The H-R Diagram: M11

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Cluster 9: Introduction to Astrophysics

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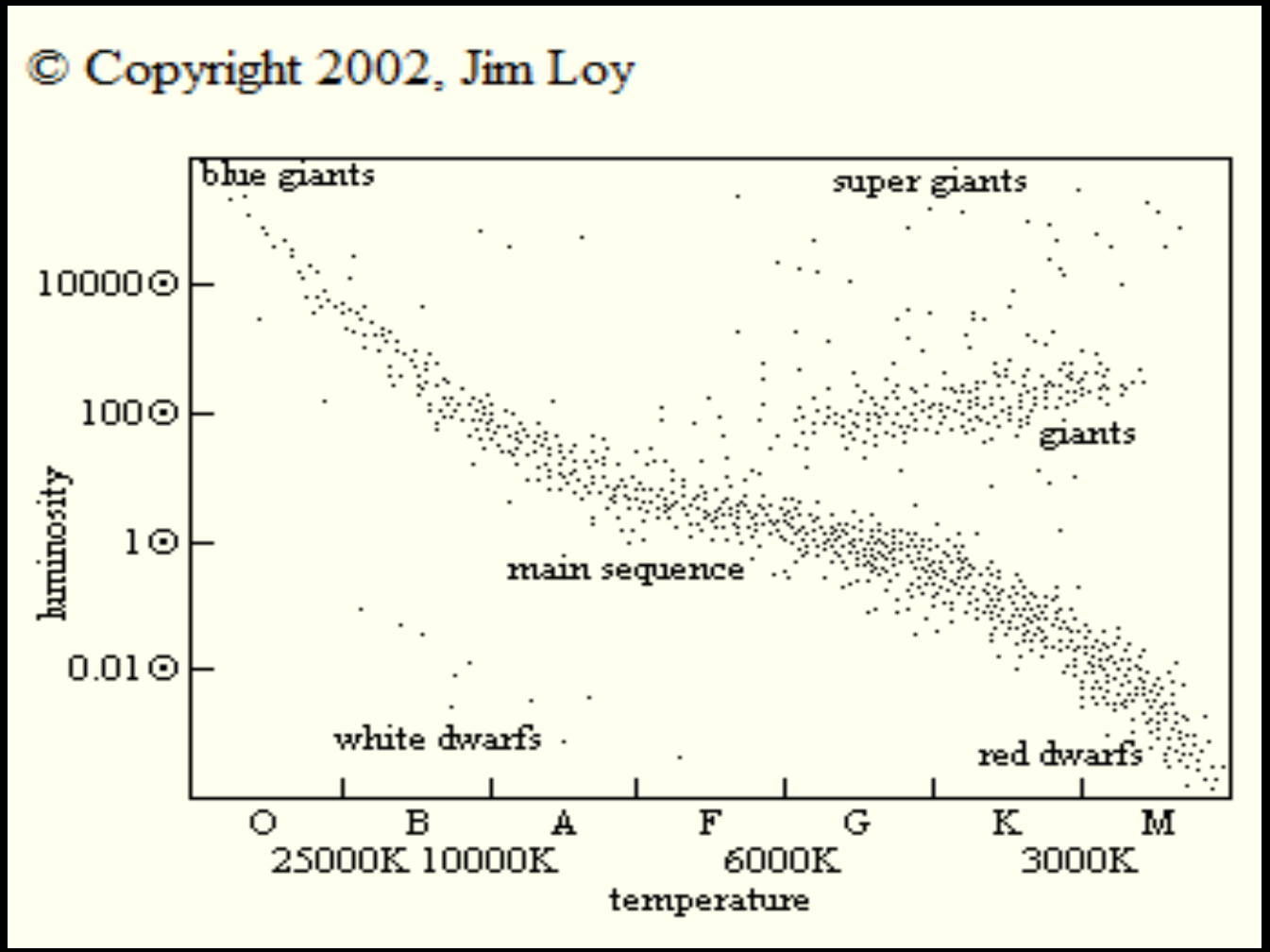
H-R Diagrams

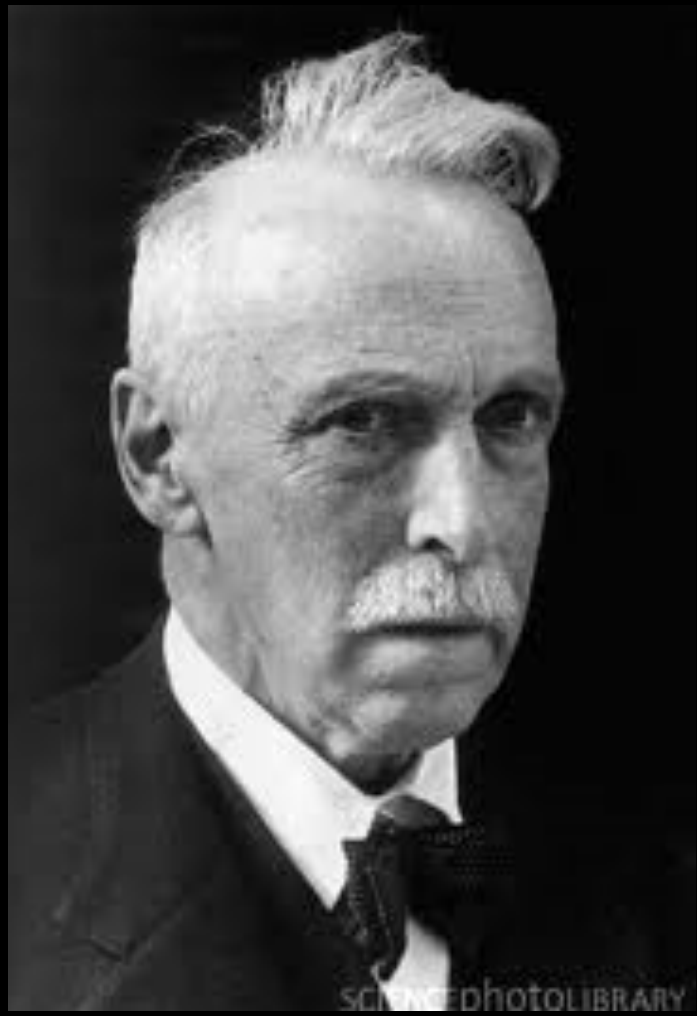
- show relationship between stars' luminosities and spectral type
- y-axis= Luminosity
- x-axis= Temperature
- Cooler (redder)stars are farther to the right on the x-axis
- Hotter(bluer) stars are closer to the left on the x-axis
- Stars with higher luminosities are higher up on the y-axis
- Help determine mass of a star using luminosity
- Help determine ages of star clusters

H-R Diagrams (cont.)



Ejner Hertzsprung

- Danish astronomer who claimed that there must be a connection between the spectrum and the luminosity of stars

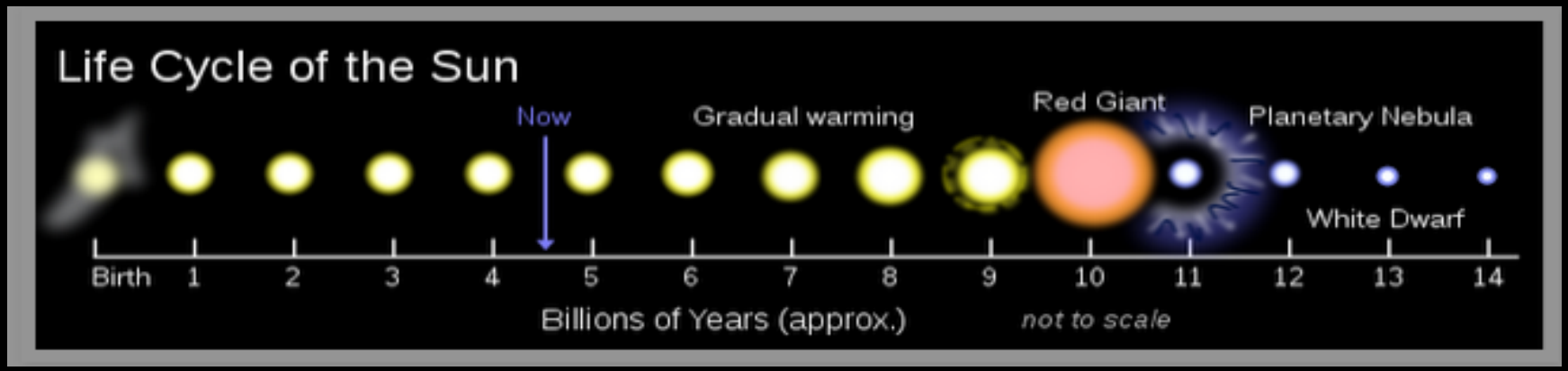


Henry Norris Russell

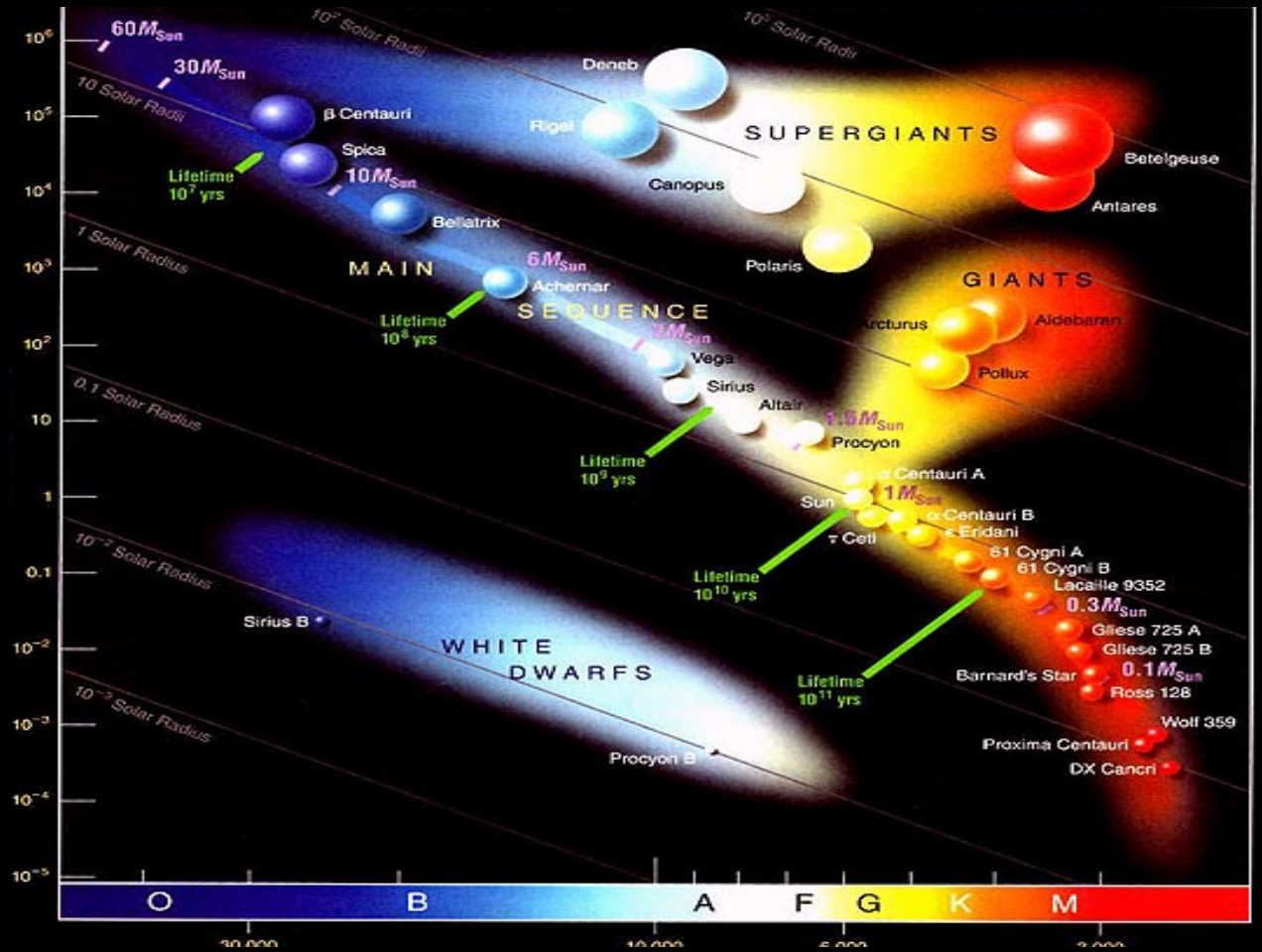
- Russell was an American astronomer who had similar ideas about the stars as Hertzsprung did, but he plotted the magnitude of the stars and their spectral types

Stellar Evolution

- Process by which pressure (gravity) alters stars
- Time scale of stellar evolution depends on mass of the star
- Stages: birth, main sequence, red giant branch, planetary nebula or supernova, remnants



Stellar Evolution(cont.)



How Stars Form

- Form from gas and dust condensing in space
- Dense parts of molecular clouds collapse to form a ball of plasma to form a protostar

Main Sequence

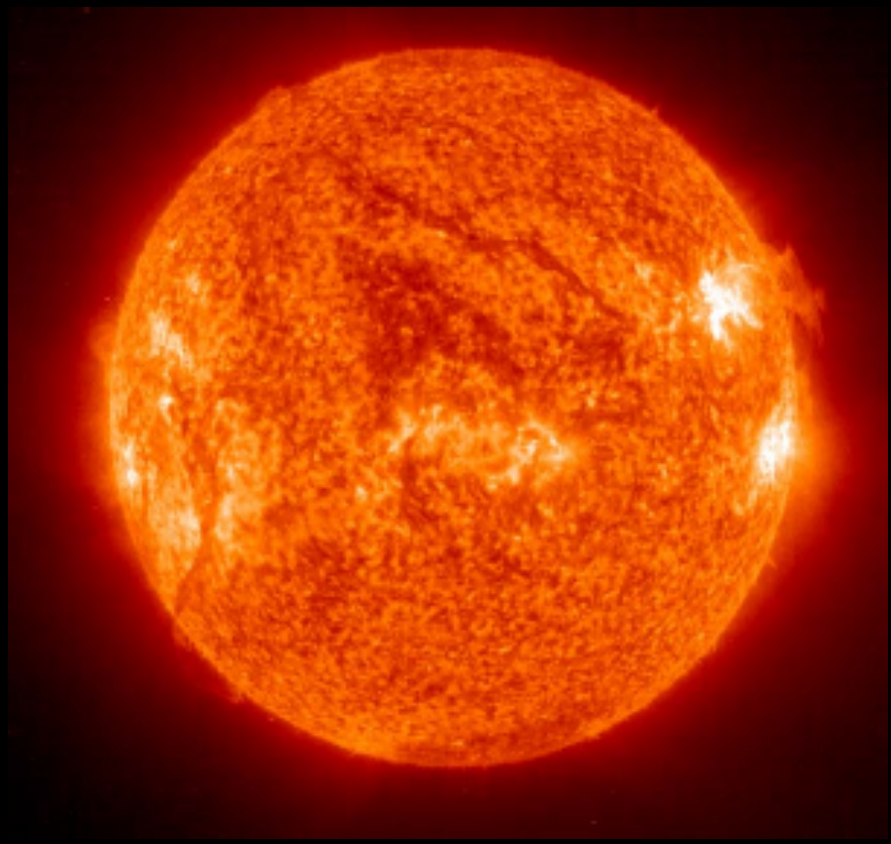
-Star spends ~90% of life time here

-Stable stars because of Hydrostatic Equilibrium

-Hydrostatic Equilibrium: pressure of fluid at rest is due to the weight of the overlying fluid

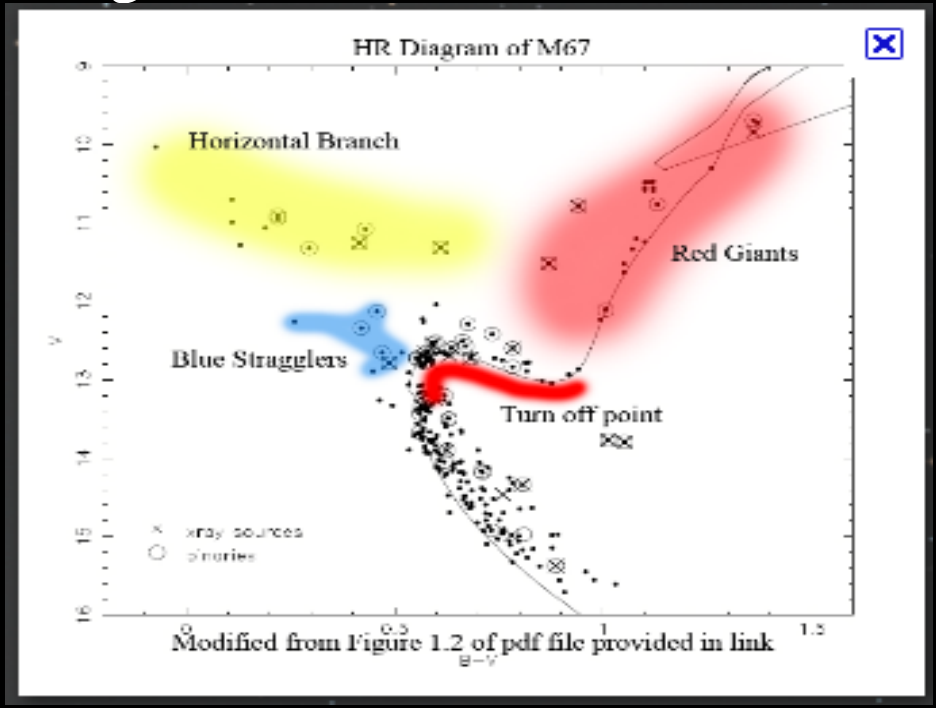
-Fusing hydrogen to helium in core

-Star collapses due to thermal equilibrium unbalance



Turn-off Point

- The point where stars move to the red giant branch
- Thermal Equilibrium unbalances as a star depletes its supply of hydrogen in the core



Red Giant Branch

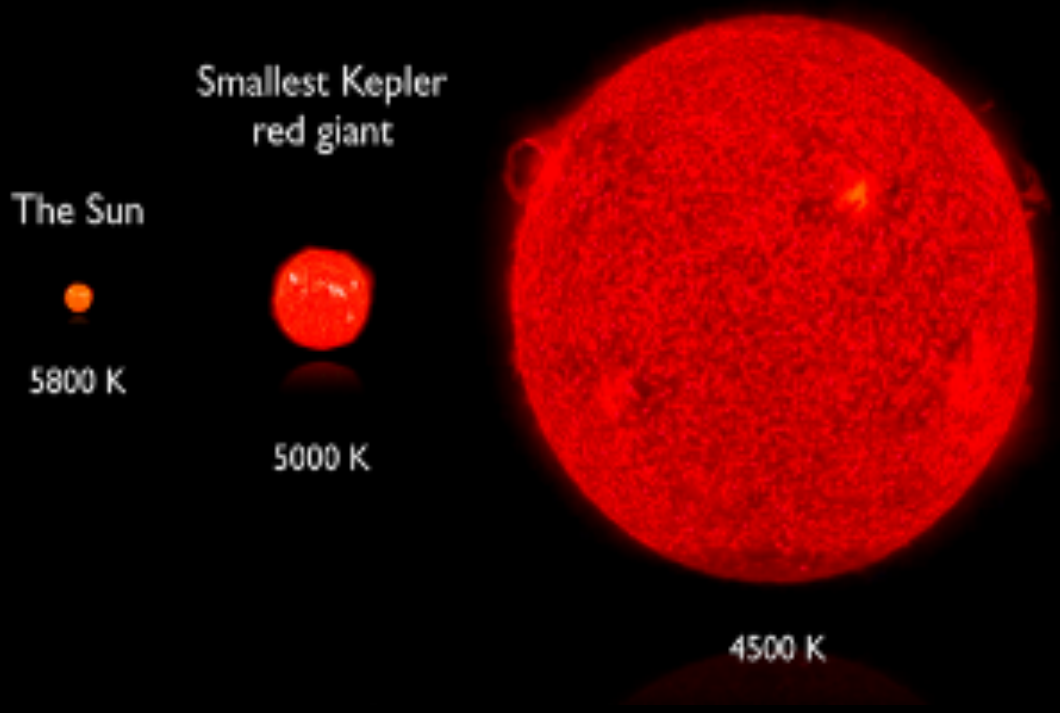
-Accelerated fusion in the hydrogen containing layer s causes the star to expand

-Gravitational pull is reduced from the layers

-Layers expand faster than the energy production

-Stars become cooler(redder) than when they were on the main sequence

-More massive stars become supergiants



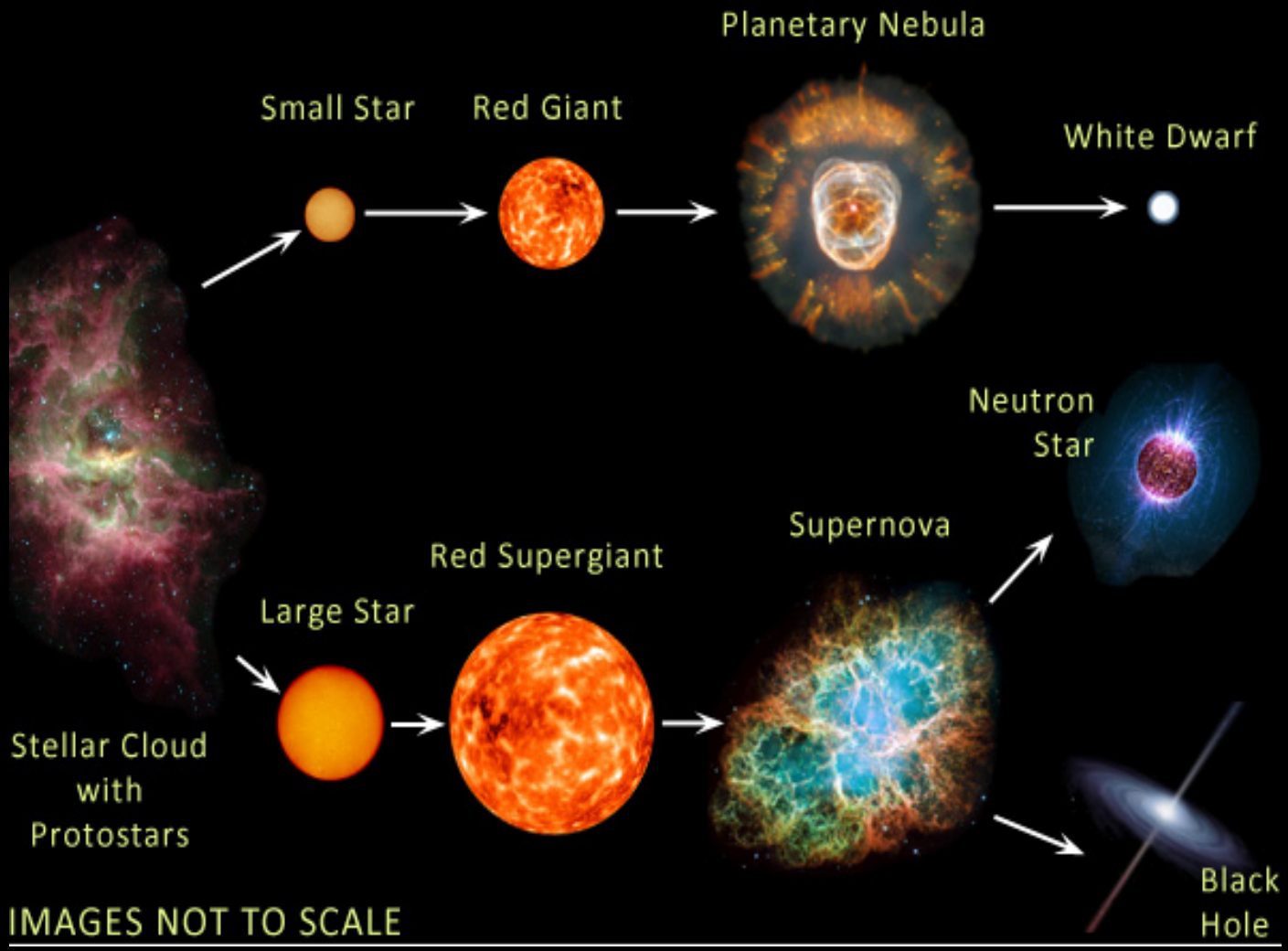
Transitions

- Stars whose masses are similar to the sun go onto the horizontal branch after leaving the red giant branch
- Luminosity decreases in stars masses similar to the sun
- A horizontal branch star is powered by helium fusion in the core

Remnants

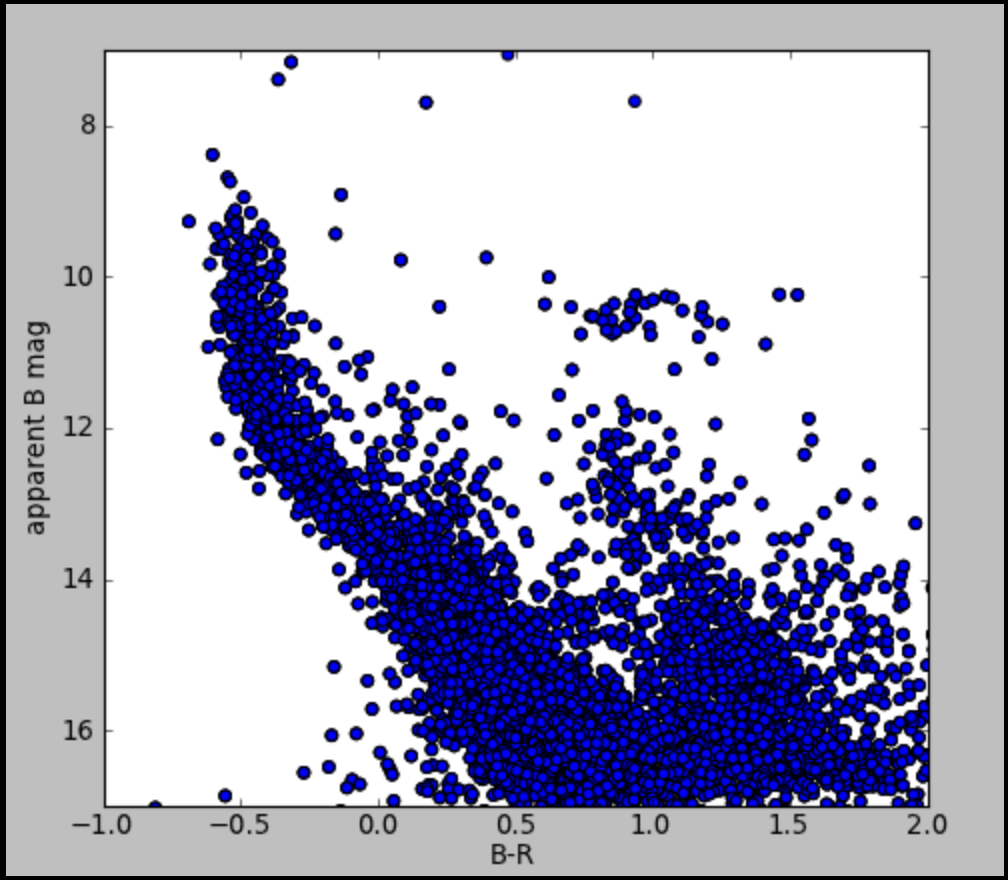
- Low mass stars: become red dwarfs because star doesn't have enough mass from the stellar envelope to exert enough pressure on the core
- Mid-sized stars: star becomes a planetary nebula & then turns into a white dwarf, which is the core of a star that has died
- High-mass stars: usually become supernovae then a neutron star or black hole
- White dwarfs result from stars that had a great enough mass to become a neutron star & have died

Remnants(cont.)



M11

H-R Diagram of M11

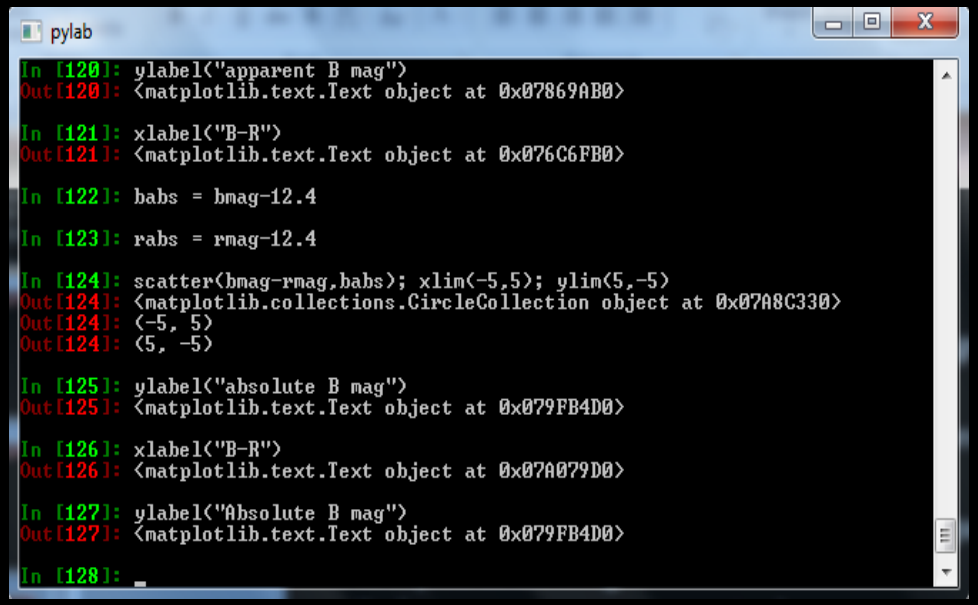


Process

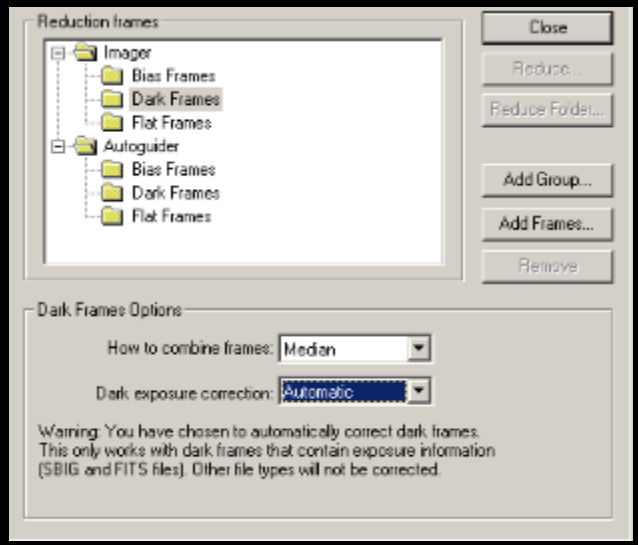
- Use CCD Soft to reduce, align & combine the images taken
- After the images were reduced, aligned & combined, the magnitudes were found
- Use source extractor(SExtractor) to build catalogues of objects in the images
- Python, a computer programming language, was used to graph the data in order to make to make the H-R diagram

Process(cont.)

Python



CCD Soft



Results

- Distance=1,600 pc
- Actual=1,900 pc

References

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Pictures Cited

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