UNIVERSITAT DE BARCELONA

IEEC

L'Univers proper i llunyà

Estrelles, galàxies i cosmologia

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Universitat de Barcelona –

Institut de Ciències del Cosmos – IEEC

UCe UNIVERSITAT CATALANA D'ESTIU

Agost-2007

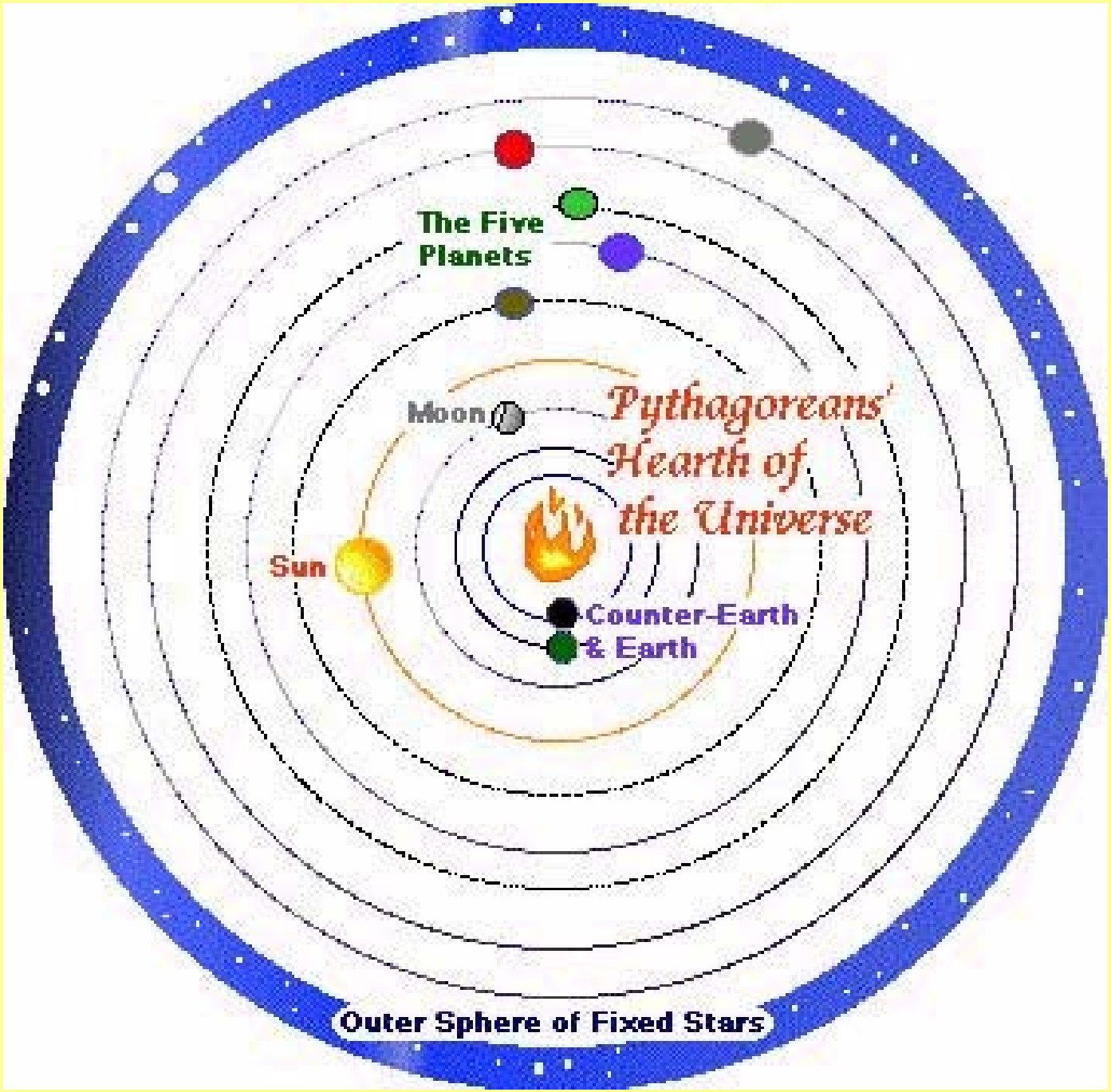
Estrelles, galàxies i cosmologia

1. Les estrelles

2. El Sol

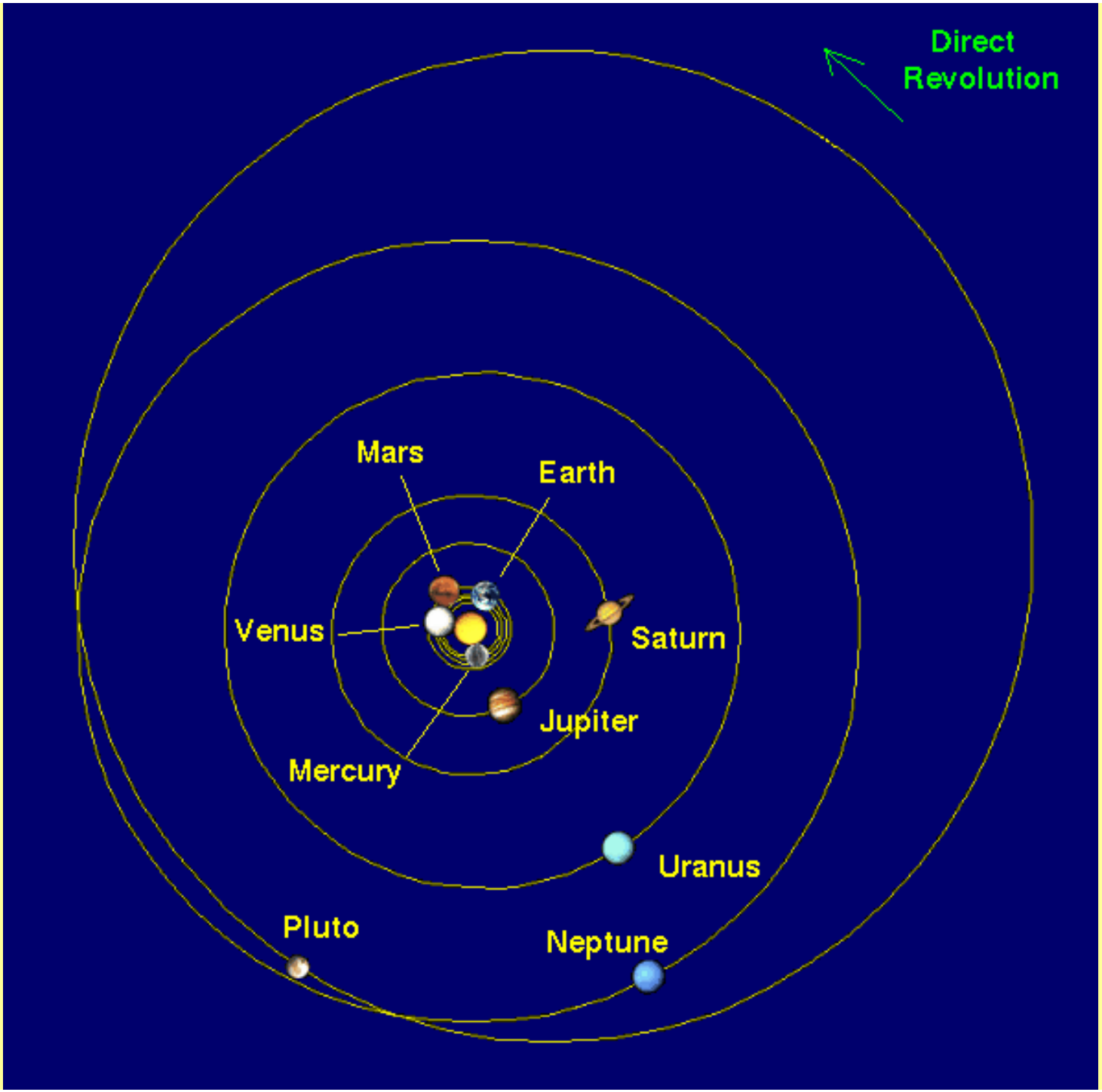
   - L'estrella més propera

   - Estudi detallat


The Five
Planets
Moon
Pythagoreans'
Hearth of
the Universe
Sun
Counter-Earth
& Earth
Outer Sphere of Fixed Stars

Lluna

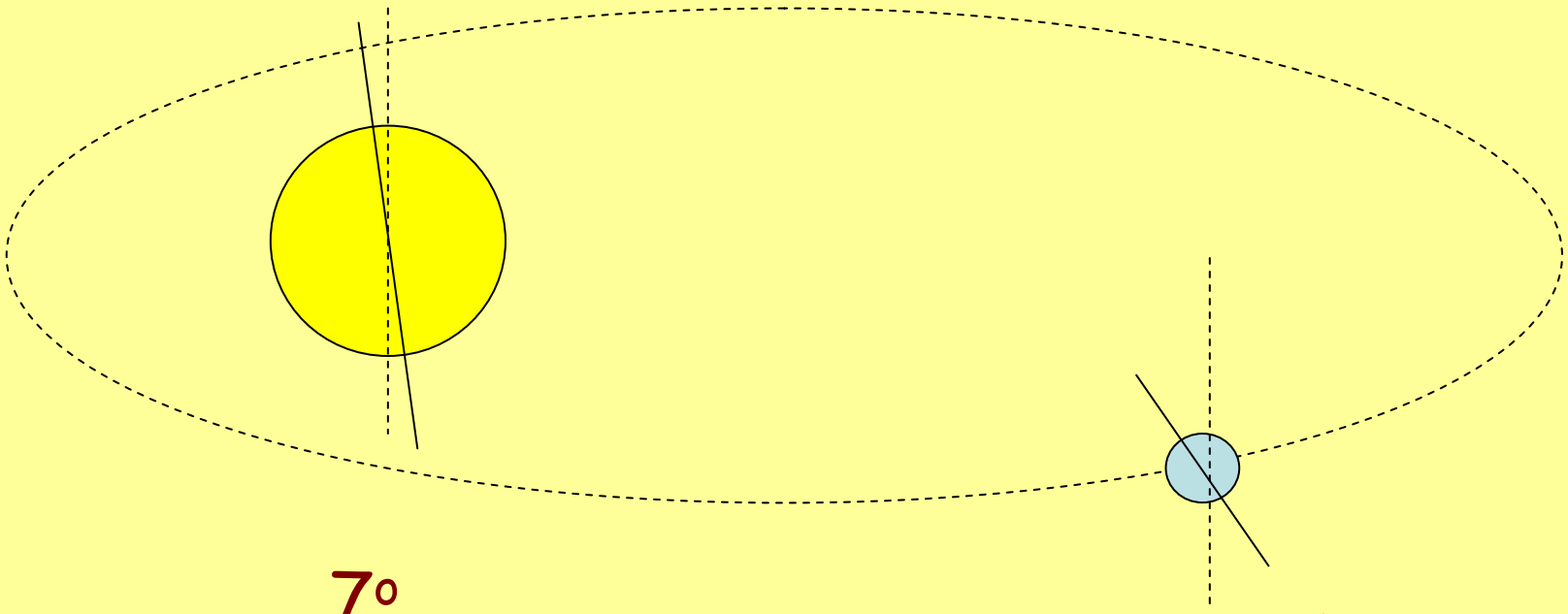
Venus: fases


Direct
Revolution
Mars
Earth
Venus
Saturn
Jupiter
Mercury
Uranus
Pluto
Neptune

Galileu Galilei

taques

enfosquiment



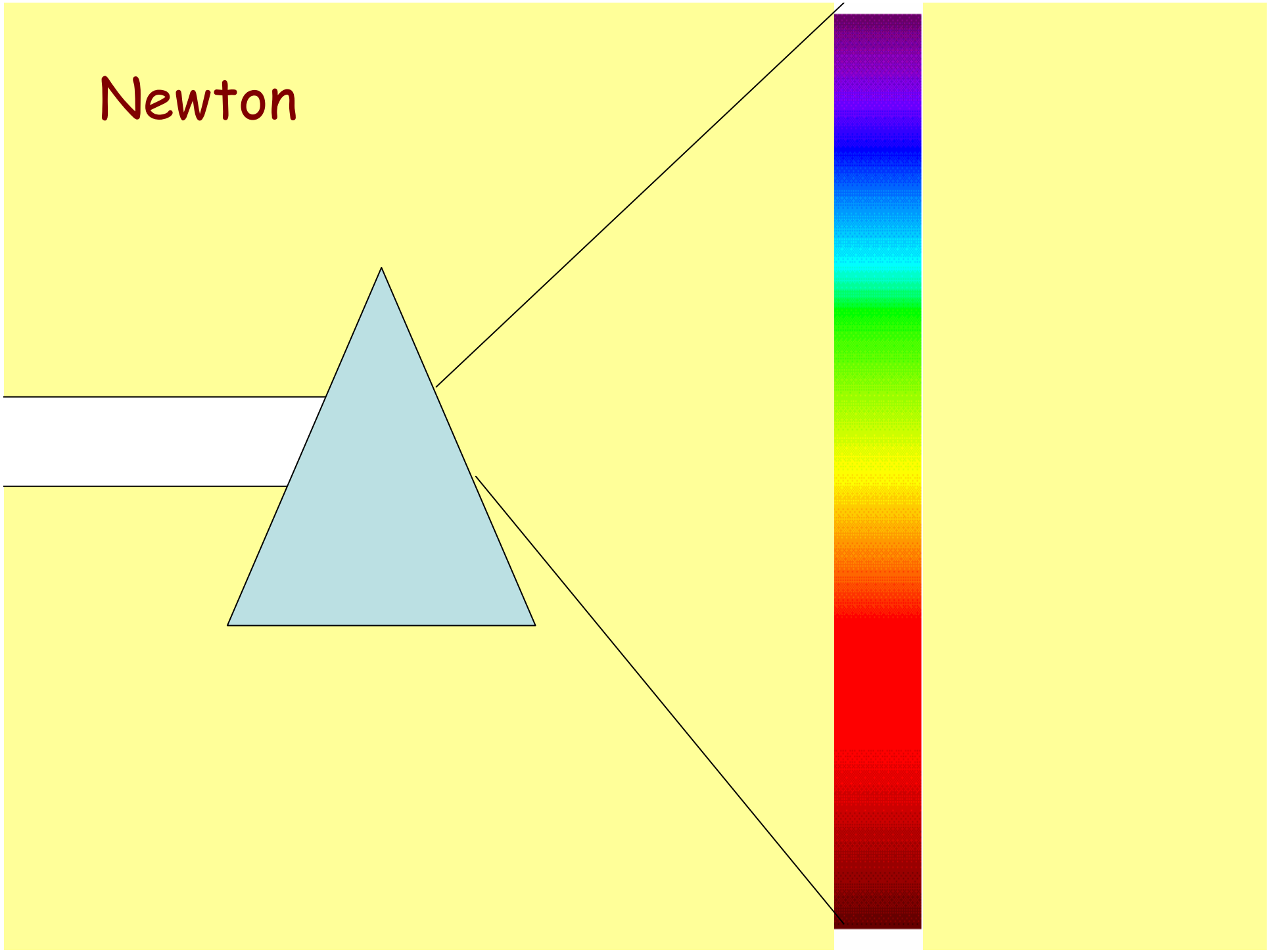
7º

Equador: 25d
Pols: 34d

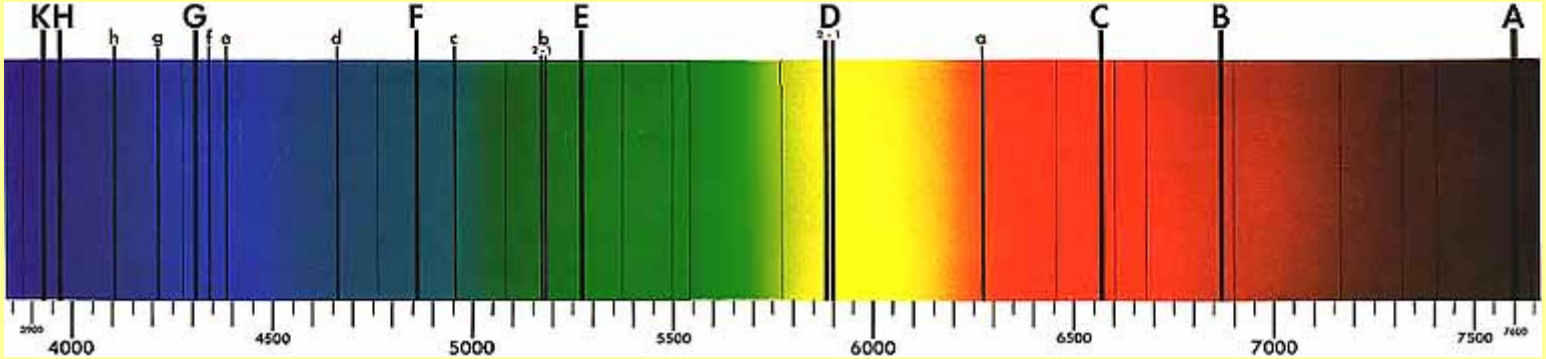
23,5º

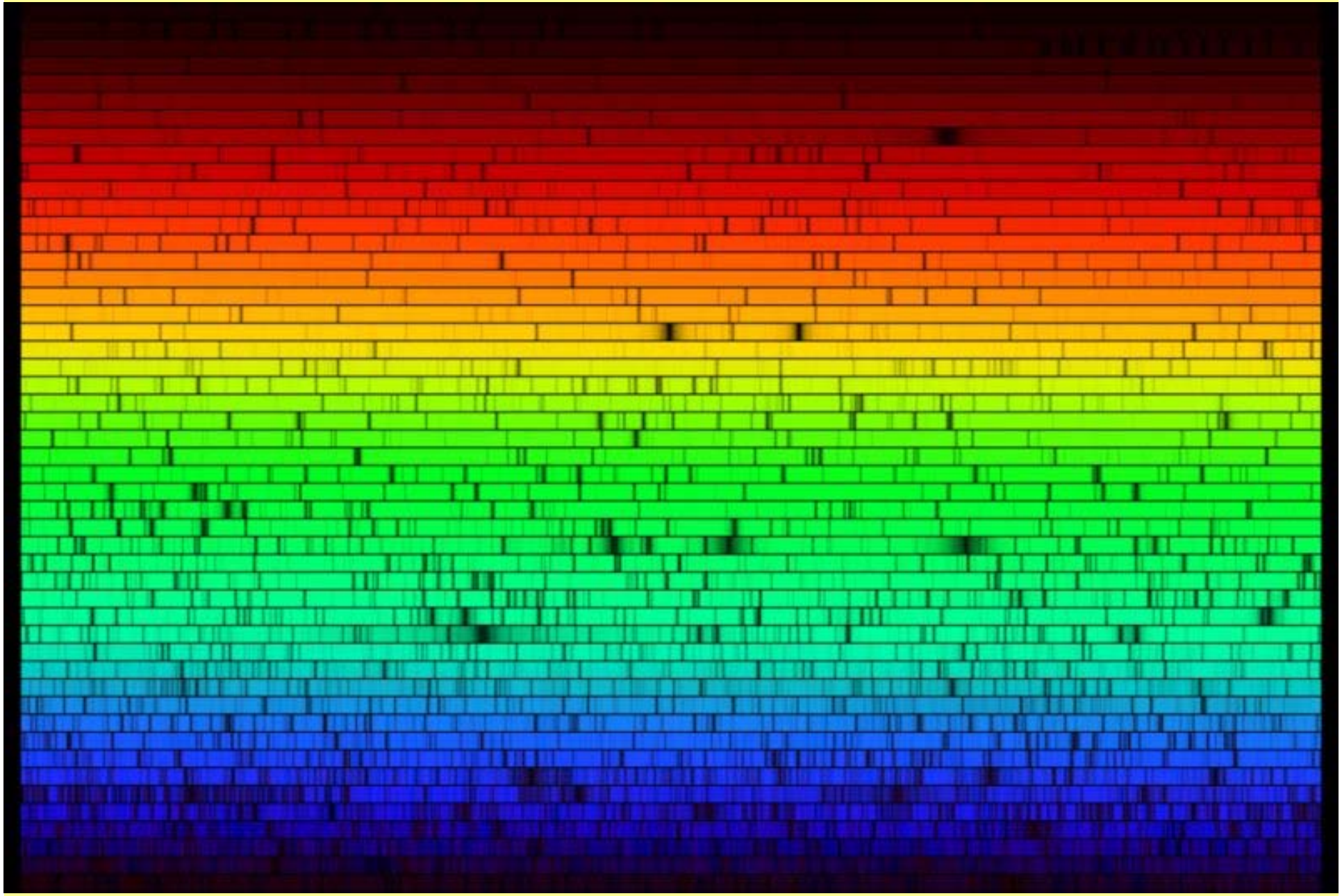
24h

Newton



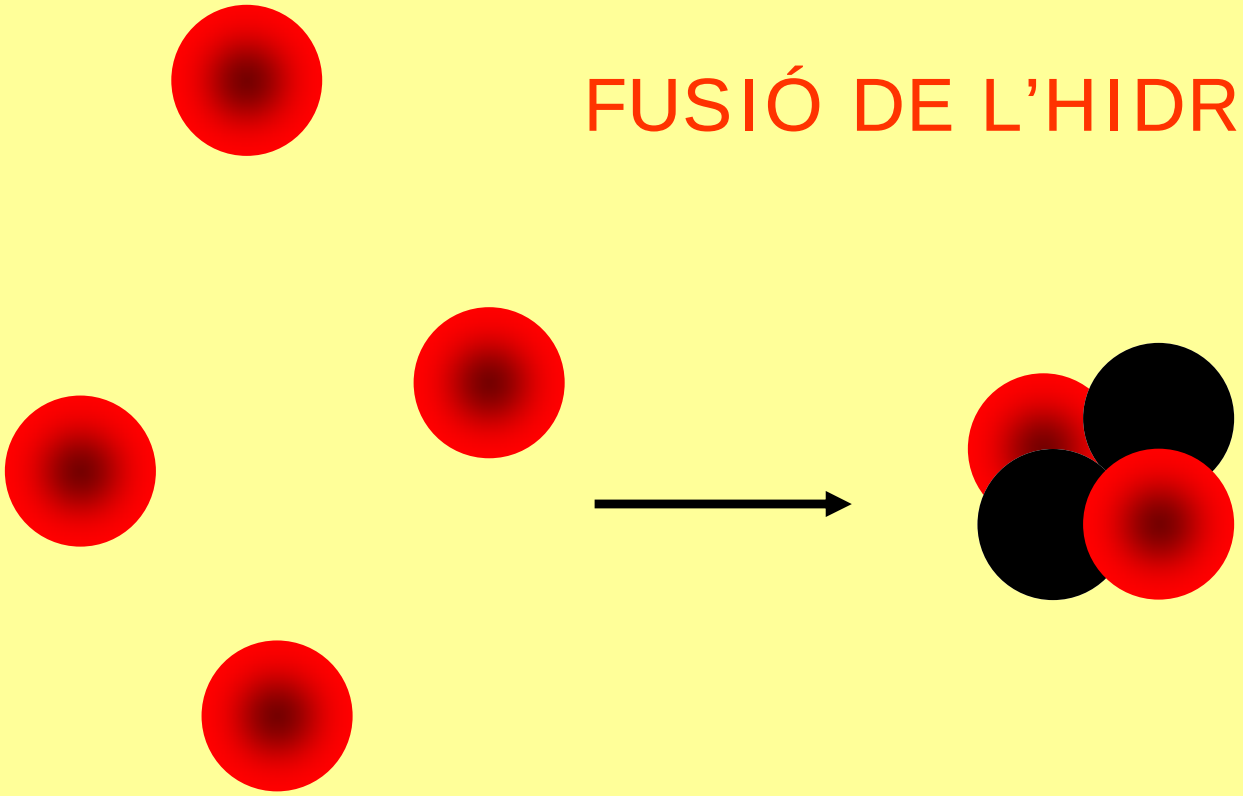
von Fraunhofer





1920: Eddington

FUSIÓ DE L'HIDROGEN



Hidrogen

Heli

i després de tots aquests anys ?

Actualment és a la seqüència principal: fusió hidrogen al nucli

Massa = $2 \cdot 10^{30}$ kg =

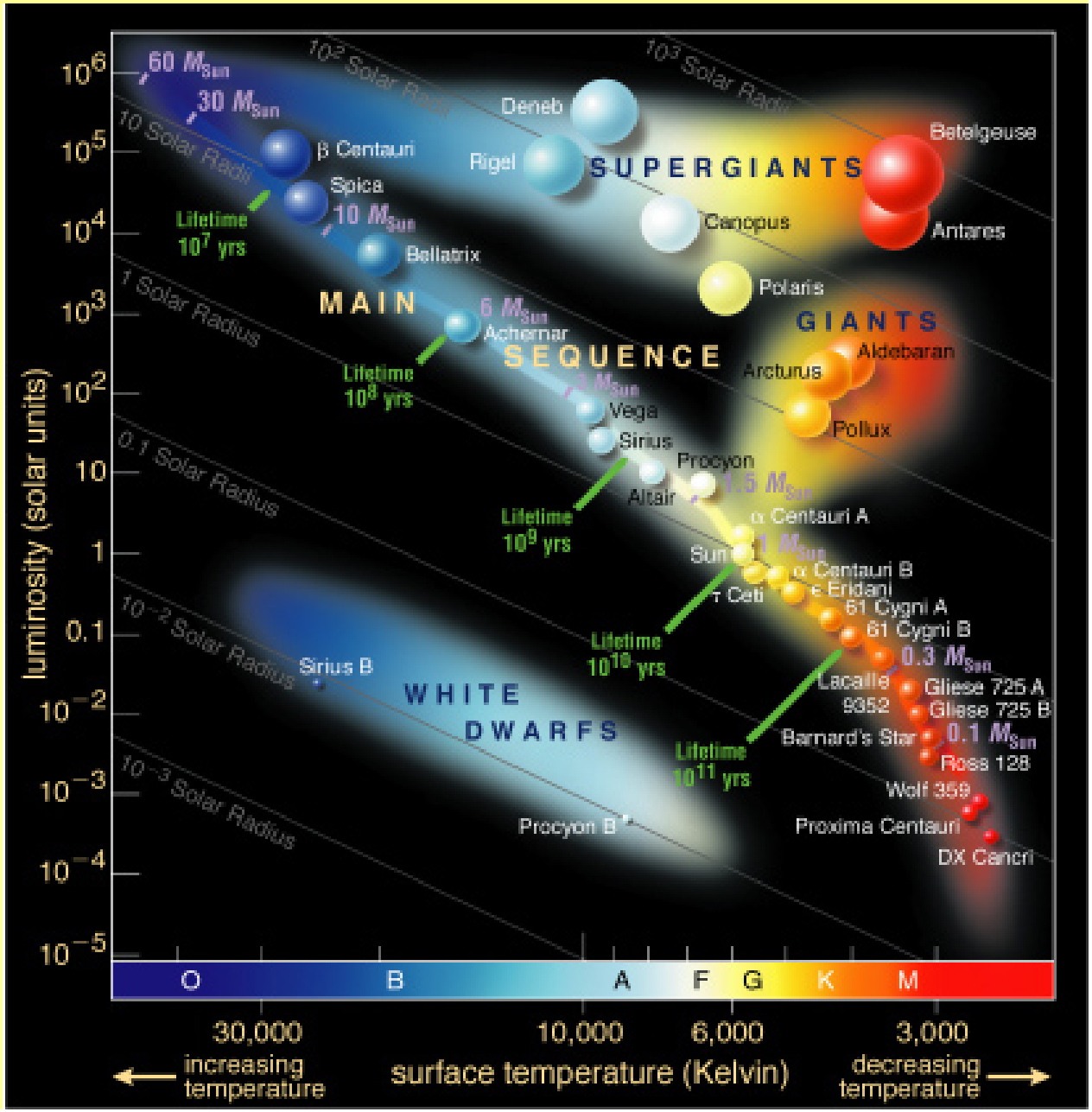
333.000 M_{Terra}

Radi (eq)= 700.000 km

= 110 R_{Terra}

Densitat mitjana=1400 kg/m^3

gravetat ~ 28 g_{Terra}



Actualment és a la seqüència principal: fusió hidrogen al nucli

Temperatura= 5500 ºC

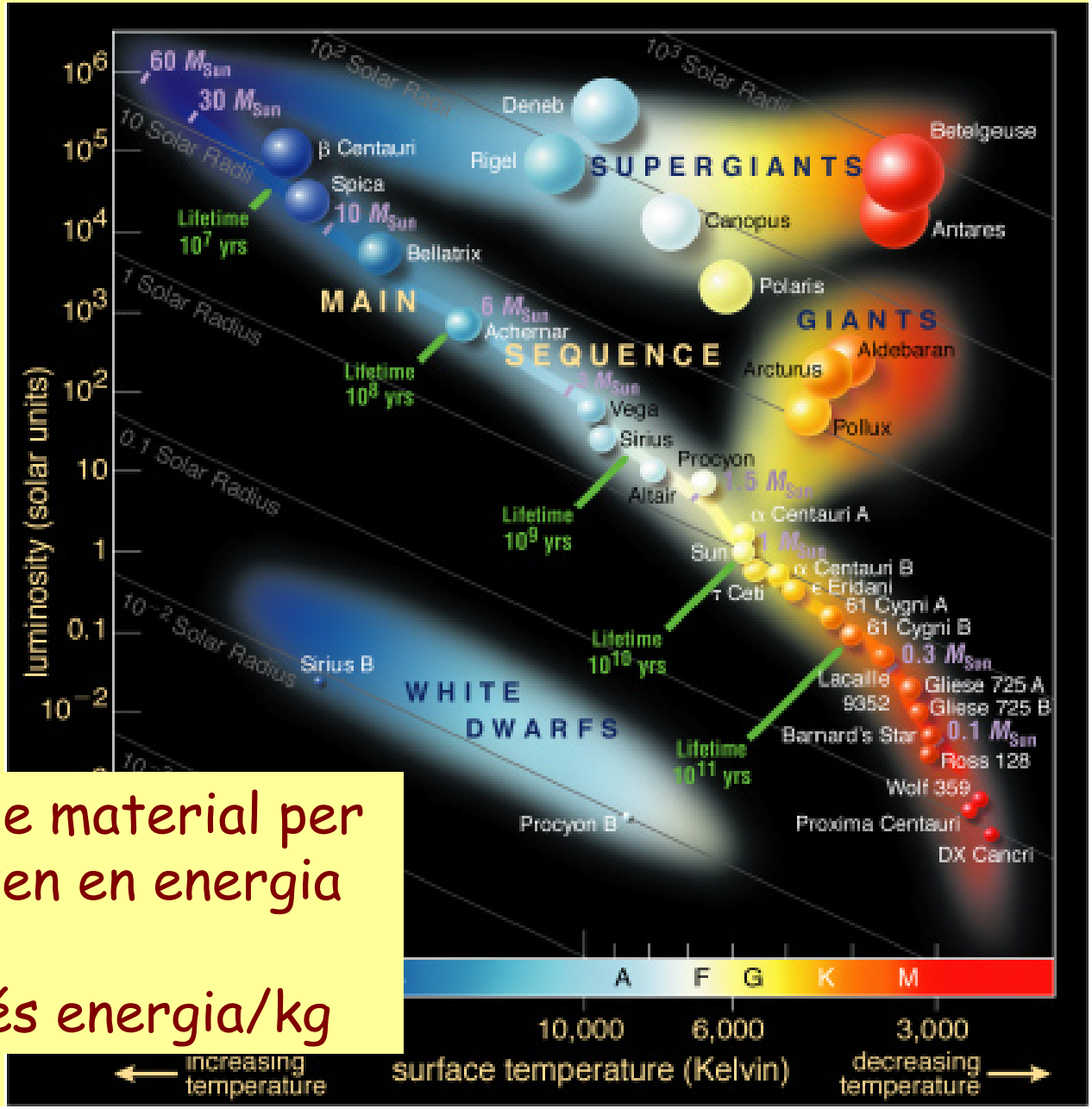
G2 V

Lluminositat= $4 \cdot 10^{26}$ W

1370 W/m^2

V= -26,74 mag

Mv= 4,83



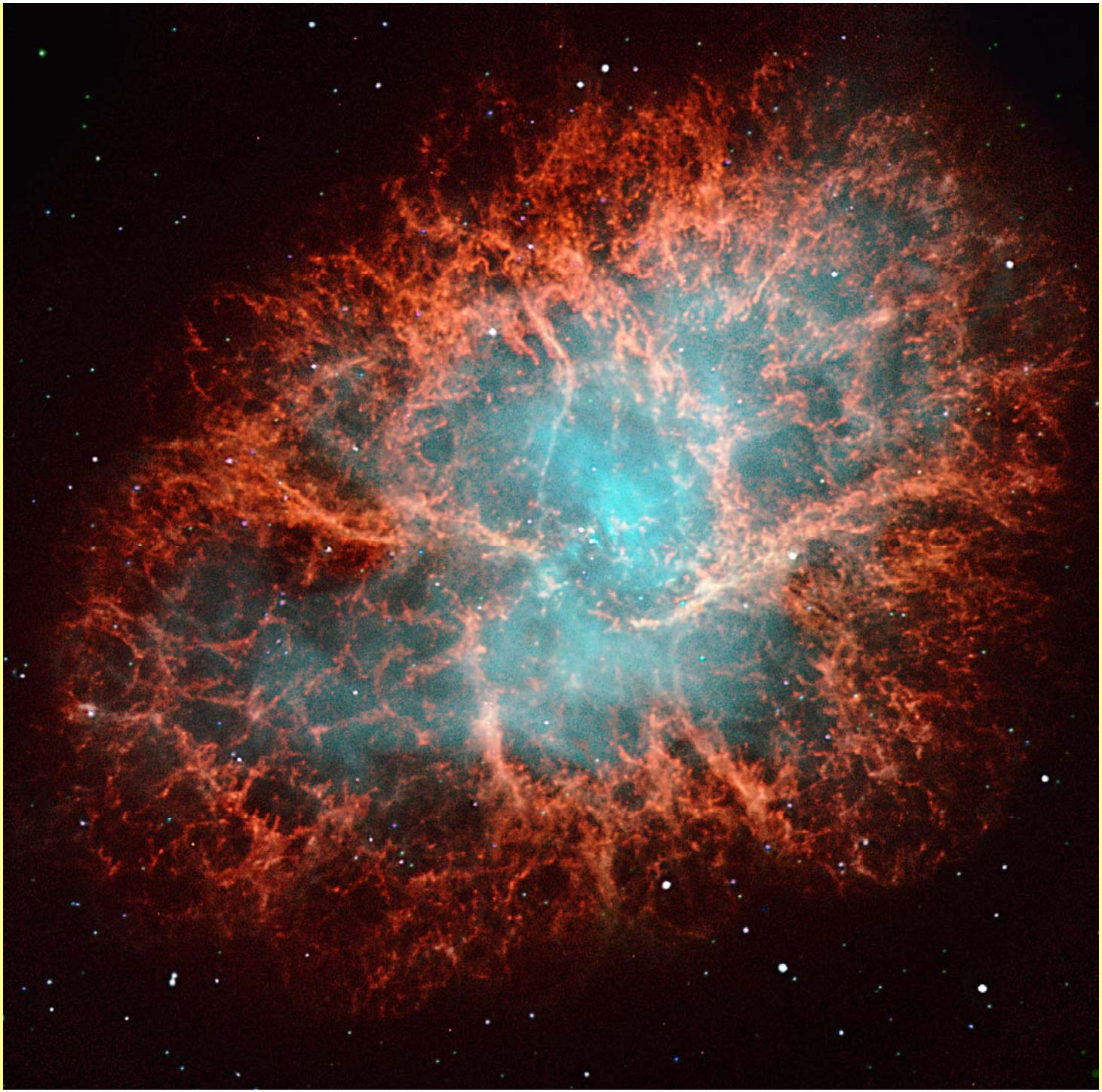
4 milions de tones de material per segon es converteixen en energia

Cos humà: 1 milió més energia/kg

Composició (en massa)	
Hidrogen	73.46 %
Heli	24.85 %
Oxigen	0.77 %
Carboni	0.29 %
Ferro	0.16 %
Sulfur	0.12 %
Neó	0.12 %
Nitrogen	0.09 %
Silici	0.07 %
Magnesi	0.05 %

Nebulosa del Cranc

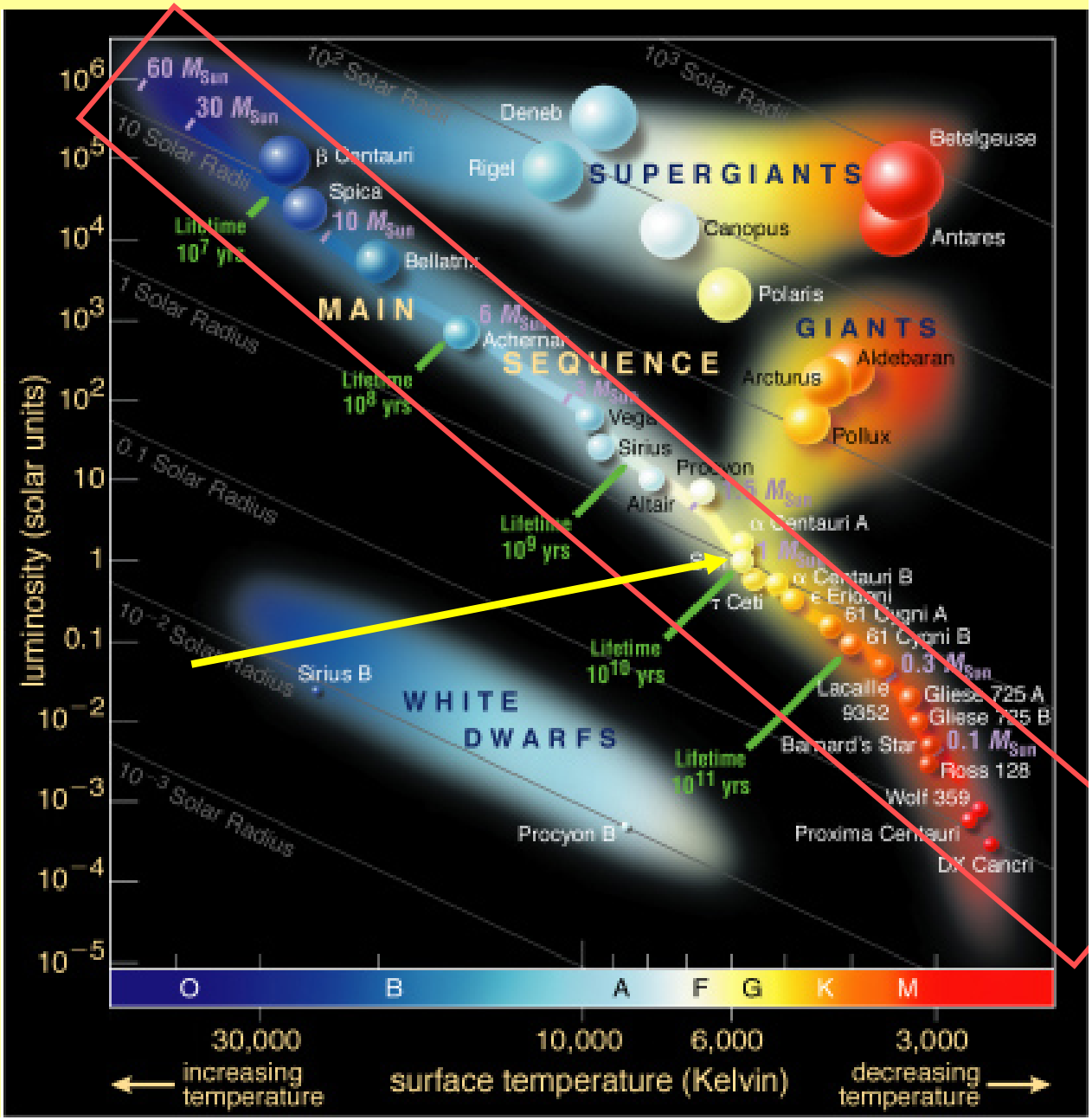
1054 d.C.

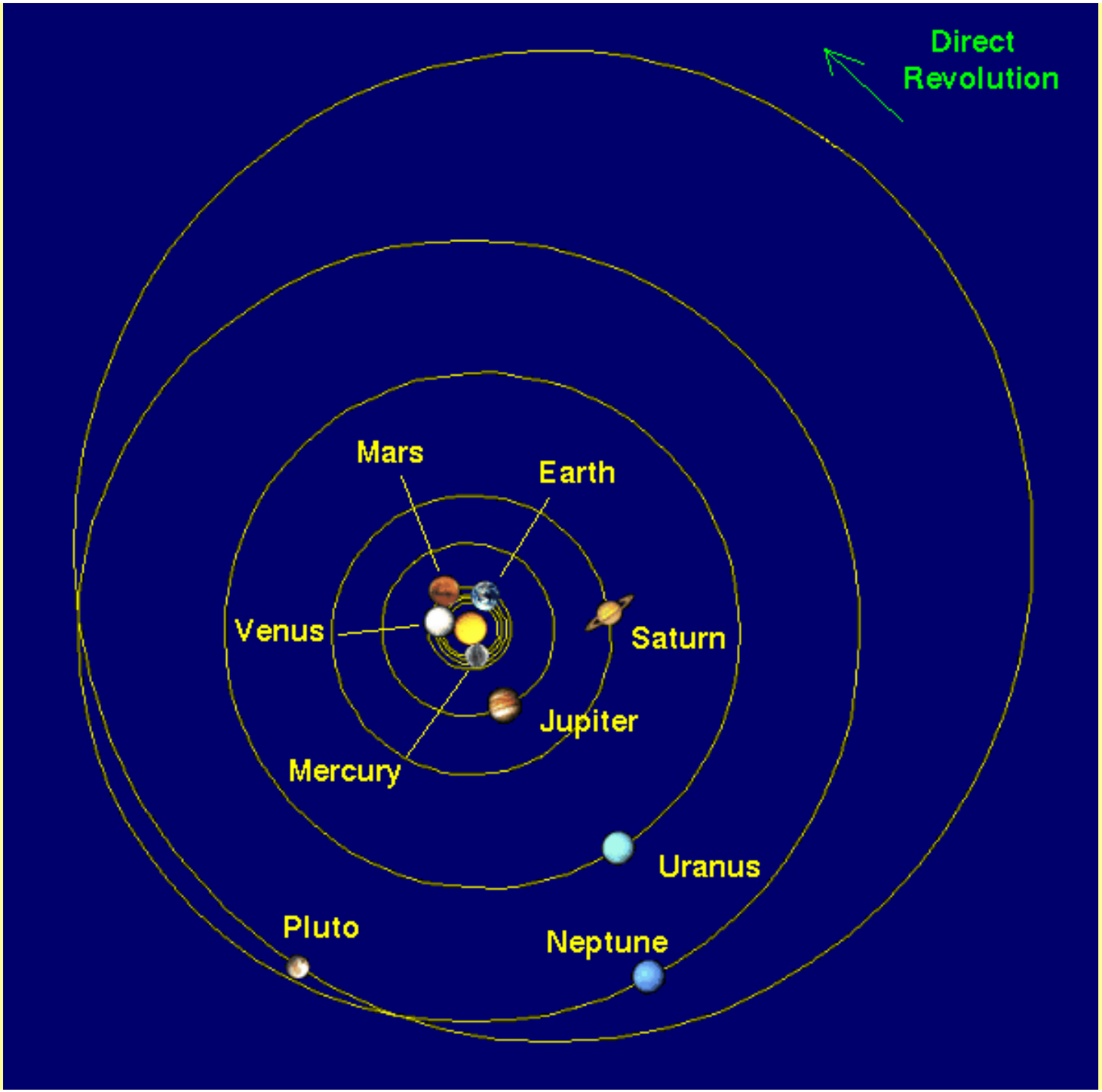


Actualment és a la seqüència principal: fusió hidrogen al nucli

5000 milions d'anys

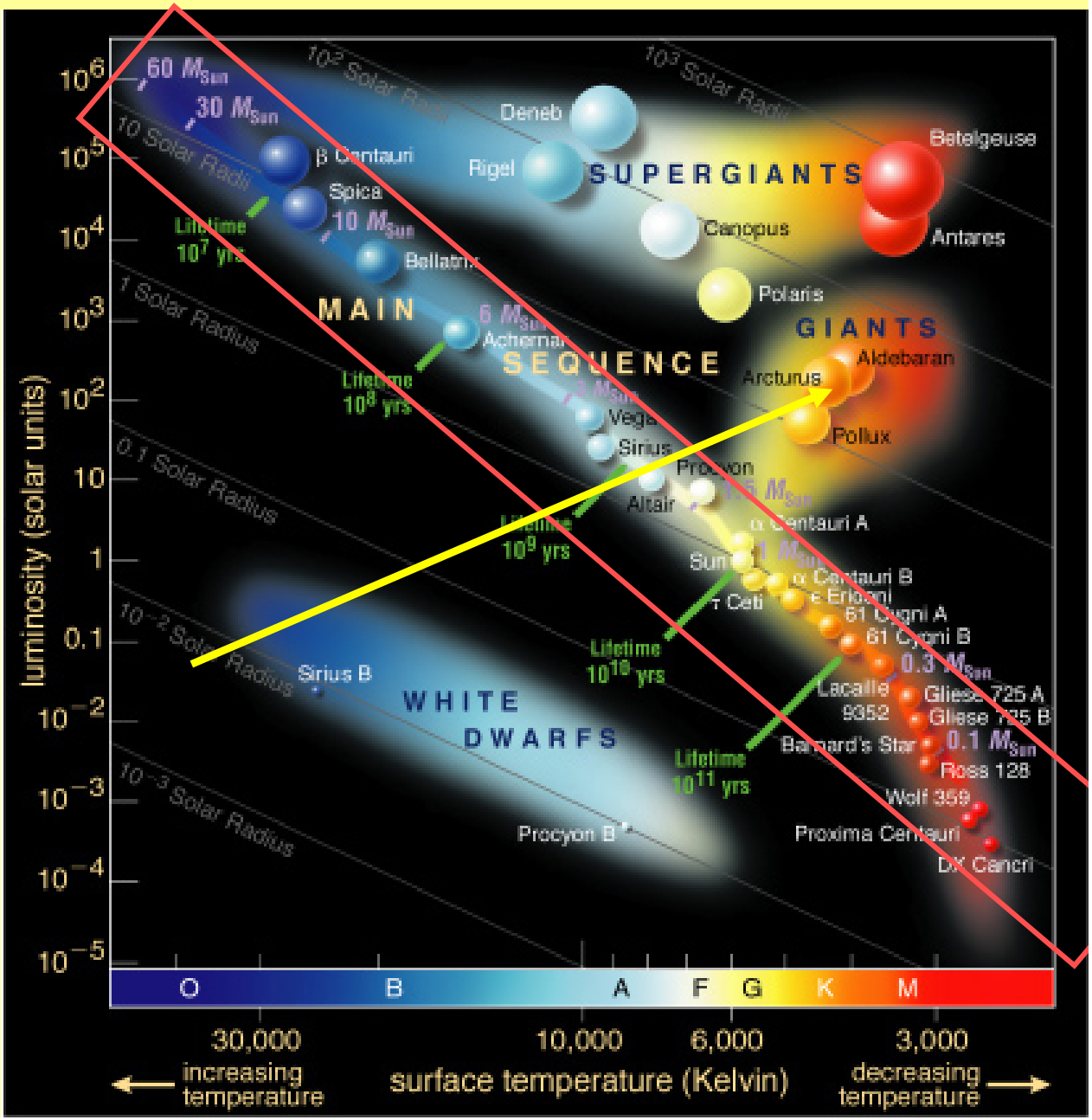
100 M_{Terra} →energia




Direct
Revolution
Mars
Earth
Venus
Saturn
Jupiter
Mercury
Uranus
Pluto
Neptune

Actualment és a la seqüència principal: fusió hidrogen al nucli

+ 5000 milions d'anys




NGC 6543

Nana blanca de C+O, de la grandària de la Terra

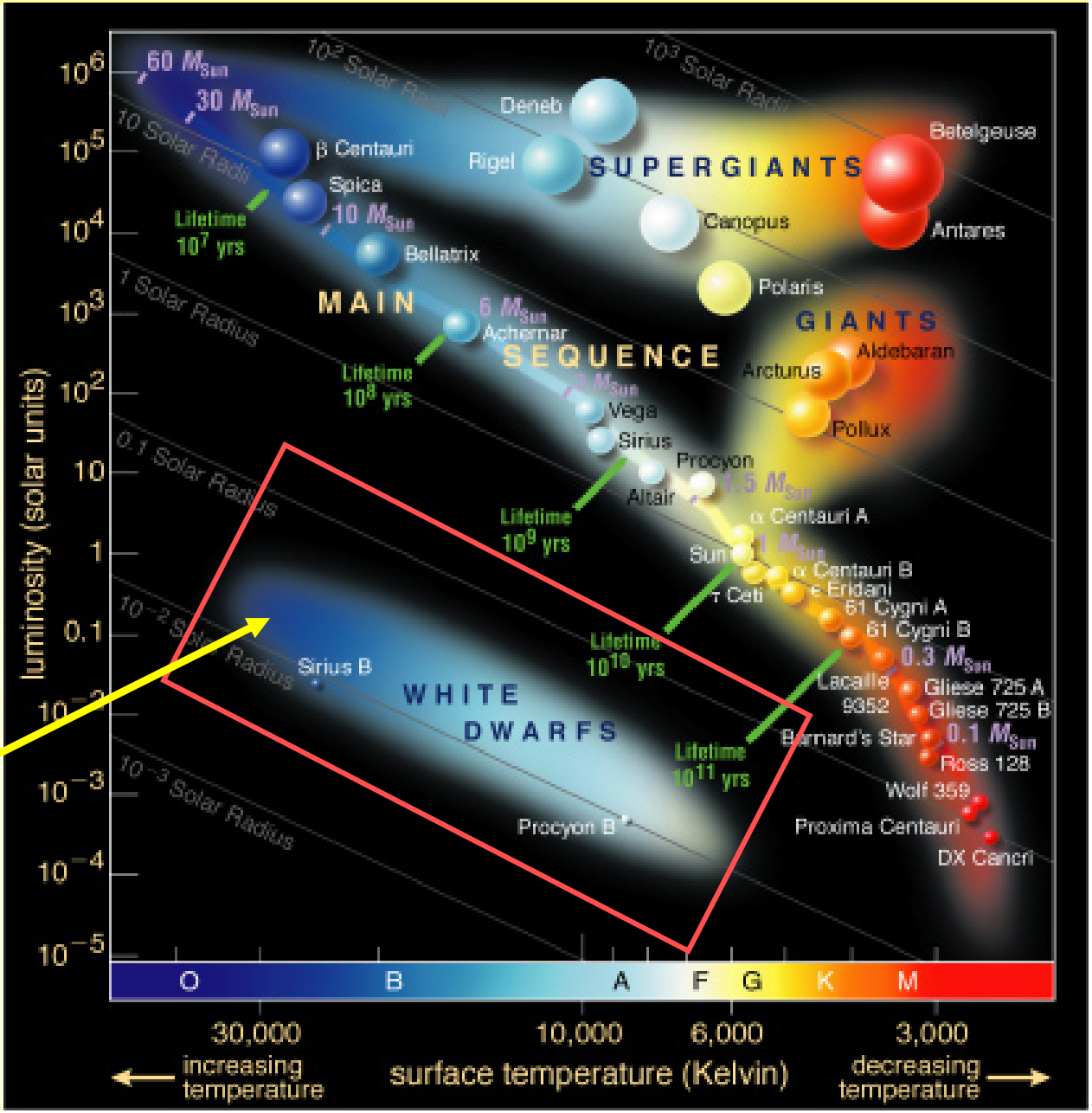
Nana blanca de C+O

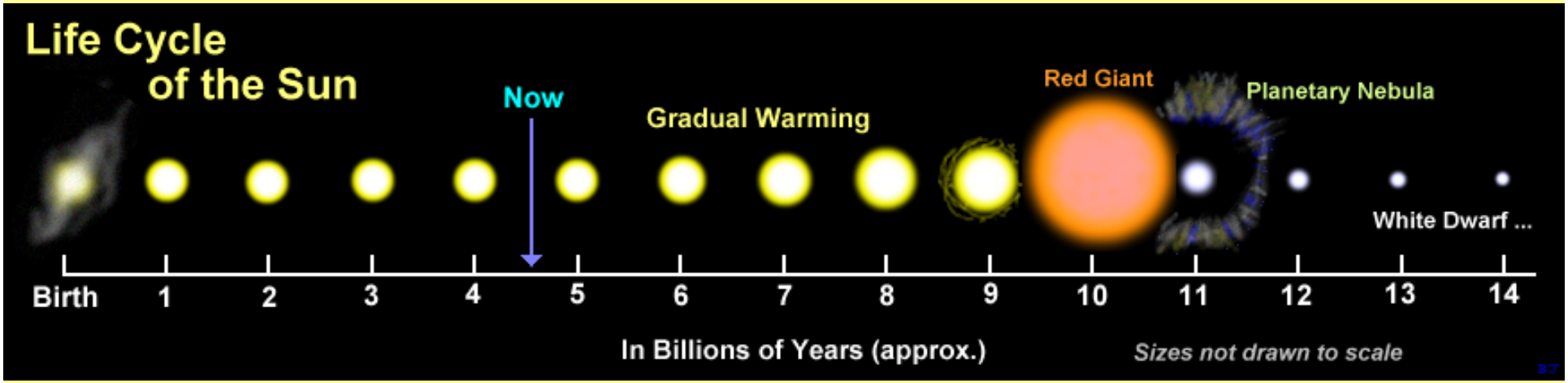
Grandària de la Terra

Molt densa

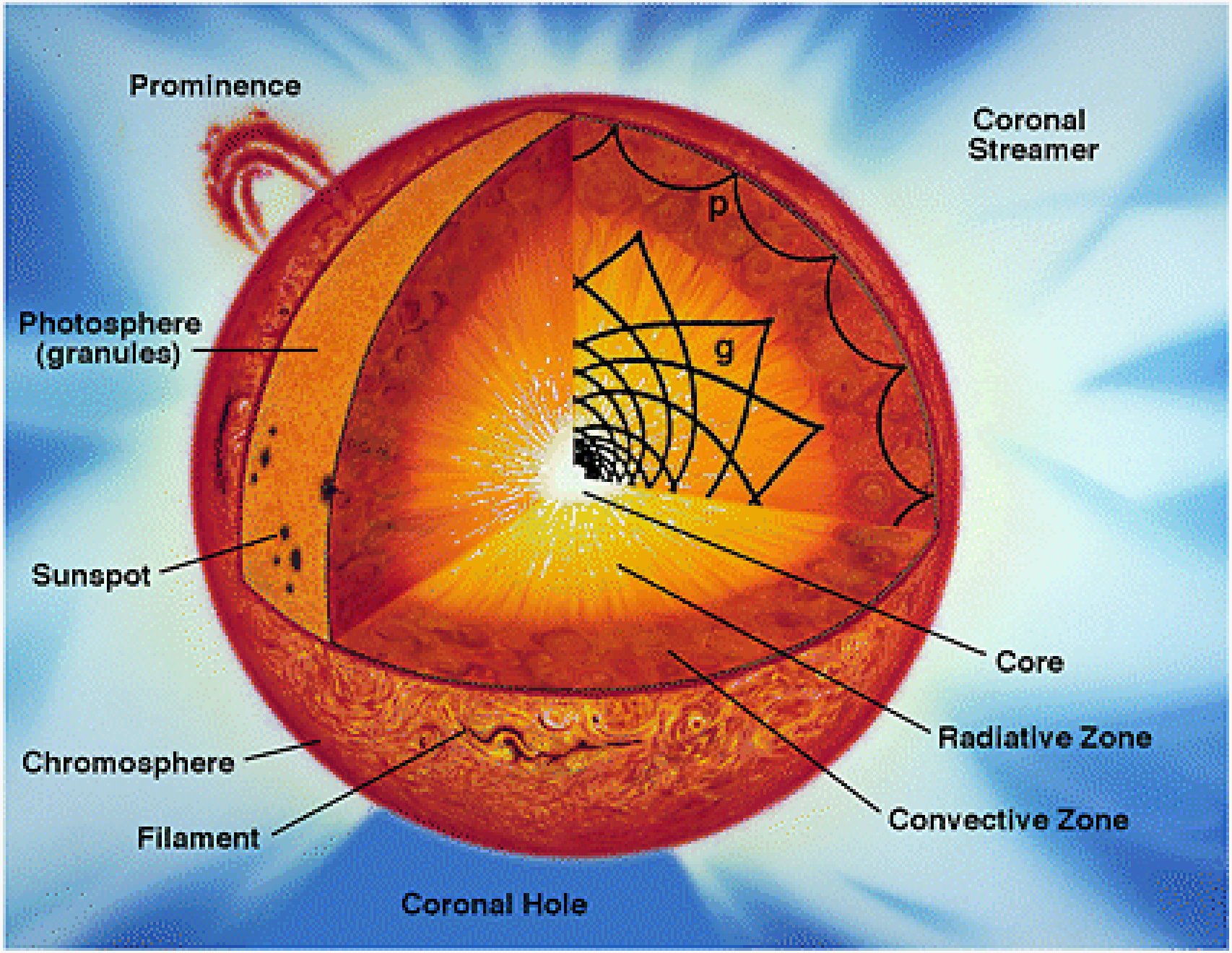
Es refredarà lentament

S'enfosquirà




Life Cycle
of the Sun
Now
Gradual Warming
Red Giant
Planetary Nebula
White Dwarf ...
Birth
1
2
3
4
5
6
7
8
9
10
11
12
13
14
In Billions of Years (approx.)
Sizes not drawn to scale

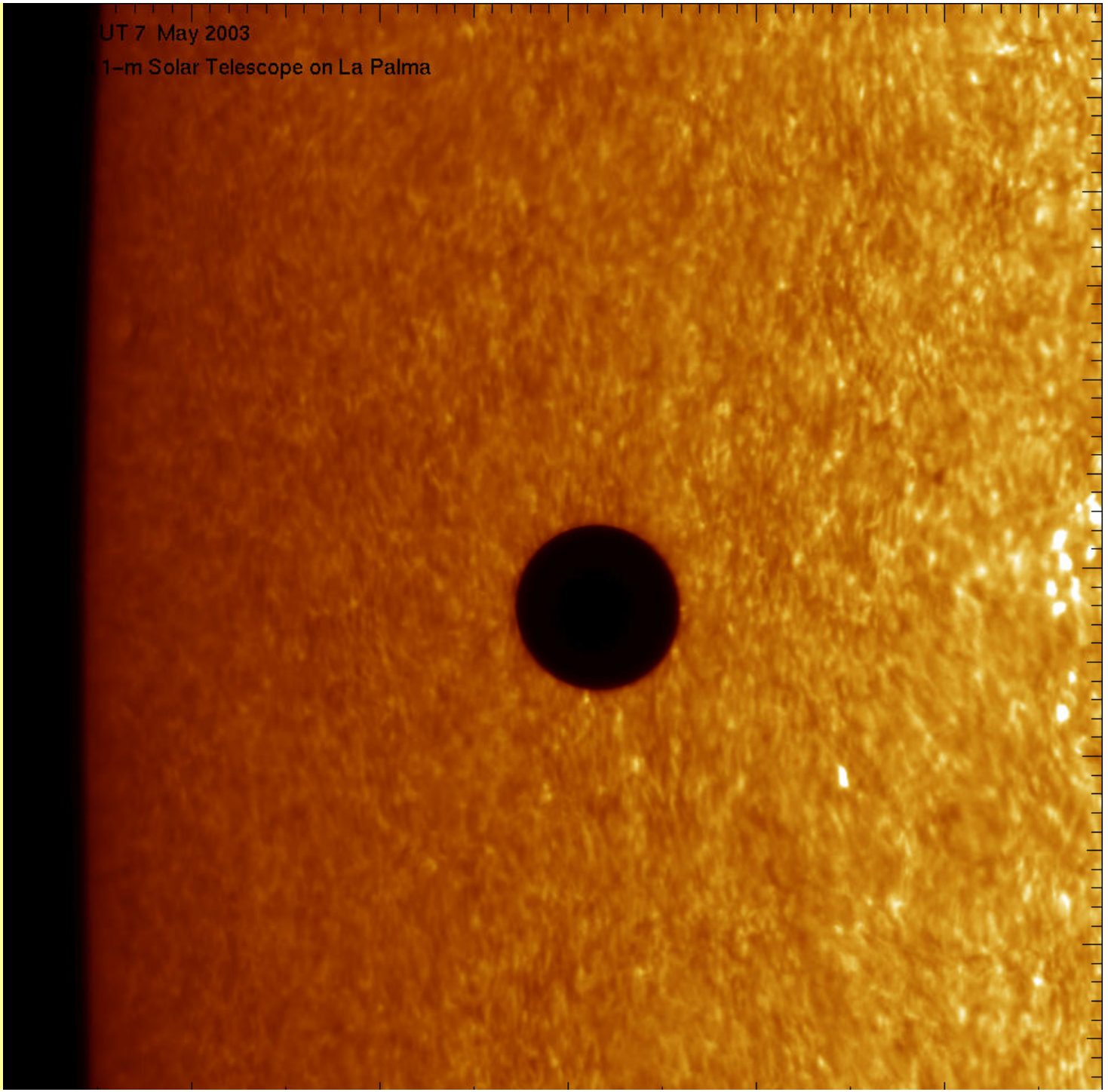
Estructura


Prominence
Coronal Streamer
p
g
Photosphere (granules)
Sunspot
Core
Radiative Zone
Chromosphere
Convective Zone
Filament
Coronal Hole
Period (min)

Fotosfera

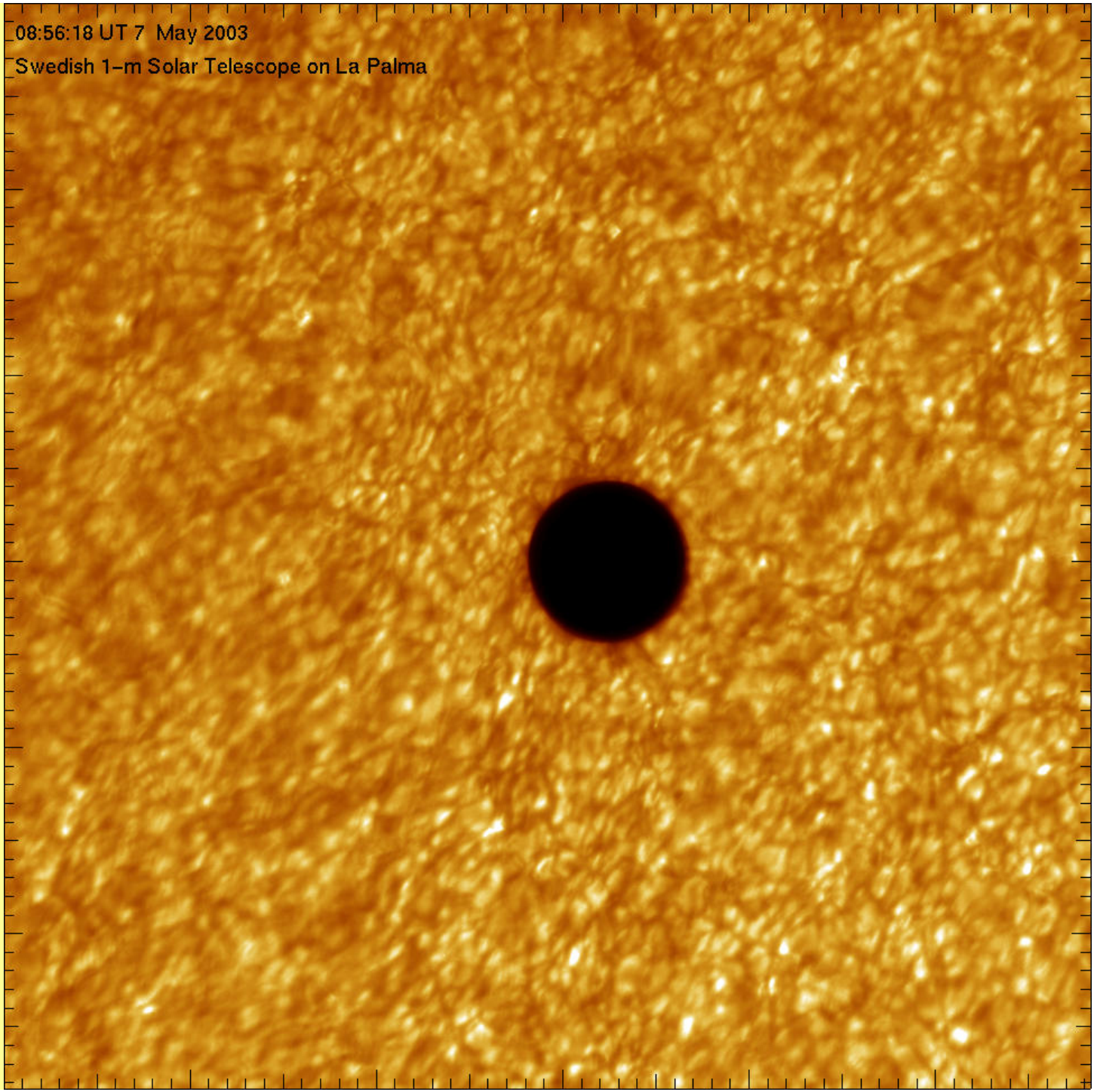
enfosquiment vores

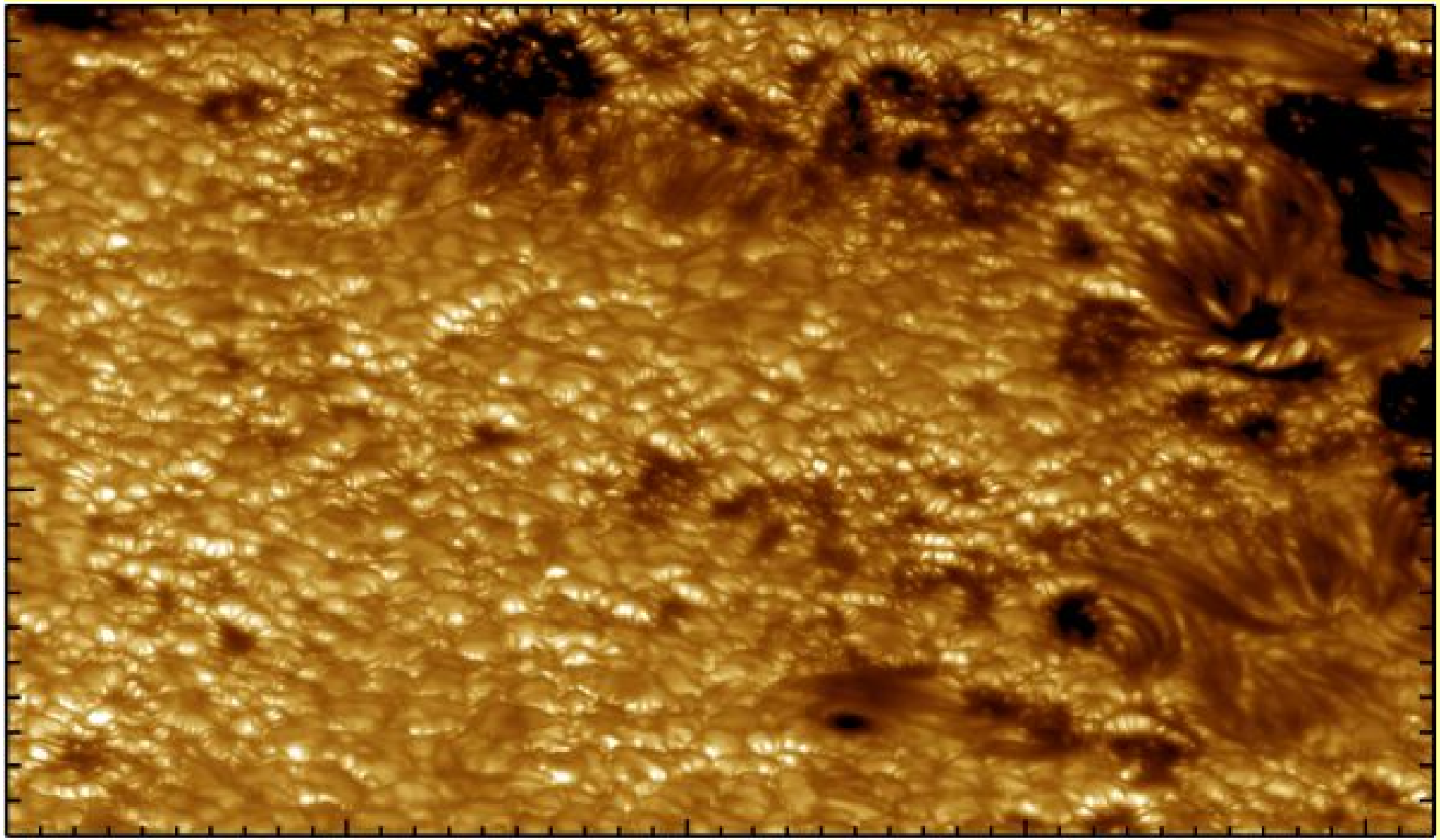
granulació



Fotosfera

granulació
supergranulació

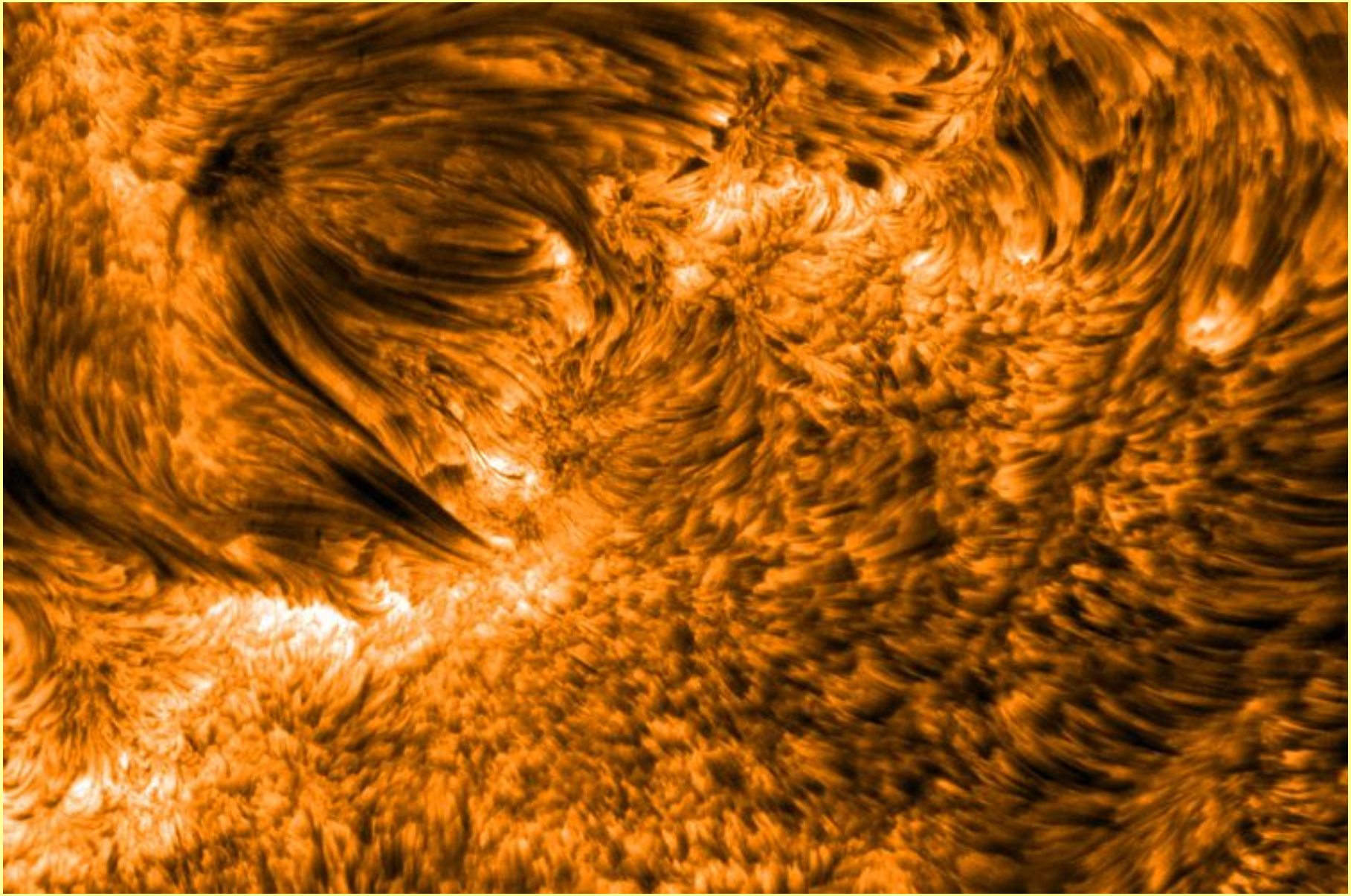





cromosfera

cromosfera

cromosfera espícules



corona

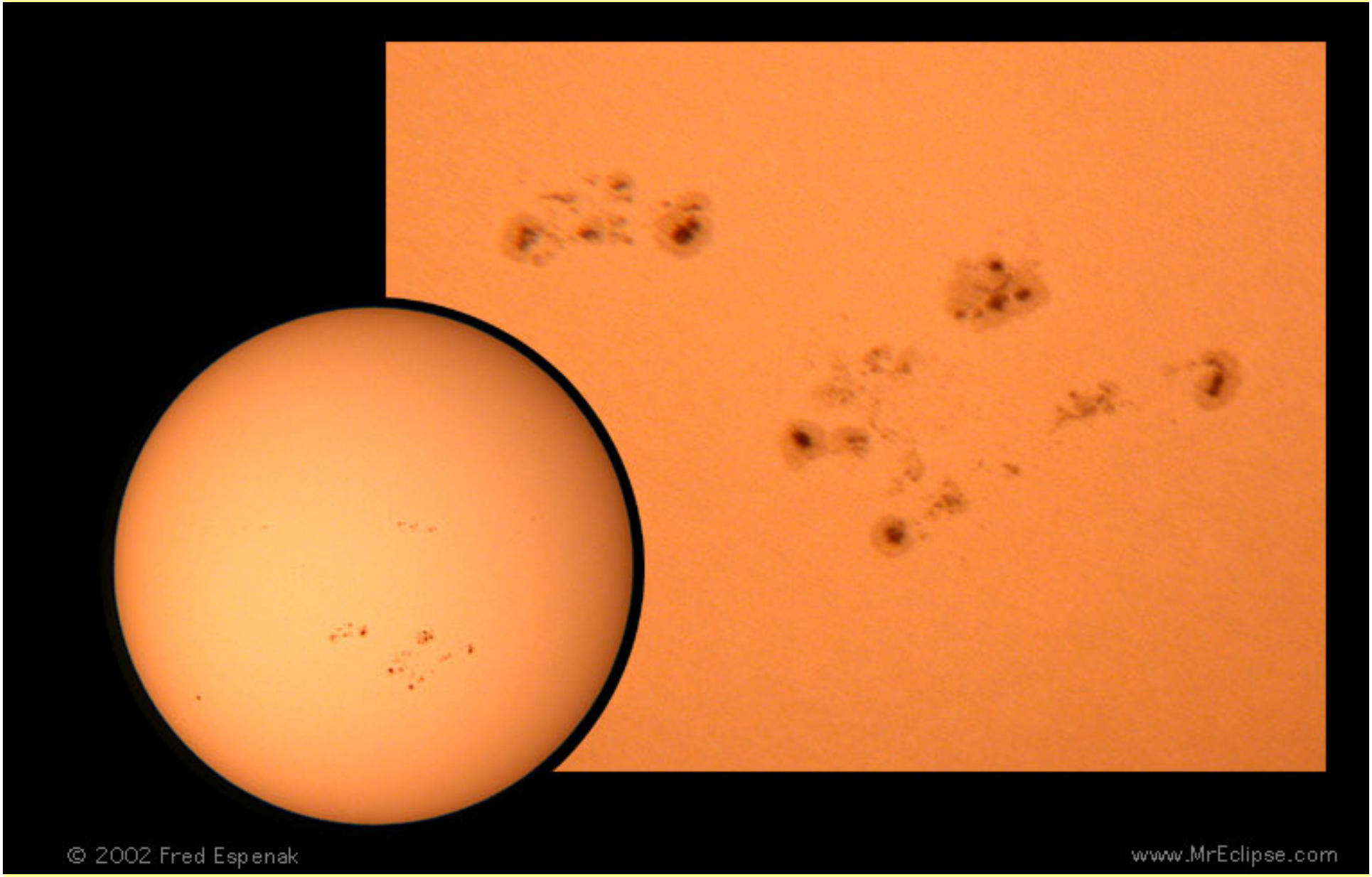
corona

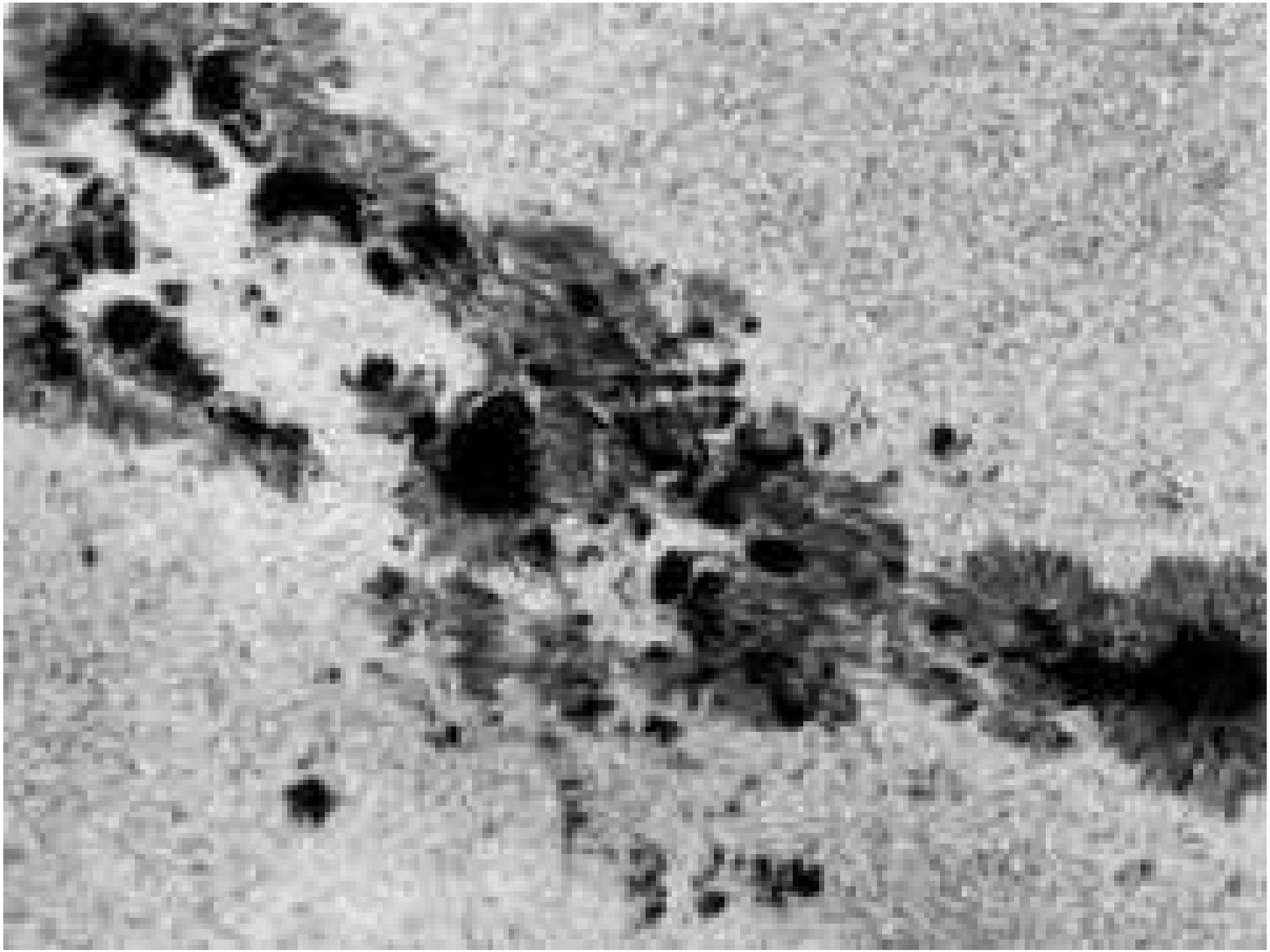

vent solar

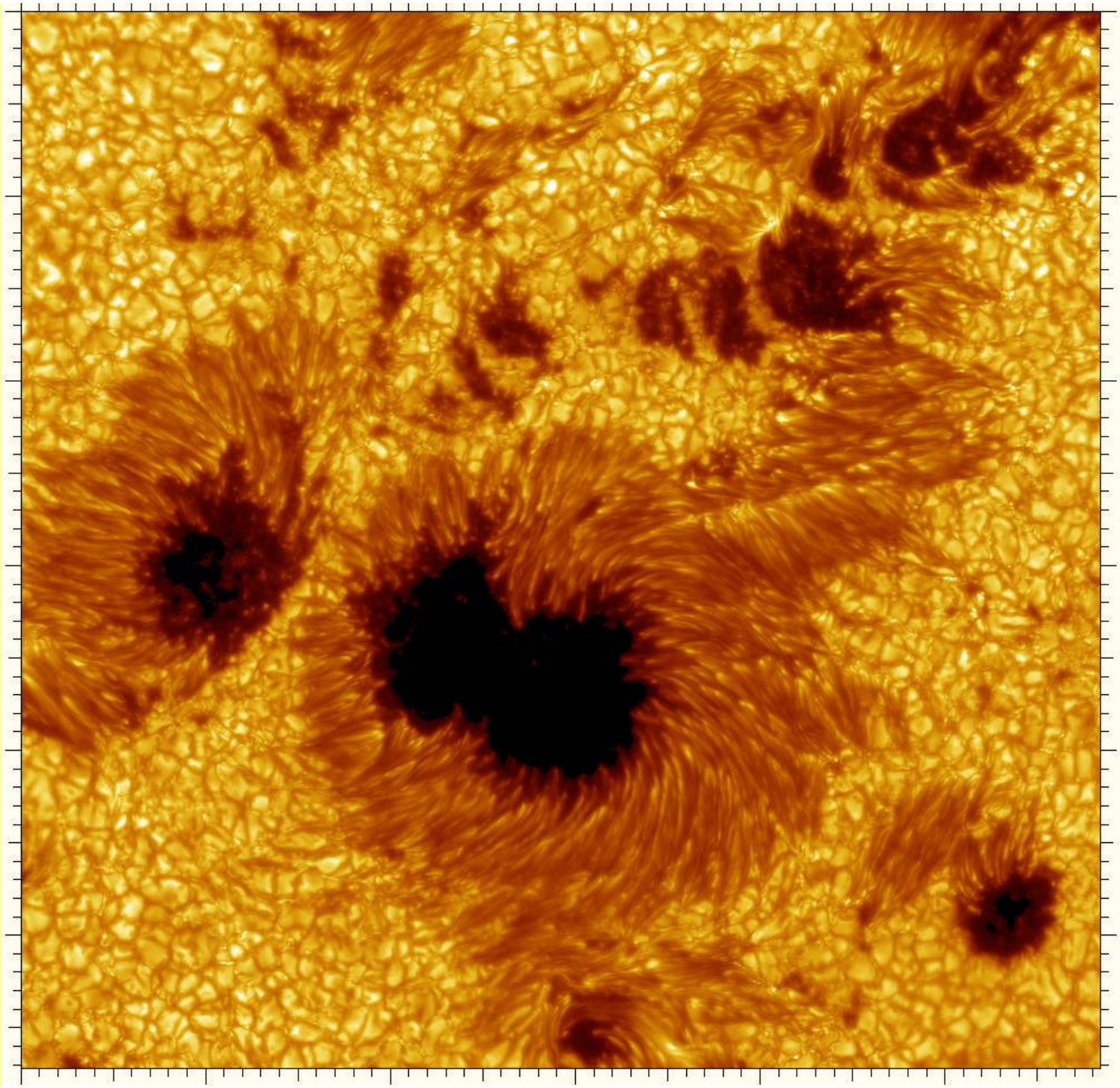
Activitat

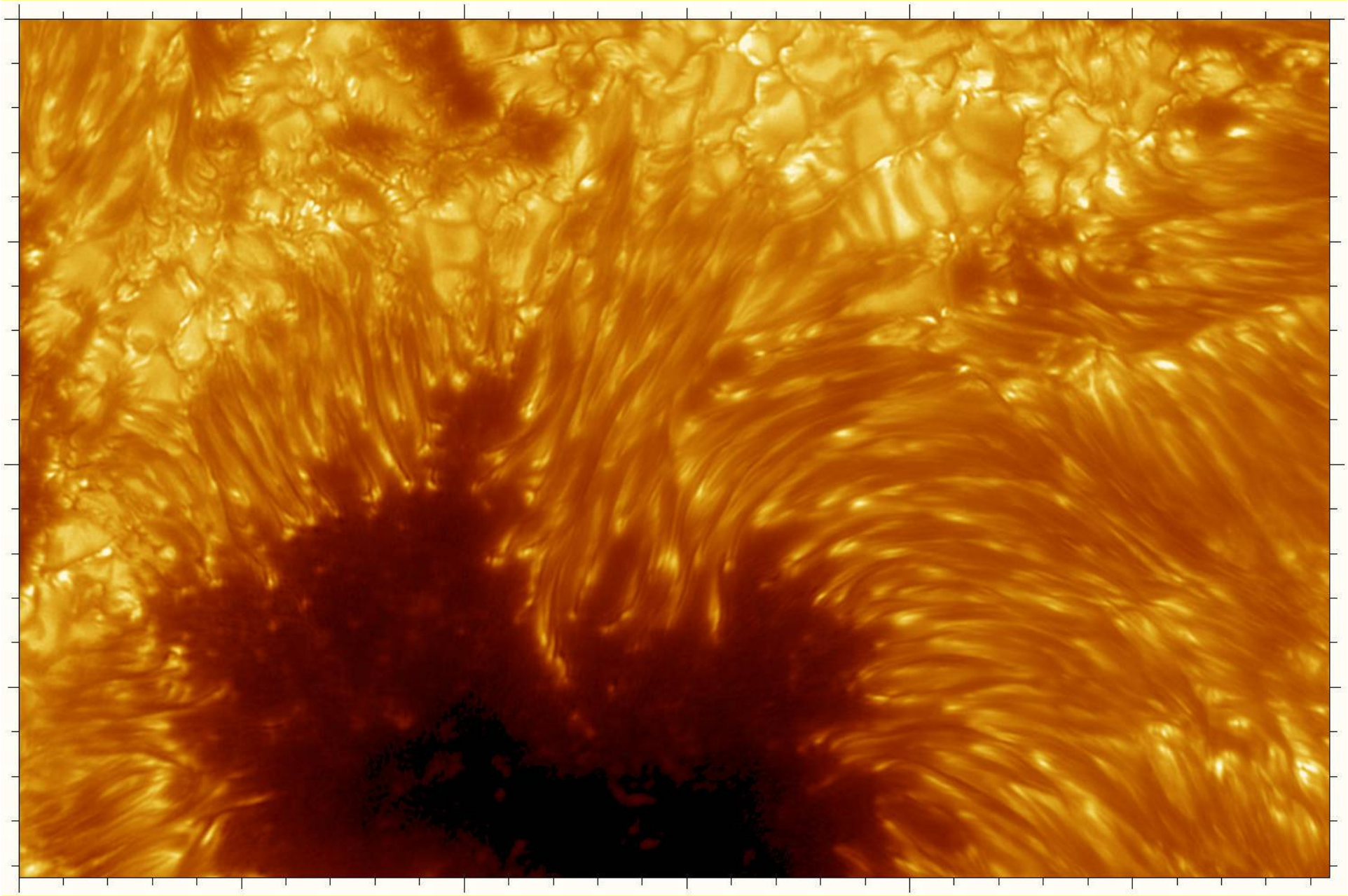
activitat solar

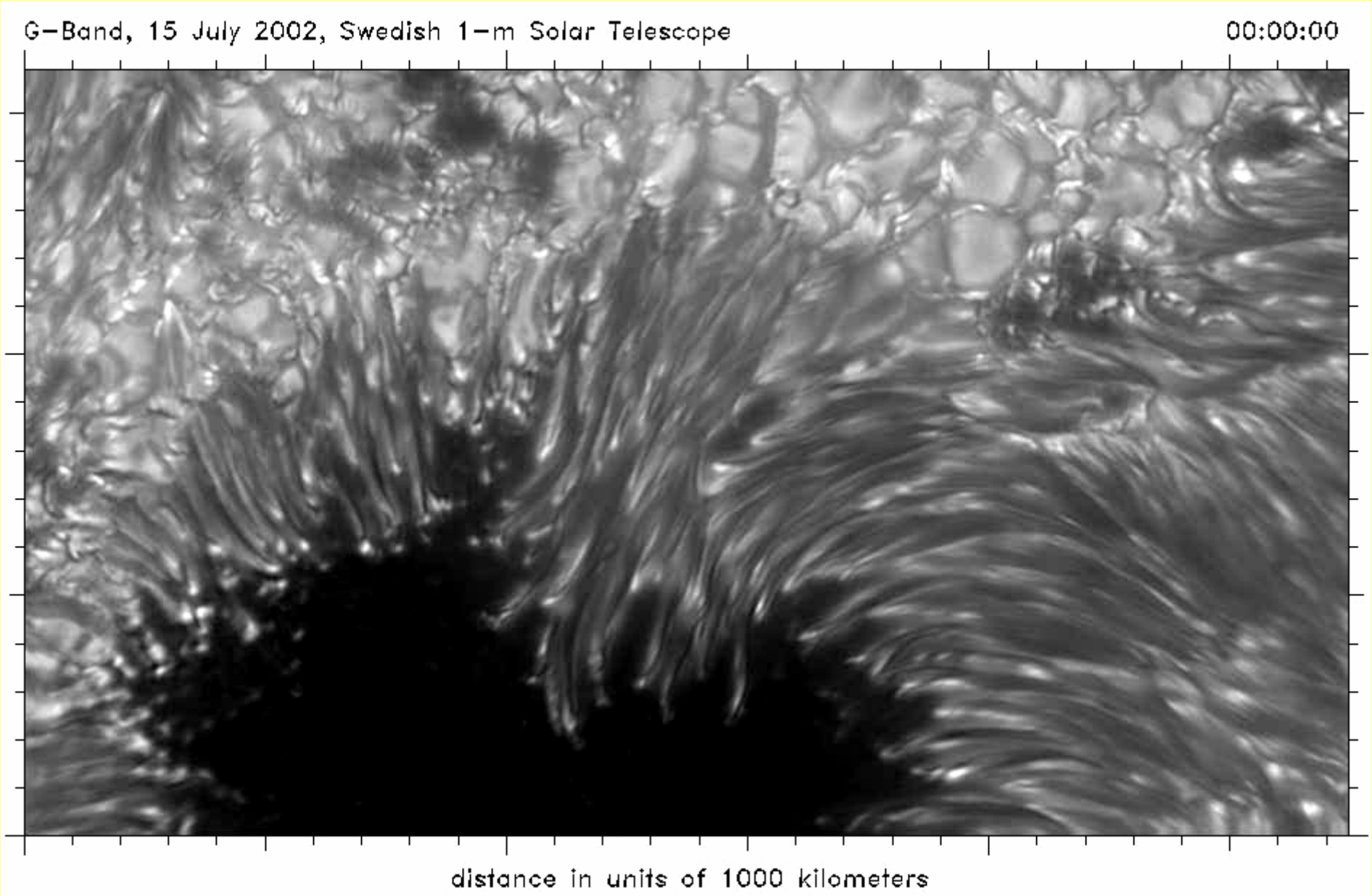
taques


© 2002 Fred Espenak
www.MrEclipse.com

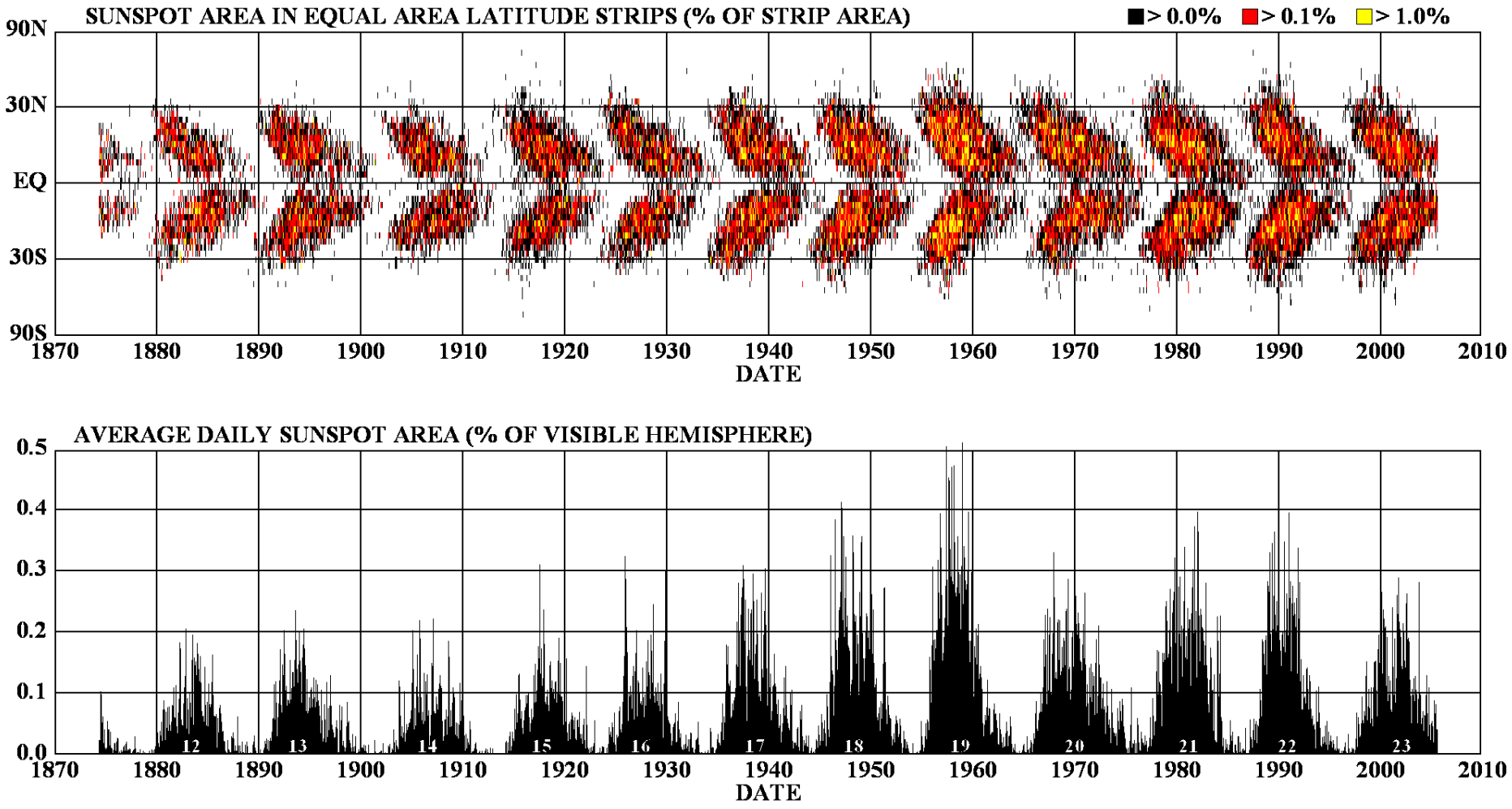






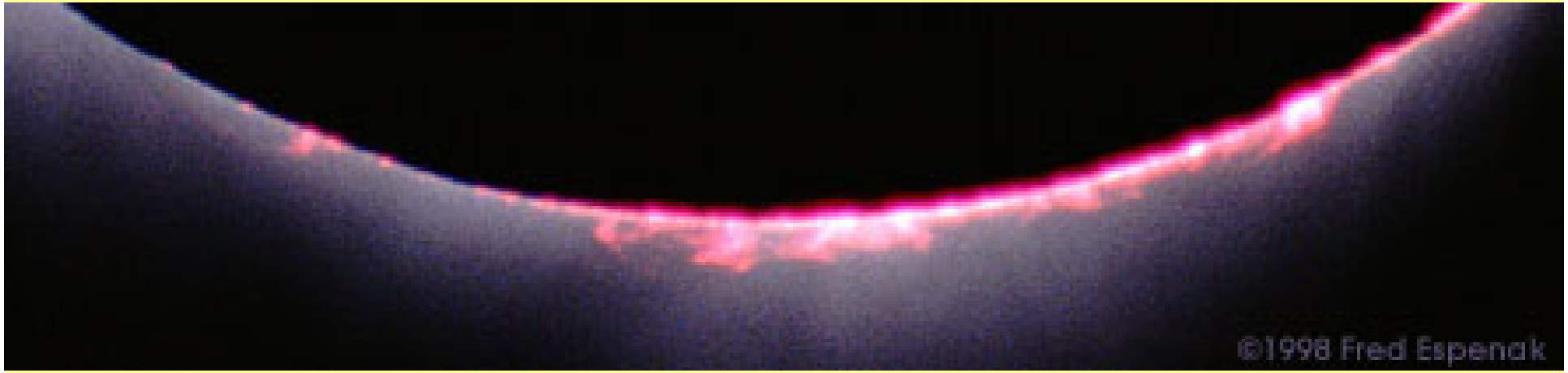

G-Band, 15 July 2002, Swedish 1-m Solar Telescope
00:00:00
distance in units of 1000 kilometers

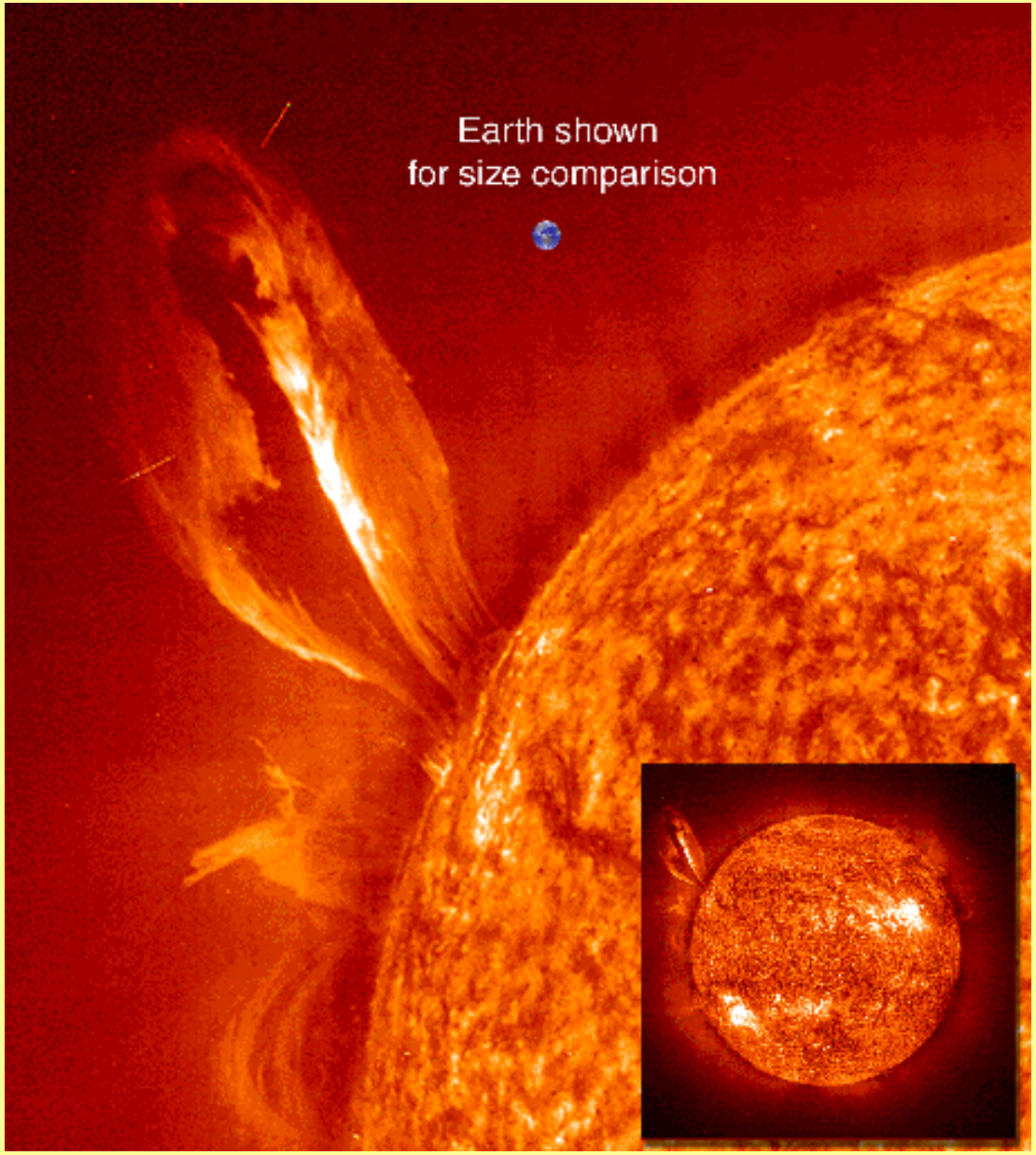
DAILY SUNSPOT AREA AVERAGED OVER INDIVIDUAL SOLAR ROTATIONS

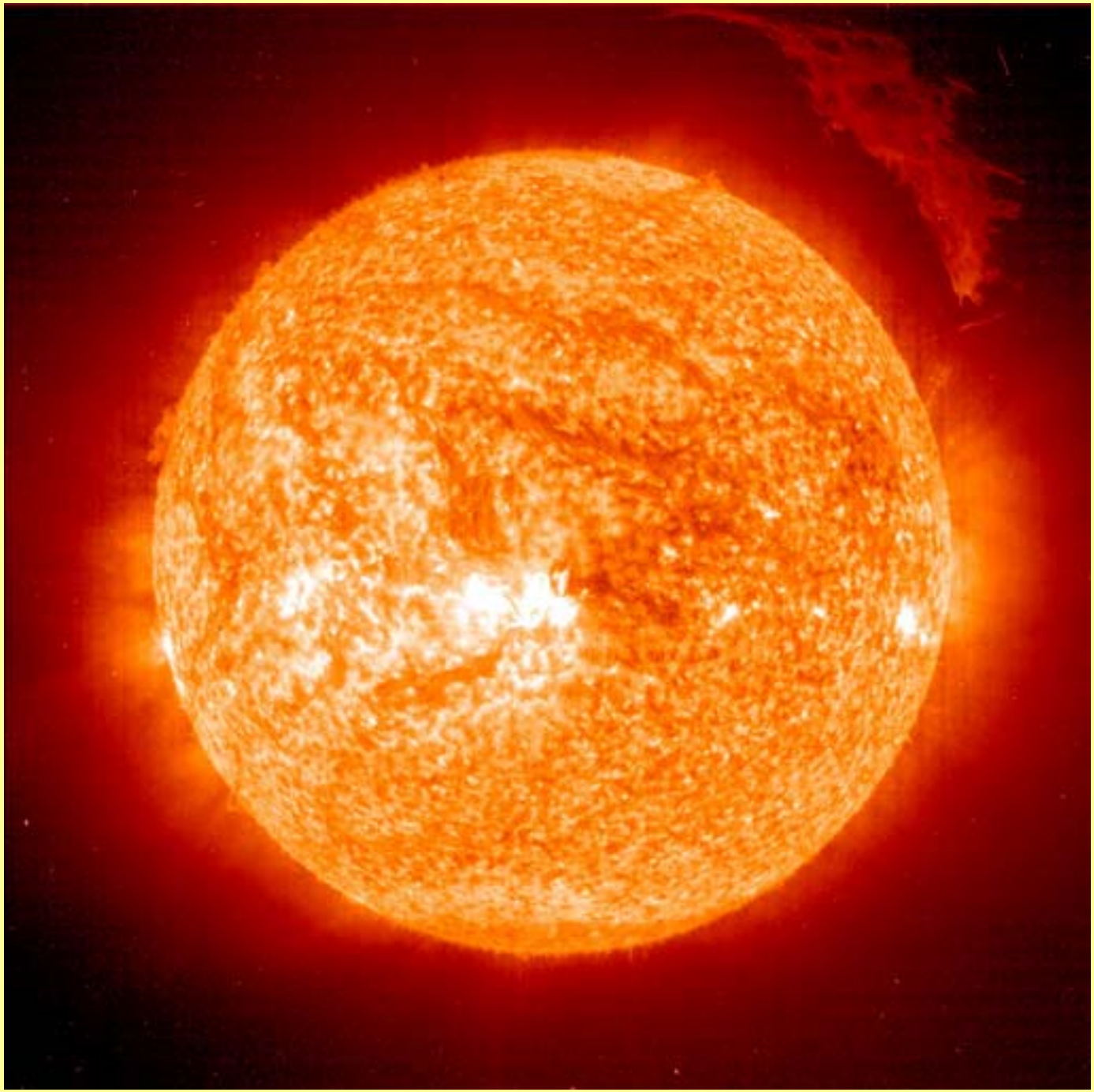


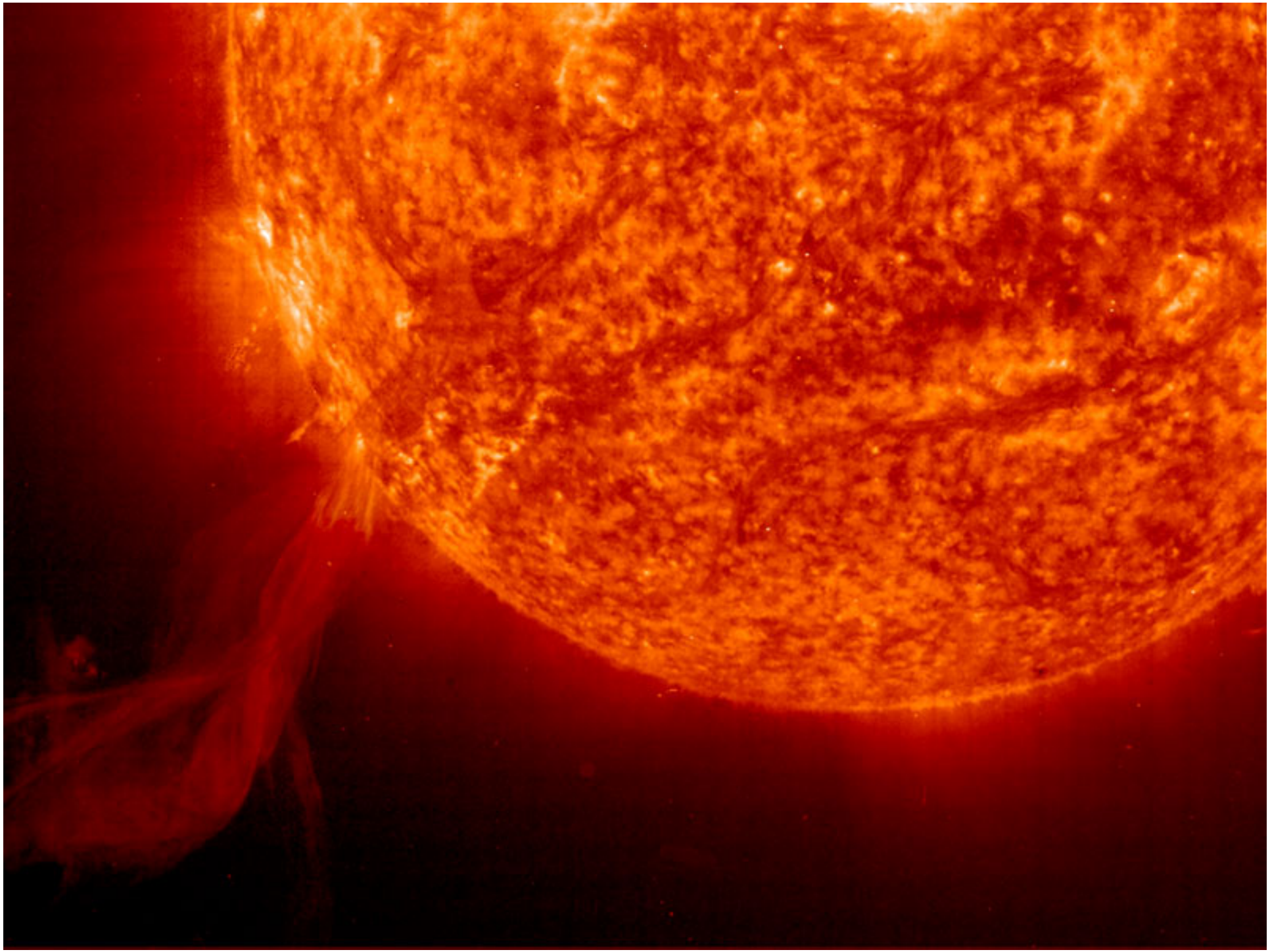
http://science.msfc.nasa.gov/ssl/pad/solar/images/bfly.gif

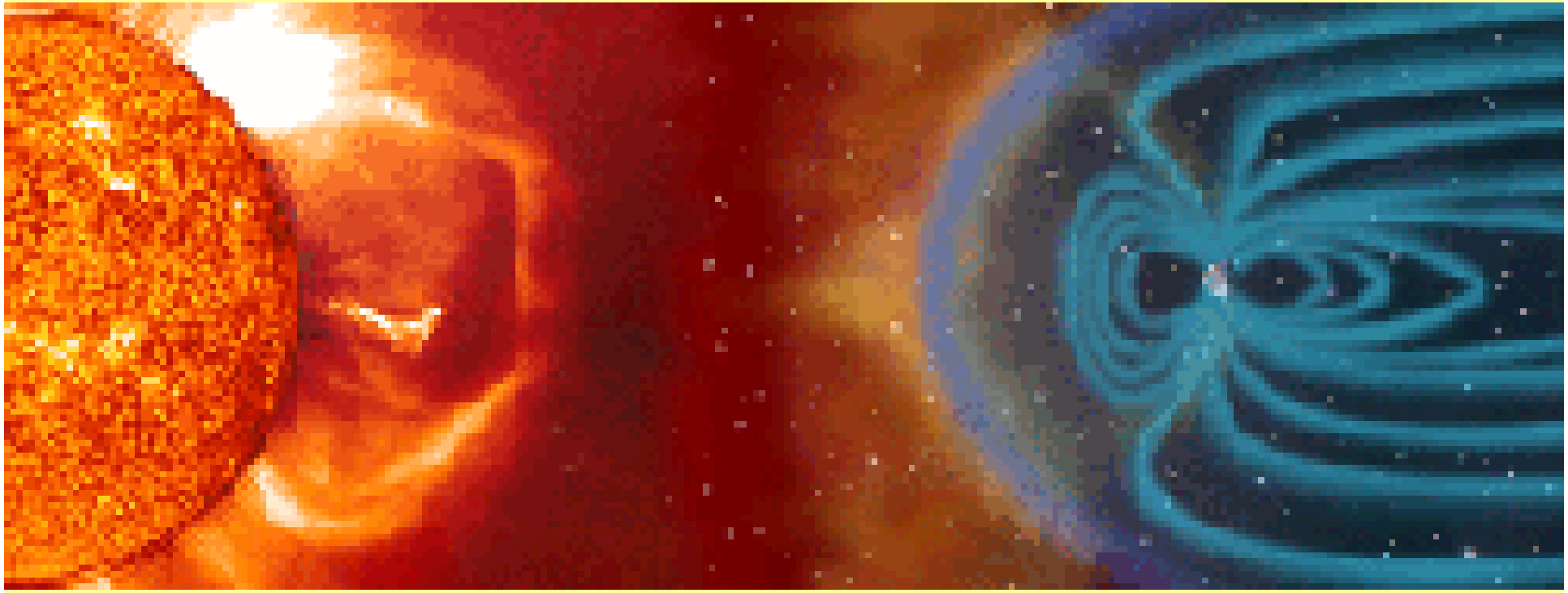
NASA/NSSTC/HATHAWAY 2005/10

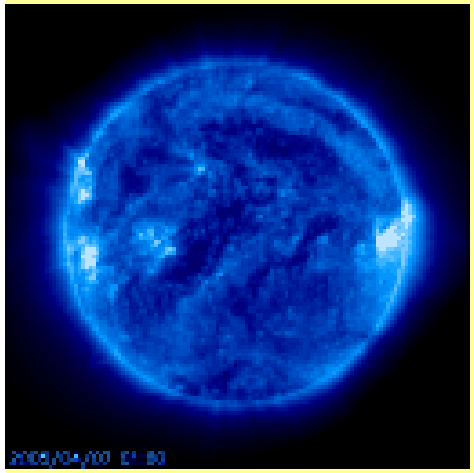

©1998 Fred Espenak

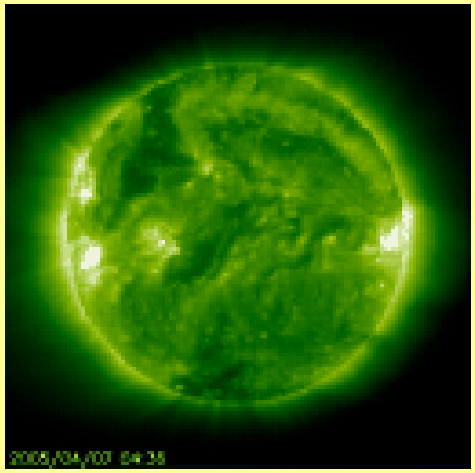

Earth shown
for size comparison

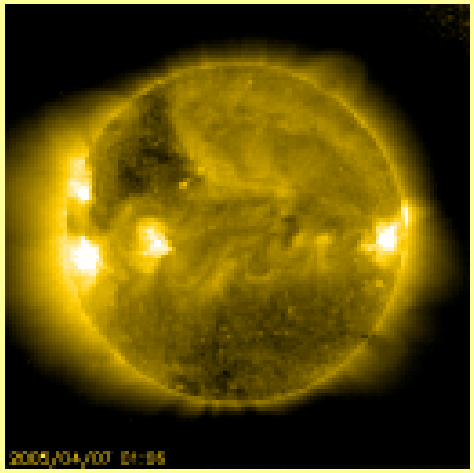


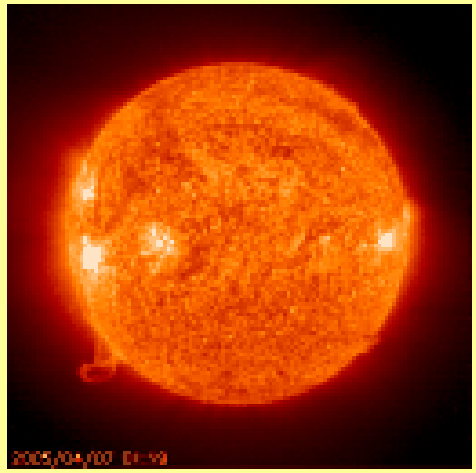


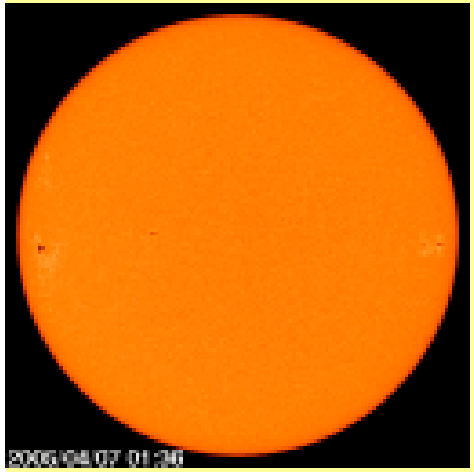


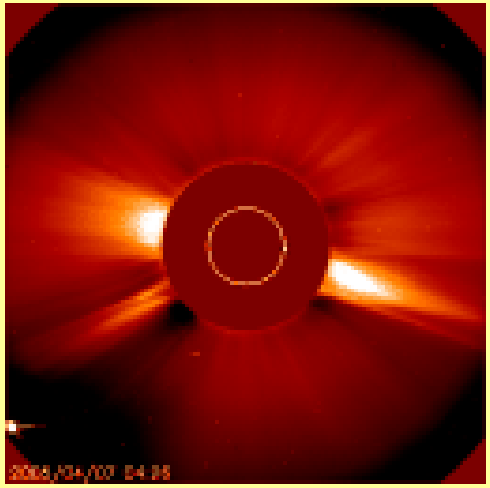


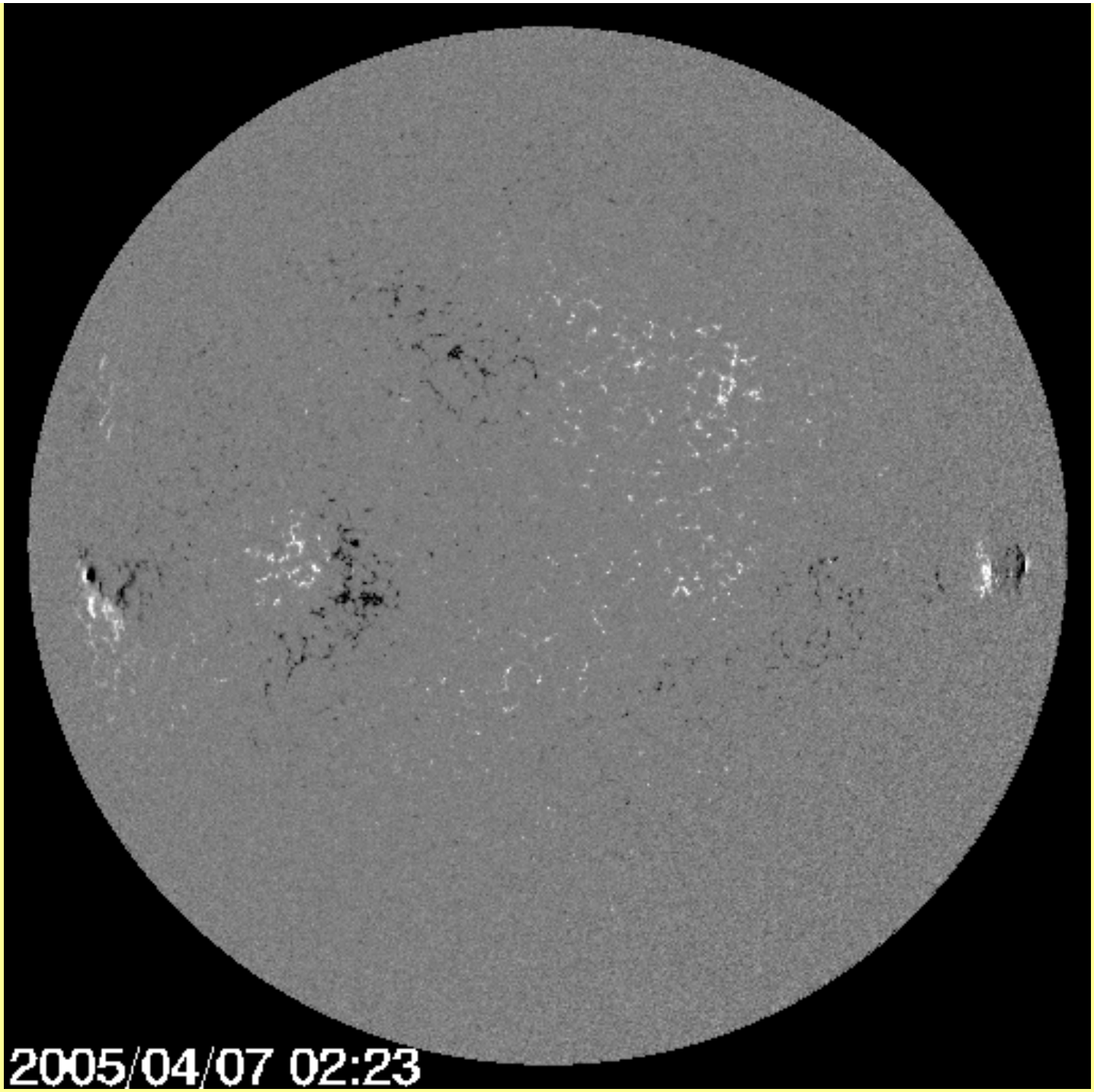








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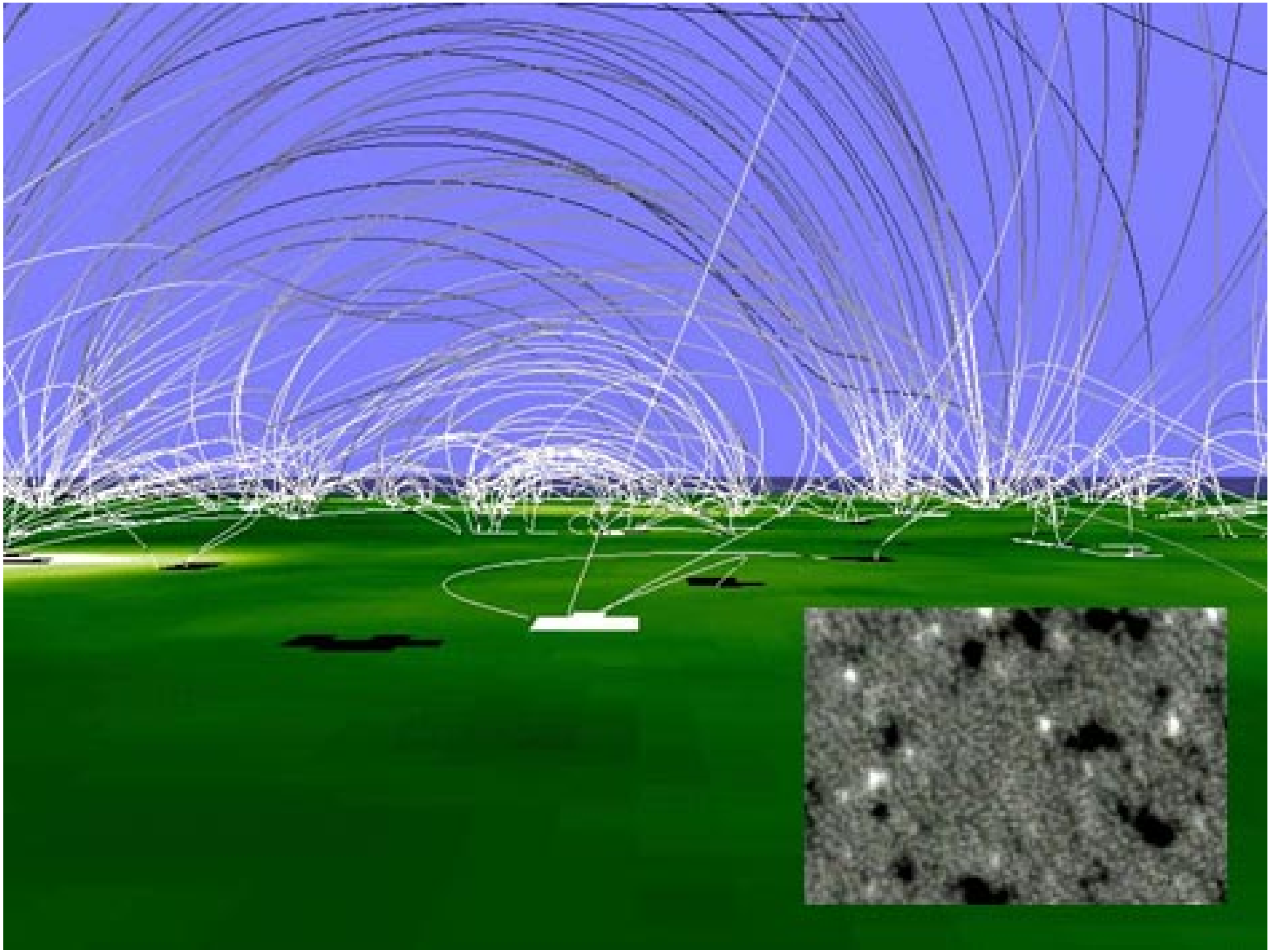

Resum

- és una estrella 'groga' (tipus G)
- és de segona-tercera generació
- és a la meitat de la seva vida
- morirà com una nana blanca (molt densa)
- nucli amb H → He
- capa radiativa + capa convectiva
- atmosfera (fotosfera, cromosfera, corona)
- activitat magnètica (cicle 11 anys)
- taques, espícules, fàcules, prominències, ...

http://www.michielb.nl/sun/kaft.htm

Solar Physics: http://science.nasa.gov/ssl/pad/solar/

S.O.H.O.: http://sohowww.estec.esa.nl/

http://seds.lpl.arizona.edu/nineplanets/nineplanets/sol.html