Project 2… Estimating the Lunar Shadow Speed

Method 1:

Step 1: What time was it to the nearest second when the full total eclipse started? This would be the time when the landscape around you began to darken quickly.

Step 2: What time was it when totality ended and the landscape started to brighten quickly?

Step 3: Take the difference in these times to get the time it took the lunar shadow to pass over your location.

Step 4: Convert your time into decimal hours.

Step 5: The average diameter of the shadow spot is 110 kilometers. Divide your time answer in hours into 110 km to get the shadow speed in kilometers/hour.

Method 2: Partner with someone located a few hundred kilometers away and share your information via a text message. You will also need to use the GPS feature on your phone to determine your latitude and longitude to be shared with your partner.

Step 1: Use your iPhone GPS App or a map to determine your geographic location in latitude and longitude. Convert to decimal degrees by dividing the minutes by 60 and the seconds by 3600 and adding the resulting two decimals to the degree value. Round your answer to two decimal places.

Example:
Partner 1:   Carbondale: Latitude: 37.56 North   Longitude: 89.06 West
Partner 2:   Hopkinsville: Latitude: 36.87 North   Longitude: 87.47 West

Step 2: Determine how far apart these locations are to the nearest kilometer.

You can either note these locations on a map and use a string calibrated to the map scale in kilometers per centimeter, or you can use this formula:

$x = \sin(Lat1)\sin(Lat2)+\cos(Lat1)\cos(Lat2)\cos(Long1-Long2)$

Angle = arccos(x) in degrees
Distance = 40000 x Angle/360   km.

Example: For Carbondale and Hopkinsville:

$x = \sin(37.56)\sin(36.87) + \cos(37.56)\cos(36.87)\cos(89.06-87.47)$

angle = arccos(0.9997) = 1.4 degrees

Distance = 40000 x 1.4/360 = **155 km**

Step 3: Measure the time when totality occurred to the nearest second at each location. Convert your answer into decimal hours to two three places accuracy.

Example: Carbondale: 18:21:56   Local Time
Hopkinsville: 18:26:03   Local Time

The difference is 4m 7s or 0.069 hours.

Make sure that if your partner is in another time zone that you allow for the 1-hour difference!

Step 4: Divide the distance by the time and round to the nearest ten to get the speed in km/hr.

Example: For Carbondale and Hopkinsville
speed = 155 km/0.069 hours = **2450 km/hr**