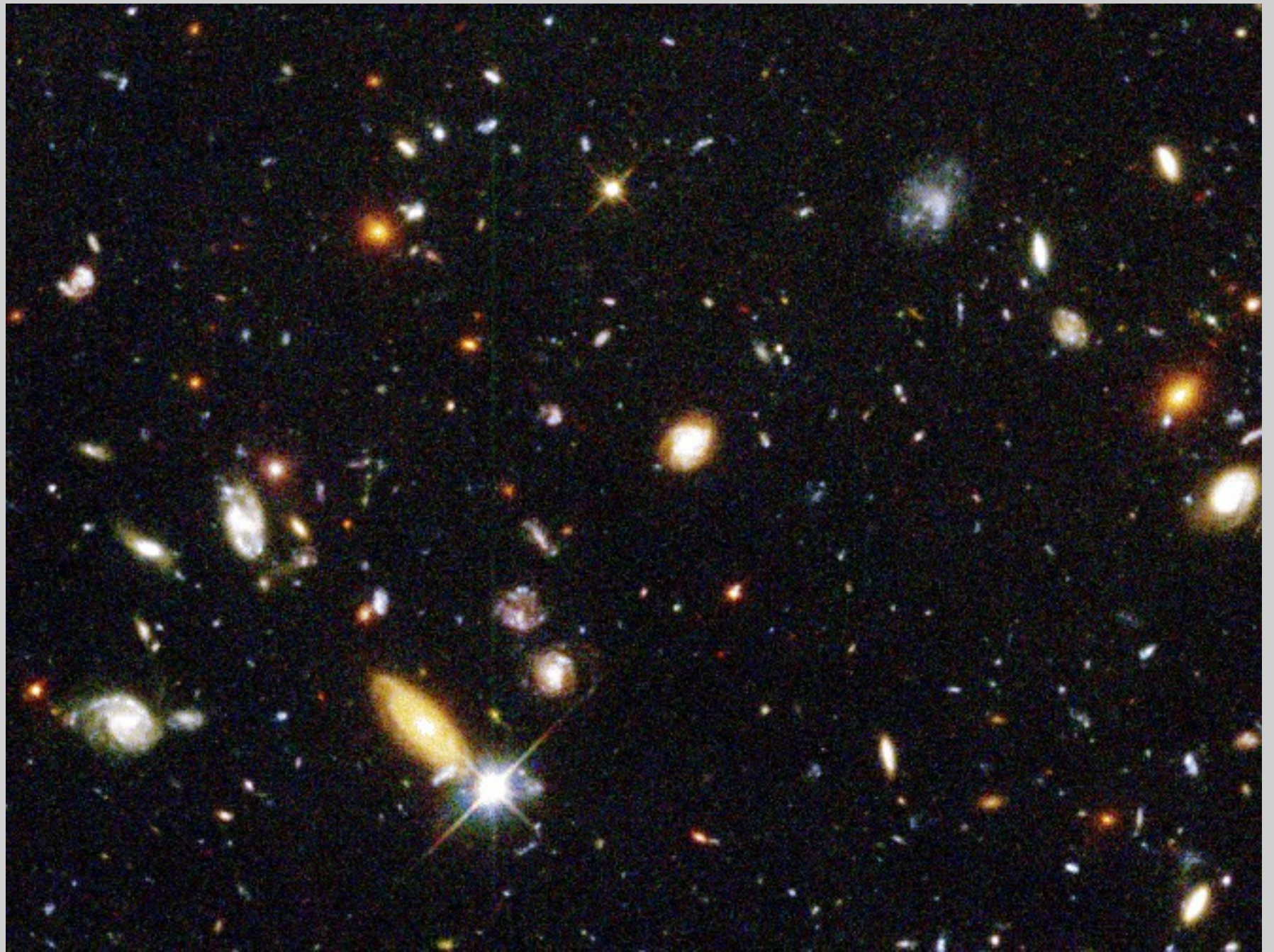
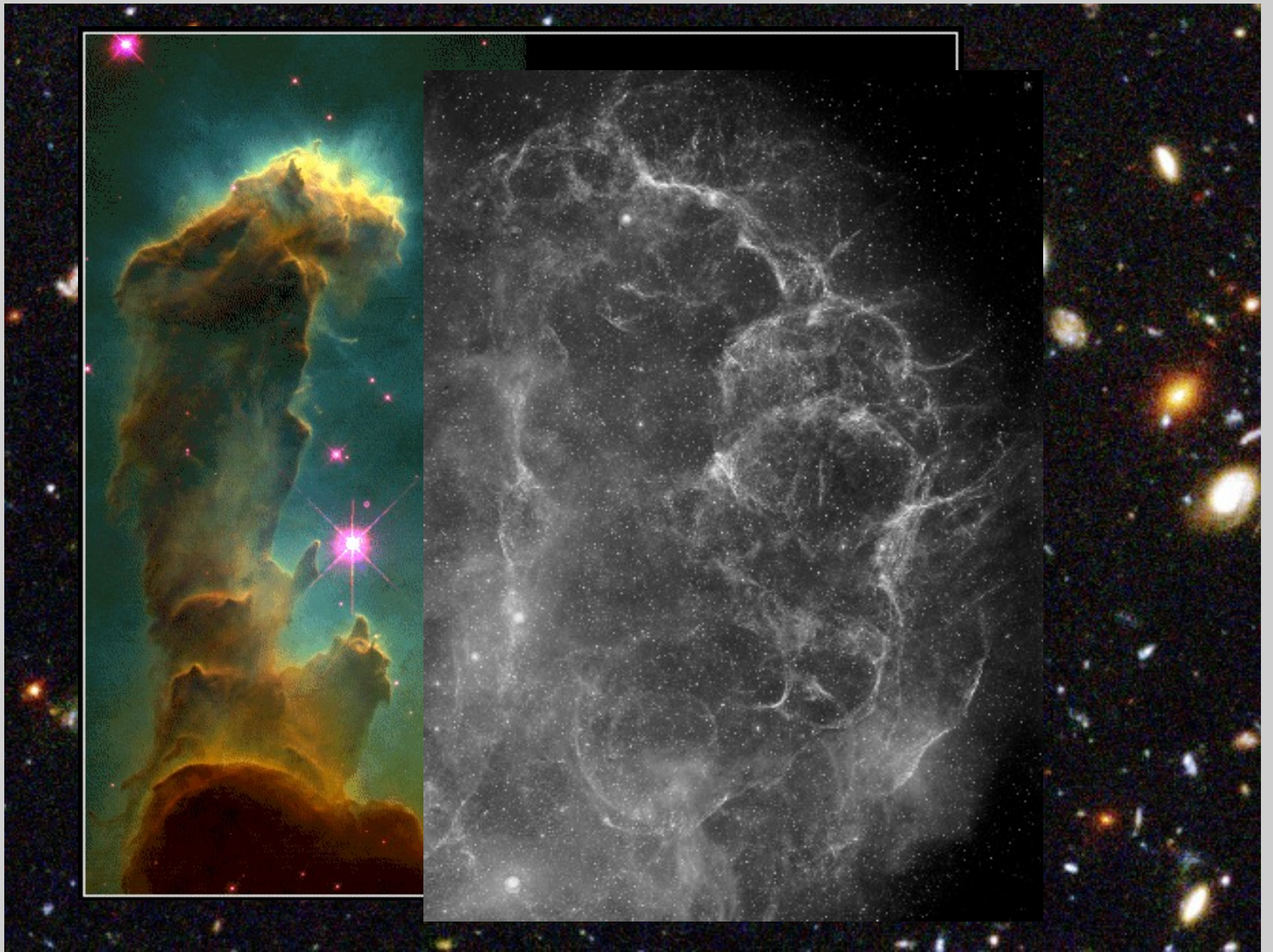


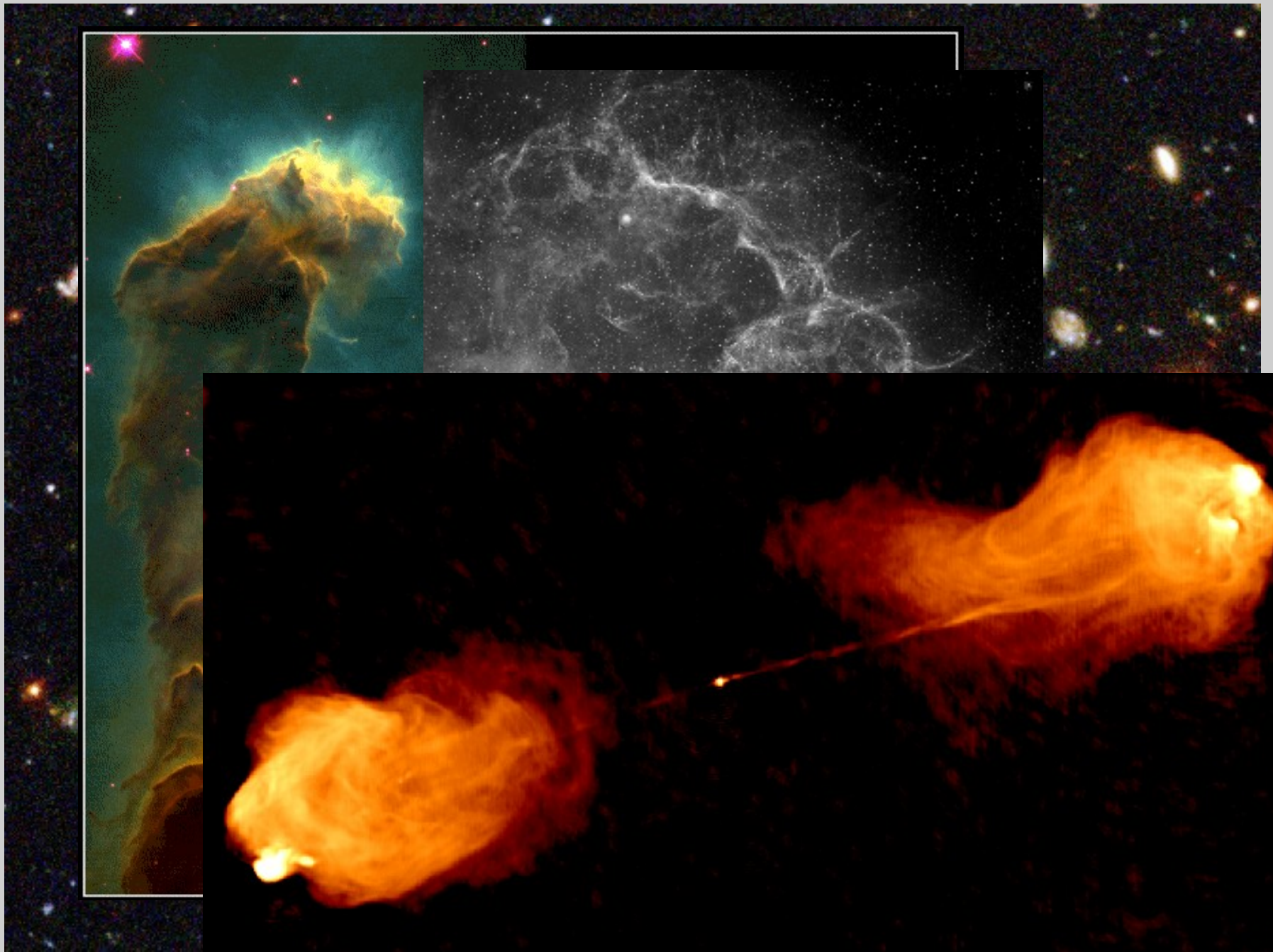
# Our place in the Universe













The Universe  
is very very  
big....





Earth

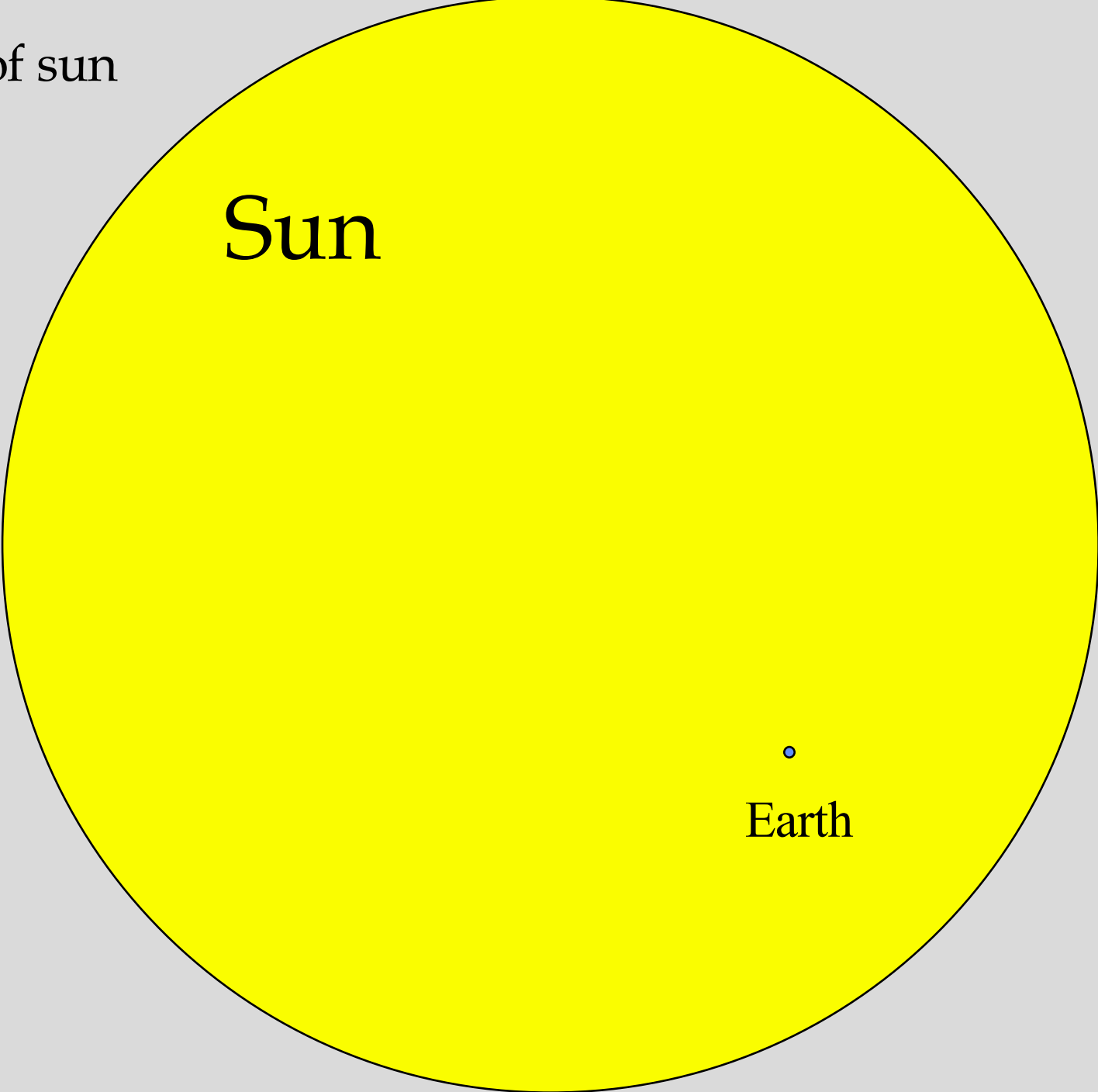
radius 6378 km

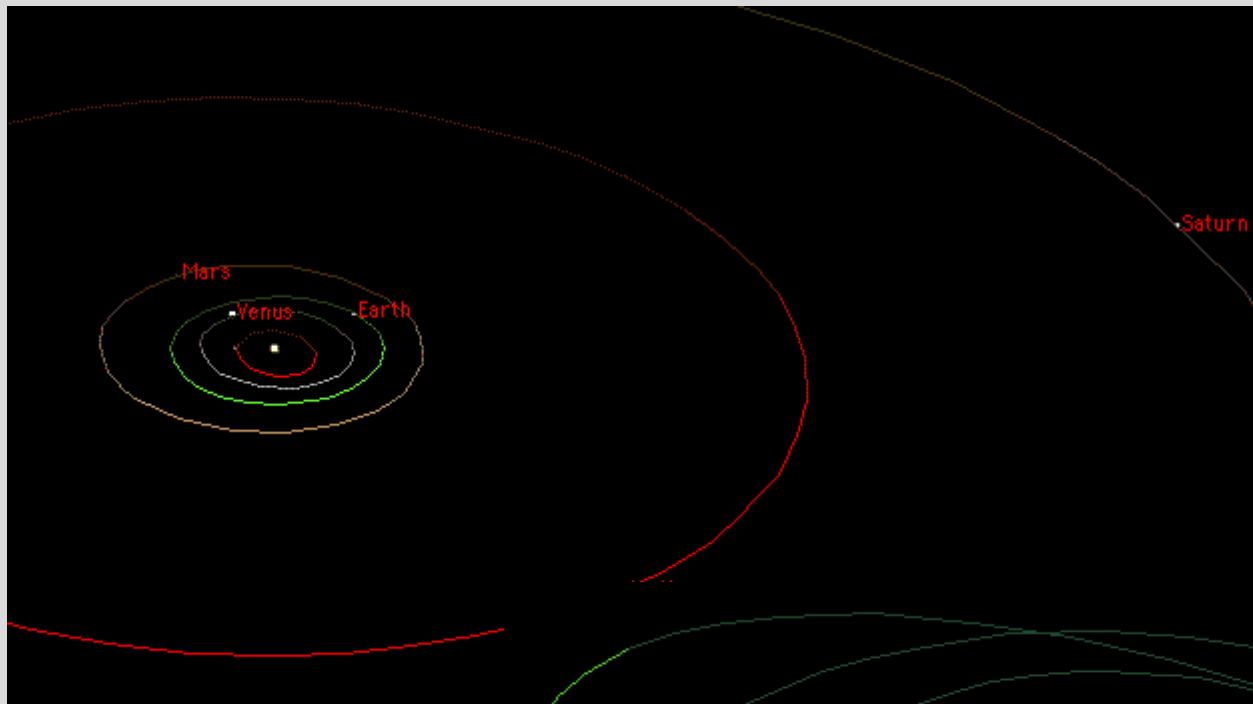
radius of sun

$\times$   
109

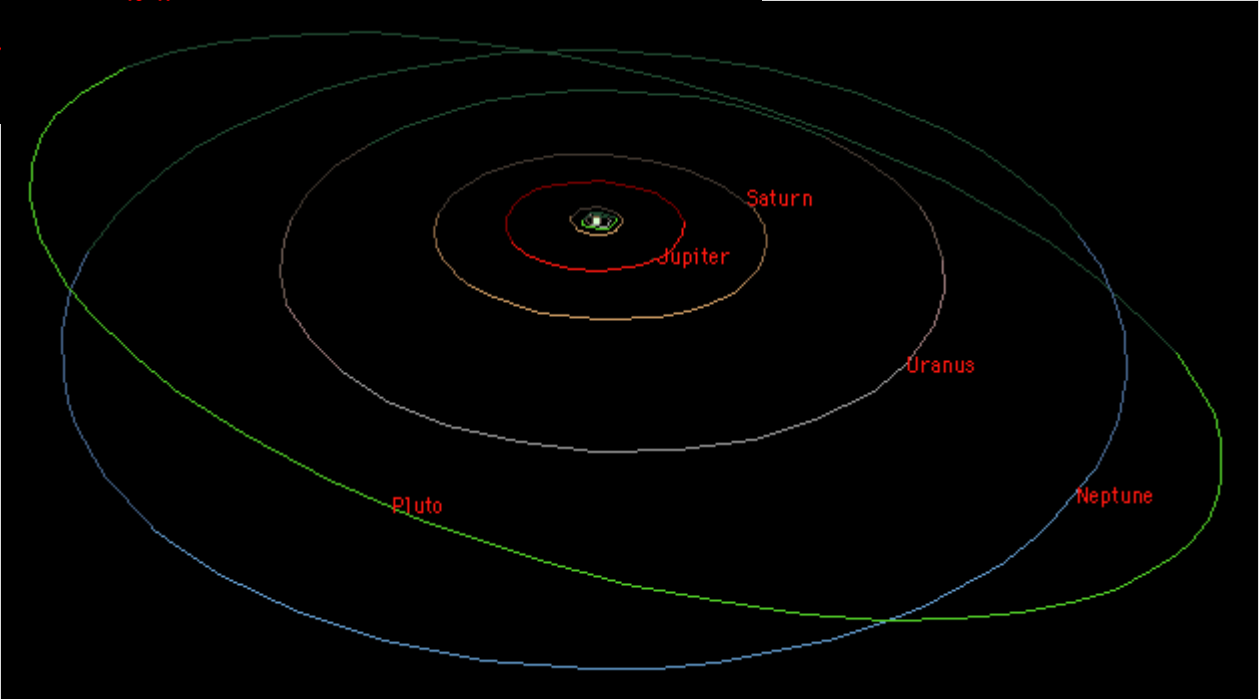
Sun

Earth



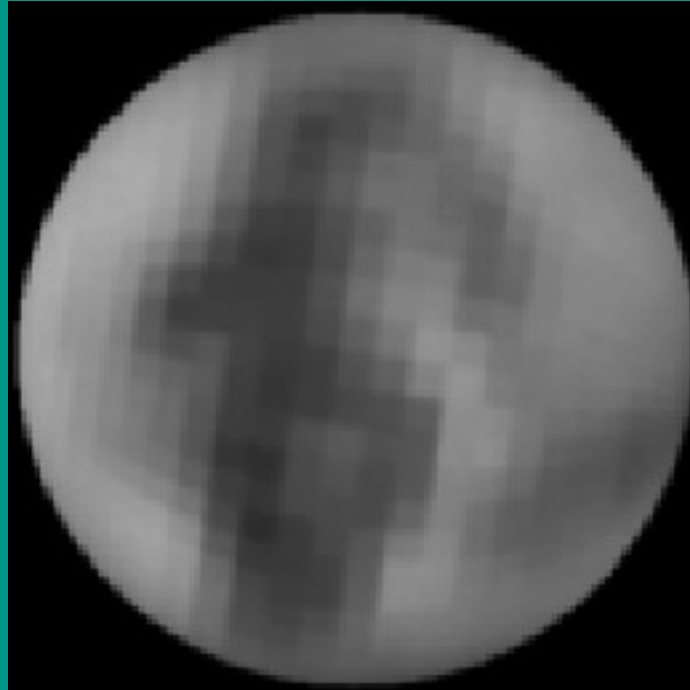


orbit of earth  
around sun  
x 214



orbit of Pluto  
x 39

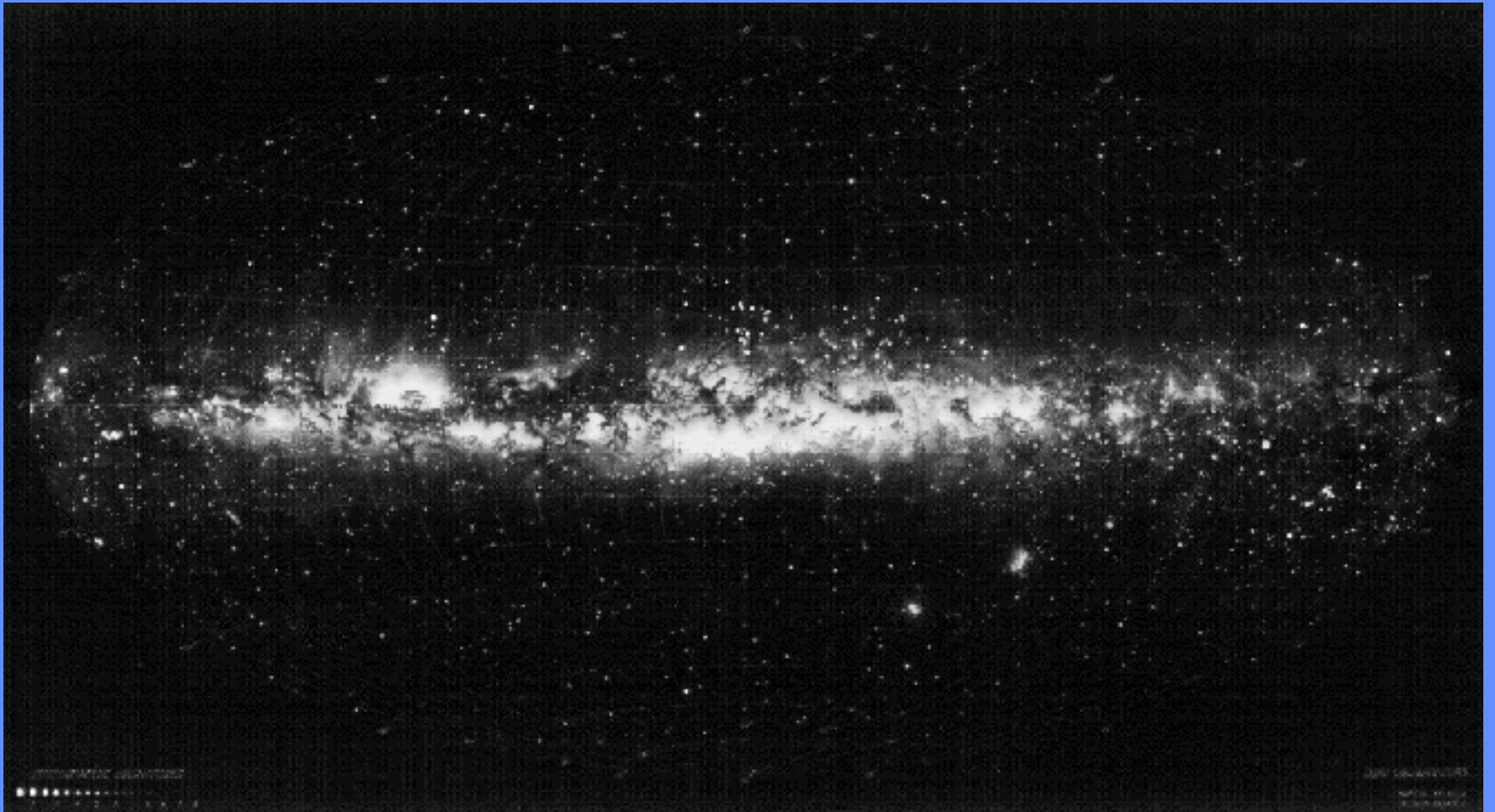
# Pluto



## Nearby Star Cluster - the Pleiades

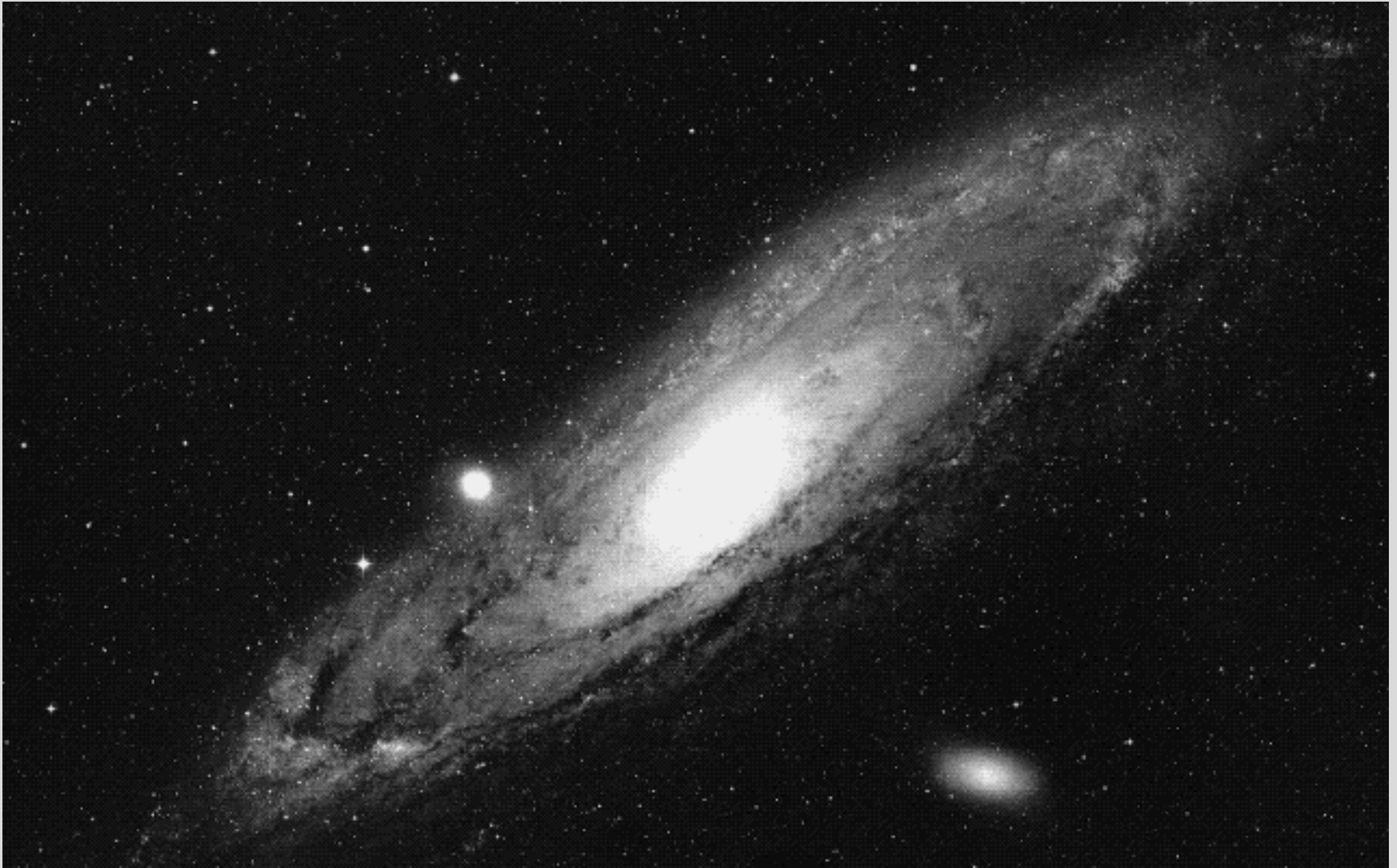


nearest star  $\alpha$  Centauri x 6841



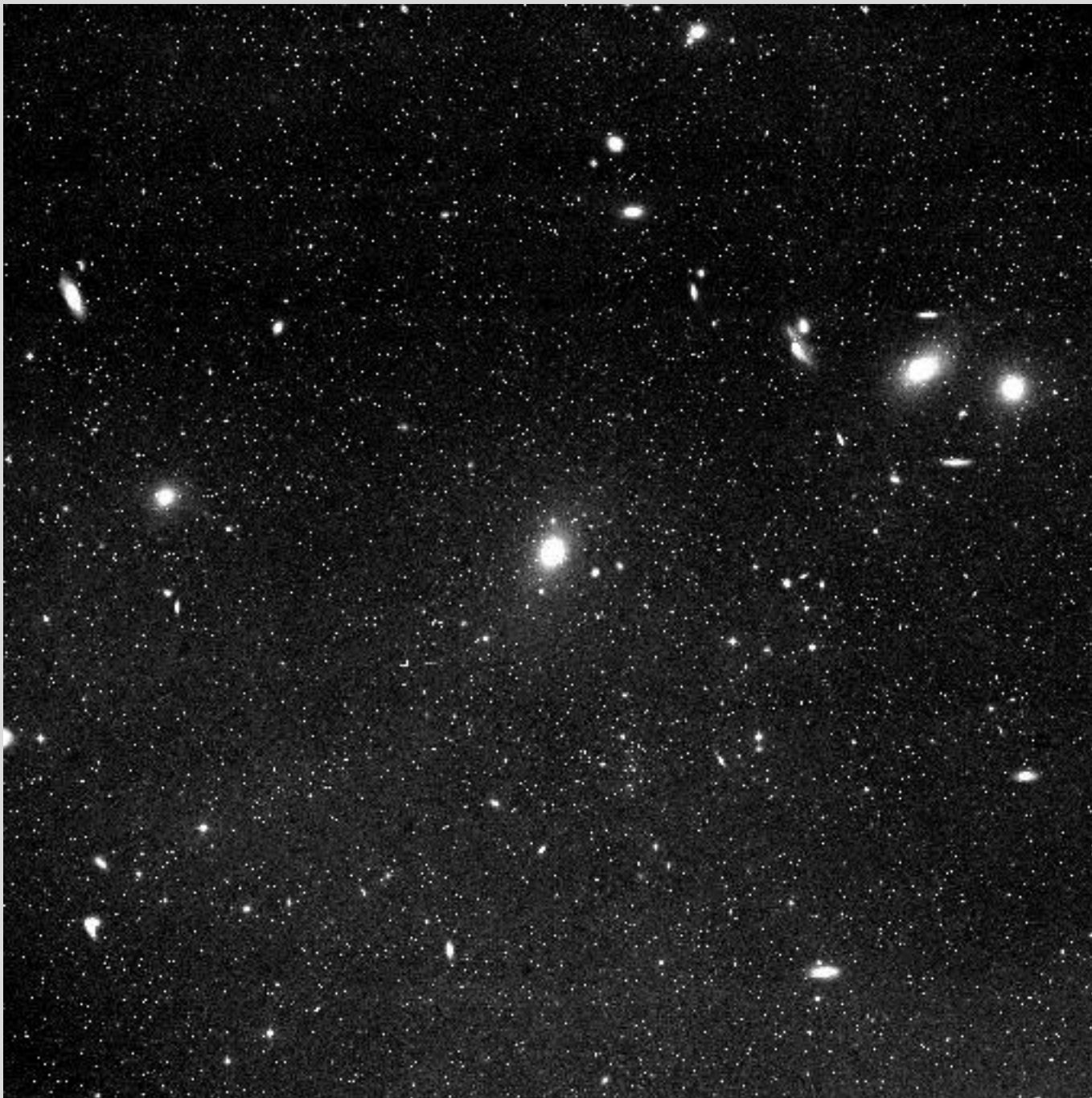
Milky Way

radius x 7639



Andromeda Nebula (M31)

distance x 73



Virgo  
Cluster  
of galaxies

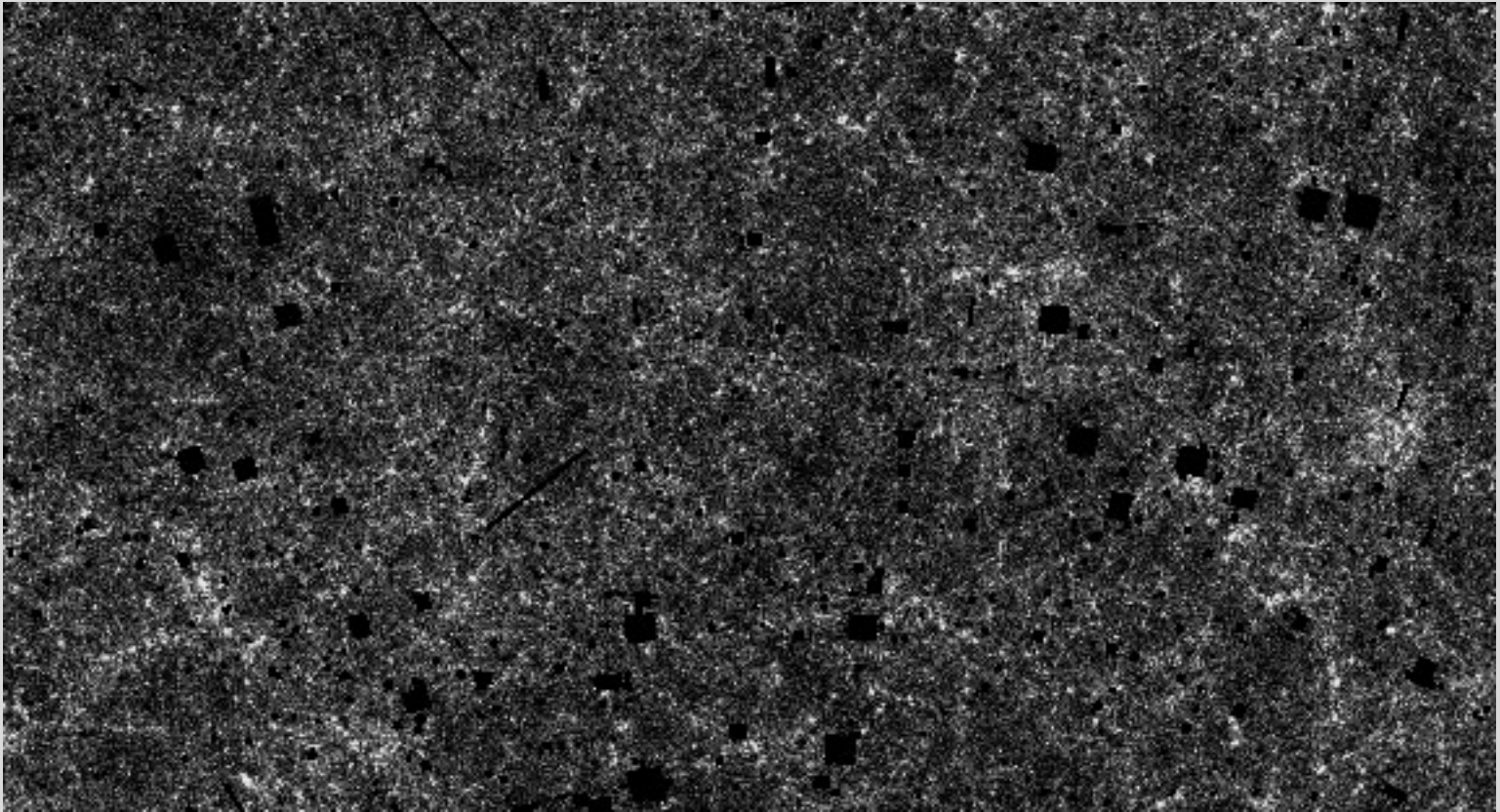
distance

x

20



# APM galaxy survey



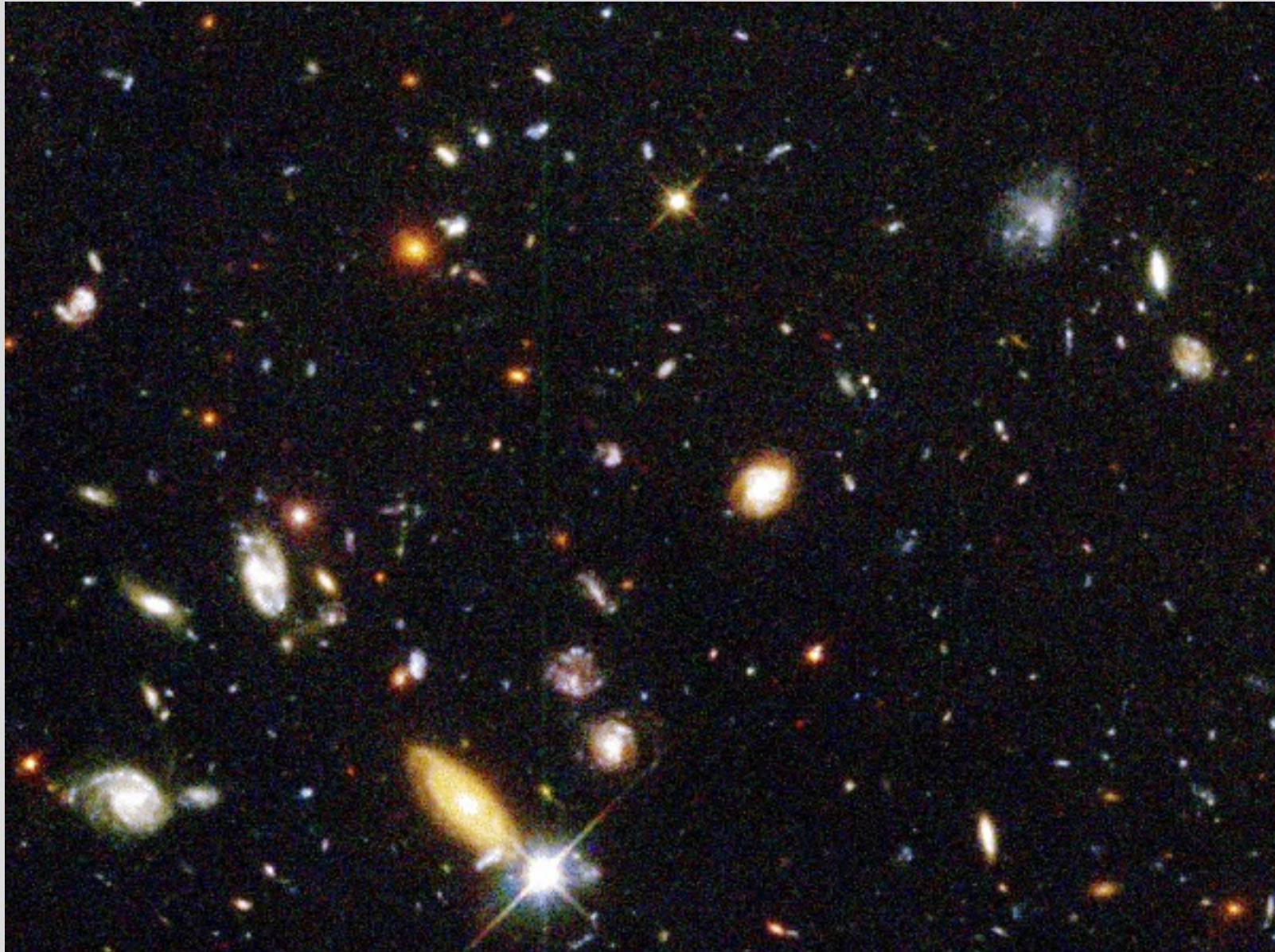
distance to faint photographic galaxies  $\times$  approx 100

# Stepping out through the Cosmos

- Radius of Earth 6378 km
- Radius of Sun x 109
- Distance to Sun x 214
- Distance to Pluto x 39
- Distance to  $\alpha$  Centauri x 6,841
- Radius of Galaxy x 7,639
- Dist. to Andromeda galaxy x 73
- Dist. to Virgo Cluster x 20

# Hubble Deep Field

... distance = Virgo  $\times$  3000



**Total Distance**  
 **$\sim 1.5 \times 10^{24}$  km**

**1,500,000**

**000,000,**

**000,000**

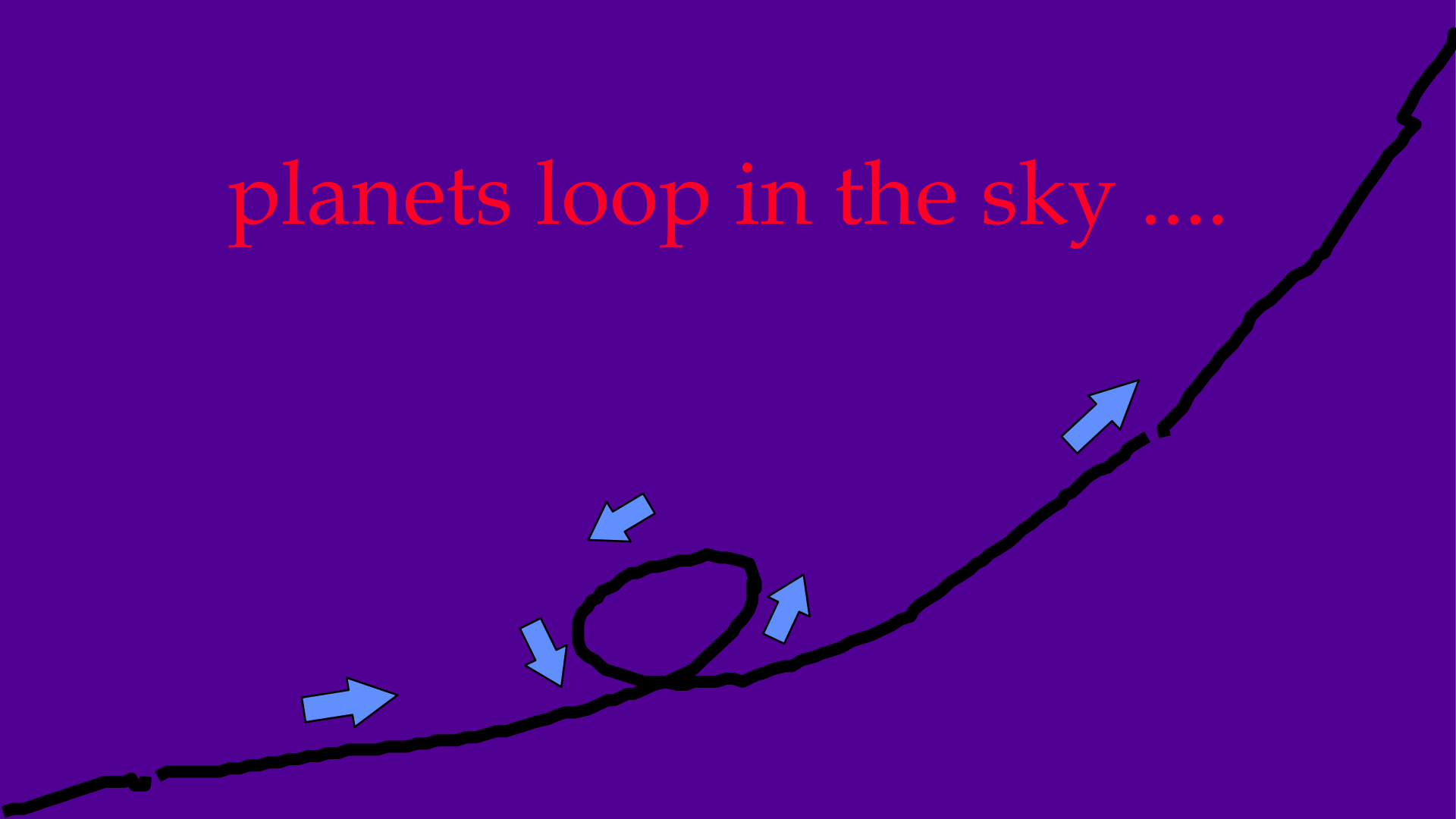
**000,000**

**km**

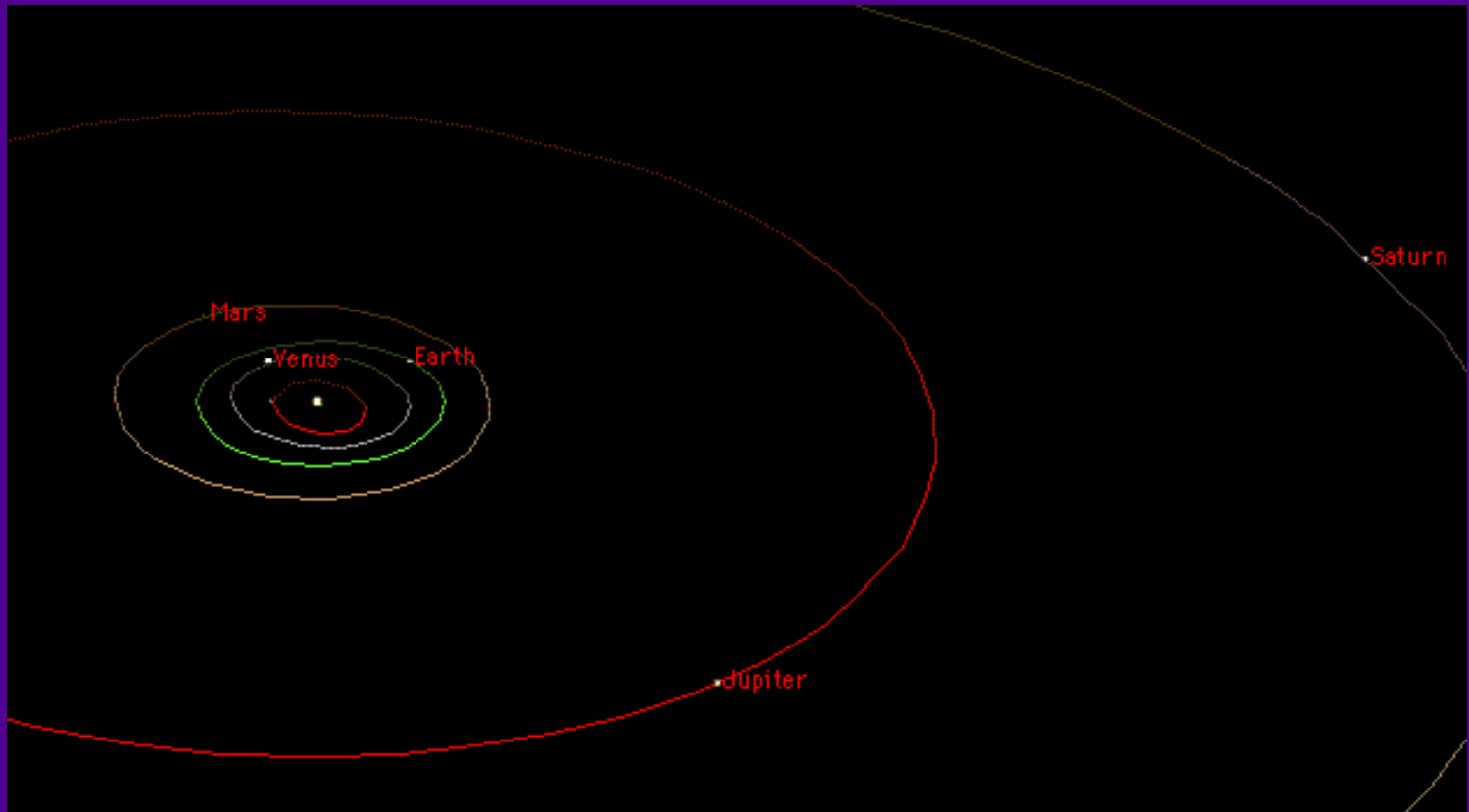


**... we are not  
in the centre  
of things.....**

planets loop in the sky ....

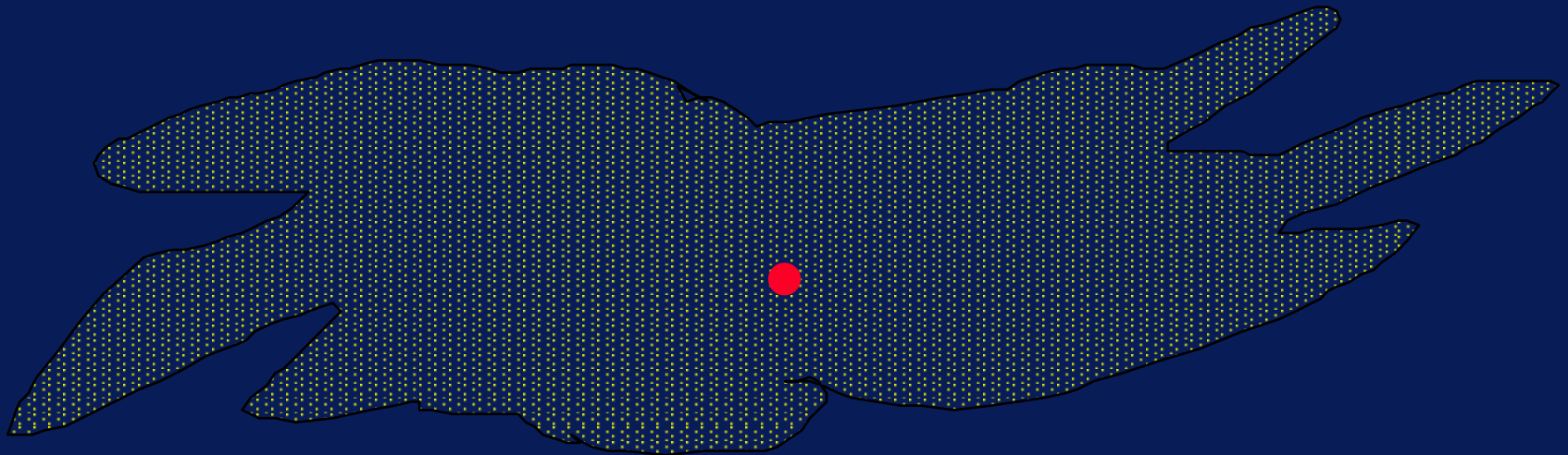


# .....Earth not at centre of solar system

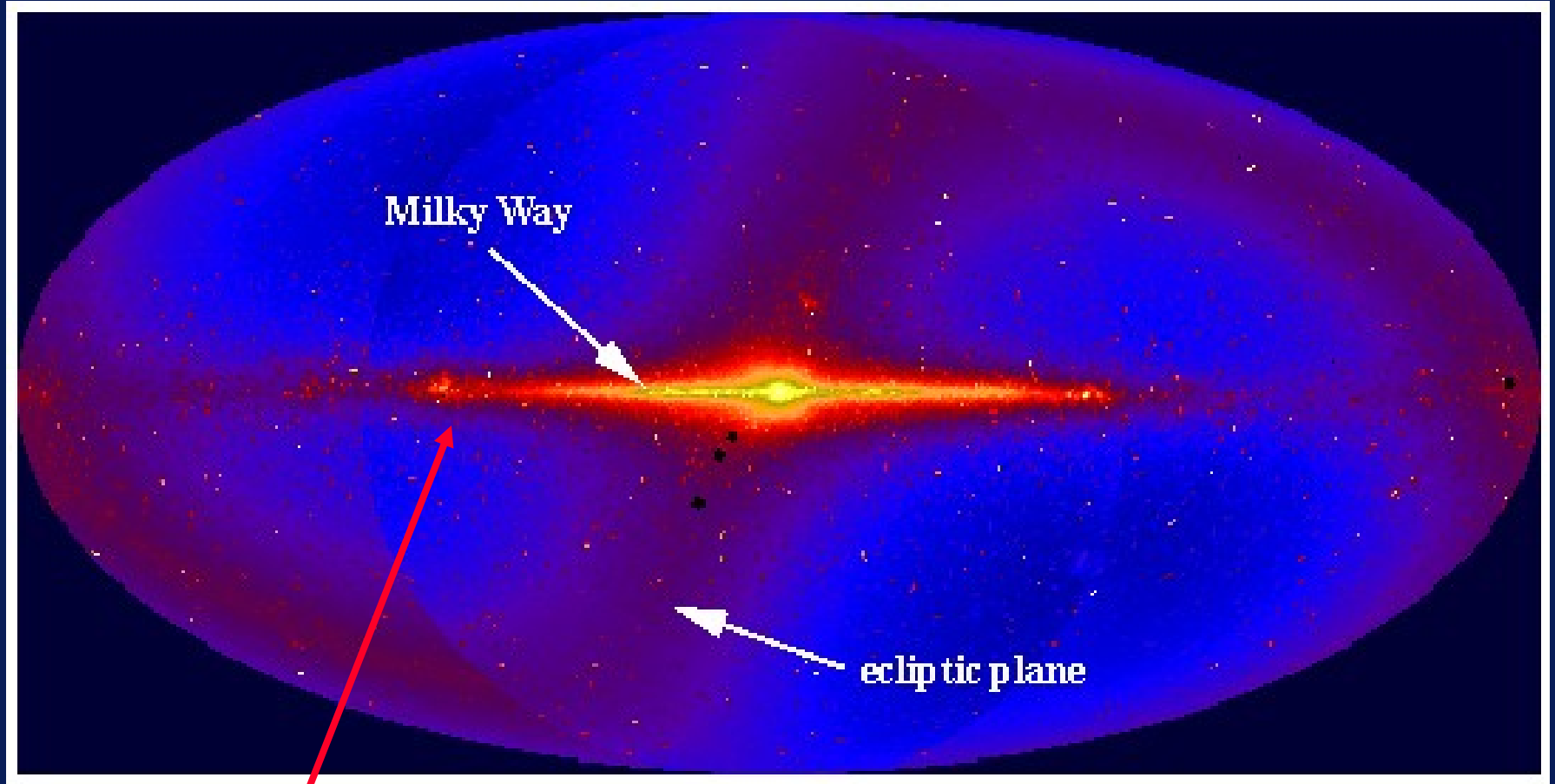




# Milky Way according to Herschel

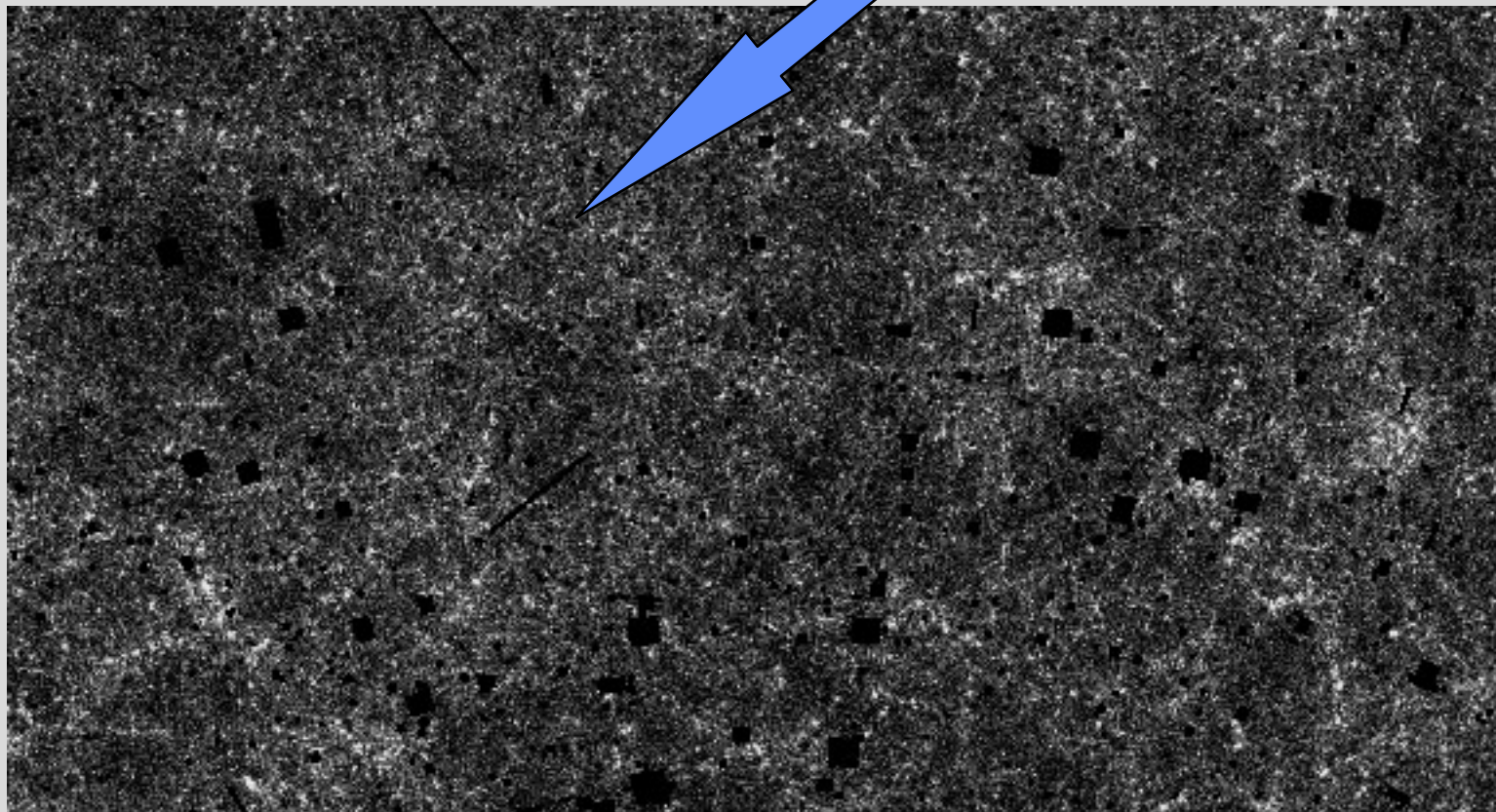


# Milky Way according to COBE



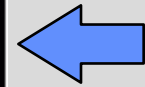
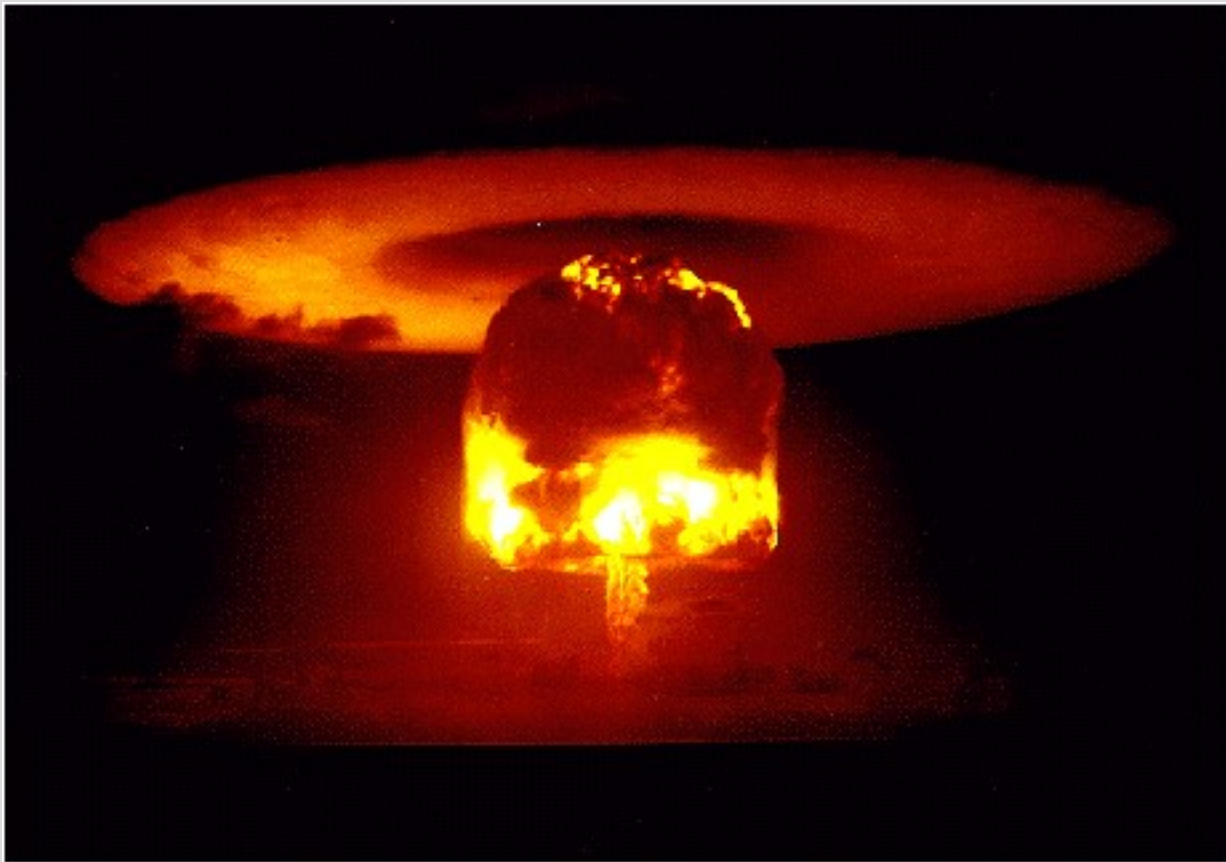
Sun

you are here ...



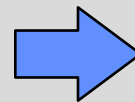


**... the universe is  
unbelievably  
violent.....**



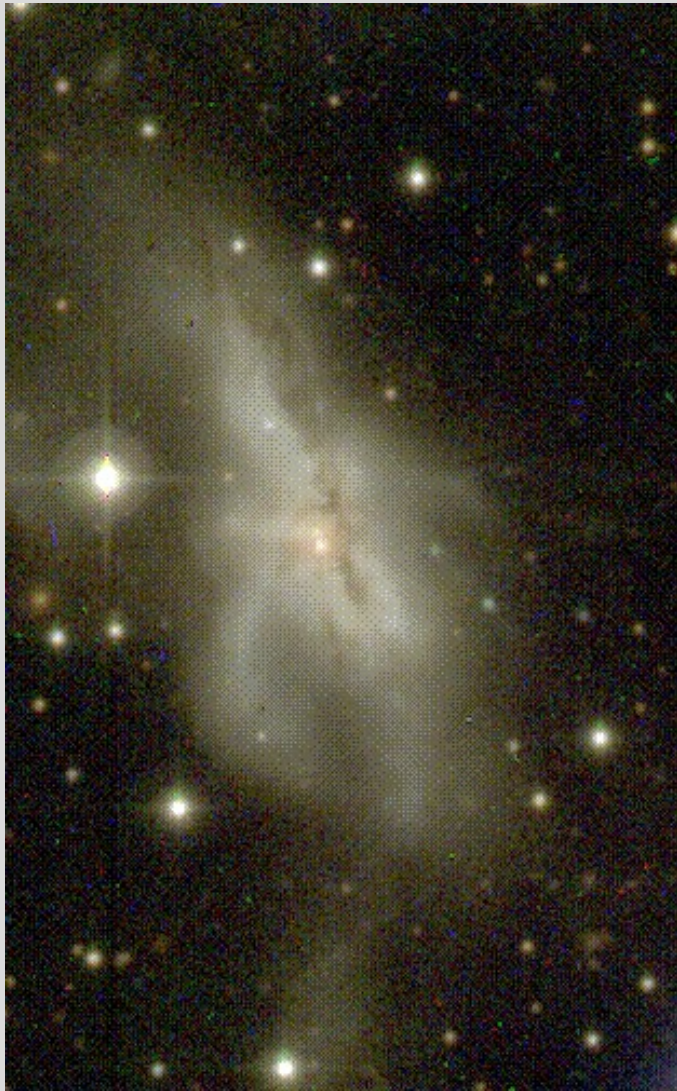
a big bang ?

.... ten billion bombs a second



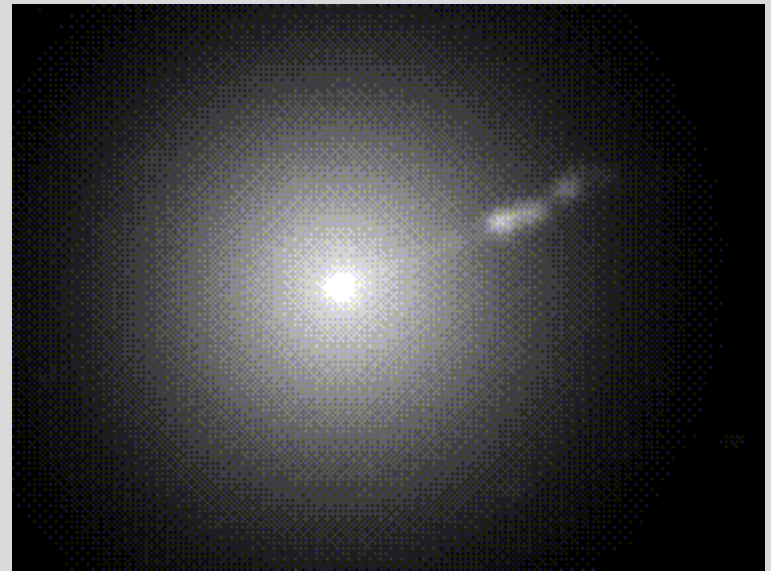
# Power Steps

- Domestic Fire 1 kW
- Large Power Station x 1,000,000
- World energy consumption x 10,000
- Sunlight falling on Earth x 20,000
- Luminosity of Sun x 1,000,000,000
- Luminosity of Galaxy x 10,000,000,000



colliding galaxy system  
NGC 6240

active galaxy M87



.... most powerful quasars  
= whole galaxy x 10000



**Total Power of distant quasar**  
 **$\sim 10^{37}$  kW**

**10,000,000**

**000,000,**

**000,000**

**000,000,**

**000,000,**

**000,000**

**kW**



... people really  
are special.....





galaxy M83

Interior  
of  
Wells Cathedral



- **Information in human DNA...**
- **five thousand books**
- **Information in human brain ...**
- **one million books**





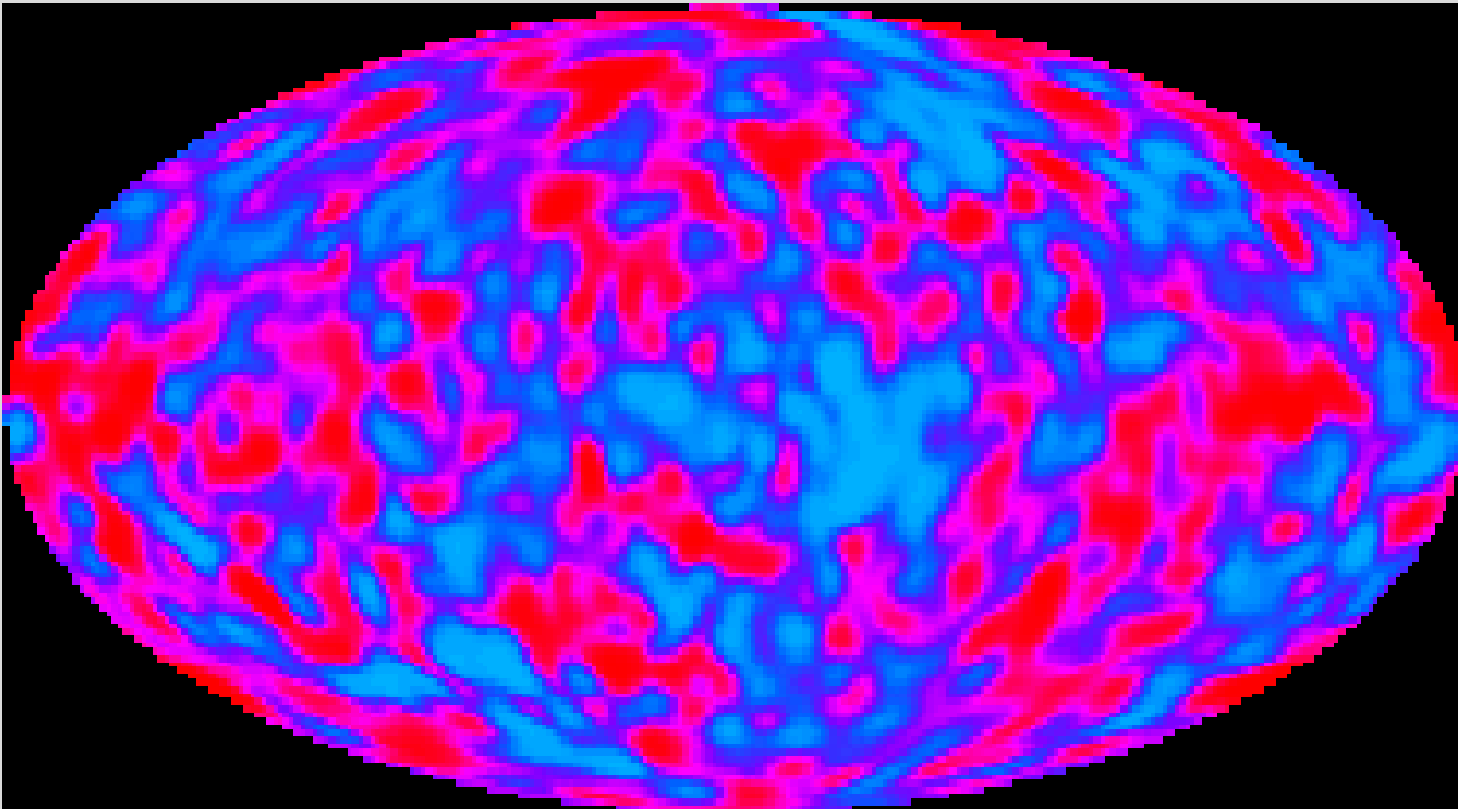
... no purpose or  
meaning ???.....







© Royal Observatory , Edinburgh / Anglo-Australian Observatory



... the face of God ???



**...are we alone ?....**

# Drake's Equation

number of communicating civilisations in Galaxy

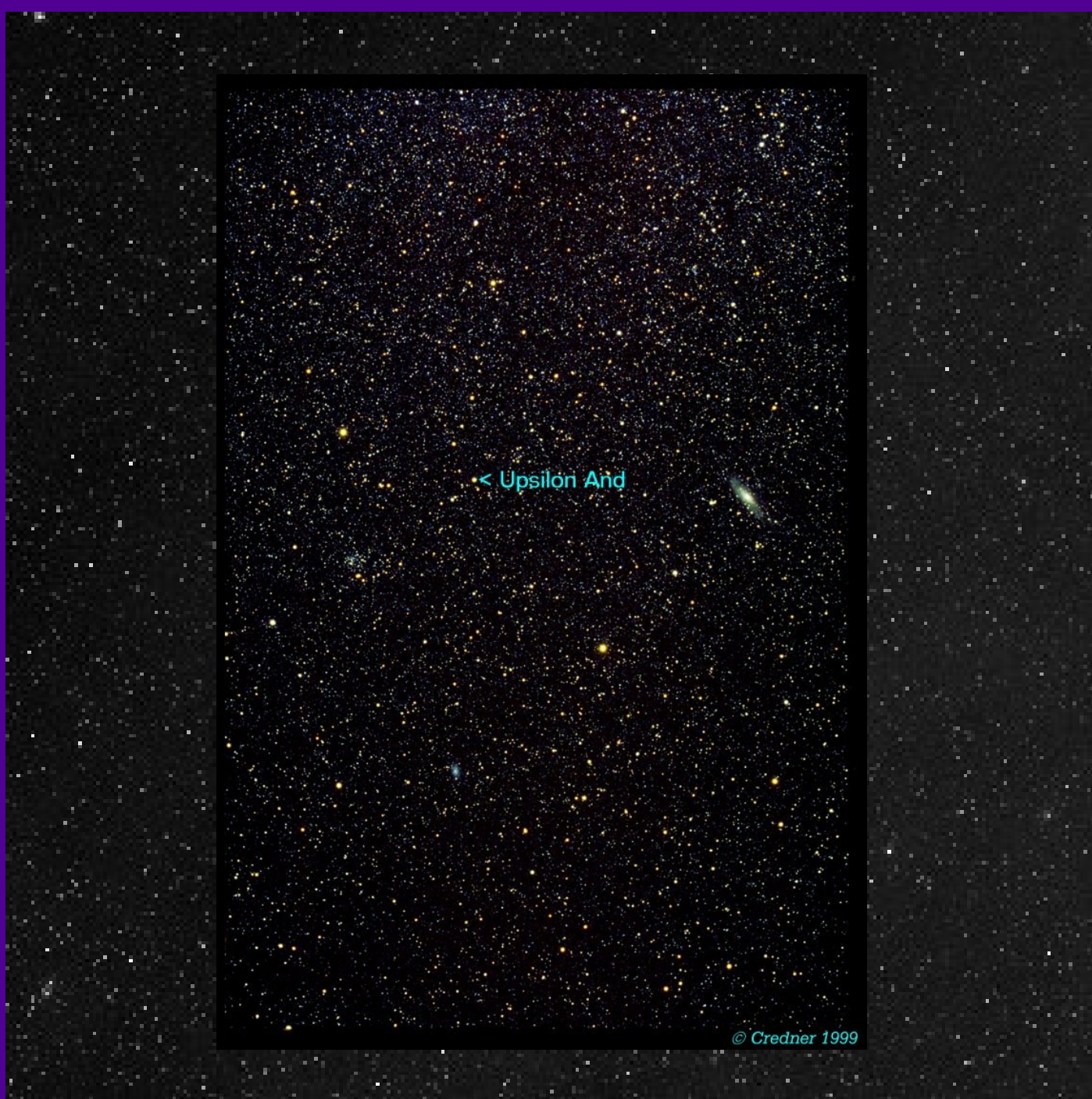
$$N = R \cdot f_p \cdot f_e \cdot f_L \cdot f_i \cdot f_c \cdot L$$

... somewhere between zero and a billion .....

...but we know

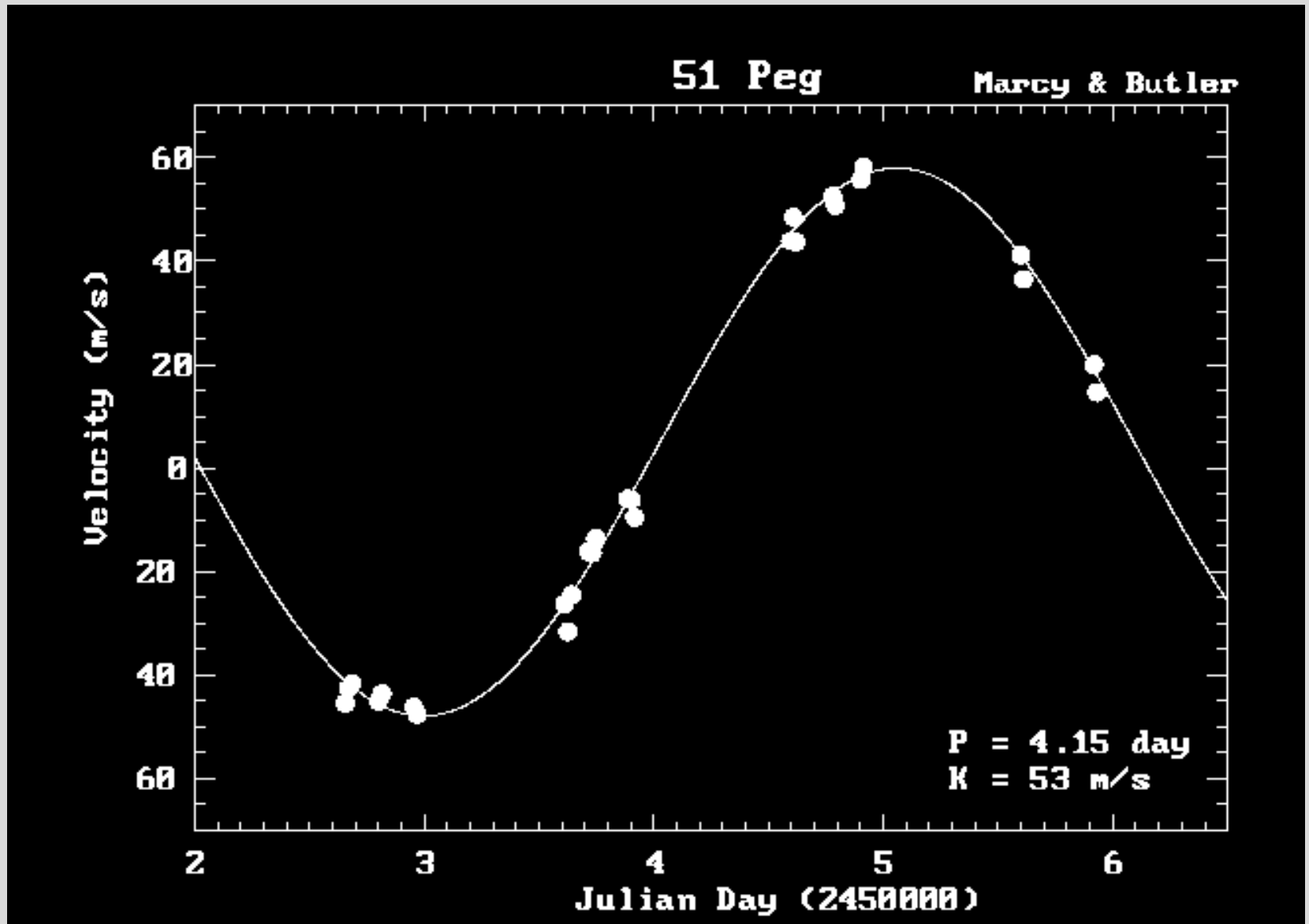
$$N \geq 1$$

Hunt  
the  
Planet

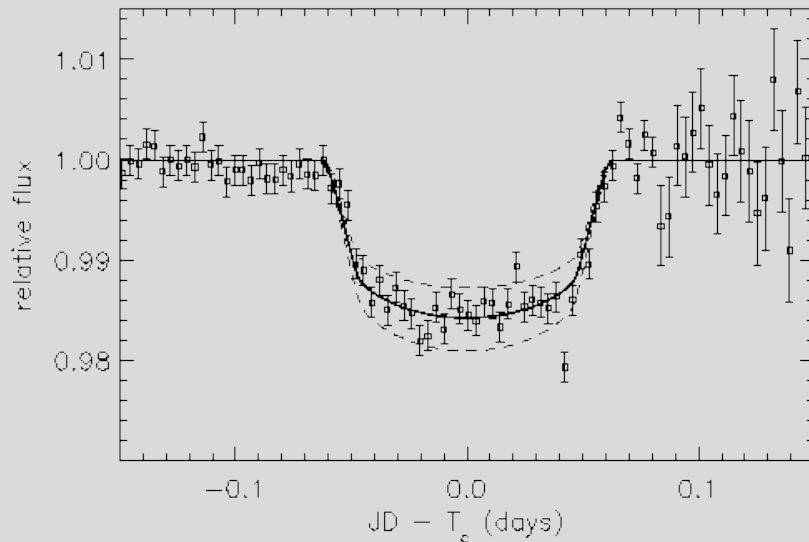
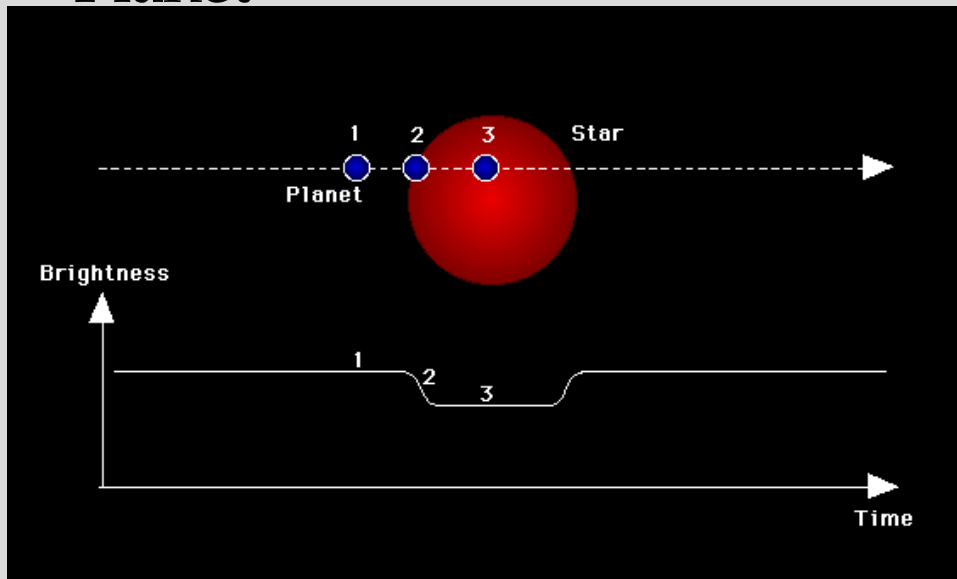




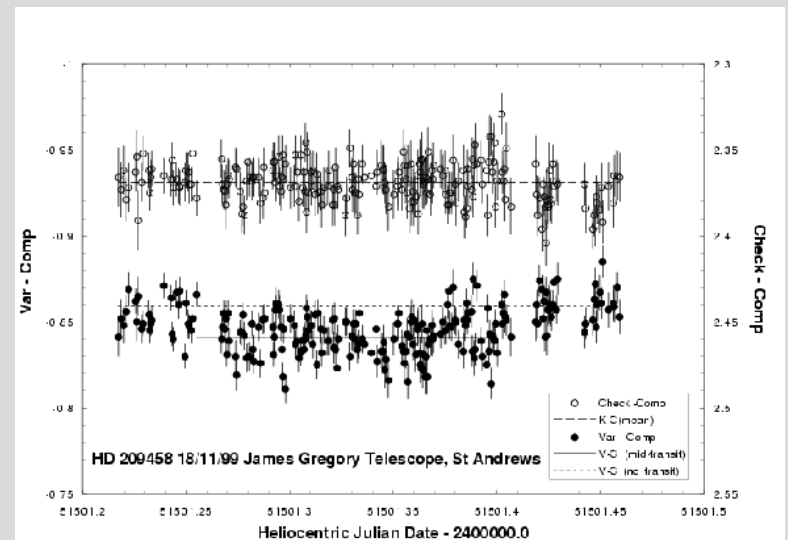
# Planets make stars wobble



# Planet

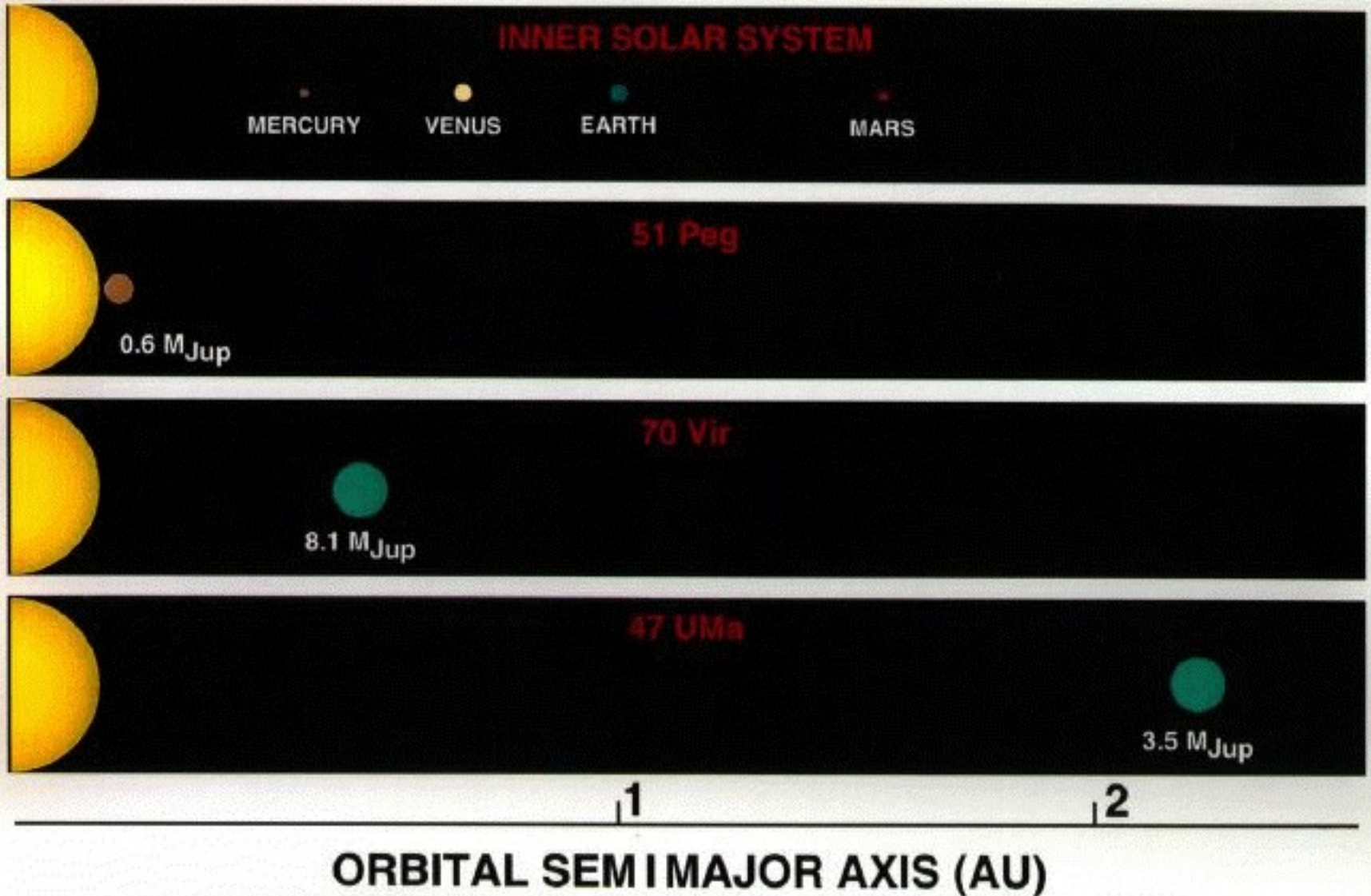


HD 209458 from Arizona...



..and St Andrews !

# PLANETS AROUND NORMAL STARS



**.. life elsewhere ?**

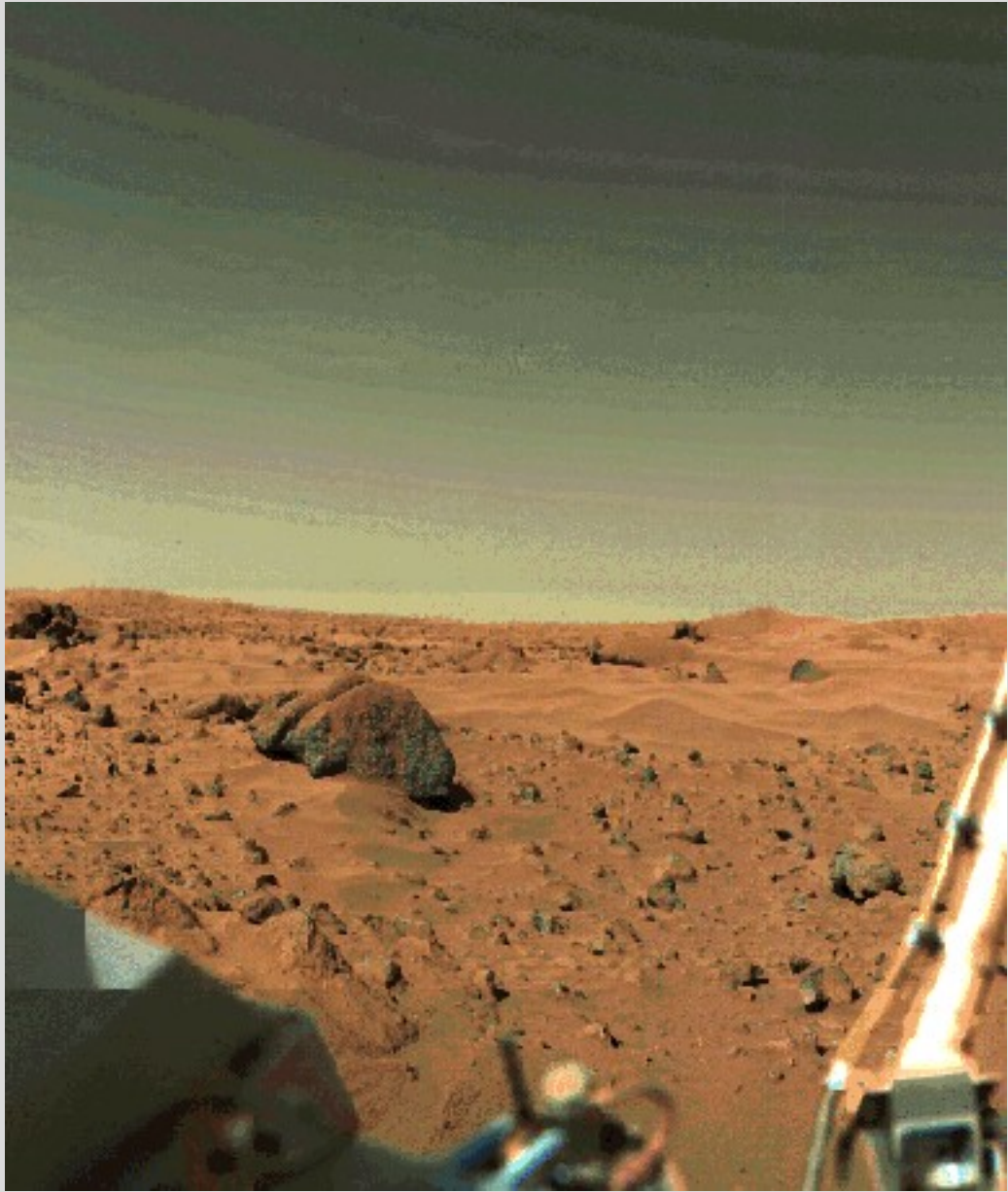
**....**



**Mars · February 1995**

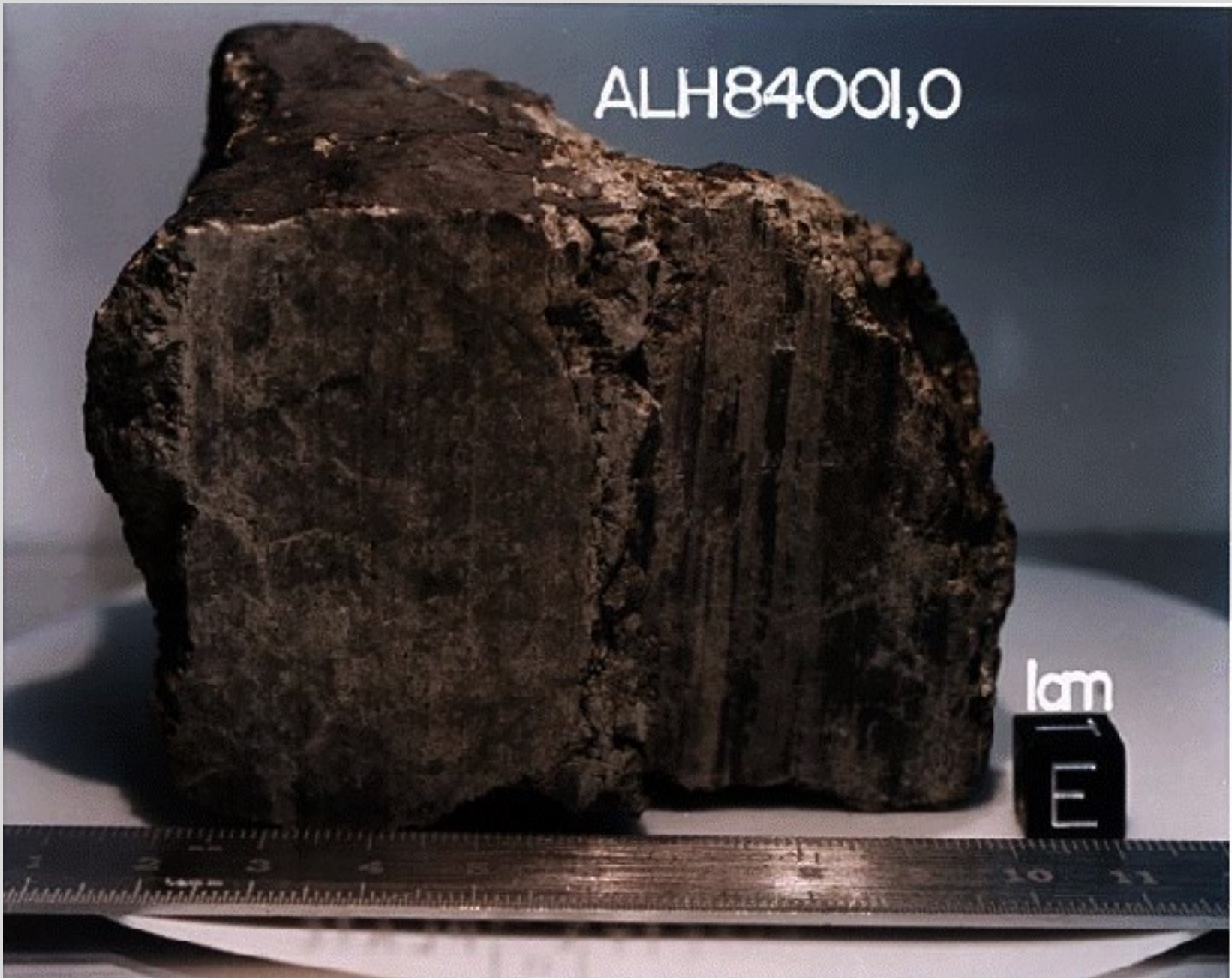
**HST · WFPC2**

PR95-17 · ST Sci OPO · March 21, 1995  
P. James (U.Toledo), S. Lee (U.CO), NASA



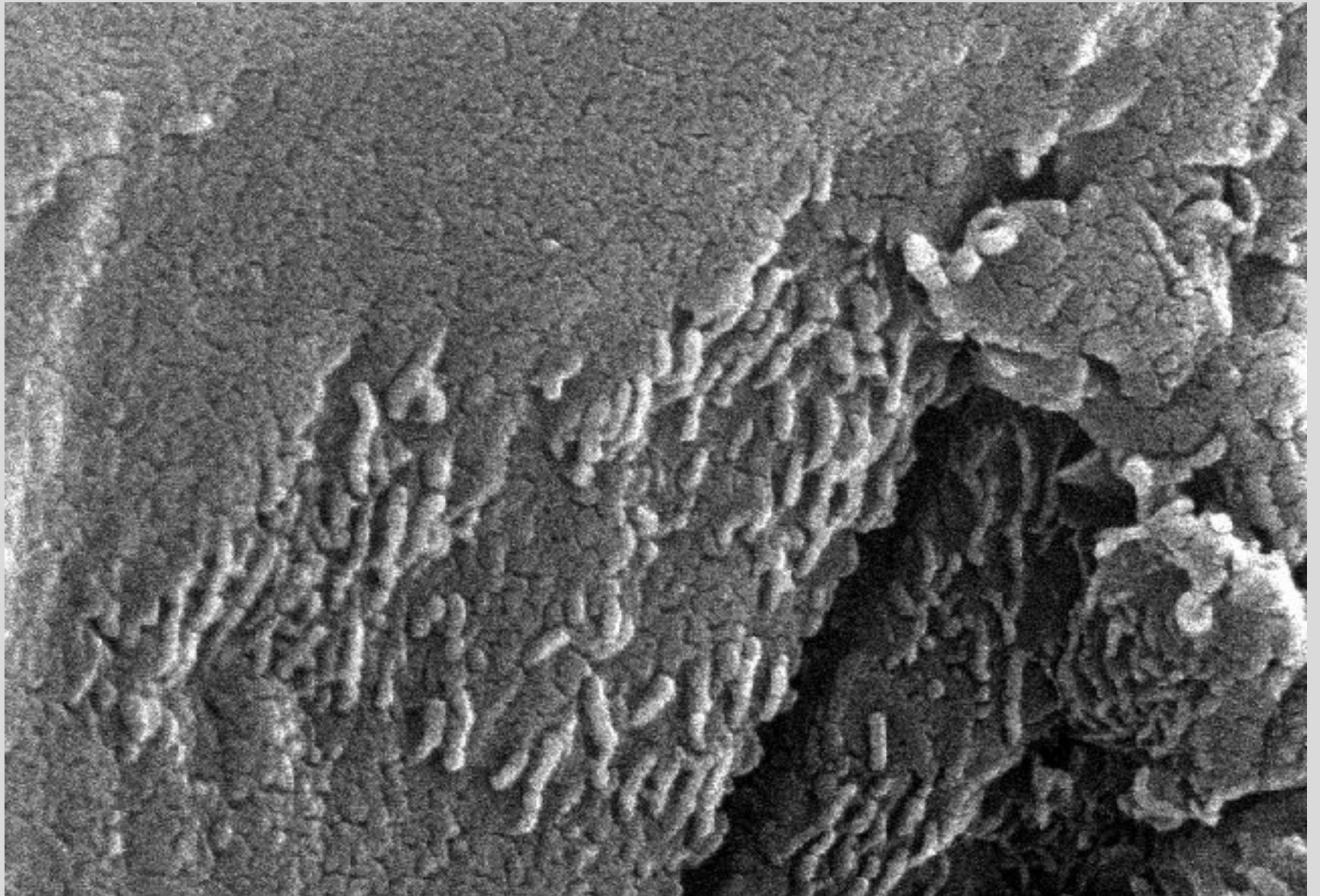
ALH84001,0

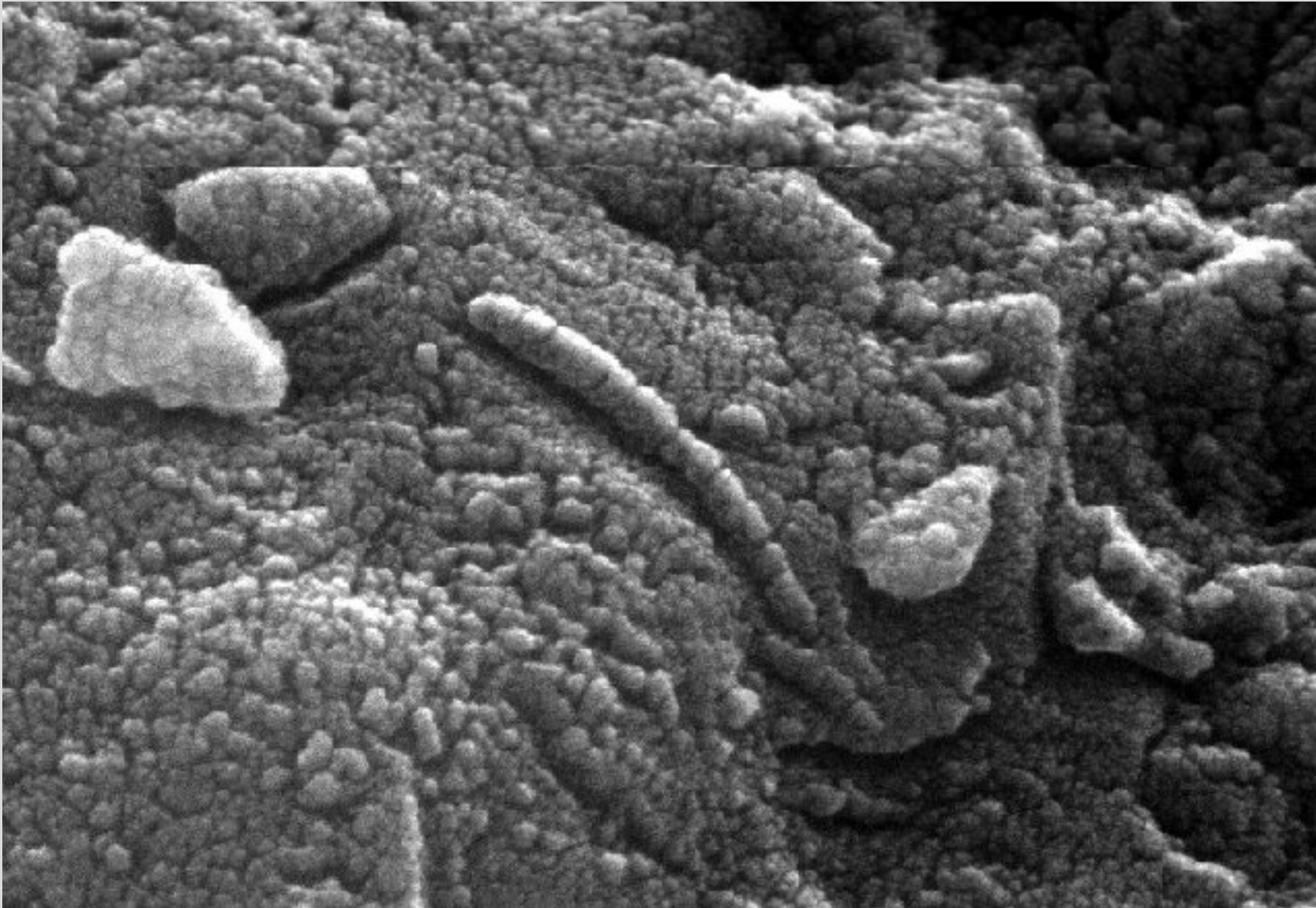
1cm











## Exploration of Mars continues ...



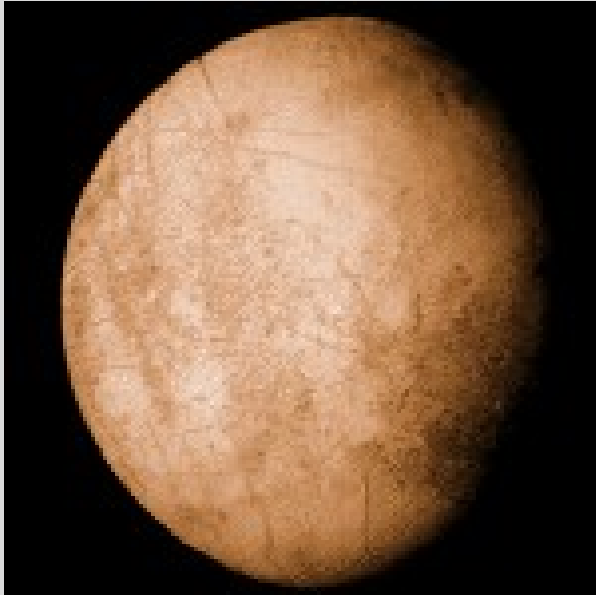
ESA tried to explore *in situ*  
(Beagle II)

NASA will return samples

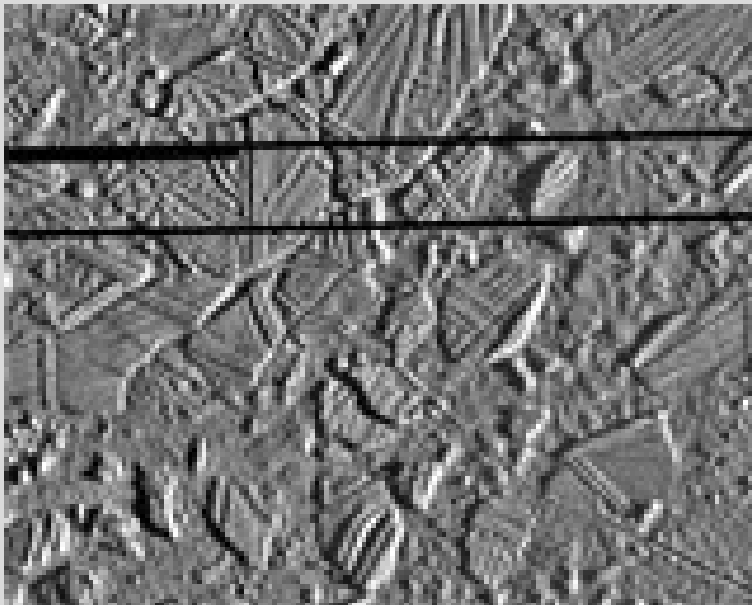


# Life under the ice in Europa ?

Europa

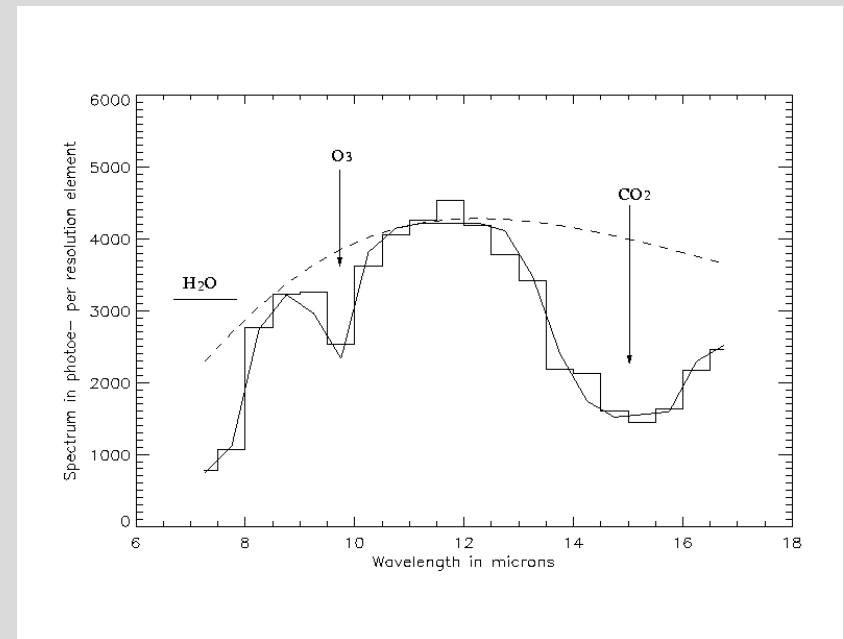
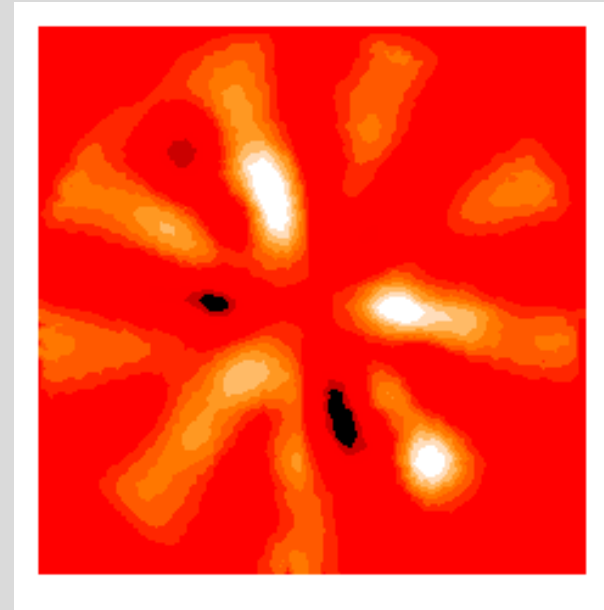
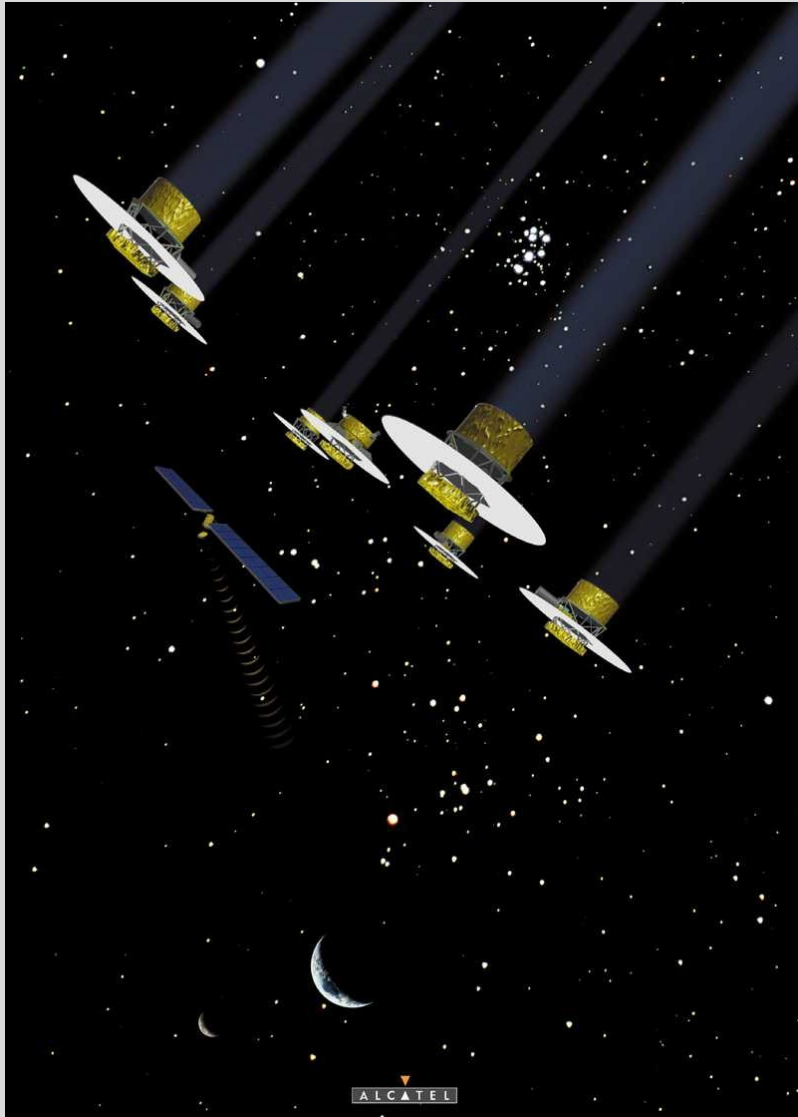


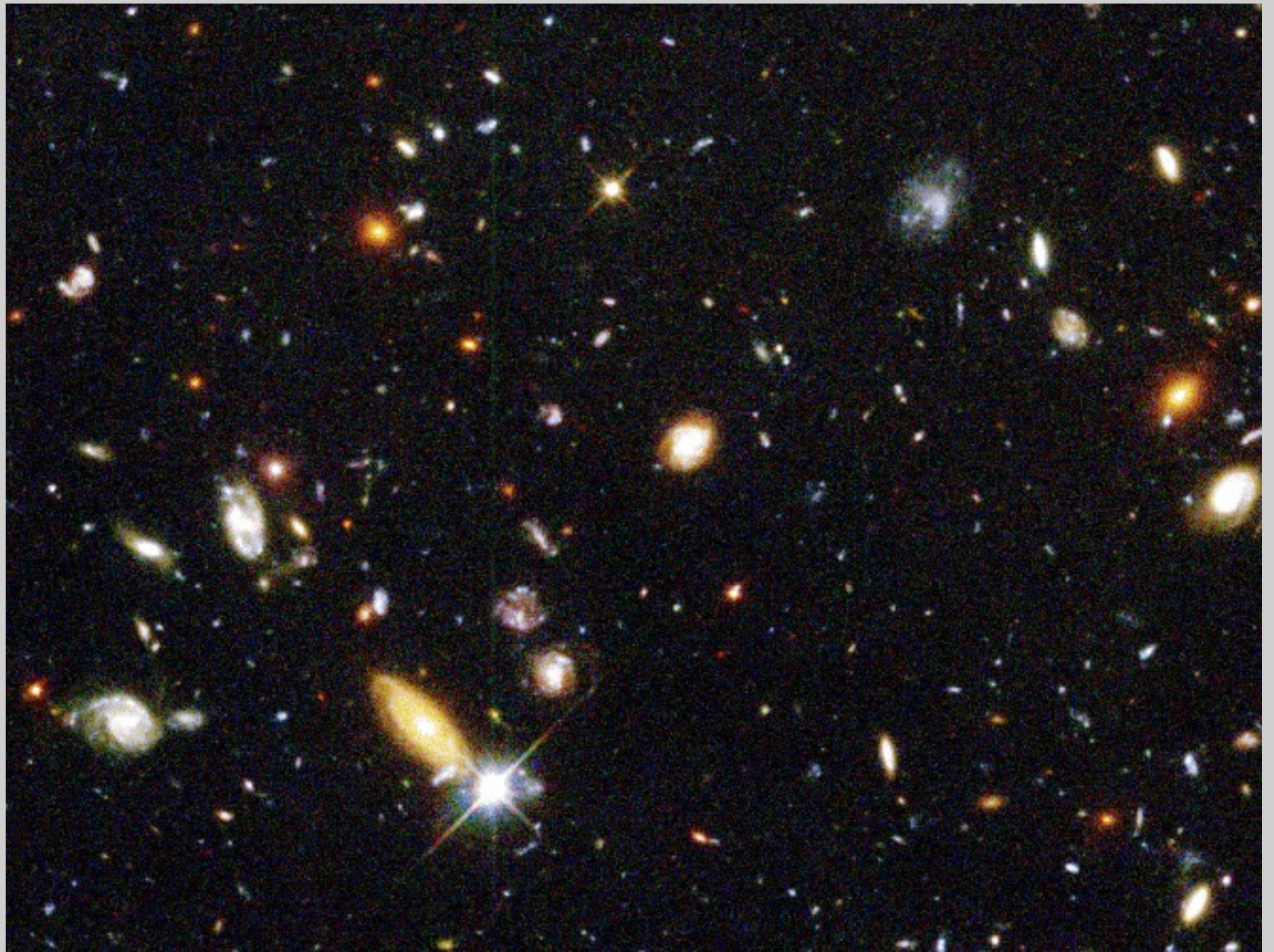
# Life under the ice in Antarctica ?



Surface of Europa imaged by Galileo

# The ESA Darwin mission (2015 ?)







富士三十六景  
甲斐御坂城

御坂