

## ASTR 1020: Stars & Galaxies

March 17, 2008

- Reading: Chapter 20, sections 20.1 – 20.2.
- *MasteringAstronomy* Homework on The Milky Way is due March 19th.
- Volunteer for “Astronomy in the News”; sign up for SBO extra-credit observing.
- **Meet Friday at Fiske Planetarium!**

## Astronomy Picture of the Day



Hearing on NASA's Science Programs  
March 13, 2008

## Today's Class

Chapter 19:  
Spiral arms  
The Galactic Center



## Spiral patterns in galaxies are very common



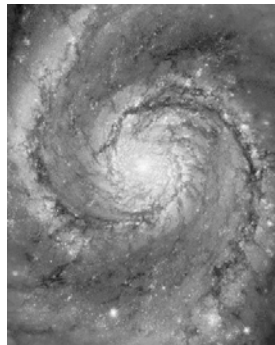
Why don't they  
“wind up?”

## Spiral Arms– why?

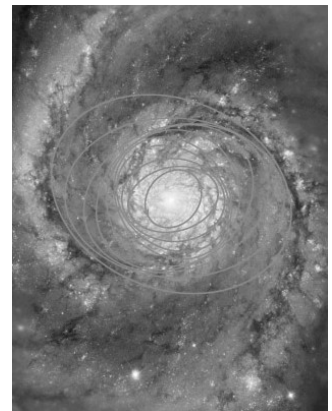
“Density waves”– stars  
move in and out of  
denser regions

More like ripples in a pond  
than arms of a pinwheel

In dense regions, star  
formation is more intense,  
so “arms” are brighter



- Material is pulled a little forward or backwards towards the high density regions
- Note how this creates a spiral pattern



## How did it get started?

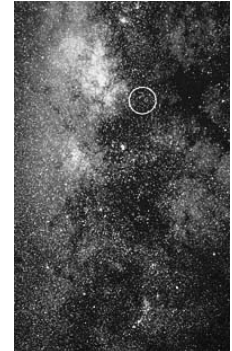
- Possibly a bump/pull from the gravity of another galaxy



## The Galactic Center

- Constellation Sagittarius

Nothing very interesting there?



**Clicker Question:** We want to map out the structure of the core of the Milky Way. What wavelength should we be using, and why?

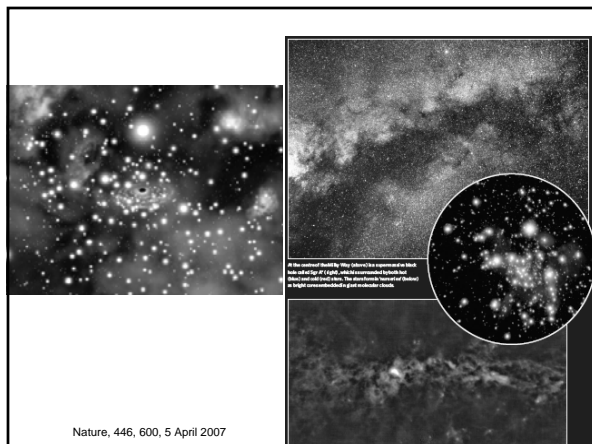
- a) IR or radio
- b) visible light
- c) X-rays

- **IR or Radio!**

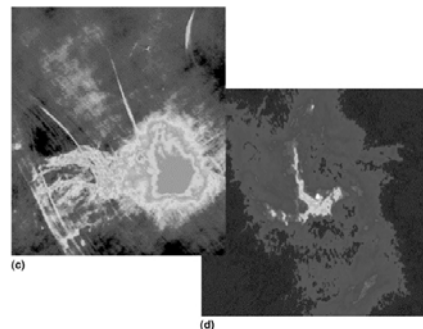
- Dust obscures our vision of much of the galaxy in visible and UV light.

- X-rays only highlight the hottest and weirdest places

IR and radio light pass through unaffected, show dust, stars gas

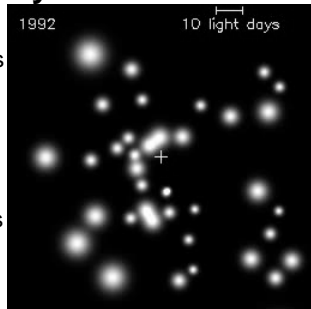


## Radio observations: “Sagittarius A\*”

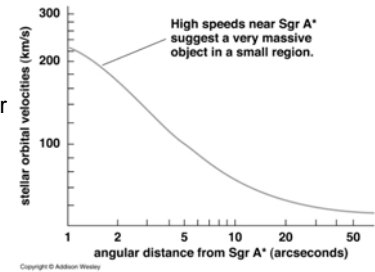


## Animation of Star Motions in the Milky Way Center

- Adaptive optics to separate star images
- Observing over several years
- Infrared wavelengths to see through dust



- Some of the mass is stars; the rest is in a 3-4 million solar mass black hole?



**Clicker Question:** A 3 million solar mass black hole represents:

- 99.9% of the mass of the Milky Way
- 1% of the mass of the Milky Way
- less than 1/1000<sup>th</sup> the mass of Milky Way

**Hint:**

- How many stars are in the Milky Way (check last class' notes)
- Dark matter outweighs this by about a factor of 10...

- **(C) Less than 1/1000th**

Number of stars = 100 billion  $\sim 10^{11}$   
 Total mass =  $10 \times 10^{11} = 10^{12}$  (a trillion)

3 million solar masses /  $10^{12}$  solar masses  $\sim 10^{-5}$ ,  
 or 1/100,000

Tiny fraction of the galaxy– but still remarkable because it's in such a tiny space!