Thank you’s are in order!

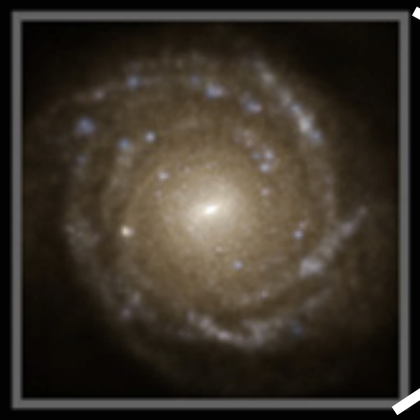
(1) Who am I?

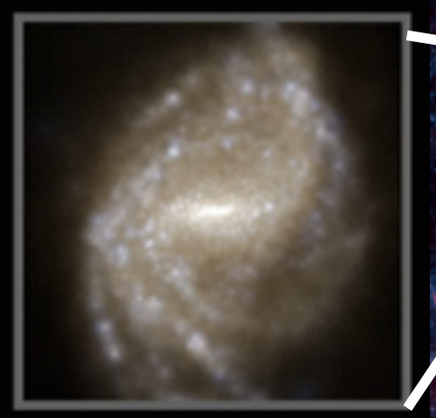
(2) What are we doing?

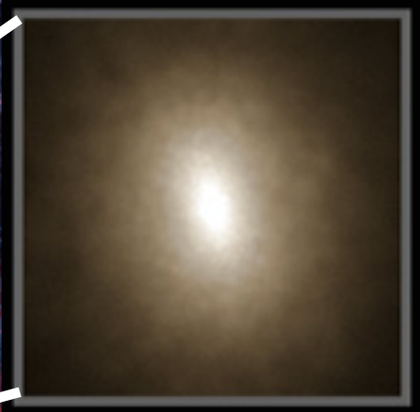
(3) How are we gonna do it?

Who are you and what do you do?

- Super computer simulations of how galaxies form in our Universe







I'm particularly interested in how metals (stuff heavier than H & He) moves from its production cites (inside massive stars) to the larger galactic scales

ILLUSTRIS

Why a large scale cosmological simulation?

List of galaxy redshift surveys

Galaxy redshift surveys aim to provide fundamental data on galaxies and the distribution of galaxies. The criteria for this list is: (1) a field survey, i.e., no specific structure is targeted; (2) spectroscopic redshifts obtained with resolving power > 100; (3) well defined selection criteria with magnitude limits from optical to near-IR, i.e., predominantly stellar light, quasar surveys are not included; (4) more than 5000 galaxy redshifts obtained.

Optical to near-infrared surveys listed in alphabetical order:

- AGN and Galaxy Evolution Survey (**AGES**): completed 18000 redshifts (galaxy targets) over 7.7 sq.deg., various selections including R < 20.0 and B_W < 21.3; links AGES web site, survey paper (2012).
- **CfA2** Redshift Survey: completed 18000 redshifts over 17000 sq.deg., [illegible]
- **CNOC2** Field Galaxy Redshift Survey: completed 6000 redshifts over [illegible]
- **DEEP2** Redshift Survey: completed 38000 redshifts over 2.8 sq.deg., R_{AB} < 24.1 with color selection; links DEEP2 web site, survey paper (2003).
- Galaxy And Mass Assembly (**GAMA**) redshift survey: aims for 300000 redshifts over 300 sq.deg., r < 19.8 and other limits in z and K; links GAMA web site, survey paper (2010).
- Las Campanas Redshift Survey (**LCRS**): completed 26000 redshifts over [illegible]
- Millennium Galaxy Catalogue (**MGC**): completed 10000 redshifts over [illegible]
- 6dF Galaxy Survey (**6dFGS**): completed 125000 redshifts over 17000 sq.deg., K < 12.75 and other limits in BRIJH; links 6dFGS web site, survey paper (2009).
- Sloan Digital Sky Survey (**SDSS**): links SDSS web site, survey paper (2000), EDR paper (2002). Various spectroscopic surveys:
  - Main Galaxy Sample (SDSS-MAIN): completed 700000 redshifts over [illegible]
  - Luminous Red Galaxies (SDSS-LRG): completed 100000 redshifts over [illegible]
  - Stripe 82 galaxy surveys (SDSS-S82): completed about 70000 redshifts over 275 sq.deg., heterogeneous selection includes [illegible]
- Southern Sky Redshift Survey (**SSRS2**): completed 5400 redshifts over [illegible]
- 2dF Galaxy Redshift Survey (**2dFGRS**): completed 220000 redshifts over [illegible]
- 2dF-SDSS LRG and QSO (**2SLAQ**) Luminous Red Galaxy Survey: completed 13000 redshifts over 180 sq.deg., i < 19.8 with color selection; links 2SLAQ web site, LRG survey paper (2006).
- 2MASS Redshift Survey (**2MRS**): completed 43500 redshifts over 37000 sq.deg., K < 12.2; links 2MRS web site, survey paper (2012).
- VIMOS Public Extragalactic Redshift Survey (**VIPERS**): aims for 100000 redshifts over 24 sq.deg., I_{AB} < 22.5 with color selection; link VIPERS web site.
- VIMOS VLT Deep Survey (**VVDS**): links VVDS web site, survey paper (2005). Three main spectroscopic surveys:
  - VVDS-wide: completed 35000 redshifts over 12 sq.deg., I_{AB} < 22.5; link VVDS wide survey paper (2008).
  - VVDS-deep: completed 12000 redshifts over 0.5 sq.deg., I_{AB} < 24.0.
  - VVDS-ultradeep: completed 1000 redshifts over 0.17 sq.deg., I_{AB} < 24.75.
- **zCOSMOS**: links zCOSMOS web site, survey paper (2007). Two main spectroscopic surveys.
  - zCOSMOS-bright: aims for 20000 redshifts over 1.7 sq.deg., I_{AB} < 22.5.
  - zCOSMOS-deep: aims for 10000 redshifts over 1.0 sq.deg., I_{AB} < 24.0 remaining [illegible]

Surveys with other wavelength selections:

- QMC-Cambridge-Durham (**QCD**) Redshift Survey: complete [illegible]
- IRAS **PSCz** Redshift Survey: completed 15000 redshifts over [illegible]
- **WiggleZ**: completed 250000 redshifts over 1000 sq.deg., GALEX NUV < 22.8 [illegible]

Other shallow/intermediate-depth surveys (less than 5000):

- Anglo-Australian Redshift Survey (**AARS**): completed 330 redshifts over [illegible]
- **Autofib** Redshift Survey: completed 1000 redshifts over 5.5 sq.deg., b_J < 22.0; link survey paper (1996).
- **CfA** Redshift Survey: completed 2400 redshifts over 9000 sq.deg., B < 14.5 (subset of CfA2); link survey paper (1982).
- Durham-UKST Redshift Survey (**DURS**): completed 2500 redshifts over [illegible]
- Eso Slice Project (**ESP**): completed 3300 redshifts over 23 sq.deg., b_J < 19.4; links ESP web site, survey paper (1997).
- Hawaii+AAO (**H-AAO**) K-Band Redshift Survey: completed 1050 redshifts over 8.2 sq.deg., K<15.0; link survey paper (2003).
- Kitt Peak Galaxy Redshift Survey (**KPGRS**): completed 328 redshifts over 1.3 sq.deg., R_{KP} < 19.0; link survey paper (1997).
- Stromlo-APM (**SAPM**) Redshift Survey: completed 1800 redshifts over [illegible]

Other deep surveys:

- Canada-France Redshift Survey (**CFRS**): completed 700 redshifts over 0.14 sq.deg., I_{AB} < 22.5; links CFRS web site, survey paper (1995).
- **DEEP** Groth Strip Galaxy Redshift Survey: completed 658 redshifts over 0.03 sq. deg., V < 24; link survey paper (2005).
- FORS Deep Field (**FDF**) spectroscopic survey: completed 341 redshifts over 0.014 sq. deg., I < 25 spectra; link survey paper (2004).
- Gemini Deep Deep Survey (**GDDS**): completed 225 redshifts over 0.03 sq.deg., K < 20.6 & I < 24.5 with color selection; links GDDS web site, survey paper (2004).
- **K20** survey: completed 500 redshifts over 0.014 sq.deg., K < 20.0; links K20 web site, survey paper (2005).
- Lyman Break Galaxies at z ~ 3 (**LBG-z3**) survey with the Keck telescopes: completed 940 redshifts over 0.38 sq.deg., R_{AB} < 25.5 with color selection; link survey paper (2003).
- **MUNICS** spectroscopic sample: completed 500 redshifts over 0.17 sq.deg., K < 17.5 (0.03 sq.deg. to K < 19.0); links MUNICS web site, related paper (2003).
- Team Keck Redshift Survey (**TKRS**): completed 1440 redshifts over 0.04 sq.deg., R_{AB} < 24.4; link survey paper (2004).

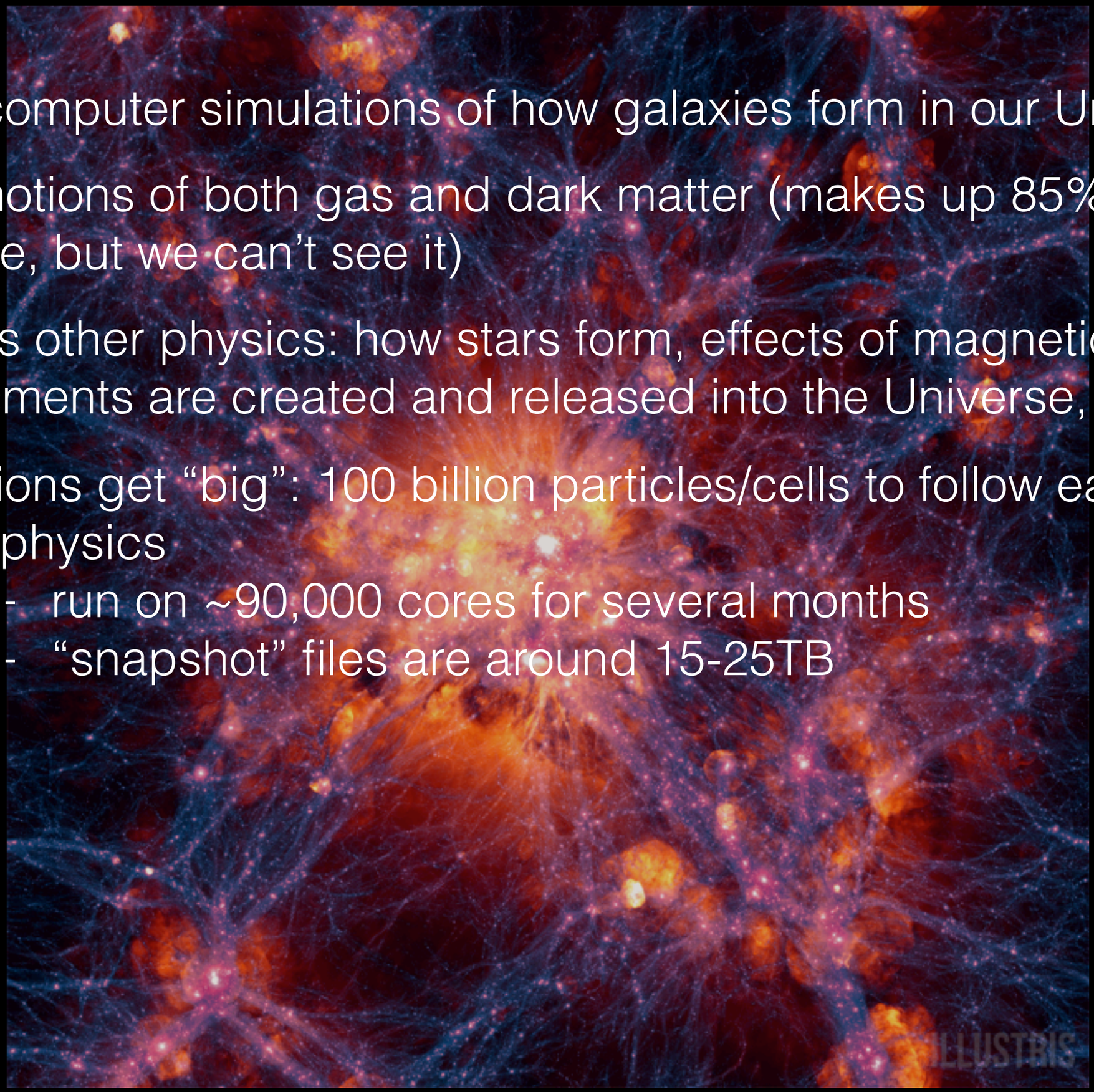
BOSS, Hubble, SDSS, COSMOS, DES, Euclid, LSST, PanSTARRS + in depth studies of many individual galaxies and galaxy clusters

(Illustris box, moving slice, c: Nelson)

Simulating Cosmological Galaxy Formation: A Problem of Scales

Credit: Nelson 2015

Who are you and what do you do?



- Super computer simulations of how galaxies form in our Universe
- Track motions of both gas and dark matter (makes up 85% of the Universe, but we can't see it)
- Includes other physics: how stars form, effects of magnetic fields, how elements are created and released into the Universe, etc
- Simulations get "big": 100 billion particles/cells to follow each with its own physics
  - run on ~90,000 cores for several months
  - "snapshot" files are around 15-25TB

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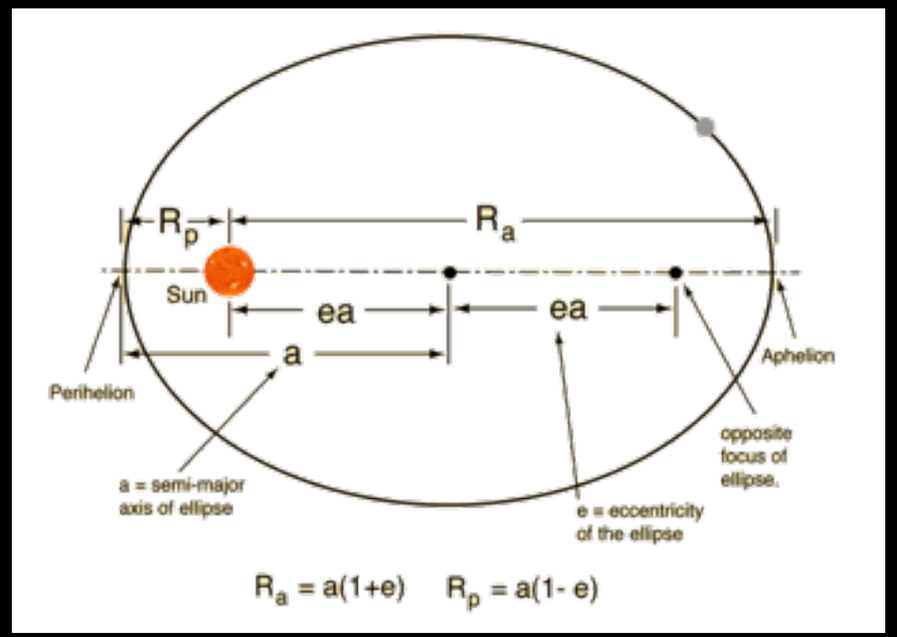
Intro - Day 2

Everything for today is posted under day 2 of:
www.astroblend.com/ba2017



* For the 2-Body problem we are working on compared the analytical and numerical solutions
* First : some hints on indexing….

Intro - Day 2

```
# loop and numerically integrate
for n in range(1,n_eu):
    r1_old = r_eu[n-1][0,:]
    #r2_old = ...
    #v1_old = ...
    #v2_old = ...
    # v1_new = (acceleration from mass 2)*dt + v1_old
    # v2_new = (acceleration from mass 1)*dt + v2_old
    # r1_new = 1/2*(acceleration from mass 2)*dt*dt + v1_old*dt + r1_old
    # r2_new = 1/2*(acceleration from mass 1)*dt*dt + v2_old*dt + r2_old
    # v_eu.append( np.array( [v1_new, v2_new] ) )
    # r_eu.append( np.array( [r1_new, r2_new] ) )
```

Intro - Day 2

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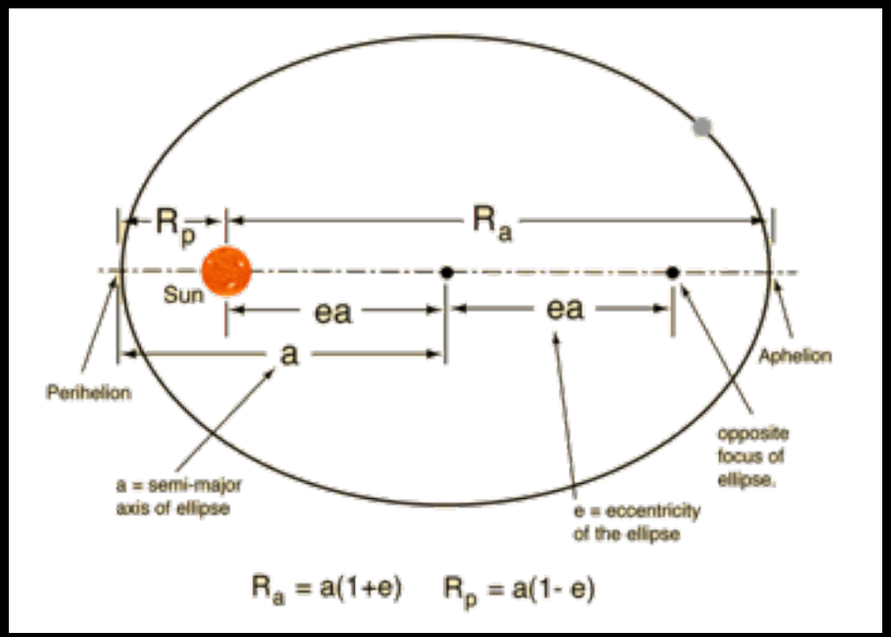

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- Also, for people that have solutions already: (1) what changes the "goodness" of your solution? (2) How are some ways you might quantify the "goodness" of your solution?

~~(1) Who am I?~~

~~(2) What are we doing?~~

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What is inquiry?

*"[Inquiry is] the **intentional process** of:*

diagnosing problems, critiquing experiments,

distinguishing alternatives, planning investigations,

researching conjectures, searching for information,

constructing models, discussing with peers

and forming coherent arguments."

Linn, M. C., Davis E.A., & Bell, P. (2004).

… i.e. we are going to actually do some science :)

What is Inquiry? How is this going to affect me?

- More open ended than traditional labs
- You might feel frustrated or confused by the lack of structure - this is normal!
- Before “helping” someone ask yourself - will this help with their learning or just give them the answer? Don’t forget, people are at different stages in their programming education!
- Stuck? Are you “done stuck” or “stuck stuck”?
- I might answer a question with another question - don’t panic.

Intro - Day 2

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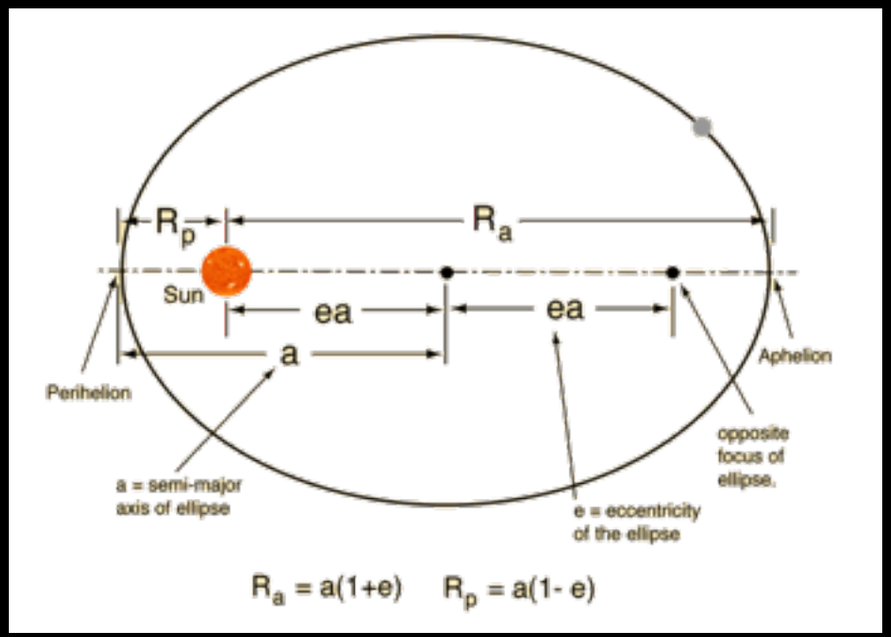

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