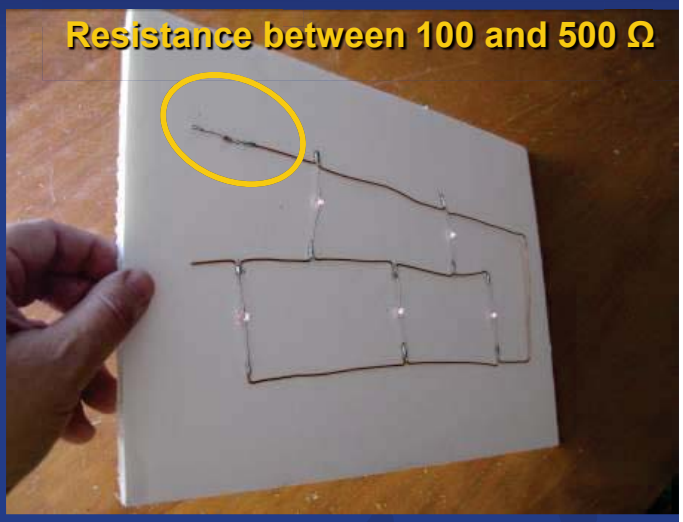


Activity 5: Detection of IR light of a bulb

- Most of the energy emitted by an incandescent bulb is in the visible region, but it also emits infrared that can penetrate some fabrics that can not be penetrated with visible radiation.
- The same happens with the galactic dust, which can be detected from its infrared emissions, but is opaque in the visible region.

Activity 6: Constellation with IR LEDs



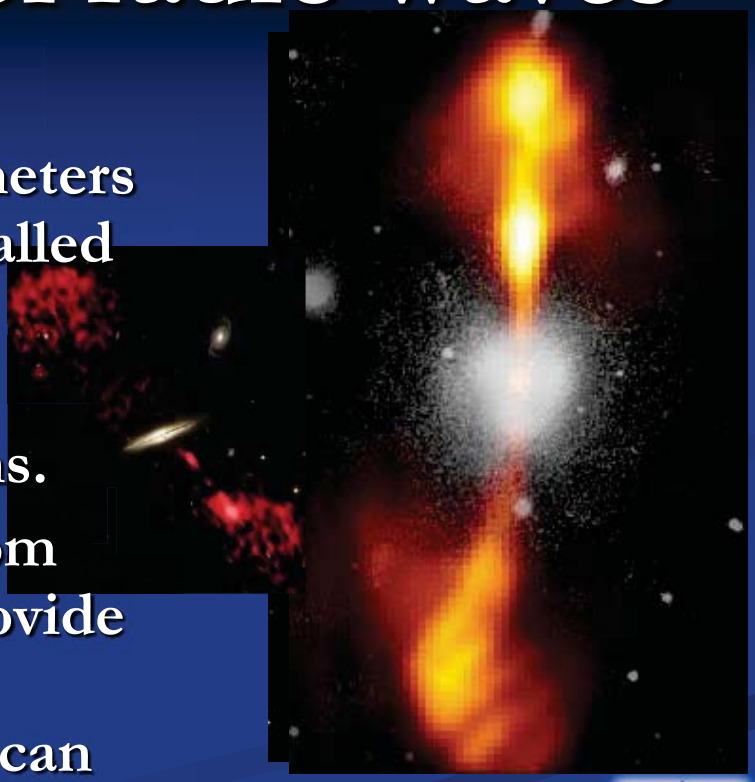


Cassiopea with IR LEDs.

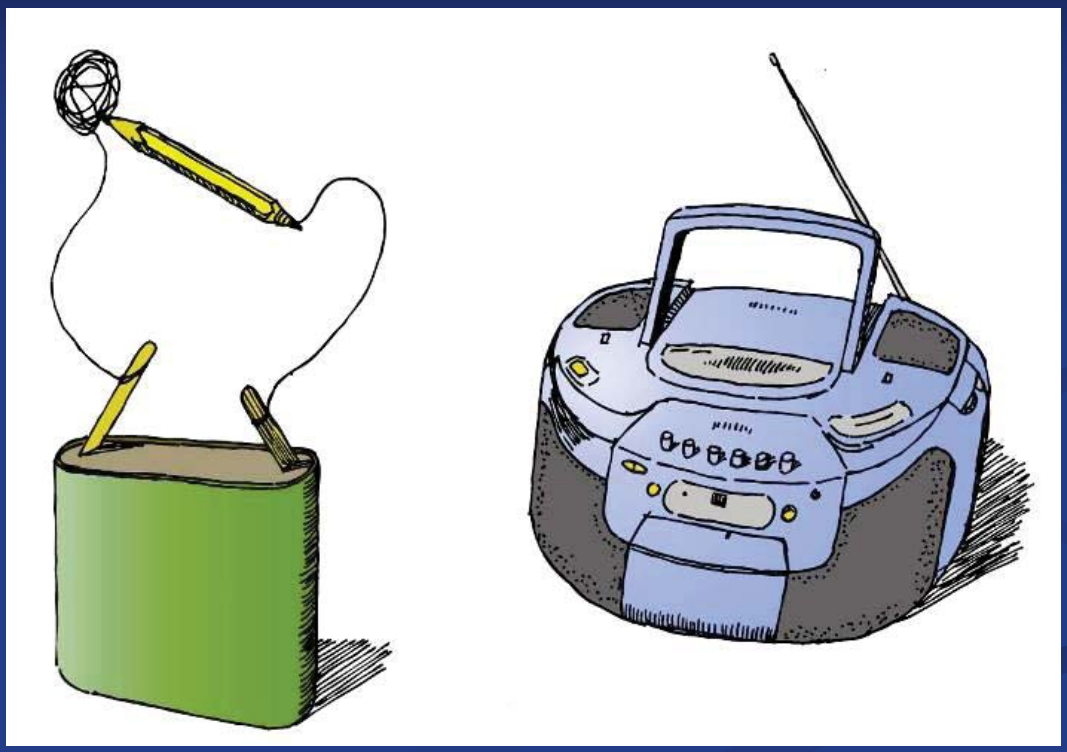
Activity 7: Constellation with remote controls

Emission of radio waves

- EM radiation with wavelength from meters to kilometers are called radio waves.
- They are used for commercial stations.
- They also come from space, and thus provide information about morphologies that can not be seen at other wavelengths.

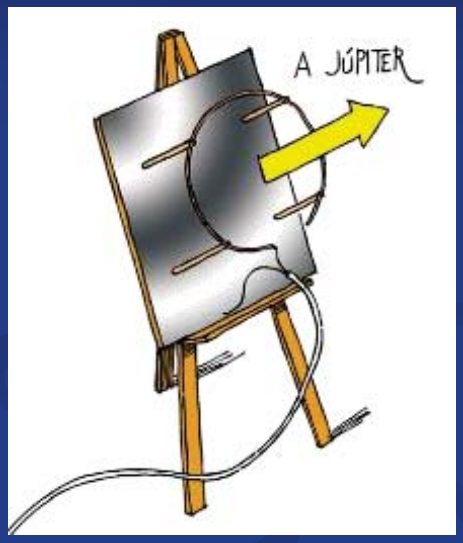


Activity 8: Producing radio waves



Activity 9: Hearing the "voice" of Jupiter

- Jupiter emits radio waves at wavelengths of 18-22 MHz (SW).
- They are discontinuous and sound like ocean waves reaching the beach.



Sin voz de Júpiter

Voz de Júpiter 1

Voz de Júpiter 2

Ultraviolet radiation

- UV photons have higher energies than those of visible light.
- UV destroys the chemical bonds between organic molecules
- At high doses UV can be fatal for life.
- UV-C radiation is filtered by atmospheric ozone

Johann Ritter , discovered ultraviolet light in 1801

Ultraviolet radiation

- The Sun emits UV radiation, but most of it is filtered by the ozone layer inside our atmosphere; the amount that arrives on Earth is beneficial for life.
- This radiation is what makes our skin tan, is absorbed by plants for photosynthesis....
- If the ozone layer decreases in thickness, the Earth would receive too high doses, and cancer would increase.

Ultraviolet light

Andromeda Galaxy in visible light (Hubble)

Andromeda Galaxy in UV light (Chandra)

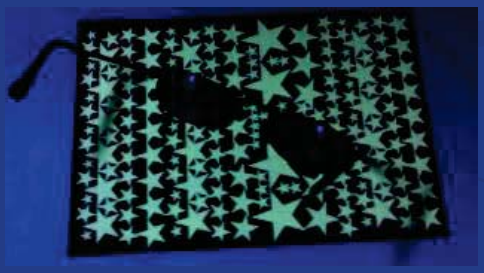
Activity 10: Black light (UV)

- Black light bulbs for plant growth.
- Counterfeit Detector for fake money and identification cards.

Activity 11: Filter UV radiation

- Black light bulbs or detector for fake money .
- Fluorescent material (reacts with UV light).
- Common glass and glasses (no organics glasses, because they are plastic): the glass filters UV radiation, the plastic does not.

Flourescent material iluminated with withe light and glasses



The same material and glasses but iluminated with UV ligh.

Footprint of the glasses on the material

Actividad 12: Filter UV radiation

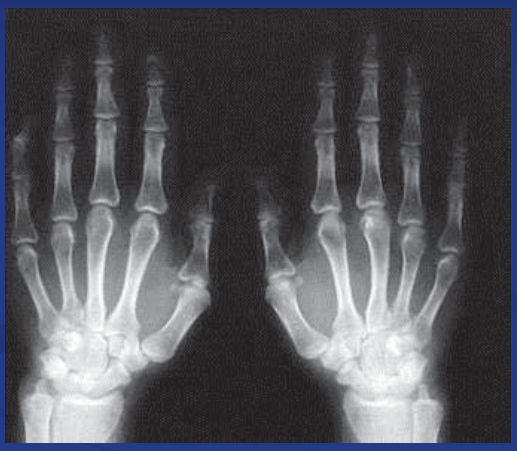
- The ozone layer is created by UV ($UV+O_2=O_3$), and at the same time O3 filters this radiation. There is the adequated equilibium for life development.

- The glass filters UV radiation, for this reason is impossible to colorate the skin if the Sun is at the other side of a window! The plastic does nor filters UV.

It is important to use sun glasses to avoid retinal damage!

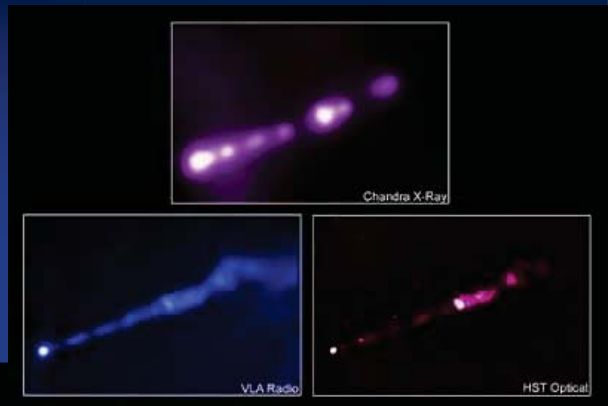
X-ray

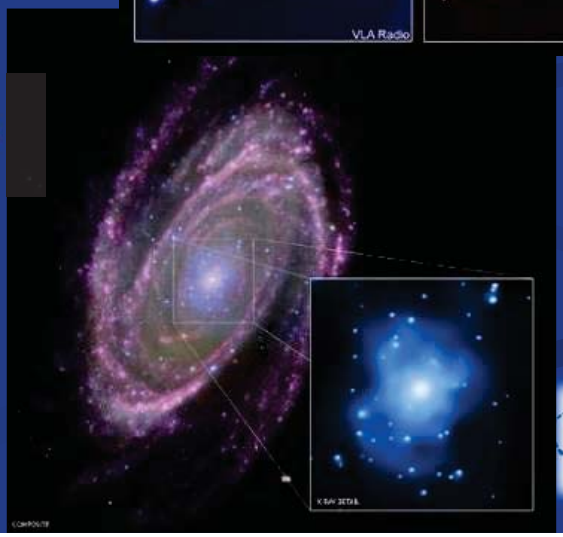
- More energetic than UV is the X-ray radiation.
- It is used in medicine in the radiographs and other forms of radiology.



X-ray

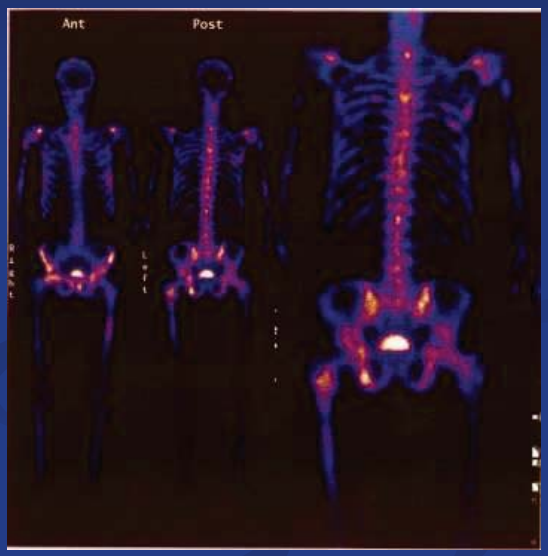
- In the cosmos, X-ray radiation is characteristic for high-energy events and objects: black holes, collisions, etc..
- The mission of the Chandra Space Telescope is to detect and monitor these kind of objects





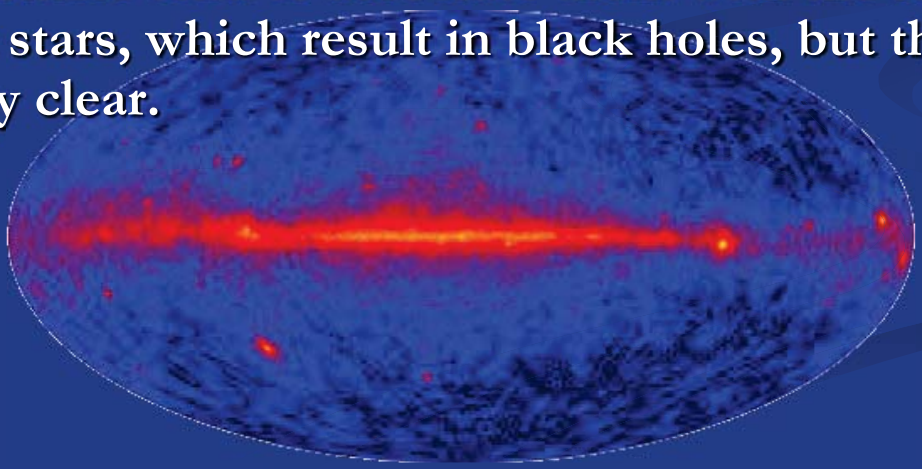
Gamma rays

- It is the most energetic radiation.
- In the Earth these rays are emitted by most of radioactive elements.
- Like X-rays both are used in medicine, in imaging tests and therapies to cure diseases like cancer.



Gamma rays

- The occasional violent eruptions of gamma rays are not unusual in the sky.
- There are different types that last from seconds to hours. One problem is to define their exact location to help indentify what objects are producing the radiation.
- Astronomers tend to associate them with the fusion of double stars, which result in black holes, but this is still not very clear.



Thank you very much for your attention!