2/21/05

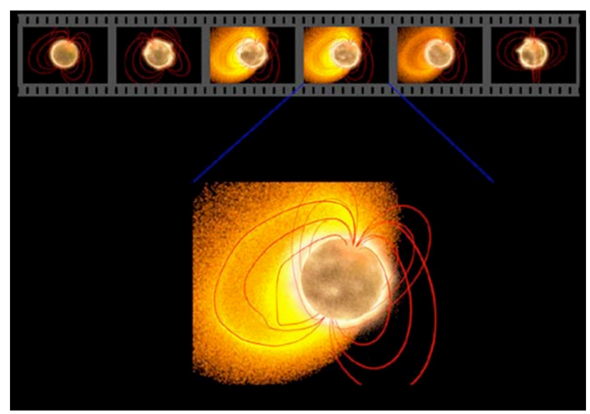
Absence/Failing notices for first exam - formality

Wheeler absent Wednesday - National Science Foundation review

Video lecture - supernovae, synopsis of course

News? Gamma-Ray outburst - Department Website

Pic of the day - ***magnetar***



Type Ia: No Hydrogen, oxygen, magnesium, silicon, sulfur, calcium early, Iron later.

Not in spiral arms, do occur in elliptical galaxies -> old when blow -> white dwarfs, total disruption, no neutron star.
Original mass on the main sequence M < 8 solar masses

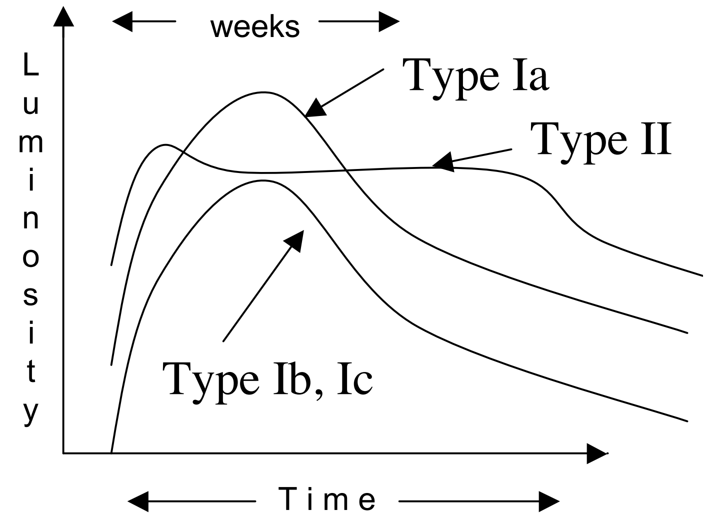
Type II: Hydrogen early, Oxygen, Magnesium, Calcium, later.

Type Ib: no Hydrogen, but Helium early, Oxygen, Magnesium, Calcium later.

Type Ic: no Hydrogen no (or *very* little) Helium early, Oxygen, Magnesium, Calcium later.

In spiral arms, never in elliptical galaxies -> short lived -> massive star -> expect core collapse, neutron star or black hole.
Original mass on the main sequence M > 8 solar masses

Type Ia, Type Ib, Type Ic Light Curve consistent with explosion in stellar core stripped of its Hydrogen envelope



Type II consistent with star that has an explosion deep within a Hydrogen Red Giant envelope

Type Ia - exploding white dwarf

Type II, Ib, Ic - massive star core collapse

Massive stars that give rise to Type II, Type Ib and Type Ic supernovae live a short time (millions, not billions of years) -> they die at the same rate at which they are born.

We have some idea of how rapidly massive stars of a given initial main sequence mass are born, the more massive the star, the rarer the birth.

We can count the rate at which massive stars die as Type II, Ib, or Ic supernovae (perhaps 3 Type II for every 1 Type Ib or Ic).

By comparing the birth rate and the death rate we can estimate that stars of about 8-20 $M_\odot$ make most of the Type II, and Type Ib, Ic supernovae.

Stars with mass >20 $M_\odot$ are rare, hard to pin down. They could all explode or none explode (by making black holes) and the rate of supernovae would not be much different.

Even more recent (late 90's), possibility of "hypernovae."

For Types Ia, Ib, Ic, II the energy of explosion (motion energy, kinetic energy) is ~1% of the energy generated by collapse to form a neutron star.

Some explosions that otherwise resemble Type Ic (no Hydrogen, no Helium) have shown exceptionally high velocities. Some people have argued that this variation of Type Ic requires perhaps $10 \times$ more explosion energy, thus coining the name "hypernovae."

These events represent a possible link to ***Gamma-Ray Bursts*** (Chapter 11), the formation of black holes (OR NOT).

Evolution - gravity vs. charge repulsion
§ 2.1

Why do you have to heat a fuel to burn it?

H → He → C → O

more protons, more charge repulsion, must get ever hotter to burn ever "heavier" fuel

Just what massive stars do!
Support by thermal pressure.
When fuel runs out, core tries to cool but gravity squeezes, core contracts and HEATS UP
overcomes higher charge repulsion, burns new, heavier fuel

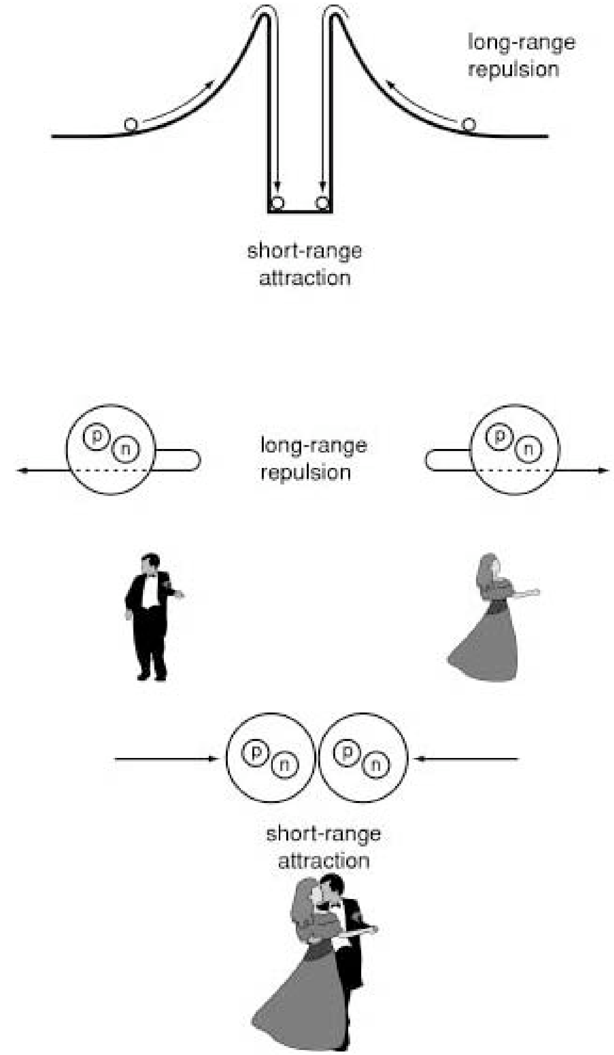
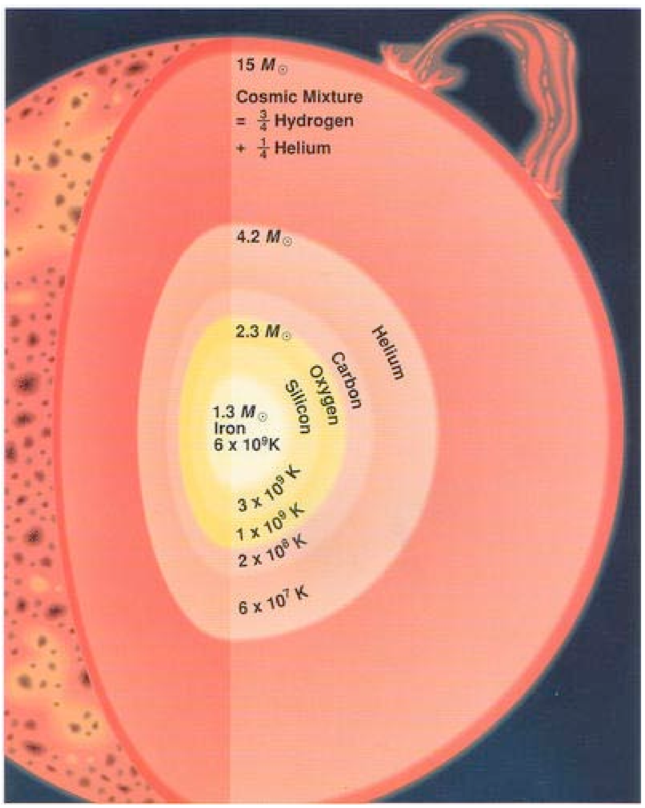


Figure 2.1

Physics: core of Helium or heavier elements, Carbon, Oxygen, Magnesium, Silicon, Calcium, finally Iron, continues to be hot even as it gets dense,

⇒ always supported by thermal pressure

⇒ continues to evolve, whether the Hydrogen envelope is there (Type II) or not (Type Ib, Type Ic).



H -> He (2 protons, 2 neutrons)

2 Helium -> unstable, no such element

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

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

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

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

Common elements forged in stars are built on building blocks of helium nuclei