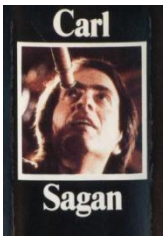
Life and Death of a Star

by **Mr. Aris Dacanalis**
(MSc in Astronomy and Astrophysics)

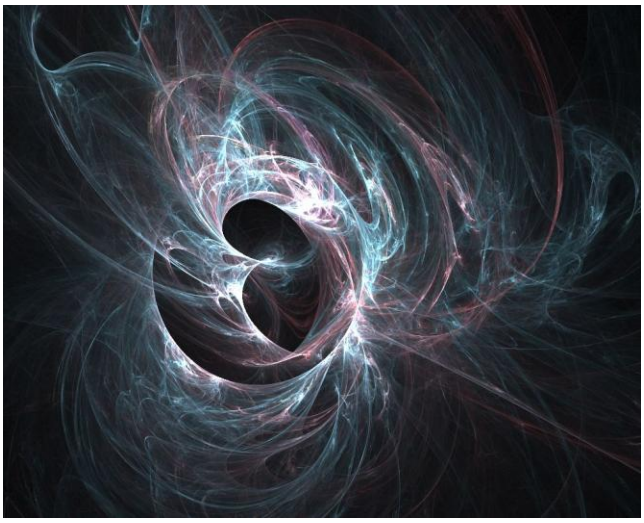


One of the most prominent Astrophysicists, Carl Sagan, as a young boy, once wondered what are the thousands of stars that could be seen on the night sky. Grown-ups provided little information, telling him that "*they're just lights in the sky, kid"*. So he went to the public library of Brooklyn, (in New York) and asked for a book about the stars. The librarian gave him a book with biographies of Audrey Hepburn, Marlon Brando and Kirk Douglas. When he protested, he finally got what he wanted: a book about *real* stars.

Why did Carl Sagan visit the library of Brooklyn?
Why was it difficult for Carl Sagan to find what he was looking for in the library of Brooklyn?

Inside those pages he became **immersed in** the ideas of the time on star formation, their life and death. Stars hold no exception to the universal law of creation, that after birth, death must follow. All things come to pass, even stars, whose lives **span from** hundreds of thousands of years, to several billions of years - durations **unfathomable** to our human mind.

What do stars have in common with any other living beings?



Our best understanding –so far– is that stars are formed out of **immense clouds of interstellar dust**, which collapse under their own **gravitational pull**. As they collapse, they gradually **coalesce** and heat up. If their initial mass is just enough, their cores reach temperatures of a few millions degrees, which allows for the first **thermonuclear reactions** to take place: **Hydrogen** atoms fuse into **Helium**, **releasing huge amounts** of energy each second. This is, actually, the definition of a star in astrophysics: *a celestial body which houses thermonuclear reactions in its core.*

What is the raw material of stars?
What is the force that turns the raw material into a star?
How do the stars emit energy?

A single factor seems to define the course of the life of the new-born star: its **initial capital** of mass. Massive stars live short lives that end with a spectacular bang. Smaller stars live much longer lives, and pass away much more **discreetly**.

How long do stars live?

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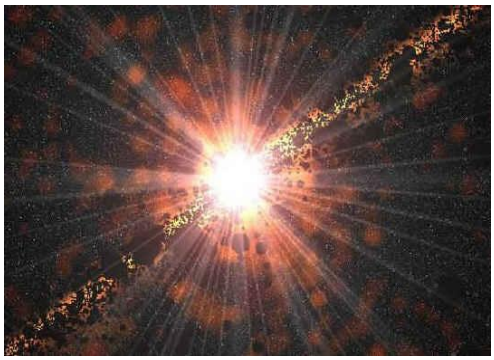
No matter how their life evolves, it plays out according to the same tune: the life of a star is a constant struggle against gravity. Gravity is what gave it life, and thereafter **looms over** the star, waiting to put an end to its existence. It is a purely attractive force, which, if left **undisputed**, could crush the star into nothingness. However, the thermonuclear reactions and the resultant radiation, provide an outward pressure which balances the **relentless** gravitational force. As long as there is balance, the star lives out its life.

Is gravity responsible for the birth or the death of a star?

Once its fuel is spent, the star is **doomed to perish**.

(a) If its mass is comparable to that of our own Sun, the star will expand and eject its **outer layers** to space. It will finally diminish, leaving behind what astronomers call a “brown dwarf”: a small husk of a star with minimal brightness.



(b) Stars of a much larger mass, **undergo** other stages of thermonuclear reactions, burning new kinds of fuel. Once that is spent as well, those stars will too meet their end.

(c) Massive stars could end their lives with nova explosions and, in the case of more massive stars, supernova explosions. Such highly energetic phenomena could produce exotic stellar remnants, such as neutron stars and black holes.

What is the difference small stars and massive stars in the way they end their life?