Friday, January 29, 2016

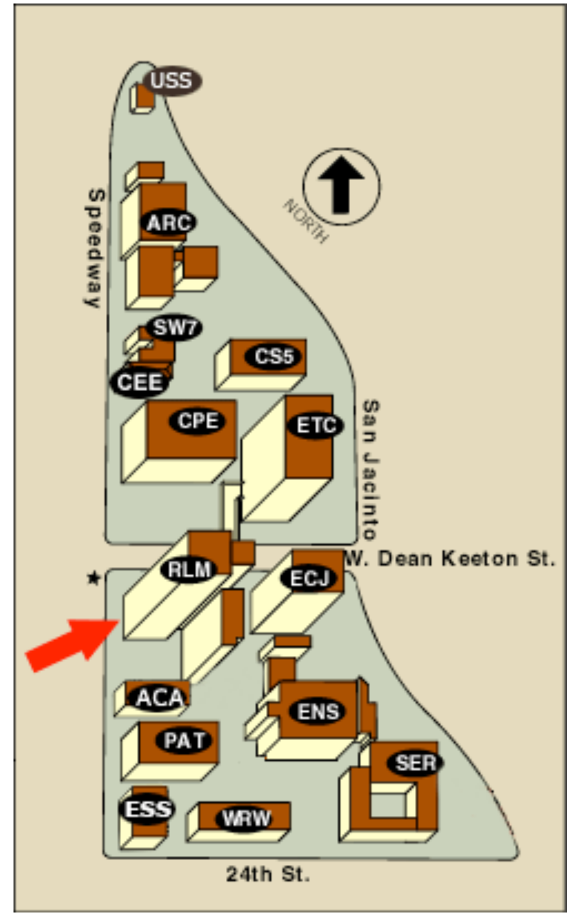
First exam a week from today.

Review sheet posted Monday.

Review session Thursday, 4:30 – 5:30 PM
RLM 15.216B

Skywatch extra credit – how is it going?

Astronomy in the news?



Babylonian (modern day Iraq) clay tablets, 50 to 350 BC, show that they used primitive calculus to track the motion of Jupiter. Plotted velocity versus time, integrated under the curve to get the distance traveled.

Discussion point: What' s going on here?

Goal:

To understand what we have learned from the study of “live” supernova explosions in other galaxies.

All supernovae since 1680, since invention of the telescope, modern astronomy, have been discovered in other galaxies (G1.9+0.3 was already a ***supernovae remnant*** when discovered).

Galaxies like our Milky Way produce supernovae about once per century.

None since Cas A in about 1680. Our Galaxy is overdue for another!

Recognition (early in the 20th century) that some "novae" (new stars) were in distant galaxies and hence were 10,000 to 100,000 times brighter than classical novae in the Milky Way.

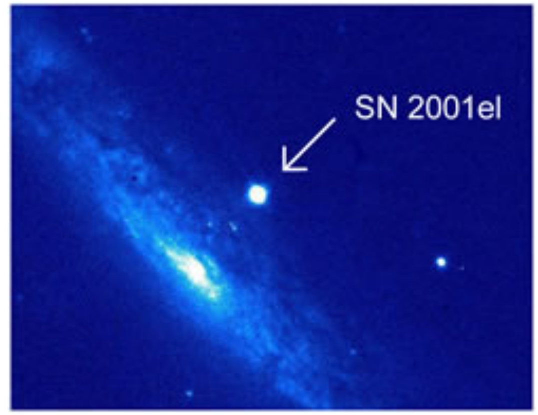
Led to the recognition and naming of "super" novae.

Web site of recent bright supernovae:

http://www.rochesterastronomy.org/snimages/

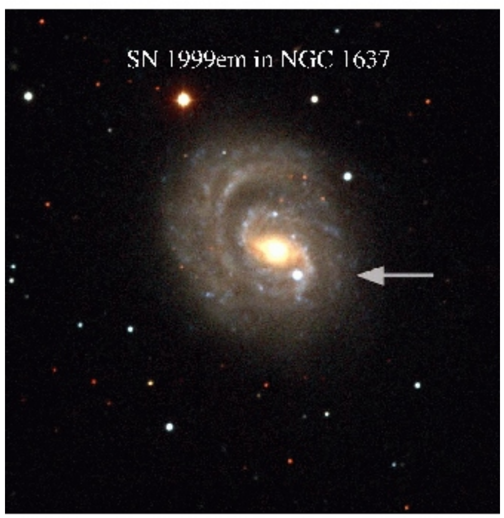
Sample of extragalactic supernovae

SN1994D



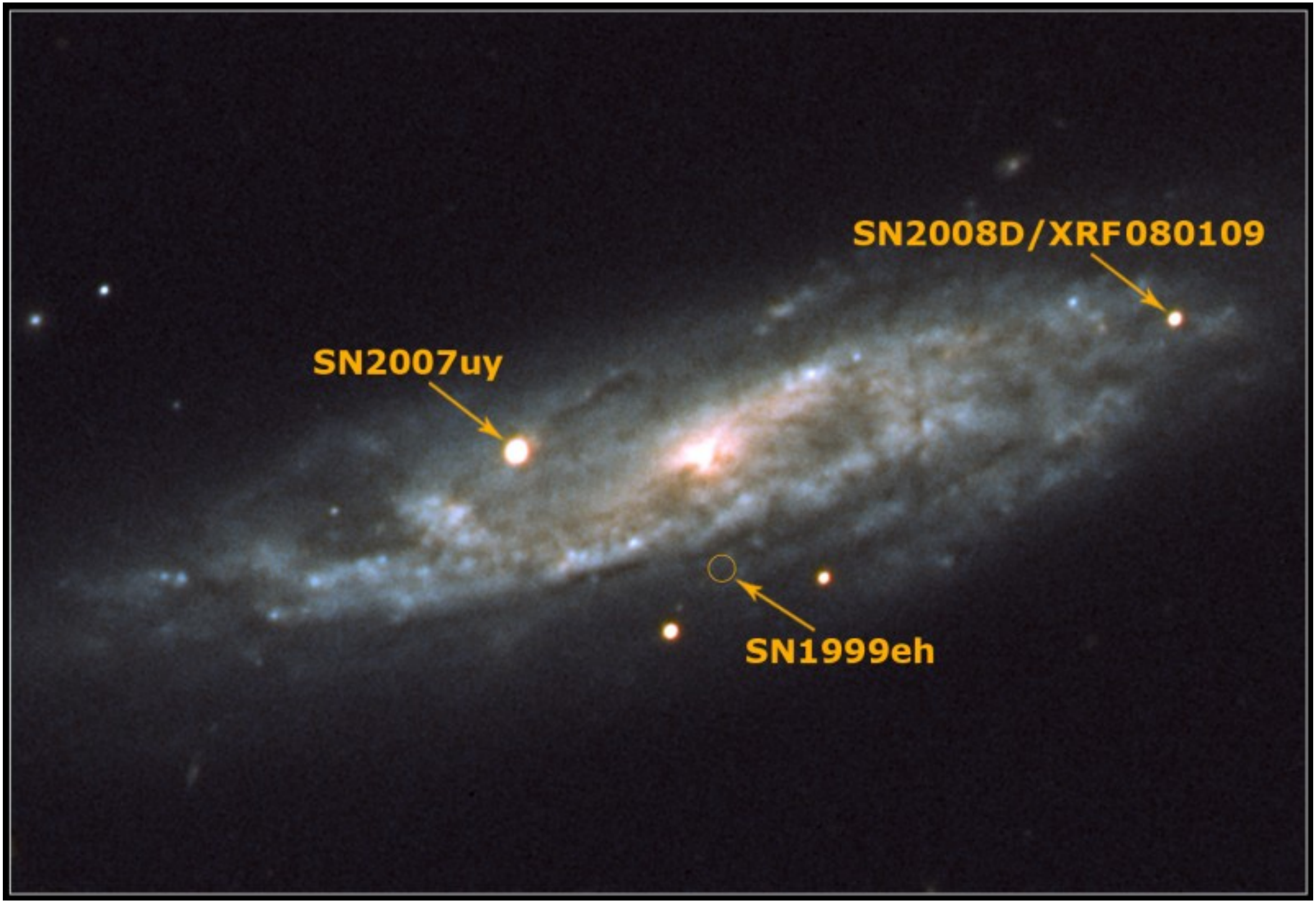
SN2001el

SN1999em



SN 2011fe

Some galaxies are rapid producers of supernovae.



Extra-galactic Supernovae: the basis for modern astronomy of supernovae.

Supernovae explode about once per second somewhere in the Universe, most unseen.

Cannot predict which galaxies will produce a supernova, so watch lots of galaxies, now days with robotic telescopes.

We found two dozen per year prior to SN 1987A, but with new attention and use in cosmology, now find several hundred per year, more than one per day, most at great distances, more difficult to study.

Nomenclature of Supernovae in other galaxies:
A-Z, aa-az, ba-bz, etc.

SN 1987A - 1st of 1987 (also most important, but that is not what the “A” means).

Currently discover several per day. This year’s latest officially named, SN 2016P, discovered January 19, but individual groups discover batches, give them their own names, and may or may not announce them publically. Group at Ohio State has found 10 so far.

New techniques will discover thousands of supernovae per year, new nomenclature, position: SUPERNOVA 2013fg = PSN (possible supernova) J08212244 -1318370

Before announced, search groups use internal names. We have used characters from Star Wars and Southpark and are currently using Nepali spirits.

Discussion Point:

How would you tell that an explosion in a distant galaxy was from a massive star or from a white dwarf star?

Goal:

To understand the observed nature of supernovae and determine whether they came from white dwarfs or massive stars that undergo core collapse.

Goal:

Certain elements show up in supernova:

Oxygen, Magnesium, Silicon, Sulfur, Calcium, Iron.

Why those elements?

Chapter 2, §2.1

H -> He (2 protons, 2 neutrons - Chapter 1, figure 1.6)

2 Helium -> unstable, no such element

3 Helium -> Carbon (6 protons, 6 neutrons)

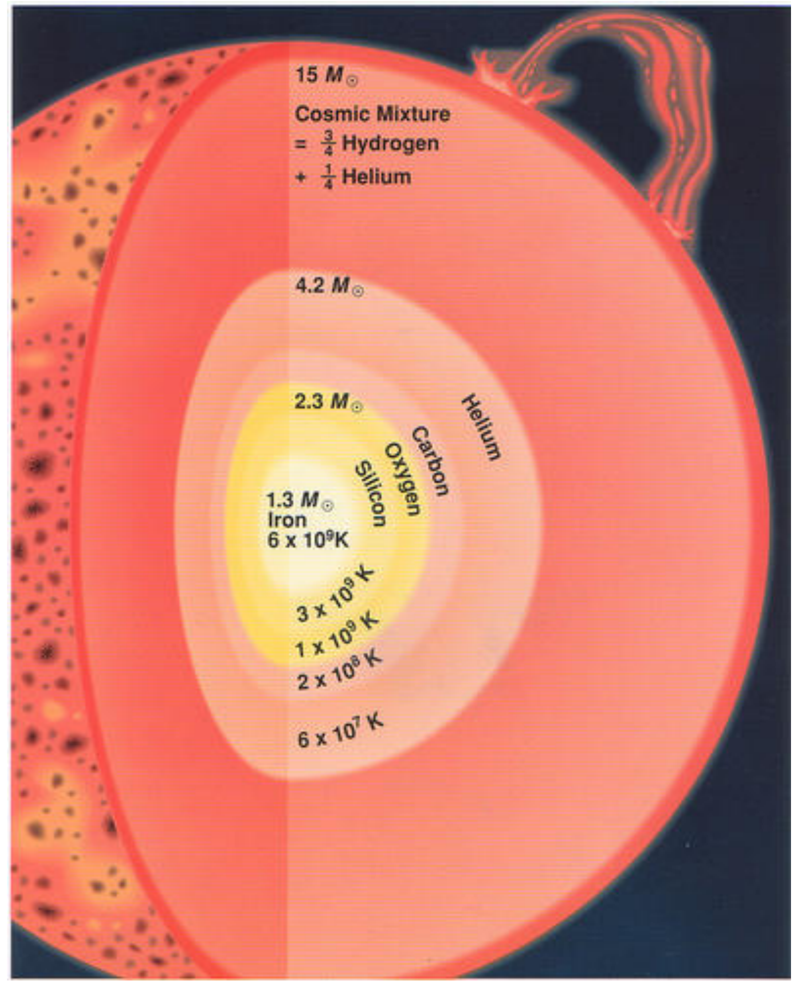
4 Helium -> Oxygen (8 protons, 8 neutrons)

5 Helium -> Neon (10 protons, 10 neutrons)

6 Helium -> Magnesium (12 protons, 12 neutrons)

7 Helium -> Silicon (14 protons, 14 neutrons)

Then Sulfur, Calcium, Titanium.



Common “intermediate mass” elements (heavier than hydrogen and helium, lighter than iron) that are forged in stars, and in their explosions, are built on building blocks of helium nuclei.

Production of the Elements:

In massive stars (more than about 12 - 15 times the Sun) the core is composed of Helium or heavier elements: Carbon, Oxygen, Magnesium, Silicon, Calcium, finally Iron.

The intermediate-mass elements are produced in the star before the explosion and then expelled into space.

In exploding white dwarfs (arising in stars with mass less than about 8 times the Sun), the core is composed of Carbon and Oxygen, and **the explosion creates the intermediate-mass elements, Magnesium, Silicon, Calcium, and also Iron.**

(between about 8 and about 12 solar masses, different story, maybe collapsing white dwarfs)

Stellar Physics:

There are many more low mass stars born than high mass stars.

High mass stars have more fuel to burn, but they burn much hotter and brighter. As a result they live a SHORTER time.

A short-lived star must be massive.

A long-lived star must be of relatively low mass.

Galaxy Physics:

Star are born in the spiral arms of spiral galaxies.

Elliptical galaxies have not formed any new stars in billions of years.

Implications:

A star that dies in a spiral arm has not had time to drift far from its birth site. It is probably short lived.

A star that dies far from a spiral arm has drifted far from its birth site. It is probably long lived.

One minute exam

Why do the elements carbon, oxygen, magnesium, and silicon frequently appear in the matter ejected from supernovae?

➡ They are built up from the element hydrogen

⬅ They are built up from the element helium

⬆ They are built up from the element calcium

⬇ They are built up from the element iron

One minute exam

If a supernova explodes in the spiral arm of a spiral galaxy

→ It was probably an exploding white dwarf

← It was probably an exploding massive star

↑ It probably ejected silicon

↓ It probably ejected helium

One minute exam

If a supernova explodes far away from any spiral arm of a spiral galaxy

➡ It was probably an exploding white dwarf

⬅ It was probably an exploding massive star

⬆ It probably left a neutron star

⬇ It probably exploded in an elliptical galaxy