Awake! For Morning in the Bowl of night
Has flung the stone that put the Stars in Flight!
And lo! The Hunter of the East has caught
The Sultan's Turret in a Noose of Light.

Rubáiyát of Omar Khayyám

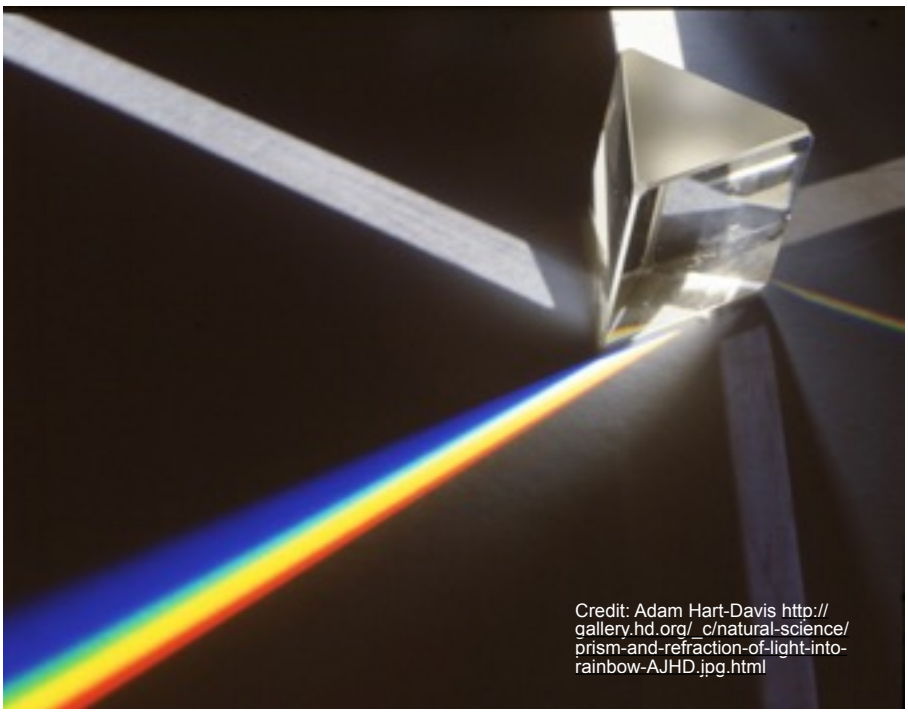
Rainbows, Selfies, and Clocks

What do astronomers do with light? How are Power, Energy and Time related?In this module we're going to start on the last basic topic - light - before we branch off into planets and exoplanets. We're exploring light, what light is, what astronomers do with it, and why light is effectively our space ship.

Credit: Wikipedia
public domain

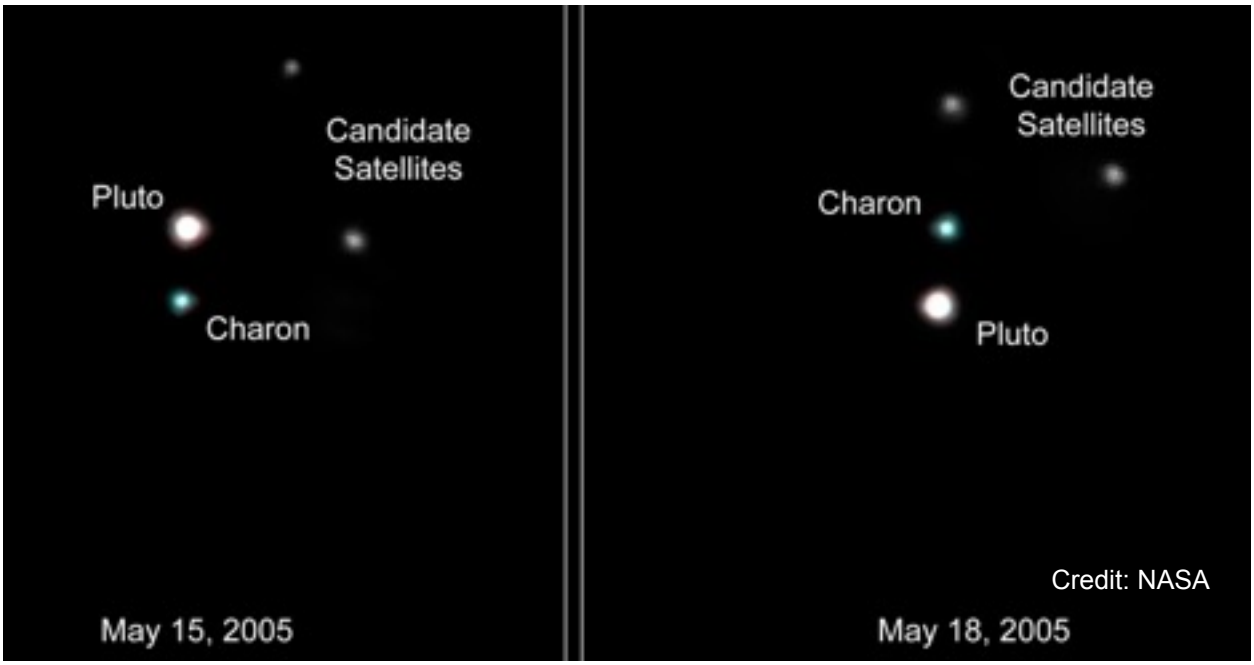
So how do we experience light? Well, light carries energy, radiative energy, which it can exchange with matter. Light exchanges that energy with matter and thus how we see or feel it. The colors of light - white light is made out of various colors - contain a great deal of information about the type of matter that the light has interacted with. For example, the red shirt shown above. White light hits the shirt and all colors except red are absorbed. This can tell you a lot about the material the shirt is made of.

Astronomers basically do three things with light: spectroscopy, imaging, and timing.



Credit: Adam Hart-Davis http://gallery.hd.org/_c/natural-science/prism-and-refraction-of-light-into-rainbow-AJHD.jpg.html

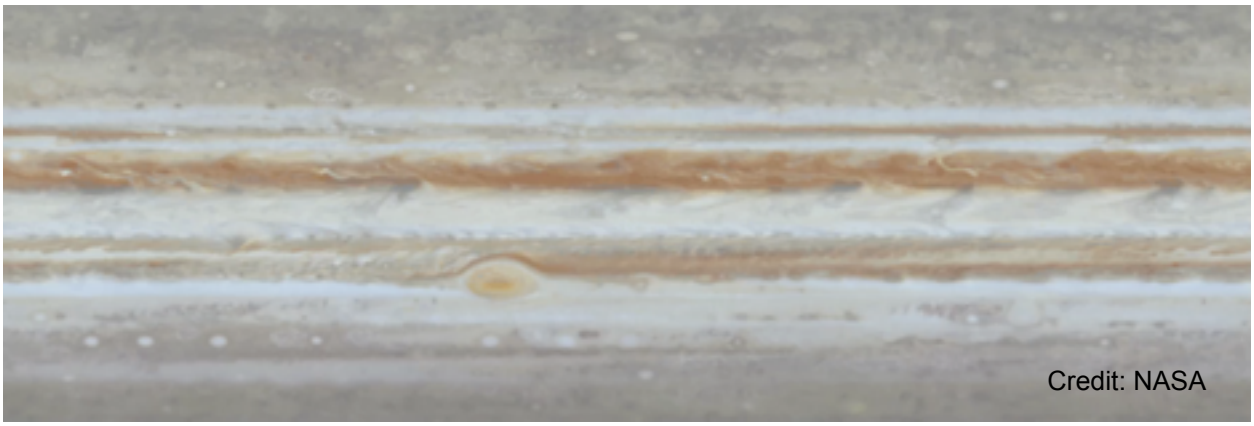
A common thing that astronomers like to do with light - the thing that gives you the most information - is to make pretty rainbows. That pretty rainbow, like the one above, is called a spectra. Spectroscopy, is where you break light into its component colors - its spectrum - and measure the brightness of each color. The image above is an example of a glass prism. White light is coming in. And what comes out at a particular angle is the breaking up of that white light into its component colors, its spectrum.



The second thing astronomers do with light is they take a picture, usually through a filter, so it's not just all light coming. You put a filter in front of the lens to take a photo of what it looks like in red light. Or you'll put a green filter or a blue filter in front. Then you measure the brightness of each pixel taken through that filter.

Next, you take all the images through the different filters, and you reconstruct the image. All of the great images you see from the Hubble Telescope site or other astronomy sites, images with all of these glorious colors all over the place - that’s nifty, but remember that's not what your eye is going to see if you were to actually go there. The colors are enhanced. The light is enhanced in certain regions to bring out particular features of whatever you happen to be looking at.

Above is an example of an image. You probably didn't know that Pluto is actually a four body planetary system. Pluto has a main moon known as Charon. It also has two smaller moons, called Nix and Hydra, orbiting farther away.



The third thing astronomers do with light is timing, which is where you measure the brightness or phase changes as things happen in time. So this is an image - an animated gif image actually if it plays in your pdf viewer - of Jupiter. It's flattened out, so the right edge meets the left edge as it goes around. And then it's not quite to 90 degrees top or bottom, so it's the middle latitudes of Jupiter.

By following Jupiter’s cloud patterns, you're measuring the brightness as it changes in time. And this is how you get a handle on the rotation period of Jupiter as you watch the clouds spin around. You'll also notice - and we'll talk about this later - those different colored bands on Jupiter. There are white bands. There are dark bands. Why are there different bands? And if you notice, they seem to be going in slightly different directions at different speeds. NIce.

It is this combination of spectroscopy, imaging, and timing that tell us all kinds of information about an object. It tells us about the temperature, density and composition. It tells us how fast it's rotating and how fast it's moving. You can get all this wholesale kind of information just from an analysis of the light. So light, in a very real sense, is our spaceship. Since we can't travel there, we wait for light to bring it to us.

A definition that we'll be using as we go through: Power. Power is the rate at which energy changes with time. A power is equal to an energy divided by a time. Power is measured in watts. And so one watt is equal to 1 joule per second, joule being a unit of energy.

Credit: Wikipedia public commons

You're kind of familiar with this already, because if you go outside and look at your electric meter — that looks like a very typical electric meter shown above— you'll notice that the units that it's measuring are given there by kilowatt hours. So forget the kilo. That just means 1,000. But it's a watt hour. A watt is a power, and hour is a time. So it's a power times a time, and that's equal to an energy. And so the electric company is measuring not how much energy you're using per-se, but how much power you're using in a given unit of time to get the total amount of energy that you're using.

Thanks! Bye Bye.