* Assume Re is a constant
  + M = mass of sun = 1.98892 x 10^30 kg
  + G = 6.67 x 10^-11 m^2/kg s
  + C = 2.9989 x 10^8 m/s
  + Distance to LMC – 48.5 Kpc 🡪 1.49655 x 10^21 - Ds
  + Halo radius – 15 Kpc 🡪 change to meters 🡪 4.62852 x 10^20 m - Dm

Solve for D, then solve for Re (which will be a constant) using the assumed values from the sun, then plug value for Re into f = Rm/Re, plug f into magnification formula and use different values for magnification from all the cases to get values for Rm.

* Since our results for LMC7 was rather big, we decided to use very precise values to check our result.
  + One of the main things we discovered was that instead of estimating the time interval, we noticed that the graph gave us a time t = 115.3
  + The new result was 5.4x10^23 kg !!!! 🡪 wrong
    - Old was 1.2x10^32 kg
* We made an excel sheet for all the masses of the MACHOs
  + Then we used different values for Dm to find the range of the mass of the MACHOs
  + The closer it is to us, the greater the velocity, the greater the mass
* PRESENTATIONS:
* 2 – trying to find dark matter within galaxy by looking at stars orbiting in galaxy and galaxy itself
  + galaxies very similar to circumstellar disks
    - fundamental difference though – galaxy made up of a lot of stars and galaxy itself is moving away or towards us – velocity for circumstellar disks has 0 velocity in center – but for galaxies, velocity in center is positive, which means they’re moving away from us – confirms theory of universe expansion
  + had degrees – convert them to coordinates – do it using distance between us and galaxy – using Hubble’s formula – relationship between distance and velocity
    - found distance of all galaxies from us
      * proportion between distance and velocity – greater velocity, more distant
      * calculating mass of galaxy:
        + by using gravitation forces – got 10^40
        + by using luminosity values – had flux values in program – flux to luminosity to mass – got 10^38

found average luminosity of star using the binary stars program

divide luminosity of galaxy/luminosity of star to find number of stars x mass of average star = mass of galaxy

FOUND DARK MATTER – because dark matter doesn’t emit light, it doesn’t give luminosity, so the difference in the two values is due to dark matter

99% of matter in the galaxy is dark matter

* 1 – study how certain stars are moving around an intense source of radio emission really far away
  + we’re 25,000 light years away from radio emission
  + 1. Calculate velocity with which stars are moving
    - take coordinates of star A for one year – find the distance it covers for one year, divide by distance to find velocity with which star A was moving
  + value of dim matter differs with each star so they think dark matter might be affecting it?
  + Find velocity of the star, use v^2r/G to find the mass of dim matter
    - Star A moving at 2600 m/s
      * Star A – mass of dim matter = 2.5x10^28
      * Star B – mass of dim matter = 1.7x10^29
* Rm will be closer to 0 for the large magnifications – focus on LMC5
* Looking at LMC10 red – find the slope = change of magnification over time
  + Linear slope: points: (185, 1.6) (205, 2.4) = slope of .04
  + Magnification increases .04 per day
  + Max did some crazy math = found relation between rate of change of magnification over time and the rate of change of Rm over time in terms of Rm and Re
    - Integrate from 185 to 205, using the slope .04, to find Rm in terms of Re, which is essentially Rm in terms of the mass because we have the equation for Re – if we can find Rm then we can find mass
    - Using the magnification = f stuff formula, we plug in the max magnification for LMC10 red to find f so we have another equation relating Rm and Re
      * Rm = f (.45)/Re
      * Max’s large Rm equation = .45/Re
        + Re = dlkfjalsdiuf;laksdfj!

NEW METHOD:

LMC7: A = 6.16

D = 3.197x10^20

G = 6.67x10^-11

C = 2.9989x10^8

Mass of sun = 1.98892 x 10^30 kg

Mass of milky way = 5.8 x 10^11 solar mass

* + Solar mass = 1.98892 x10^30 kg
* R = 15 kpc (radius of halo)
  + 1 kpc = 3.085x10^19 m
* Use M = v^2 r/G to find the velocity of the MACHO then divide by the time period to find how far it moves in the time interval. That’s 2Rm, divide by 2 to find Rm.
* Find f using the specific magnification for LMC7
* Rm/f = Re, plug into the Re equation to find the mass of the MACHO

🡪 result for LMC7 – mass is 100x bigger than sun???

* New method to find Rm:
  + Instead of using the total time interval for when magnification starts/ends, we need to pick a value for magnification corresponding to a certain point on the graph.
    - Before, we were finding the Rm at the point when the magnification was just starting to show a change but using the value for the maximum magnification A – that’s not true because the max magnification is the peak, not at the bottom of the curve where the magnification is just starting – therefore the value for magnification does not correspond to the distance
    - Now, we’re going to pick a specific value for magnification on a specific point on the curve, find the time interval of that, and redo f using our new magnification and re-find Rm using the new time interval
* Pretend the LMC is a circle facing us. Use the old Rms to find the radius of one star so that its surface area becomes the “bullseye”. Then use the radius of the LMC to find its total area (assuming it’s a perfect circle). There are 1.9 billion starts in the LMC, multiply that by the area of one star to find the total area of bulls-eyes. Then find a ratio of bulls-eyes to the total area.
  + For ex. If the ratio is 50%, and we see 8 MACHOs, then that means there are 8 more MACHOs we’re not seeing
* Found ratio of bulls-eyes to LMC
  + 🡪 4.19x10^-9
* To find mass of all MACHOs in universe:

1. find orbital circumference: 2pi(radius of halo)
2. find orbital period: orbital period/velocity of MACHO
3. turn orbital period into days
4. divide by 840 to find sections of 840 days because that’s the amount of time we observed
5. total # of MACHOs in one section (including possible duplicates) – 8 observed MACHOs/ratio of bullseyes to LMC because bullseye/total area = observed events/total number of events so total number of events = observed/ratio
6. total number of MACHOs = total number of machos in one section times the number of sections of 840 days
7. #6 times average mass of MACHO from the 8 observed events to find the total mass of MACHOs in universe
   * 1. WE GOT 6.92 x 10^47, which is 10^5 bigger than the total mass of the universe