

A MEDIDA DO UNIVERSO



Walter J. Maciel

<http://www.astro.iag.usp.br/~maciel>

O SISTEMA SOLAR

ESTRELAS E NEBULOSAS

A VIA LÁCTEA

GALÁXIAS

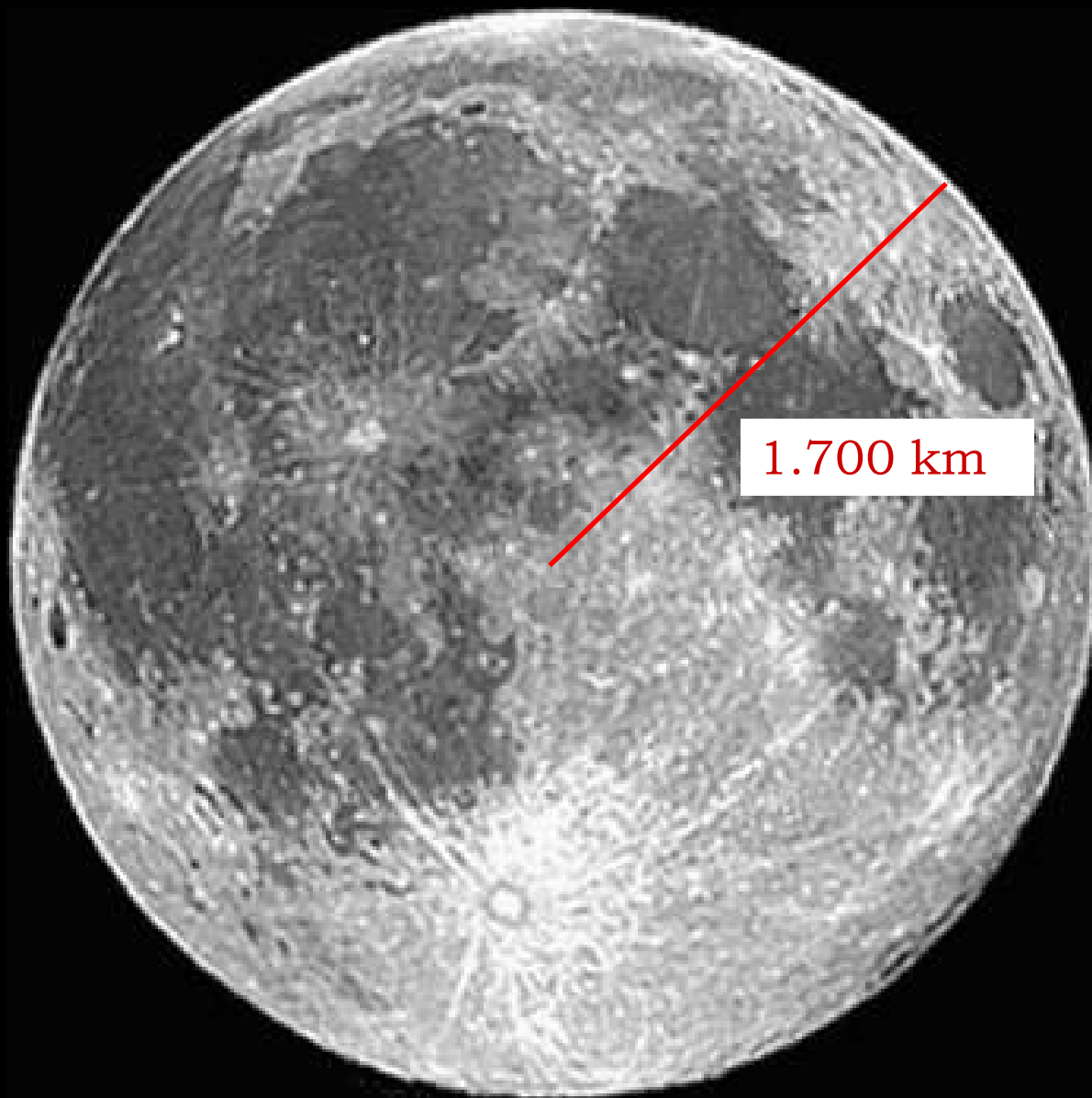
AGLOMERADOS DE GALÁXIAS



O SISTEMA SOLAR



6.400 km



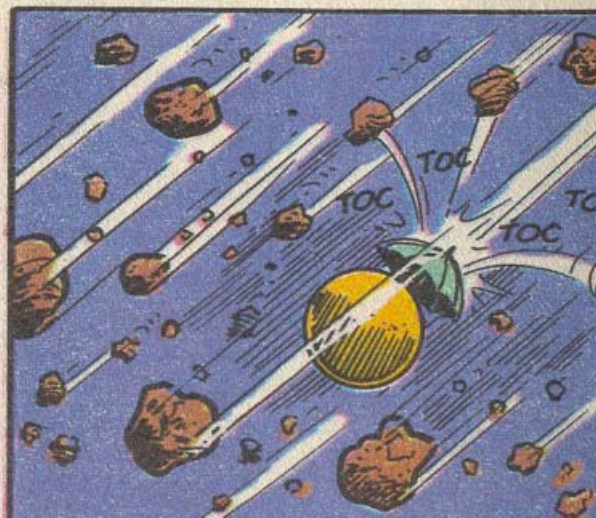
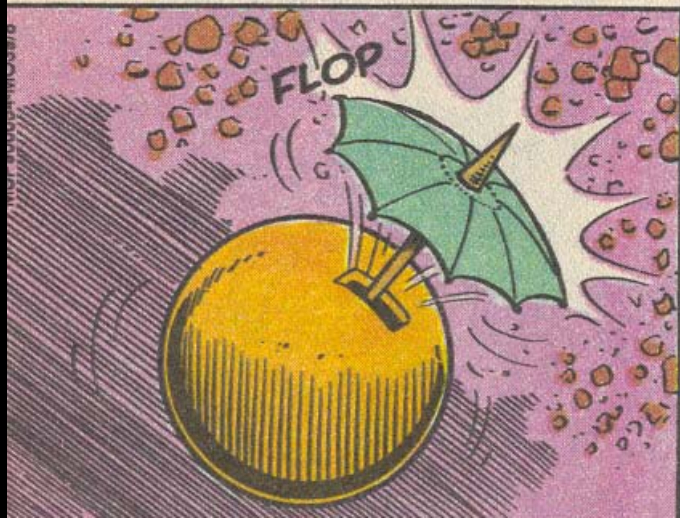
1.700 km

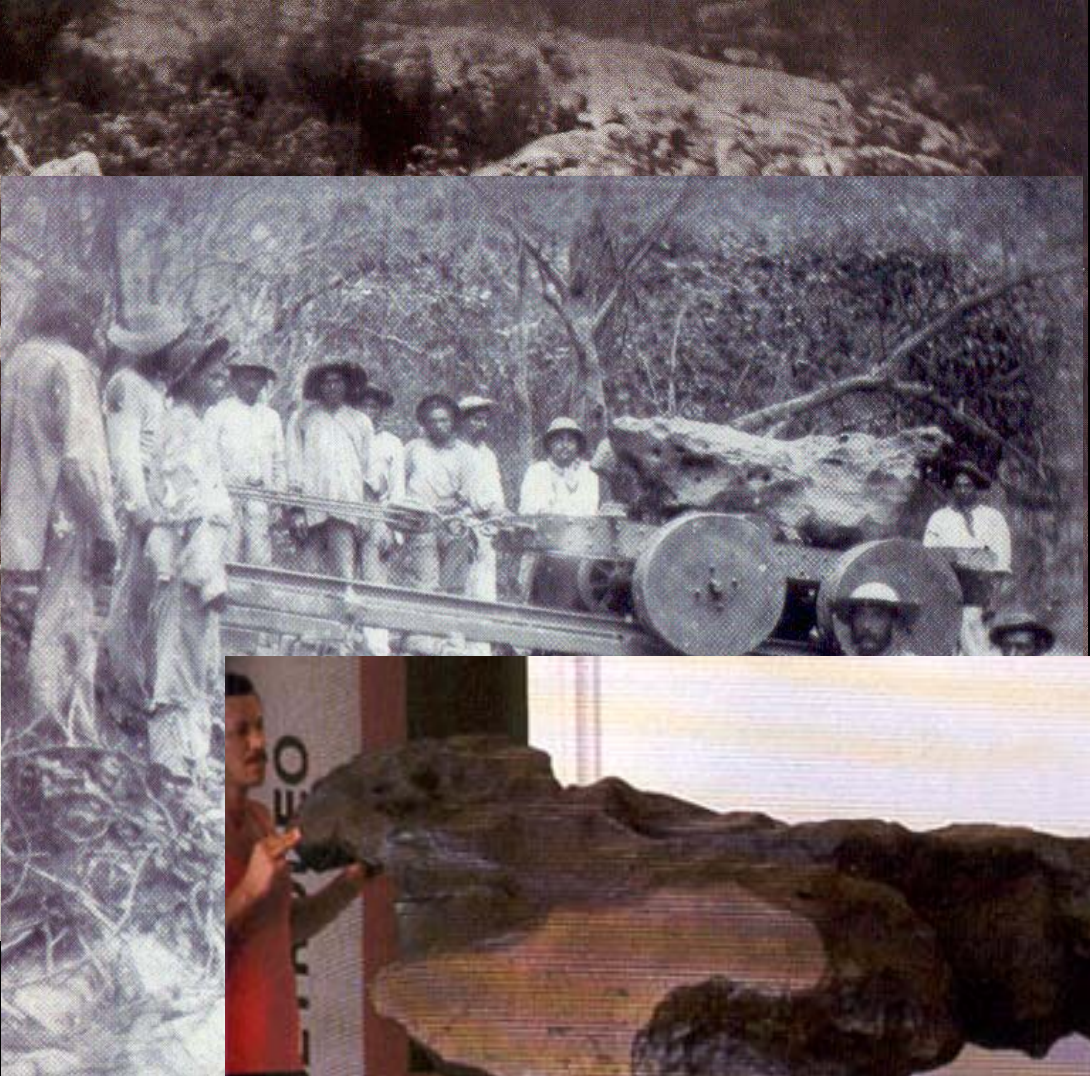
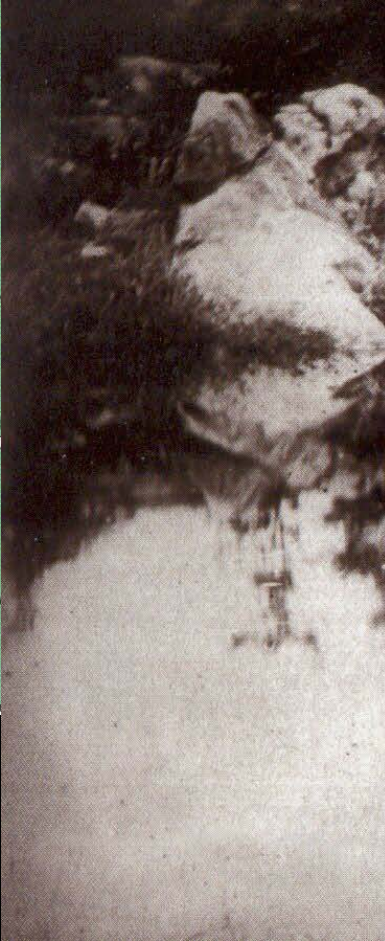
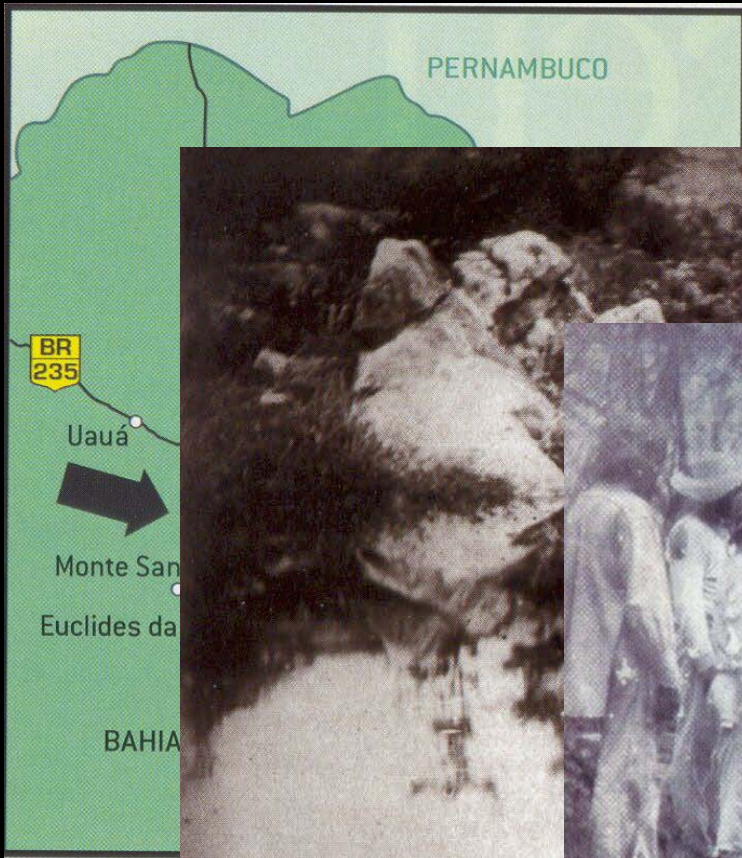
OH! VEM
AÍ UMA CHUVA
DE METEOROS!

PRECISO
ACIONAR
O SISTEMA
DE DEFESA!

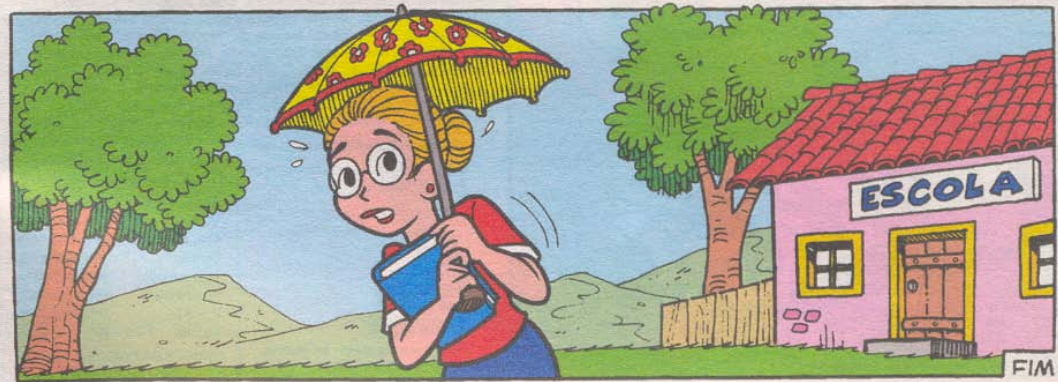


MAURICIO





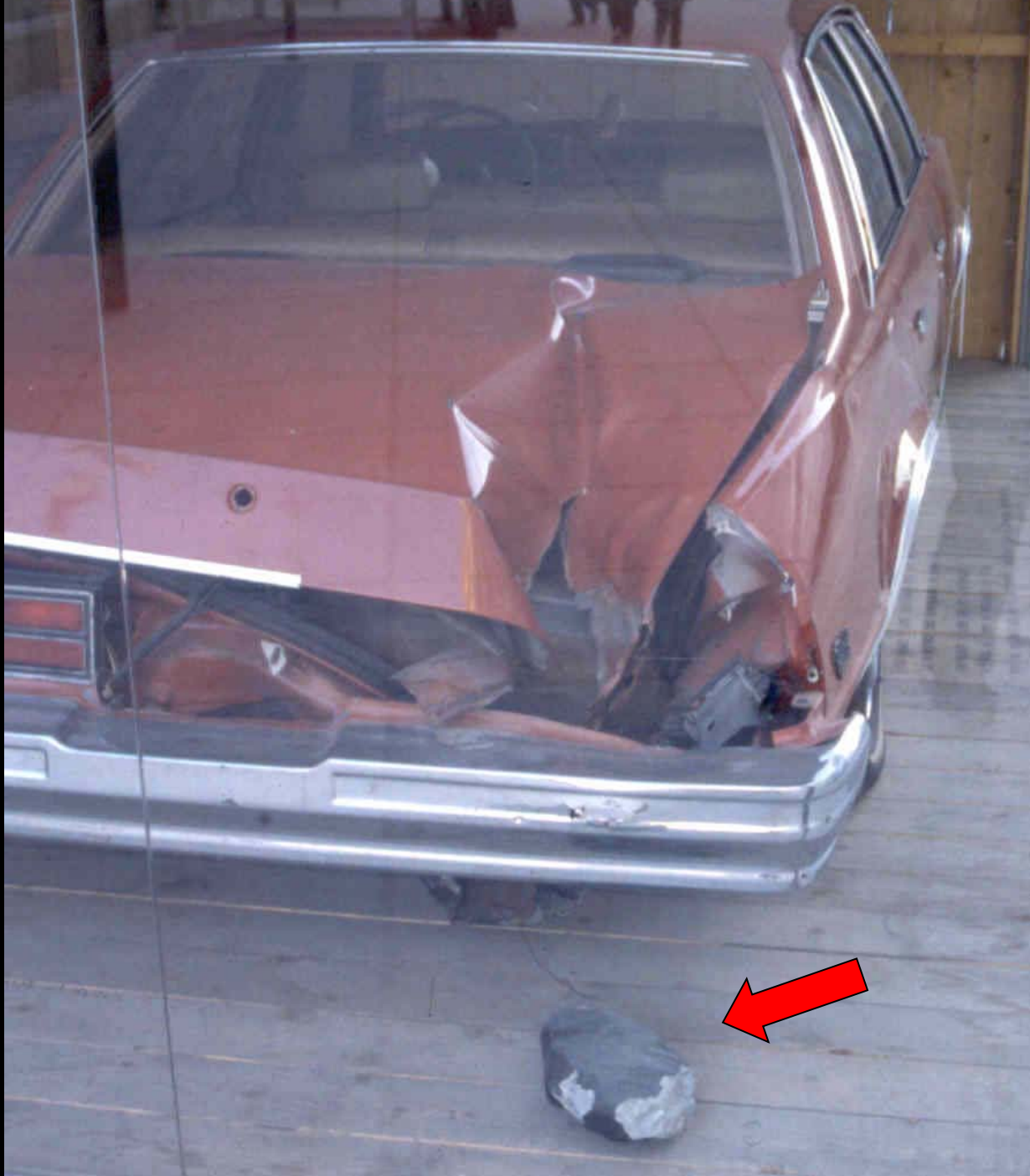
Bendengó
1784



Bendengó
1784

Peekskill

09.10.1992

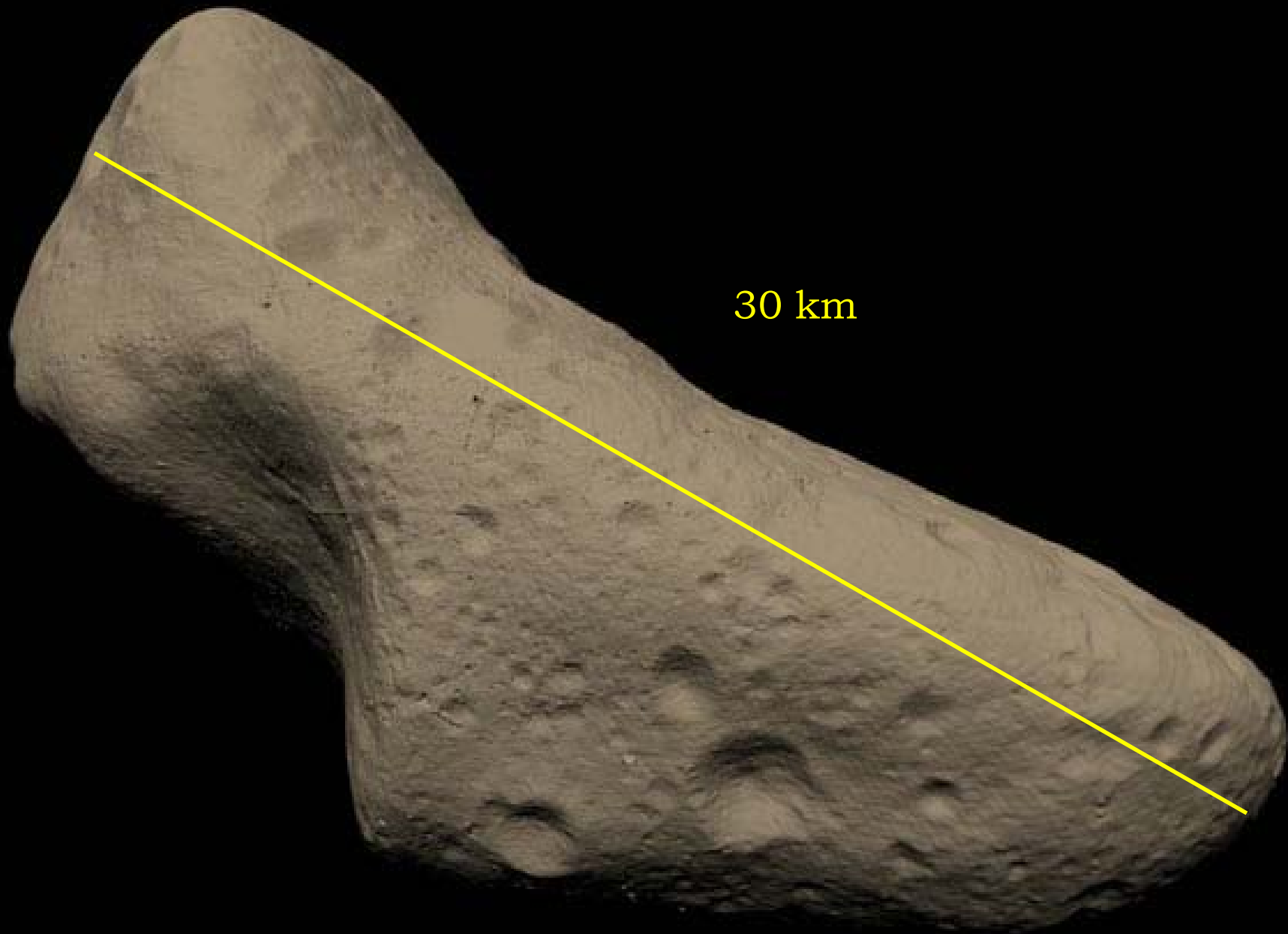


Hodges

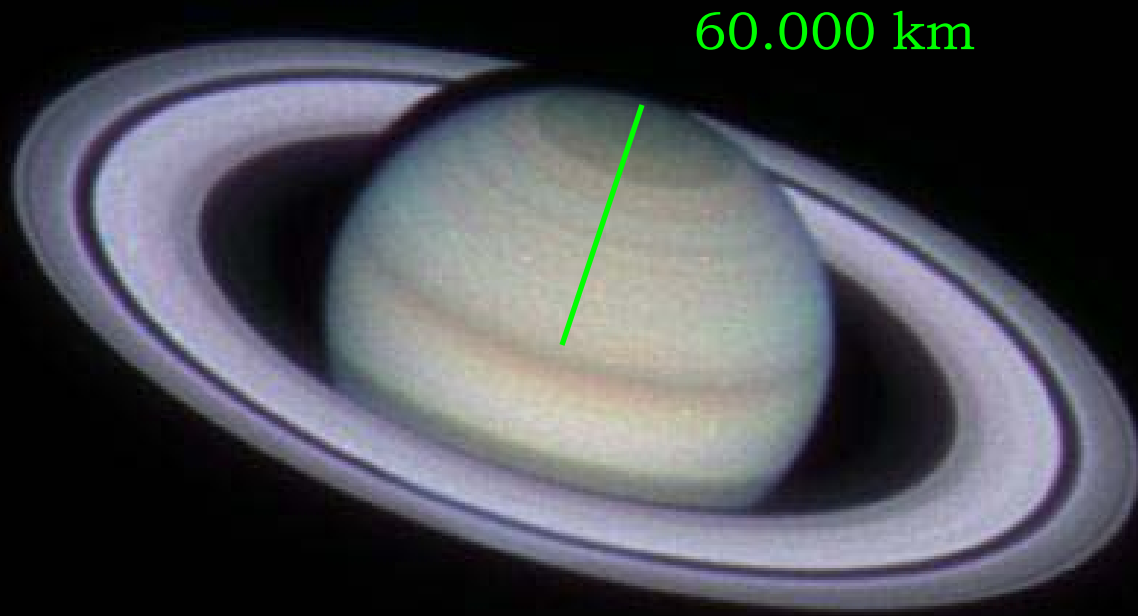
30.11.1954



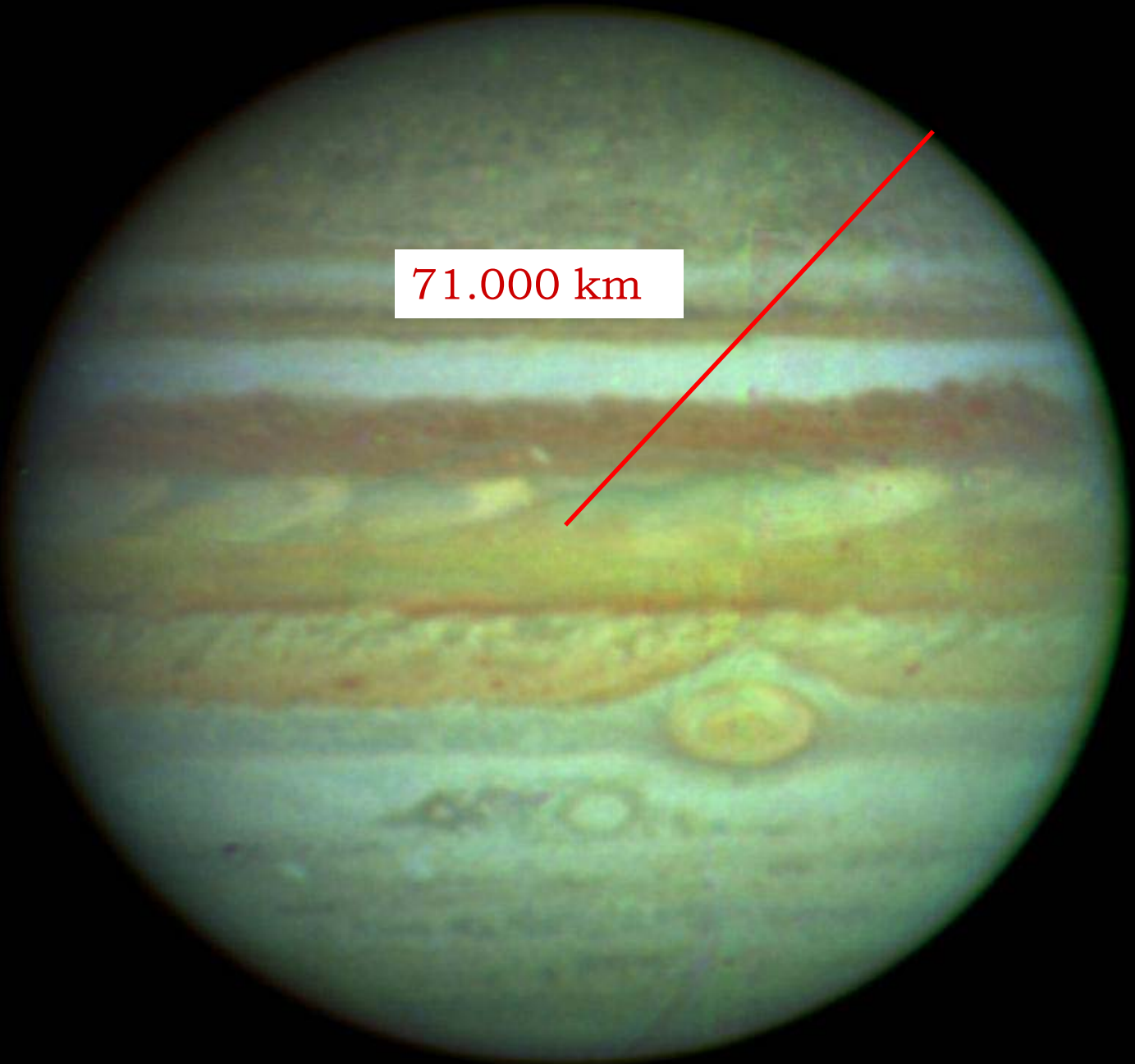




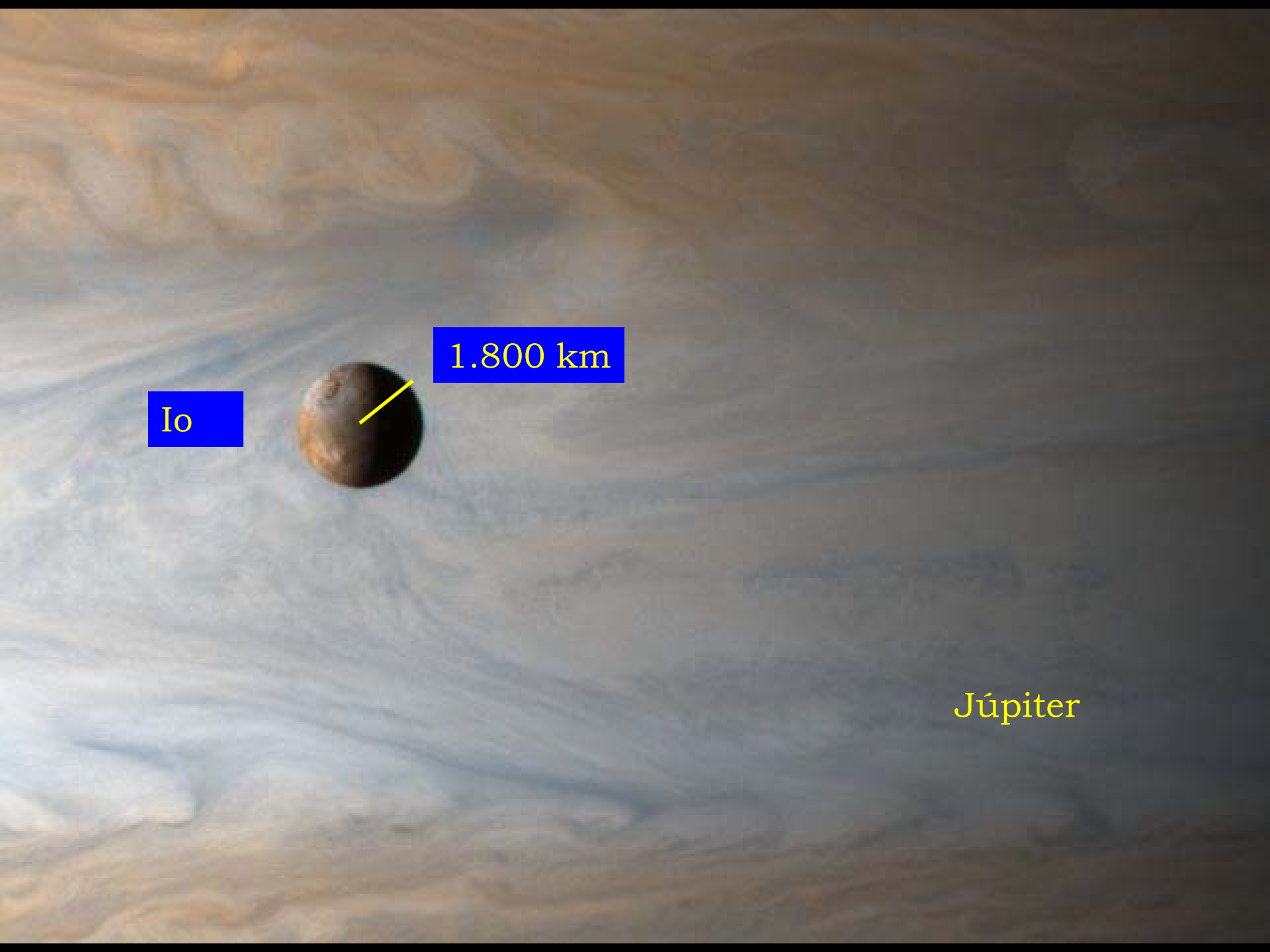
30 km



60.000 km



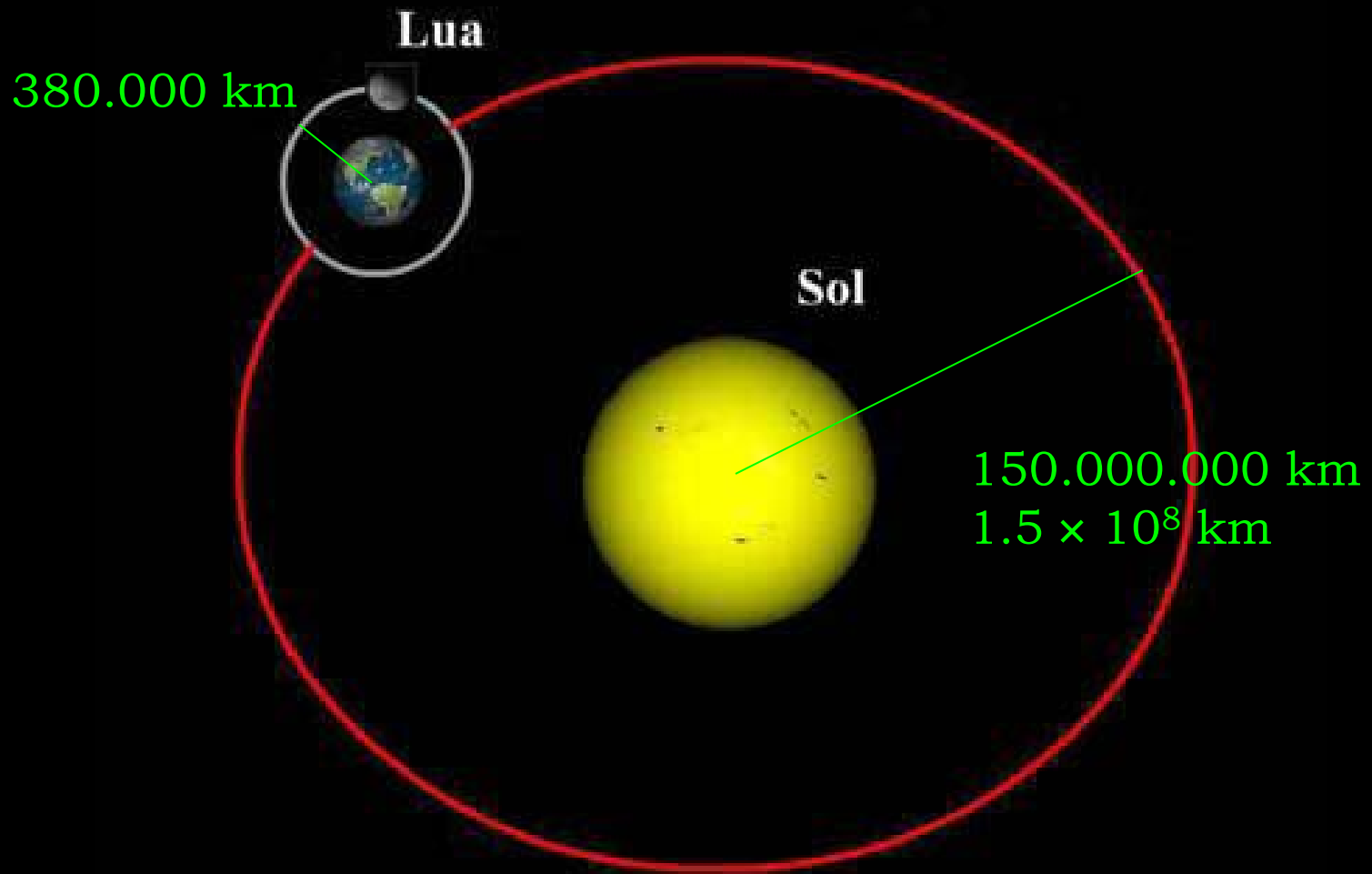
71.000 km



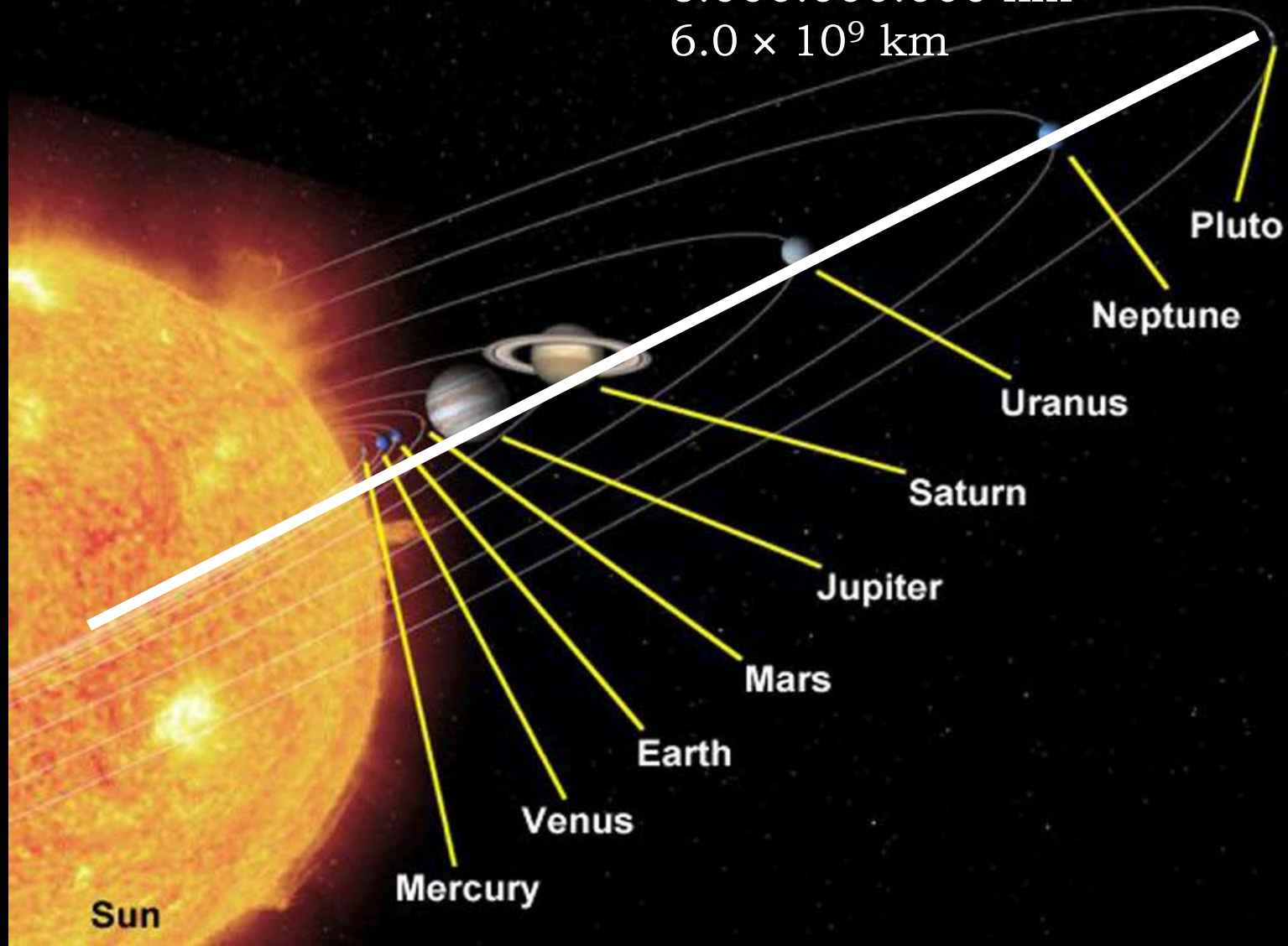
Io

1.800 km

Júpiter



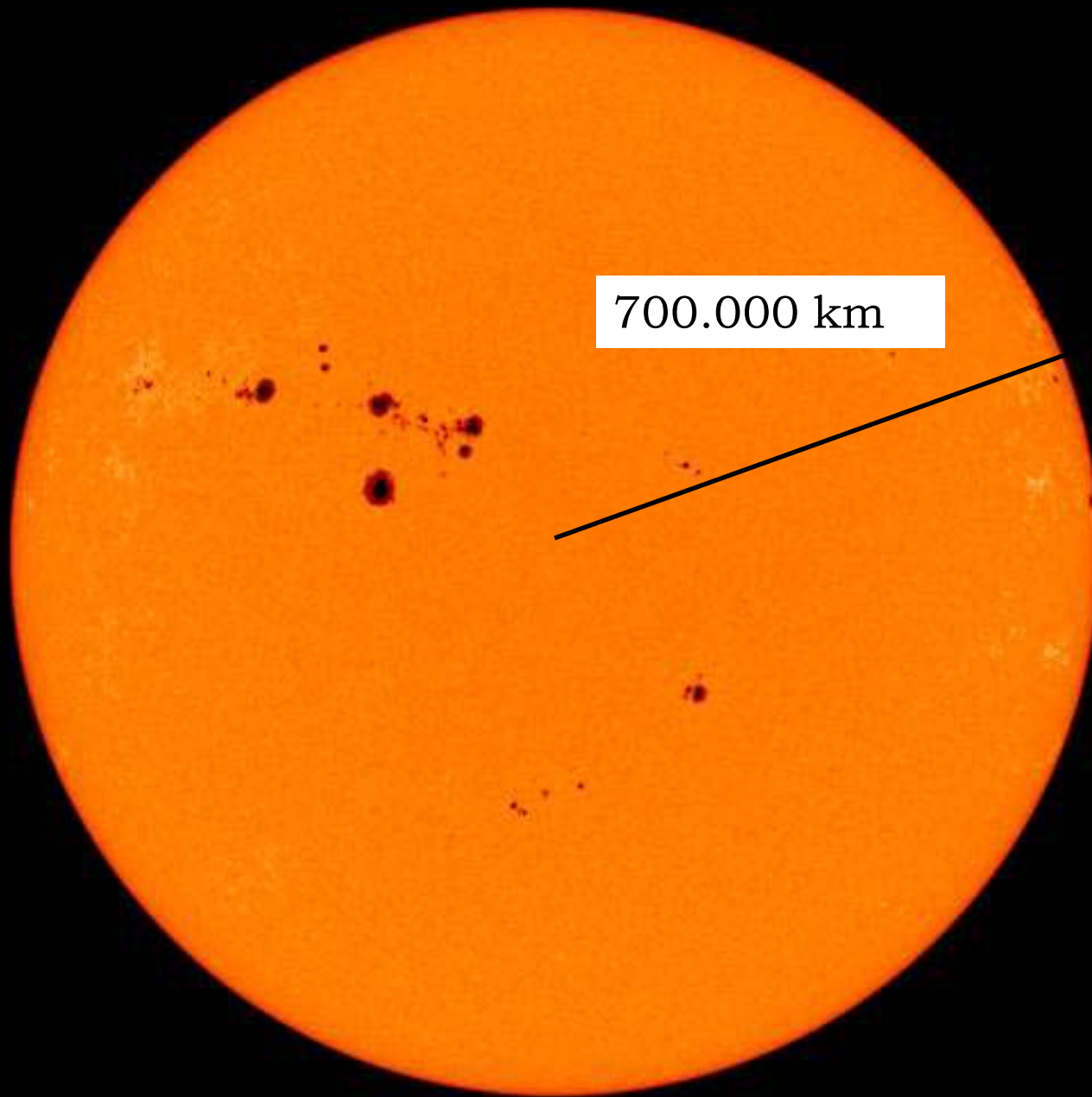
6.000.000.000 km
 6.0×10^9 km





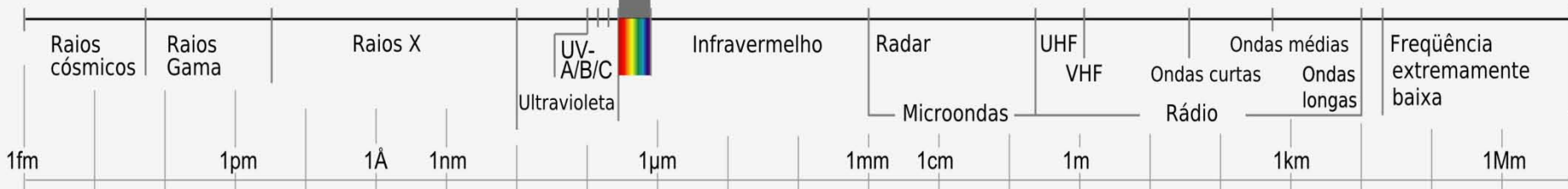
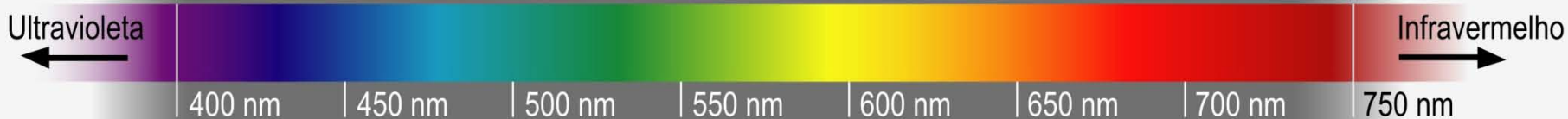
ESTRELAS E NEBULOSAS

visível

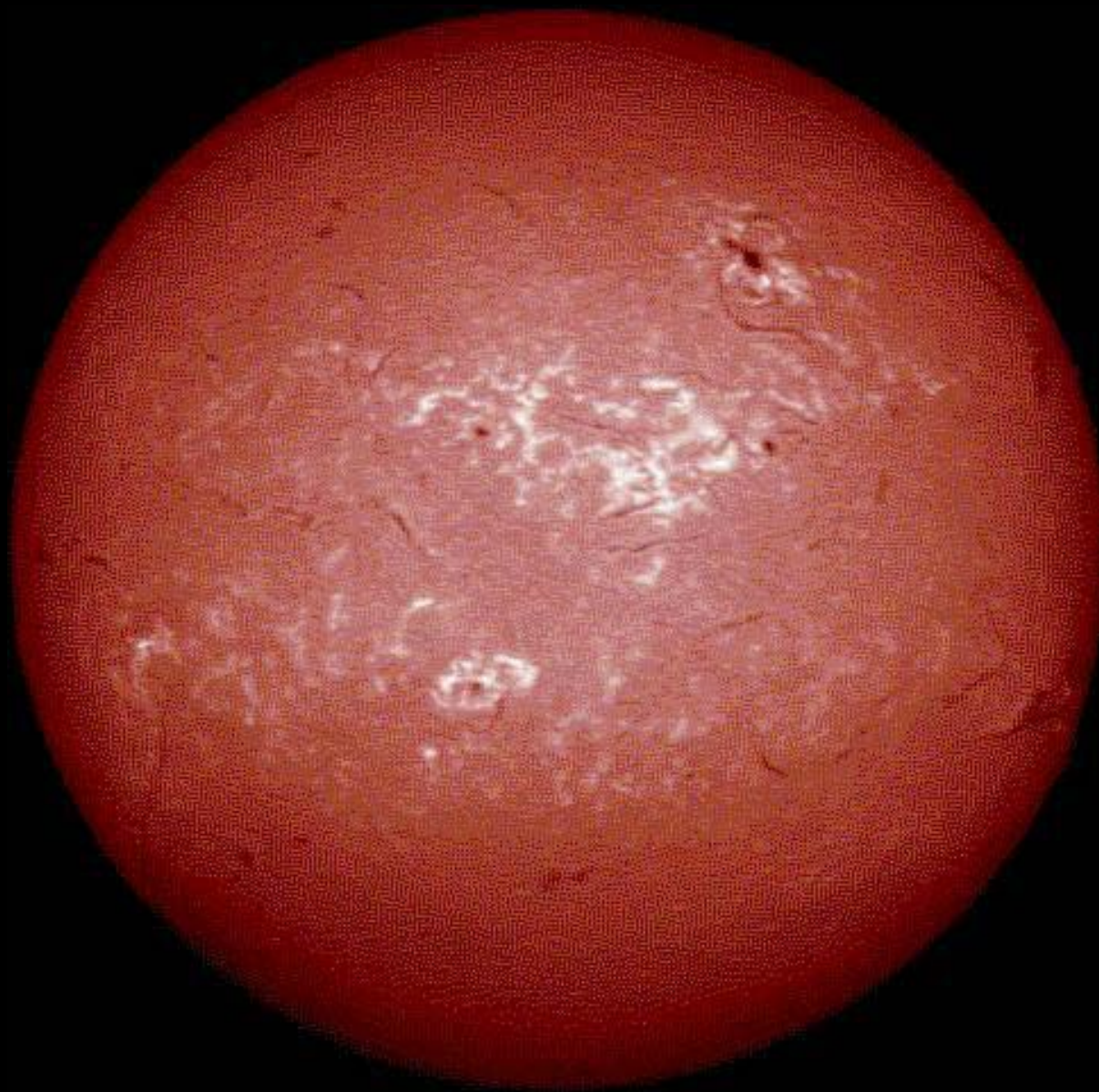


700.000 km

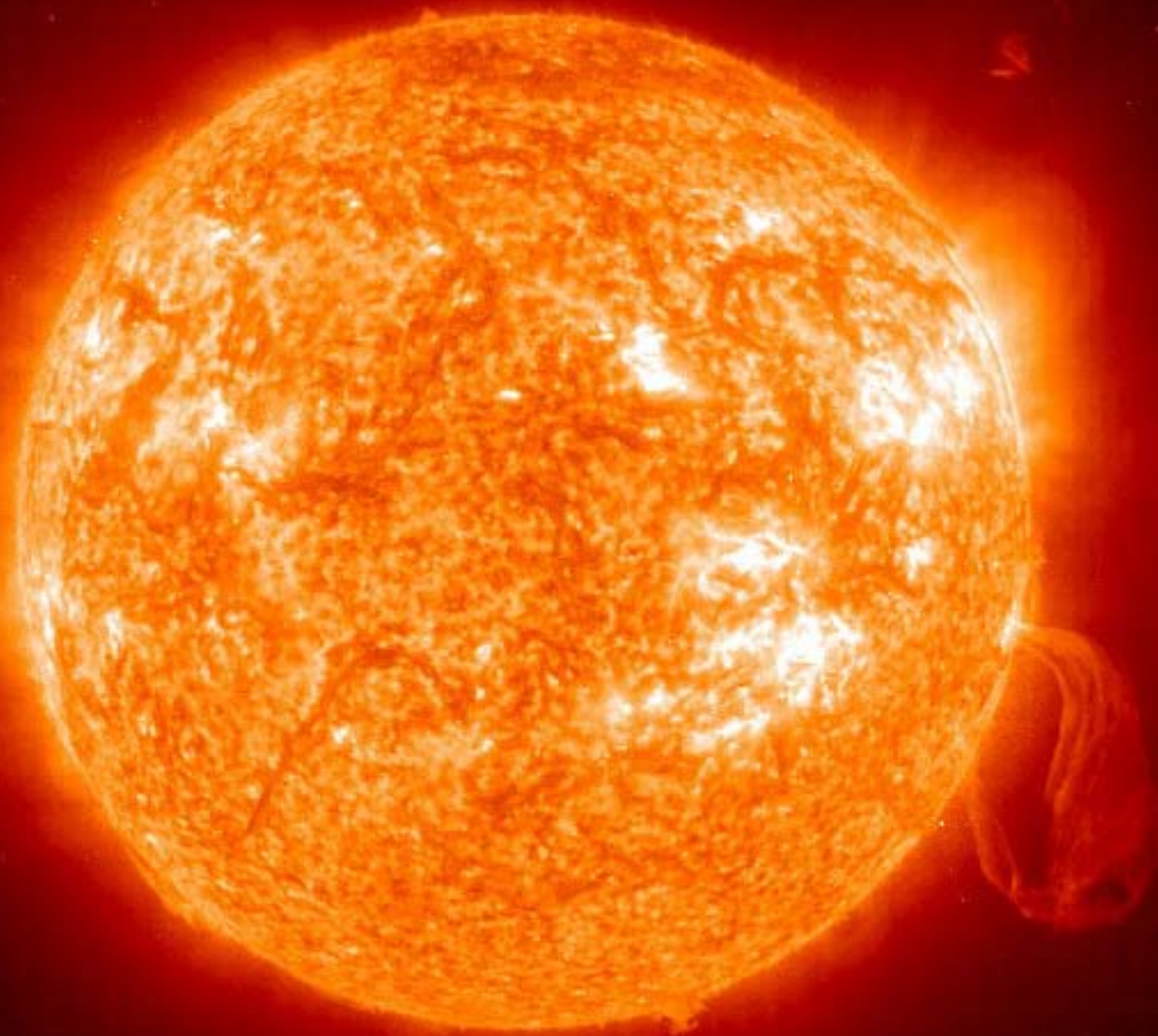
Espectro visível ao Homem



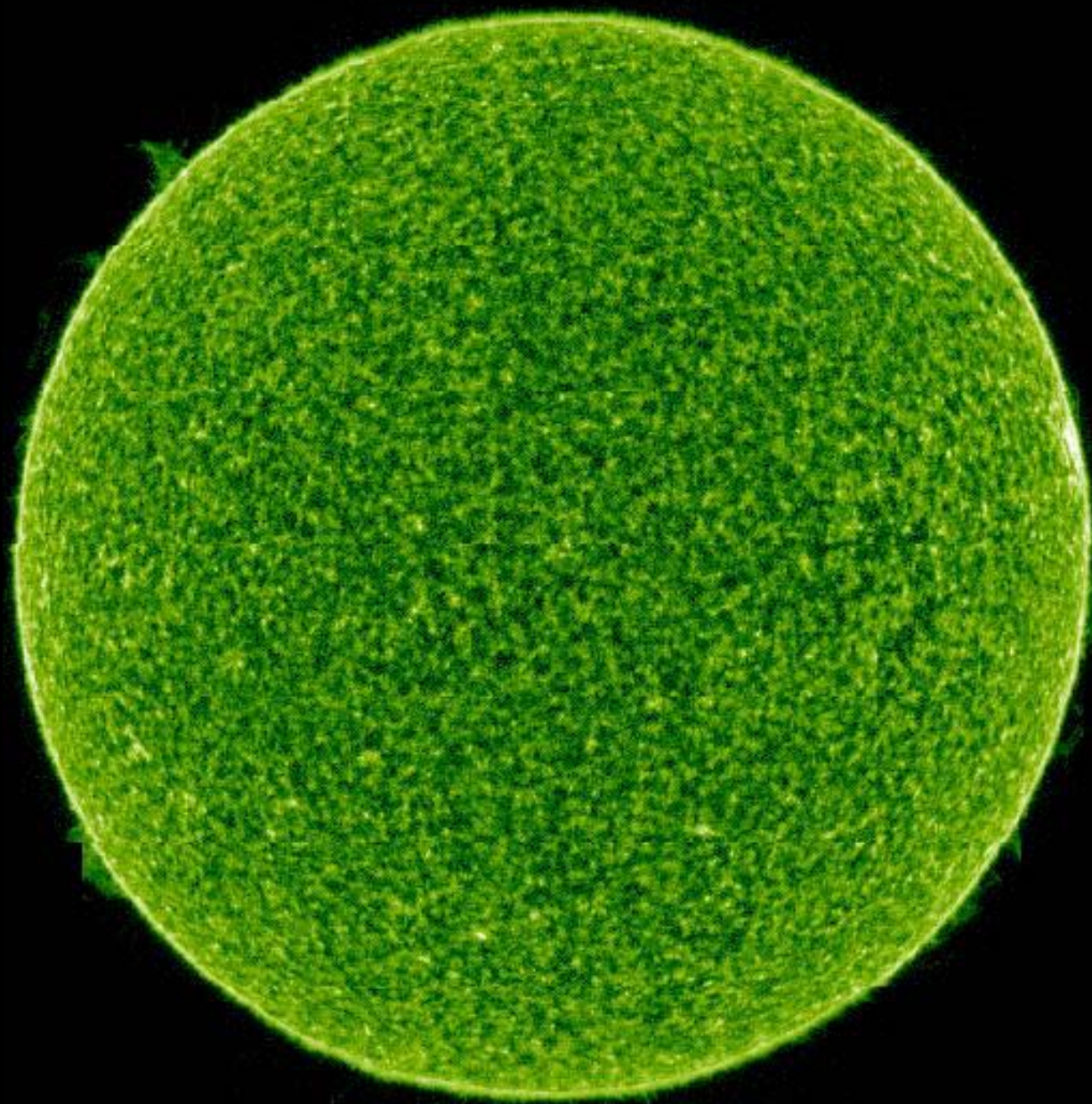
H-alfa



UV



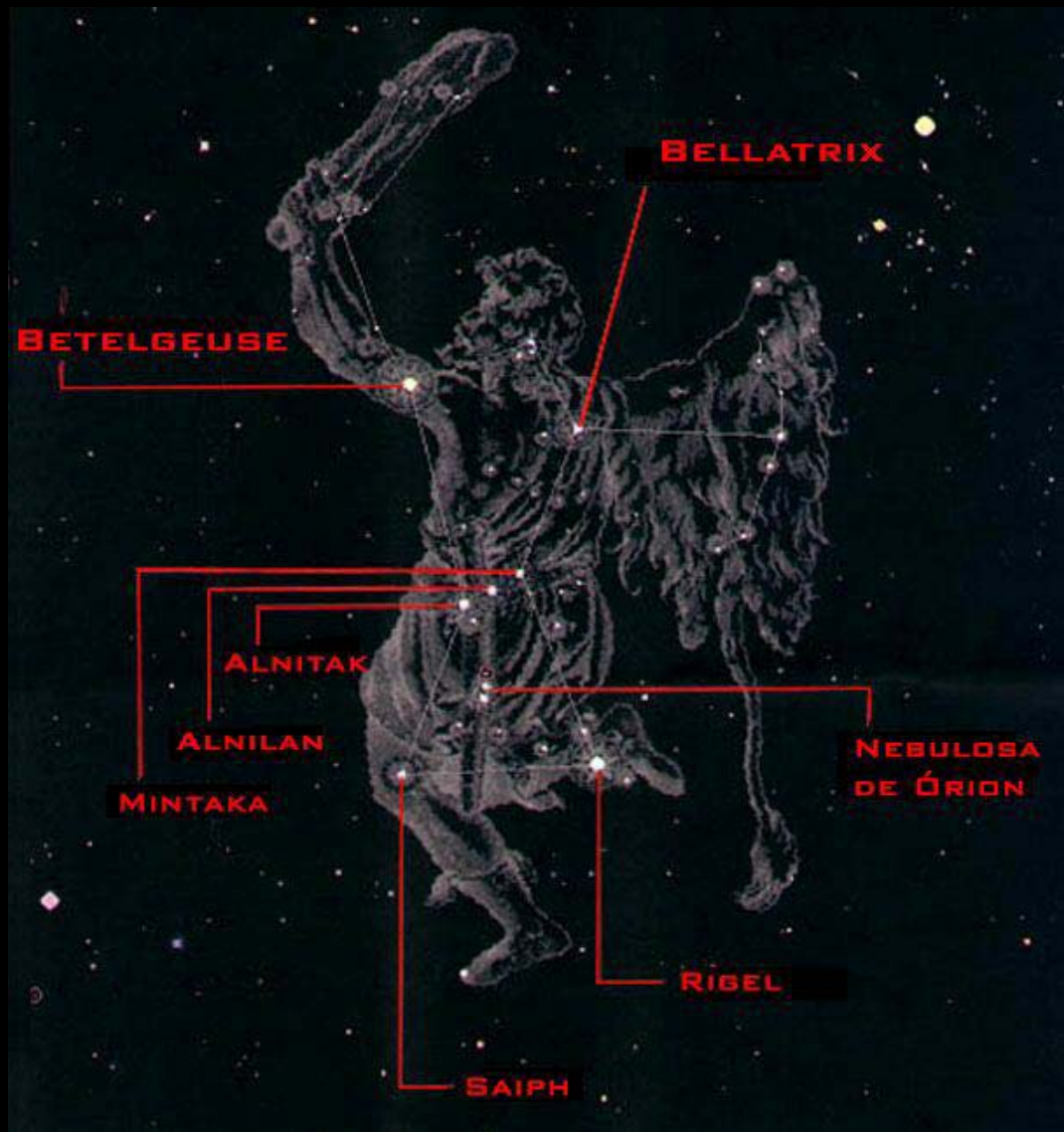
região de
transição
UV/CIV



cromosfera
coroa

**Diferentes comprimentos de onda:
diferentes processos físicos**





BELLATRIX

BETELGEUSE

ALNITAK

ALNILAN

MINTAKA

**NEBULOSA
DE ÓRION**

RIGEL

SAIPH



AQUELA É A
CONSTELAÇÃO DO
OLHO TORTO!

E AQUELA
É A ESTRELA
APAGADA!

Estrelas de campo



Aglomerados abertos



Aglomerados globulares



Aglomerados: importantes para estudar a evolução das estrelas

PIRATAS DO TIETÊ - Laerte

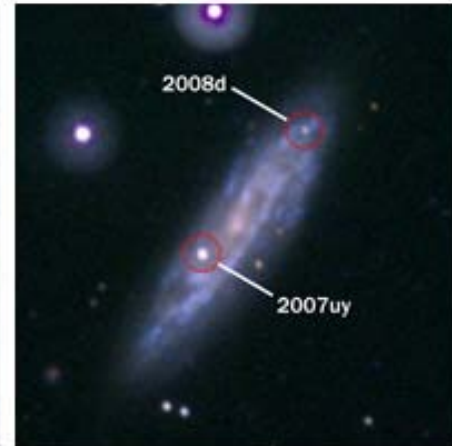
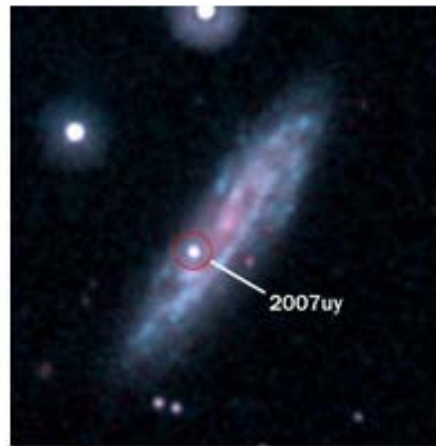


Supernovas

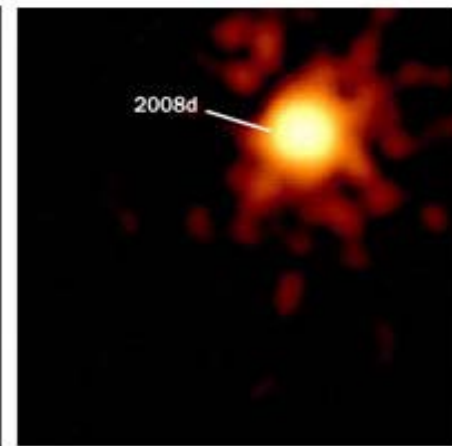
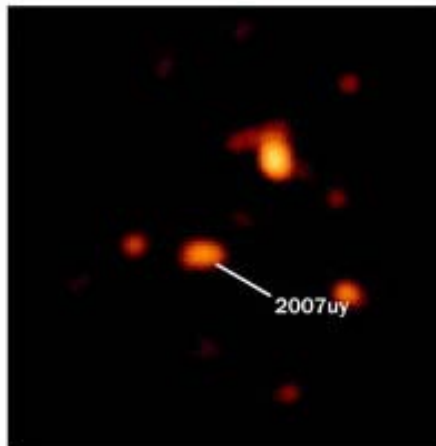
January 7, 2008

NGC2770

January 9, 2008



ultraviolet



X-ray

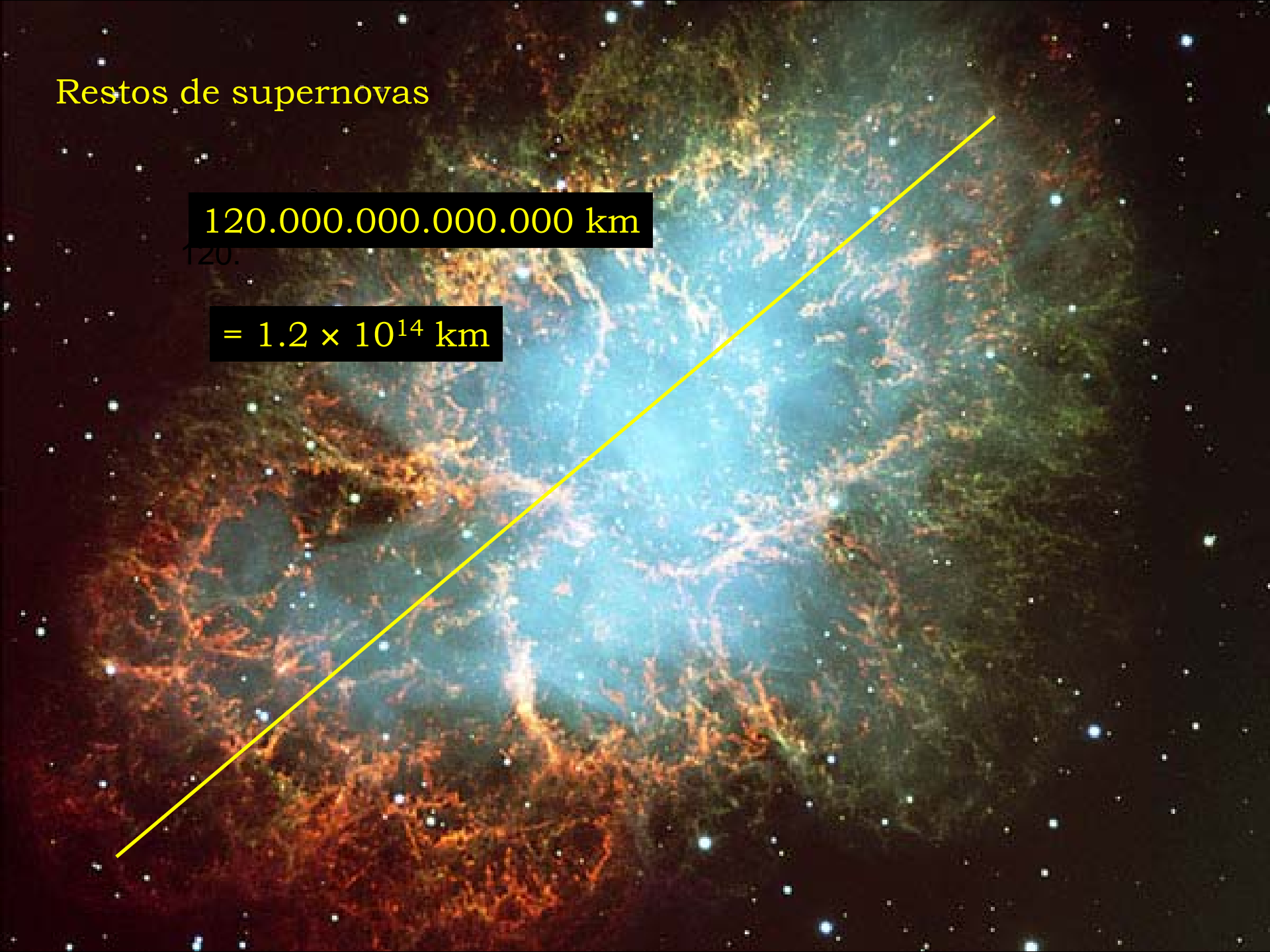


DETESTO ESSAS
SUPERNOVAS!

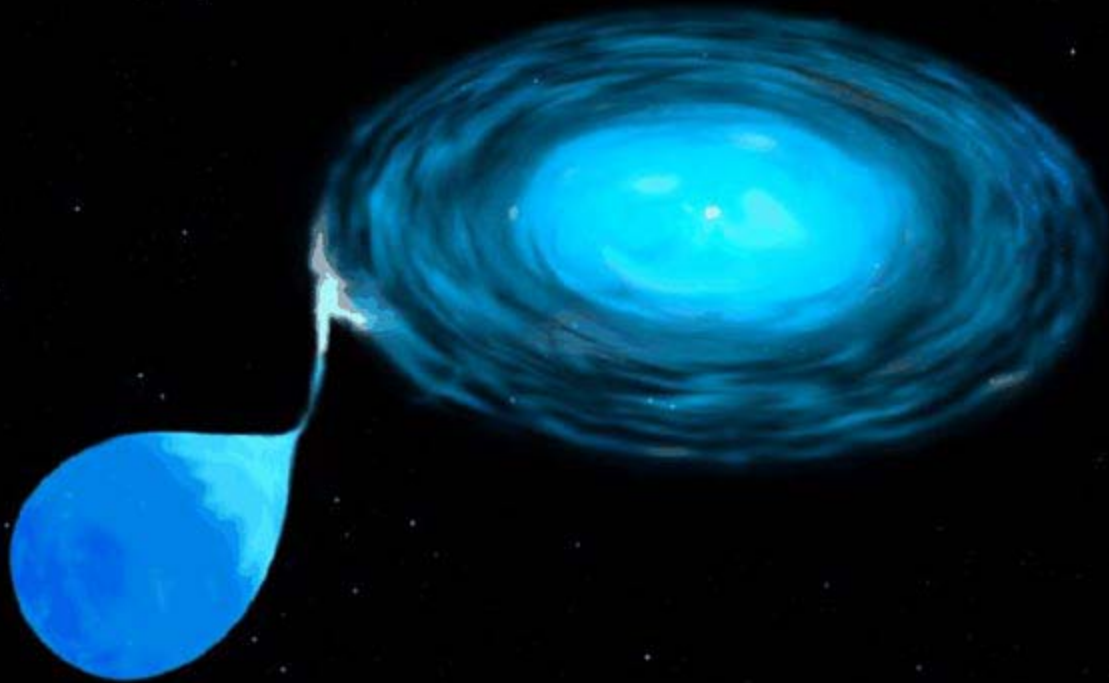
Restos de supernovas

120.000.000.000.000 km

= 1.2×10^{14} km

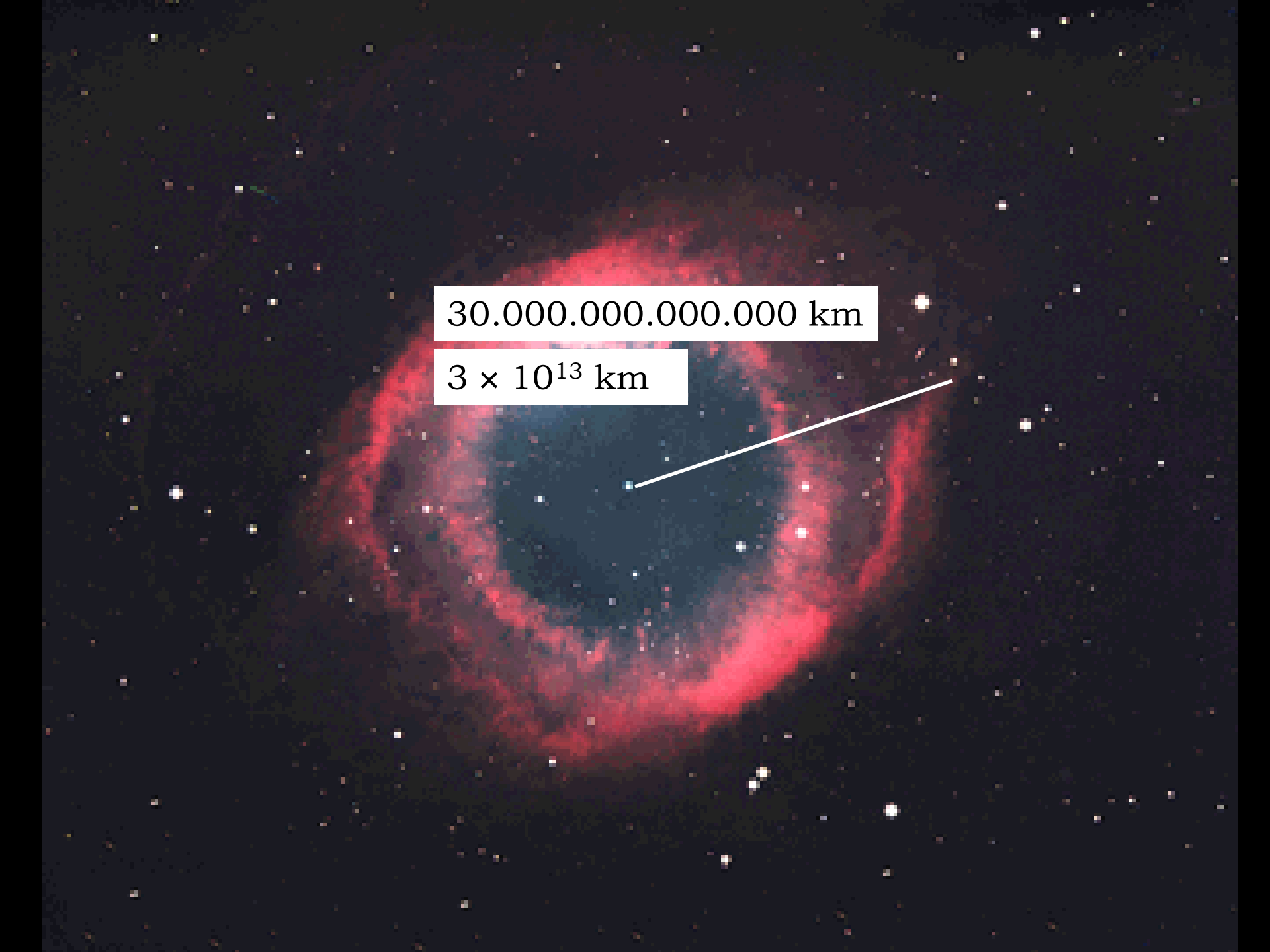


Buracos negros



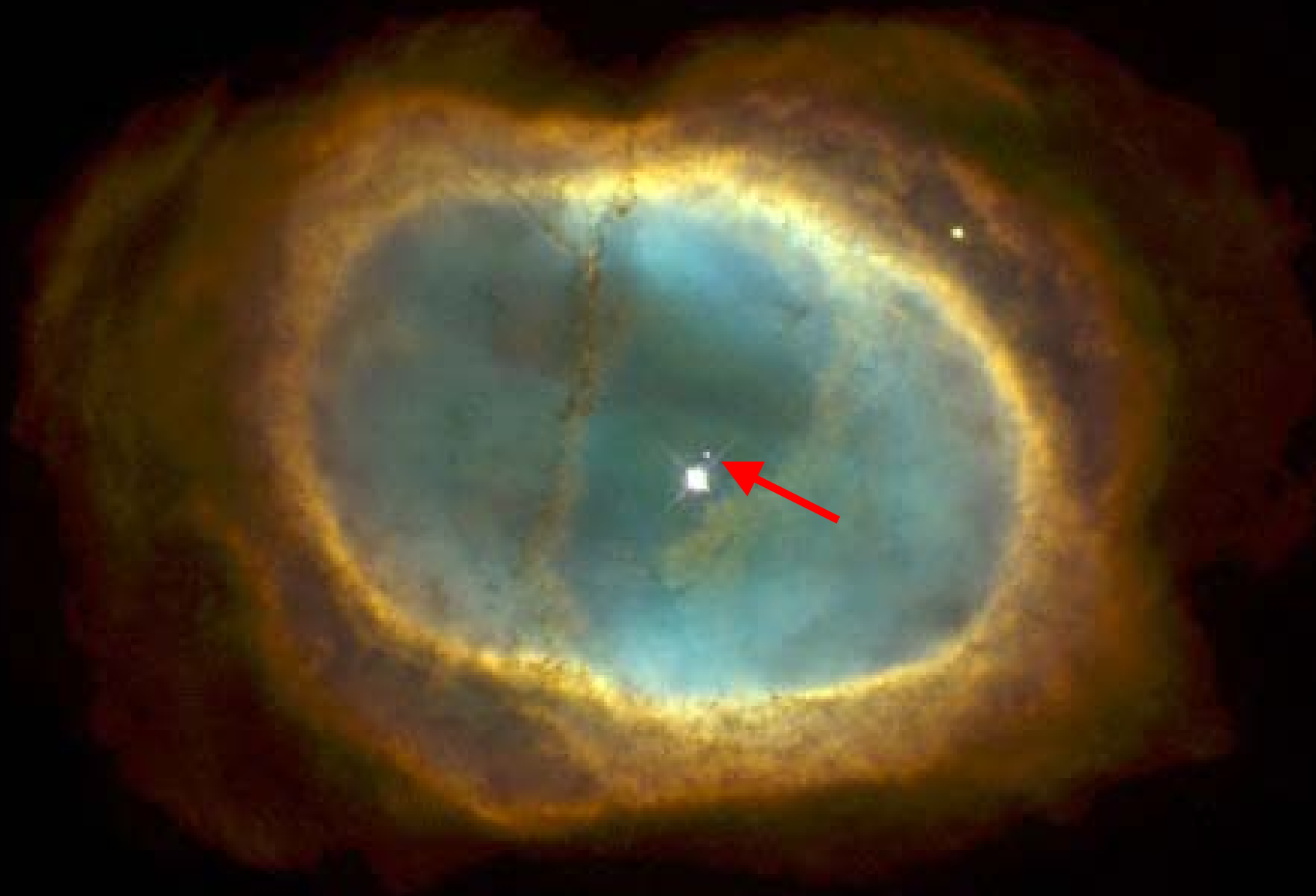
Nebulosas planetárias

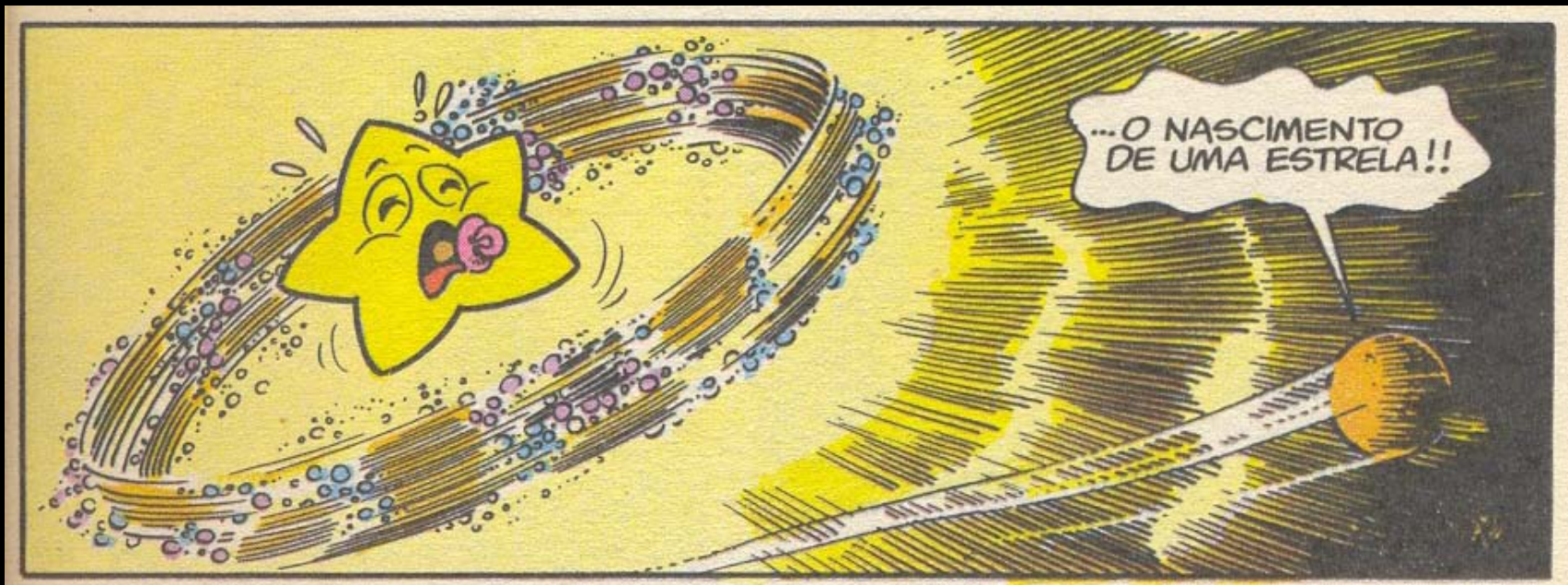




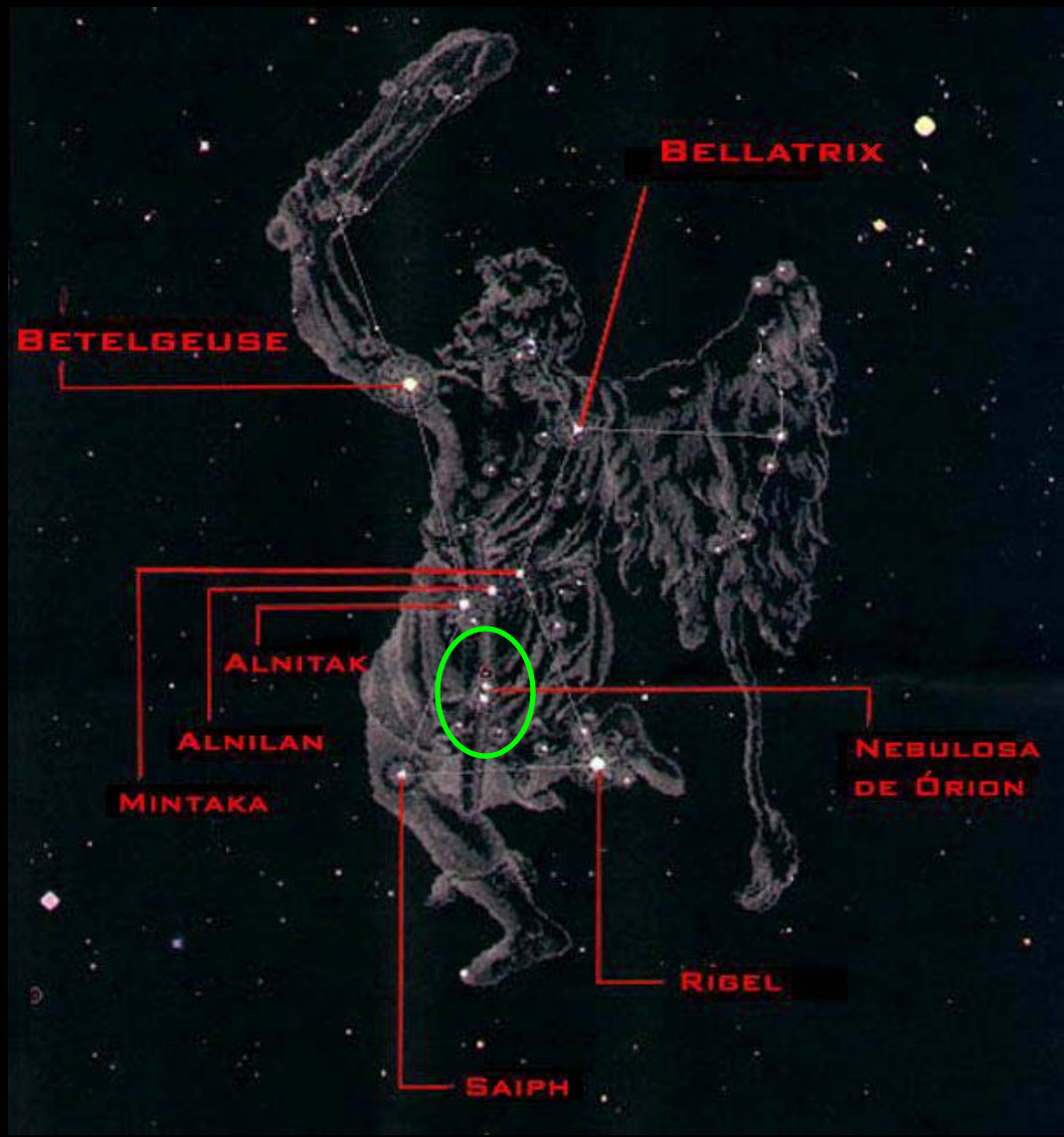
30.000.000.000.000 km

3×10^{13} km





...O NASCIMENTO
DE UMA ESTRELA!!



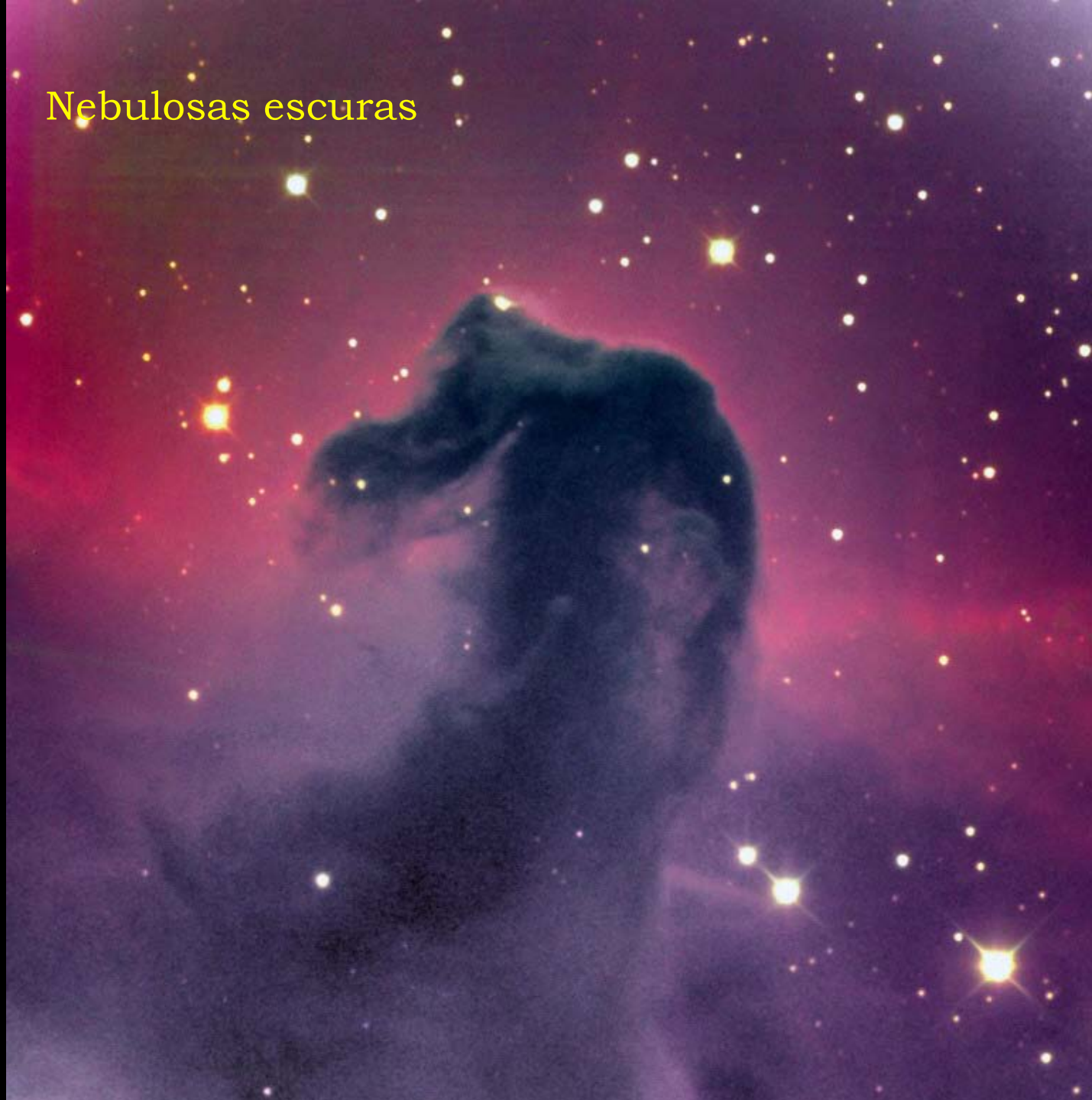
Nebulosas difusas

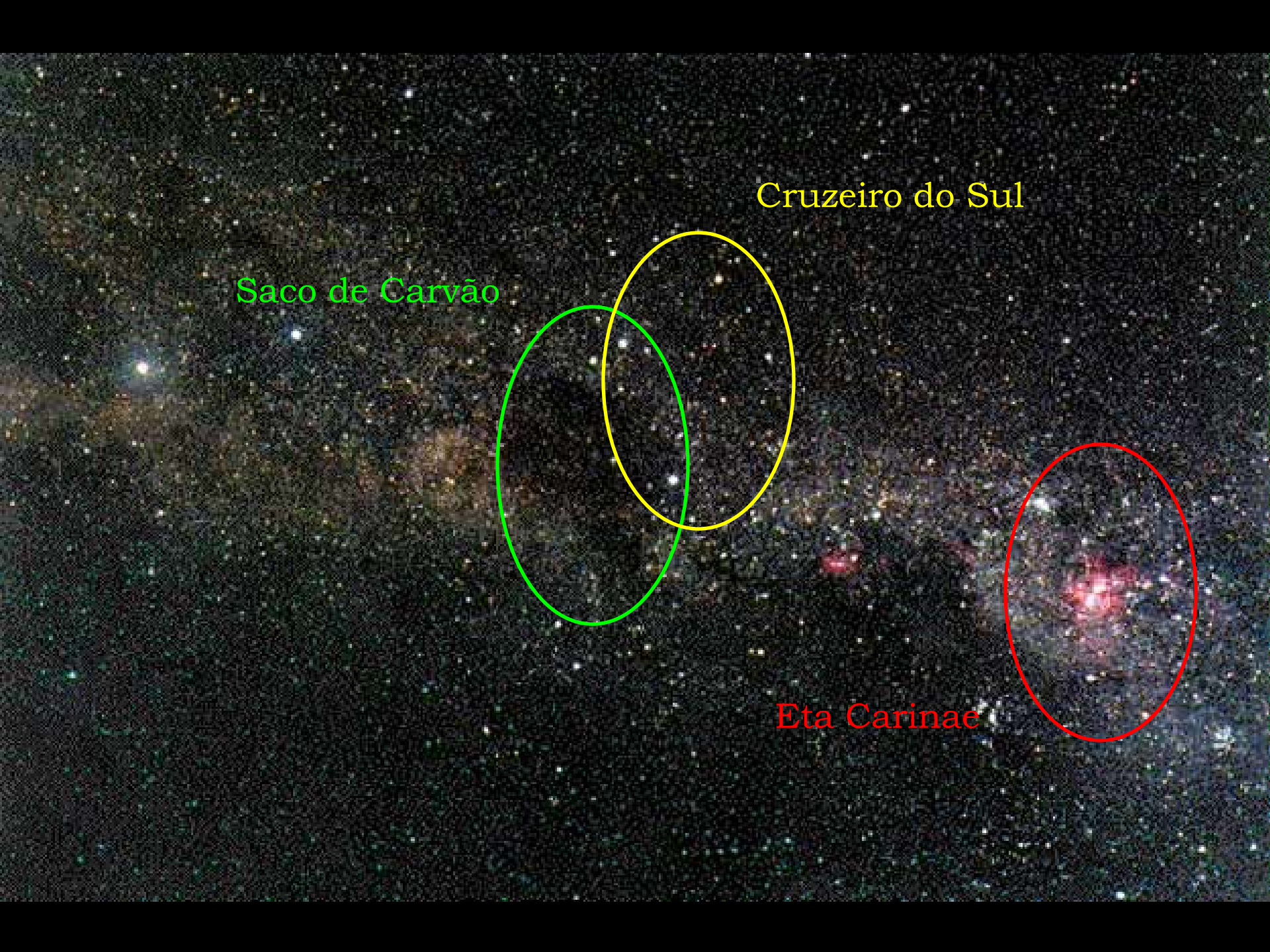
Regiões HII





Nebulosas oscuras

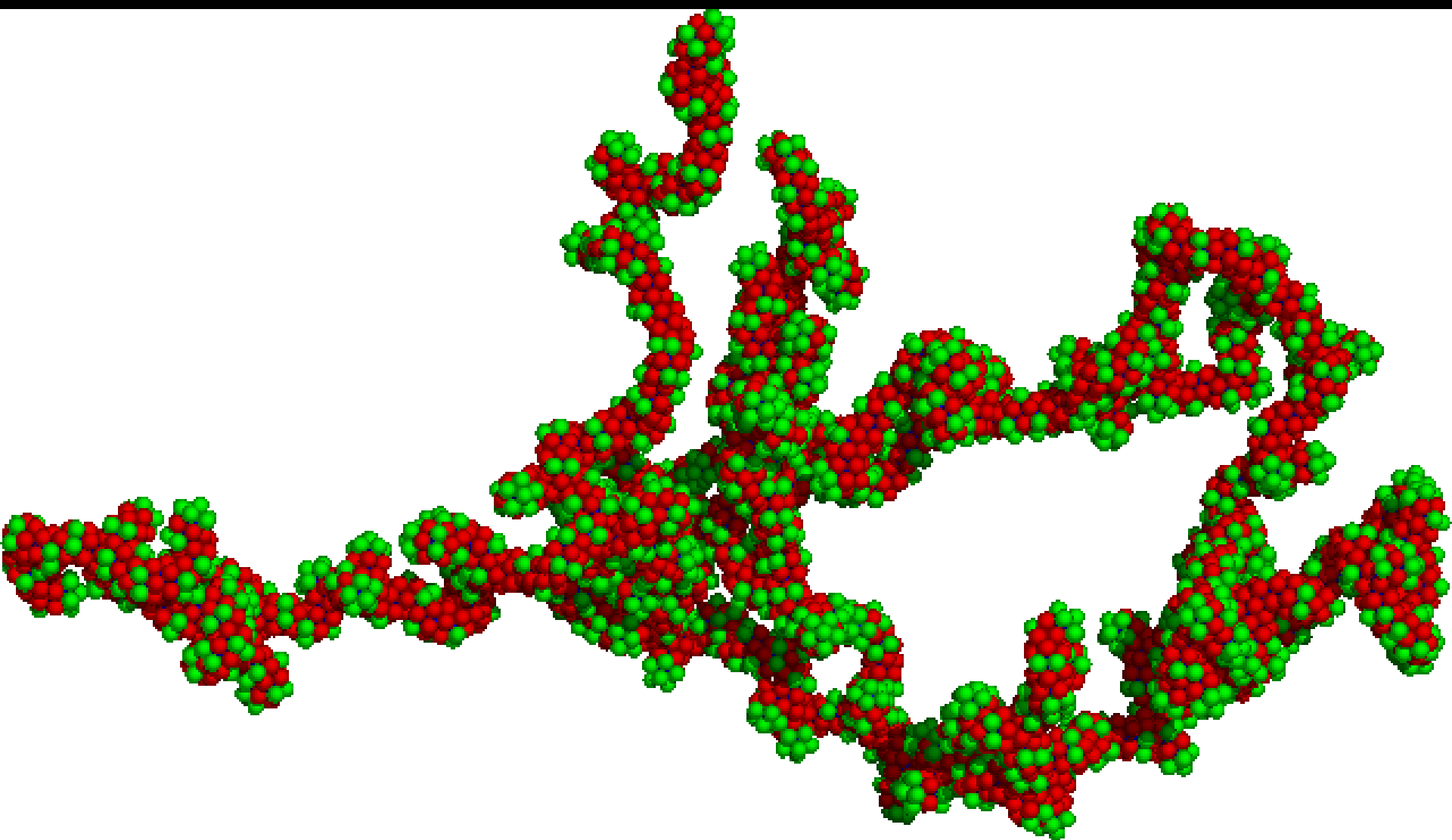




Cruzeiro do Sul

Saco de Carvão

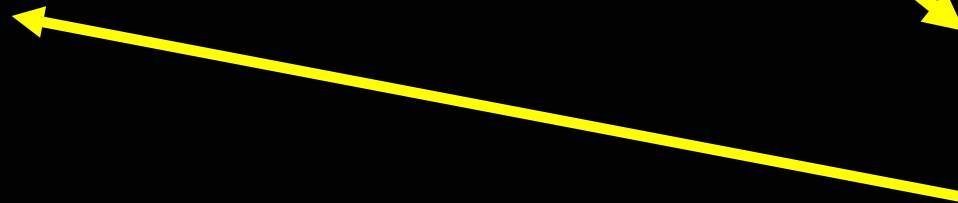
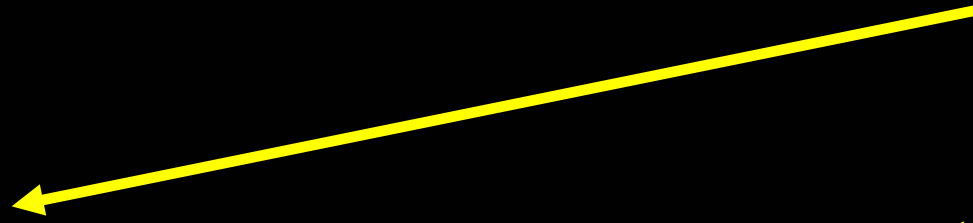
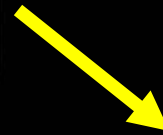
Eta Carinae



Gás

Estrelas

Restos

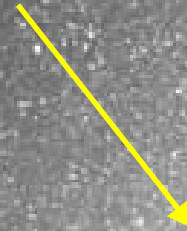


Evolução : gás e estrelas



A VIA LÁCTEA

Via Láctea



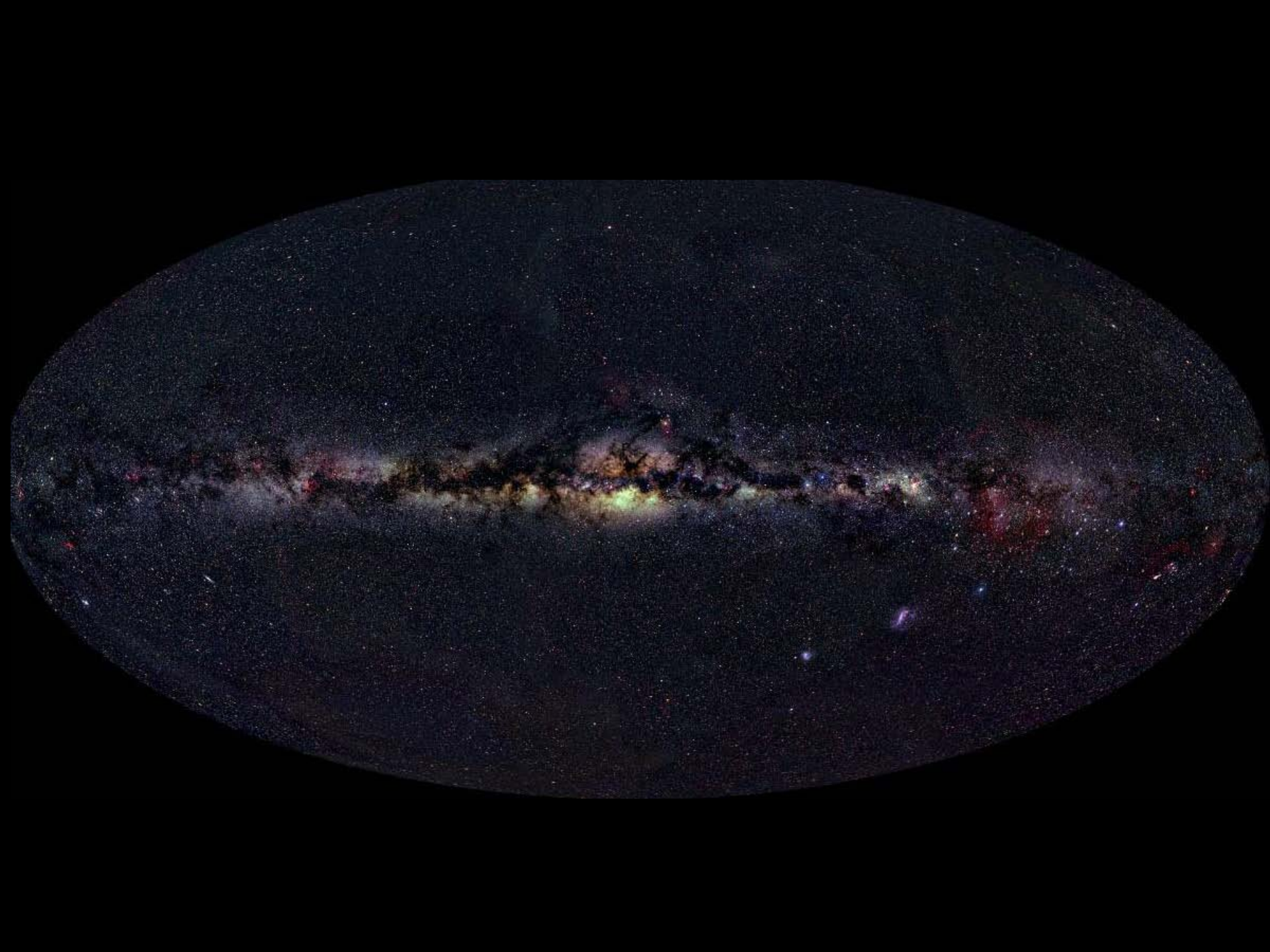
CHICO BENTO

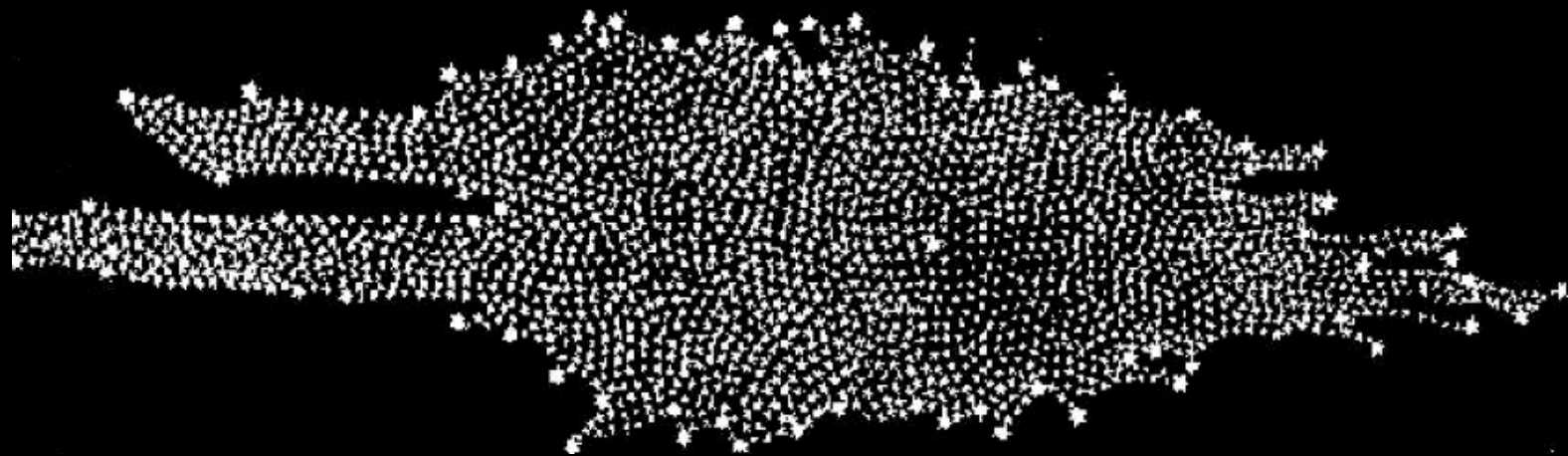




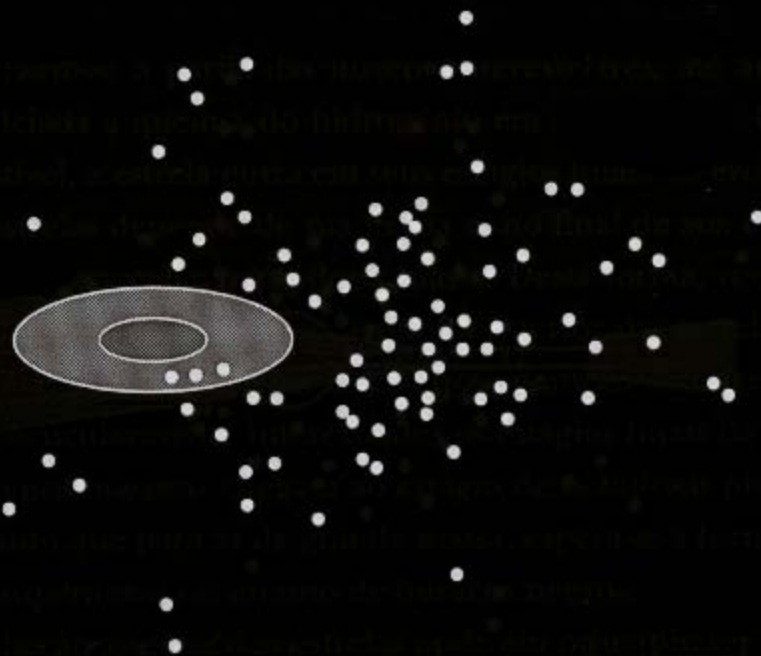
Via Láctea
Jacopo Tintoretto (1518-1594)







Herschel (1785)



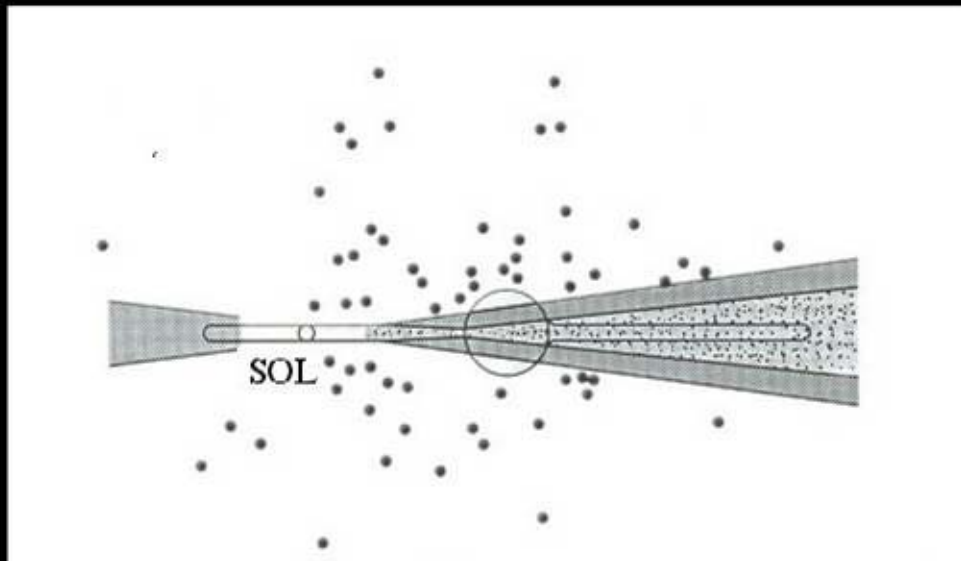
Kapteyn (1920)

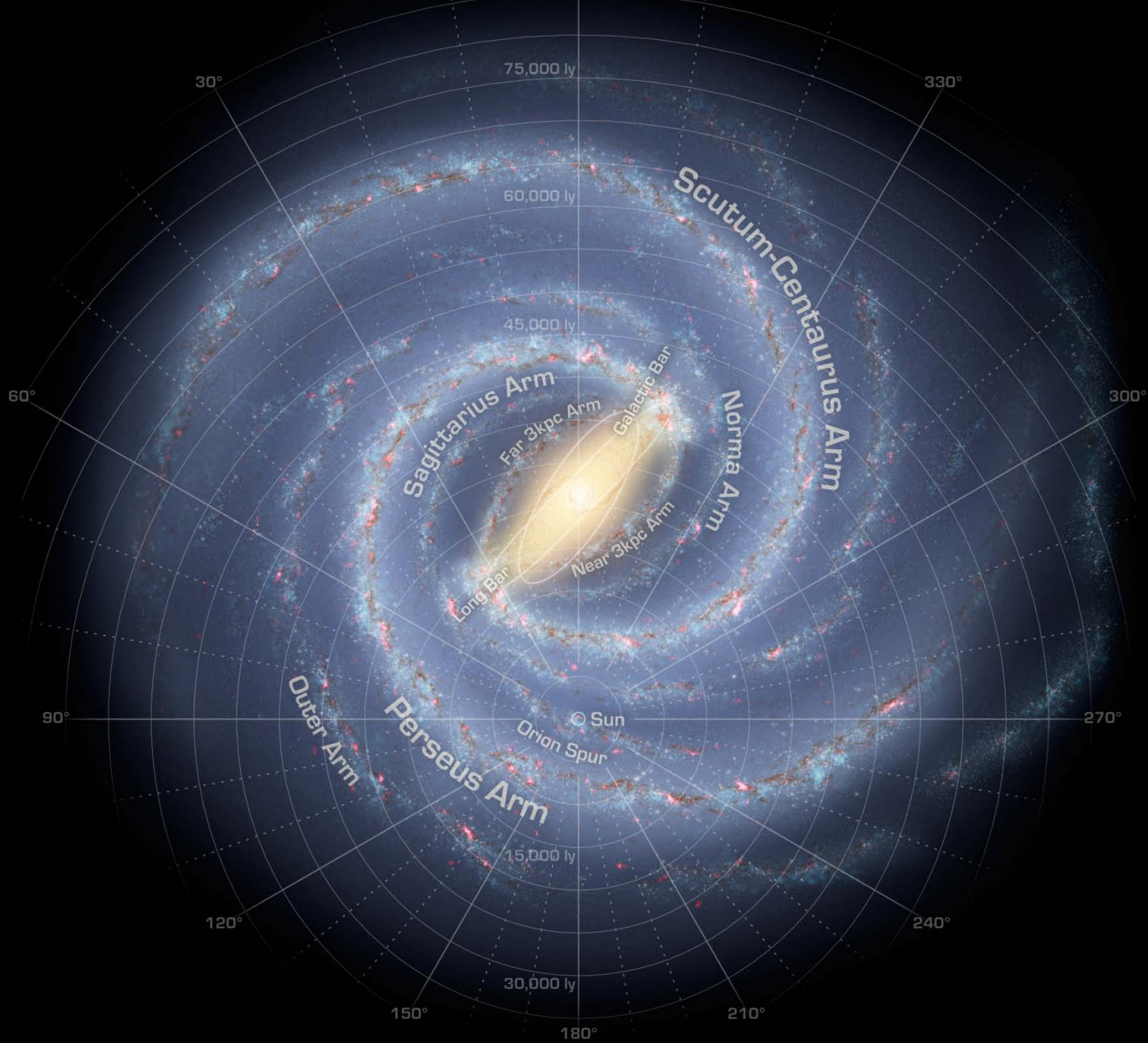
BRAÇOS ESPIRAIS

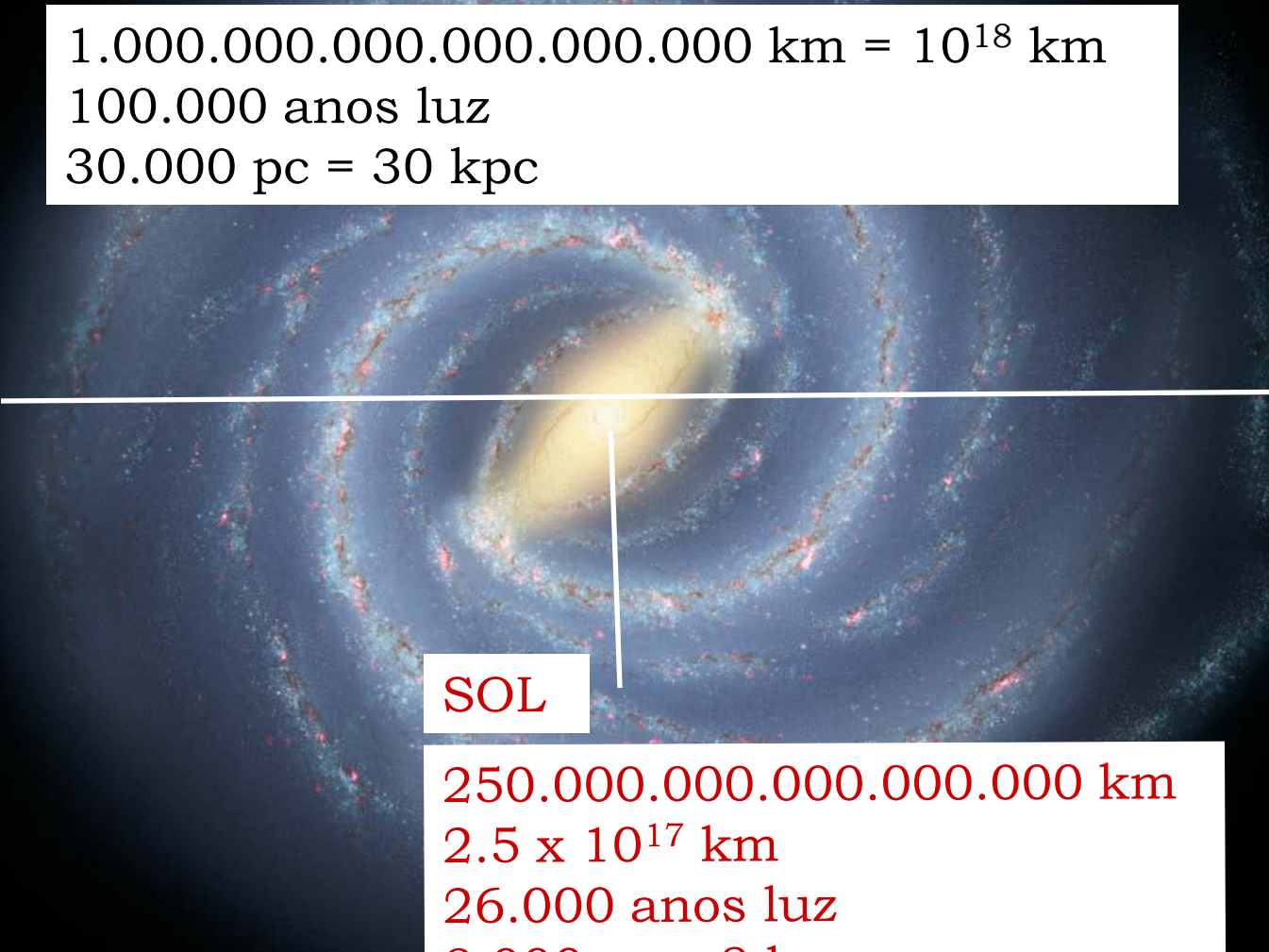
DISCO

BOJO

HALO





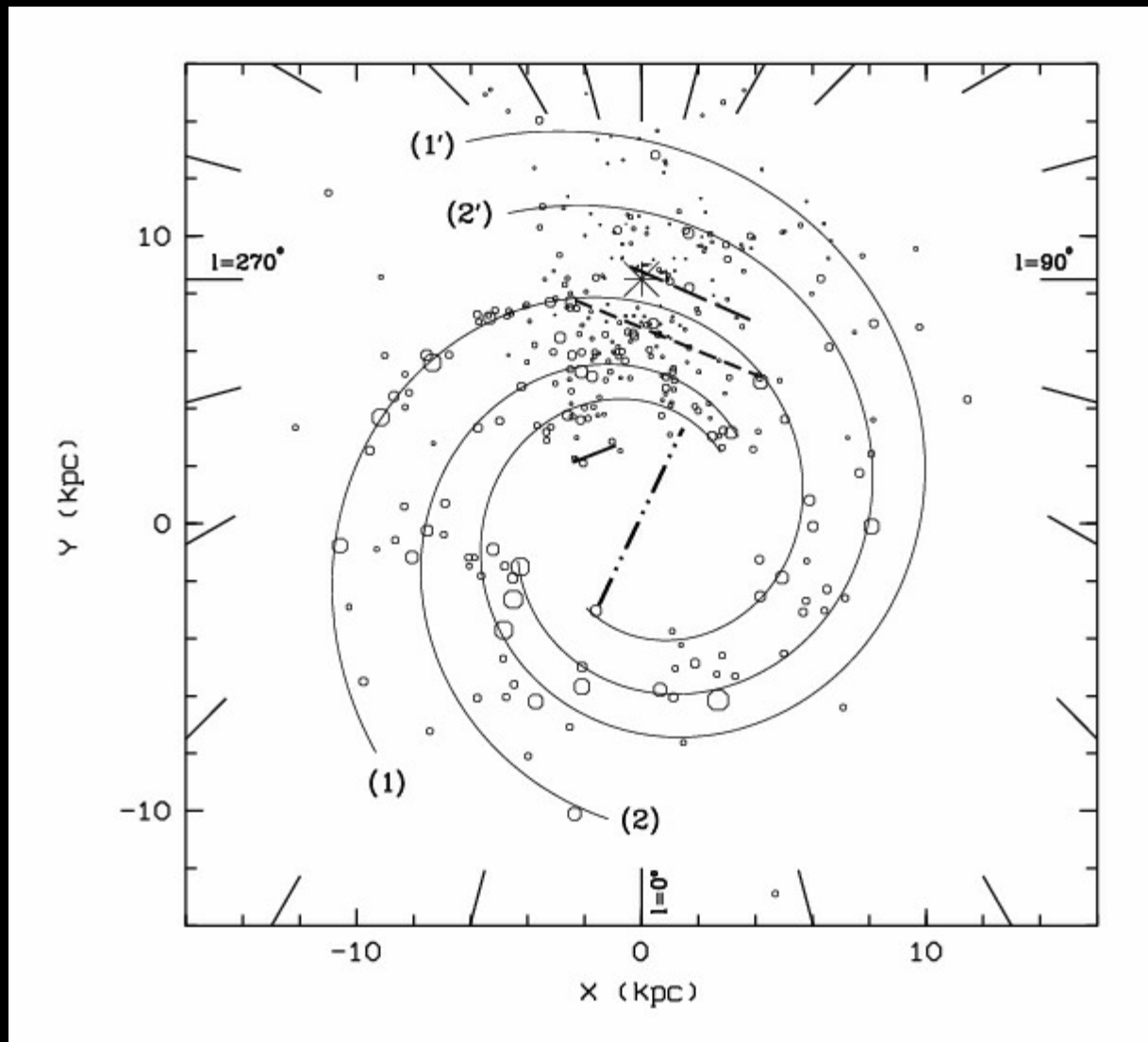


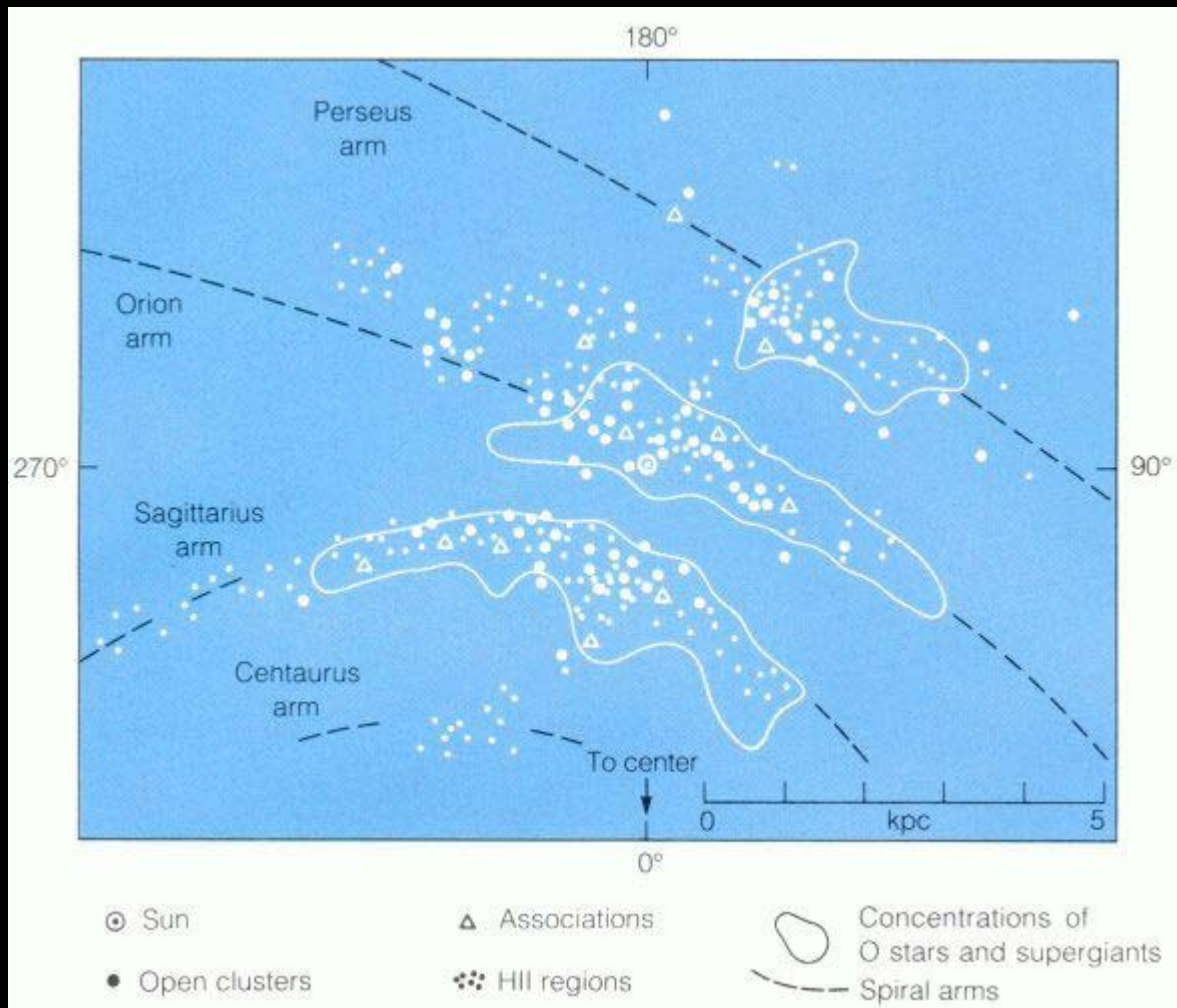
1.000.000.000.000.000.000 km = 10^{18} km
100.000 anos luz
30.000 pc = 30 kpc

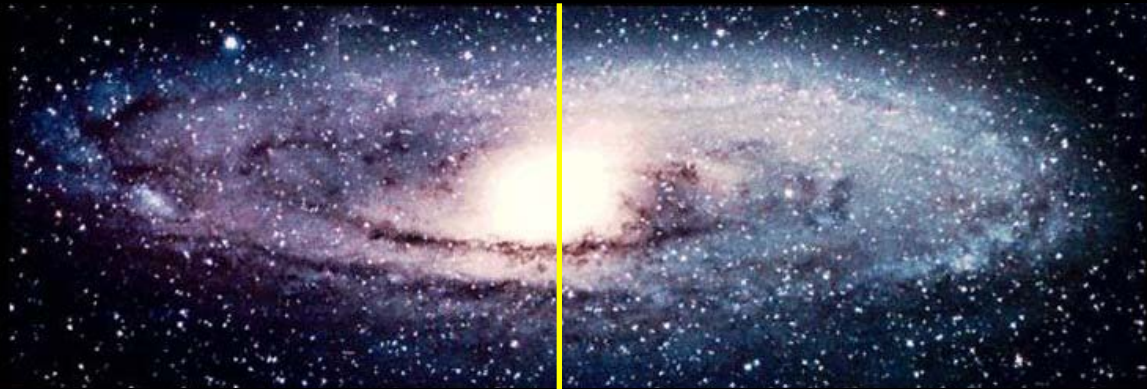
SOL

250.000.000.000.000.000 km
 2.5×10^{17} km
26.000 anos luz
8.000 pc = 8 kpc

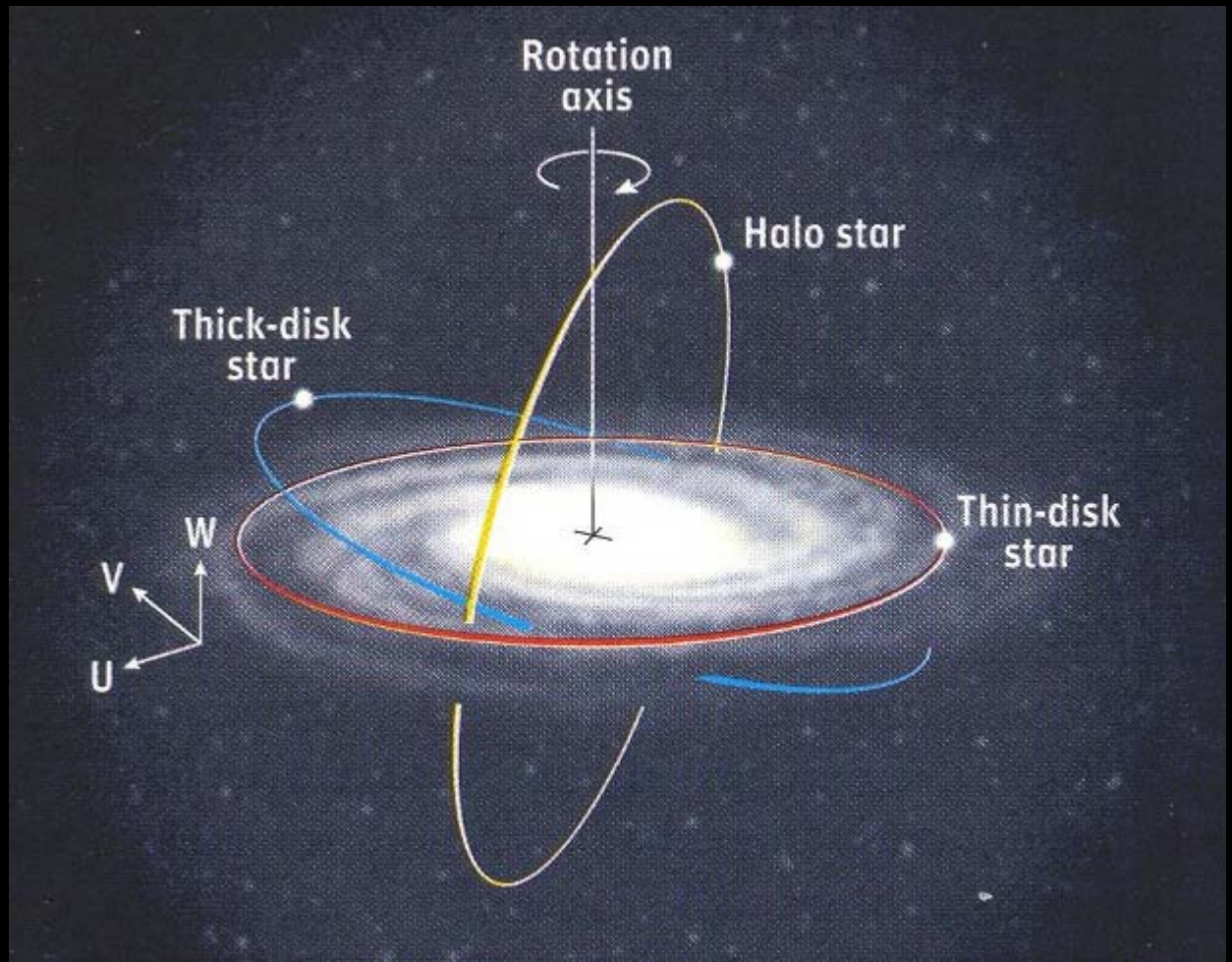
Regiões III: Mapeamento dos braços espirais





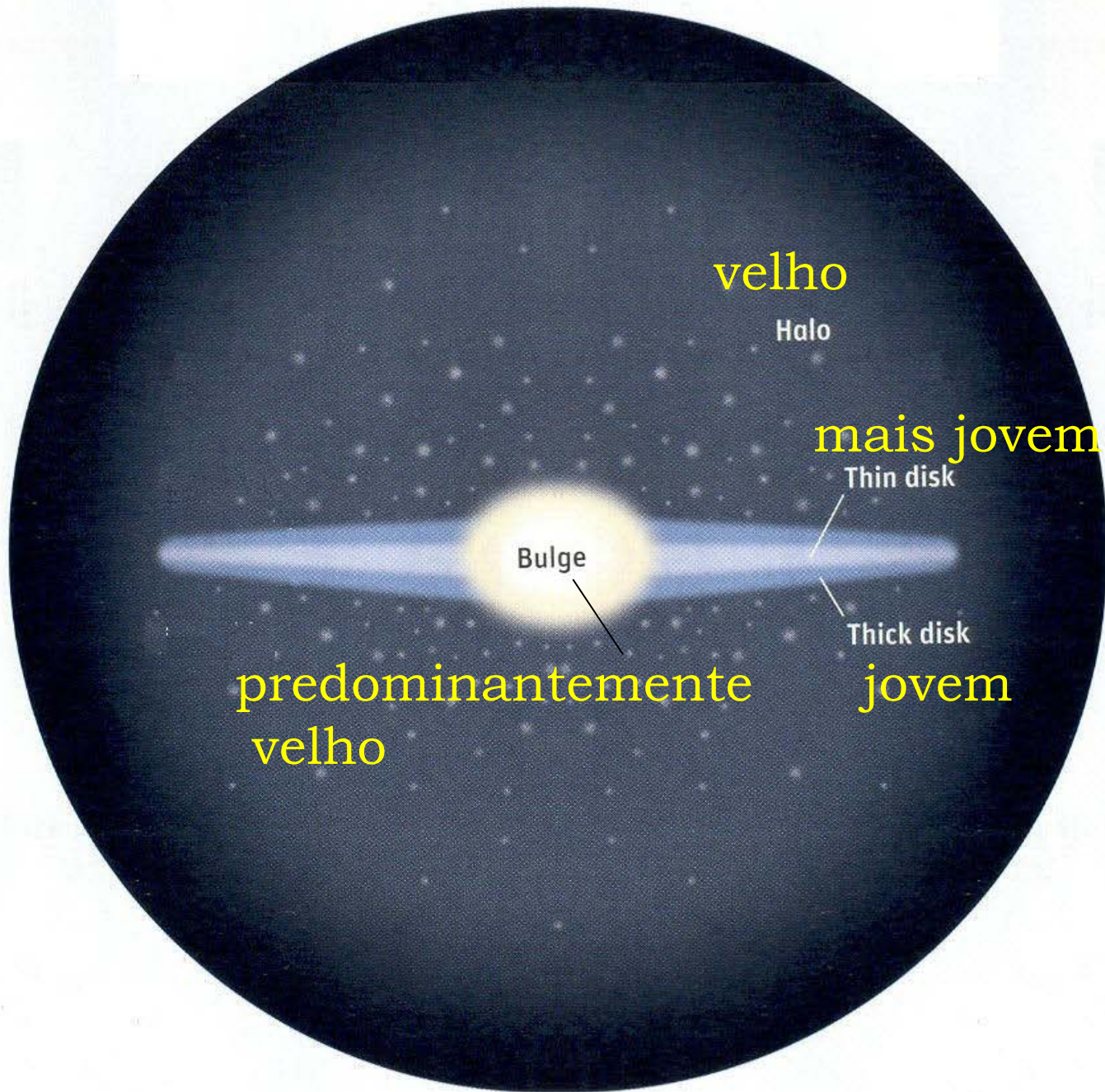


Movimentos das estrelas na Galáxia



O centro da Galáxia





velho

Halo

mais jovem

Thin disk

Bulge

Thick disk

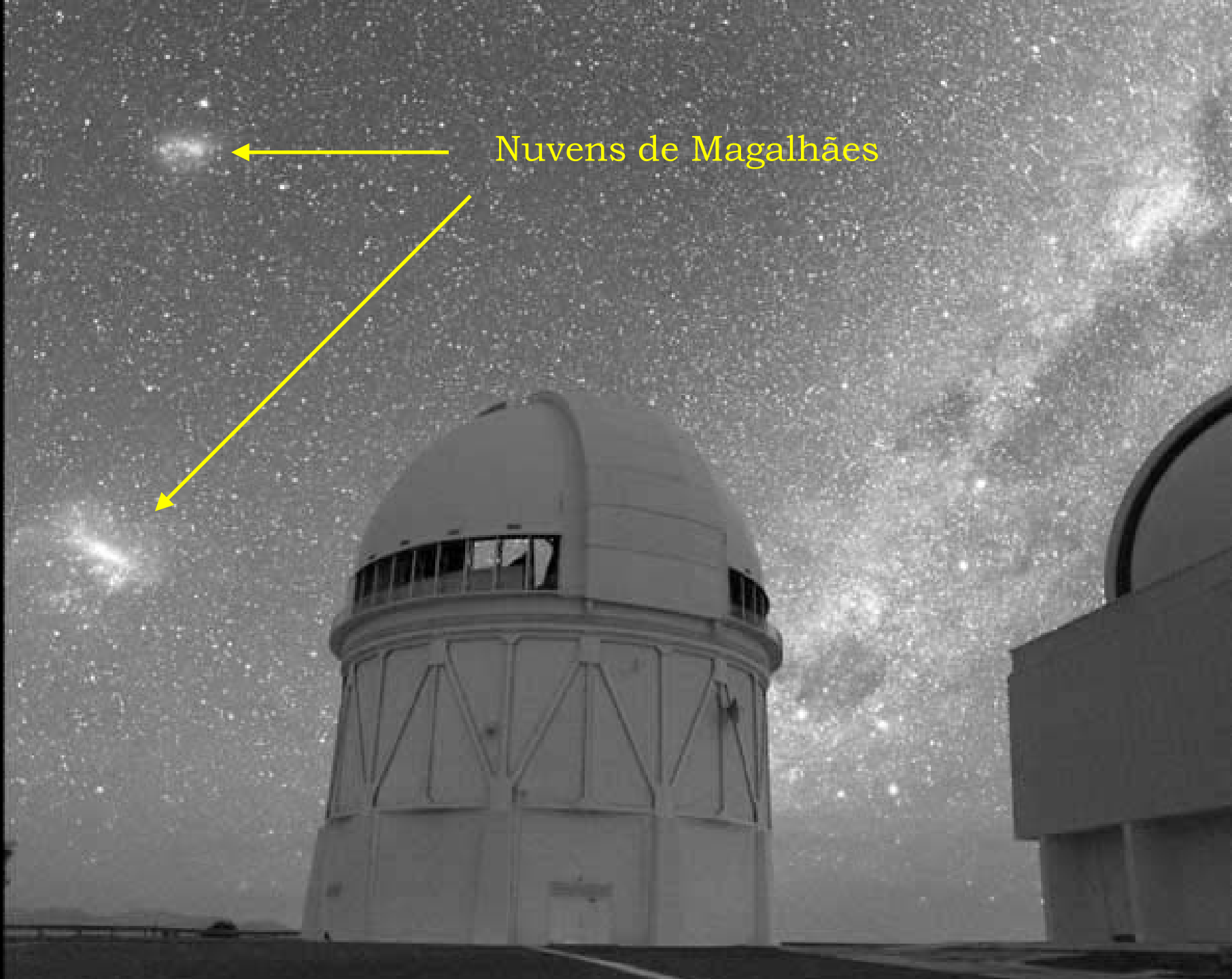
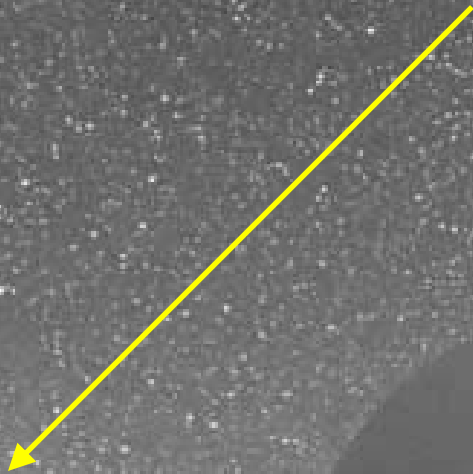
jovem

predominantemente
velho



GALÁXIAS

Nuvens de Magalhães





40 kpc = 40.000 pc

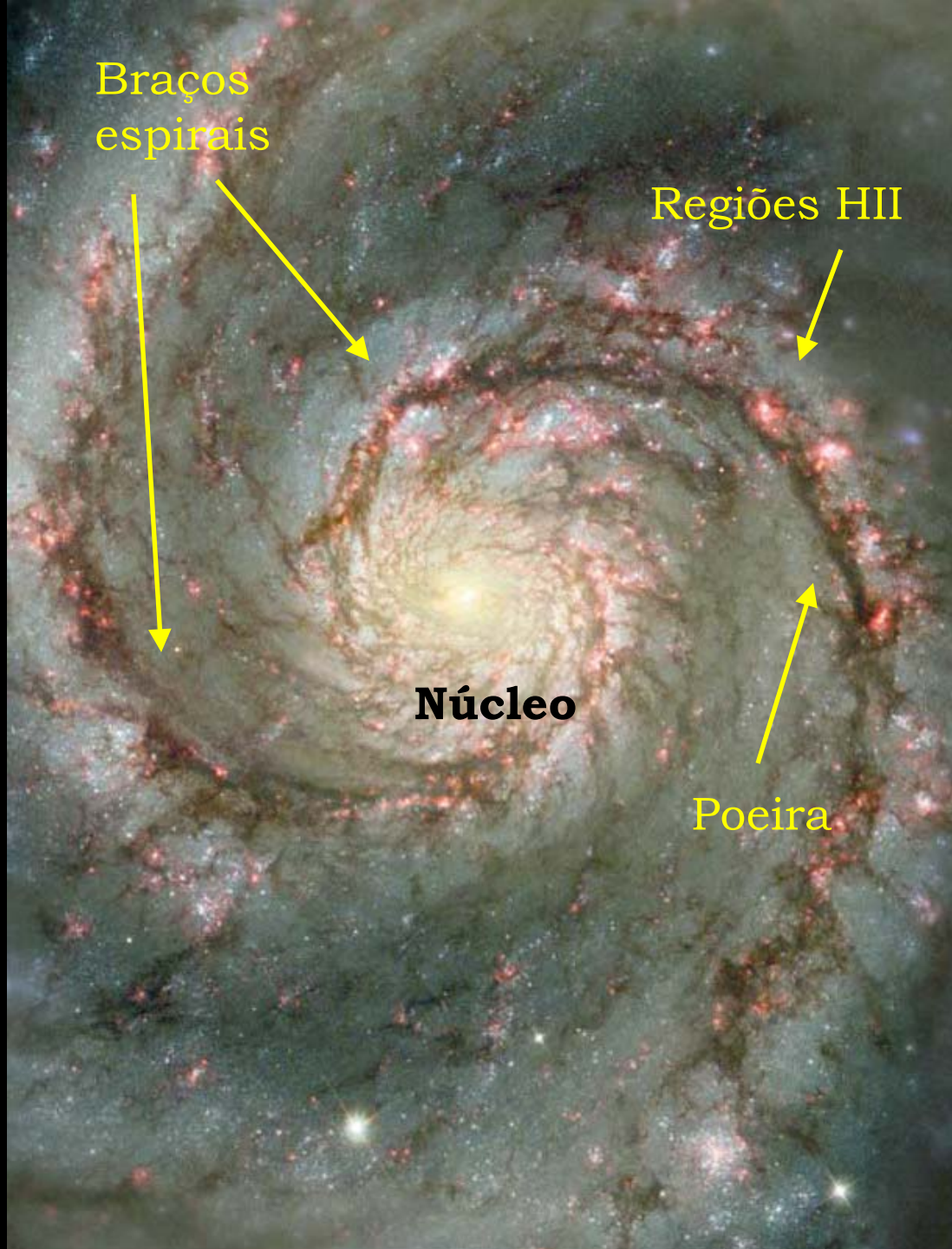
130.000 anos luz

1.200.000.000.000.000.000 km

1.2×10^{18} km

Andromeda

M51



Braços
espirais

Regiões HII

Núcleo

Poeira

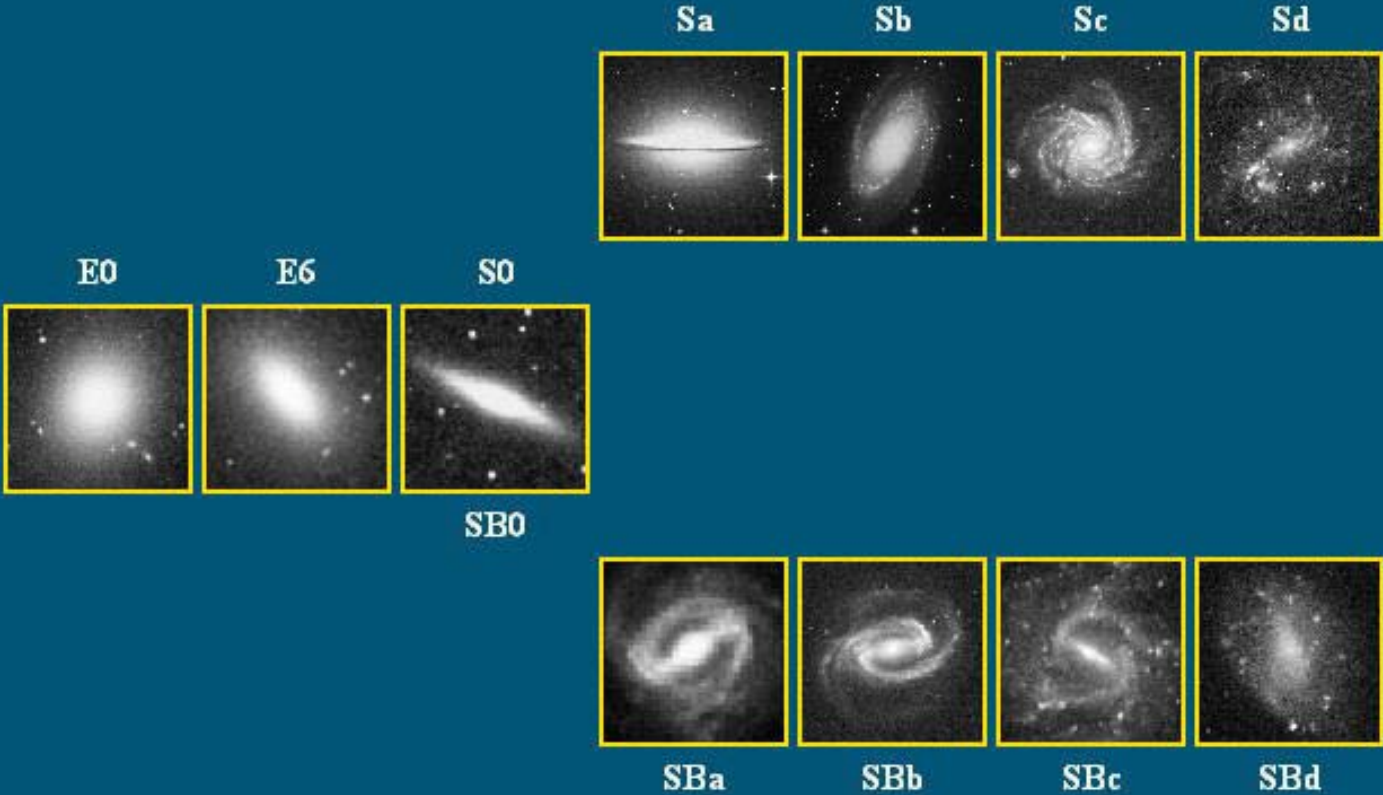
Galáxias espirais



Galáxias espirais



Tipos de Galáxias



Galáxia
elíptica



Galáxias irregulares



SMC



LMC



Nuvens de Magalhães:

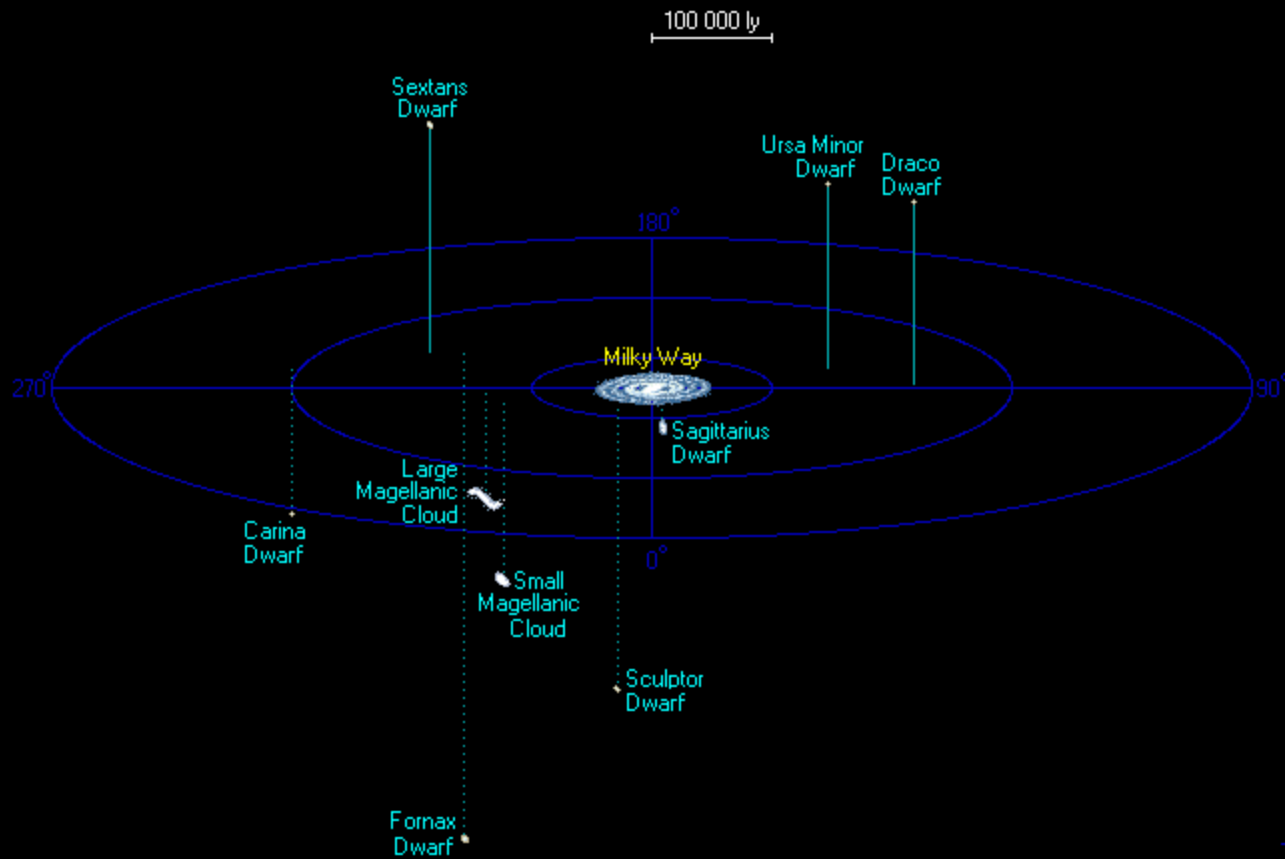
$d = 55\text{-}60 \text{ kpc}$

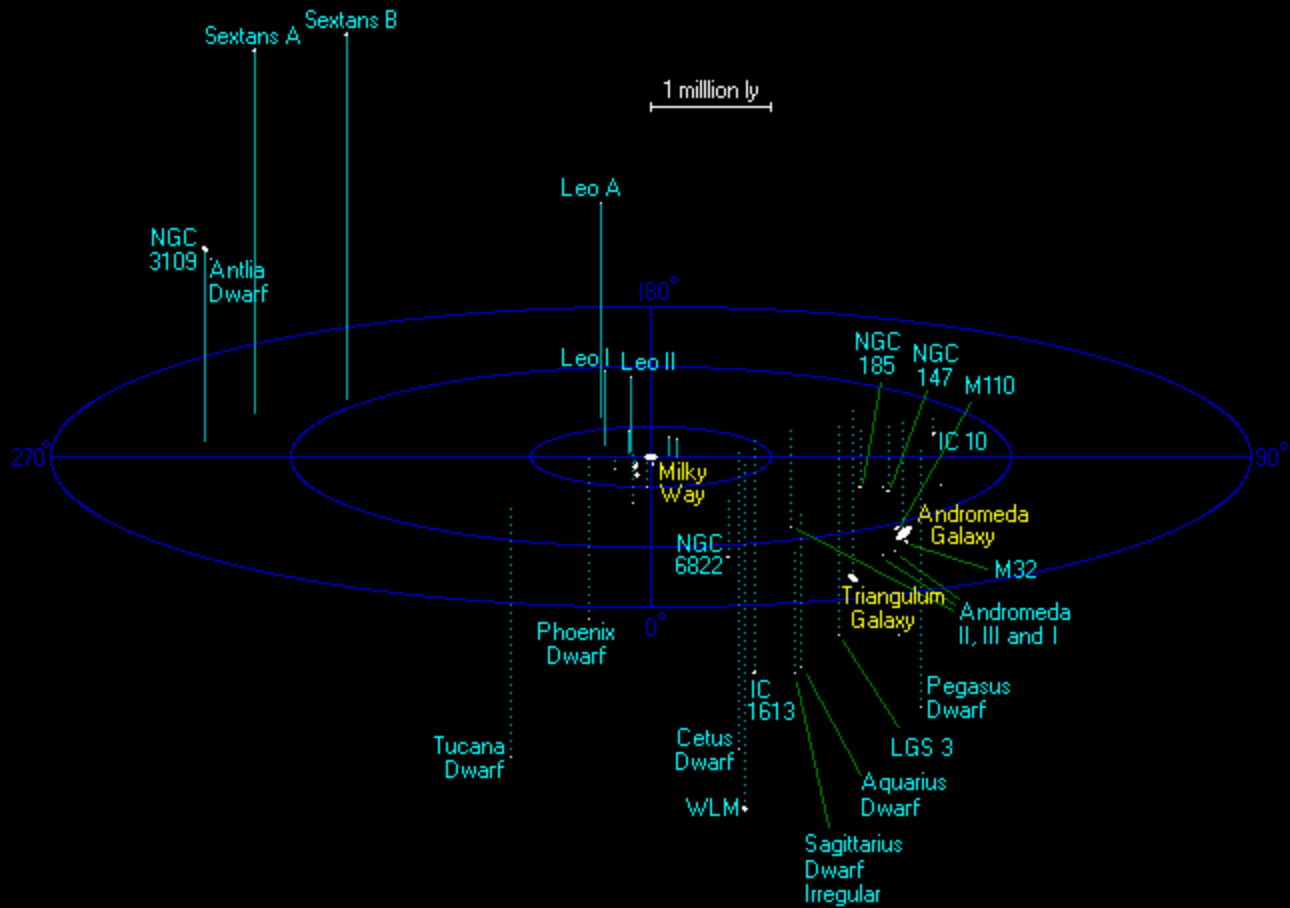
180.000 – 200.000 anos luz

1.700.000.000.000.000.000 - 1.850.000.000.000.000.000 km

$1.7 \times 10^{18} - 1.85 \times 10^{18} \text{ km}$

O Grupo Local de galáxias



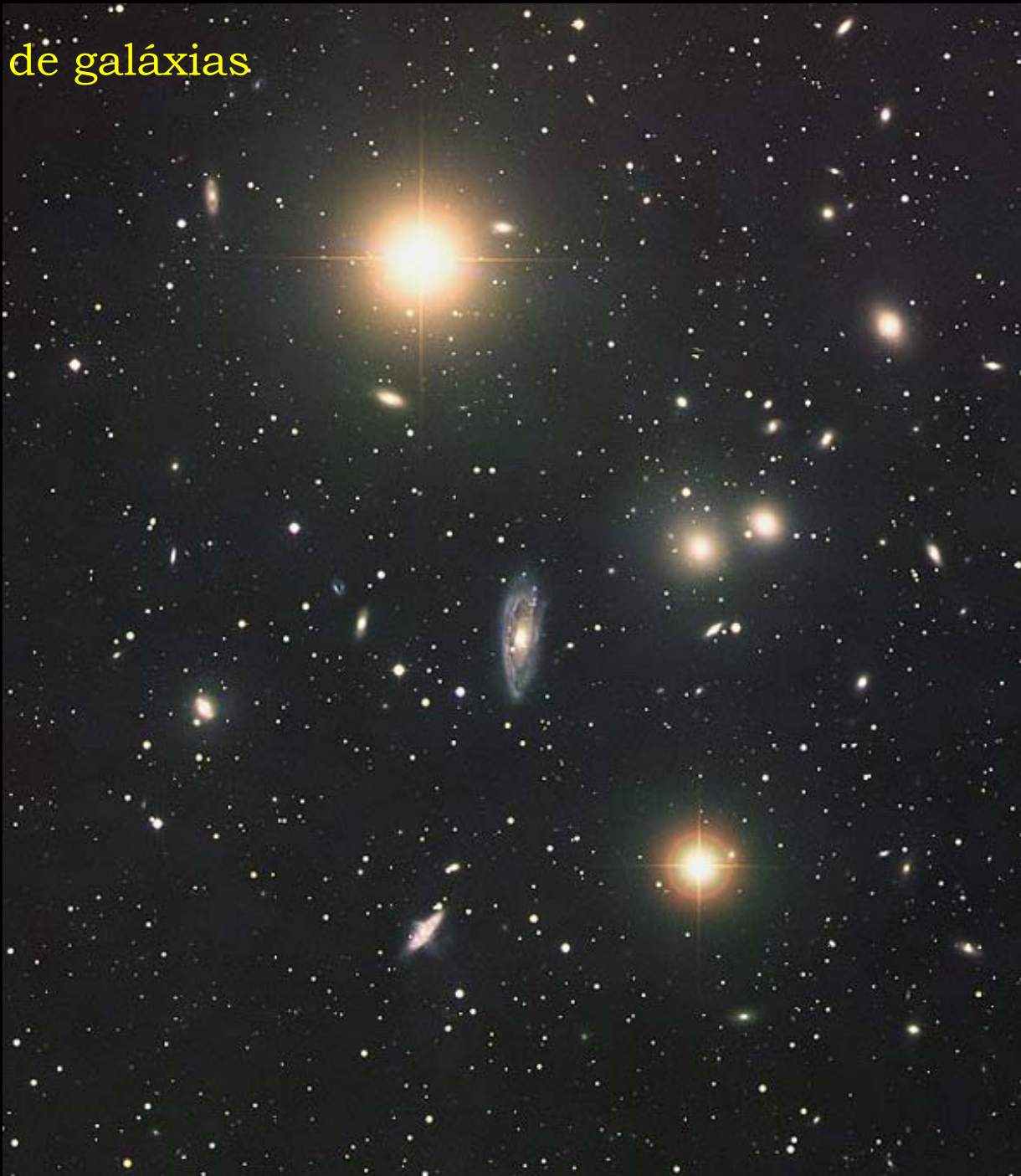




AGLOMERADOS DE GALÁXIAS

Aglomerado de galáxias

Hydra

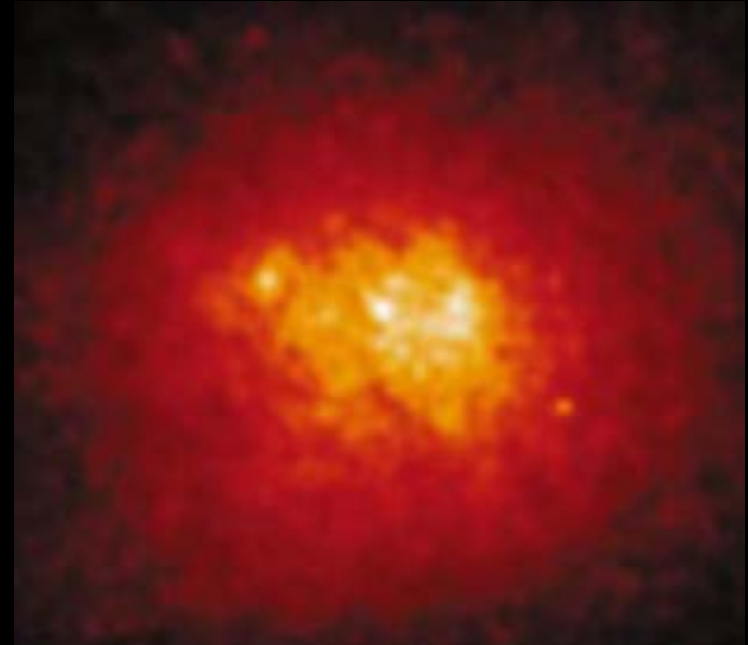


Aglomerado de galáxias

Coma



Luz visível



Raios X

Aglomerado de galáxias

Virgo

1 Mpc

30.000.000.000.000.000.000 km

3×10^{19} km

3.26 milhões de anos luz

“Tamanho” do universo:

c: velocidade da luz = 300.000 km/s

t: idade do universo ~ 15 bilhões de anos

$R \sim c t$

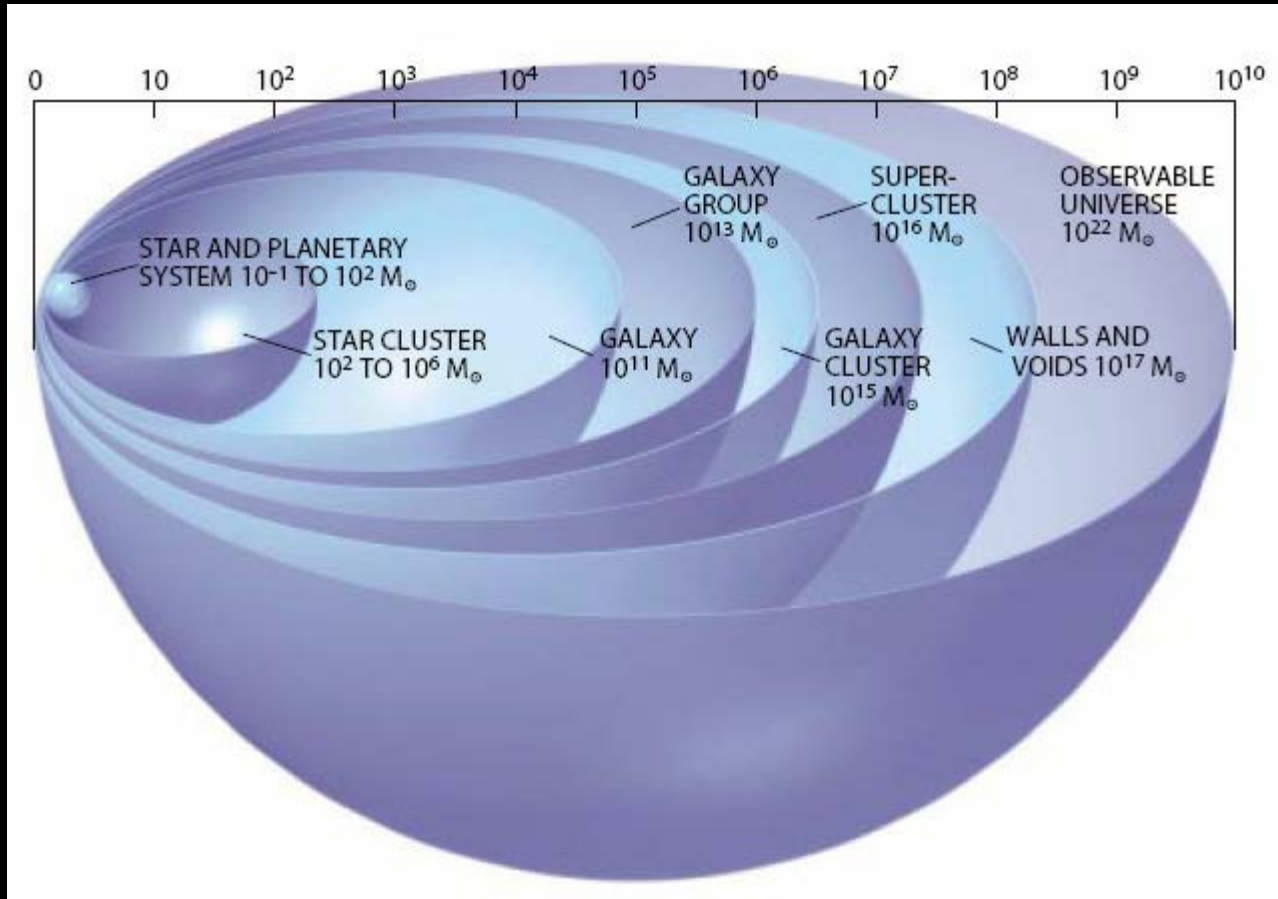
$R \sim 140.000.000.000.000.000.000.000 \text{ km}$

$= 1.4 \times 10^{23} \text{ km}$

$= 4500 \text{ Mpc}$

$= 15 \text{ bilhões de anos luz}$

Diâmetro aproximado em anos-luz



HIERARQUIA COSMICA



FIM