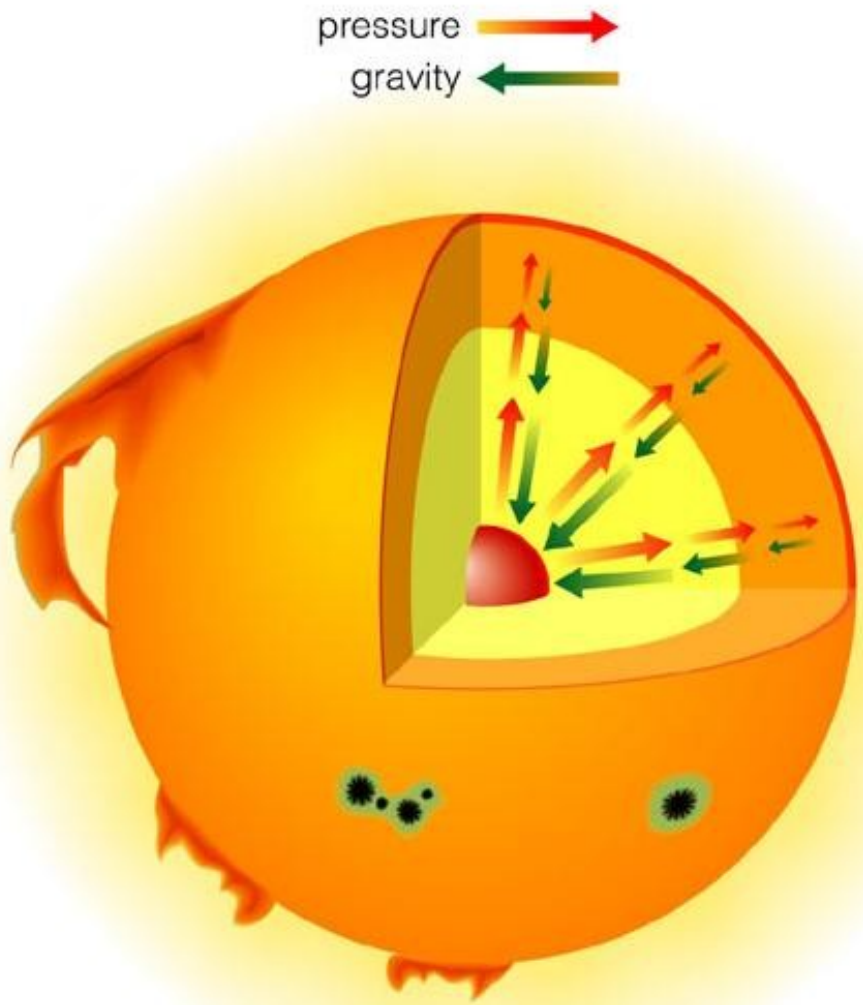
Stellar Graveyards

Protracted battle with gravity



To support weight:

⇒ need high pressure

⇒ need high temperature

⇒ will loose energy

⇒ need energy source:
- Gravitational contraction
- Nuclear fusion

Ultimately,

fuel exhaustion

Mira ('the wondeful') -- the ceremonial dance for death

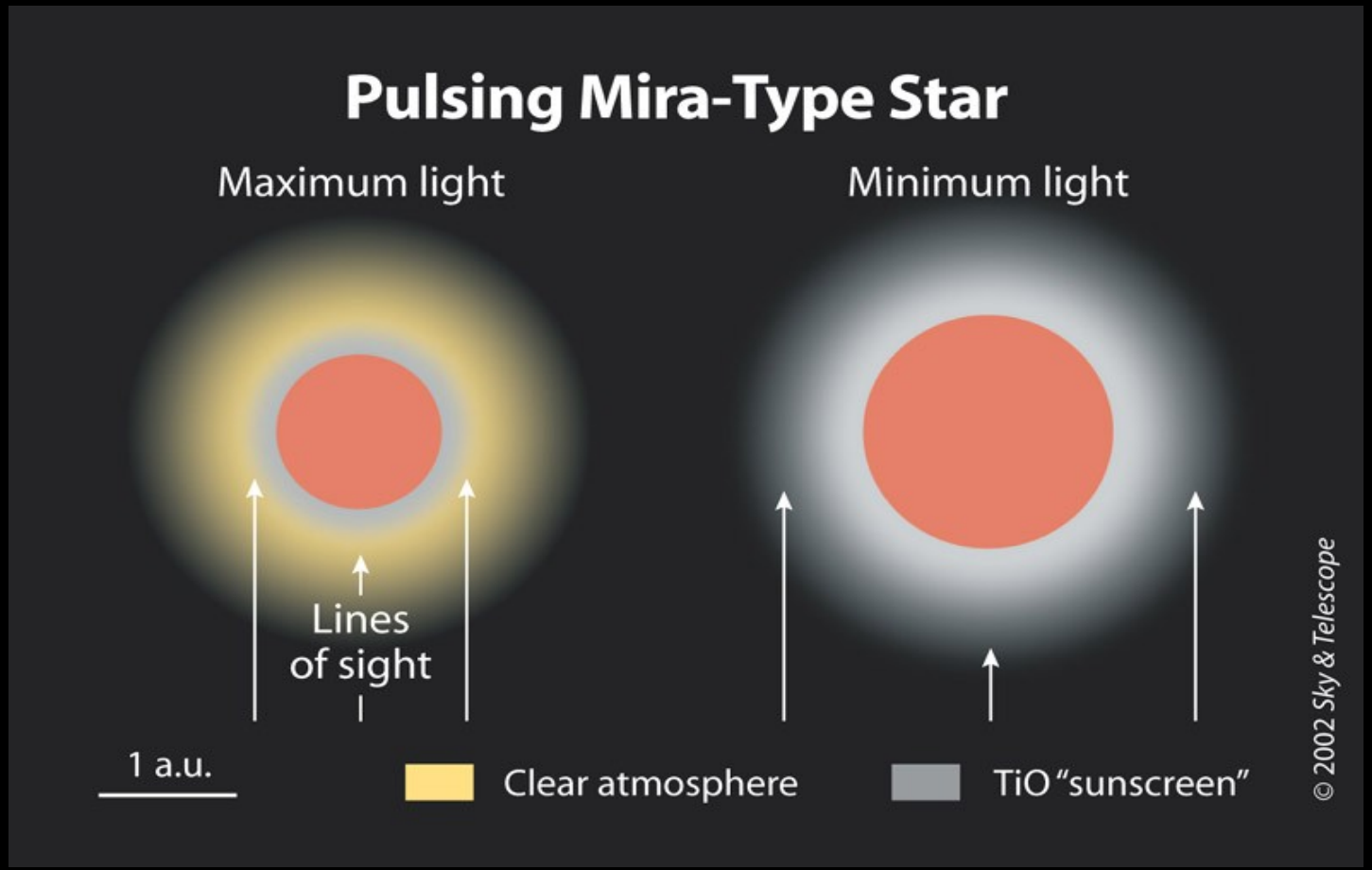
An old star (asymptotic giant), ~ 10 Billion years

change brightness drastically over ~ year, pulsing

(Mira: discovered 1596, visible at bright phase)

losing ~ Earth mass every pulsing

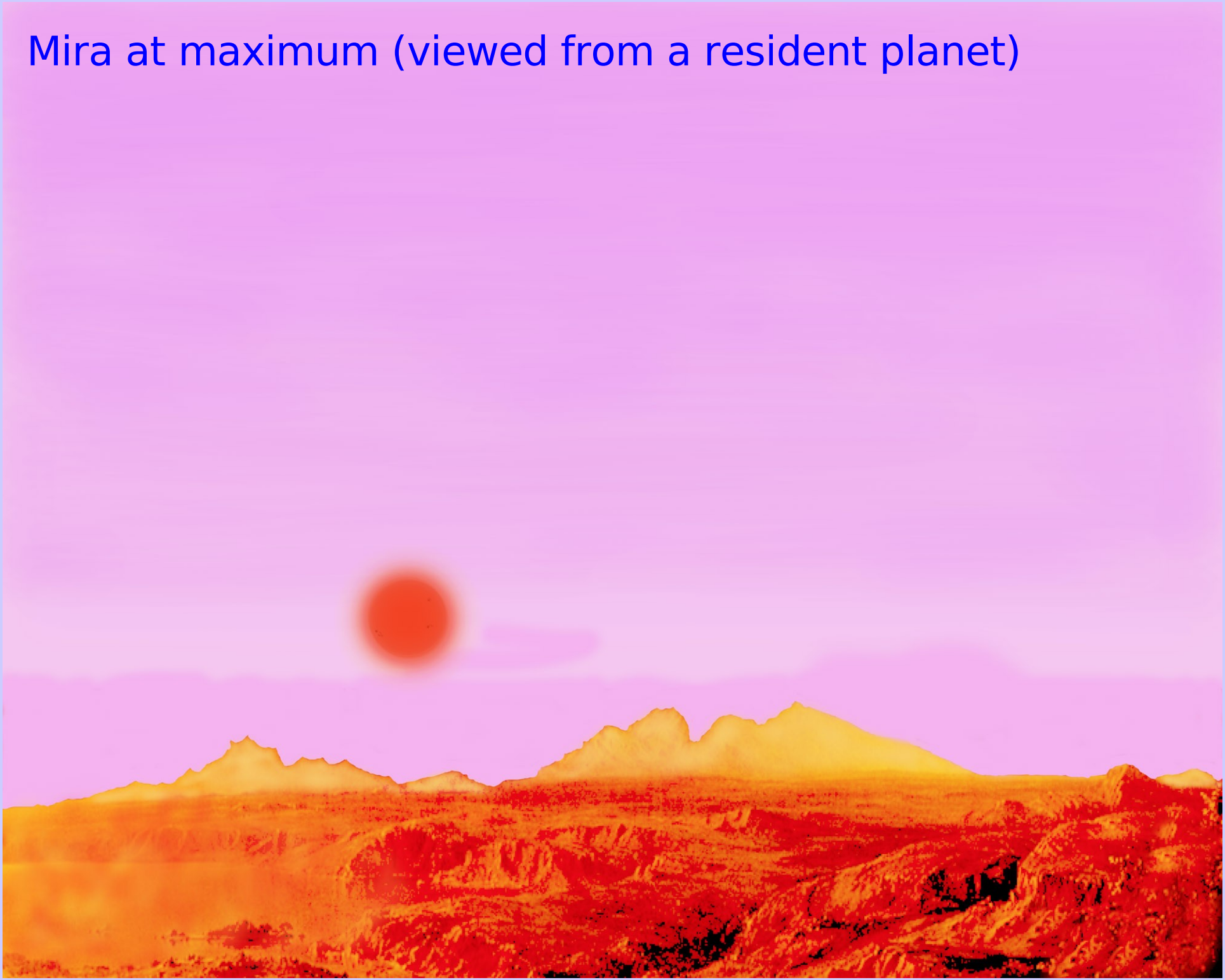
live for ~ few Million years



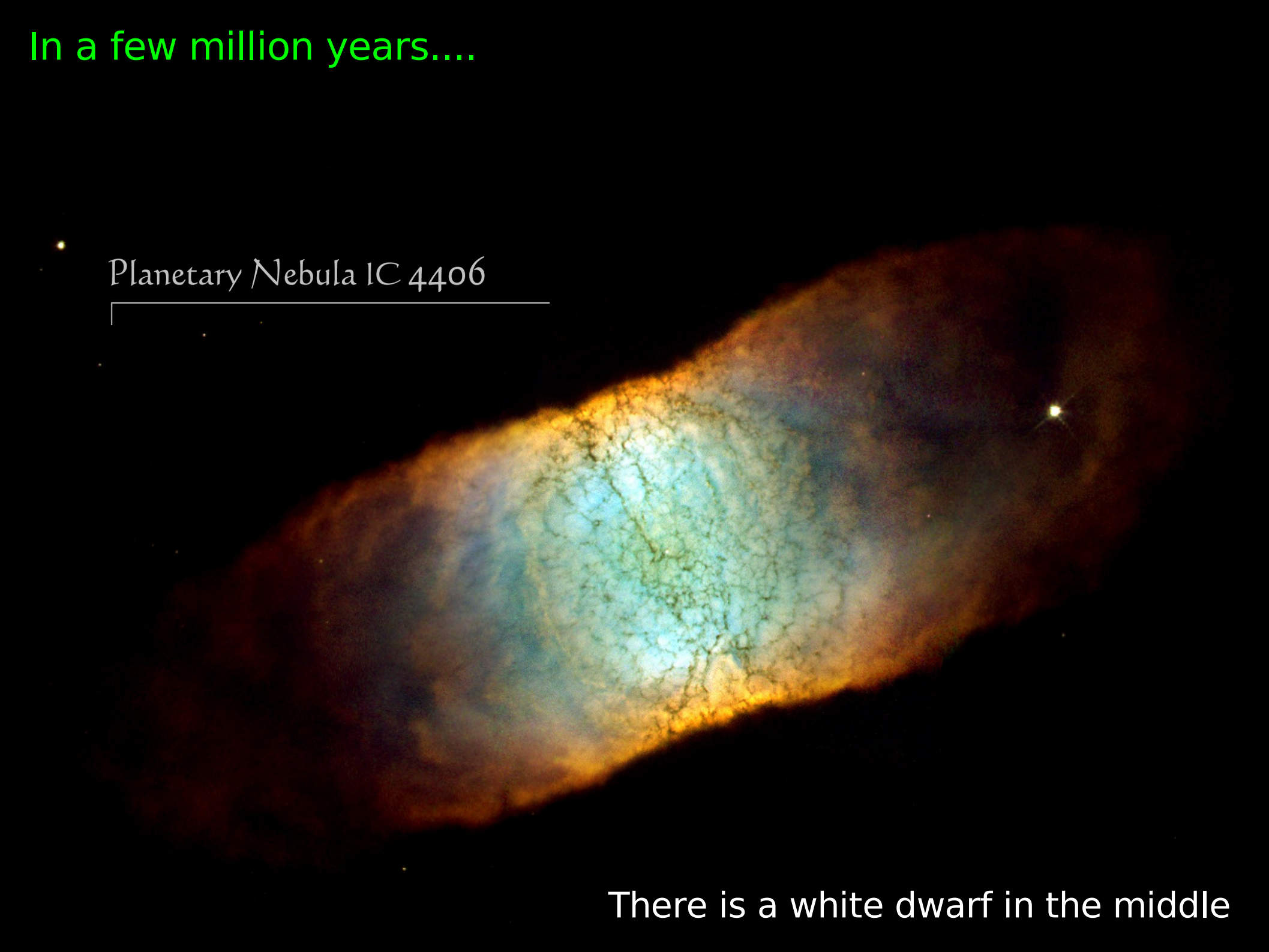
Dimmest when biggest


Mira at minimum (viewed from a resident planet)

Mira at maximum (viewed from a resident planet)



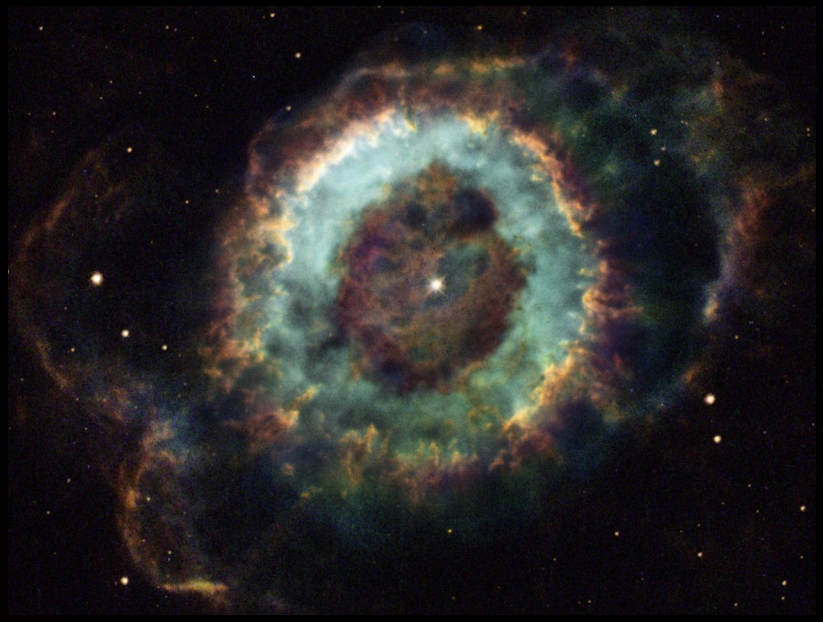
In a few million years....



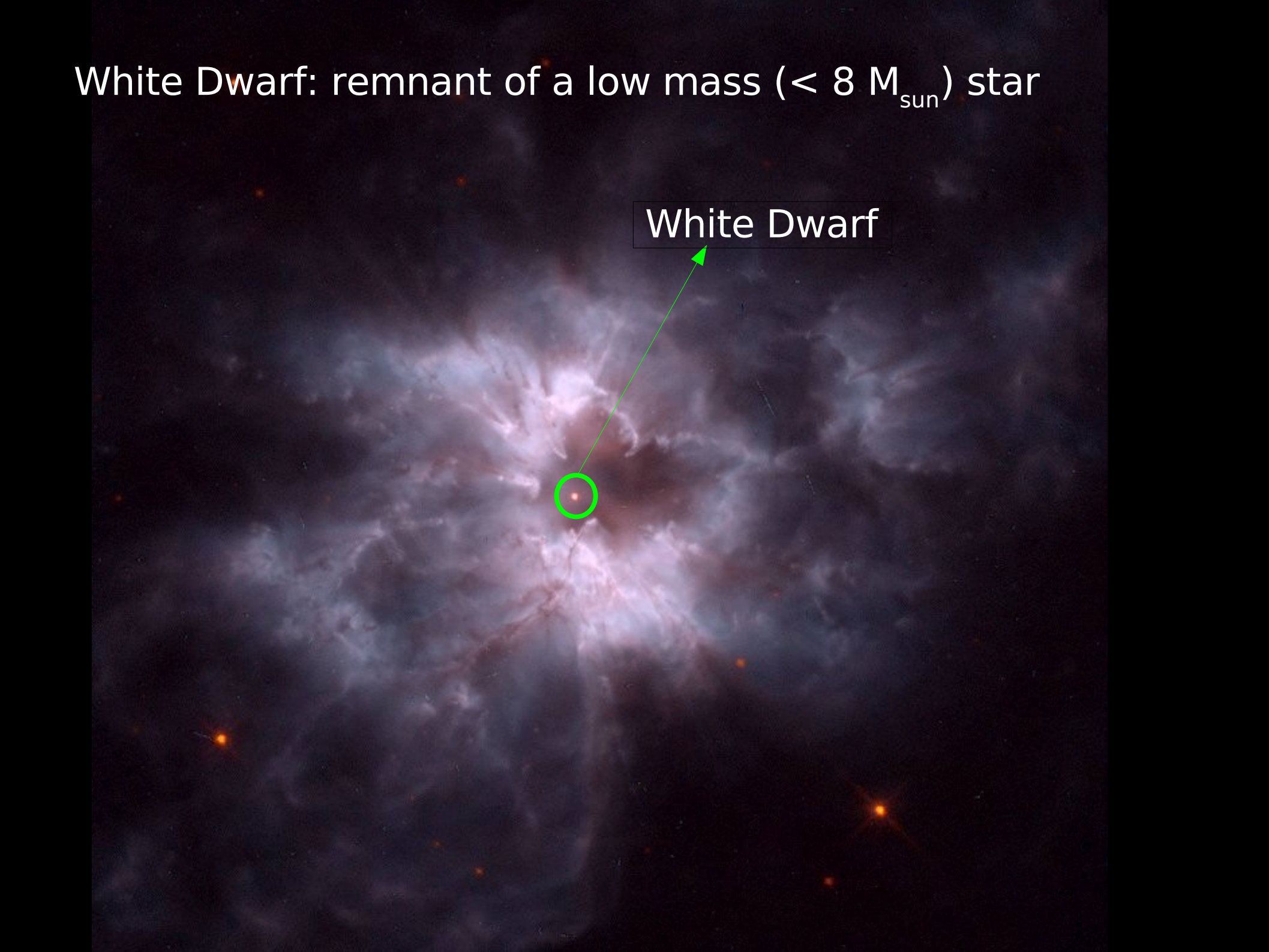
There is a white dwarf in the middle

So will the Sun (in another 5 billion years...)

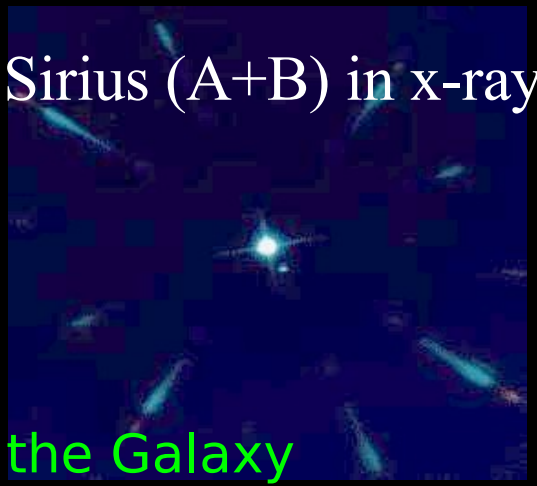
And how will we look like in death?



White Dwarf: remnant of a low mass (< 8 M_{sun}) star

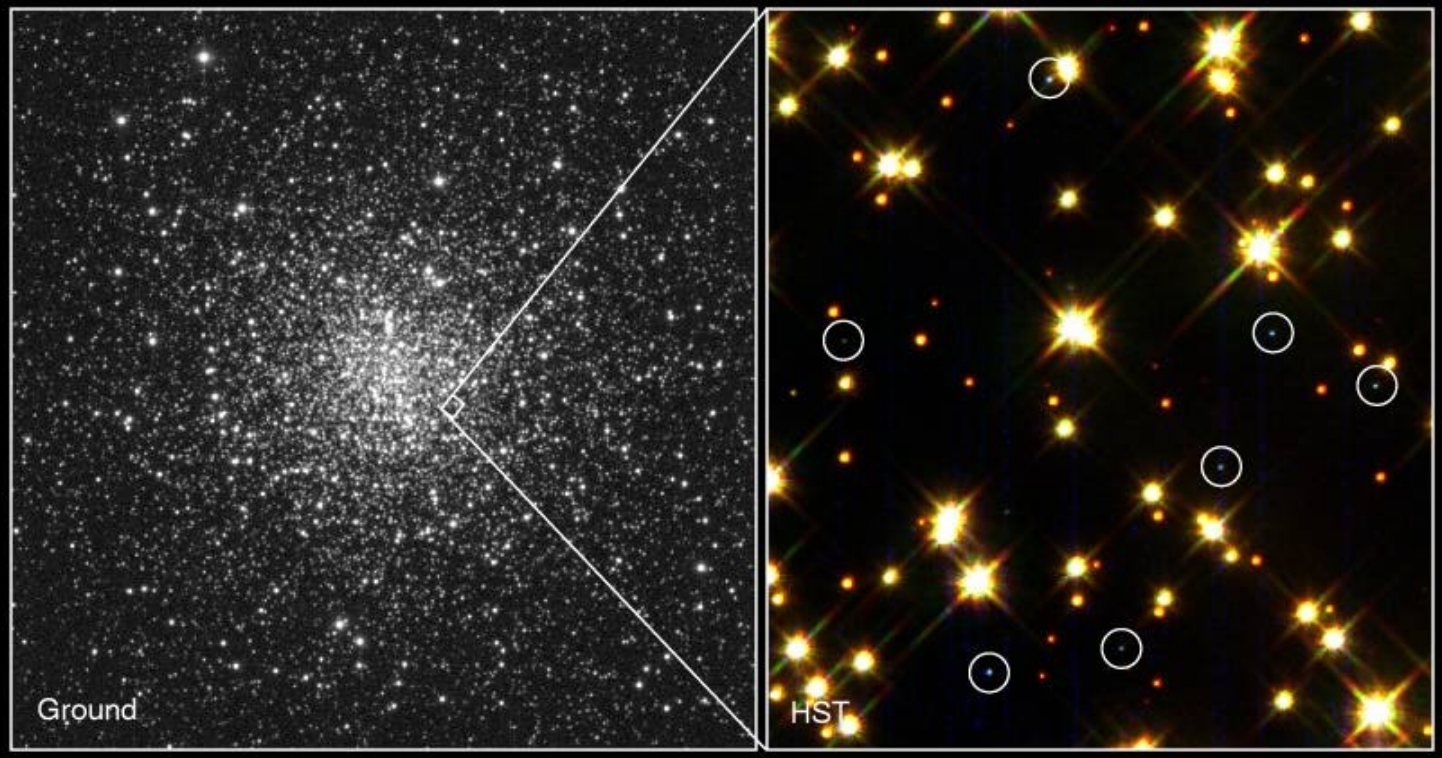


White dwarfs



There are as many white dwarfs as luminous stars in the Galaxy

they are dead objects simply fading with time



Sirius: the brightest star on the sky
also has a white dwarf companion

Mass ~ Sun,

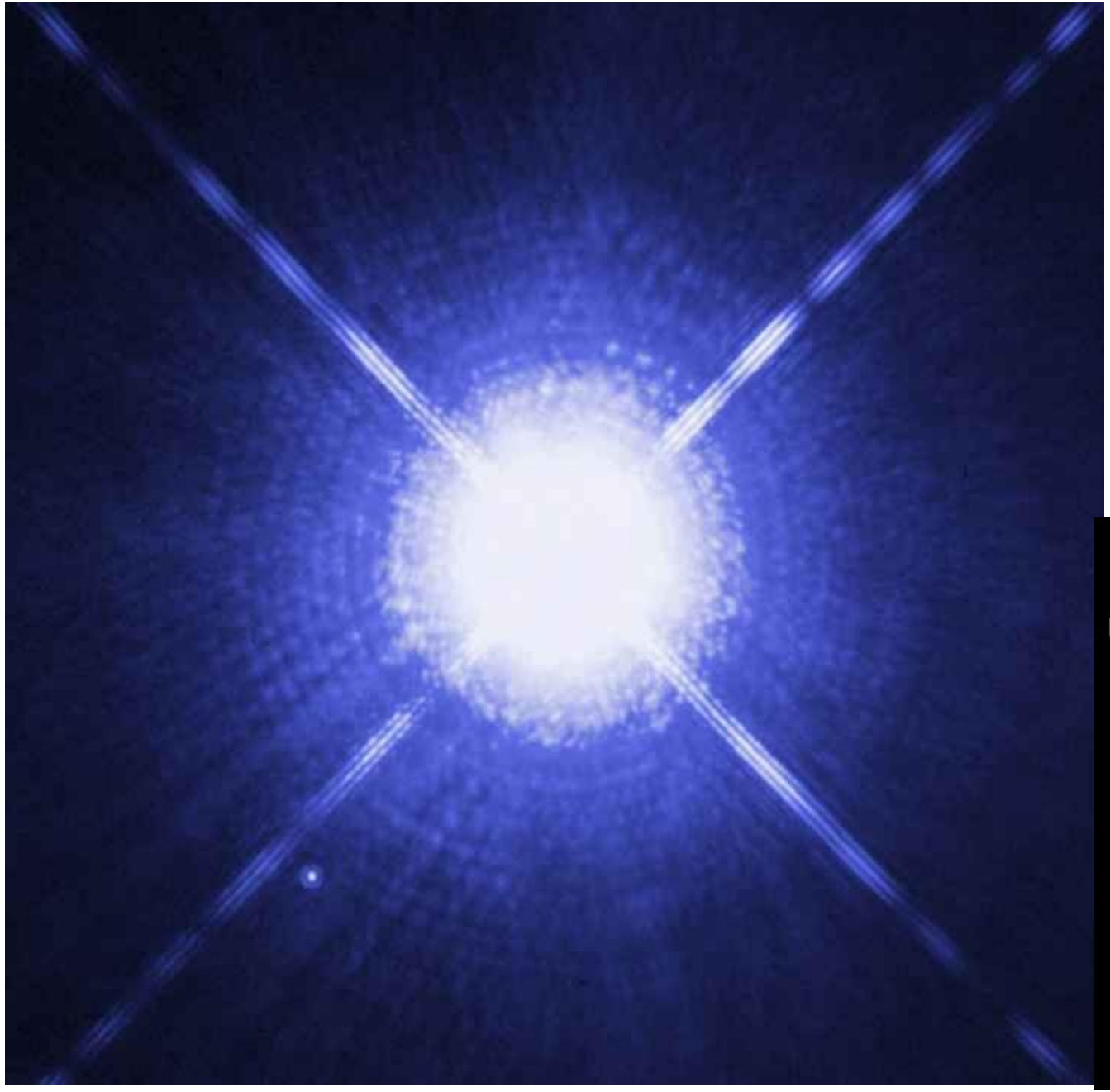
Radius ~ Earth

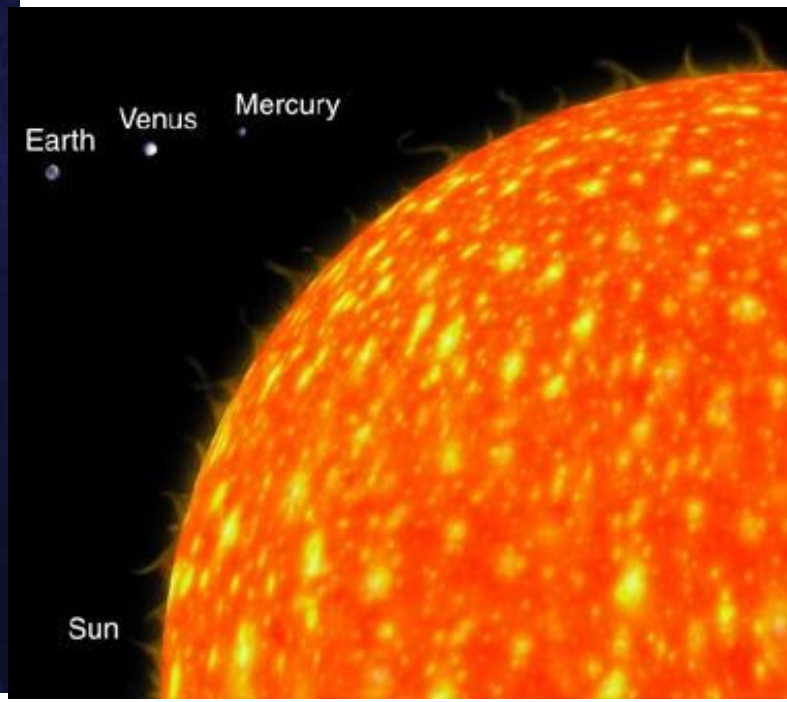
⇒ very dense

(degenerate matter)

density ~ 1 ton/cm^3

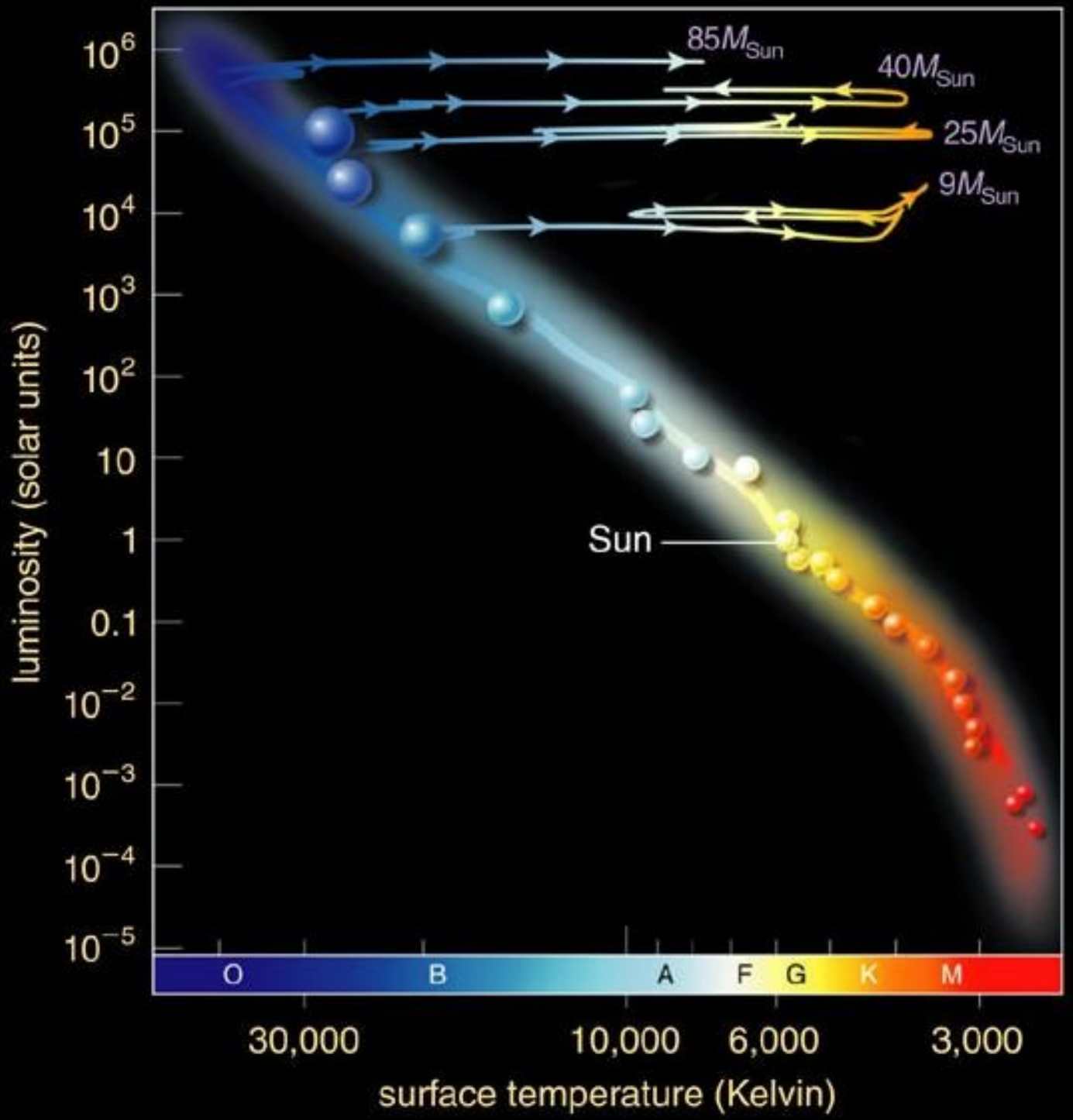
(a million times denser than water, pack an elephant into a sugar cube)





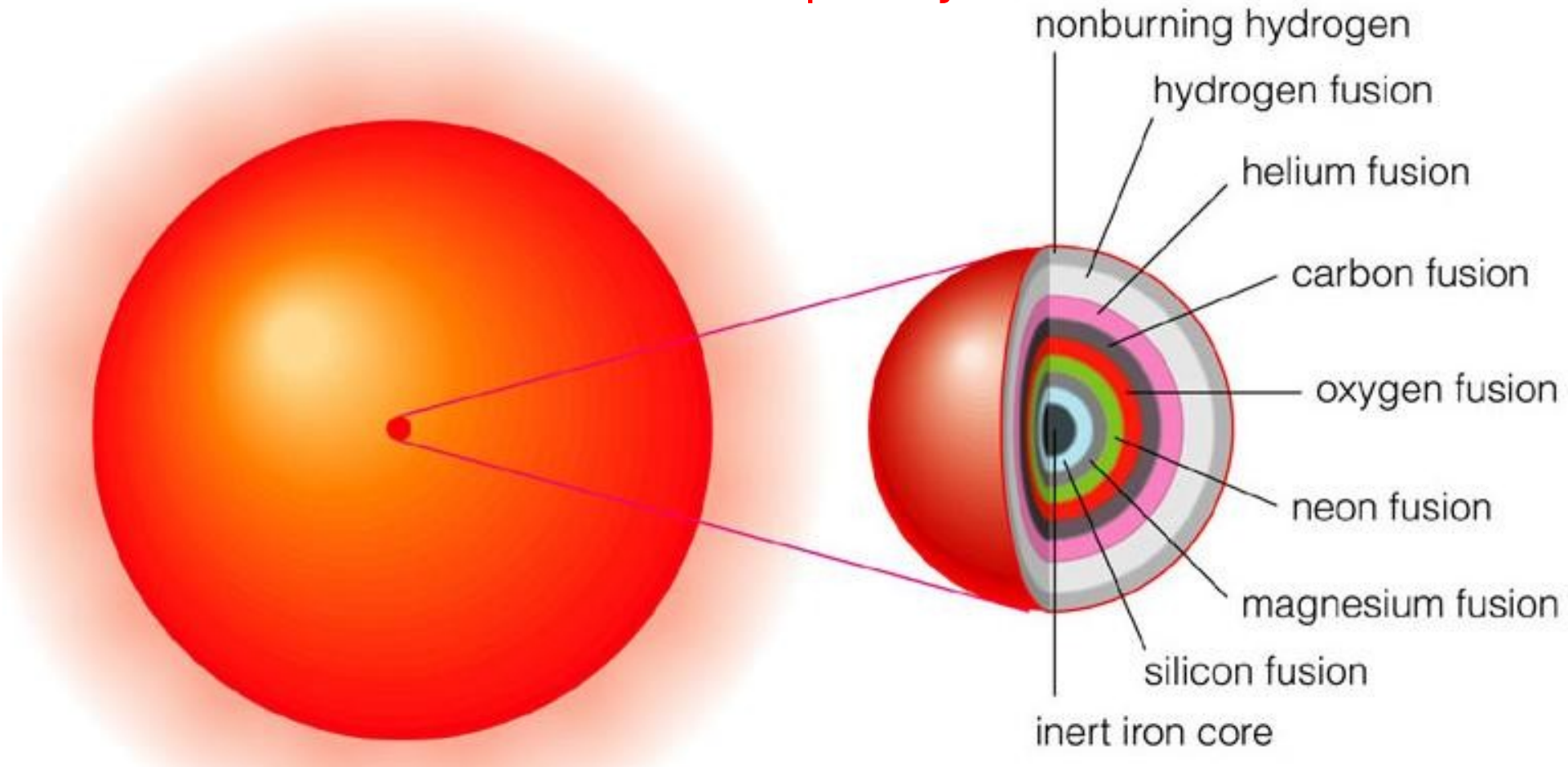
What about higher mass stars?

Stellar life tracks



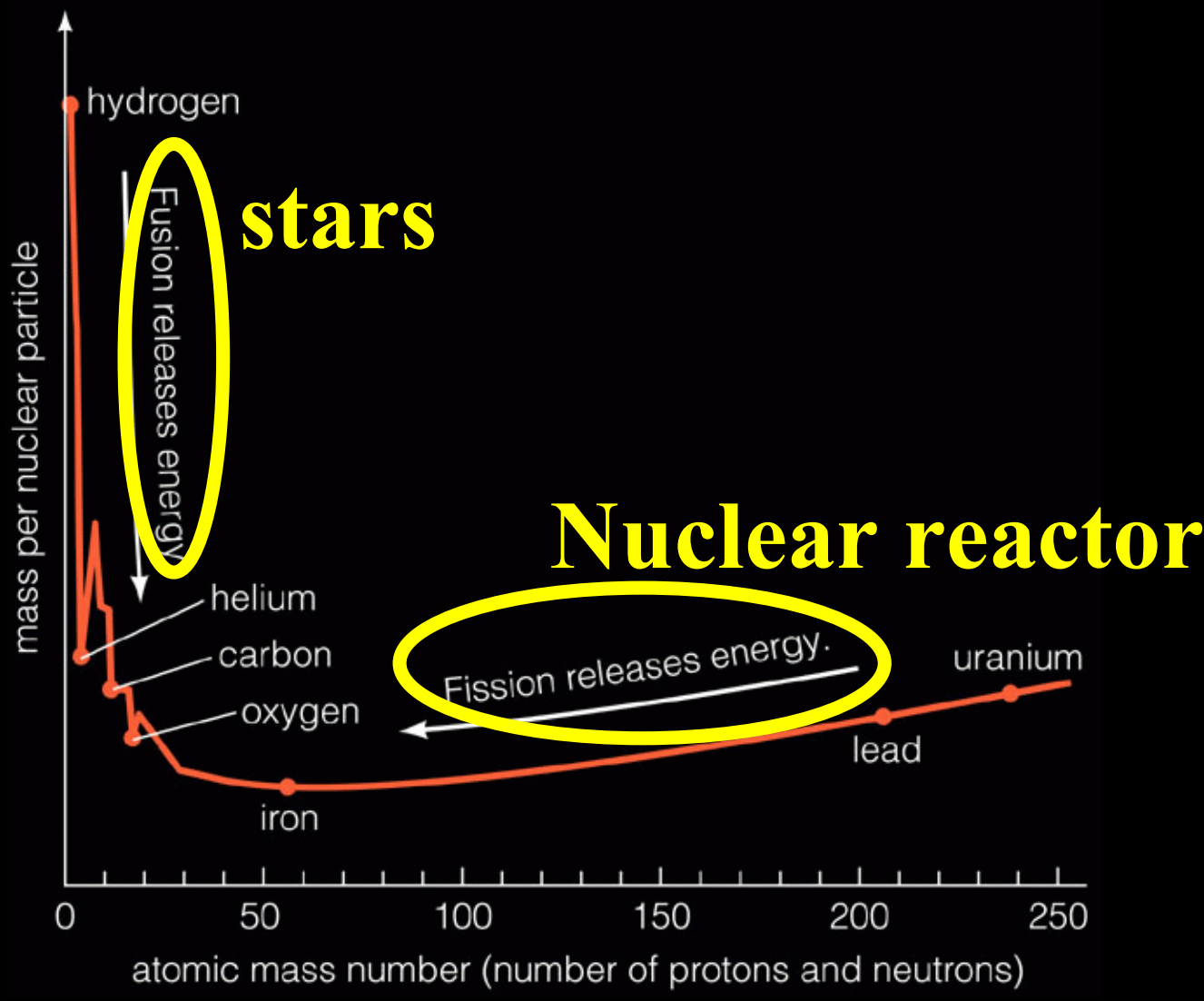
Stellar Onion

Unlike low-mass stars which can only process hydrogen and helium to carbon and oxygen, high-mass stars have hotter cores and therefore can burn more completely.



However, when silicon is burned to iron in the stellar core, no more nuclear fusion possible!!!!

Nuclear energy



They go SUPERNOVA!

the explosion of a star, possibly caused by gravitational collapse, during which the star's luminosity increases by as much as 20 magnitudes and most of the star's mass is blown away at very high velocity, sometimes leaving behind an extremely dense core. --- Random House dictionary

SN 1987A

First discoverer: Dr. I. Shelton (UofT)

Astronomers are trying to reconstruct this most energetic event using computers (movie).

So far we haven't totally succeeded.

SN 1987A

Supernova 1987A HUBBLESITE.org

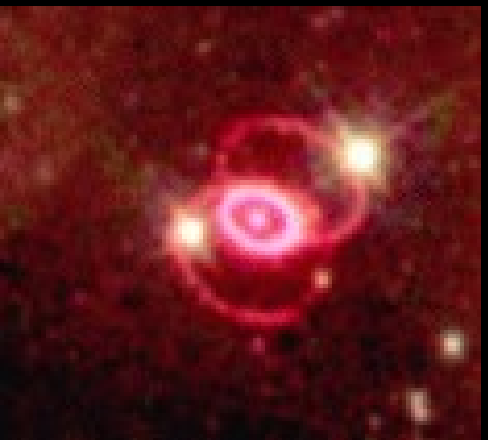
SN 1987A

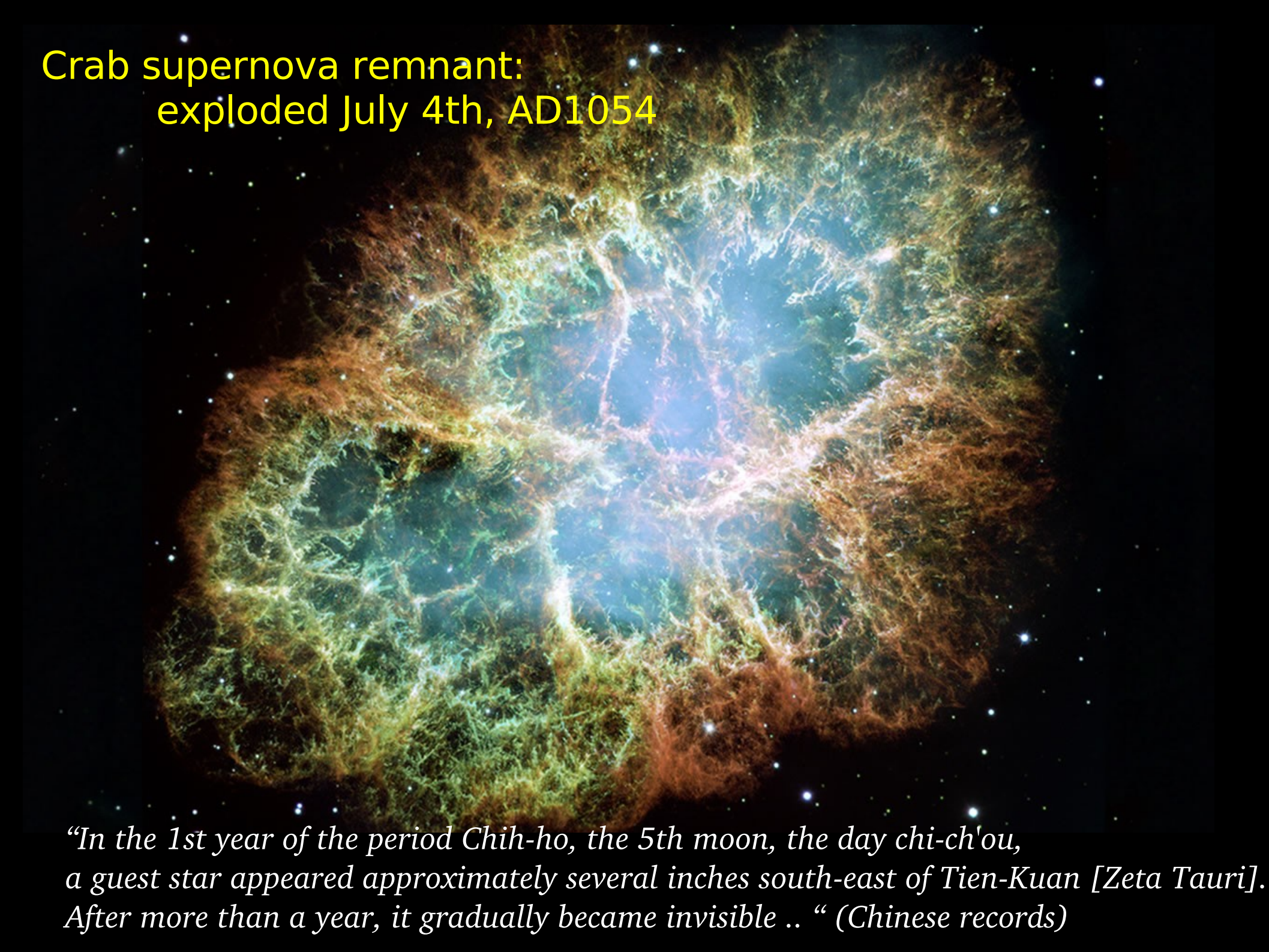
1994

1997

2000

2003

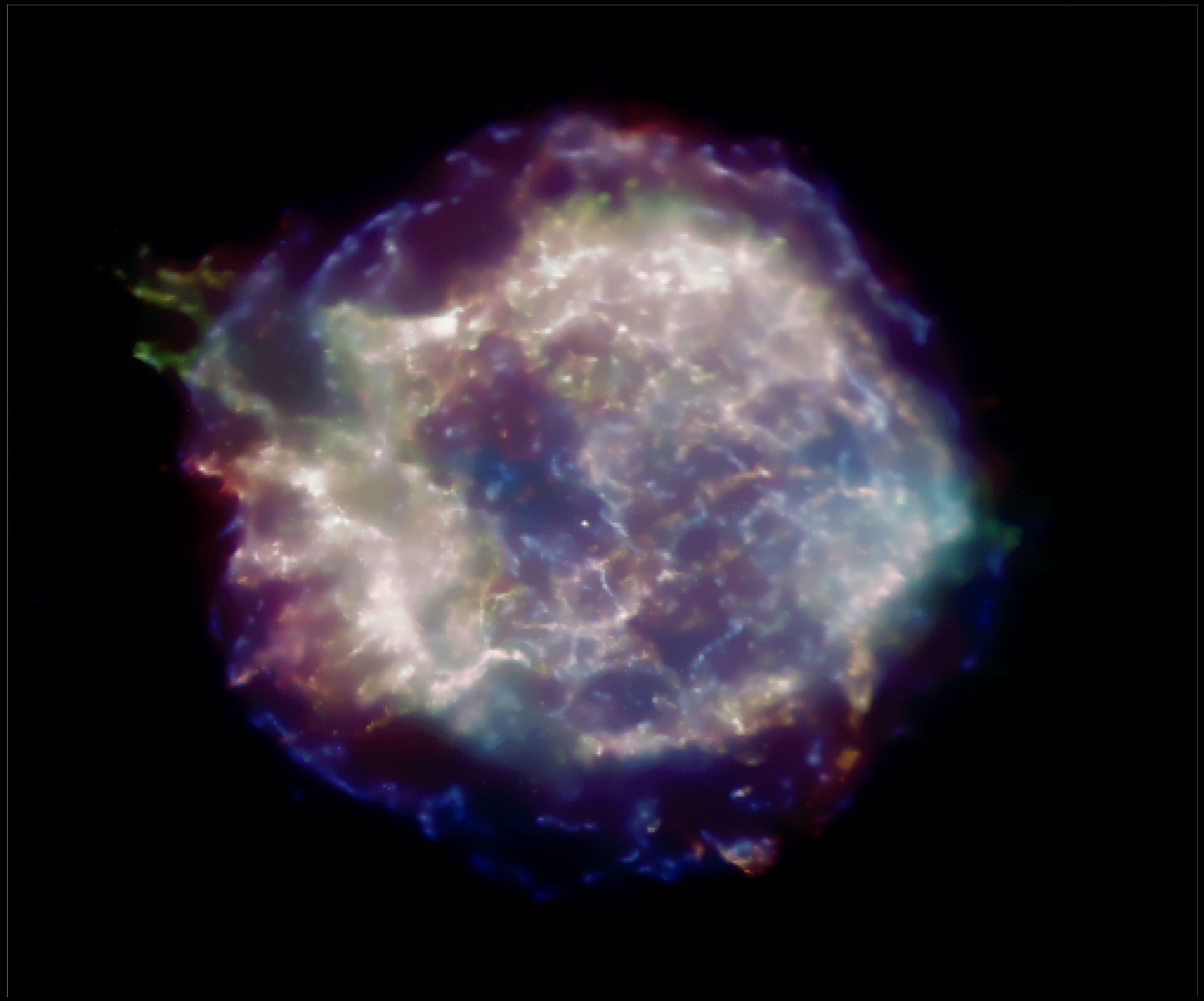


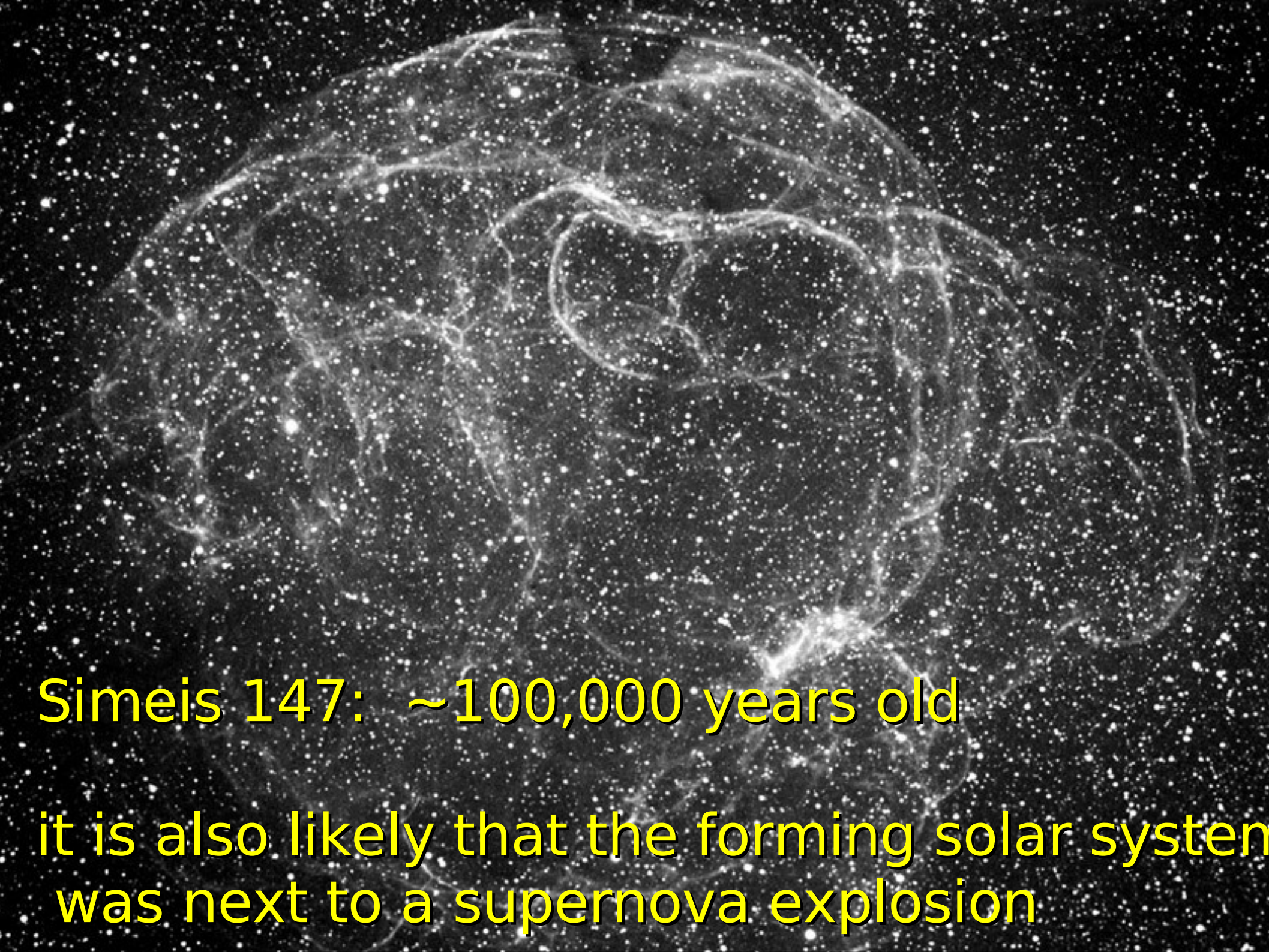


“In the 1st year of the period Chih-ho, the 5th moon, the day chi-ch'ou,
a guest star appeared approximately several inches south-east of Tien-Kuan [Zeta Tauri].
After more than a year, it gradually became invisible .. “ (Chinese records)

Cassiopeia A supernova remnant:

Milky way, 300 years old





Simeis 147: ~100,000 years old

it is also likely that the forming solar systen
was next to a supernova explosion

An extra-galactic supernova (2005cs) – spot it if you can.