MARK HARTMAN: So we've been taking a look at this X-ray binary star system model, and we're seeing how with different parameters we can make different predictions, and see if those match up with what we're actually seeing. That helps us take observations and then think about, what kind of model do we want apply to it.

But we've discovered that if we're looking for things like linear sizes of these objects, if we just look at the image, and if it's just a point source because those objects are so far away, it's hard for us to figure out what's the actual linear size. Now we have a prediction of about 10 to the 15th meters would be the size of whatever this object is.

10 to the 15th meters could be the diameter of the orbit. Or maybe it's a little bit bigger, but it's going to be representative of the whole thing. Right now, what we want to try and find out is-- and this is where want to take a couple of notes on. How can we find linear size using a light curve? That's a question.

So I just want to do a simple-- oops, thank you. I just want to do a simple estimation here. If we have a source of light that's small and we have an object that's large, obviously we can measure the size of this object. But if this object is moving in front of this, that light gets blocked for a certain amount of time. If you can measure how long the object is blocked and you know how fast this object is moving, you can figure out how big this object is.

For instance, if I move faster, what happens to the amount of time that that light is blocked?

AUDIENCE: Decrease.

MARK HARTMAN: And if I move slower. What happens, the amount of time that this is blocked?

AUDIENCE: It increases.

MARK HARTMAN: It increases. In this simple situation, here's what's happening on the light curve. We're starting out at a certain luminosity or certain flux that we're collecting. It drops down. And then it stays at zero for a while. And then it comes back up. Because my object is much bigger in angular size than my source.

So right when it gets to the edge-- bloop-- it covers up that source. And then-- bloop-- it comes back really quickly. So this is going to be time. This is going to be the light curve, which is flux as a function of time.

Right here what's happening, what does this system look like from the from the front. At this point right here, here's our orange poster. And there's a light-- it's putting out light-- right at the edge of it.

And right there there, this orange poster is moving that way with a certain velocity. So we're moving that way. Right here at this time it blocks it out.

And then at a later time-- this is going to be a later time-- we're going to see, here's the orange poster. And at this point, where is the light going to be seen?

At the end. We're going to see the light over here on this side. And the orange poster is still moving with a certain velocity that way.

Let's take a look and see if that makes sense. Here we've got-- if you guys were recording the amount of flux that you get from this object, it's constant, and then-- bloop-- it drops. And then-- bloop-- it comes back.

So this is a front view of what happens at each of these times. This is going to be t start. This is going to be t stop. This is going to be the start of the eclipse or the stop of the eclipse.

AUDIENCE: t start.

MARK HARTMAN: t start, t stop. If I know that this poster is moving in a certain velocity, I can say, if I wanted to find let's just say the width of the poster, I know that in general the distance that something travels-- and this is just a general formula that I'm hoping most of you have seen-- the distances something travels is the speed of the object times-- oops, let's put these in parentheses-- the time it takes to travel. Distance equals velocity times time.

So let's check the units. Whenever we're looking at a new equation, we always want to check the units. The units of distance traveled would be-- so this is going to be units, that's going to be meters.

Speed of the object is going to be in meters per second. And then the time it takes could be in seconds. Does that make sense? Do meters equal meters per second times seconds? Yeah.

Seconds cancel out, and we're just left with meters equals meters. That makes sense. Pretty amazing.

Now in our case, let me go ahead and move this. I'm going to just get rid of this. Hopefully everybody still has this picture. We're going to redraw it several times, though.

In our case, we can rewrite this as the width of the poster because how far did the orange poster travel. Well, the front of the orange poster traveled from this place all the way over to this place here in the amount of time that it took for this poster to move in front.

So the length that the front of the object had traveled was from there to here. That's the width of my poster. Here's where it starts-- blink-- stops. It starts back up. So I configure the width of my poster. That's going to be equal to the velocity of the poster.

Well, let's keep it at speed-- speed of the poster times the difference in time, the time that we stopped to the time that we started. So we're going to say t stop minus t start.

So if I was really, really far away and you couldn't come up and measure this with a ruler, say, I was standing really, really far back there, you guys could measure the amount of time that you would see this blocked. And I can tell you how fast I was moving this object. Then you could figure out how wide this poster is.

Any questions on that?

So these all look really good. This is what you should have. From the front view of the telescope, first, we see the compact object on this side. The companion is moving across.

In the middle, where is the compact object?

AUDIENCE: Behind.

MARK HARTMAN: It's behind it. And on this case, the compact object is on that side. The companion has moved further to that side.

We can see the same thing over here in the top view. Here, the object is moving this way, it hasn't quite intersected our line of sight. Here, we've got the compact object behind the companion star. And here, we've got that the companion has moved a little bit further so that we can actually see the compact object again.

So how would we estimate the size of our companion star?

AUDIENCE: [INAUDIBLE]

MARK HARTMAN: So if we looked at how long it took, we could estimate the diameter of companion star is equal to the speed of the companion star times the amount of time that it took to move in front of the compact object, because this distance here is the diameter of our star. So linear diameter of a companion star is equal to the speed of the companion star in orbit times time to eclipse the compact object.

So we could say, linear diameter equals speed times t stop minus t start, because that difference-- t stop minus t start-- is how long it took for our object to move all the way in front.