MITOCW | Optics: Multi-mode fiber | MIT Video Demonstrations in Lasers and Optics

PROFESSOR: Now, we've replaced the previous fiber with another one. The only difference between this fiber and the previous one is that the core diameter is now a little bit bigger. It's about 6 microns instead of 4 microns in the previous one.

The setup is exactly the same. Again, we have the laser here getting reflected by this mirror and this mirror into the lens, into this fiber-- this new fiber. And then, the output of the fiber goes onto the screen. So let's now take a look at the output of this fiber.

Aha. So the first thing we see, that doesn't look like a single-mode at all, that single low. And if I change the adjustment-- if we can have a camera looking at my adjustments-- then you see that I can get a variety of shapes. All I'm doing is changing the adjustment, and I can get a variety of shapes. And clearly, it's not like what we had before-- the single-mode behavior that we had before.

And this is then the so-called multi-mode. What you're seeing are different transverse modes that can propagate in this fiber, because the core diameter is bigger. But I'm going to leave it to you then to explain why-- exactly why you get higher transverse modes propagated in this fiber. Again, the wavelength is the same. The only difference is that the core diameter is bigger.

You can see this one here, you get a nice, dark line in the middle. And then if I align it over here, you can see it's blobby. It's a mixture of modes. That's why you don't see a sharp, dark line in the middle where you get a mixture of modes. While, remember, in the other one, no matter what I did in the alignment, it was still single-mode coming out-- just one low coming out.

Now, multi-mode fibers have many applications also. But for today, for a lot of sophisticated sensor applications and communications, one generally uses single-mode fibers. So here a pretty mode with a dark line down the middle.

Now, what I would like to do is show how touchy this fiber is to bending. In fact, If we take a look at the fiber here, as soon as I just press on it-- if we take a close look-- I can kick light kit light out. If I just simply press on it, I can kick some light out. So it's very touchy to stress and to bends.

What I would like to do then is show that I can kick out some of the transverse modes by simply bending or stressing the fiber. What I'm going to do is then bend this fiber. And if you watch in the inset, and see that the intensity will go down. But if I keep increasing the bend, I end up with a single-mode propagation but weak. And this illustrates that you can strip off the high order modes by simply bending the fiber. But the penalty is you get much less light getting propagated.

So here we have single-mode propagation, and here we have multi-mode or a mixture of multi-modes that are propagating in the fiber. Again, you can see that there's a lot of light that gets kicked out-- has to be kicked out of the fiber. You can see the bend absolutely low. In fact, this bending effect on the transmission of light in a fiber can be used as a sensor-- a sensor of pressure, a sensor of stress, bends, and what have you.

So then, in summary, we've looked at the propagation of laser light in a single-mode fiber, and we also saw what happens when the fiber core is a little bit big, and we saw the propagation of multi-modes. And, as I mentioned earlier, the popular fiber today is the single-mode fiber. But, again, there are applications for multi-mode fibers.