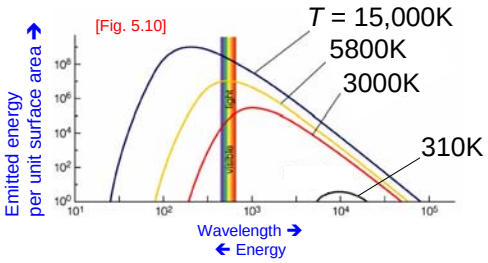
Basic Properties of Stars

Today's slides are on the web

- Composition
- Luminosity = *L*
- Mass
- Diameter = *D*
  - Measure temperature *T* from spectrum.



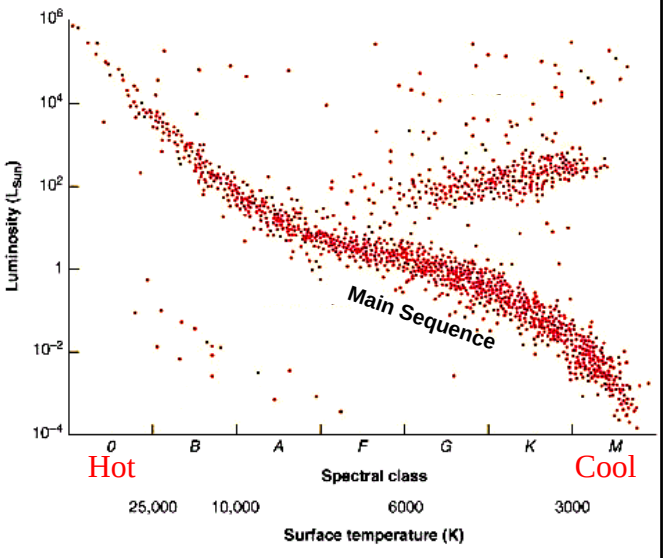
- Total energy emitted *per unit surface area* = $E = \sigma T^4$
- Total energy from whole star:

$L = E \times (\text{surface area}) = (\sigma T^4) \times (\pi D^2)$

Measure *L* and *T*, solve for *D*

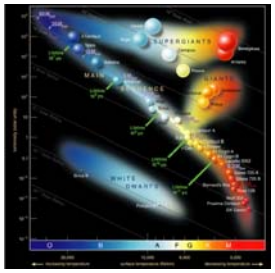
The Hertzprung-Russell (H-R) Diagram [11.2]

- Representative sample of stars.
- Plot Luminosity vs. Surface Temperature.
- Most stars fall along "main sequence".
- Any theory about how stars work has to explain this.

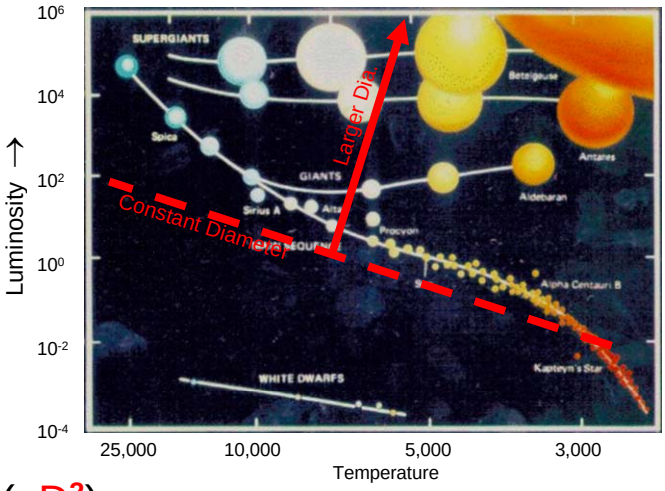


[see Fig. 11.10]

The H-R Diagram (with sizes)



[Fig. 11.10]

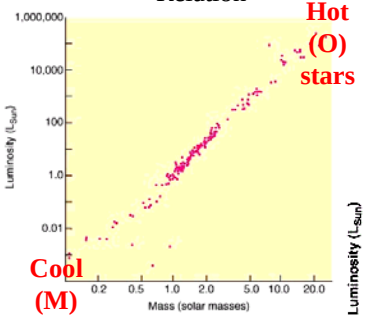


$$L = (\sigma T^4) \times (\pi D^2)$$

↑ *Diameter!*

Here's what we observe about stars.

The Mass-Luminosity Relation



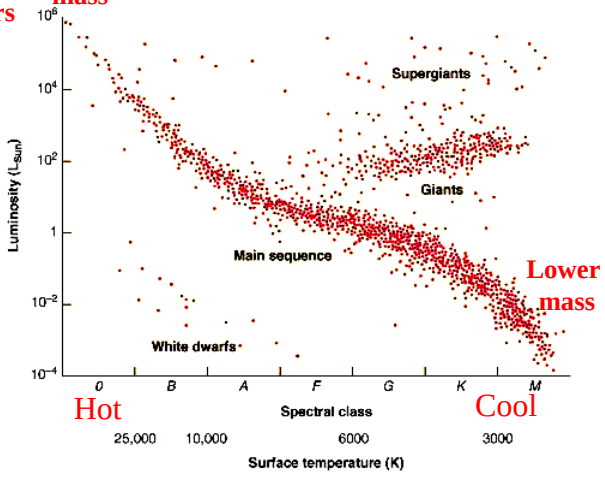
Hot (O) stars

Cool (M) stars

Main sequence is a mass sequence

The H-R Diagram (Luminosity, Temperature, Diameter)

Higher mass



Lower mass

Hot

Cool

What is inside the Sun?

Measure
- Luminosity
- Mass
- Diameter
- Chemical composition

Infer
(from our knowledge of Physics)
- Internal structure

What is inside other stars?

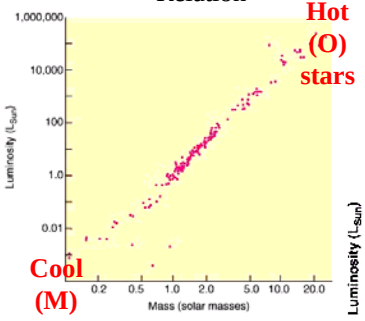
Measure
- Luminosity
- Mass
- Surface temperature
- Chemical composition

Calculate
Diameter
from
Luminosity and Temperature

Infer
- Internal structure

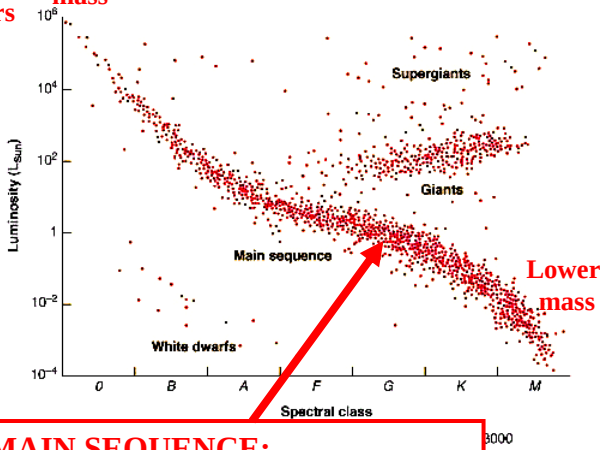
Here's what we observe about stars.

The Mass-Luminosity Relation

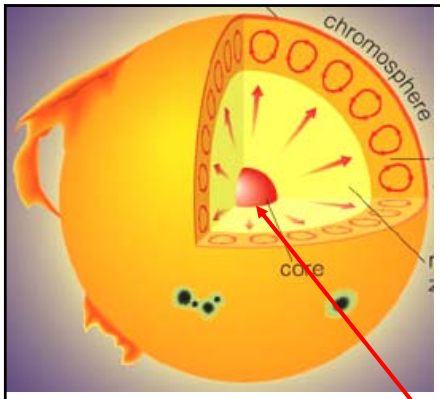


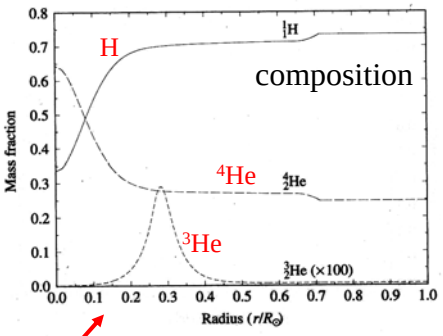
Main sequence is a mass sequence

The H-R Diagram (Luminosity, Temperature, Diameter)



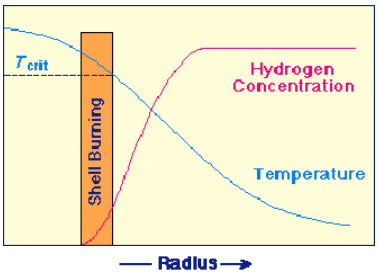
MAIN SEQUENCE:
Stars convert H into He in their cores.





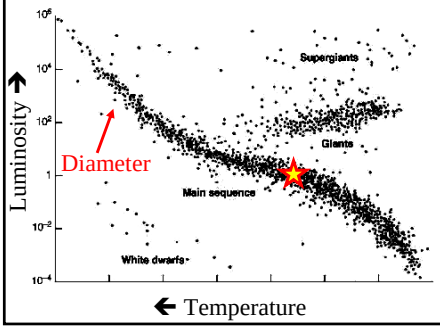
Models of Sun show:
Burning of H in center has already changed the composition a lot!

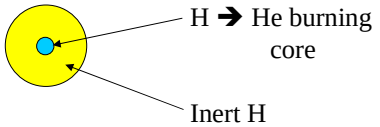
Eventually, H burns outward in a shell



- Heat source moves closer to surface.
- Layers below surface swell up.
- Star becomes larger
- Surface becomes cooler

➔ *Red giant.*





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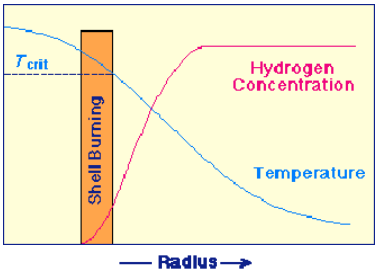

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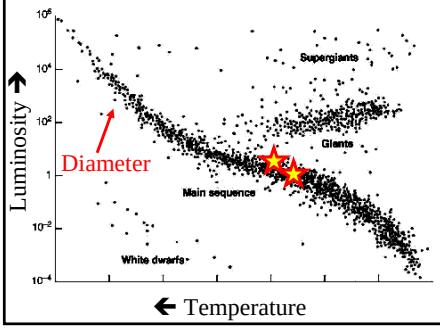

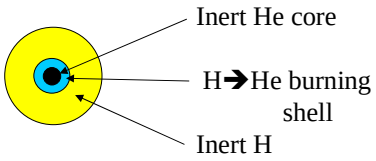

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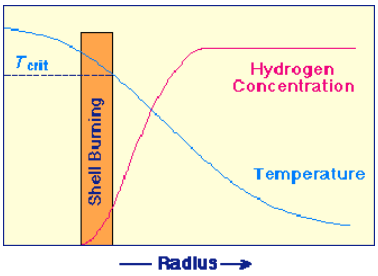

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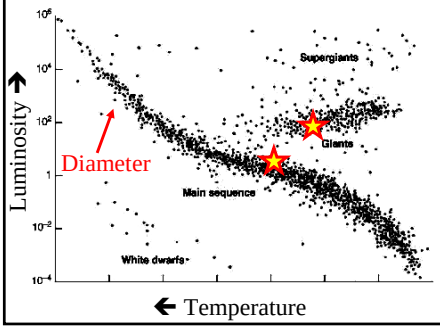

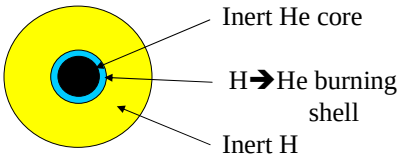

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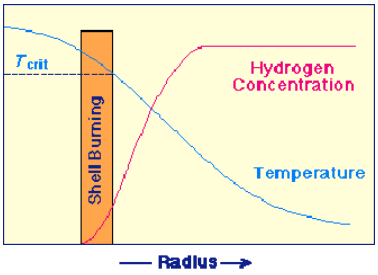

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