

Black Hole Theory

A presentation by:

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THE LIFE CYCLE OF STARS

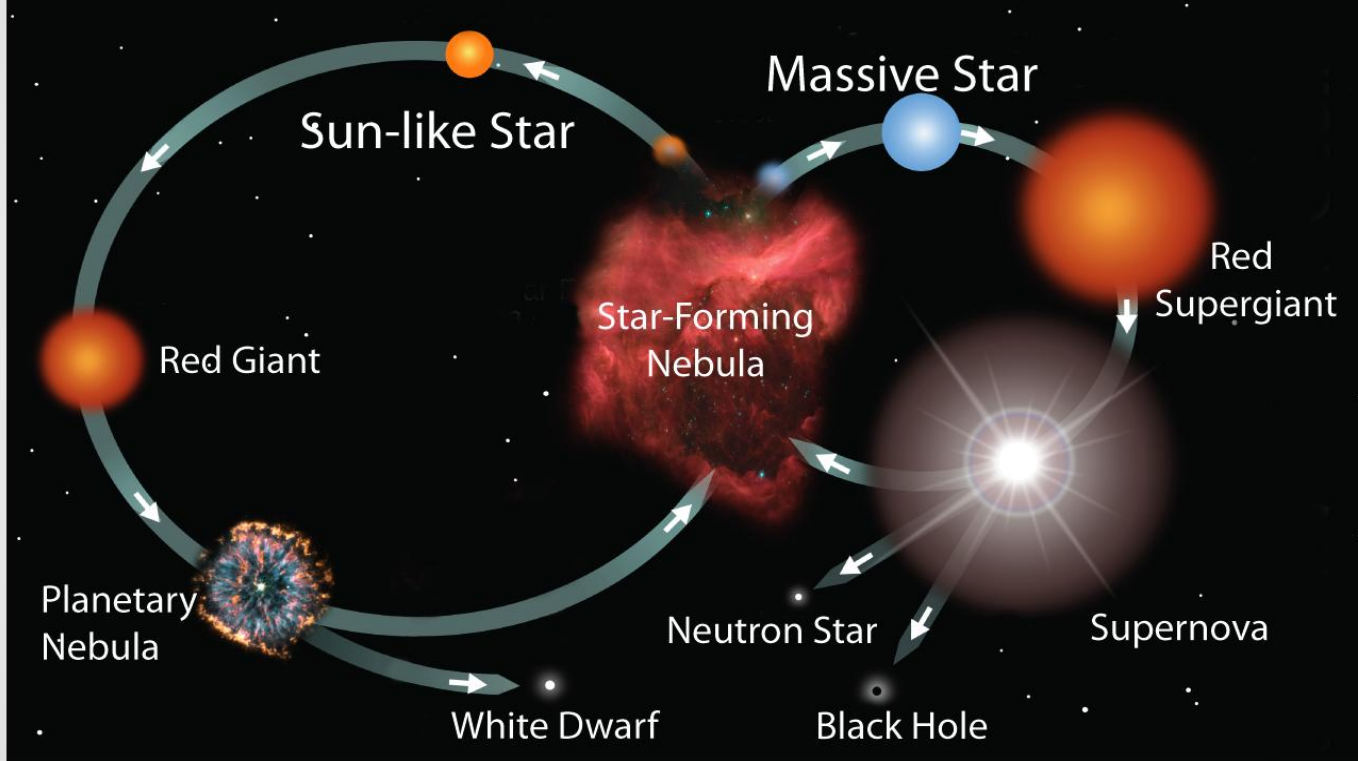


Image source: <http://www.cmso.info/lifecycst>

Nebula

- ★ An interstellar cloud of dust and ionized gas.
- ★ “Stellar Nursery”



Image source:

http://sacredgeometryinternational.com/?attachment_id=1067

Protostar

- ★ Gas spirals and collapses to form a star.
- ★ Early stage of forming star.

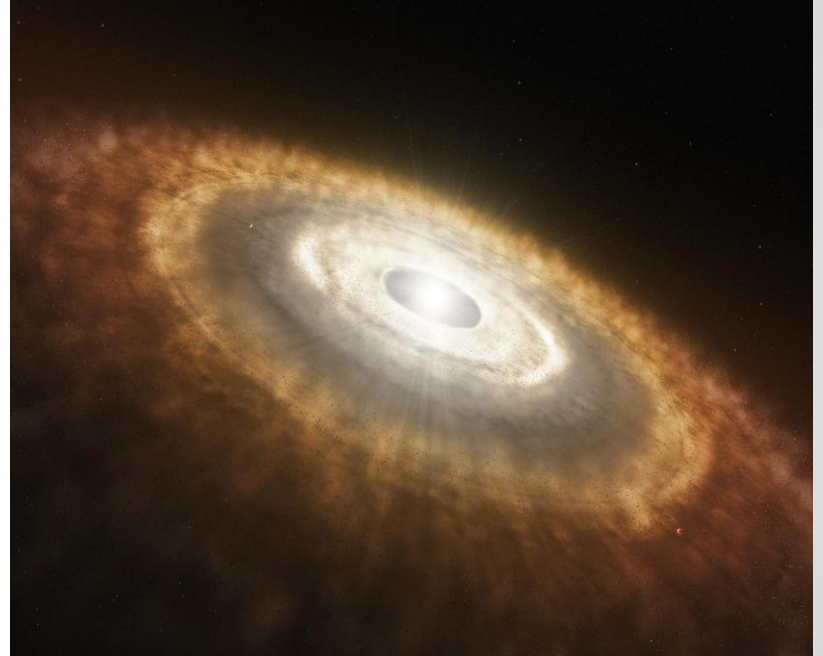


Image source:

<http://aswathigalaxy.wordpress.com/2012/10/02/early-stages-of-star-protostar/>

Main Sequence Star

- ★ Stars that fuse hydrogen in their core.
- ★ 90% of stars in the universe.
- ★ These stars can range from about a tenth of the mass of **the sun** to up to 200 times as massive.

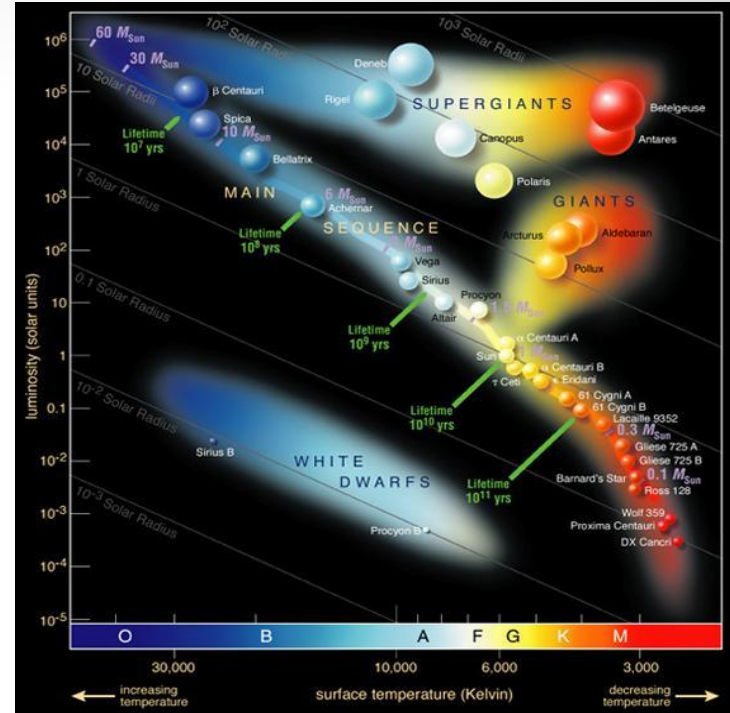


Image source: <http://www.ask.com/question/what-is-a-main-sequence-star>

Dying Stars

- ★ Main sequence turn into Red Giants then Planetary Nebula and the core remains as a White Dwarf.
- ★ Larger stars (>3 Solar masses) turn to Red Supergiants then Supernova
- ★ Core remains to form a Neutron Star, or for super massive stars a **Black Hole**.



Image source:

http://www.nasa.gov/multimedia/imagegallery/image_feature_624.html

Conventional Black Hole Theory

- ★ Based off of Einstein's Theory of Relativity
- ★ Black Hole defined: a region of space having a gravitational field so intense that no matter or radiation can escape.
- ★ Escape Velocity defined: lowest velocity that a body must have in order to escape the gravitational attraction of a particular planet or other object.
- ★ For a black hole, escape velocity is greater than the speed of light 3×10^8 m/s. Escape velocity of Earth is 11000 m/s.



Image Source: <http://www.wired.com/2014/01/brief-history-of-black-holes/>

Einstein's Theory of Relativity states that nothing can travel faster than the speed of light. Therefore even photons that have no mass could not escape the gravitational pull of a black hole.

$$v_{\text{esc}} = \sqrt{\frac{2GM}{R}}$$

- ★ The gravitational pull is the greatest force within a black hole where all matter collects in to what is defined as a Singularity.

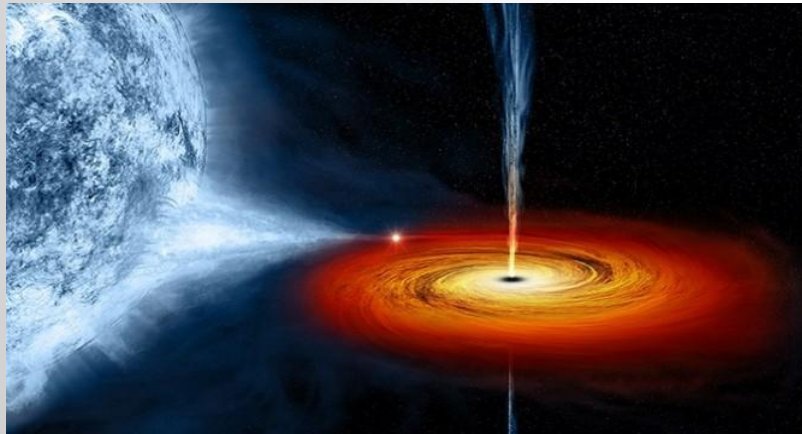
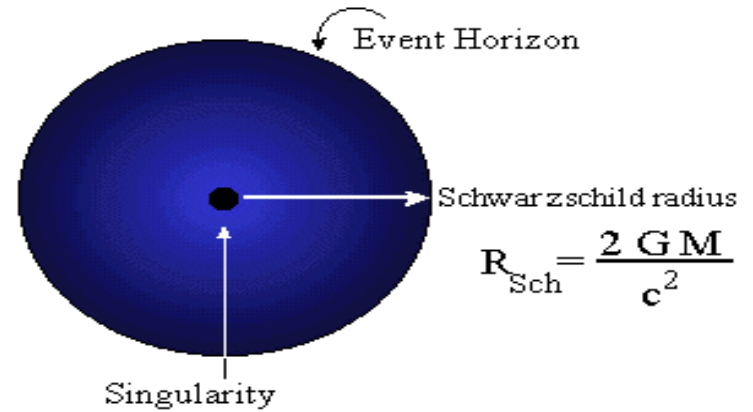


Image Source:
<http://www.redstate.com/diary/checkmate2012/2013/04/09/breaking-a-new-black-hole-is-discovered-and-its-sucking-up-the-private-sector/>

Image Source: <http://hendrix2.uoregon.edu/~imamura/123/lecture-2/bulge.html>

- ★ Event horizon defined: the boundary of the region of a black hole from which no radiation may escape. Any event that happens within the event horizon is invisible to a distant viewer.
- ★ The distance from the singularity to the event horizon is called the Schwarzschild radius.

- ★ If you were watching someone fall into a black hole and they were heading feet first towards the event horizon, a process called the tidal effect aka spaghettification, would occur. The closer to a black hole you get the stronger the gravitational pull becomes and the faster you travel, which make you look stretched out.
- ★ You can imagine the person's feet having a stronger pull than the person's head. Tidal forces would compress you and stretch you.
- ★ Time dilation- Just as a clock runs a bit slower closer to sea level than up on a space station, clock run really slow near black holes which all has to do with gravity.



Image Source:
<http://sciencehorrors.tumblr.com/post/32833882834/spaghettification>

Stephen Hawking's Paper

- ★ It attempts to resolve a paradox between the theories of general relativity and quantum mechanics.
- ★ The notion that light cannot escape within the event horizon may not be true.



Image Source: <http://www.bbc.com/future/story/20140203-hawkings-new-black-hole-theory>

Firewall Paradox

- ★ Einstein's theory of general relativity predicts the existence of black hole.
- ★ Nothing should be happening inside of the Event Horizon.

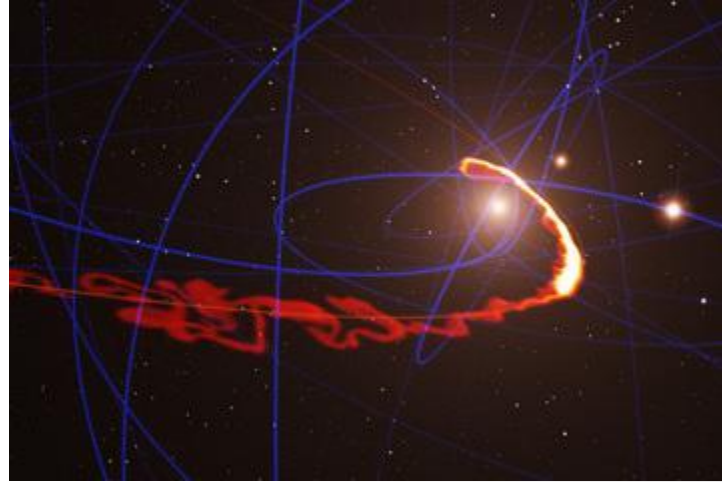


Image source:<http://www.livescience.com/42875-hawking-rethinks-black-holes.html>

Contradiction between QM

- ★ Black holes were losing mass and would eventually evaporate. If they evaporated, they would take all traces of what fell into them with it. The information would not, in fact, be conserved. It would vanish.

Apparent Horizon

- ★ Proposed by Hawking.
- ★ Matter energy are trapped and suspended, and eventually released.

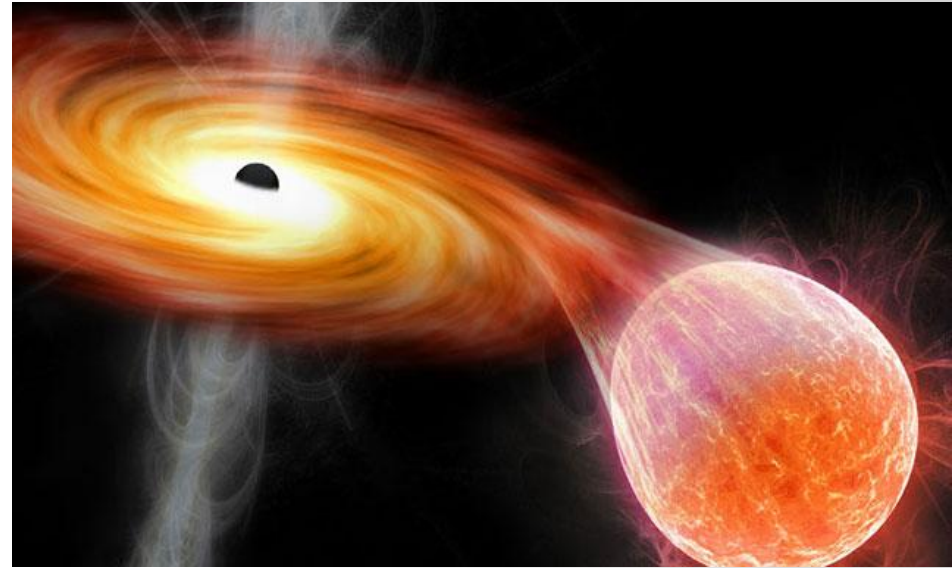


Image source:<http://news.priyo.com/2014/01/25/stephen-hawking-black-holes-may-not-have-event-hor-98505.html>

SOURCES

- ★ Stars and Galaxies, 7th ed. Seeds, Backman (6th edition)
- ★ http://www.nasa.gov/vision/universe/starsgalaxies/black_hole_description.html#.U2lHAvldV8E
- ★ <http://www.pbs.org/wgbh/nova/space/birth-black-hole.html>
- ★ <http://www.bbc.com/future/story/20140203-hawkings-new-black-hole-theory>
- ★ <http://www.livescience.com/42875-hawking-rethinks-black-holes.html>