ASTR 1040 Recitation: Star Formation – Jeans Mass

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Next Week

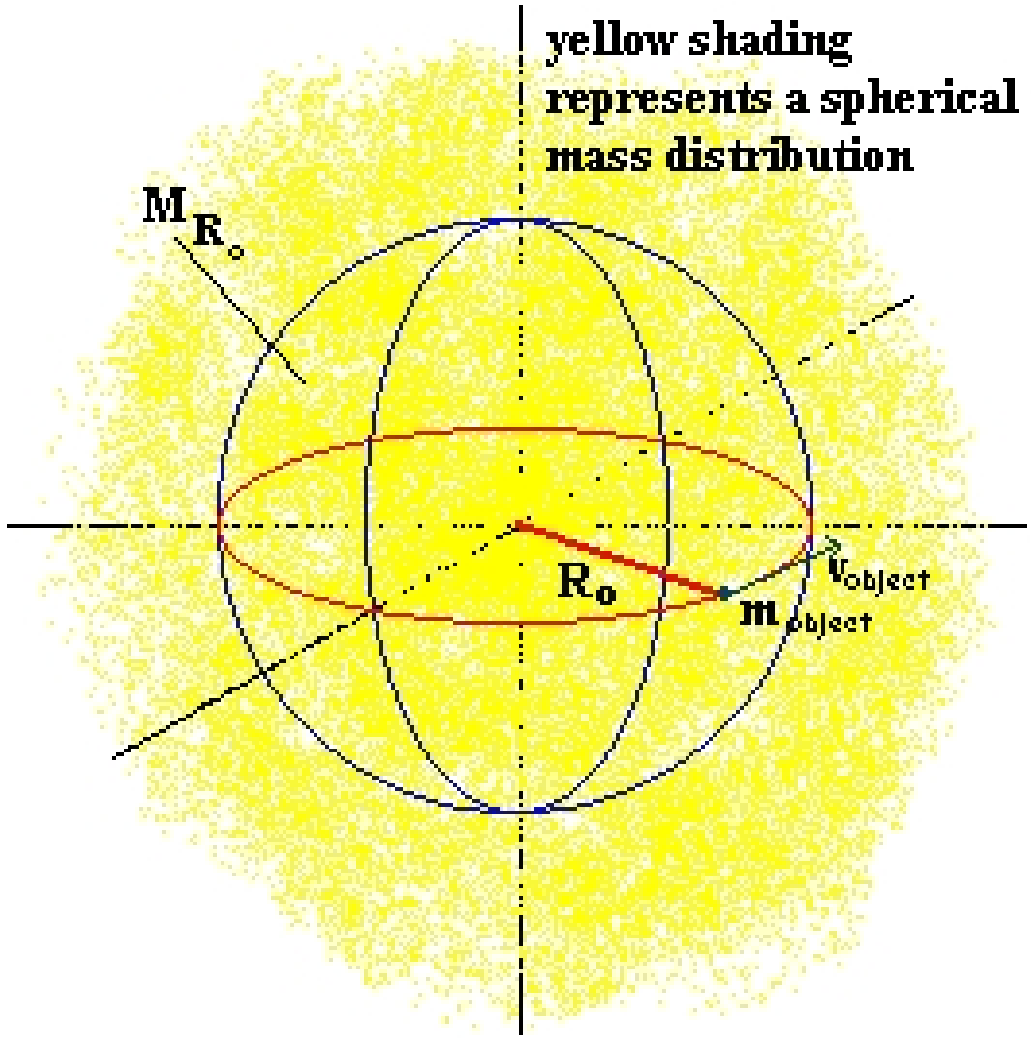
- Observing Session: Mon Mar 10 (8:00 pm)

Today's Schedule

- Past / Current Homework Questions?
- Fun with Jeans Length & Mass
- Group Projects
- Survey / Poll

Potential Energy of a Star

- What is gravitational binding energy of a star?
- Spherical mass distribution, constant density
- $U \approx -\frac{3}{5}\frac{GM^2}{R}$



Jeans Mass

- Too much mass $\Rightarrow$ not enough pressure support
- Cloud will become unstable against gravitational collapse
- Virial Theorem, constant density, no outside pressure, no magnetic fields

Sir James Hopwood Jeans

Jeans Mass & Length

$$M_J \approx \left(\frac{5kT}{G\mu m_p}\right)^{3/2}\left(\frac{3}{4\pi\rho_0}\right)^{1/2}$$

$$R_J \approx \left(\frac{15kT}{4\pi G\mu m_p \rho_0}\right)^{1/2}$$

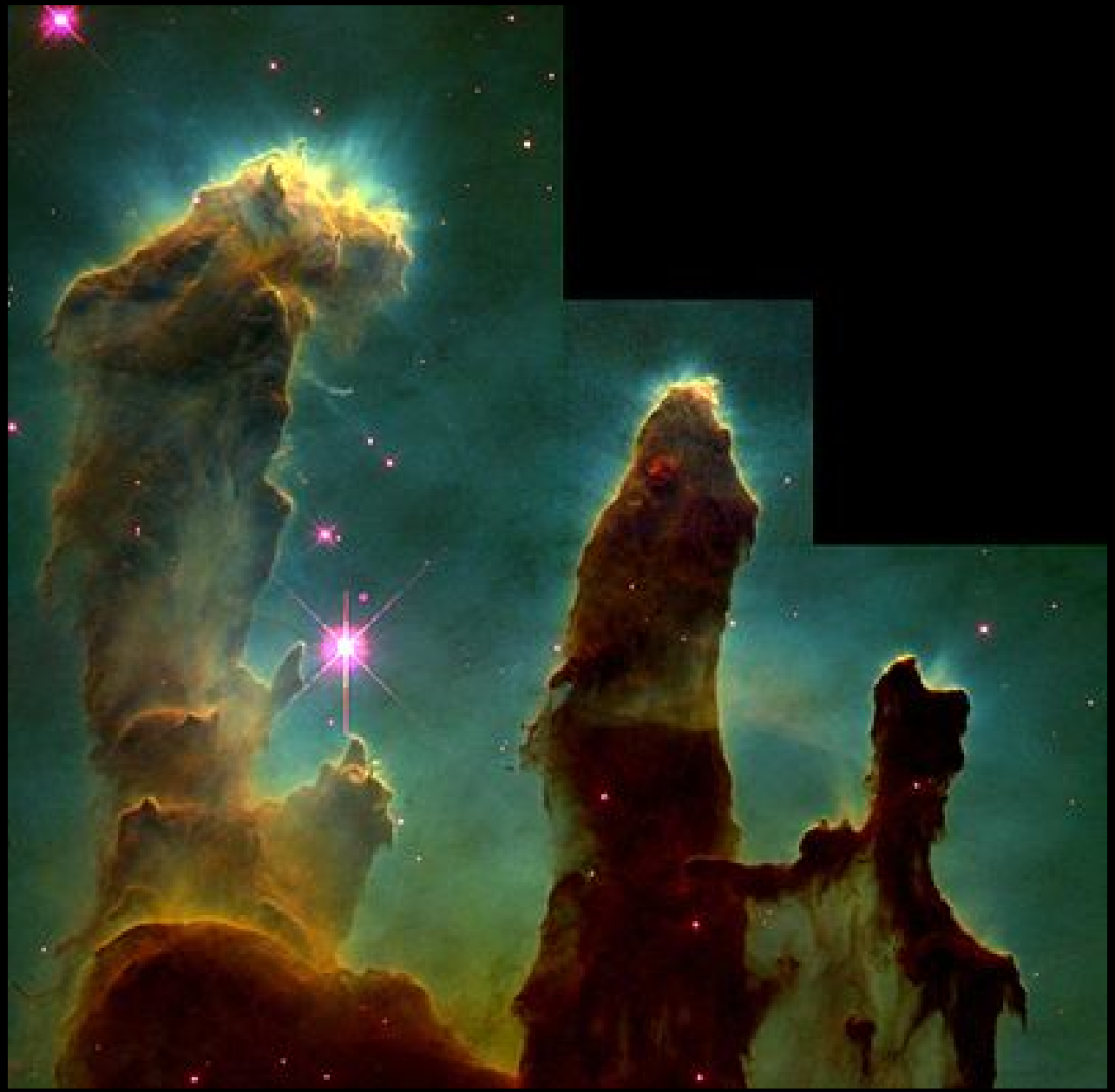
Diffuse HI Cloud

$$T \sim 50 \text{ K}$$
$$n \sim 5 \times 10^8 \text{ m}^{-3}$$
$$\rho_0 = nm_p \sim 8.4 \times 10^{-19} \text{ kg m}^{-3}$$
$$M_J \sim 1500\ M_\odot$$

Dense core of Molecular Cloud

$$T \sim 10 \text{ K}$$
$$n \sim 5 \times 10^{10} \text{ m}^{-3}$$
$$\rho_0 = 2nm_p \sim 3.0 \times 10^{-17} \text{ kg m}^{-3}$$
$$M_J \sim 8\ M_\odot$$

Eagle Nebula: "Pillars of Creation"



M42/NGC 1976: "Orion Nebula"

Group Project I

There is a dense molecular cloud with a radius of 30 pc and a mass of 10^6 $M_\odot$. What radial velocity (v_r) would you expect to measure?

Things to keep in mind:

- You might need the Virial Theorem
- Is v in Virial Theorem the same as v_r?

Group Project II

A dense HI (neutral Hydrogen) cloud is 3000 pc away with an angular size of $4'$ and a column density of $N = 10^{21}$ cm^{-2}. What is the cloud's mass?

Column density defined as: $N = \int n ds = nD$

Group Project II

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Step 1:

Find diameter of cloud

Group Project II

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Step 1:

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Step 2:

Convert column density into number density

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Step 1:

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Step 2:

Convert column density into number density

Step 3:

Convert number density into number of particles

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Find diameter of cloud

Step 2:

Convert column density into number density

Step 3:

Convert number density into number of particles

Step 4:

Calculate total mass from total number of particles

Survey

What do you think of Recitations?

What do you like?

What don't you like?

What would you like me to change?

Too much math? Not enough math?

Too many words? Not enough words?