Be Stars

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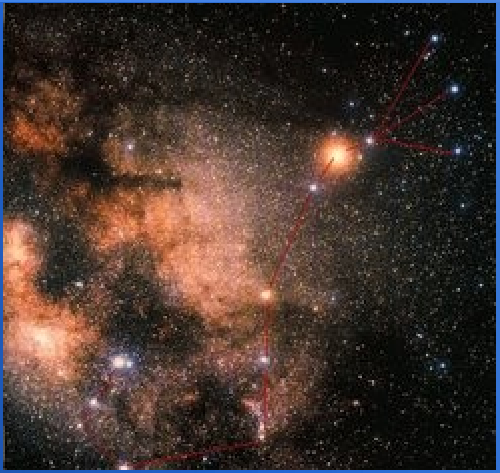
How stars are formed



- Stars are composed of gas
- Hydrogen is the main component of stars.
- Stars are formed by a process in which gas clouds, condense and collapse in on them selves because of gravity. Building up pressure causes a rise in temperature in the developing star. Nuclear fusion begins if the core´s temperature gets to about 14 000 000 degrees Kelvin.
- A star is now formed.

Stars: A quick summary

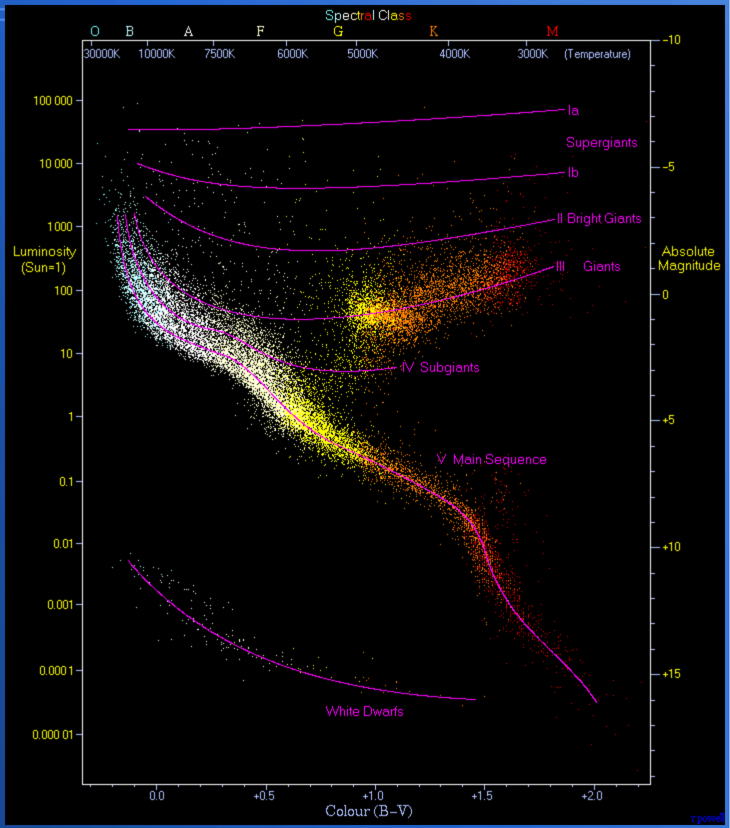
- The brightness of stars depend on their energy (luminosity) and how far away from earth they are.

- Stars appear to have different colours because of their temperature
  Hot stars are white or blue whereas cooler stars appear to have orange or red hues.

- Stars exist in many sizes.
  These different sizes are categorized in a range from dwarfs to super-giants

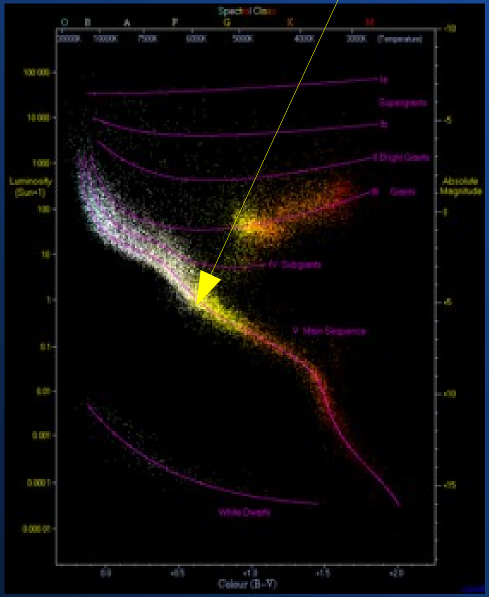
HR diagram

- This picture is called the Hertzsprung-Russel Diagram (or HR diagram).
- The diagram shows the relationship between luminosity and temperature in stars.
- Based on temperature there are different spectral types stars can be classed into. The different spectral types that stars can be classified into are; O, B, A, F, G, K and M.
- O stars are the hottest, meaning the temperature of the types of stars in the diagram declines.
- In each spectral type there are sub-categories. These categories are numbered from 0-9 eg. O1, B4, F6, K8 etc.



Main Sequence

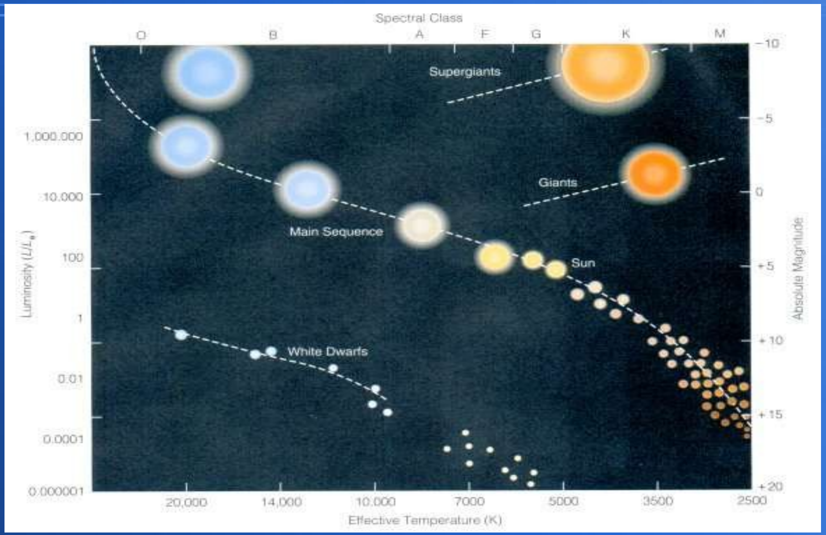
- The main sequence is the main curve that lies on the HR diagram. It is a continuous and distinctive group of stars.

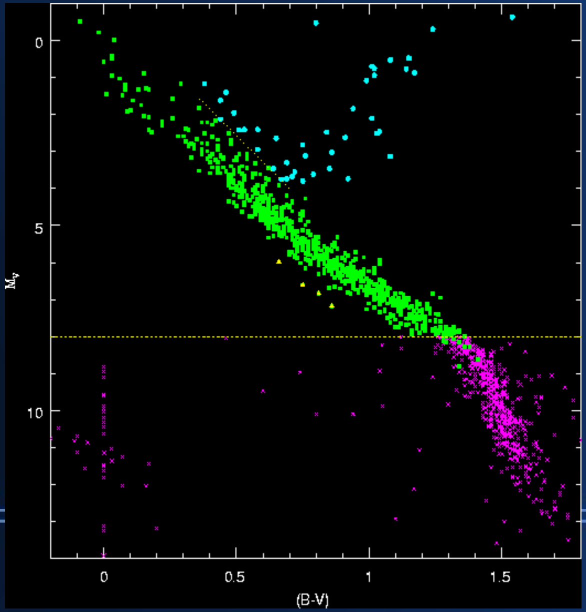


- After a star has formed it creates energy in its core through the <u>nuclear fusion of Hydrogen atoms into Helium</u>. During this stage of a star´s lifetime, it is located along the main sequence.

- The more massive a star is the shorter its lifespan on the main sequence.

- In all main sequence stars the outward thermal pressure from the hot core is balanced by the inward gravitational pressure from the star´s overlying layers.





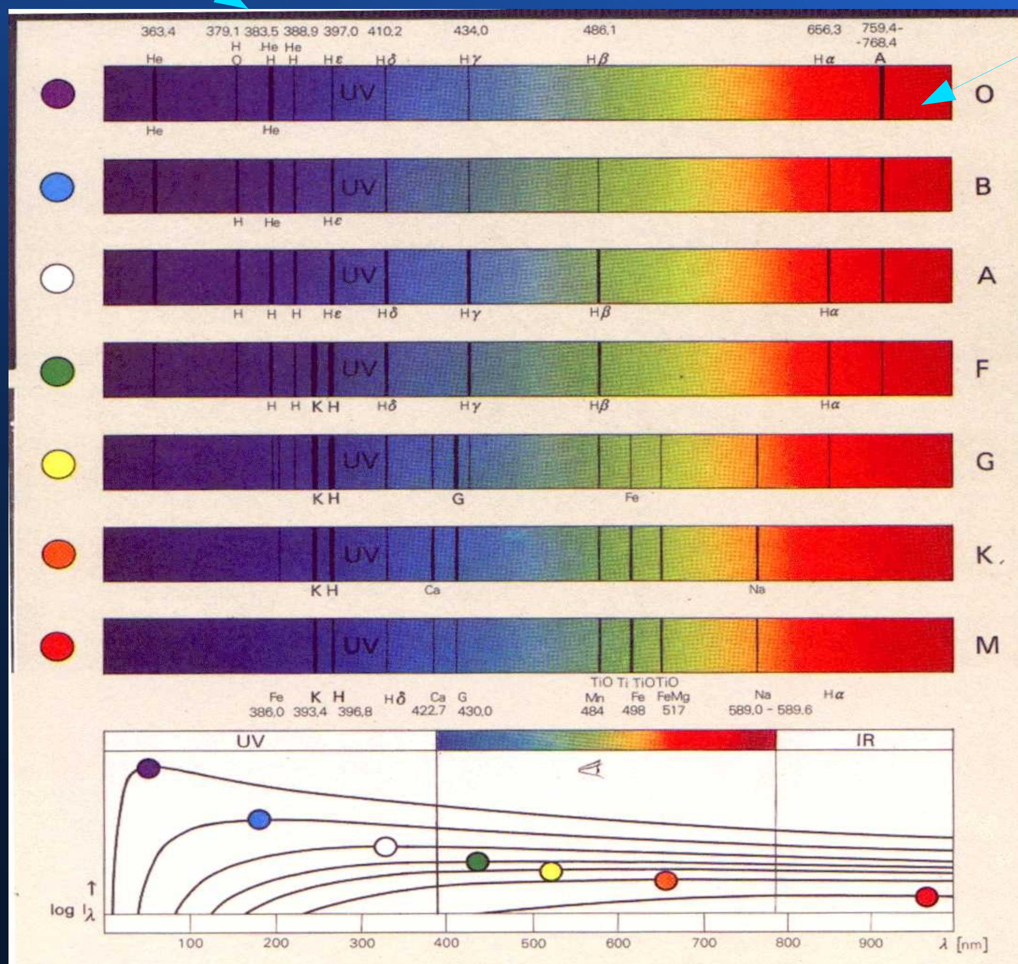
2. Spectral Types

Spectral Class	Intrinsic Color	Temperature (K)	Prominent Absorption Lines
O	Blue	41,000	He+, O++, N++, Si++, He, H
B	Blue	31,000	He, H, O+, C+, N+, Si+
A	Blue-white	9,500	H(strongest), Ca+, Mg+, Fe+
F	White	7,240	H(weaker), Ca+, ionized metals
G	Yellow-white	5,920	H(weaker), Ca+, ionized & neutral metal
K	Orange	5,300	Ca+(strongest), neutral metals strong, H(weak)
M	Red	3,850	Strong neutral atoms, TiO

StellarClass	Radius R/R⊙	Mass M/M⊙	Luminosity L/L⊙	Temperature K
O6	8	40	251,000	45,500
B0	7.4	18	20,000	30,000
B5	3.8	6.5	800	16,400
A0	2.5	3.2	80	10,800
A5	1.7	2.1	20	8,620
F0	1.4	1.7	6	7,240
F5	1.2	1.29	2.5	6,540
G0	1.05	1.10	1.26	6,000
G2	1.00	1.00	1.00	5,920
G5	0.93	0.93	0.79	5,610
K0	0.85	0.78	0.40	5,150
K5	0.74	0.69	0.16	4,640
M0	0.63	0.47	0.063	3,920
M5	0.32	0.21	0.0079	3,120
M8	0.13	0.10	0.0008	—

The Sun is a G-type star.
Luminosity and mass of all other stars are measured relative to the Sun

The visible light from a star can be decomposed in a bundle of colors from red to violet (each color corresponds to a different wavelength) - The Spectrum.



This shows the continuous spectrum of a star, the black lines are absorption lines.

We can tell the spectral type of a star and temperature based on its absorption lines.

3. B Stars

- B stars are the next in the spectral series after O stars.
- These stars are about 4-18 times bigger than the Sun.

B-type stars are extremely luminous and blue.

Some of the best known and most distinctive stars (visible to the naked eye) in the sky belong to the type B star group. For example Spica and Regulus.

- Along with type O stars, type B stars are short-lived (5-10 million years, short in relation to the sun).

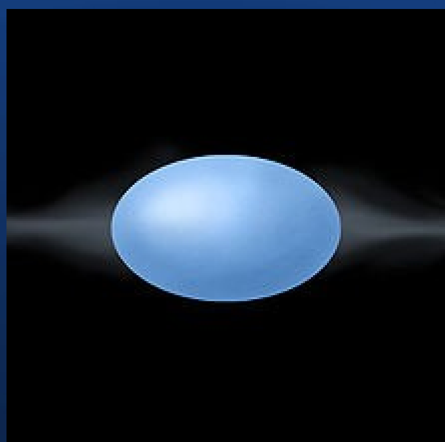
Some sub-categories of B-type stars have different features or qualities to the more ´normal´ B star.

- Some stars exhibit unusually strong lines of non-ionized helium. These chemically strange stars are termed helium-strong stars. These often have strong magnetic fields.
- In contrast, there are also helium-weak B-type stars with understrength helium lines and strong hydrogen spectra.
- Other chemically strange B-types stars are mercury-manganese stars.

- Finally, there are Be stars that show a prominent emission spectrum of hydrogen this is because they have a rapid rate of rotation, with an equatorial rotation velocity of about 200km/s, which in relation to the suns rotation of about 2 km/s is very fast

4. Be Stars

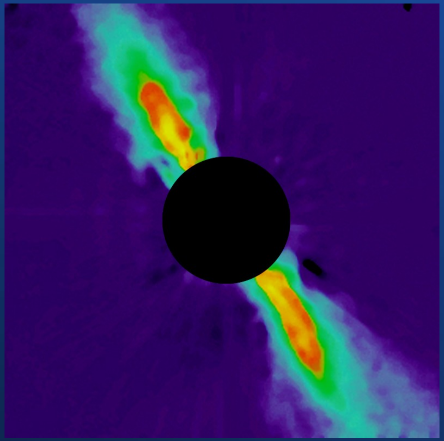
- Be stars have strong emission lines of Hydrogen in their spectrum.

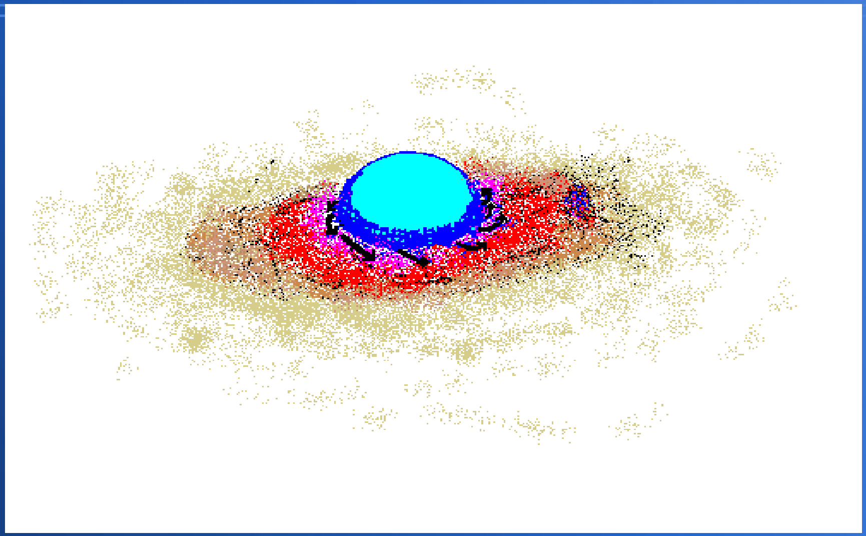


A characteristic of a Be star is that it has optical linear polarization and often their infra-red radiation is much greater than other B-type stars. This infra-red radiation is called infrared excess. Be stars show emission lines whereas normal B stars show absorption.

- The reason for the emission lines and Infrared excess is because of a circumstellar disc of gas surrounding the star.

- The circumstellar disc is a cloud of material that has been ejected from the star itself.

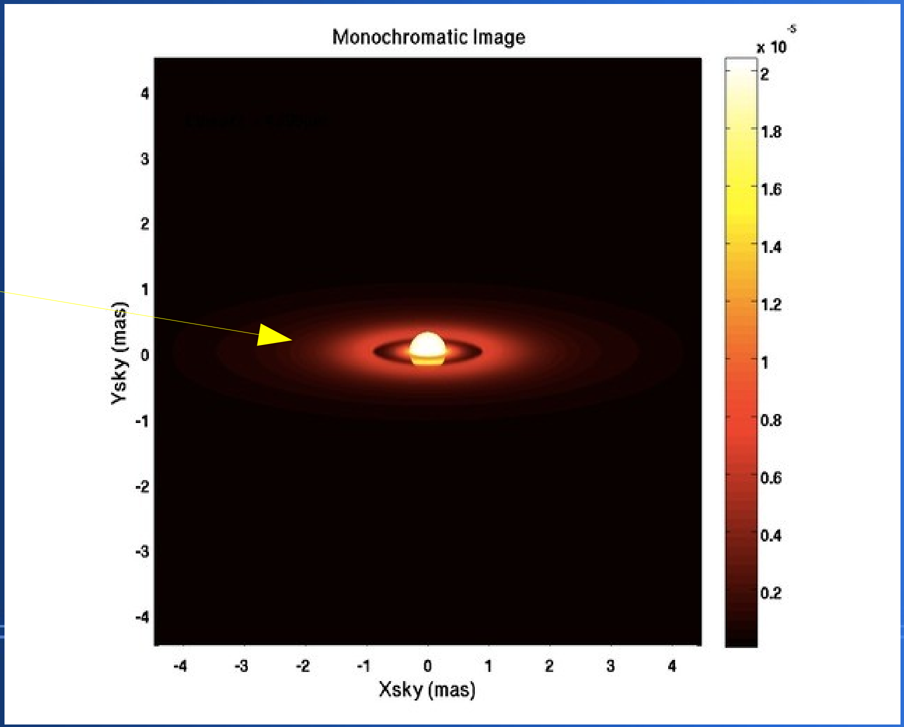




- The disc of material is hot, though cooler than the star itself.
- It is generally assumed that it is a result of the high spin velocity of the star that creates the circumstellar material. The force of gravity hardly compensates for the centrifugal force at the equator.

- It is not known for sure how large the circumstellar discs are, it is thought that their radii are somewhere between 5 and 20 times bigger than the star itself.

This is a theoretical picture of Be star. We can see the star along with the circumstellar disc around it



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Images found at:

http://www.google.de/imghp?hl=de&tab=wi

and

See previous web-pages.