MITOCW | Optics: Fraunhofer diffraction - thin wires | MIT Video Demonstrations in Lasers and Optics

PROFESSOR: Now, we're ready to look at diffraction by thin fibers or wires, opposite to slits. The setup is essentially very simple. We even took out the lens that we had here so the laser beam can go directly onto these wires. So if we take a close look at what we have here, we have just four wires then I can just put in the way of the laser beam, and then we, on the screen, can see the associated diffraction pattern.

So let's start with the thickest wire. So you can see on the screen, here is the diffraction pattern associated with this wire. And what you can see-- well, first of all, let me remind you that we have the little circles there, which are the 5 centimeter markers. So you get a feel for the spacing. Again, the distance between the wire and the screen is 200 centimeters, and the wavelength of the laser is 6328 angstroms.

I'm not going to tell you the diameter of the wire, because I'm going to let you work that out for yourself. But first you want to look at the diffraction pattern. And you can see it looks very similar to the single slit diffraction pattern, except for the blob in the center. And the blob in the center is a little complicated, but I can attenuate the laser beam. And you can see that it is pretty bright, because essentially it is the laser beam.

And so it's very difficult to get information from it. The information is hidden in the lobes on the side and the spacing between them. Because that will be then related to the diameter of the wire. So then, for the thickest wire, we see this kind of pattern, this kind of spacing.

Now, let me move on to wire number two, which is thinner. Here's wire number two. And we can see that, first of all, there's less light in the wings, because the wire is thinner. So we don't see as many side lobes. And then, again, you'll see this ugly blob in the center. But the information is in the lobes on the side. And you can see them very clearly, and you can see their spacing very clearly.

Now, let me go on to wire number three, which is, again, thinner still. And maybe here we can zoom in a little bit so that we can see it a little bit better. And again, you can see the central spot is a little messy, but the information, as I said before, is in the fringes on the side. Now, here, again, if I reduce the laser intensity, you see what the central fringe looks like. And as I bring it up, we'll see the rest of the fringe. Now,

Finally, I'm going to go to my thinnest wire, which is over here. And now we may have to zoom out a little bit so that we can see the spacing. And maybe we can increase the sensitivity a little bit, because this isn't all that much light. So we can see good. Now, we can see the separation between the fringes in the wings.

So I hope you've been watching carefully the spacing between the fringes, so that you can come up with the diameter of the individual wires. Now, this brings me to the end of the one-dimensional Fraunhofer diffraction patterns. Next, what we're going to do is look at two-dimensional Fraunhofer diffraction patterns. And I assure you, they're even more fun than the one-dimensional.