MITOCW | Optics: Fraunhofer diffraction - rectangular aperture

PROFESSOR: Now we're ready to look at 2-dimensional Fraunhofer diffraction bands. The setup is the same as before. And just let me remind you of it. Here is the helium-neon laser. Here's the beam from the laser. Gets reflected by this mirror, then gets reflected by this mirror into this lens. Then the output of the lens falls on this 2-dimensional aperture. And then the diffracted light from this aperture then goes onto the screen.

Now let's look at this 2-dimensional aperture here. It's made of two pairs of slits, a fixed one and an adjustable one. And the adjustable one is behind the fixed one. I'm not going to tell you the spacing, because I'm going to leave it as an exercise for you to find out later.

So what I can do with the adjusted one, I can adjust the slit width by just moving this translation stage, OK? So now we're ready to look at the 2-dimensional Fraunhofer diffraction pattern on the screen. So now if we bring in the pattern on the screen, we can see-- this is before I do any adjustment. We can see, now, it's different from what we had before. It's in two dimensions.

And also, what I'd like to bring to your attention is the cross terms, the cross terms over here and over here. I hope you can see it well, because they're very weak. But they're very important to the 2-dimensional diffraction band. As you can see, the diffraction band looks like the 2-dimensional Fourier transform of the field at the rectangular aperture.

What I'm going to do now is vary the separation of one of the slits. That's the one behind. As you can see, the pattern changes. Now if we pull back with the camera-- if we pull back to-- OK, that's enough. Fine-- then you can see that I can change the spots-- the size of the spots on the screen.

Now in order for you to calculate that we're seeing what we're supposed to be seeing, and also to get a feel of what the slit widths are, I'm going to now put in a scale over here. And the scale here, the markers represent a 2-centimeter spacing. Now, the separation between the aperture and the screen is a meter. And the wavelength of the laser is 6,328 angstroms.

So now you should be able to calculate the size of the rectangular aperture just from the information I've given you. And here, again, let me do some adjustments so you can calculate it here. And then you can calculate the change in this slit width when I go to this position.

Now you can see the high-order ones. Also, I'd like you to notice the intensity variations. It's not that easy to see on video, because the central spot is so bright. But at least you can see that, indeed, there are lots of spots available. And I hope you can calculate it with ease.

Now that we've looked at the 2-dimensional Fraunhofer diffraction pattern of a rectangular aperture, we're now going to look at the circular aperture. We're going to look at the Fraunhofer diffraction band associated with various sizes of circular apertures. So when we come back, we'll have that ready for you and see what those look like.