

# Tajni život zvijezda



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**FESB - Split**

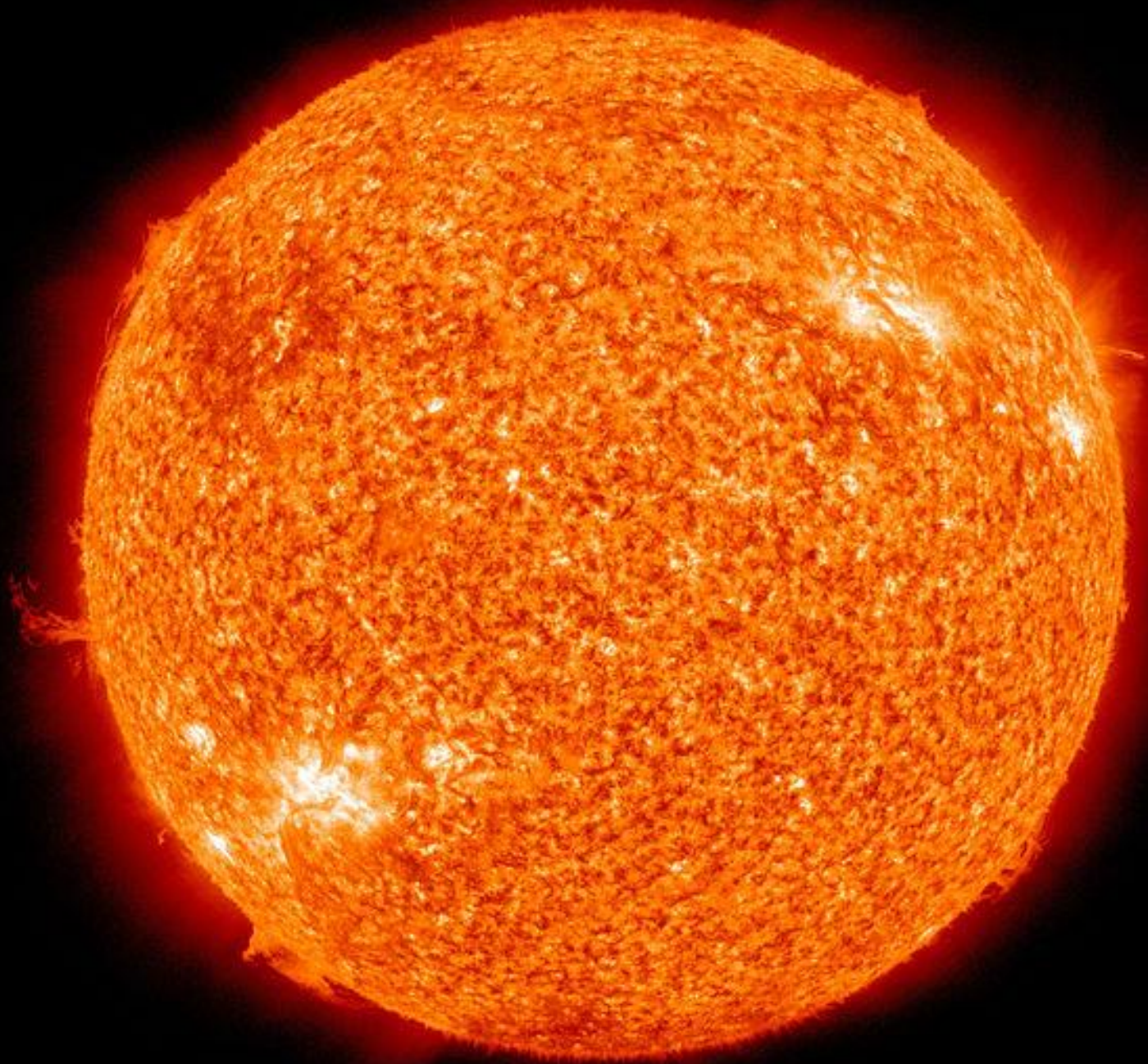
**Osnovna škola "Plokite", Split, 21. svibnja 2015.**











# Koliko zvijezda ima u svemiru?



# Gdje smo sada?



Split, Croatia

ovdje

970 m

Image © 2013 DigitalGlobe

I. Puljak, FESB, Split

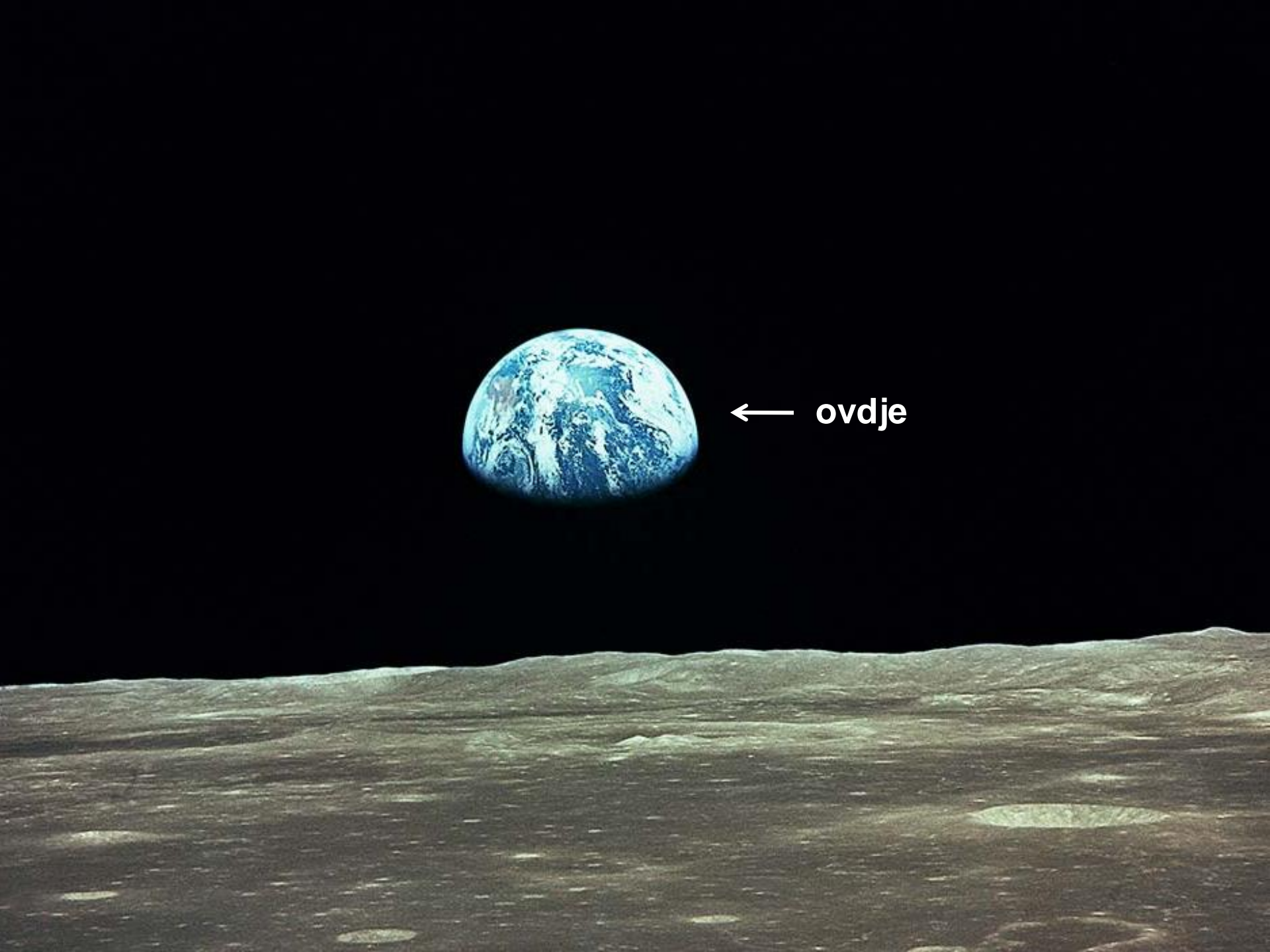


ovdje



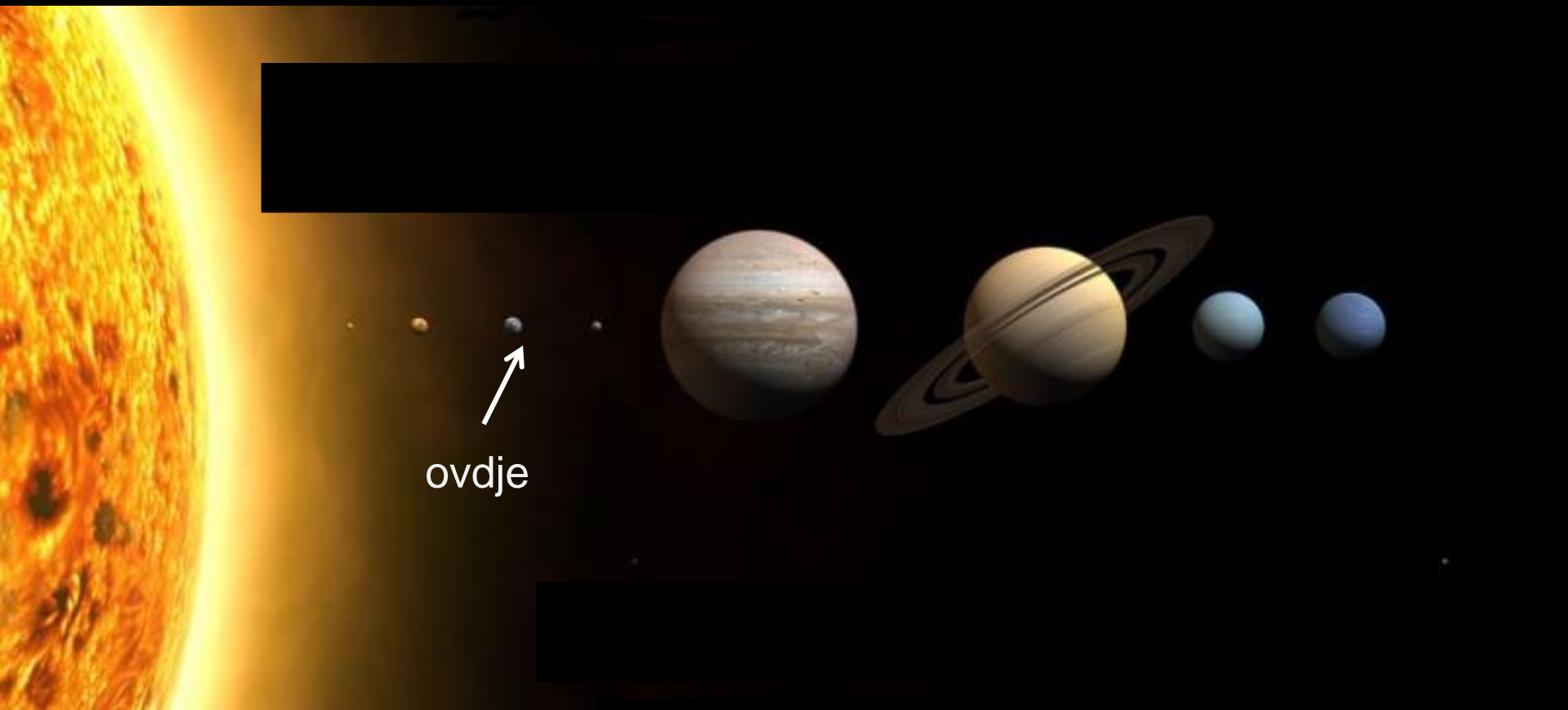
Image Landsat  
Image IBCAO  
Image U.S. Geological Survey  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO


Google earth



← ovdje





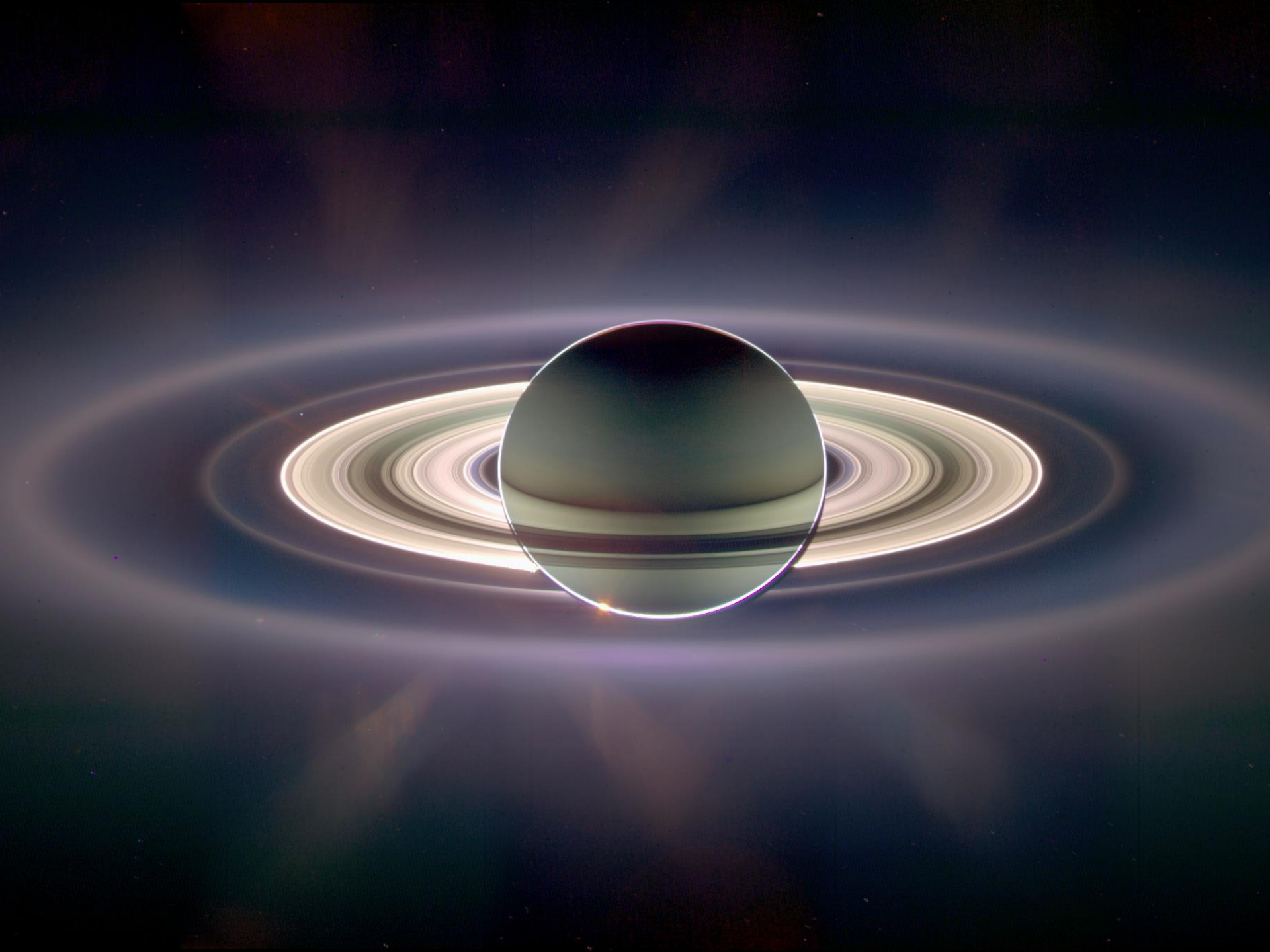
Approx. size of Earth → 





Earth as seen from Mars

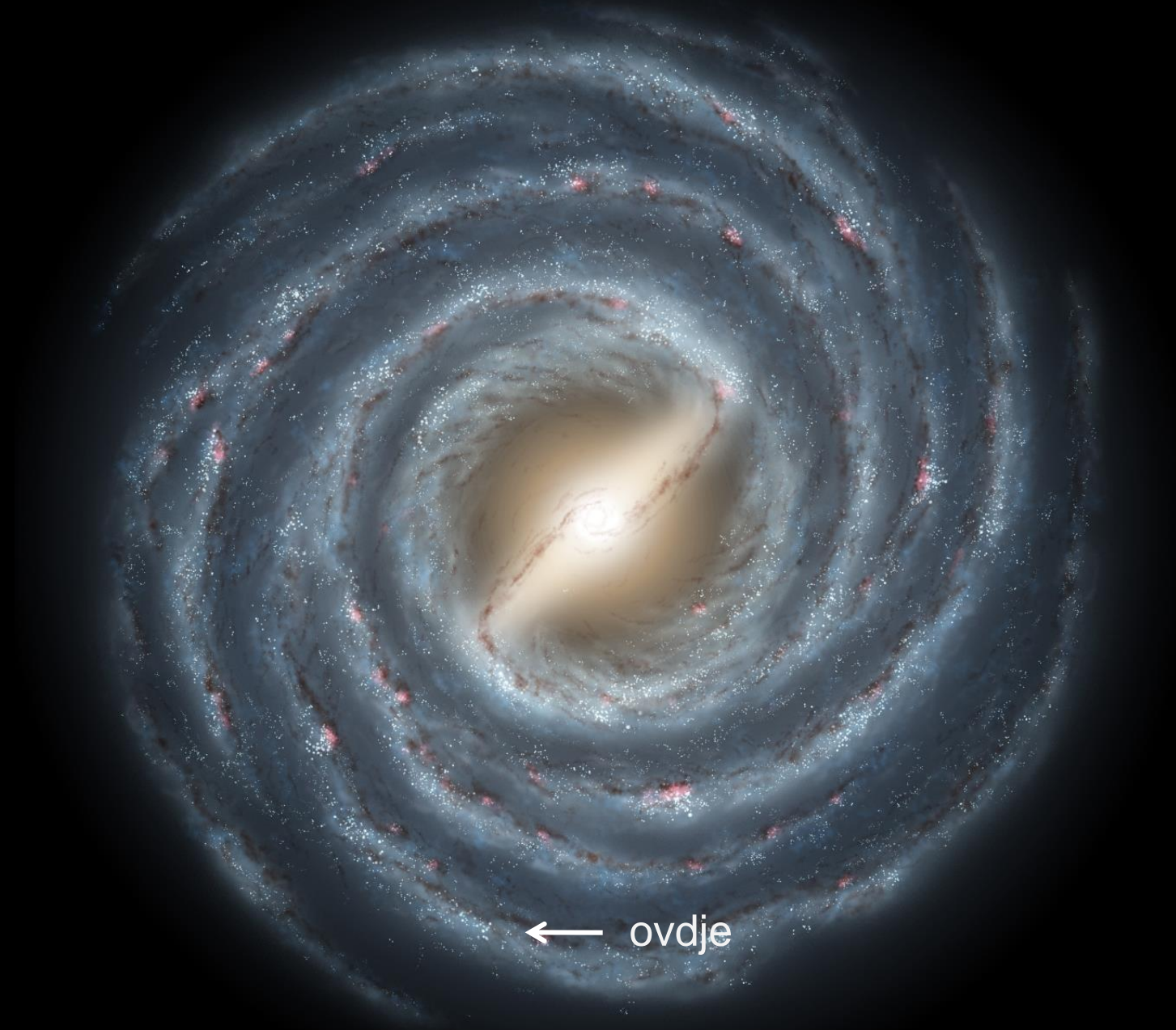








← Zemlja



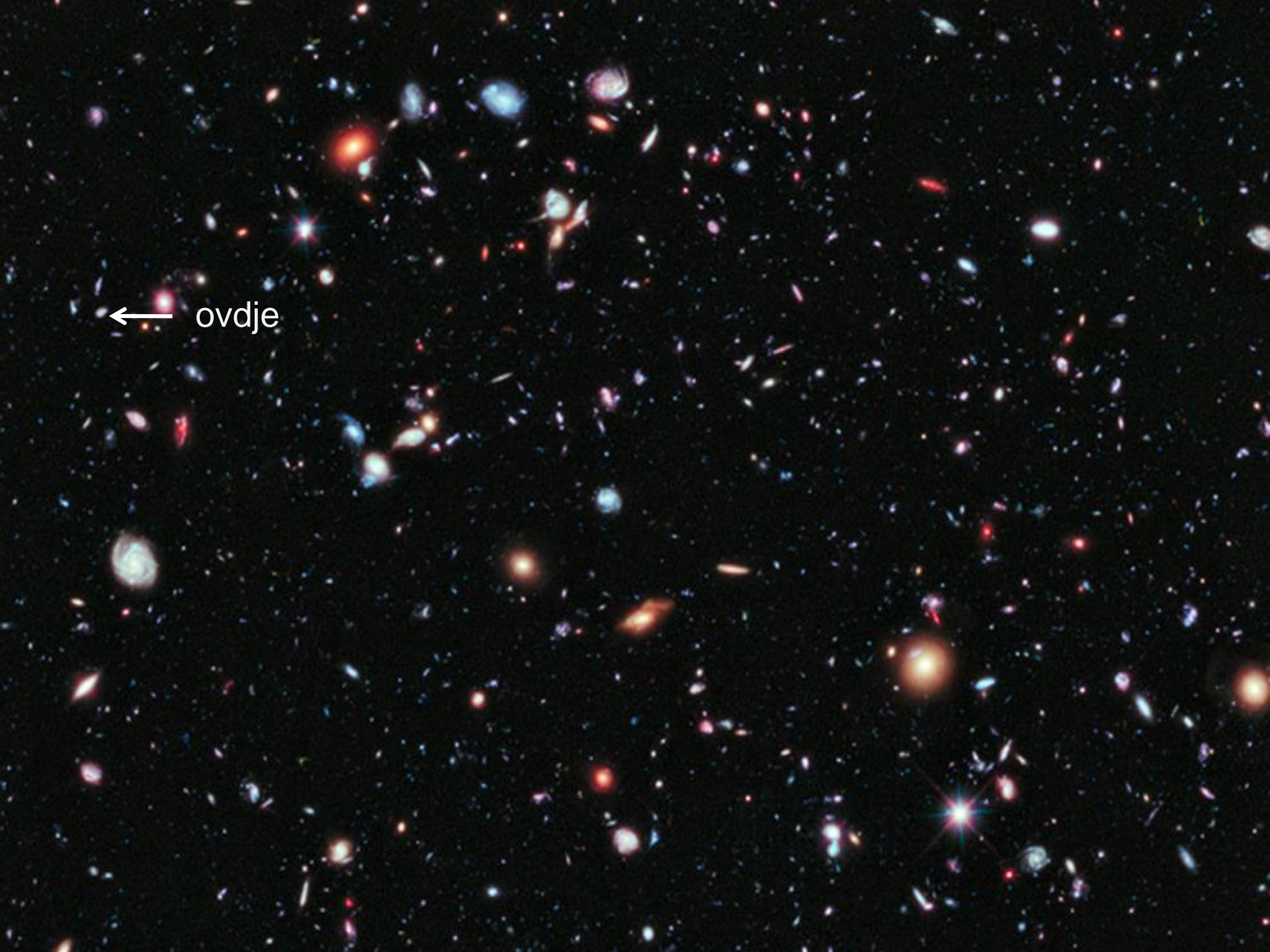
← ovdje





Skoro sve zvijezde koje  
vidite na nebu su unutar  
ove žute kružnice





← ovdje



100 milijardi

10 000 000 000 000 000 000 000 000 000

zvijezda

100 milijardi



A close-up photograph of sand grains, showing a variety of sizes and colors from light beige to dark brown. The grains are densely packed and have a granular texture.

Koliko zrna pijeska ima na  
Zemlji?



# Koliko zrna pijeska ima na Zemlji?

1. Kolika je dimenzija jednog zrna?

- Oko  $0.5 \times 0.5 \times 0.5 \text{ mm}^3$

2. Koliko zrna stane u  $\text{m}^3$  volumena?

- U jedan  $\text{mm}^3$  ih stane  $2 \times 2 \times 2 = 8$
- U **jedan  $\text{m}^3$**  ih stane  $8 \times 1000 \times 1000 \times 1000 = 8\ 000\ 000\ 000 \text{ zrna/m}^3$

3. Koliko plaža ima na svijetu i koji im je volumen?

- Širina jedne plaže: **50 m**
- Dubina jedne plaže: **25 m**
- Dužina svih plaža na svijetu:
  - **Svaki kontinent** ima plaža dovoljna da **dva puta** obiđe Zemlju
    - Opseg Zemlje =  $40\ 000 \text{ km} = 40\ 000\ 000 \text{ m}$
- Volumen svih plaža:  $50 \times 25 \times 7 \times 2 \times 40\ 000 \text{ km}^3 = 700\ 000\ 000\ 000 \text{ m}^3$

4. Ukupan broj zrna pijeska na Zemlji?

- $8\ 000\ 000\ 000 \text{ zrna/m}^3 \times 700\ 000\ 000\ 000 \text{ m}^3 =$

**5 600 000 000 000 000 000 000**

Broj zvijezda: **10 000 000 000 000 000 000 000**

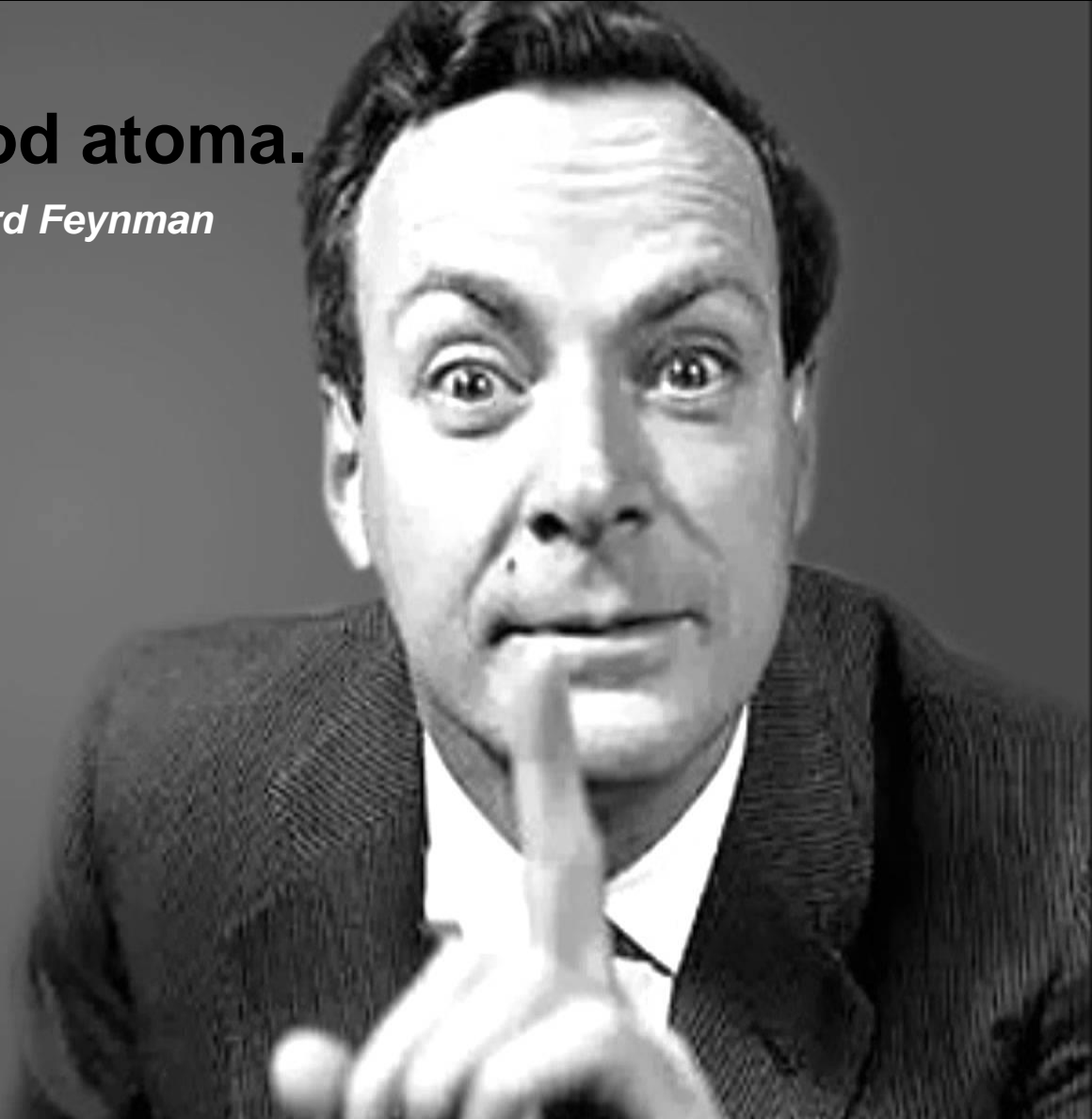
*Gruba procjena*



Kada su velikog američkog fizičara Richarda Feynmana pitali koja bi da razmisli o jednoj rečenici u kojoj bi bilo sadržano najviše ljudskog znanja, on je odgovorio jednostavno:

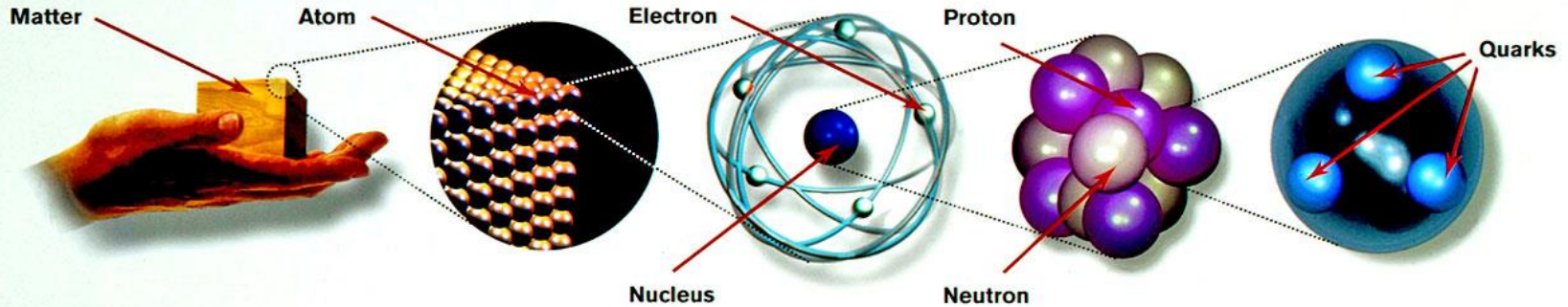
**Sve je napravljeno od atoma.**

*Richard Feynman*











# “Sve je napravljeno od atoma.”









## Matter particles

All ordinary particles belong to this group

These particles existed just after the Big Bang. Now they are found only in cosmic rays and accelerators

LEPTONS				
FIRST FAMILY	<b>Electron</b> Responsible for electricity and chemical reactions; it has a charge of -1		<b>Electron neutrino</b> Particle with no electric charge, and possibly no mass; billions fly through your body every second	
SECOND FAMILY	<b>Muon</b> A heavier relative of the electron; it lives for two-millionths of a second		<b>Muon neutrino</b> Created along with muons when some particles decay	
THIRD FAMILY	<b>Tau</b> Heavier still; it is extremely unstable. It was discovered in 1975		<b>Tau neutrino</b> not yet discovered but believed to exist	

## QUARKS

<b>Up</b> Has an electric charge of plus two-thirds; protons contain two, neutrons contain one		<b>Down</b> Has an electric charge of minus one-third; protons contain one, neutrons contain two	
<b>Charm</b> A heavier relative of the up; found in 1974		<b>Strange</b> A heavier relative of the down; found in 1964	
<b>Top</b> Heavier still		<b>Bottom</b> Heavier still; measuring bottom quarks is an important test of electroweak theory	

## Force particles

These particles transmit the four fundamental forces of nature, although gravitons have so far not been discovered

### Gluons

Carriers of the strong force between quarks

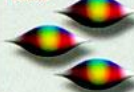


Felt by: quarks

The explosive release of nuclear energy is the result of the strong force

### Photons

Particles that make up light; they carry the electromagnetic force



Felt by: quarks and charged leptons

Electricity, magnetism and chemistry are all the results of electro-magnetic force

### Intermediate vector bosons

Carriers of the weak force



Felt by: quarks and leptons

Some forms of radio-activity are the result of the weak force

### Gravitons

Carriers of gravity

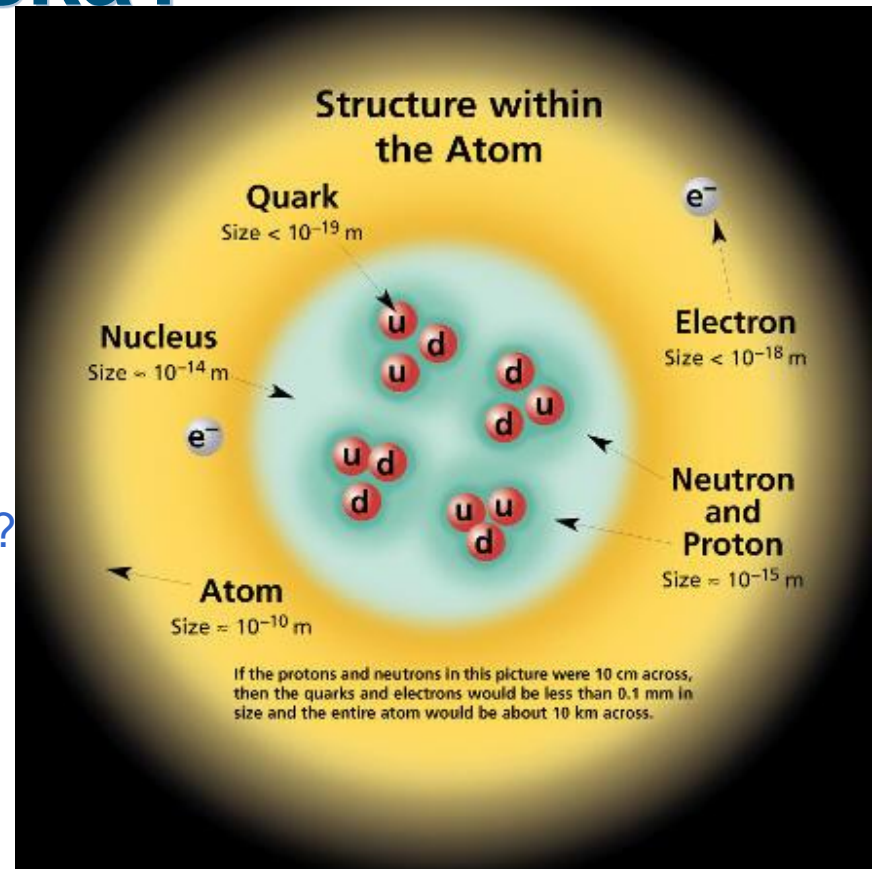


Felt by: all particles with mass

All the weight we experience is the result of the gravitational force

# Koliko atoma ima u jednom zrnu pijeska?

1. Kolika je dimenzija jednog zrna?
  - Oko  $0.5 \times 0.5 \times 0.5 \text{ mm}^3$
  - Volumen =  $0.125 \text{ mm}^3$
2. Kolike su dimenzije atoma?
  - Promjer oko  $10^{-10} \text{ m} = 10^{-7} \text{ mm}$
3. Koliko ih stane u jedan  $\text{mm}^3$ ?
  - Oko  $10^7 \times 10^7 \times 10^7 = 10^{21}$
4. Koliko ih stane u jedno zrno pijeska?
  - $0.125 \times 10^{21} =$   
**125 000 000 000 000 000 000**







10 000 000 000 000 000 000 000



5 600 000 000 000 000 000 000

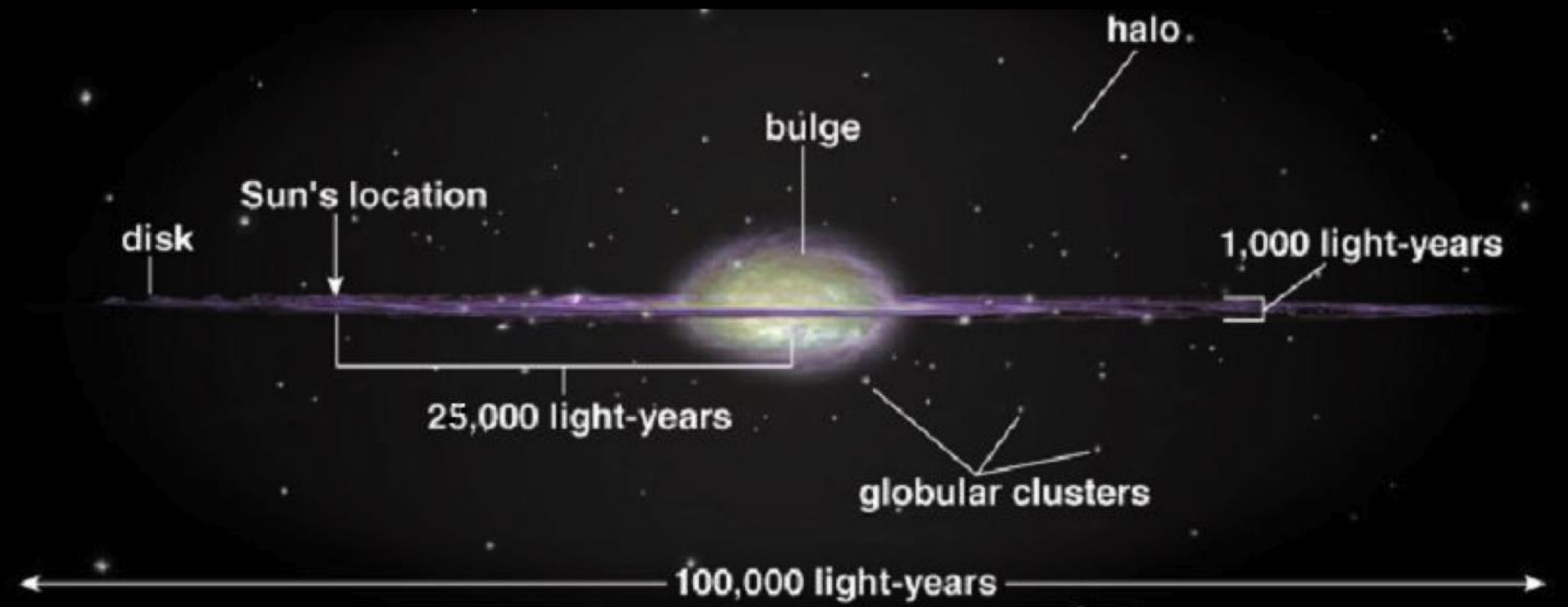


125 000 000 000 000 000 000









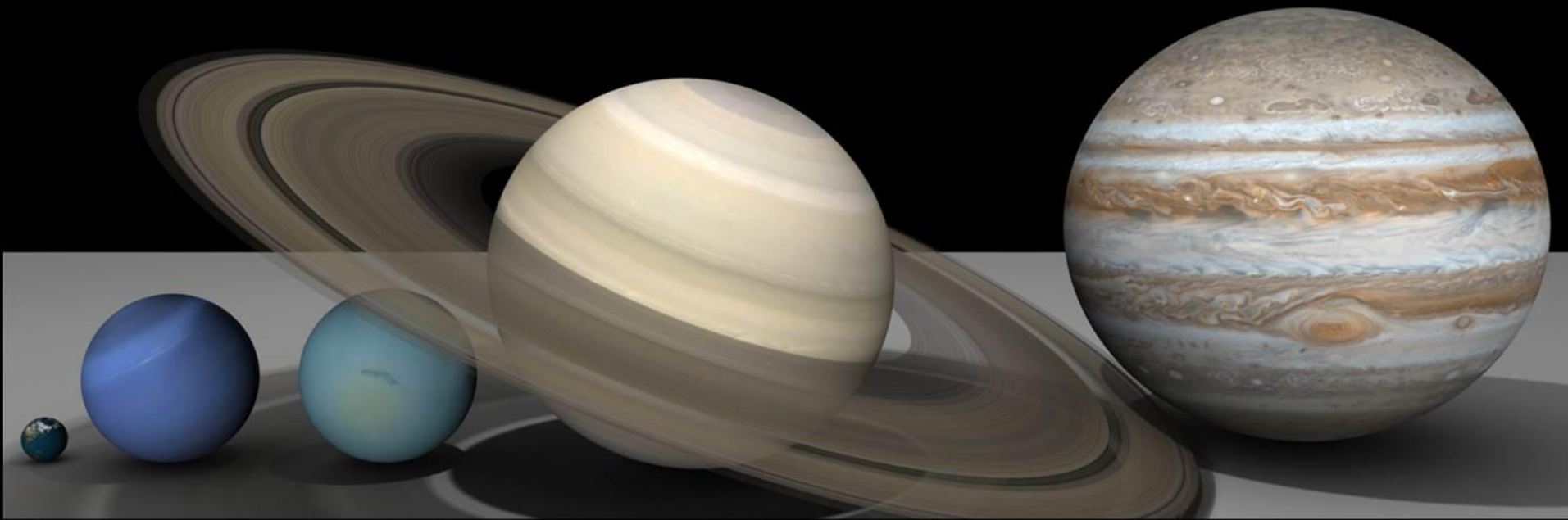
# Koliko su velike zvijezde?



# EARTH



# SOLAR SYSTEM



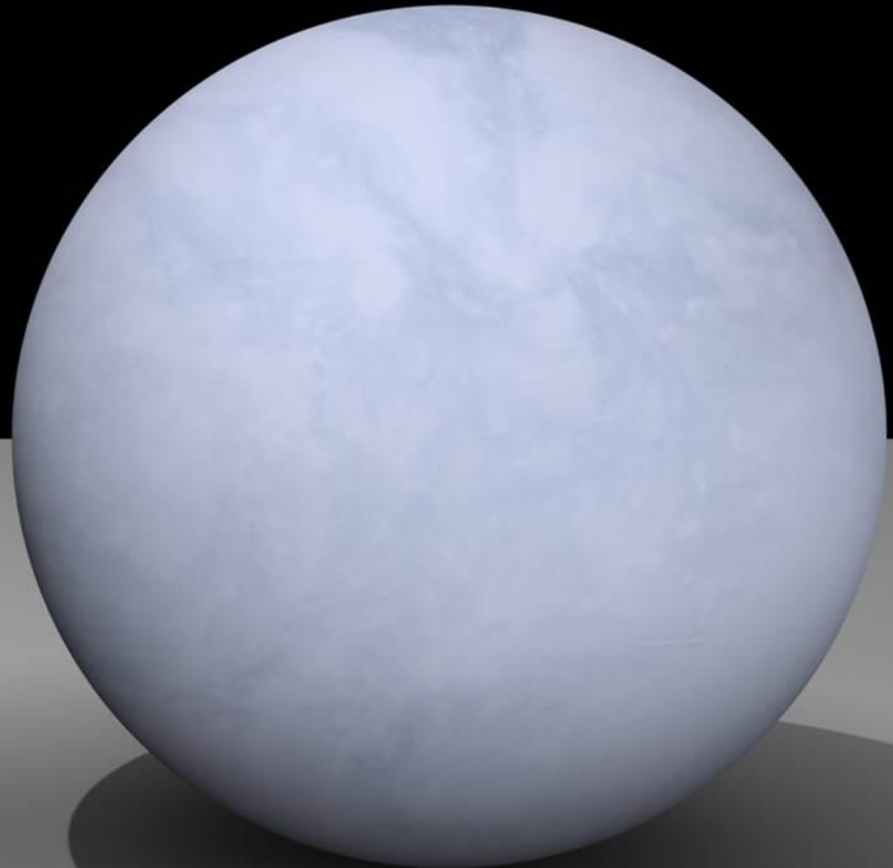
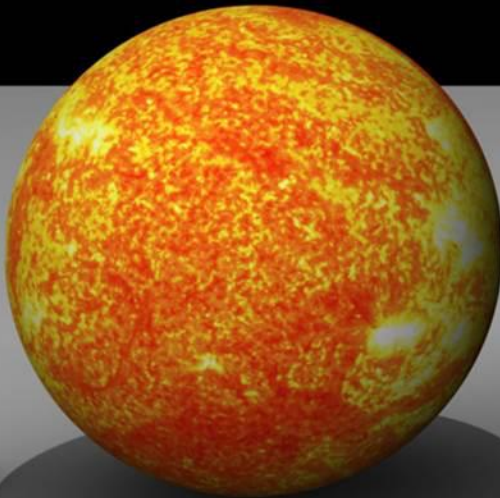
Courtesy, Dave Jarvis (<http://www.davidjarvis.ca/>) This file is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license, at Wikipedia.com



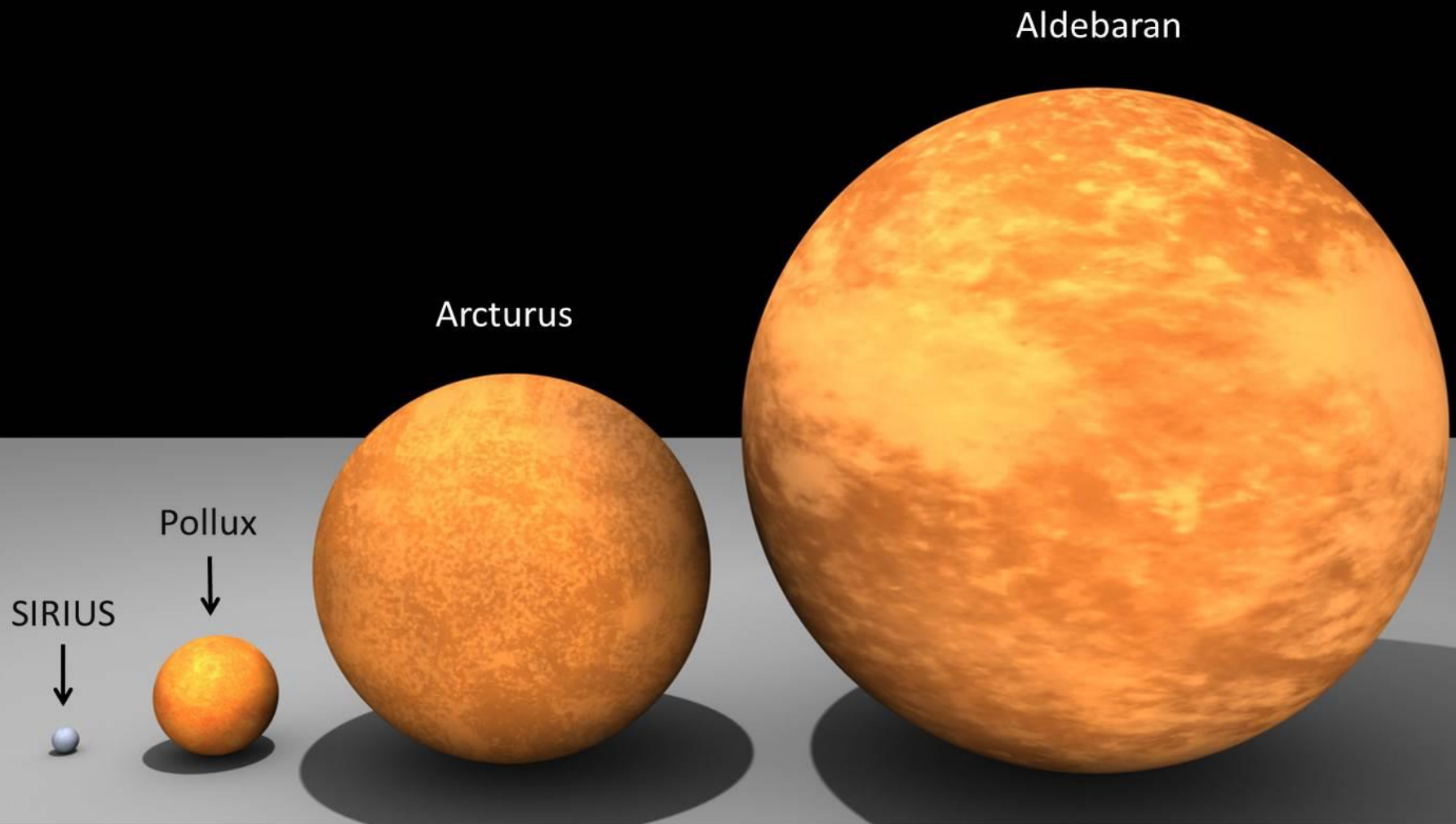
# SUN VS. SIRIUS

SIRIUS

SUN



# ALDEBARAN





# BETELGEUSE

Antares

Betelgeuse

Aldebaran

