EASY TO BUILD, FUN TO USE AND LEARN ABOUT SPECTROSCOPE WORKING MODEL.

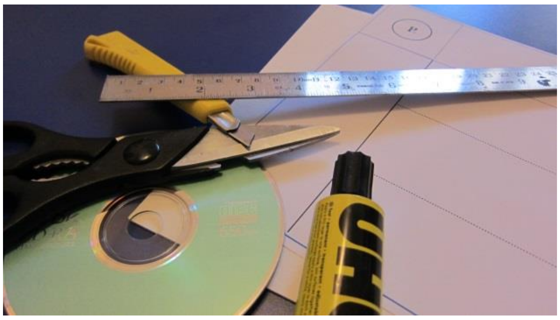
Required materials:

1. Task-board sheet, A4 in size or larger.
2. An expandable CD or DVD disk.
3. Duct tape, preferably black.
4. A diagram from the end of this guide, printed.
5. Contact-glue, such as yellow UHU. Glue-stick will work just as well.

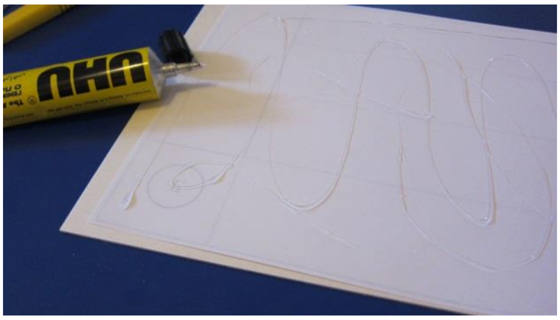
Tools:

1. Heavy-duty scissors
2. Utility knife
3. Ruler, preferably metal

Use the correct diagram for your choice of disk. DVDs spectrum is much larger and better defined, but prone to "vingeting".

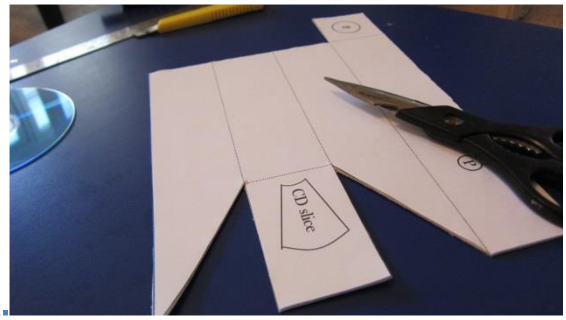


1. Glue the diagram to the task-board.

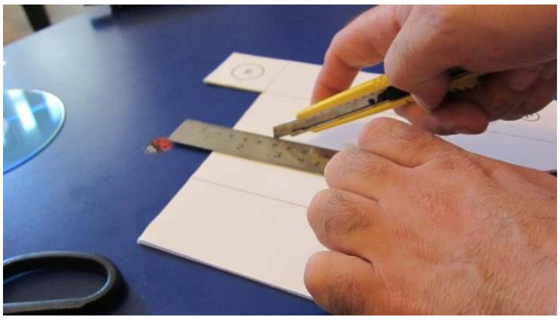


2. If the task-board is larger than the diagram, cut along the lines that mark the edges of the diagram and cut away the surplus task-board using the scissors.

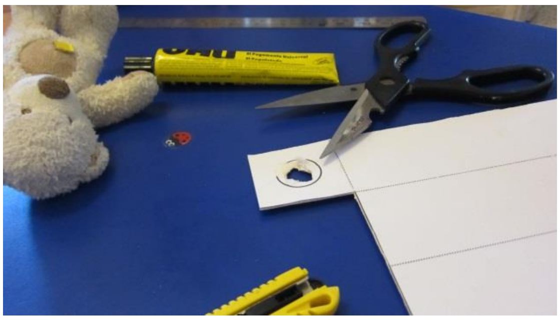
3. Cut along the continuous lines of the diagram.



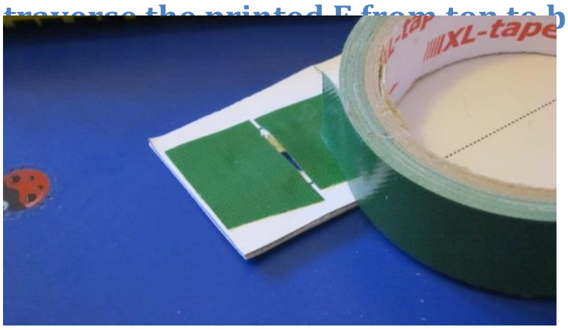
4. With the utility-knife and ruler, mark the dotted lines of the diagram. Do not cut through! The result scratches will be used to fold the task-board accurately and easily.



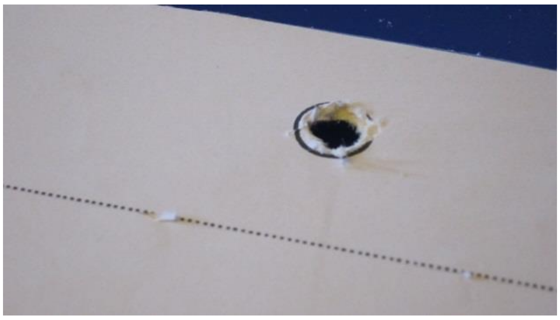
5. Using the tip of the scissors bore a 1cm -2cm (½"-1") wide entrance hole, marked E in the diagram.



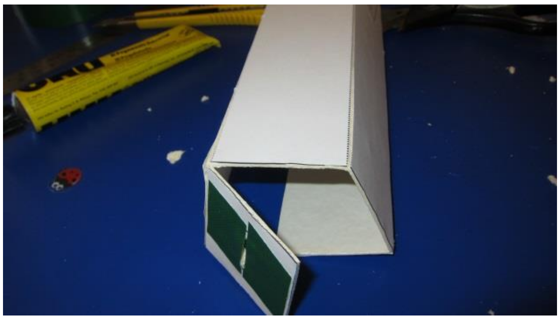
6. Use two strips of duct-tape to form a narrow, ½$_{mm}$-1$_{mm}$ (1/32"-1/64") slit. Narrow slit will give better definition, but darker spectrum. Note the direction of the slit – it should traverse the printed F from top to bottom.



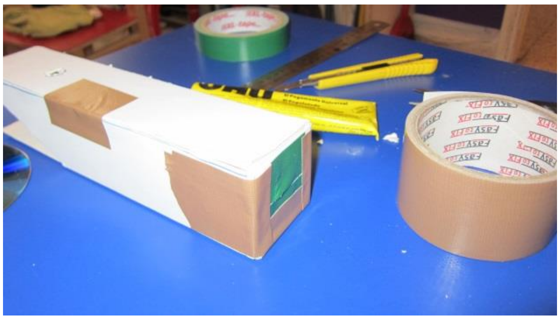
7. Using the tip of the scissors bore a 1$_{cm}$ (½") peeping hole, marked P in the scheme.



8. Fold the model to form a long box, with the sleet at its front end.

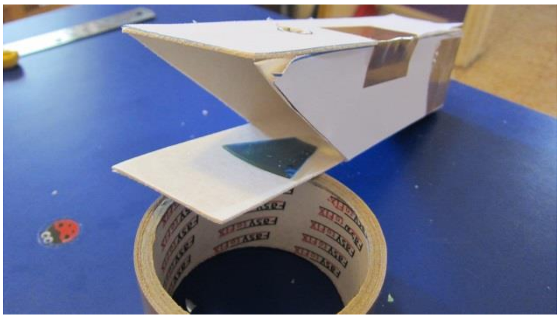


9. Use some duct tape to hold it firm the front (near the sleet) and middle, but stay away from the rear of the box.

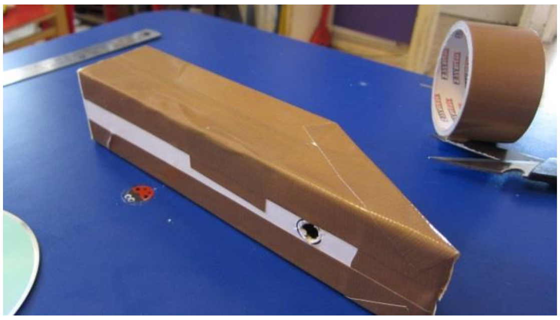


10. Cut a slice of the CD or DVD. The slice must be narrow enough to fit onto one of the box's sides.

11. Glue the CD/DVD slice to the inner side of the box, against the peeping hole. The diagram shows the correct position, marked "slice". Note that the slice should be glued inside the box, on the task-board, not on the diagram. Also, the direction of the slice is crucial. Turning the slice 30° will render the model unusable. Turning the slice full 180° will work fine, though.



We're almost done. Close the box on the rear side, forming a wedge. Now use Duct tape to hold firm the entire model, taking care not to cover the peeping hole or the entrance slit, Also, make sure to block any light entrance except the entrance slit in the front.

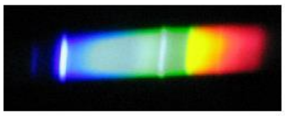


It's ready! To use it, look through the peeping hole while the entrance slit is pointed to a source of light, but **never, ever, look at the sun!** You can photo the sun spectrum – no harm will come from that. But looking at the sun – **never!**

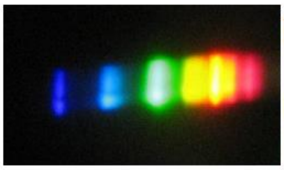
Check different types of light bulbs, you'll soon find out that there is a distinct difference.

Taking shots is easy – just point a camera to the peeping hole. Here are some shots I made. These were taken with an outdated 3MegaPixel phone camera.

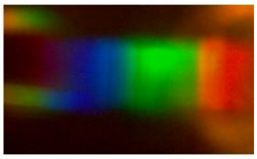
Incandescent bulb



White fluorescent



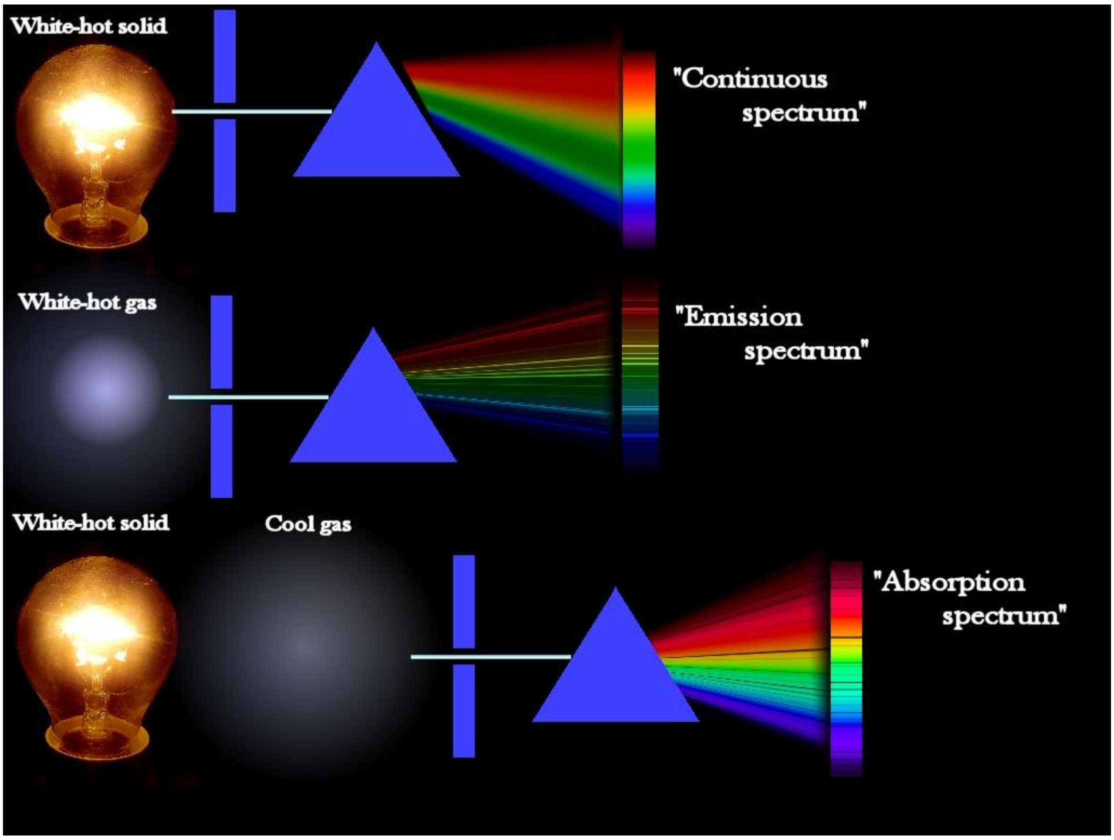
Yellow fluorescent



Sunlight

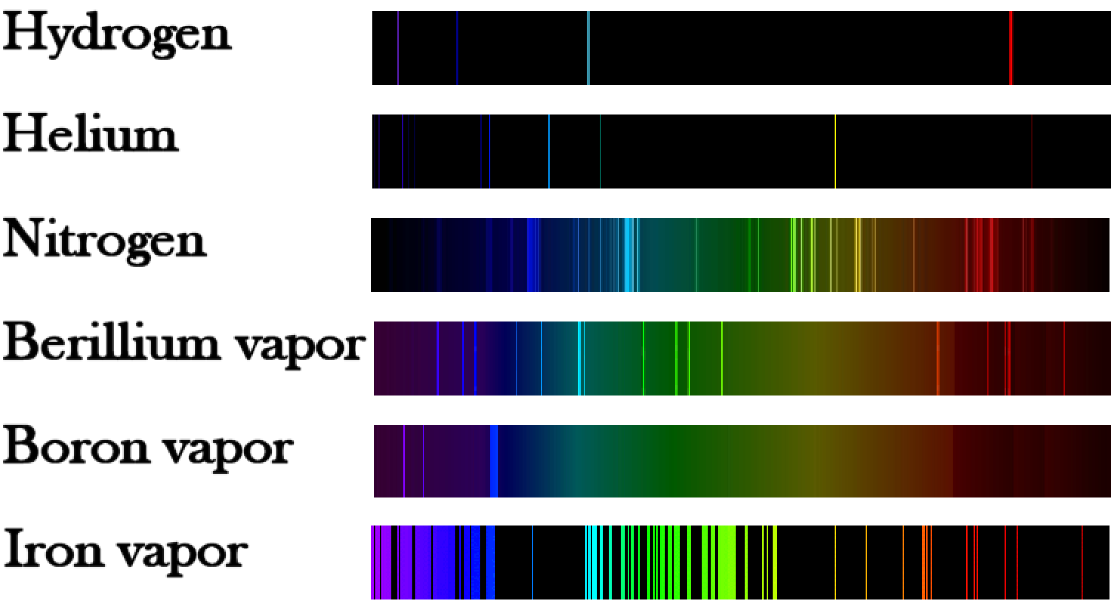
WHY?

At the 18th century Fraunhofer found that the spectrum (rainbow colors) of white light that travels through cold gas is changed – dark streaks appear. Also, if you heat up a gas to the point that it's glowing, the result spectrum is very, very different than any seen before – only narrow streaks of color appear.



Following this discovery much research took place. Soon it was evident that different gases result in different spectra, as if each gas had its own finger print!

During the 18th and 19th centuries many materials spectra were catalogued. In the sunlight it was evident that a new, unknown element exist, to which they gave a name derived from the name of the Sun in Greek –Helios →Helium.

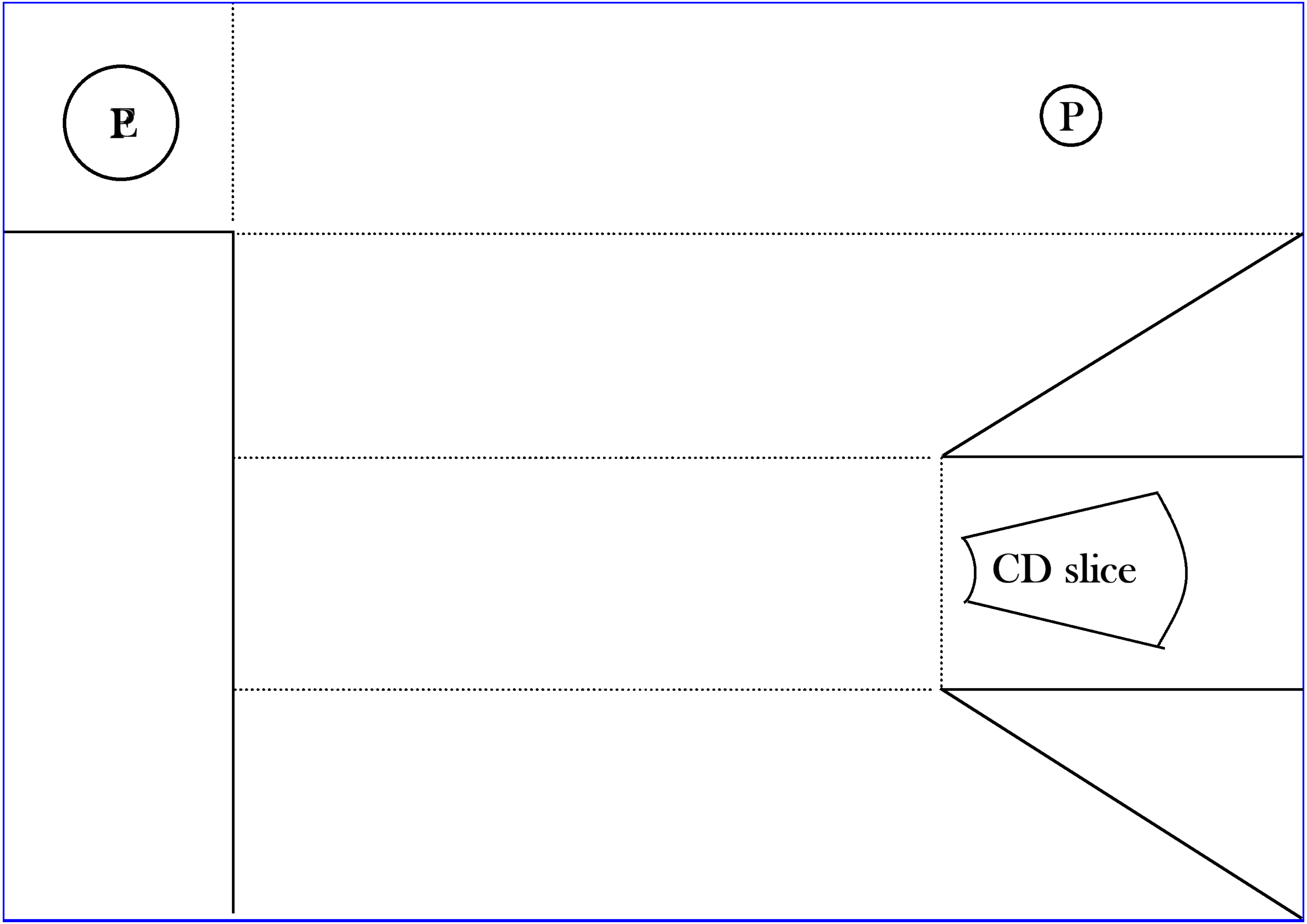


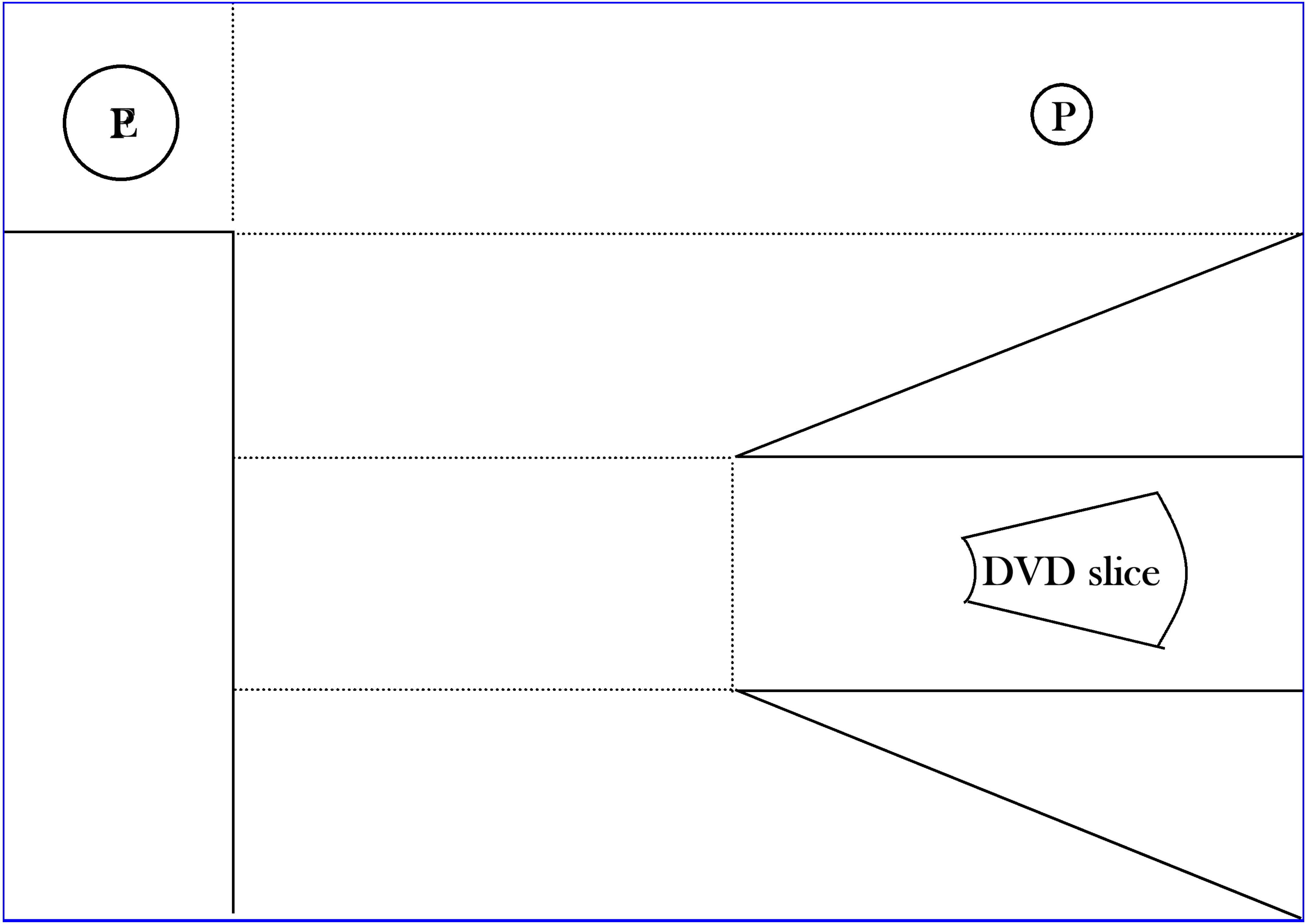
Only at the beginning of the 20th century Albert Einstein and Nils Bohr managed to give a sound theoretical explanation to these phenomena. Einstein explained that while electrons are changing their orbit around the atom they emit, or absorb light – and the light color is determined solely by the energy difference between the orbits. Bohr explained that each atom type – that is, each element, has a unique electrons configuration. Combining this explanations, it is clear the each element will absorb and emit only certain colors.

So... what's it good for?

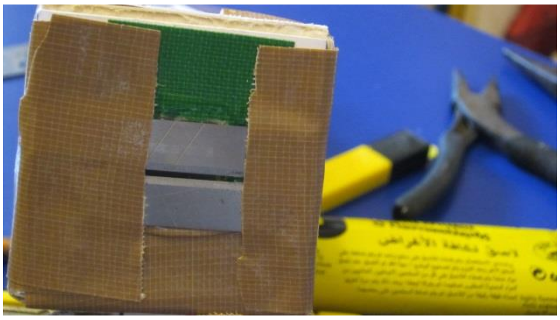
Besides being beautiful and curious, the spectroscope and its more advanced sibling, the spectrometer, are a powerful means to analyze the composition of nearly every light-emitting object. For example- stars! Only through spectrometry, the technology of using spectroscopes, we know the composition of stars hundreds of light years away, and of quasars – <u>billions</u> light years distant.

As if this isn't enough, by calculating the Doppler effect, an effect that changes the spectrum of an object that is approaching or receding, the speed of the approach can be determined. An approaching object's spectrum will be blue-er than it would have been if it stood still. This is called Blue-shift. A receding object's spectrum's lines will move a bit towards the red – a Red-shift. This is used in hundreds of applications, including guiding missiles.


P
CD slice


P
DVD slice

P.S. increasing resolution: To gain a small but noticeably sharper spectrum use sharp blades to make the entrance slit, here I use utility-knife blade:



P.S.S. Why the panic-tone in "never, ever, look at the Sun"? Well, having a scar in my own eye retina is a good starting point. The retina has no heat-sensing , so retina cells fry and die as you watch the Sun, and you don't feel a thing. The damage builds up – few dead cells won't matter, but as they accumulate a permanent stain will appear in your view of the world. Once it's there, there is no way to cure it.