PROFESSOR: I would like us-- we're going to apply Hubble's law again.

AUDIENCE: Oh.

PROFESSOR: Yes, you guys haven't had enough practice with it. Here we said, here is the hot gas. Here is different galaxies.

We saw when we looked at Ned that there was a bunch of those little red circles. Each one of those red circles was another galaxy, that it was a part of this galaxy cluster. We couldn't see them all, because they might have a small angular size. I'm sensing there's not a whole lot of attention being paid in the room.

How did we find the distance to the galaxy cluster? So the distance to the cluster is that much. How did we find the distance? Juan?

AUDIENCE: Velocity-- what is it? Oh, speed times distance? I mean, speed equals distance?

PROFESSOR: Speed equals distance? That's wrong. Speed does not equal distance.

AUDIENCE: I mean, the speed [INAUDIBLE] times distance [INAUDIBLE].

PROFESSOR: How did we get the distance to the cluster? Look at your solving problems in science sheet. What process did you go through? What did we have to do to get the distance to this cluster? Peter?

AUDIENCE: Divide velocity by [INAUDIBLE].

PROFESSOR: OK, we used Hubble's law, and we said, if we can get a measurement for the redshift of the cluster, how fast it's moving away from us, if we can get a measurement of that, we can use Hubble's law to predict what the distance is. That was for the average for the whole cluster.

What if I wanted the distance to the front of the cluster, which is here, the distance from us to the front, and I also wanted the distance to the back of the cluster, which is over there? How could I get those values? Because we figured out how wide the cluster is side to side, let's figure out how deep it is.

AUDIENCE: I would subtract the linear diameter from the distance to the cluster.

PROFESSOR: OK. So the linear diameter on our model here is measuring this way.

AUDIENCE: The radius.

PROFESSOR: The radius, right. But how do we know what the cluster looks like? Maybe the cluster is football shaped. When we look at it on the sky, it's just going to be a blob.

We want to know, what is the shape of this cluster? Is it as wide as it is deep? Because if it was round, if it was spherical, yeah, we could say, all right, the distance to the back is just we'll take the radius and we'll add the radius on for the back, and we'll take the radius and we'll subtract the radius off for the front. How could we do this? What's at the front of this galaxy cluster?

AUDIENCE: Stars.

PROFESSOR: Are there stars?

AUDIENCE: [INAUDIBLE].

PROFESSOR: Say that again.

AUDIENCE: [INAUDIBLE].

PROFESSOR: OK, yeah, there's dust in the way here. If we could look at the redshift of this galaxy and the redshift of this galaxy, could we use those to predict the distance to the front and the back?

AUDIENCE: Maybe.

PROFESSOR: Maybe? Yeah, maybe. What I want you to do is this-- go ahead, Bianca.

AUDIENCE: If it's in front of the other one, won't you be able to not see the one behind it?

PROFESSOR: Oh, right? So Bianca's saying, if this one's here, wouldn't that block out the one behind? Well, I don't know. I just drew a diagram here.

What we need to do is, let's go into the cluster and let's find the galaxy that is moving away the slowest. And then let's find the galaxy that's moving away the fastest. If we find the galaxy that's moving away from us slowest, couldn't we get the distance to the front of the galaxy? And if we find the galaxy that's moving away fastest, wouldn't that be the galaxy that's far back in the cluster?

So what I want you guys to do-- here's your task-- I want you to predict the distance to the front of the cluster and the distance to the back of the cluster.