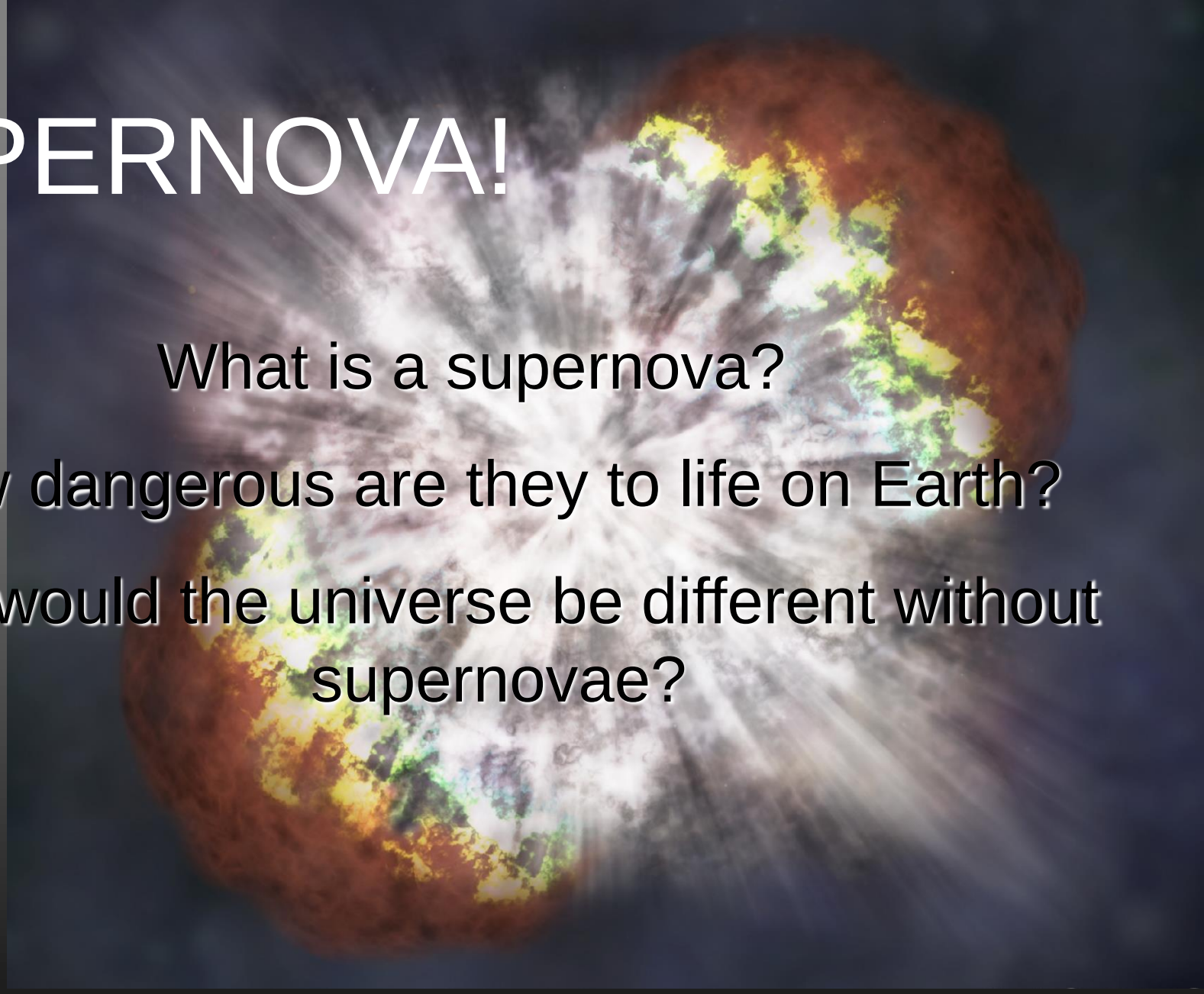
SUPERNOVA!



What is a supernova?

How dangerous are they to life on Earth?

How would the universe be different without supernovae?

RECENT HEADLINES

Astronomer predicts that a red supergiant star nearby could go supernova very soon

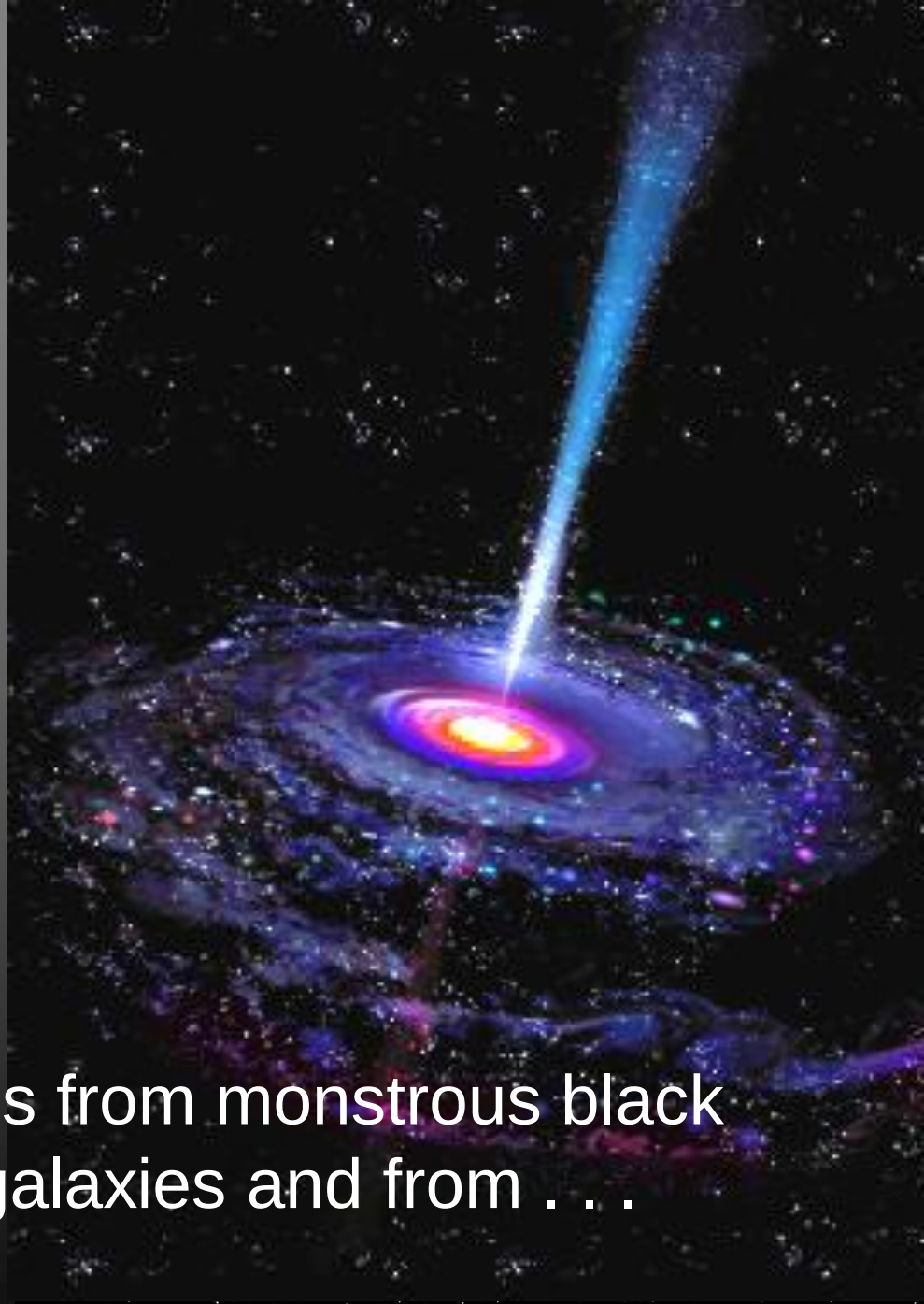
Betelgeuse's Brightening Raises Hopes for a Supernova Spectacle

Is the puzzling star Betelgeuse going to explode in our lifetime after all?

A hundred years ago, we believed we lived in a quiet, safe universe . . .

Today we know the universe is filled with powerful cosmic radiation our eyes cannot see:

- Gamma-rays
- X-Rays
- Fast-moving atomic particles (“Cosmic Rays”)



Much of which originates from monstrous black holes in the centers of galaxies and from . . .

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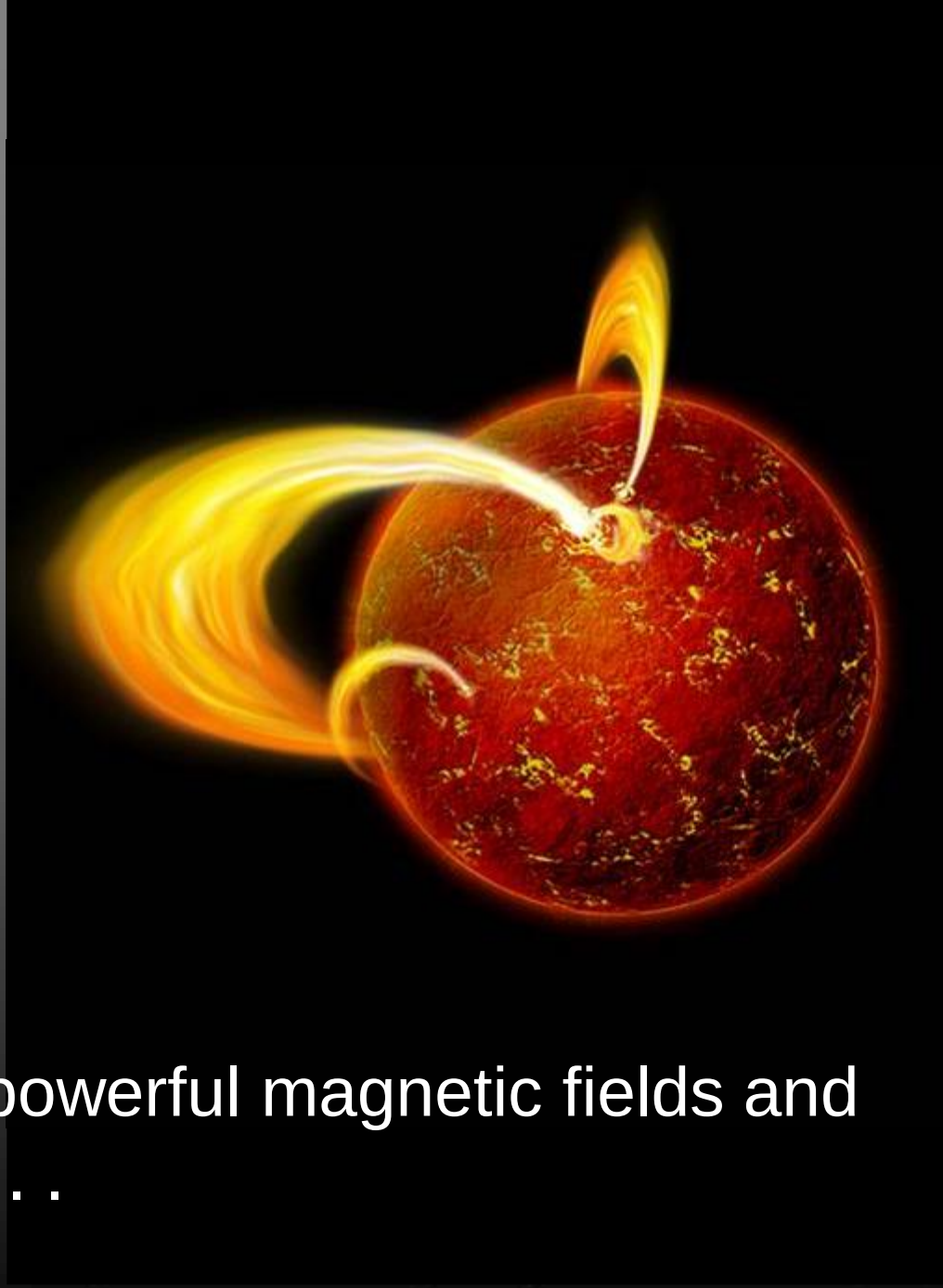
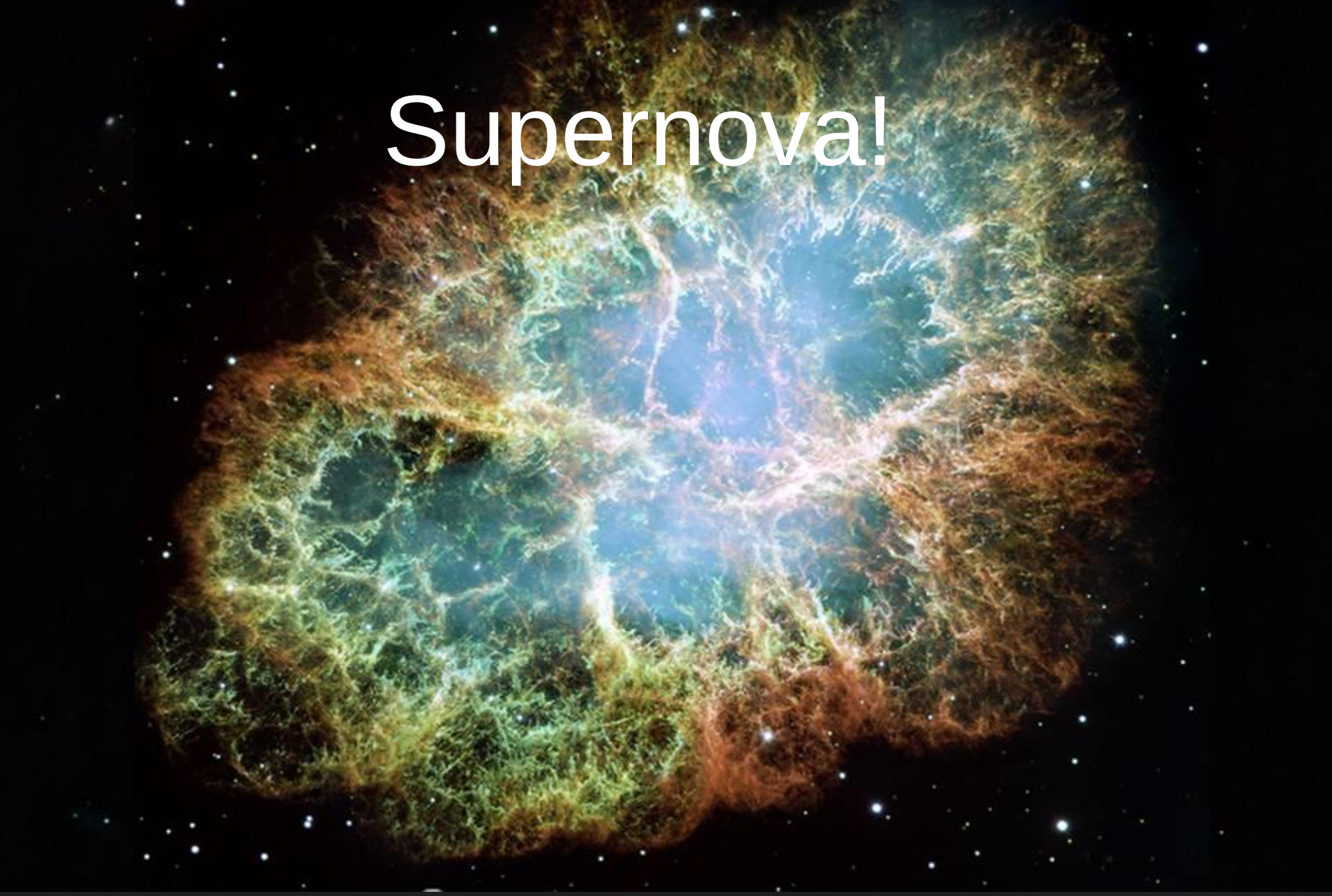
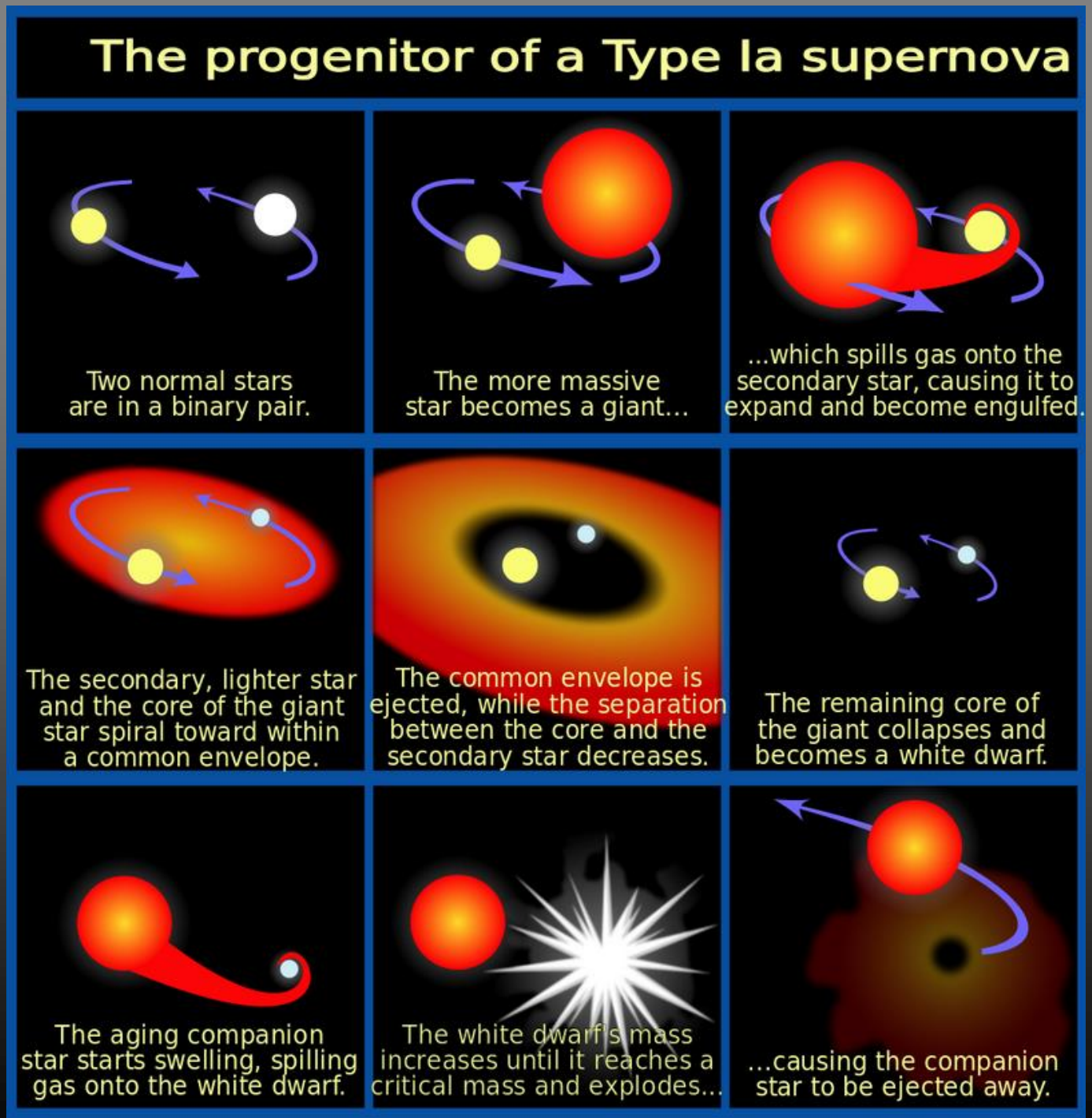


. . . neutron stars with powerful magnetic fields and more commonly from . . .

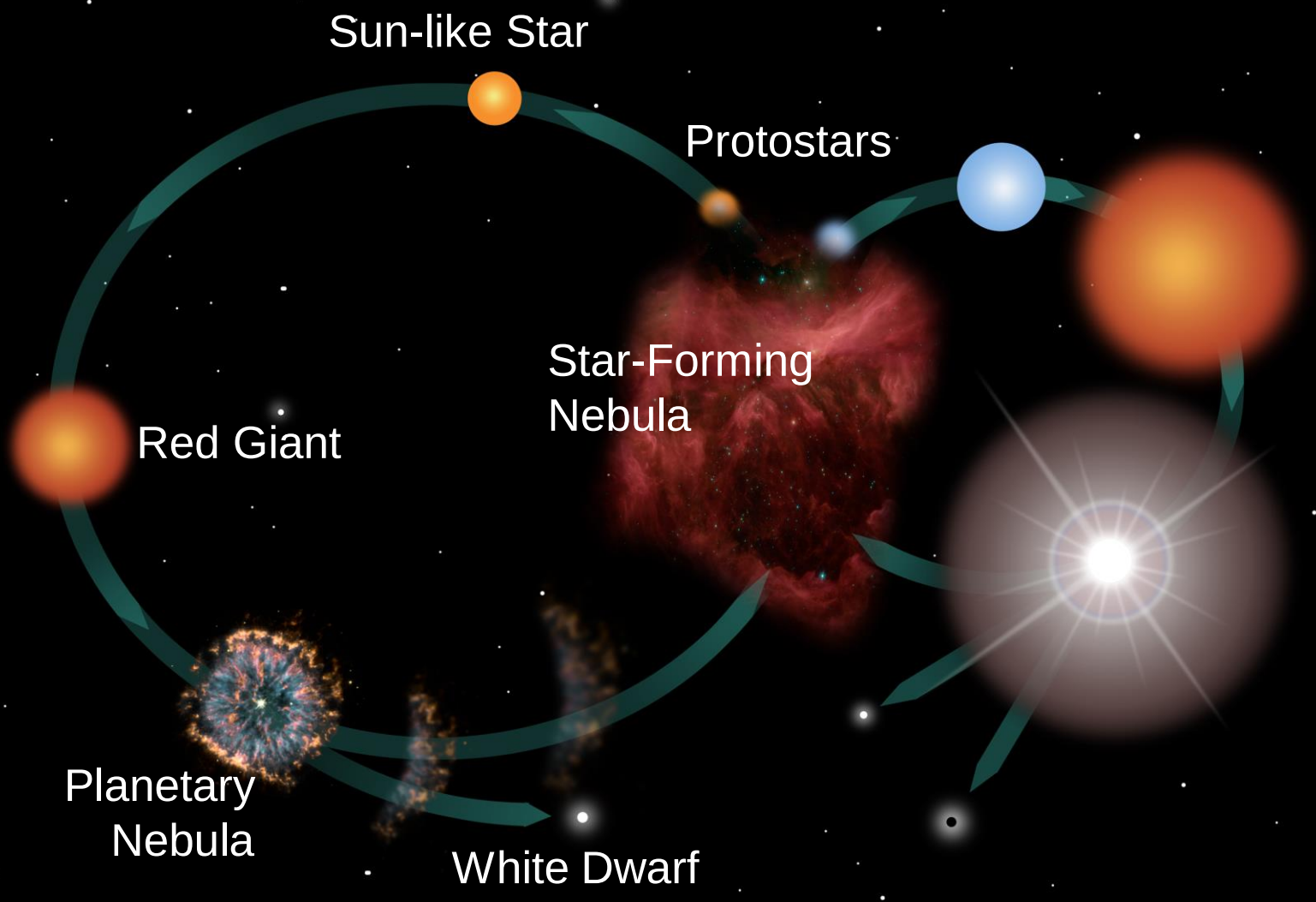

Supernova!

Types of Supernova

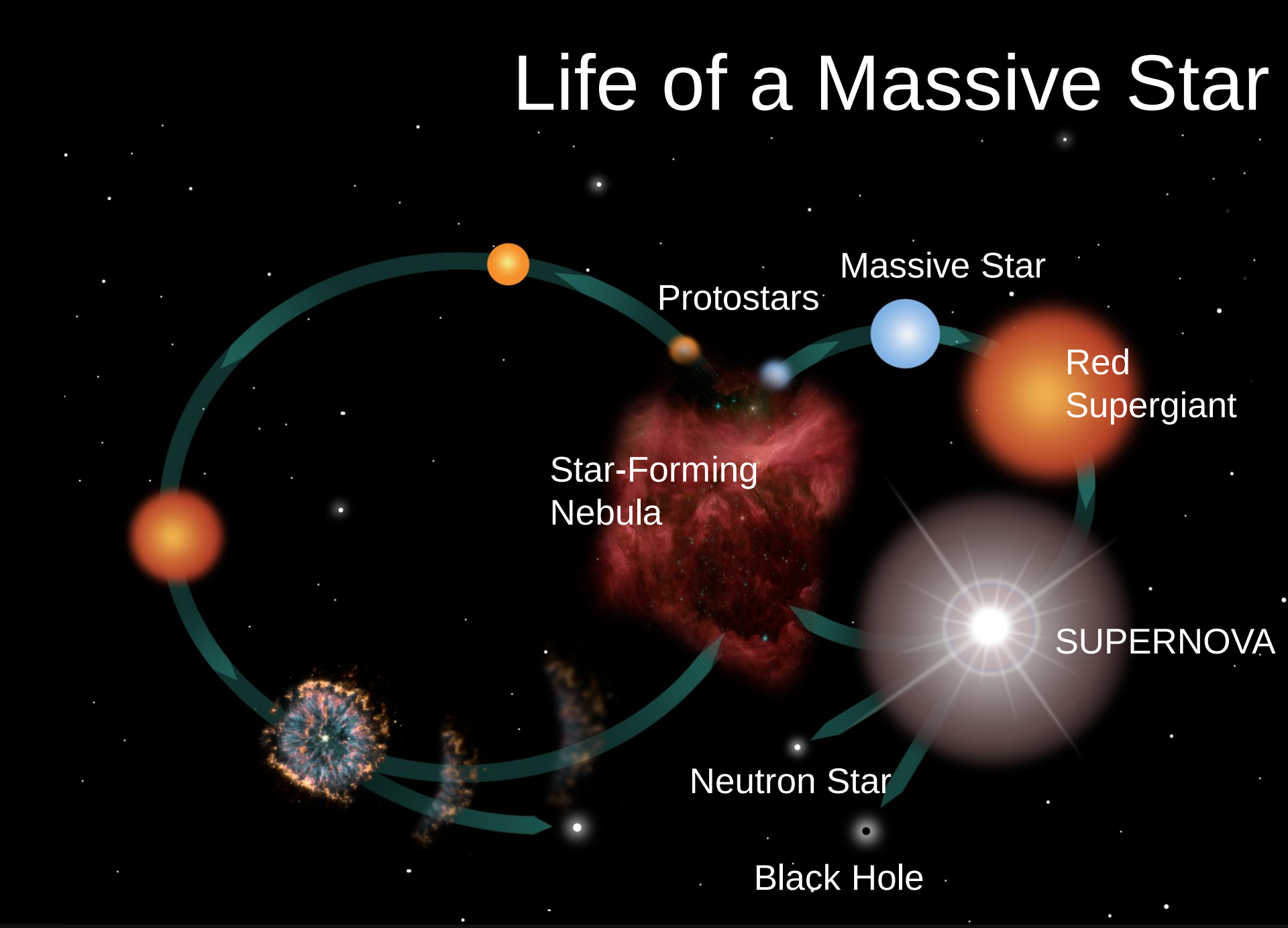
- Type IA – White dwarf experiencing thermal runaway after absorbing material from a companion star
- Type IB – White dwarf experiencing core collapse after absorbing material from a companion star
- Type II – Supermassive star undergoing core collapse


The progenitor of a Type Ia supernova
Two normal stars are in a binary pair.
The more massive star becomes a giant...
...which spills gas onto the secondary star, causing it to expand and become engulfed.
The secondary, lighter star and the core of the giant star spiral toward within a common envelope.
The common envelope is ejected, while the separation between the core and the secondary star decreases.
The remaining core of the giant collapses and becomes a white dwarf.
The aging companion star starts swelling, spilling gas onto the white dwarf.
The white dwarf's mass increases until it reaches a critical mass and explodes...
...causing the companion star to be ejected away.

Life of a Sun-like Star



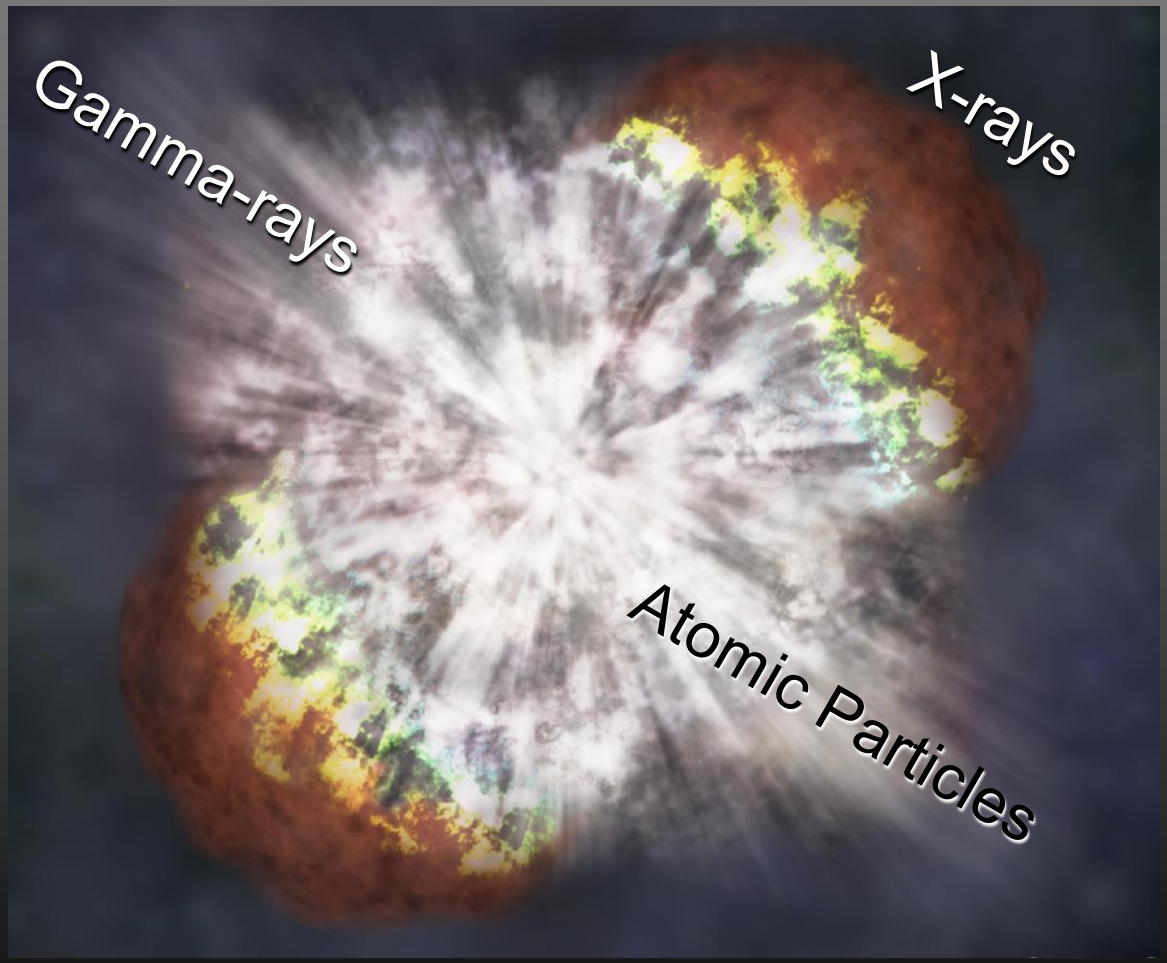
Life of a Massive Star



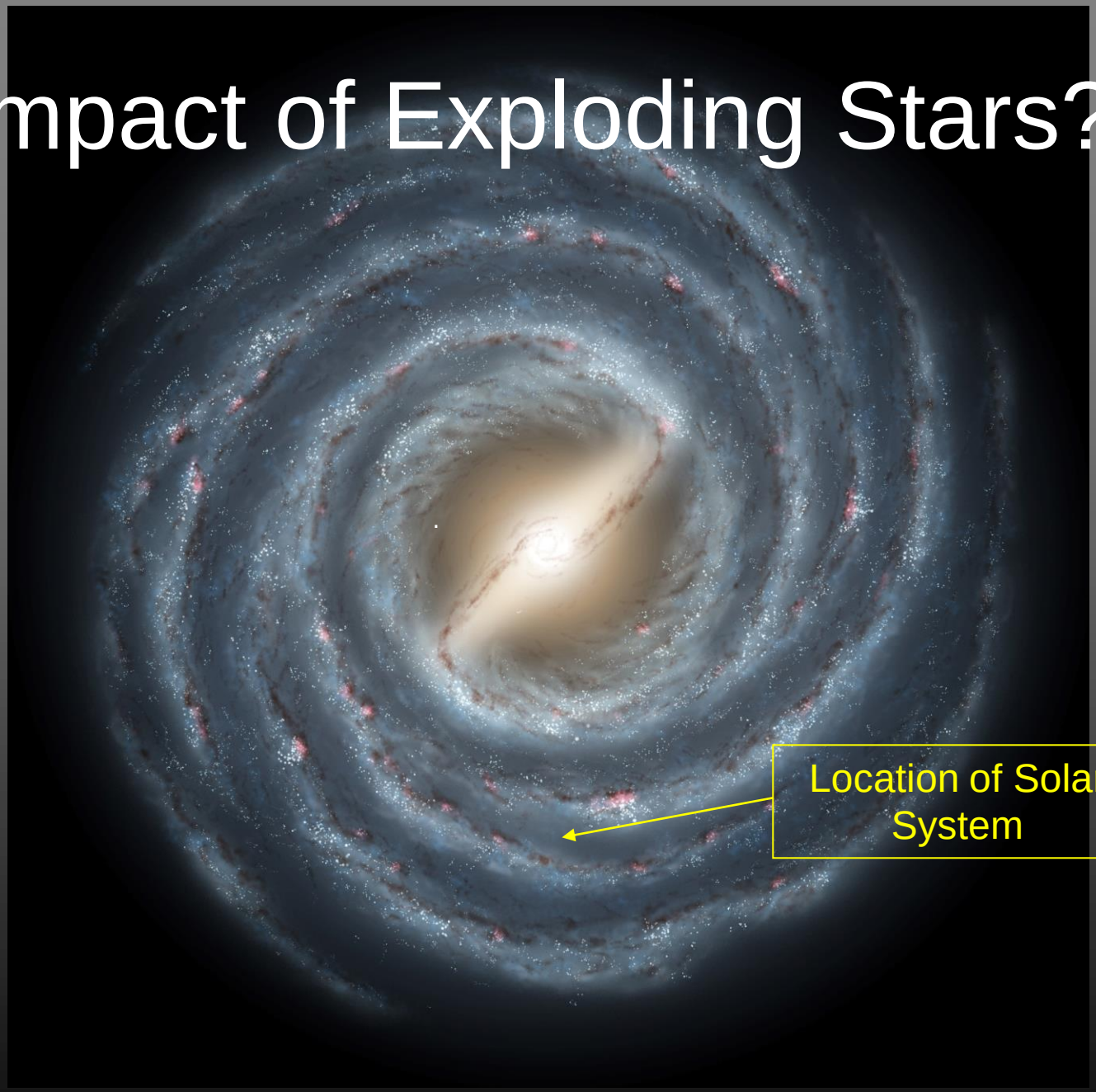
Is radiation from supernovae and GRB sources dangerous to Earth?

How close would they have to be?

Radiation from exploding stars



Impact of Exploding Stars?!



Artist's Conception of the Milky Way Galaxy

How close would a Supernova have to be dangerous?

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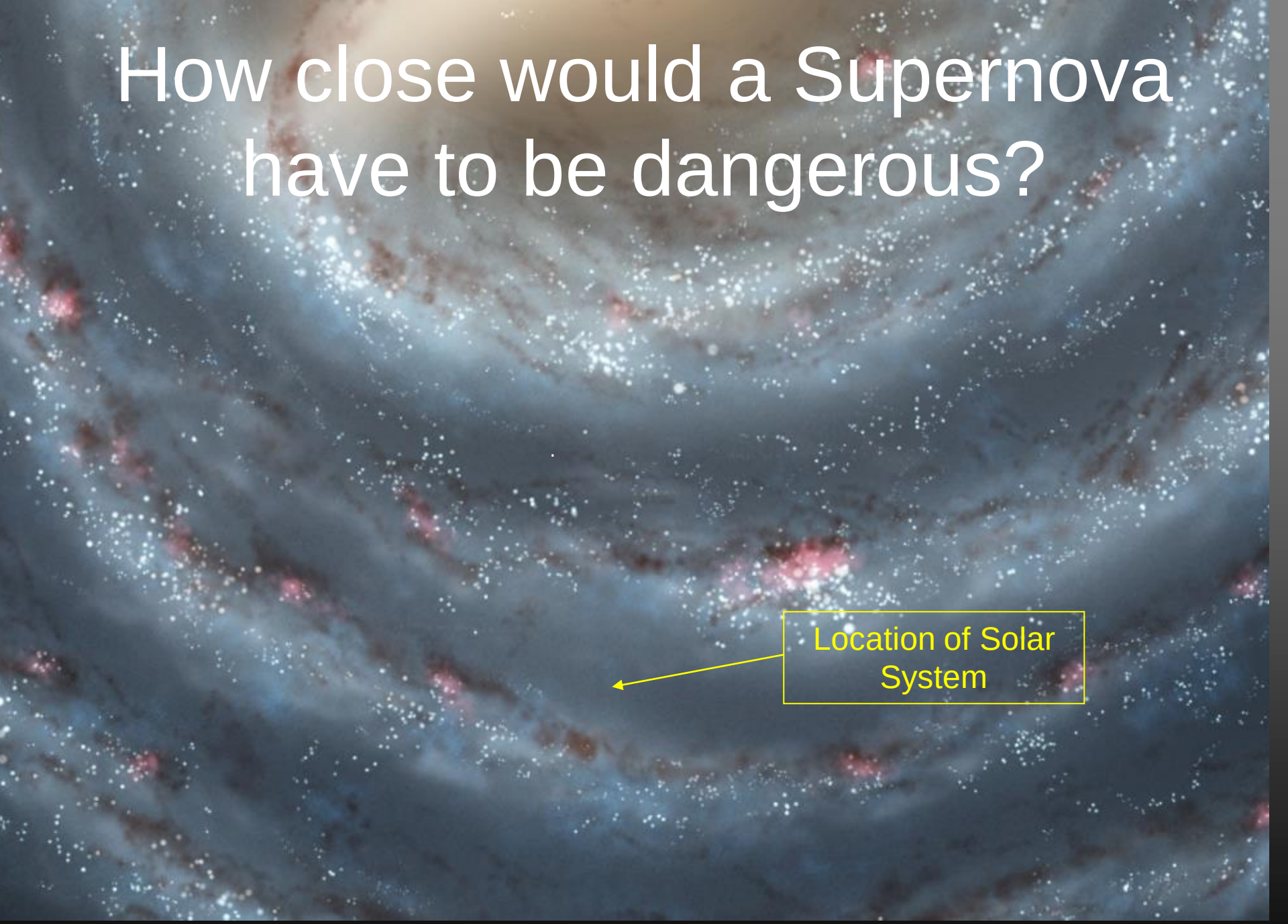

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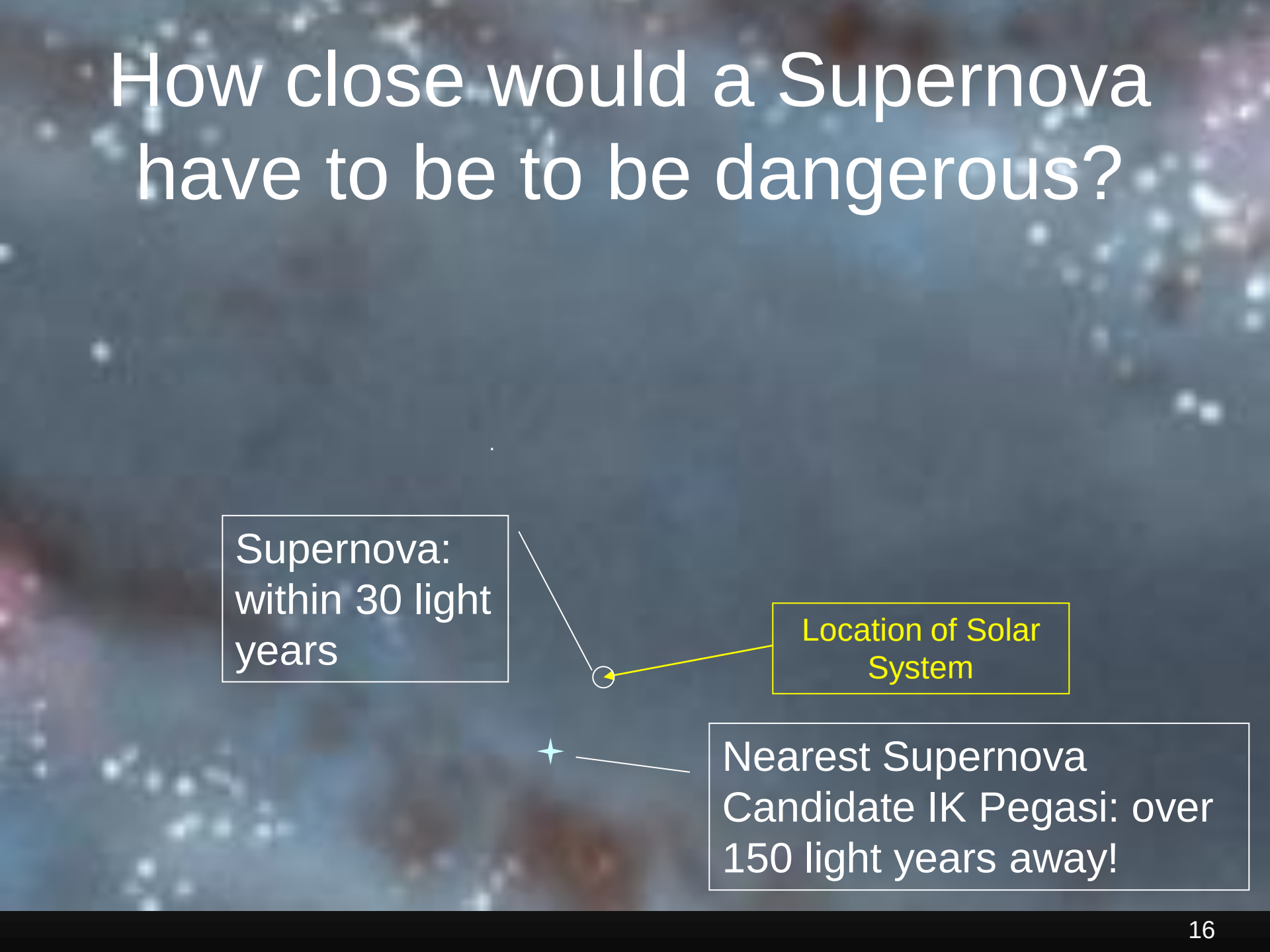
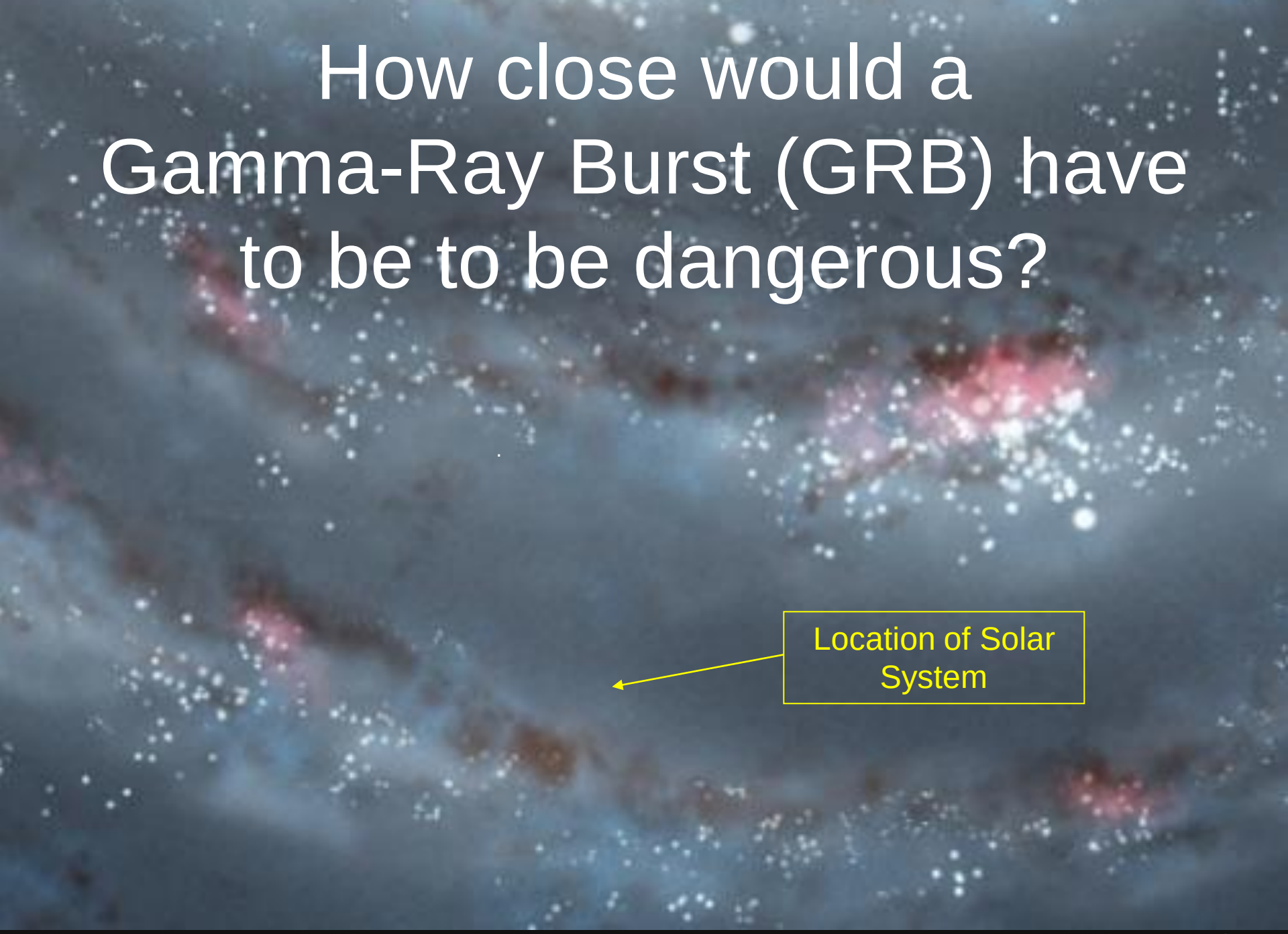


Gamma-Ray Burst (GRB)!

Formed from the collapse of a supernova into a black hole

How close would a Gamma-Ray Burst (GRB) have to be to be dangerous?



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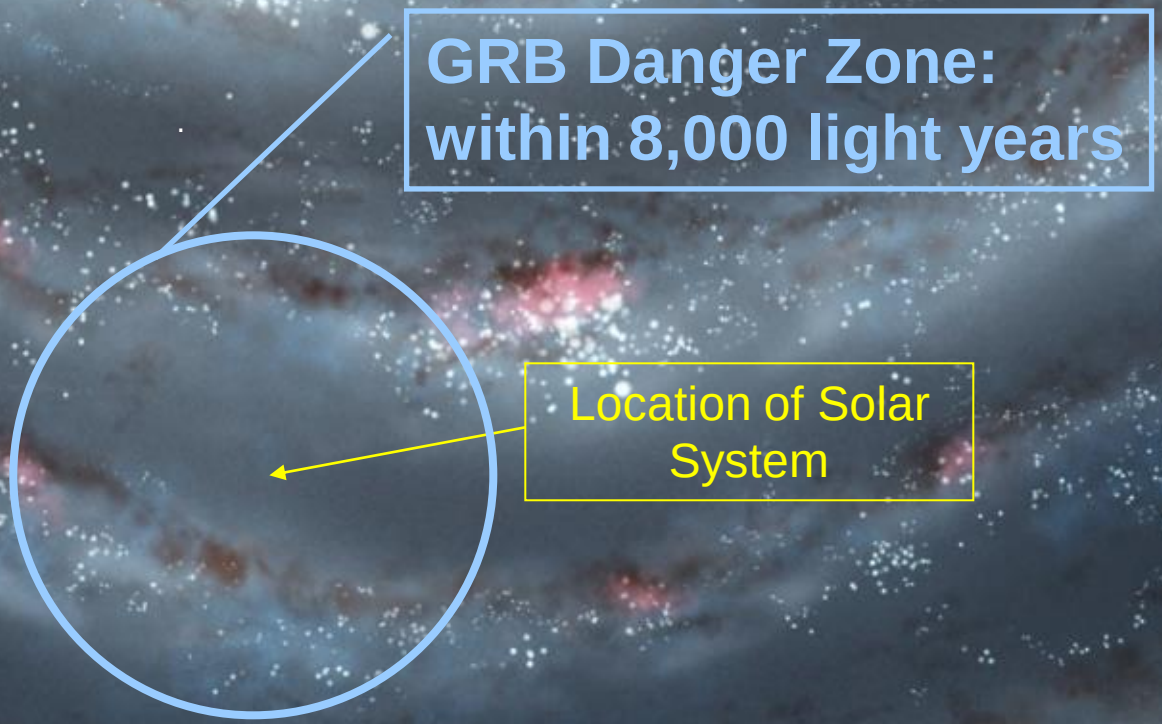
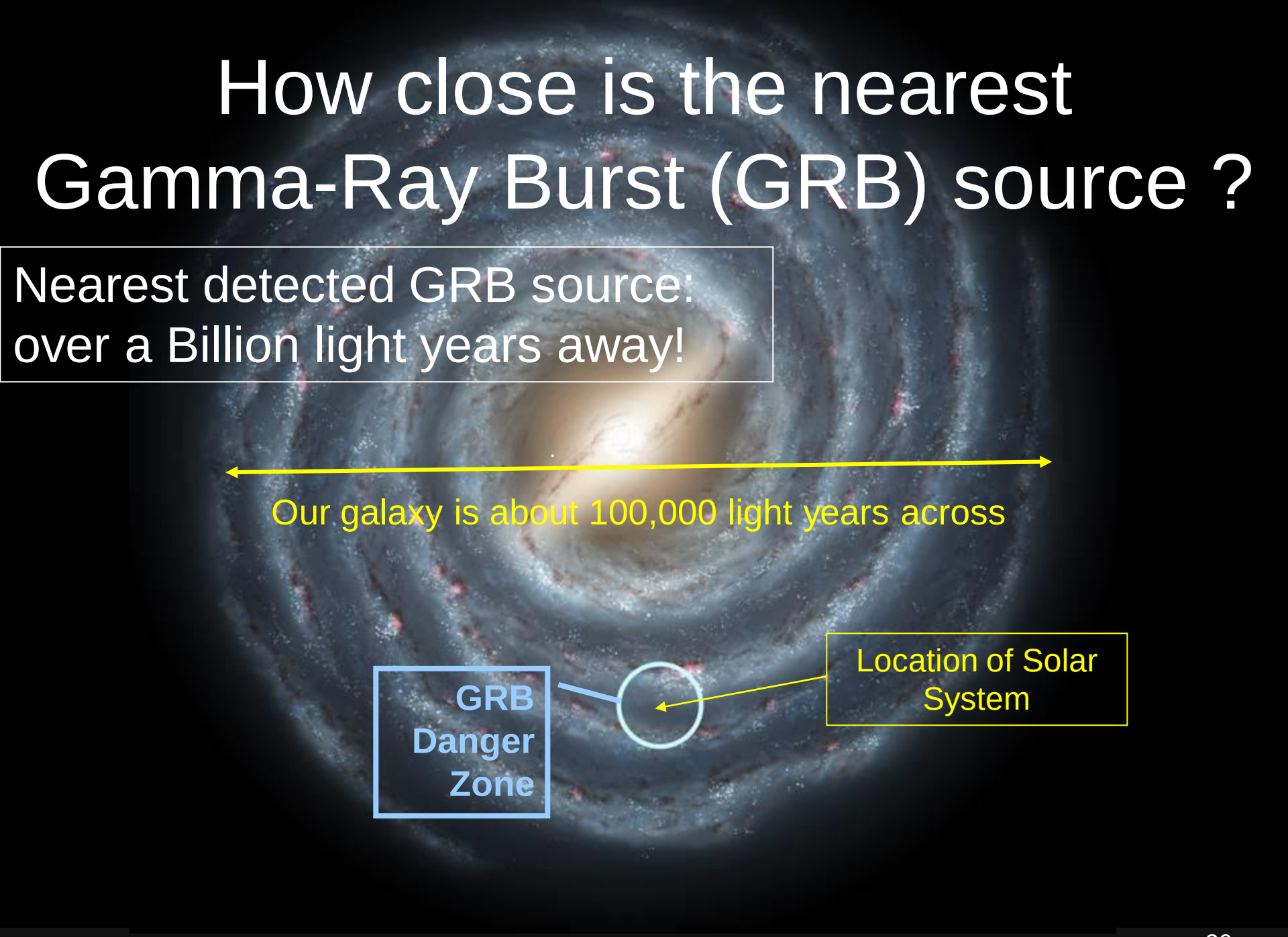
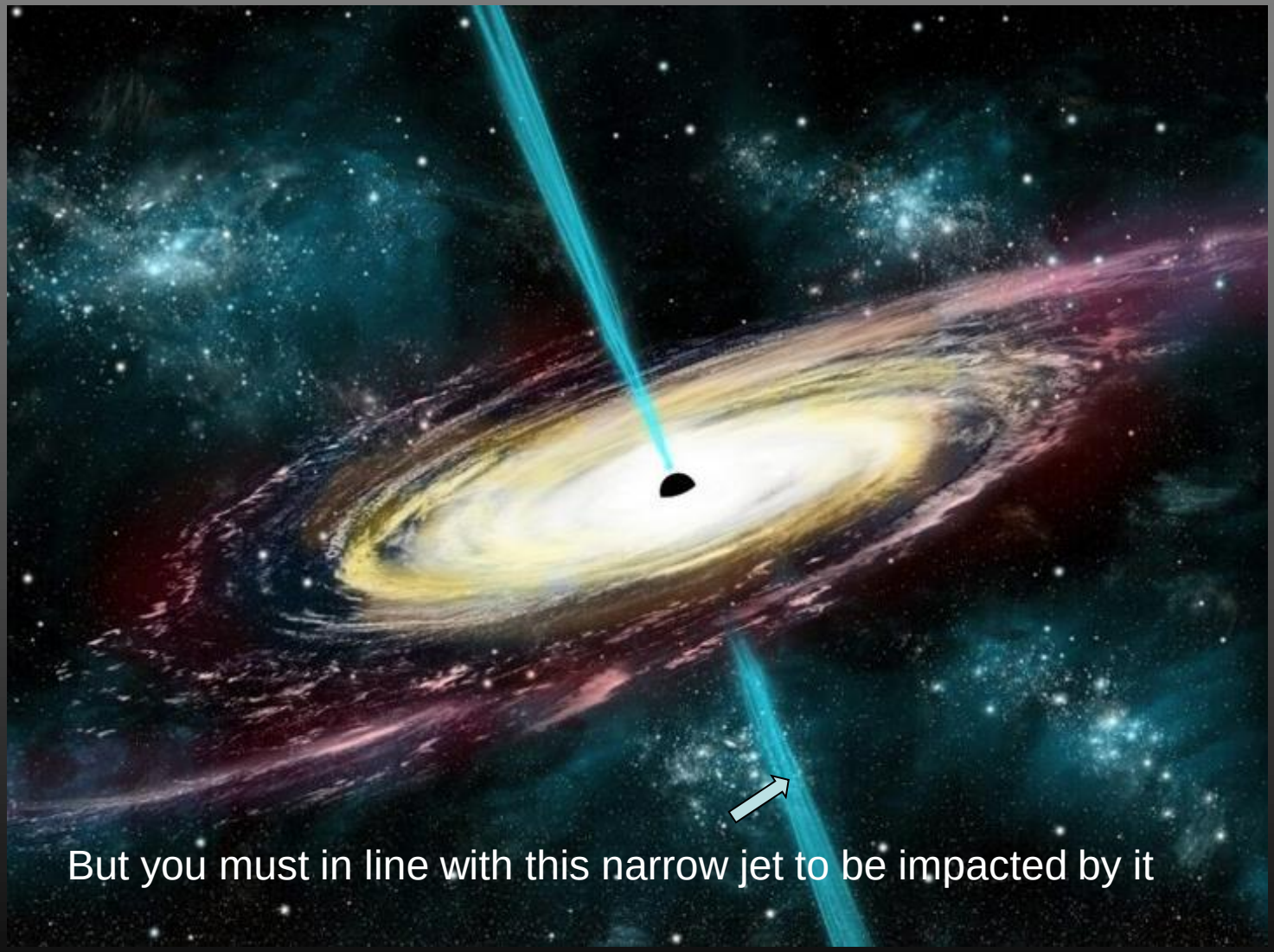


How close is the nearest Gamma-Ray Burst (GRB) source ?

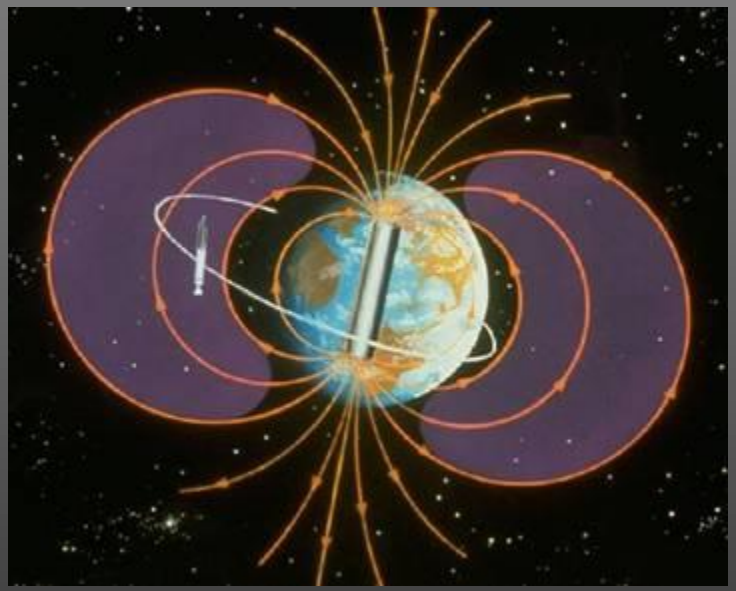
Nearest detected GRB source:
over a Billion light years away!



There may be some closer



Earth's Atmosphere & Magnetic Field

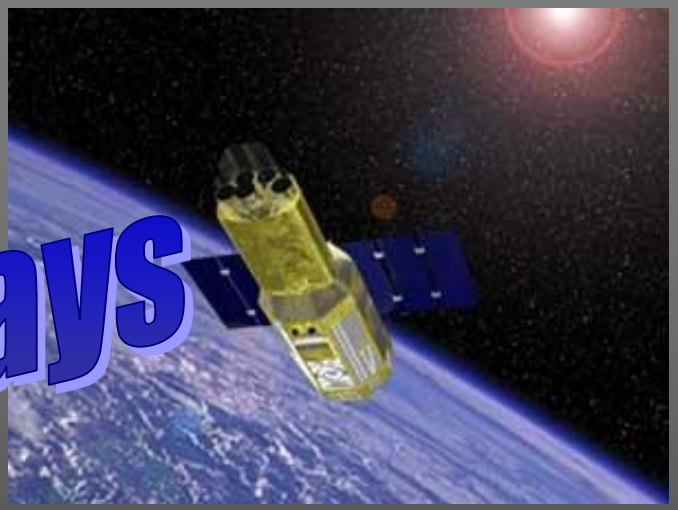


Protect Earth from most high-energy radiation . . .

But prevent us from detecting it here on Earth

The high view: getting a better look

XMM-Newton

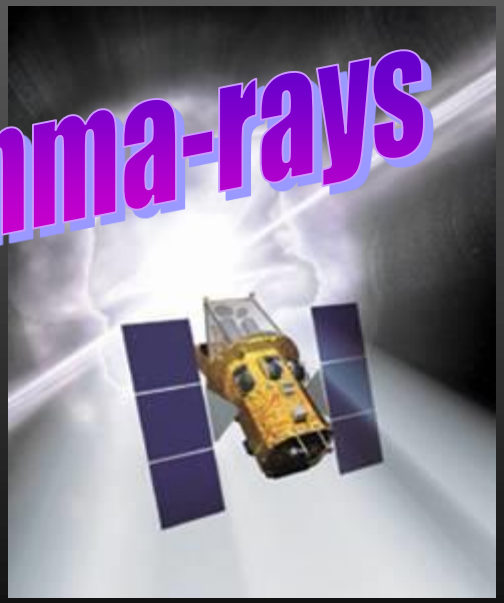


Suzaku

X-rays

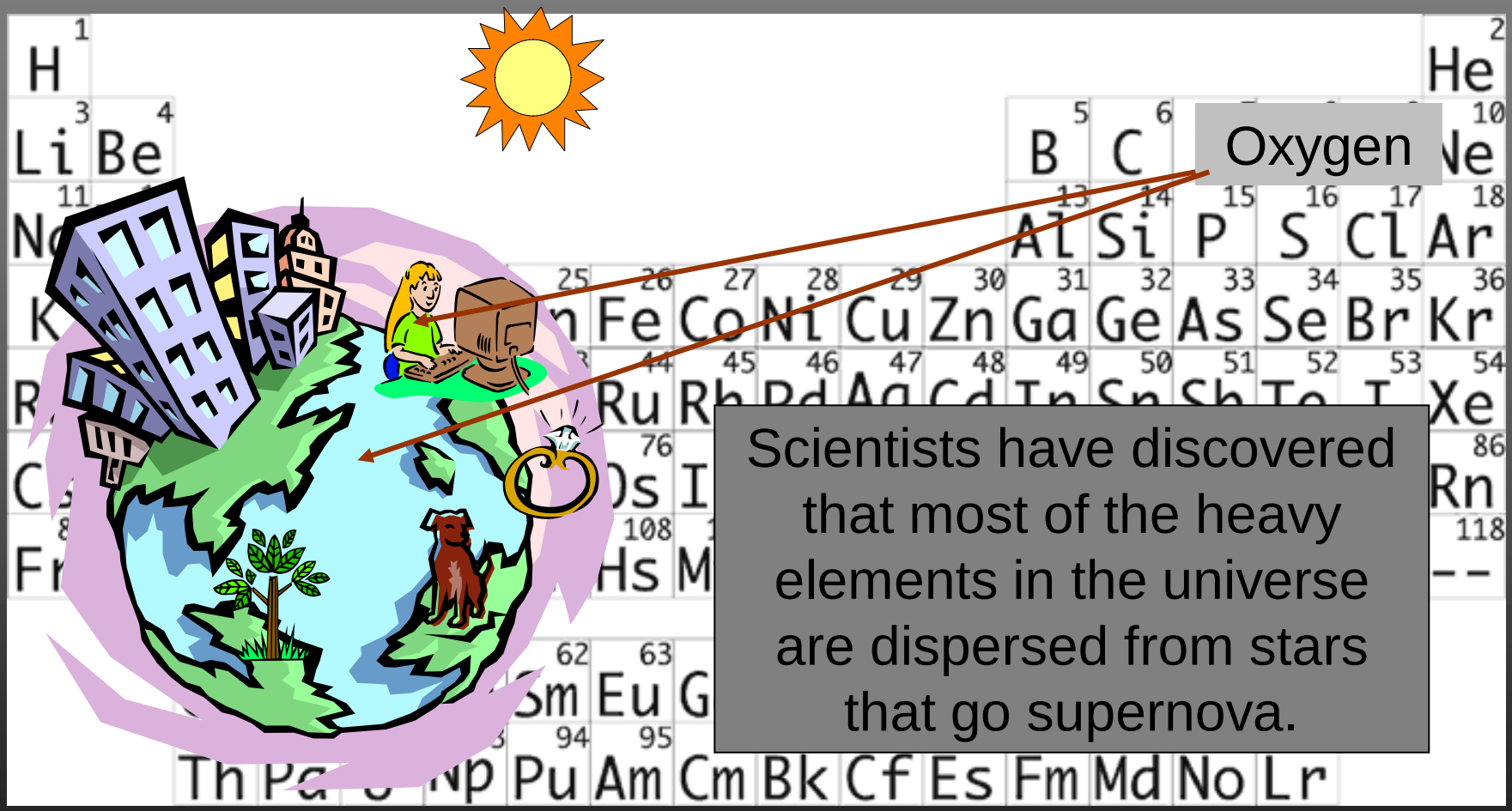
GLAST

Gamma-rays



Swift

Life from Exploding Stars!



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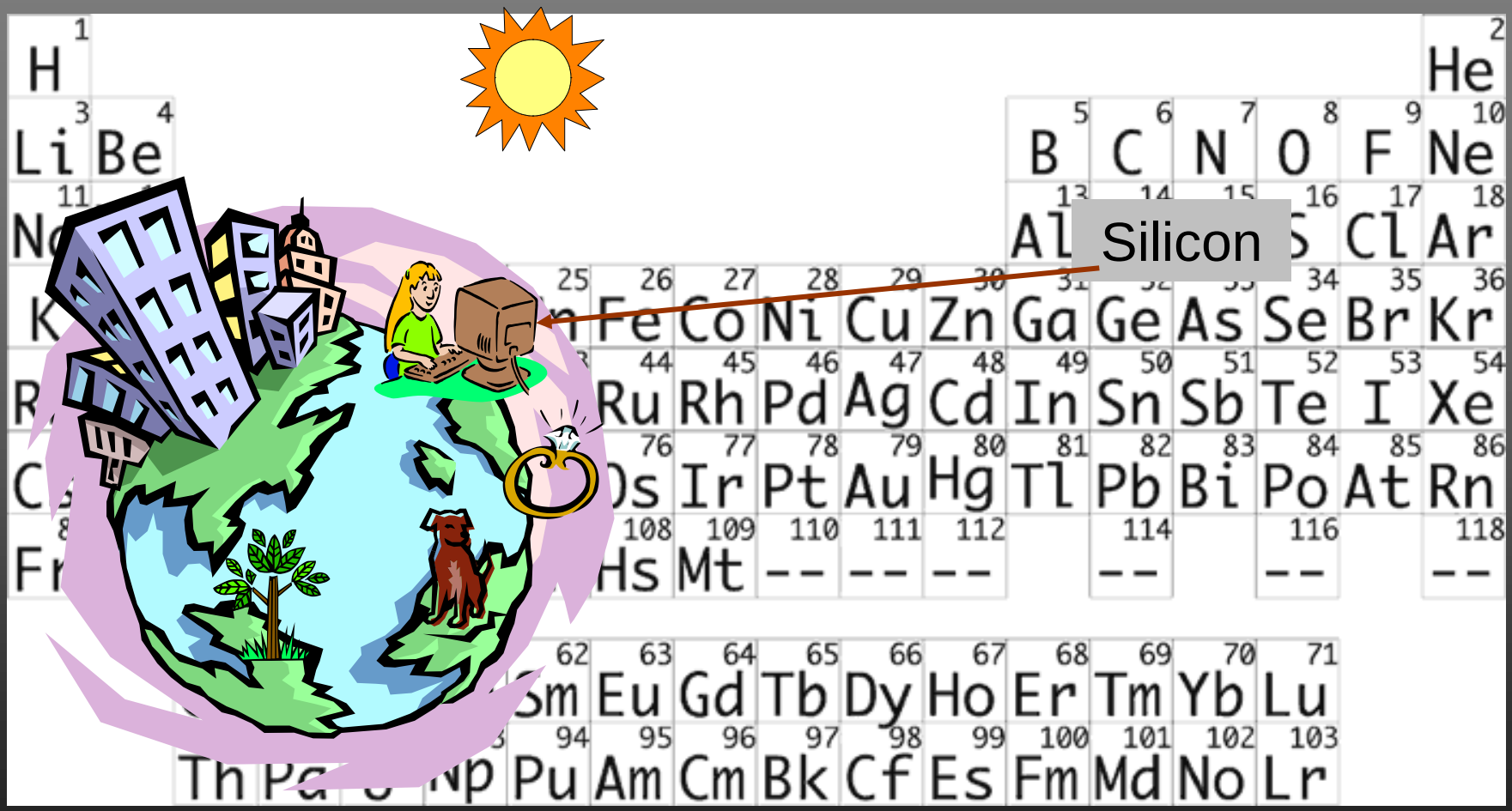

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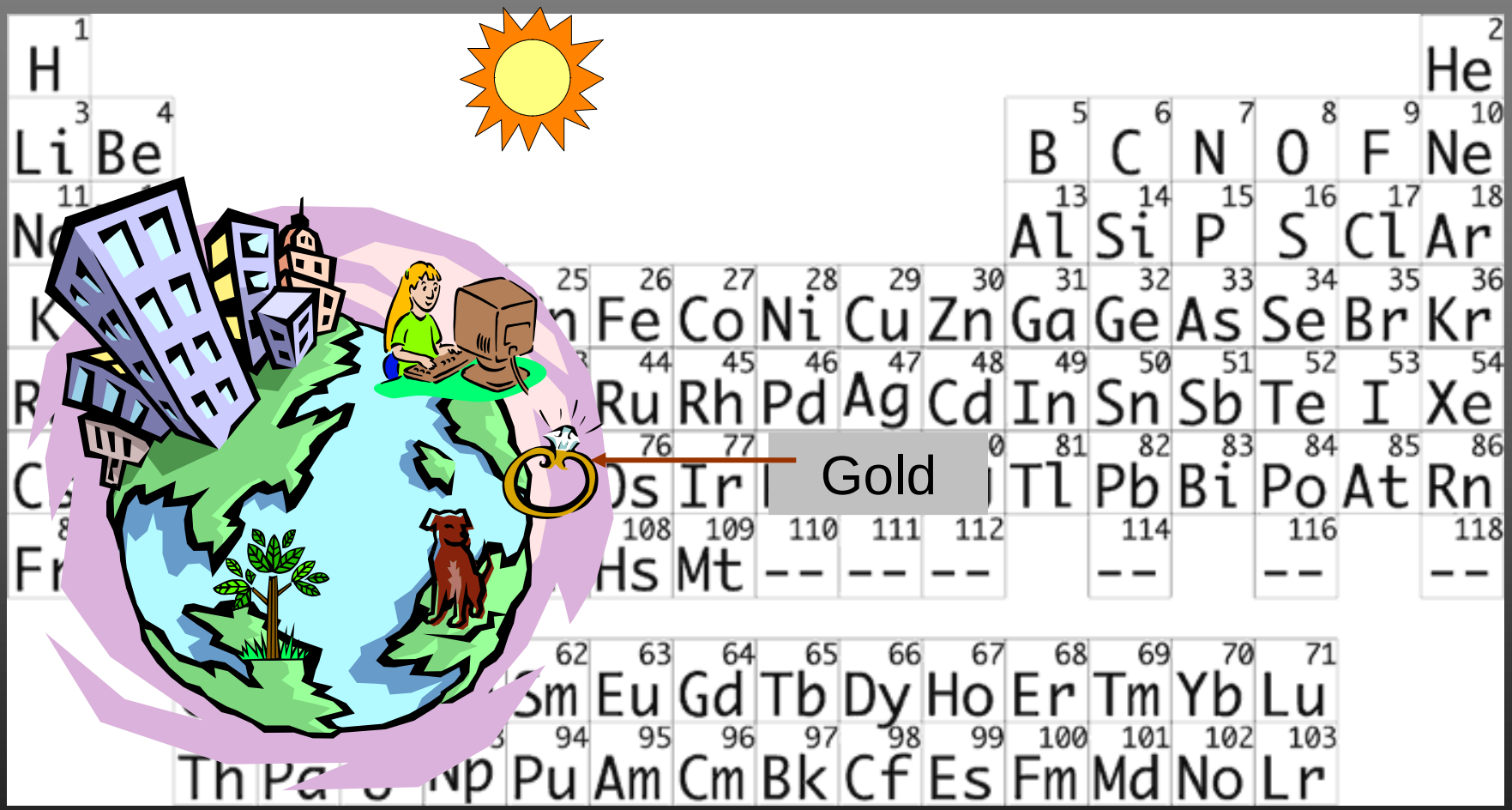

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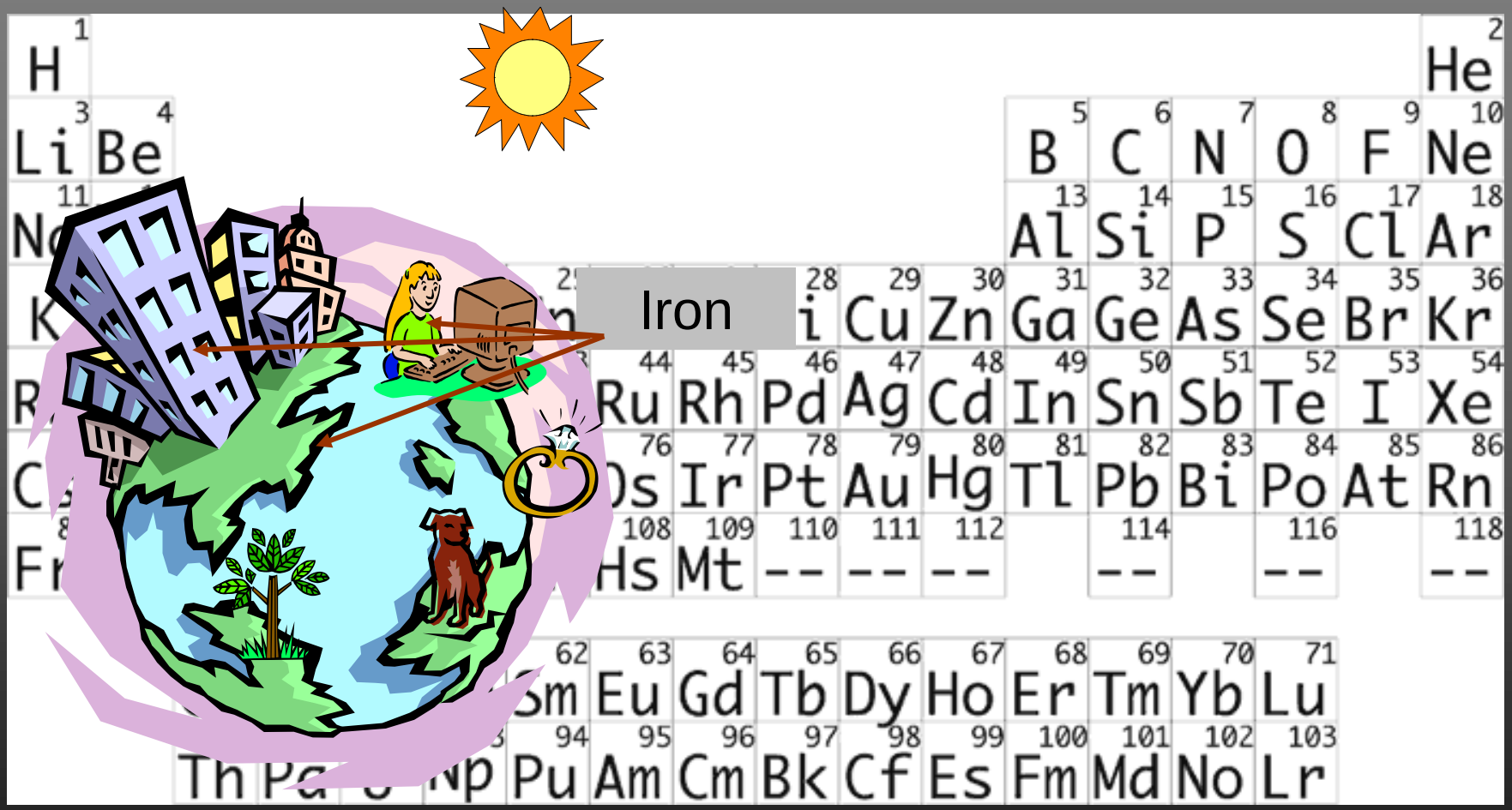

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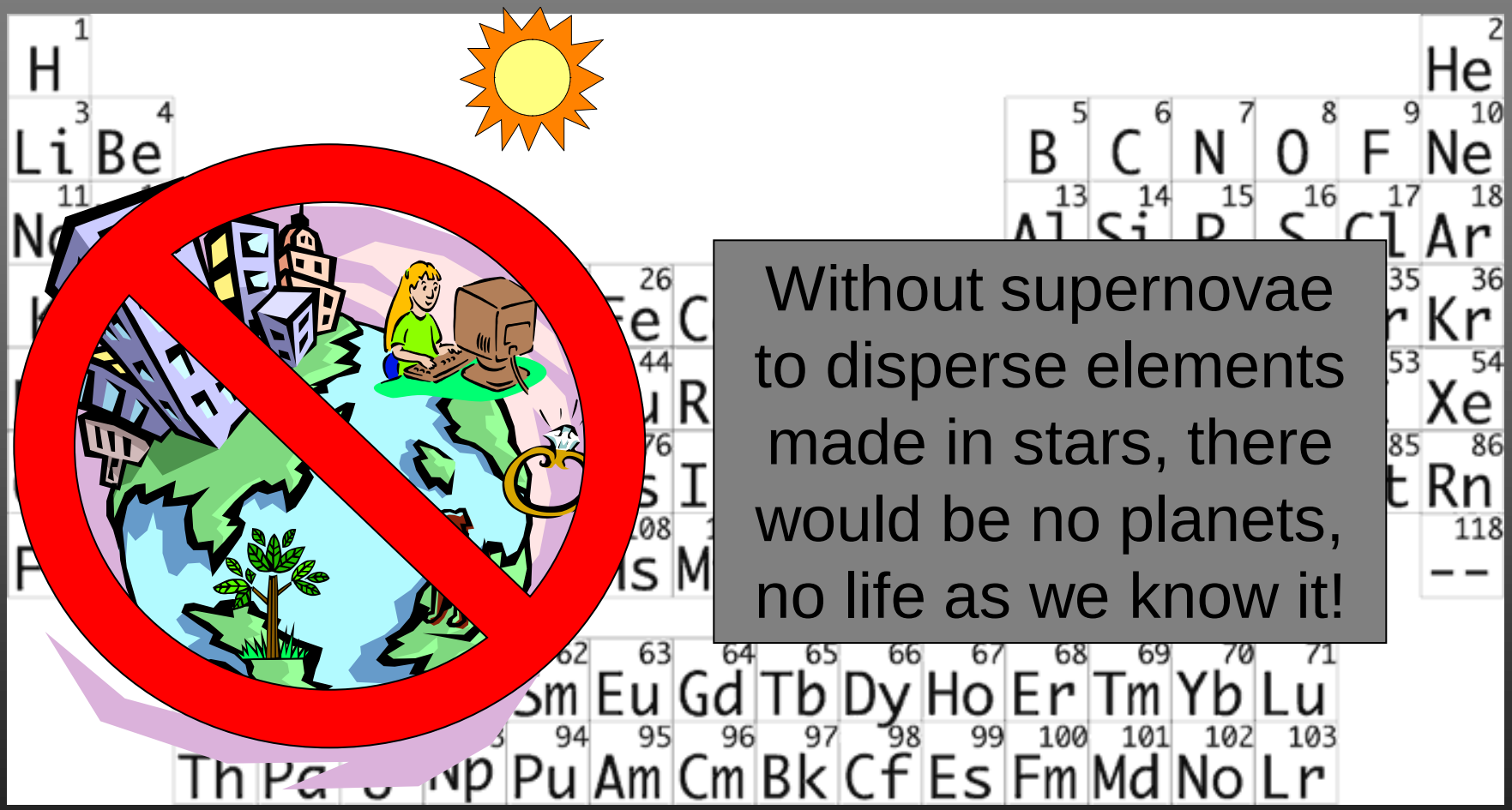
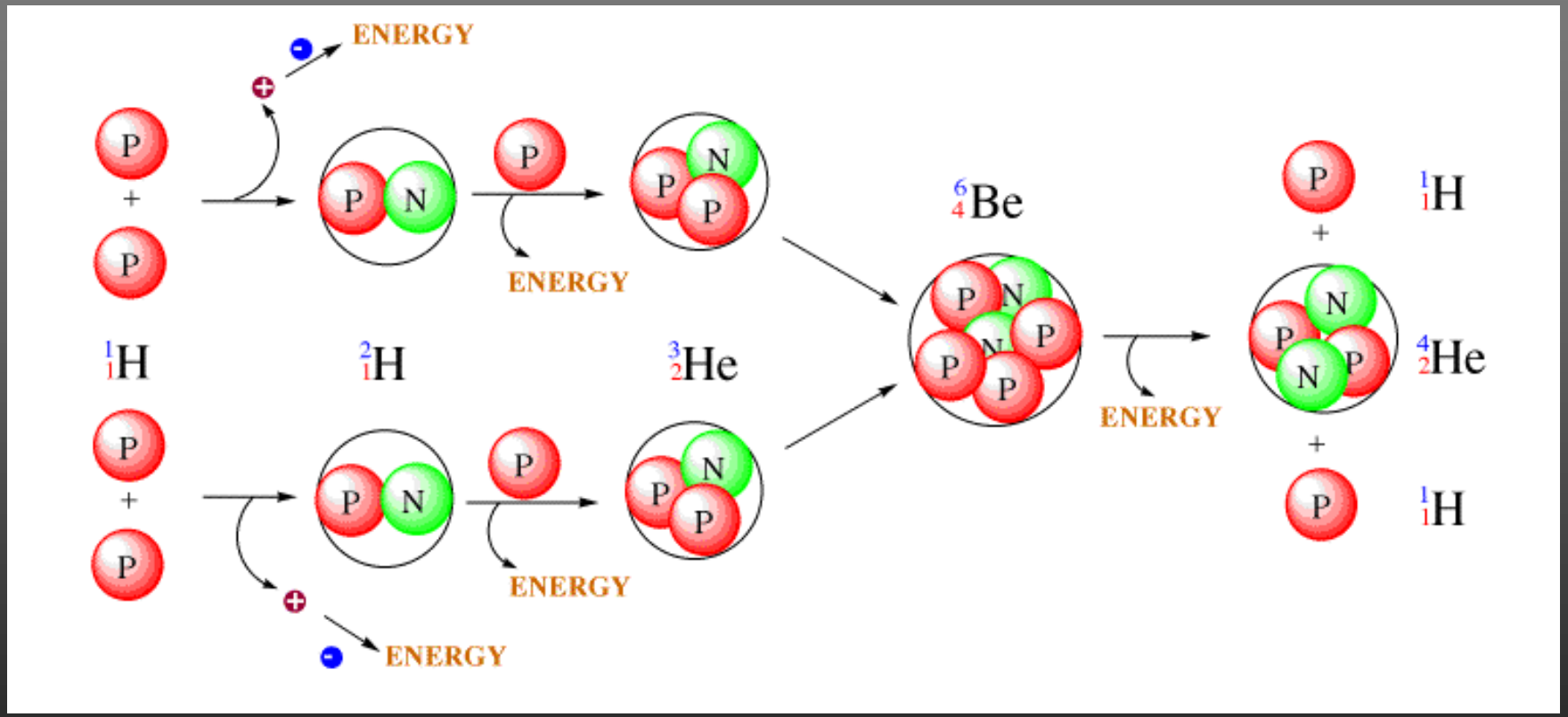
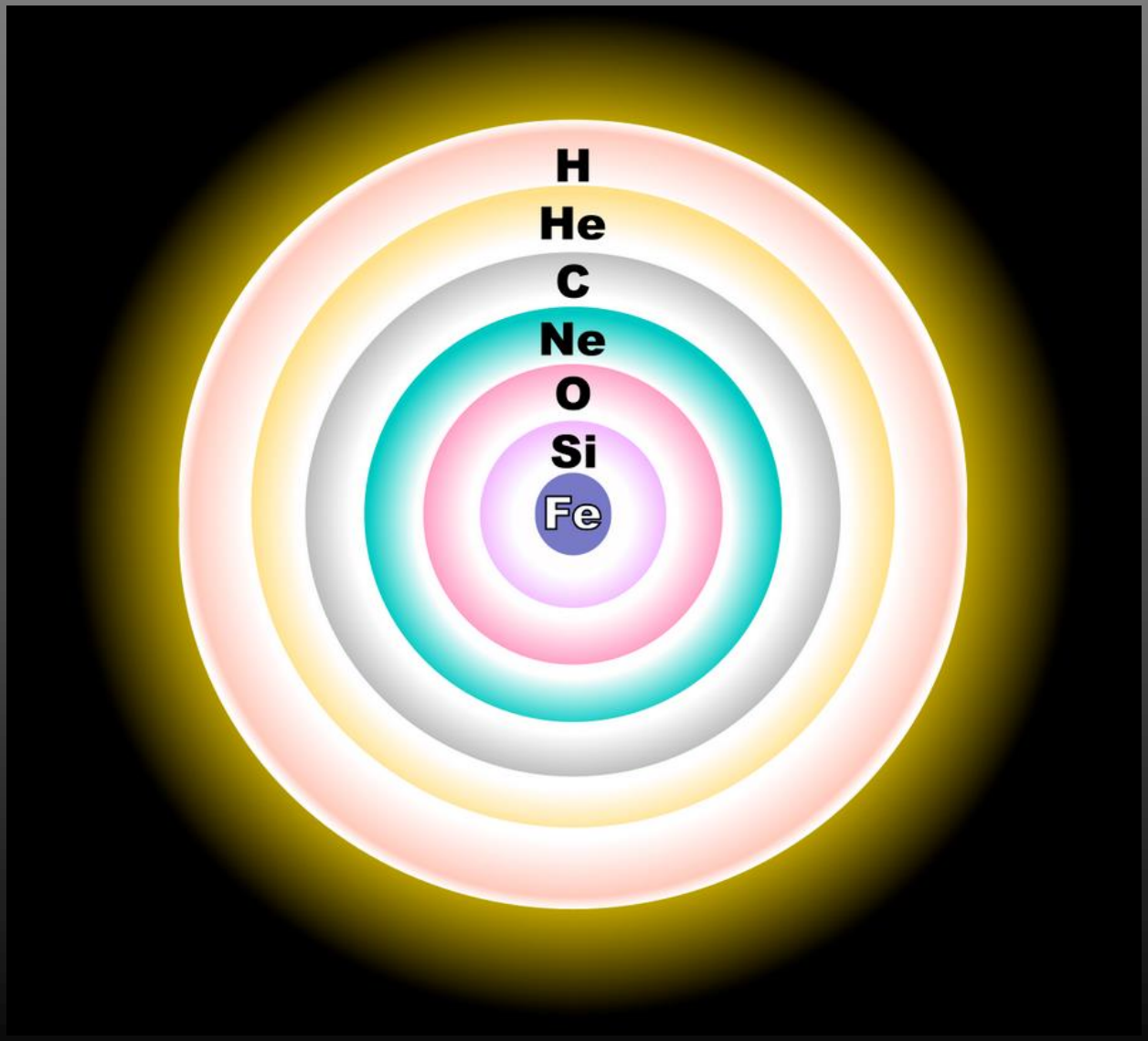


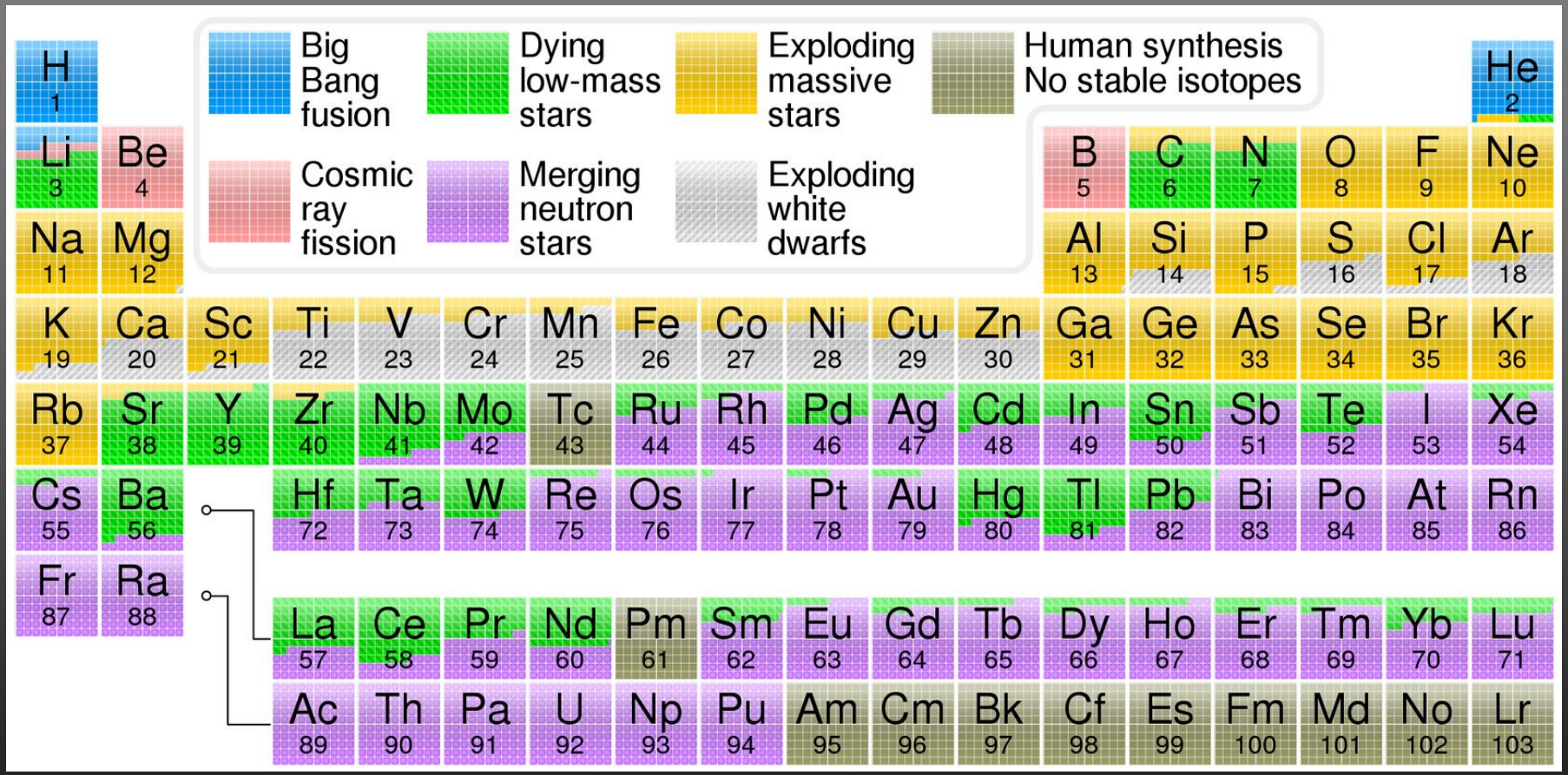
How are elements produced?



Fusion Sequence within Stars



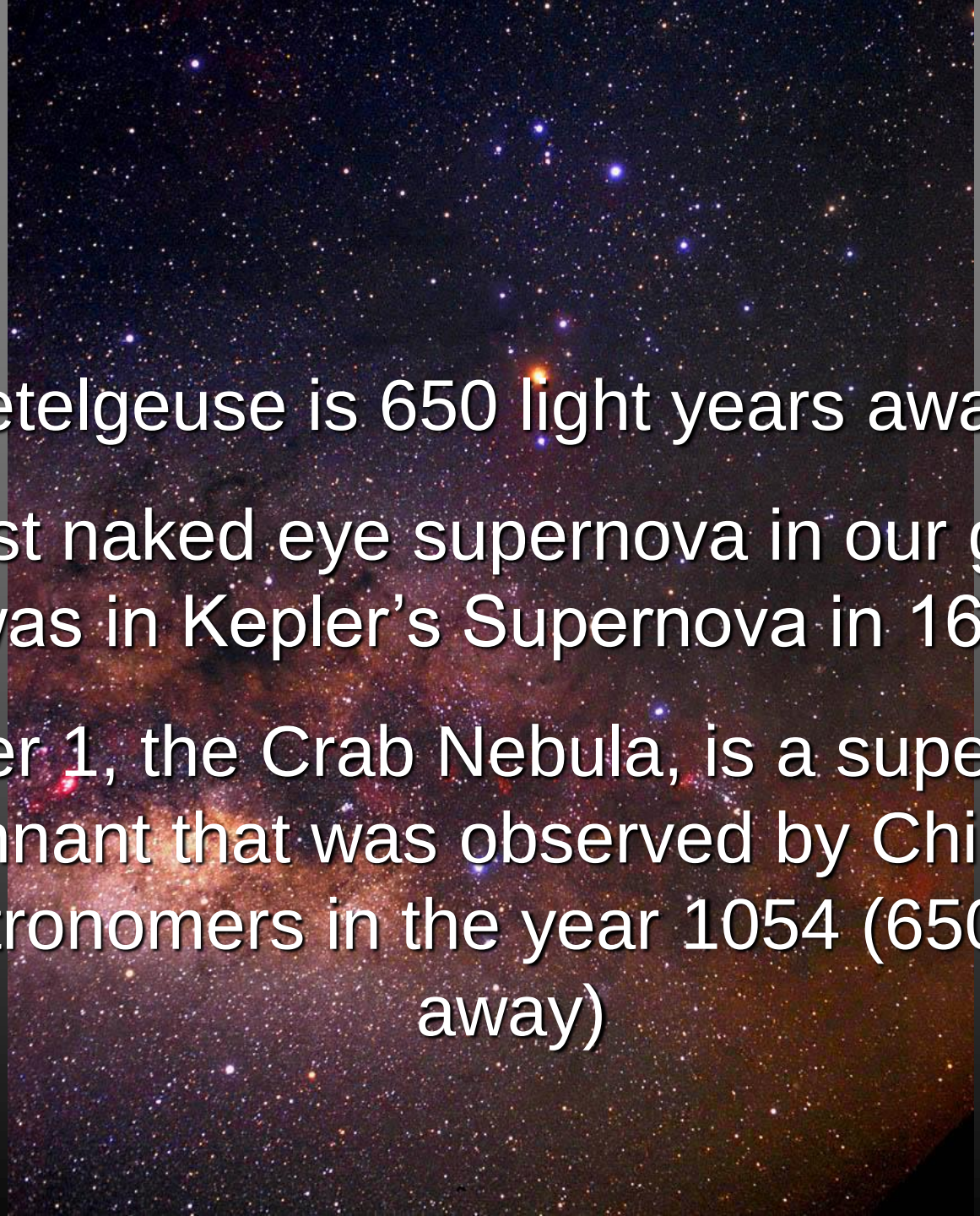
Formation of the Elements



So aren’t you glad we live in a universe where stars explode?

Which stars?

Orion’s stars likely to go supernova!



Betelgeuse is 650 light years away

The last naked eye supernova in our galaxy was in Kepler's Supernova in 1604

Messier 1, the Crab Nebula, is a supernova remnant that was observed by Chinese astronomers in the year 1054 (6500 ly away)