PROFESSOR: This demonstration is for those of you who would like to dig a little more deeply into laser behavior. As we know, a laser, like this one here, consists of two mirrors and an amplifier. And if the gain of the amplifier is bigger than the losses in the cavity, then we can get laser action. And if let's say, this mirror has a bit of transmission, then we can get laser light coming out that we can use. So let me turn this laser on and show you here on this card the output of the laser.

Now in this demonstration, we'd like to show that the light inside the laser cavity, that's going backwards and forwards between the two mirrors inside the laser cavity, is much bigger than the light that's coming outside. Question is, how do we do this? Because if we try to place a detector inside the laser cavity, like here, we would interrupt the laser action. And the laser quits. So obviously, that's not a smart way of doing this. So what we're going to do is we're going to use a simple method like this.

We're going to take a piece of glass. And depending on the orientation of the piece of glass, we're going to sample the light both outside the cavity and inside the cavity. And hopefully that the last that we will place inside the cavity, the laser cavity, is so small that we will not interrupt the laser action at least by too much. So here we go. So first, we have to show that we can sample some of the light with this piece of glass. So here we are. Here's this piece of glass.

Now, let me tell you what's happening. This piece of glass is placed at this orientation. And then, I can rotate it like so using this rotation stage. Now, if you look at the reflection from piece of glass on this little screen, you can see that the light gets extinguished when I am at the Brewster angle. Remember the polarization of this laser in the vertical plane so that I can achieve Brewster angle condition using this orientation of the glass.

So now when I have Brewster's angle, it's when these two markers-- one on the rotating part of the stage and the other one on the fixed part of the rotation stage-- when they line up, we're at Brewster's angle. And when I move away from Brewster's angle, like so, I can increase the amount of light sampled by the piece of glass. So let's say, if I set it this position here, then I have a small percentage of light that's reflected by the piece of glass onto the screen.

Now, what I'm going to do is take a similar piece of glass and put it again in the beam like so. And again, the markers are the same as in the other stage. So when the markers are lined up, then I get no light reflected. This means Bruce's condition. And when I'm over here, I get pretty much the same amount of light as in this case. So now, I've calibrated these two pieces of glass in terms of angle.

Now, what I'm going to do, I'm going to take one of them. And without changing the angle, place it inside the laser cavity. And hopefully, the laser won't go out on me. So as I put it in here, without changing the angle, you can see I'm going to sample some of the light. And you'll see it on this screen. And note that the word "inside" here, that means that this piece of glass is inside the laser cavity. And then, the one outside the laser cavity is labeled again by the word "outside."

And now, I would like you to look at the spot reflected by the piece of glass outside the cavity and the spot reflected by the piece of glass inside the cavity. So if we have now the split screen in position, you can see that the one inside is much brighter than the one outside. In fact, it's brighter in this case by about a factor of 50 or so. The question I want to leave with you is, why the light coming out of the laser is much weaker than the light inside the laser? And what determines that ratio? So that's a nice little puzzle for you.

Now sometimes, one would like to increase the light coming out of the laser. Now, how can you do it? Well, you notice that since there's a lot of light inside the cavity, one way of quickly increasing the laser intensity, even though for a very short time, is by removing one of the mirrors-- like for example, if I take this mirror out from the laser very quickly, then I can essentially dump out all the photons that are stored in the laser cavity. In fact, this is called cavity dumping.

And what this gives you, this gives you a huge increase in the number of photons coming out from the laser, but only for a very short time. In fact, it just takes all the photons that's stored in the laser cavity and just dumps them out and, of course, for a very short time. In fact, the time is just twice the transit time of the cavity. So the fact that one knows something about the light inside the laser is bigger than the light outside the laser, then one can come up with this concept of cavity dumping which can be useful for some applications.