MITOCW | Optics: Fraunhofer diffraction - crossed multiple slits

SHAOUL EZEKIEL: Now we're all set to look at the Fraunhofer diffraction pattern associated with the two-dimensional multi slits. The setup, again just to remind you, same as before-- here's the laser. Here's the beam from the laser reflected by this mirror and reflected by this mirror into a lens. Now, the lens here is used to expand the beam so that we can illuminate quite a chunk of a two-dimensional multiple slits. And then the diffracted light then goes on onto the screen.

Now let's look at the two-dimensional multiple slits. What we have for you-- we have two Ronchi rulings. Each one has so many lines per inch. I'm not going to tell you because I'm going to leave that, again, as an exercise. So we have two identical Ronchi rulings that are crossed.

The first one is fixed, which is over here. And the second one is attached to a rotation stage behind the first. So we can rotate the second Ronchi ruling, and then we can see what it does to the diffraction pattern.

So now let's look at the screen. And then as we-- and as you can see on the screen now, you see the two-dimensional diffraction pattern of multiple slits. You can see that they look different than the single slit. We have a lot more dots. And again, as I say, I'm going to leave it as an exercise for you to figure them all out. Again, I'd like to draw attention to the dots around here, to all these cross terms in this pattern.

So this pattern, then, is associated with the rulings crossed or orthogonal. Now what I'm going to do, I'm going to rotate the Ronchi ruling or the multiple slits in the back of the fixed one. See? So again you can see that the pattern rotates.

Now, if we get rid of the insert and then look at the entire pattern, now you can see what happens as I rotate the Ronchi ruling in the back. Here we are. I could rotate the other way. And I hope you can see all the weak spots, which are the cross terms in the pattern.

Now, in order for you to calculate the line spacings in the Ronchi rulings, I will give you the information you need. We have a plane wave that impinges on the Ronchi ruling. And the diameter of it is about a little over a centimeter.

The screen is about 100 centimeters away from the Ronchi rulings. And the wavelength of the light, as before, is 6328. And with all this information, you should be able to calculate the number of lines per inch or millimeter of the Ronchi ruling.

But you need still one more information, and that is the scale on the screen. And I'm not going to put a scale on. But I will tell you that the separation between these dots here, these pair of dots, is about 6 millimeters. So now, you have all the information you need to calculate the spacing between the lines in the Ronchi ruling.

Now, just before we quit, if we can pull away-- the camera pull away-- and show you the extent of the pattern, now you can see the pattern extends quite a bit. And now we can come in again and back to where we were before. This completes our demonstrations of two-dimensional Fraunhofer diffraction pattern. Next, what we have for you is Fresnel diffraction. So when we come back, we'll have the setup rearranged so we can look at some Fresnel diffraction patterns.