The Charlie Bates Solar Astronomy Project

presents

Our Sun

presented by
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Executive Director
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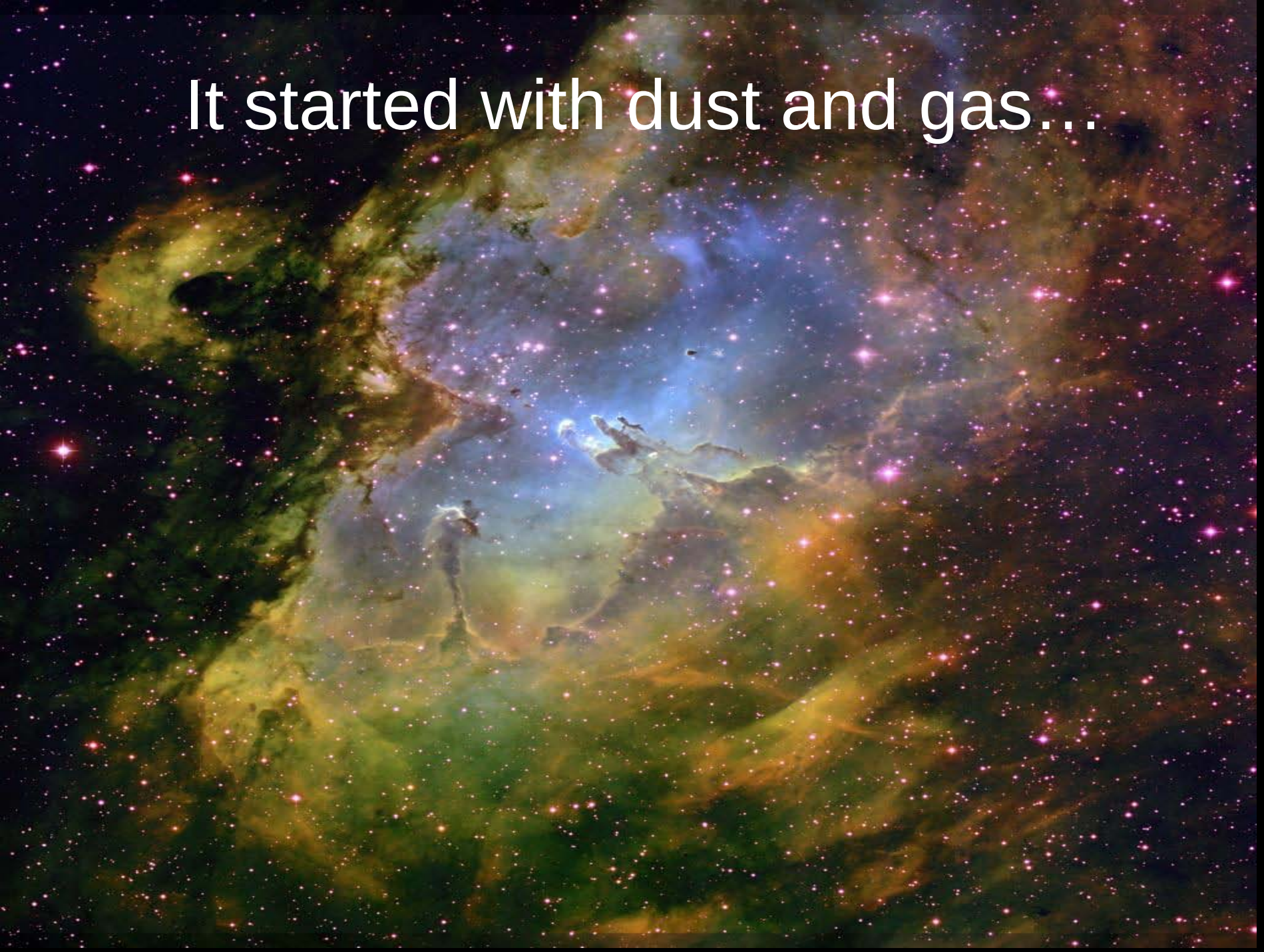
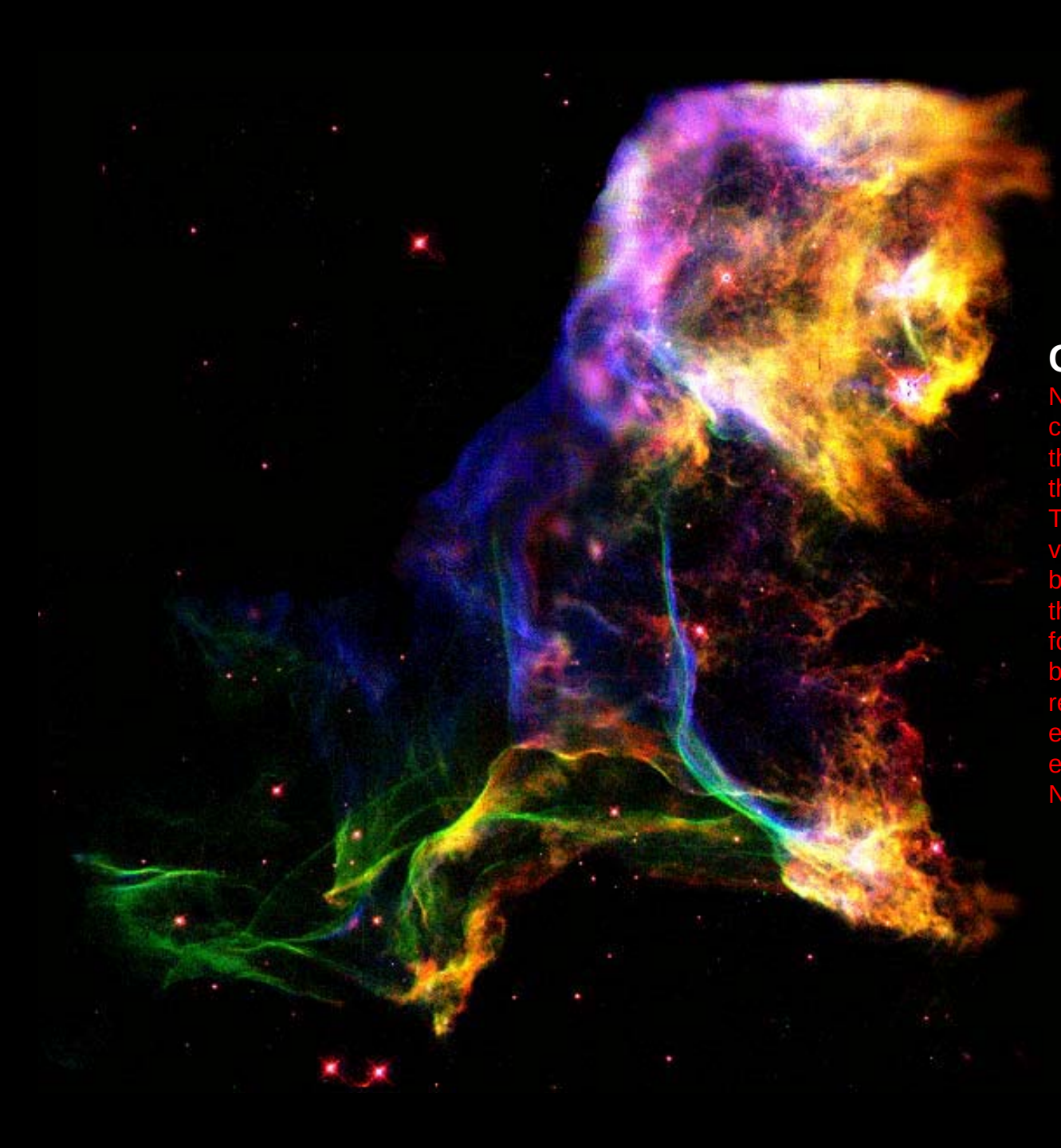
www.charliebates.org

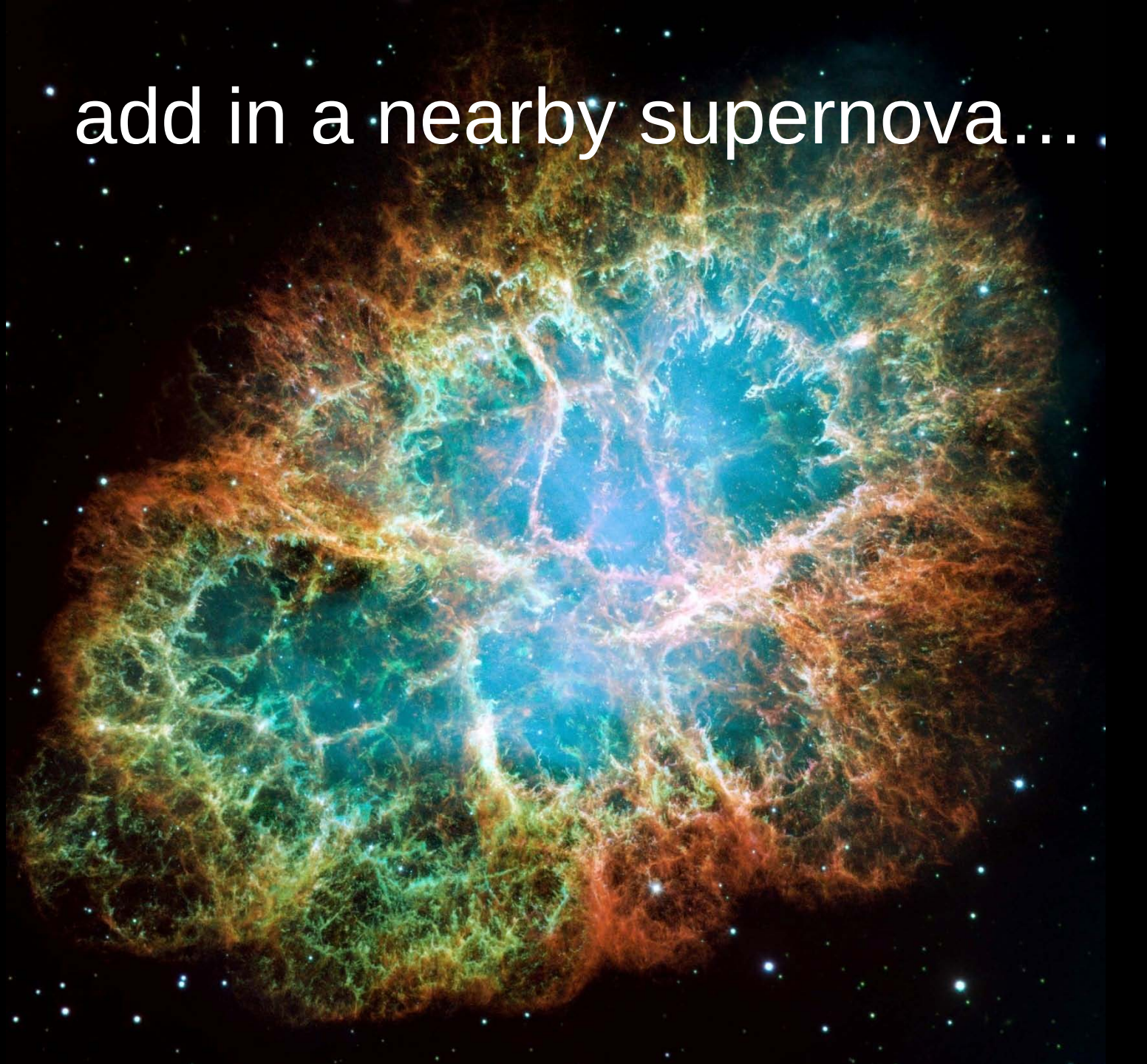

It started with dust and gas…



Cygnus Loop

Nebula means “cloud”. Nebulas can be 100,000 times less dense than cigarette smoke or so dense that lioght cannot penetrate them. These clouds float around in the vacumn of space for millions or billions of years sometimes before they are disturbed by an outside force. Then the creation process begins. Most nebula are remnants of previous steller explosions so they contain heavier elements like Carbon, Oxygen, Nitrogen etc…

add in a nearby supernova…



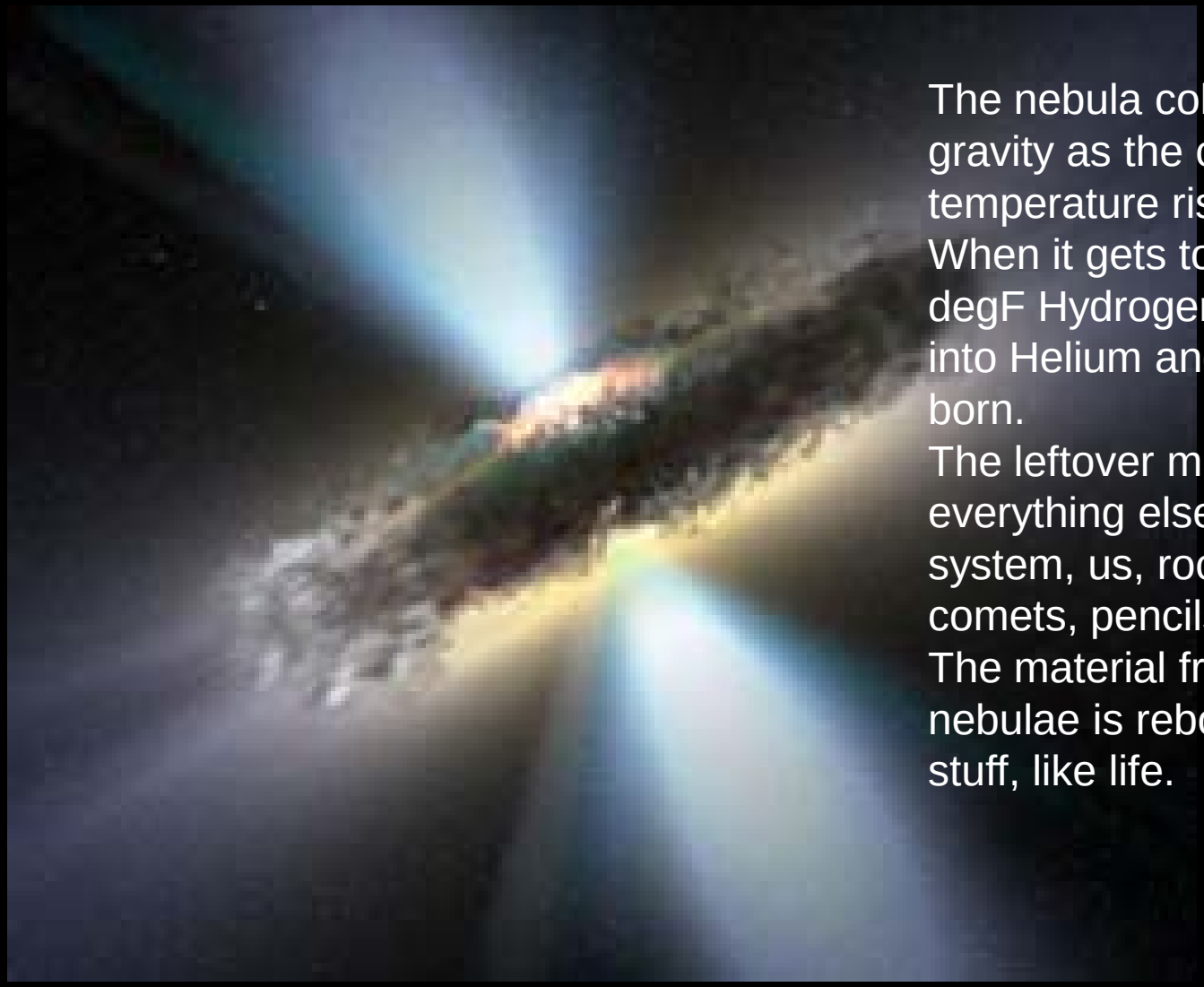
…or a passing star or shockwave

Gravitational collapse of dust and gas clouds

"Pillars" of dense, cold dust and gas, in which new stars are forming.

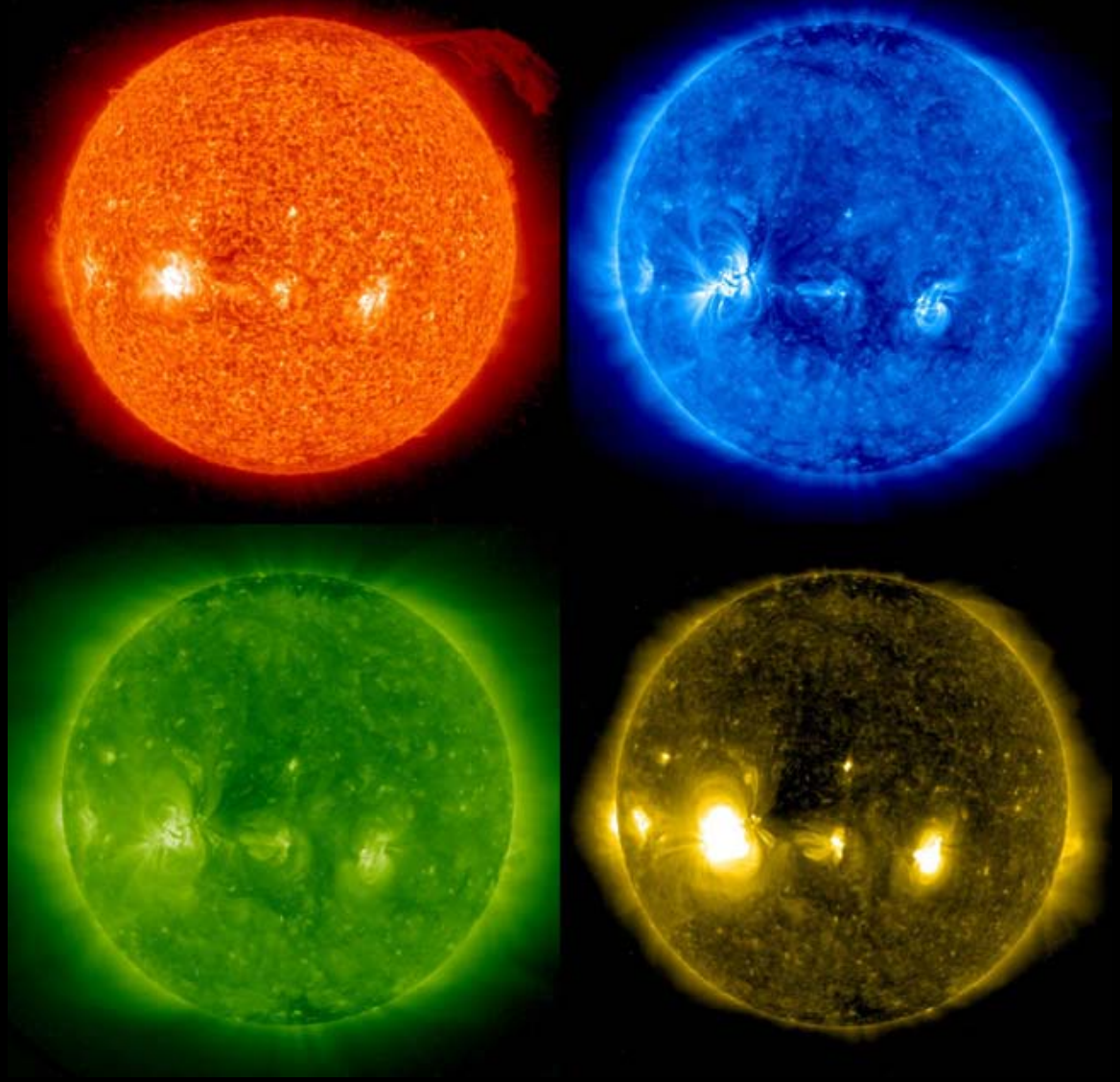
M42 (Orion Nebula)

Collapsing protostars forming in the interior of the Orion Nebula.



The nebula collapses due to gravity as the core temperature rises.
When it gets to around 25M degF Hydrogen starts to fuse into Helium and the Star is born.
The leftover materials make everything else in the solar system, us, rocks, planets, comets, pencils, steel, etc..
The material from the nebulae is reborn into new stuff, like life.

What exactly is the Sun?



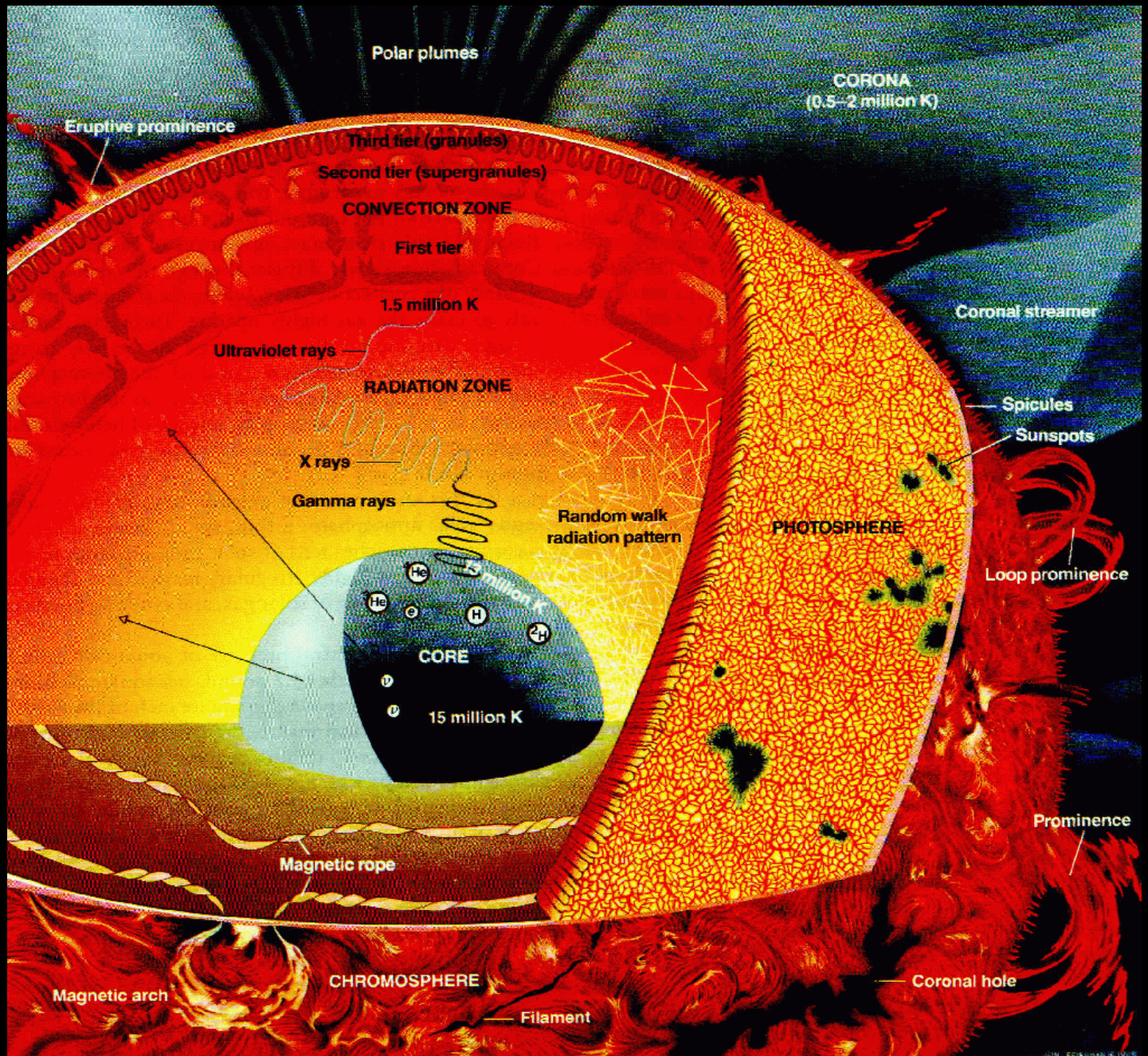
75% Hydrogen

24% Helium

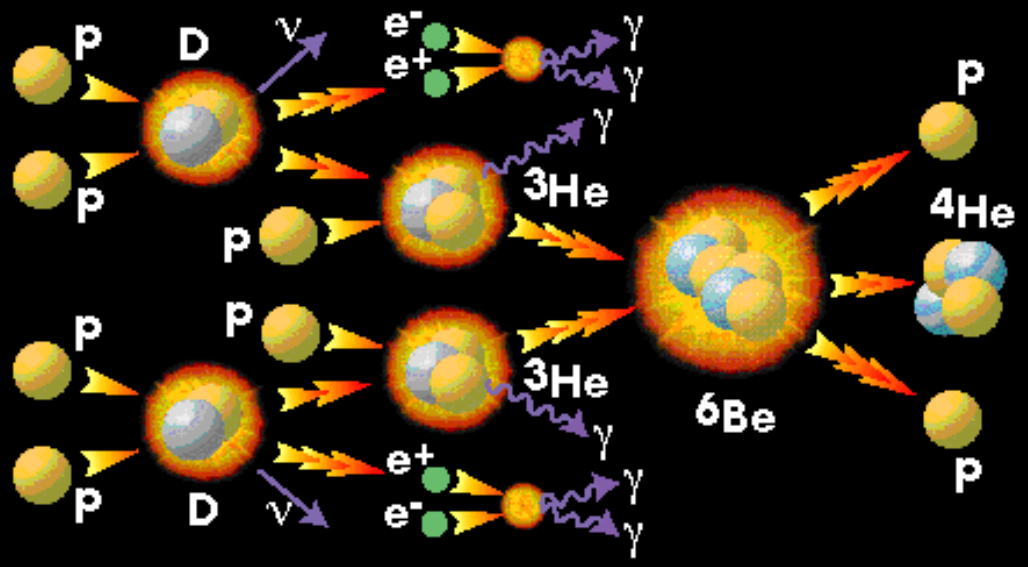
<1% heavier elements

Element	Abundance (percentage of total number of atoms)	Abundance (percentage of total mass)
Hydrogen	91.2	75.0
Helium	8.7	24.1
Oxygen	0.078	0.97
Carbon	0.043	0.40
Nitrogen	0.0088	0.096
Silicon	0.0045	0.099
Magnesium	0.0038	0.076
Neon	0.0035	0.058
Iron	0.0030	0.14
Sulfur	0.0015	0.040

Inside the Sun



Solar Fusion



H nucleus (p) made of one proton

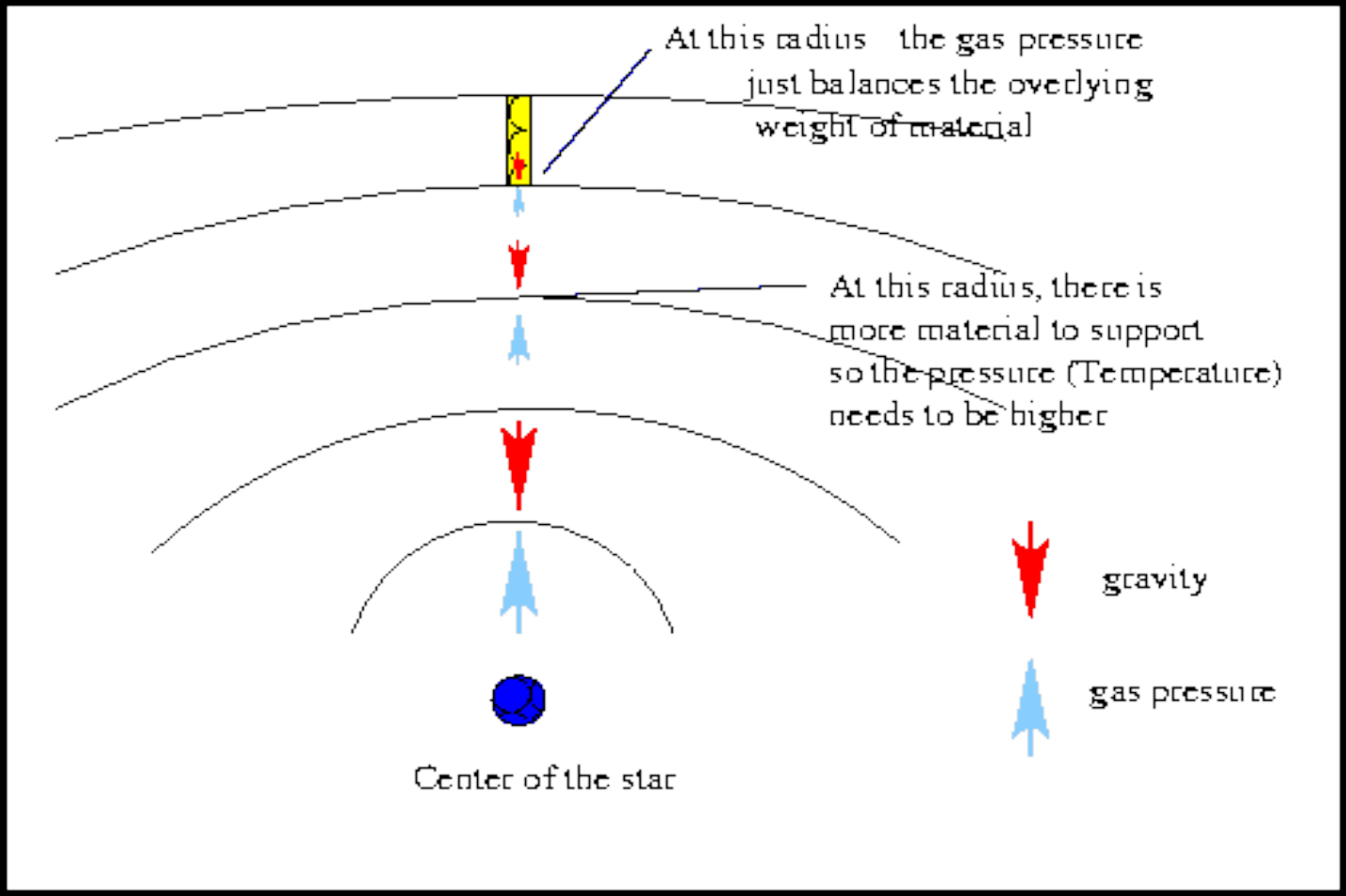
$$4\ {}^{1}H + 2\ e \rightarrow {}^{4}He + 2 \text{ neutrinos} + 6 \text{ photons}$$

^{4}He nucleus (ppnn) made of two protons and two neutrons (called alpha particles)

$$E = mc^2$$

The Sun puts out enough energy EVERY second of EVERY day
to power all mankind's current energy needs for over 1 million years

The Sun is almost a perfect sphere because of the mechanical balance between gravity causing collapse and gas pressure causing expansion.



685 million tons of hydrogen is converted to helium each second.

E=mc2

The Suns Energy each second = 685,000,000 x .00001 x 186,000m/sec x 186,000m/sec

or

3.8×10^{26} Watts/sec

380,000,000,000,000,000,000,000,000

Watts per Second

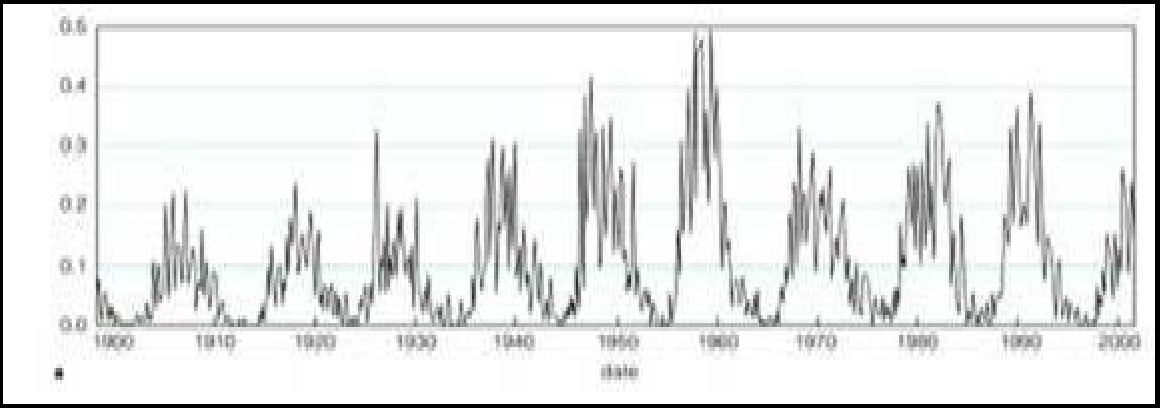
The Moon does not emit light.

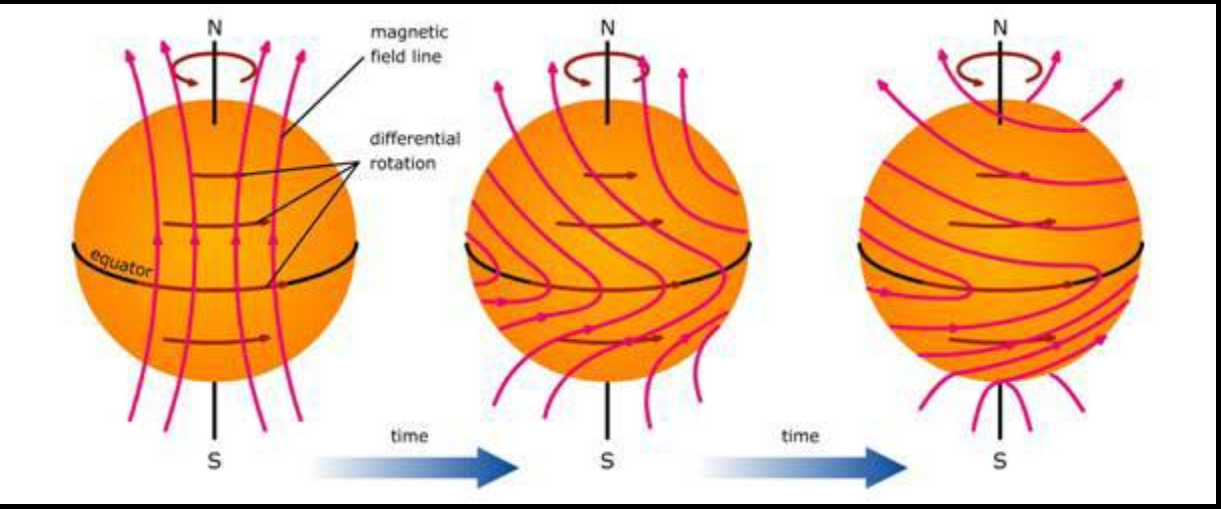
What are you seeing here?

Only stars emit light in the sky.

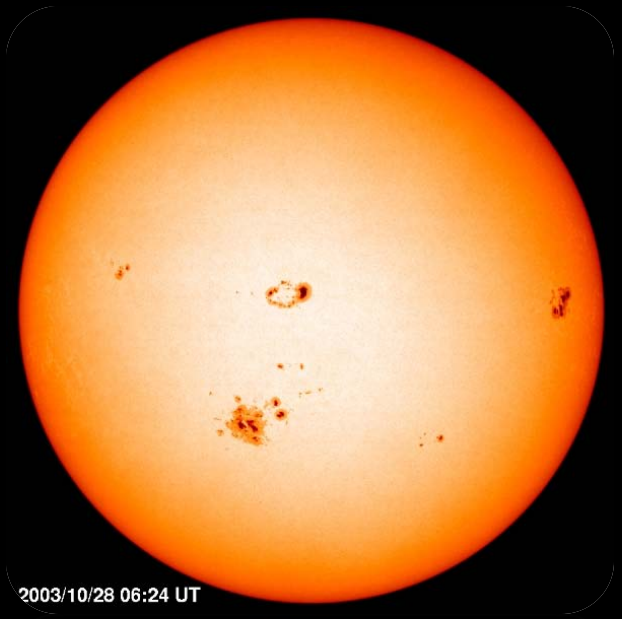
Everything else reflects or absorbs it.

The Solar Cycle





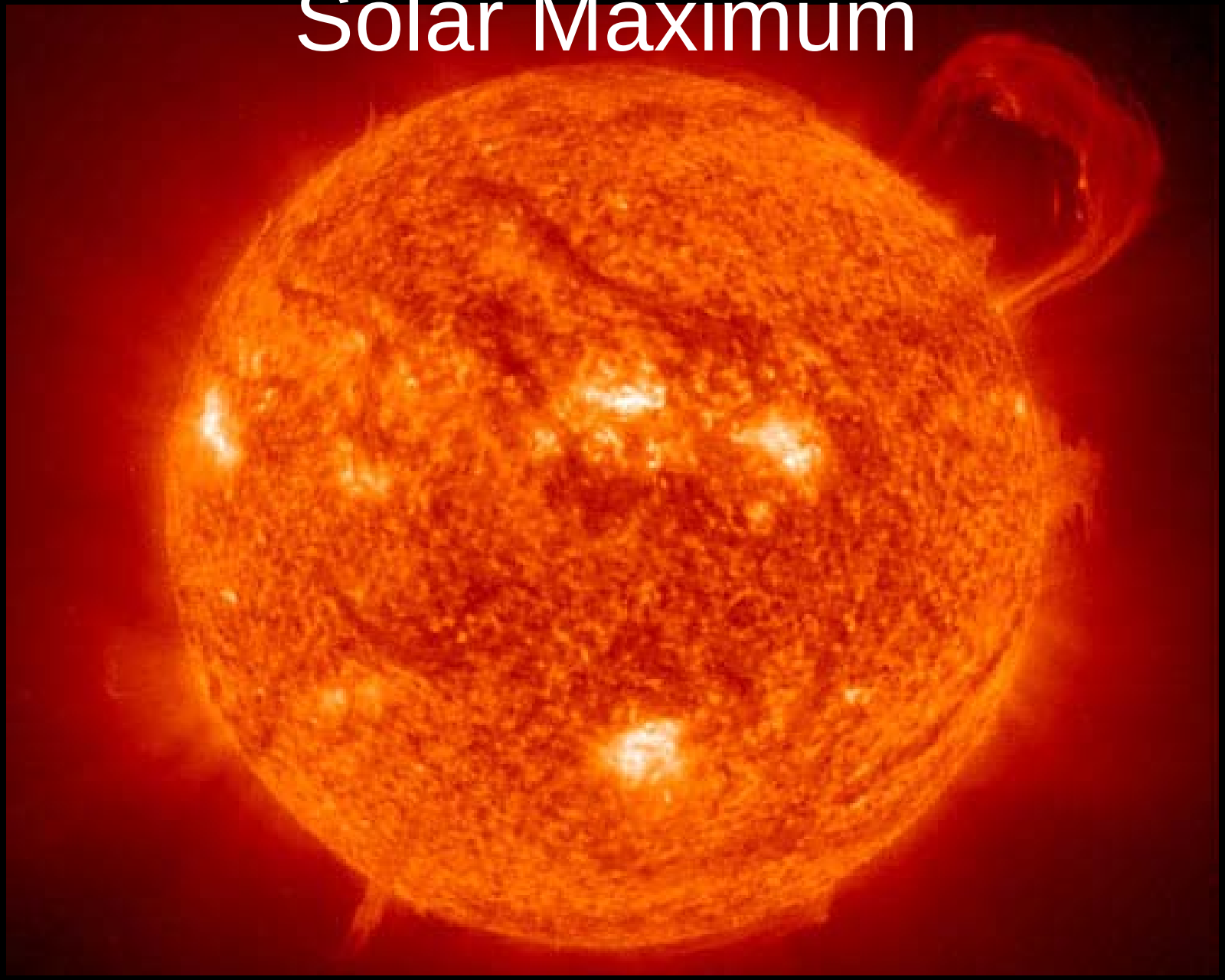
The number of Sunspots and solar flares increase and decrease on an 11-year cycle.



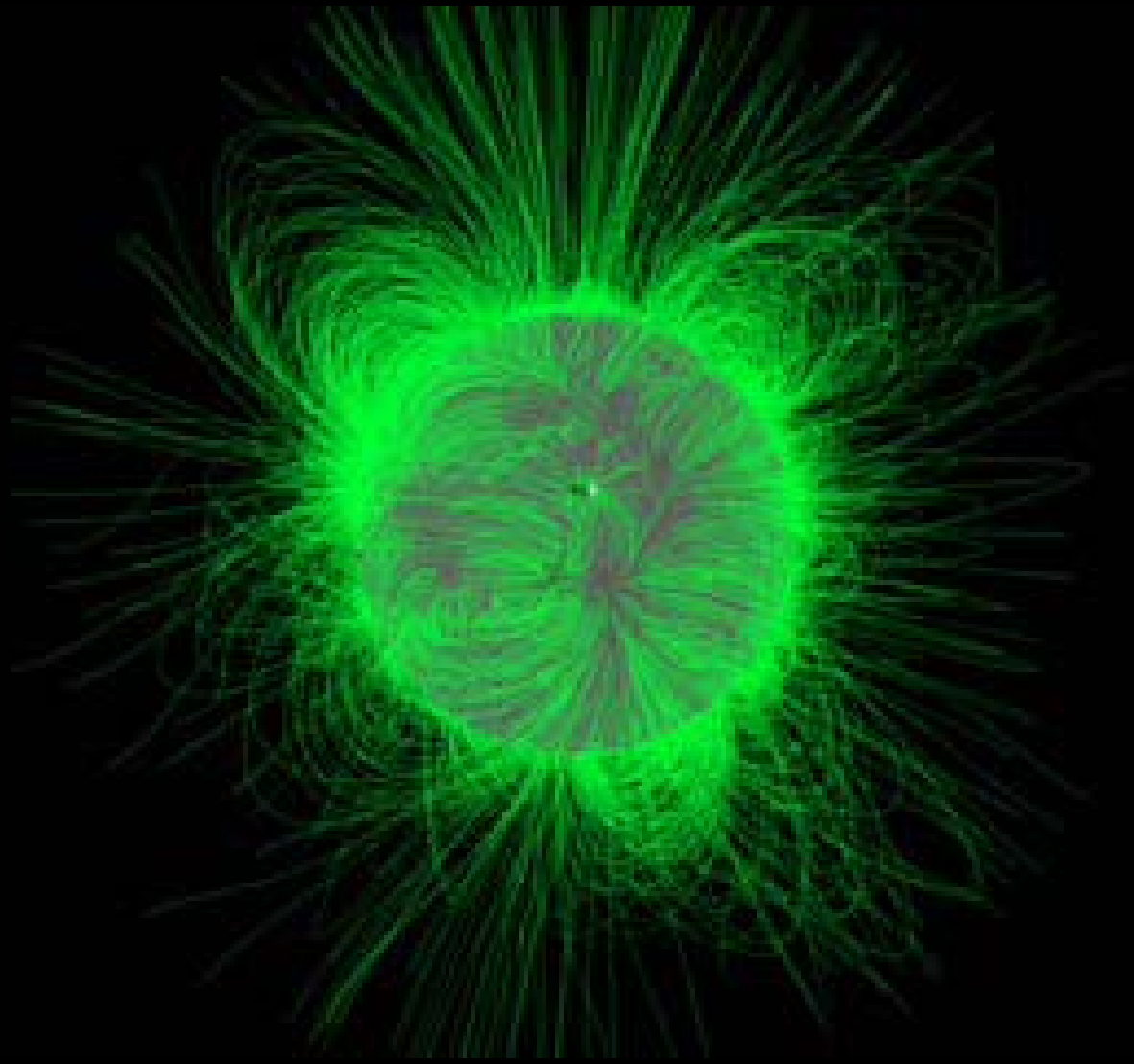
The Sun's magnetic field becomes more and more twisted and complex from differential rotation. It finally breaks and flips every 11 years. So the total cycle is really 22 years from start to finish.

WHAT CAN I SEE ON THE SUN?

Solar Maximum

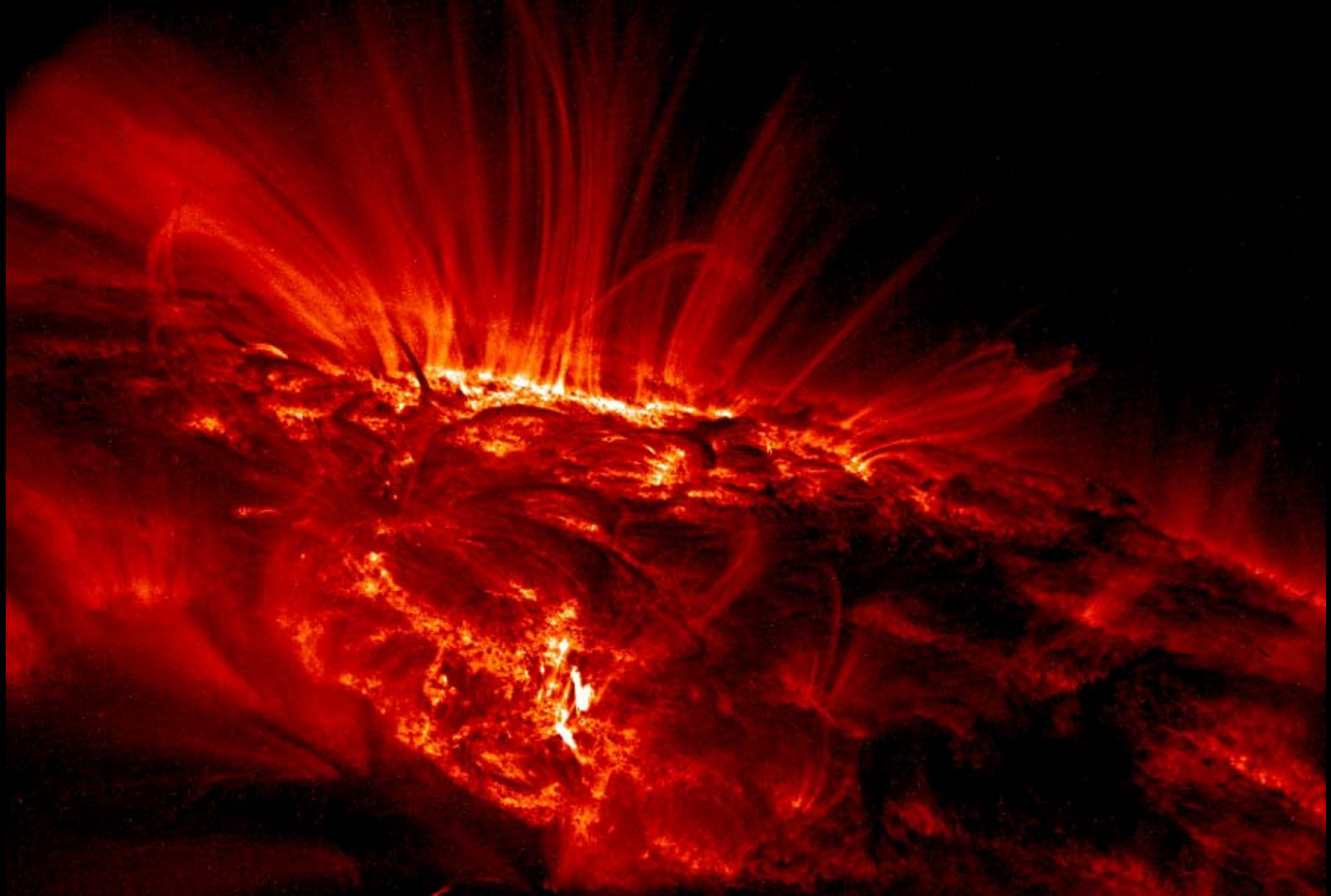


Magnetic Fields



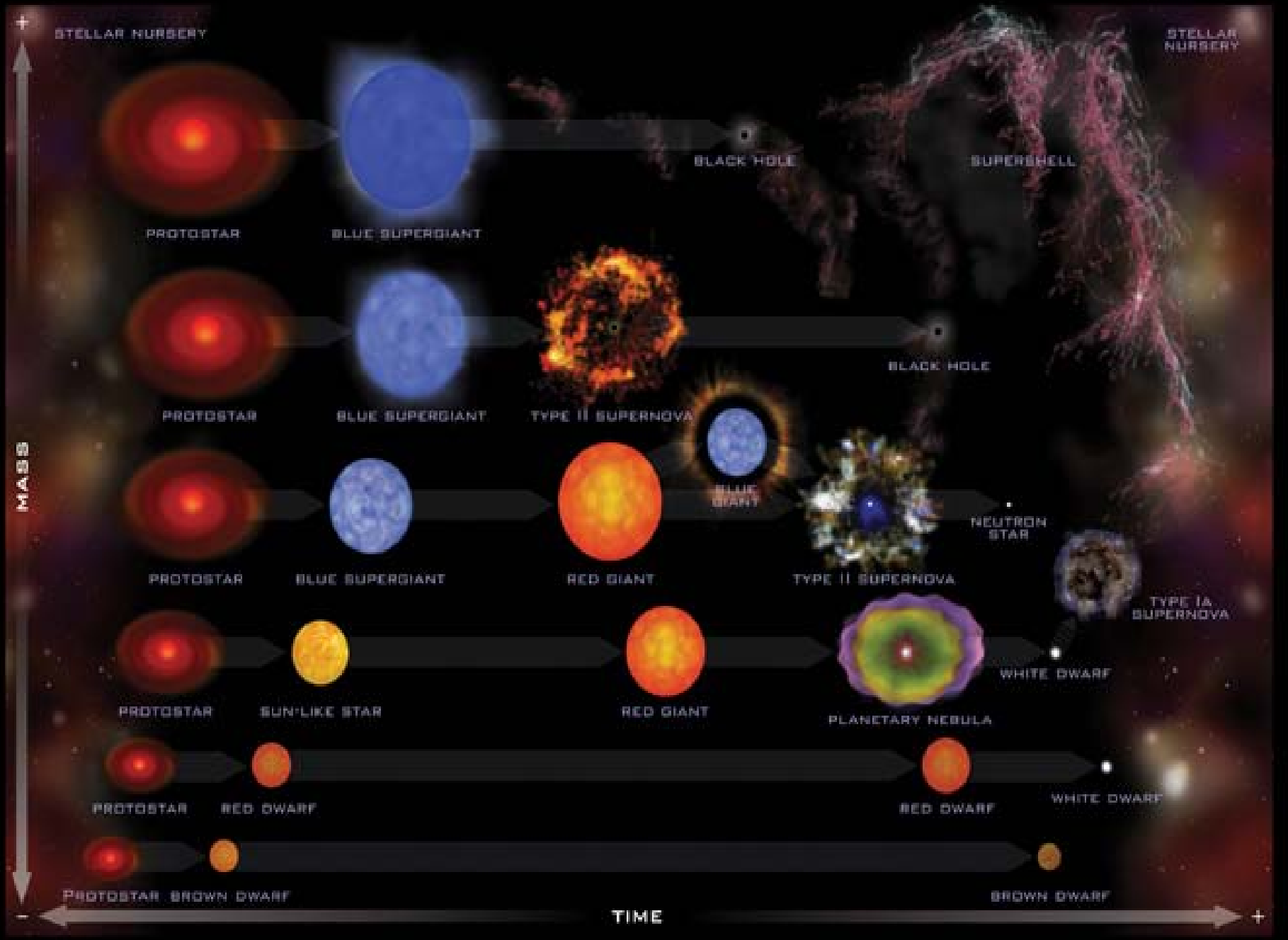
Sunspot Formation

Solar Flares and Prominences

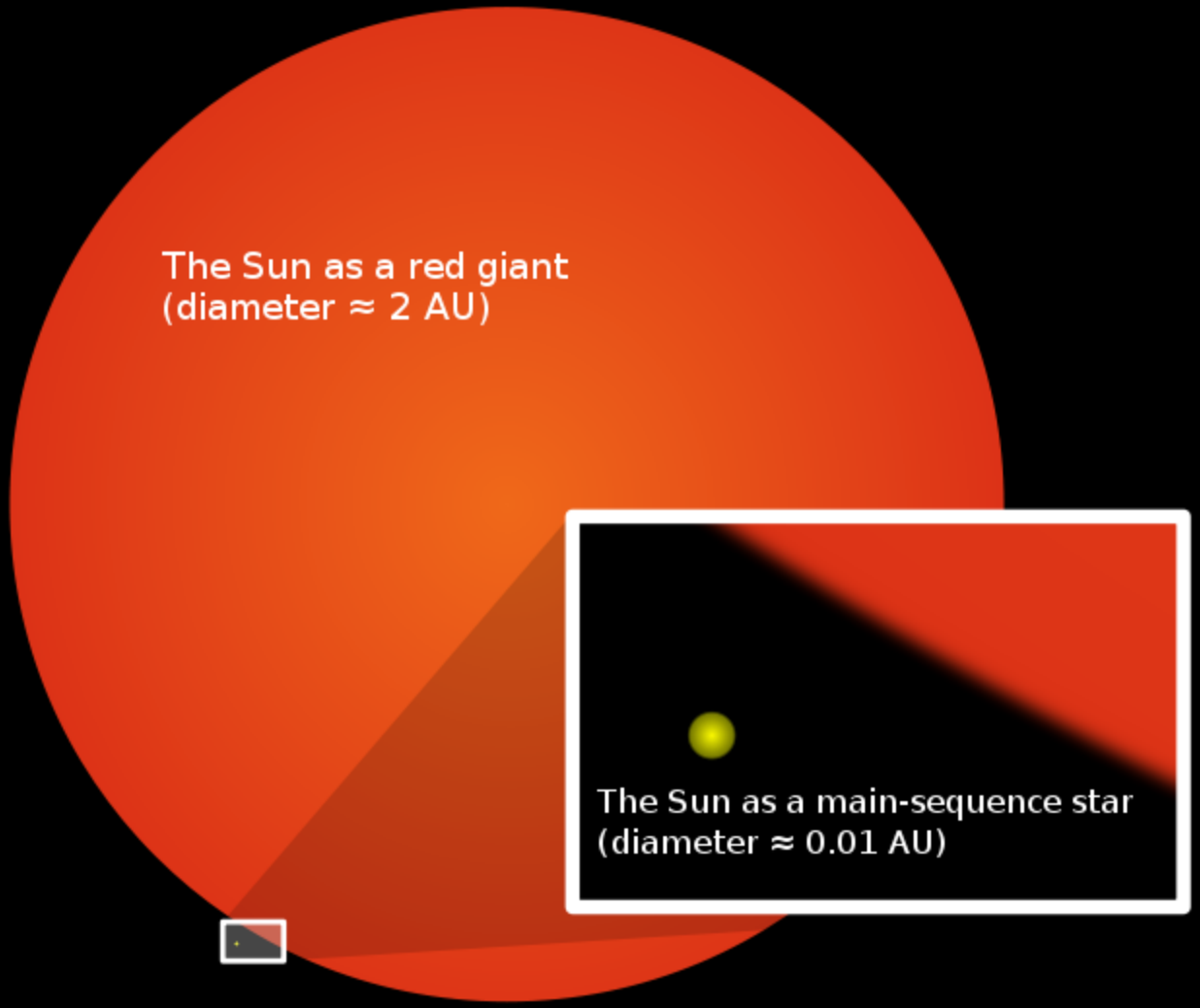


How long do we have?

Stellar fusion reactions gradually convert hydrogen into helium through the p-p chain. When a star runs out of hydrogen fuel, it either stops burning (becoming a dwarf star) or, if it is large enough (so that gravity compresses the helium strongly) it begins burning the helium into heavier elements. Because fusion reactions cease to release energy once elements heavier than iron are involved, the larger stars also eventually run out of fuel, but this time they collapse in a supernova. Gravity, no longer opposed by the internal pressure of fusion-heated gases, crushes the core of the star, forming things like white dwarfs, neutron stars, and black holes (the bigger the star, the more extreme the result).


+
STELLAR NURSERY
STELLAR NURSERY
BLACK HOLE
SUPERSHELL
PROTOSTAR
BLUE SUPERGIANT
PROTOSTAR
BLUE SUPERGIANT
TYPE II SUPERNOVA
BLACK HOLE
MASS
BLUE GIANT
NEUTRON STAR
PROTOSTAR
BLUE SUPERGIANT
RED GIANT
TYPE II SUPERNOVA
TYPE IA SUPERNOVA
PROTOSTAR
SUN-LIKE STAR
RED GIANT
PLANETARY NEBULA
WHITE DWARF
PROTOSTAR
RED DWARF
RED DWARF
WHITE DWARF
PROTOSTAR
BROWN DWARF
BROWN DWARF
−
TIME
+

Red Giant Stage



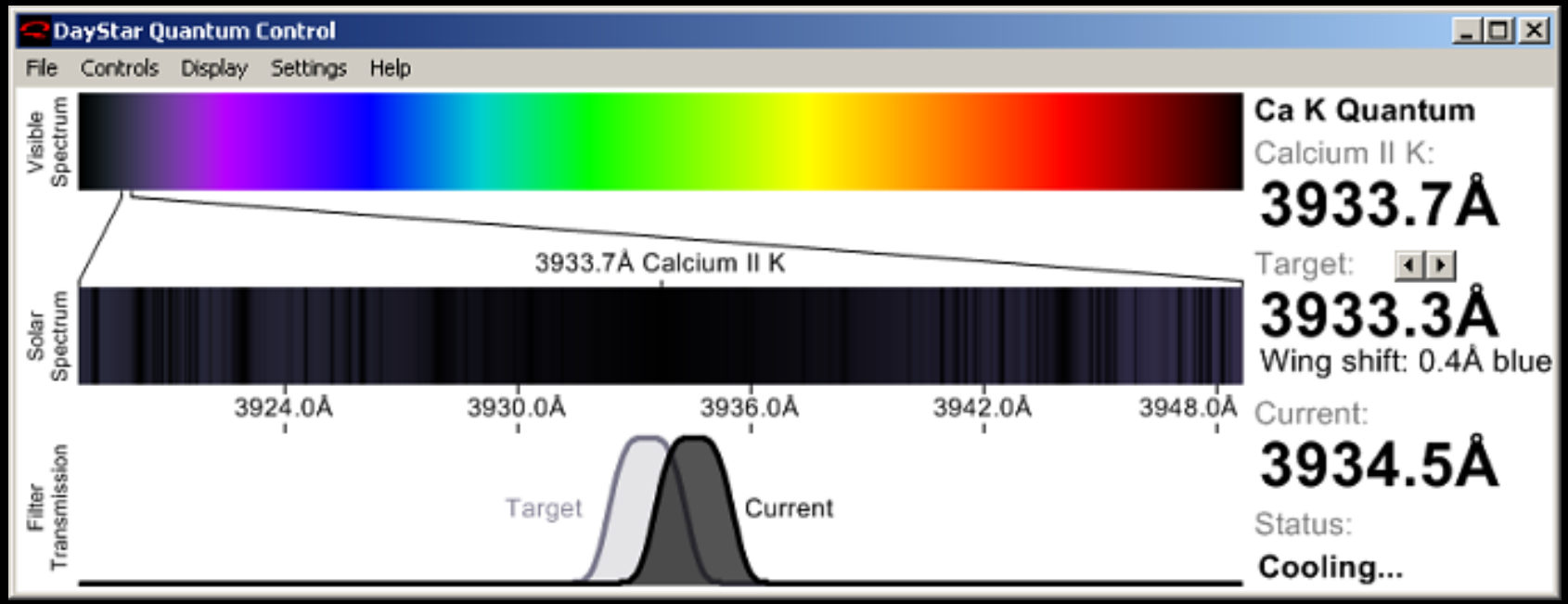
About 5-9 billion years left…

The Mayans and 2012 have nothing to do with the death of our Star or anything else.

Don’t believe the hype.

How To Observe The Sun

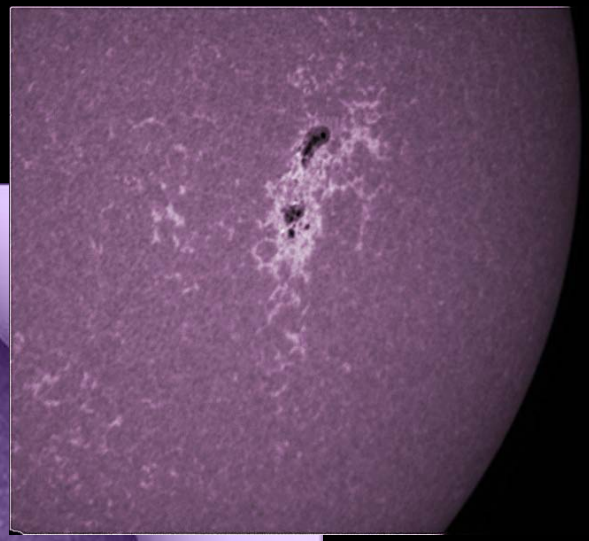
AMATEUR SOLAR ASTRONOMY

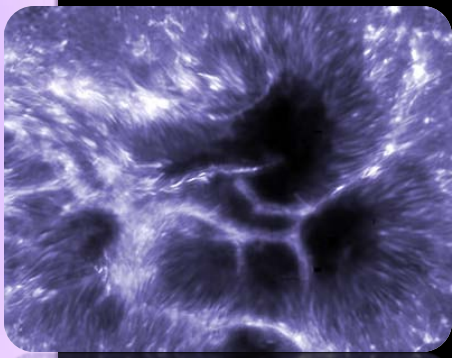


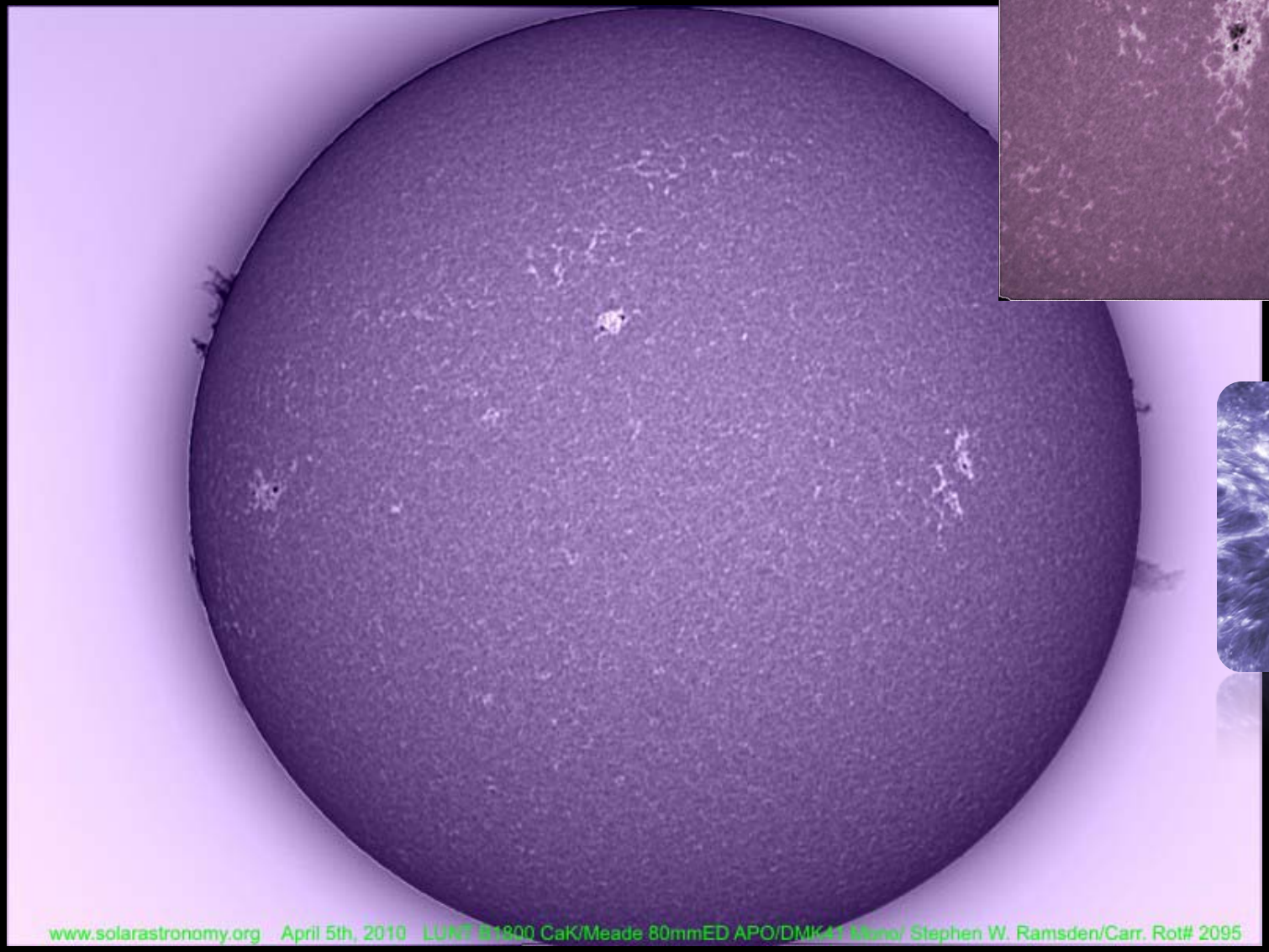
CALCIUM K LINE EMISSIONS

AMATEUR SOLAR ASTRONOMY

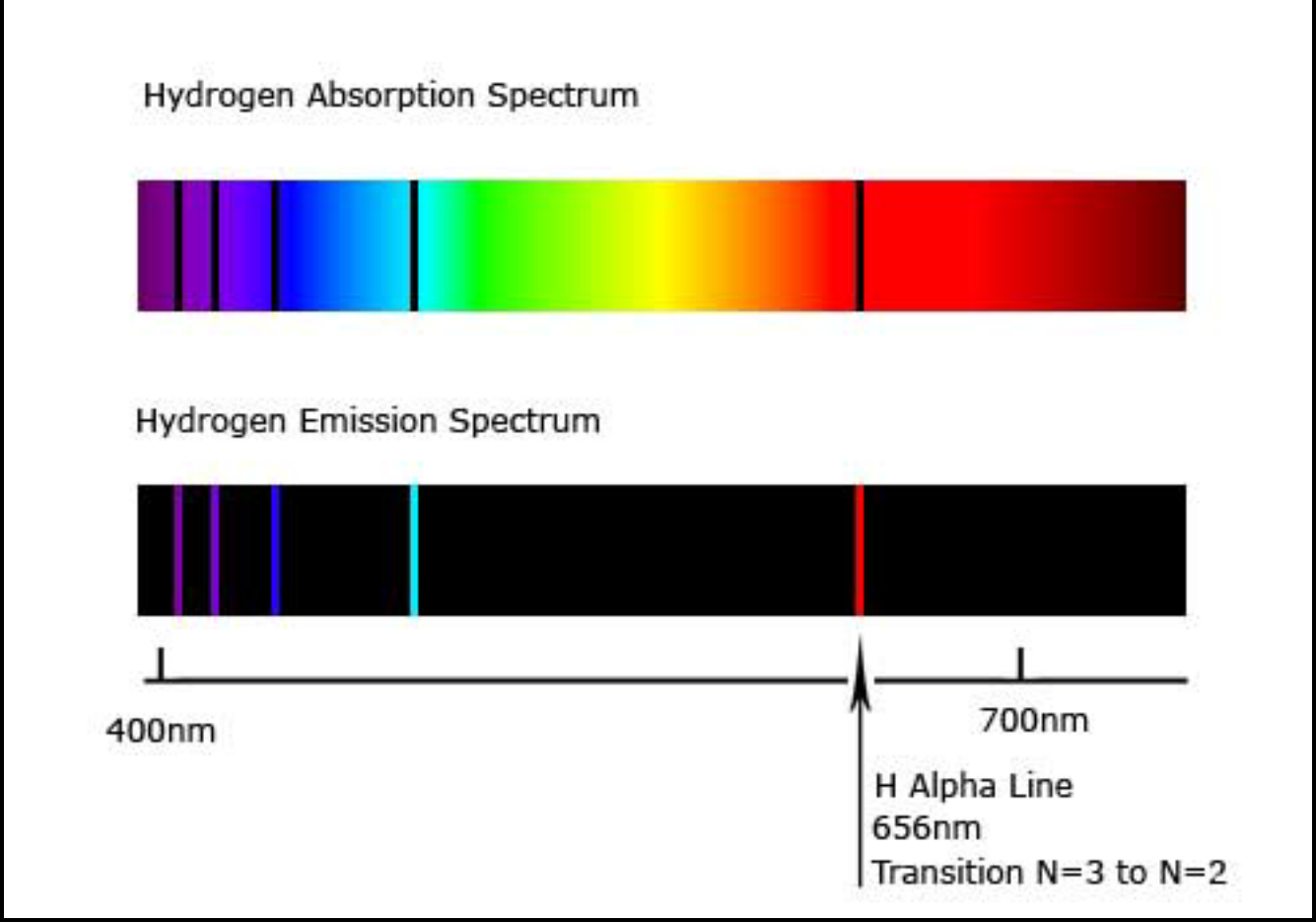
CALCIUM K







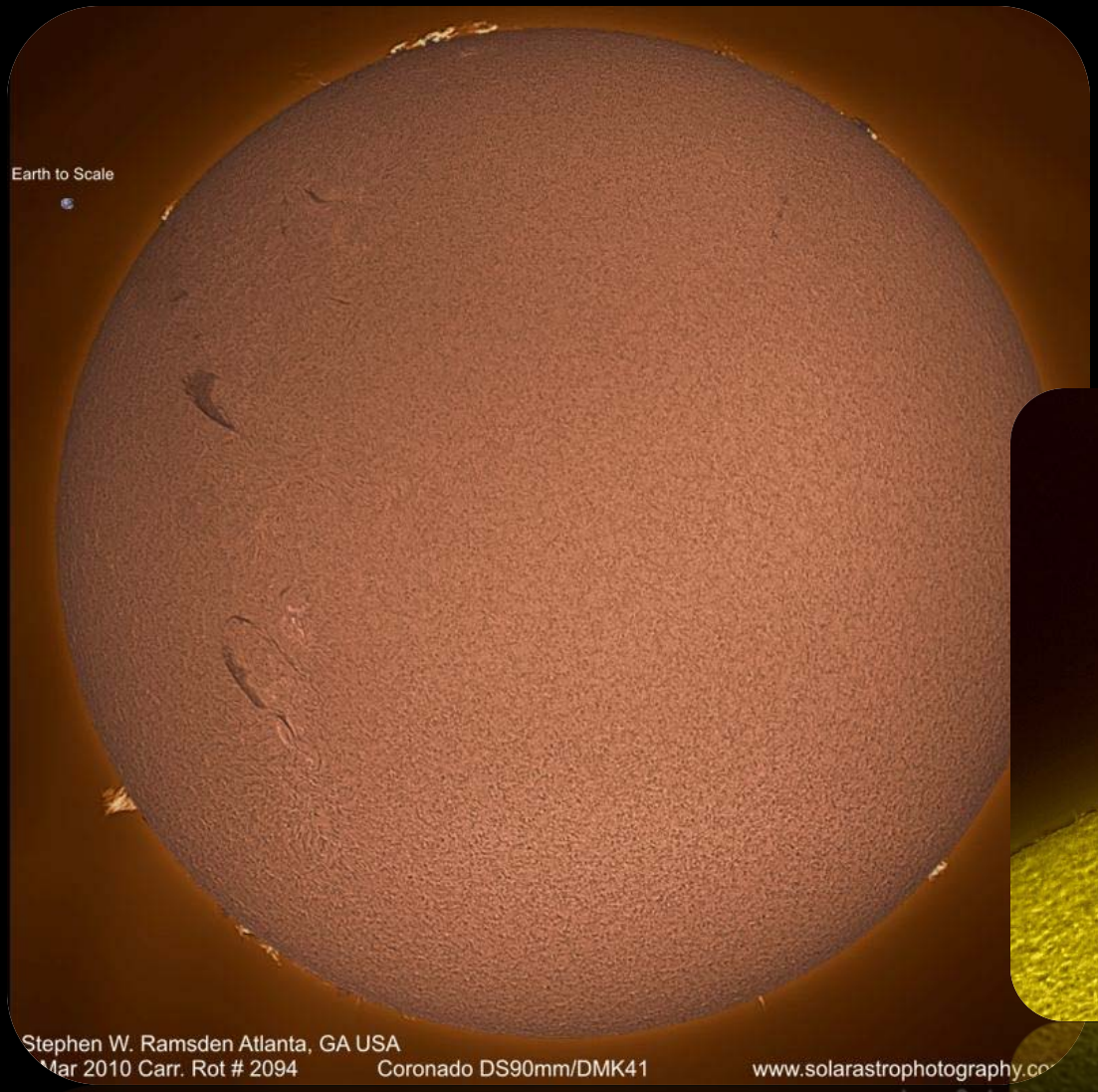
AMATEUR SOLAR ASTRONOMY

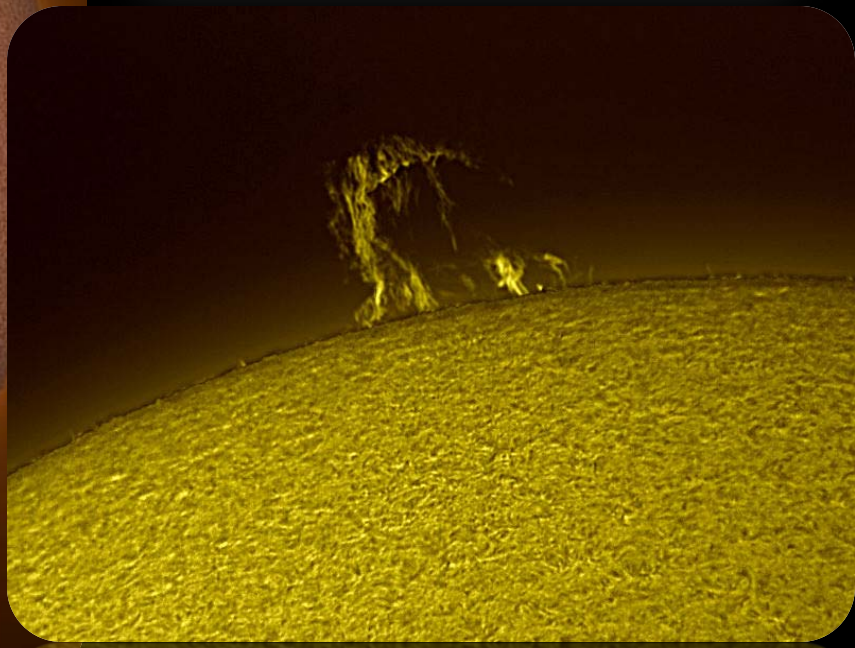


HYDROGEN A LINE EMISSIONS

AMATEUR SOLAR ASTRONOMY

HYDROGEN Alpha





AMATEUR SOLAR ASTRONOMY

WHITE LIGHT GLASS FILTER

WHITE LIGHT BAADER FILM

AMATEUR SOLAR ASTRONOMY

WHITE LIGHT

AMATEUR SOLAR ASTRONOMY

SKETCHING

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