ASTR 1000: Introduction to the Universe

Dr. D. J. Drake

Email: djdrake@valdosta.edu

Office: NH 3026

Resources to help you succeed

- Blazeview – videos, websites
- Textbooks
  - Pathways to Astronomy by Schneider and Arny
  - Any introductory astronomy textbook
- Tutors
  - Tutors are available in NH 3027, see posted schedule

Course Grade

- Parts of your grade:
  - Final Exam: 20%
  - Tests: 20% each
  - Average of Quizzes and Class Assignments: 20%

- The course grading scale:
  - **A** 90% - 100%
  - **B** 80% - 89%
  - **C** 70% - 79%
  - **D** 60% - 69%
  - **F** 0 - 59%

Final Exam and Tests

- Tests
  - Three closed book tests
  - Will be taken in class
- Final Exam
  - Closed book
  - Will be taken in class
- What to expect:
  - No calculator allowed on day of test
  - Must bring a No. 2 pencil with you
  - Make-ups only if your absence is excused
  - No cell phones allowed on your person

Quizzes

- Found on Blazeview
- Typically 7-10 multiple choice questions
- You have 1 hour to complete once you begin
- Can use your notes and textbook
- You are responsible for knowing due dates
- No make ups or extensions for any quiz

Class Assignments

- Found on Blazeview in the Assignments Folder
- Typically 10 short answer questions
- Can use your notes and textbook
- You are responsible for knowing due dates
- No make ups or extensions for any class assignments

What constitutes an excused absences?

- Death or serious illness in the immediate family
- Serious illness or injury of the student
- Court ordered appearances or a call to jury duty
- Military duty and deployments
- Religious prohibitions
- Collegiate Athlete

Questions??????

SCIENCE

What it is and what it is NOT

The bedrock of science is
MEASUREMENT

The device of science is
HYPOTHESIS

The product of science is
PREDICTION of new measurements

Hypothesis, Theory, and Law

Hypothesis: An idea that can be tested

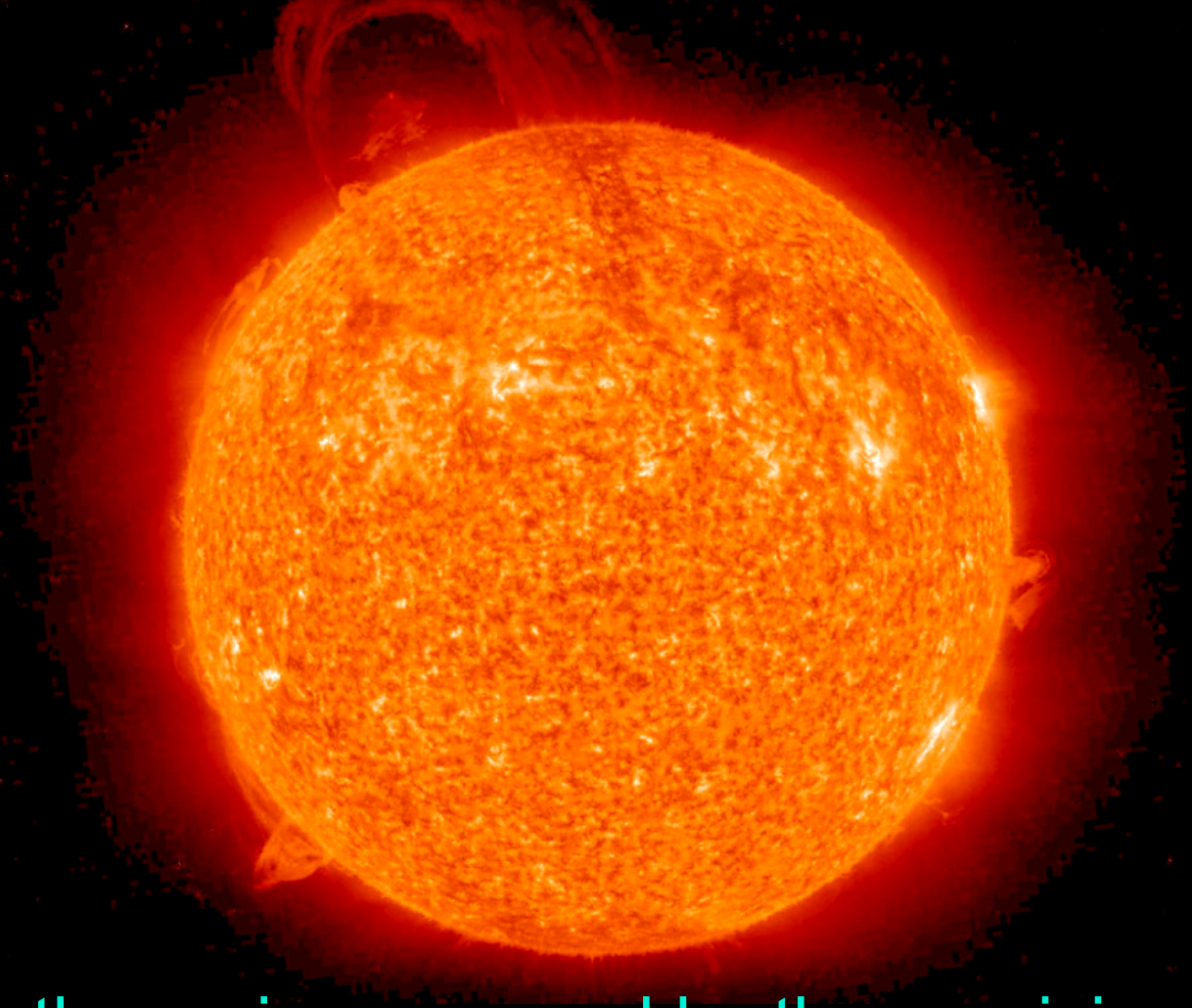
Theory: A very well tested hypothesis described in words

Law: Similar to a theory but generally described with mathematics

A scientific hypothesis or theory, must make a PREDICTION which can, in principle, be measured. Laws are already generally well established and tested.

Otherwise, it is PSEUDO-science

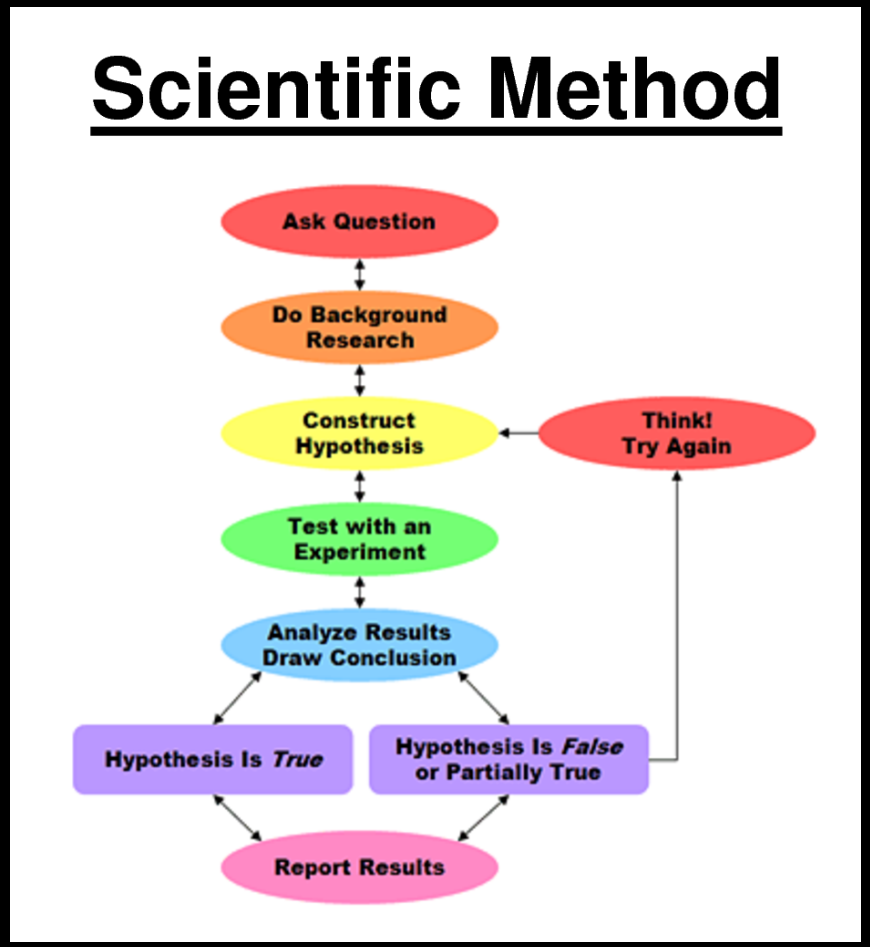
Science is NEVER absolutely sure about anything, so we continue to test theories to see if we can poke holes and thereby learn something even more wonderful about nature.

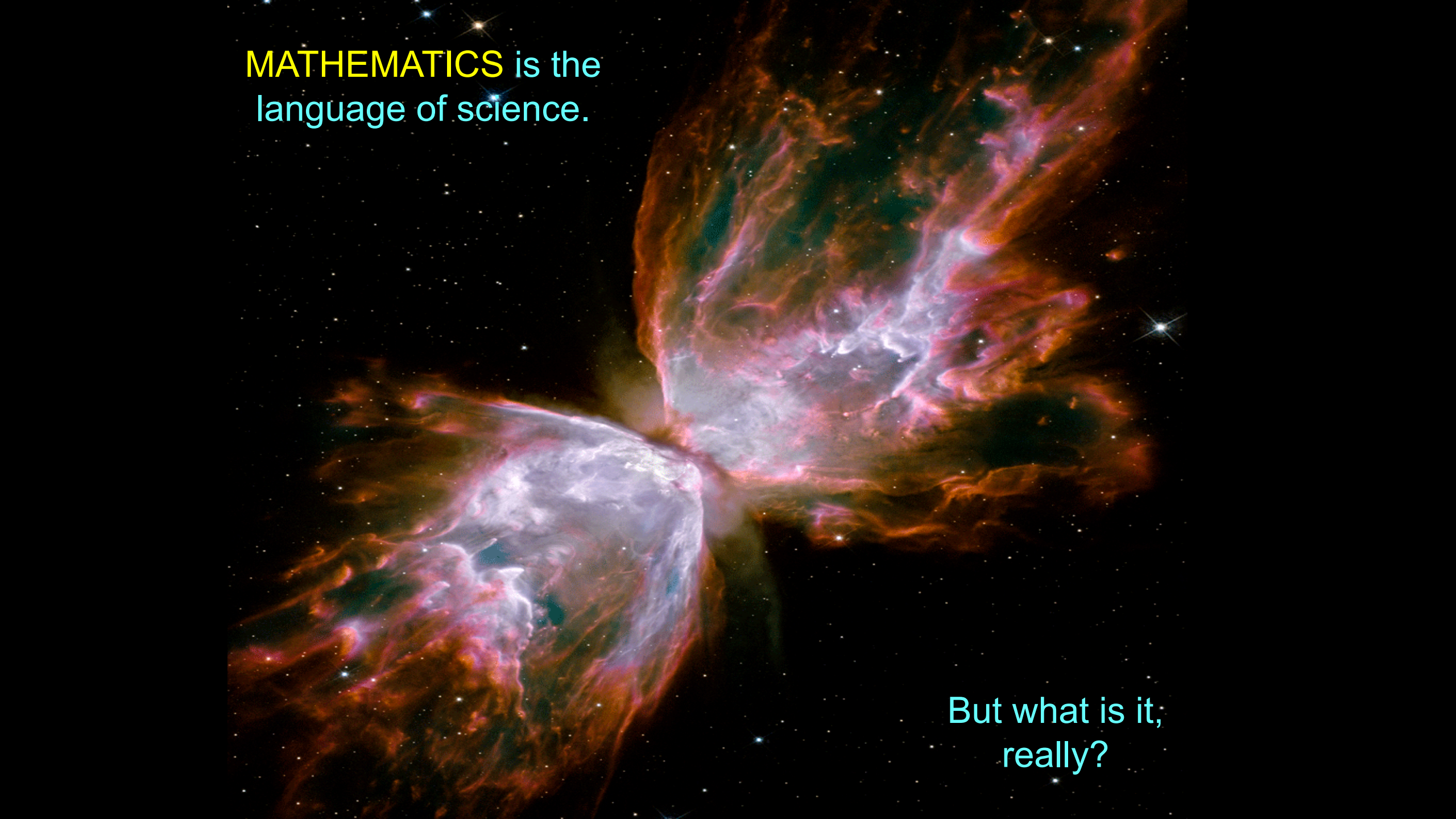


The SUCCESS of a theory is measured by the precision of its predictions.

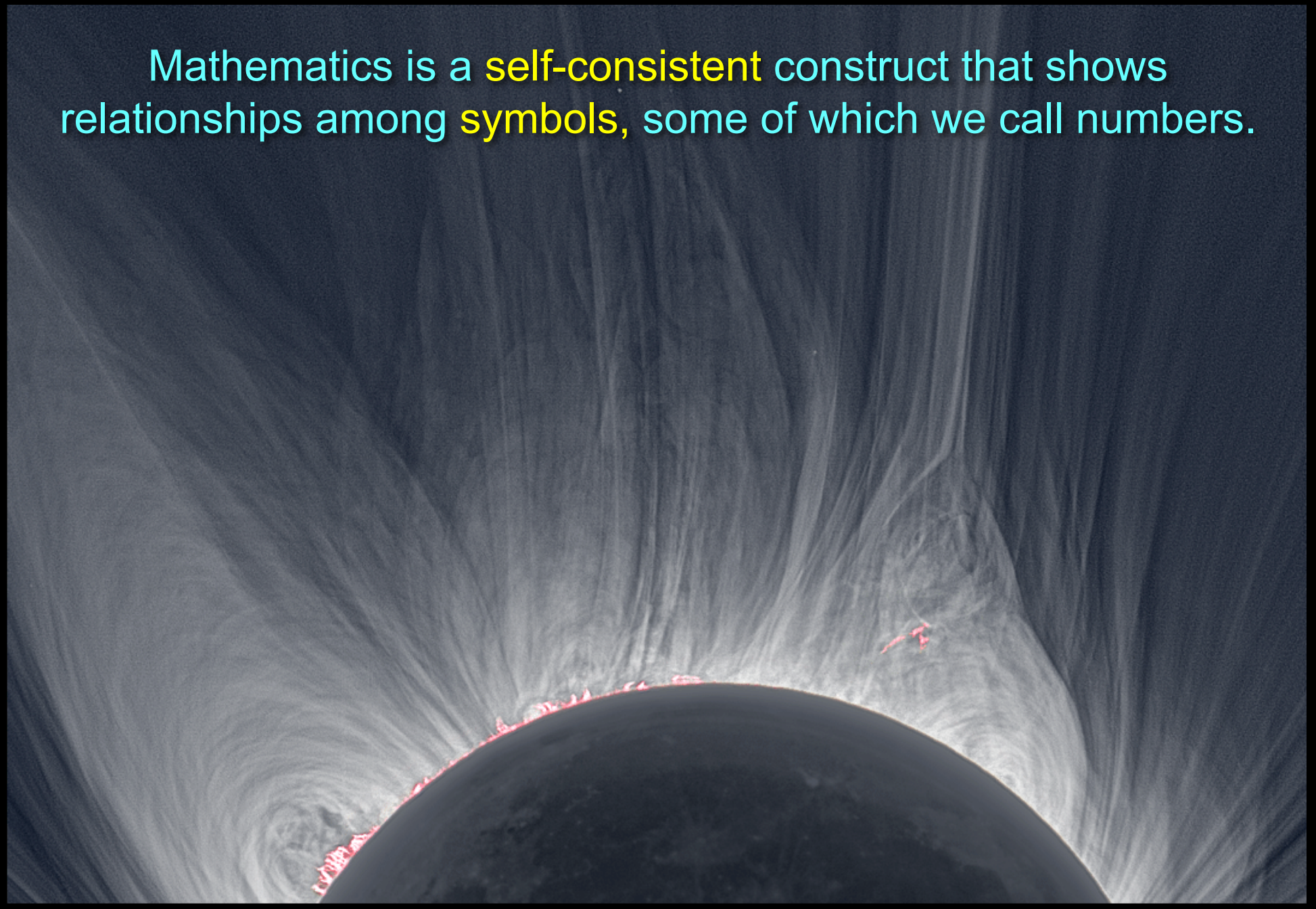
An idea at the foundation of all science:

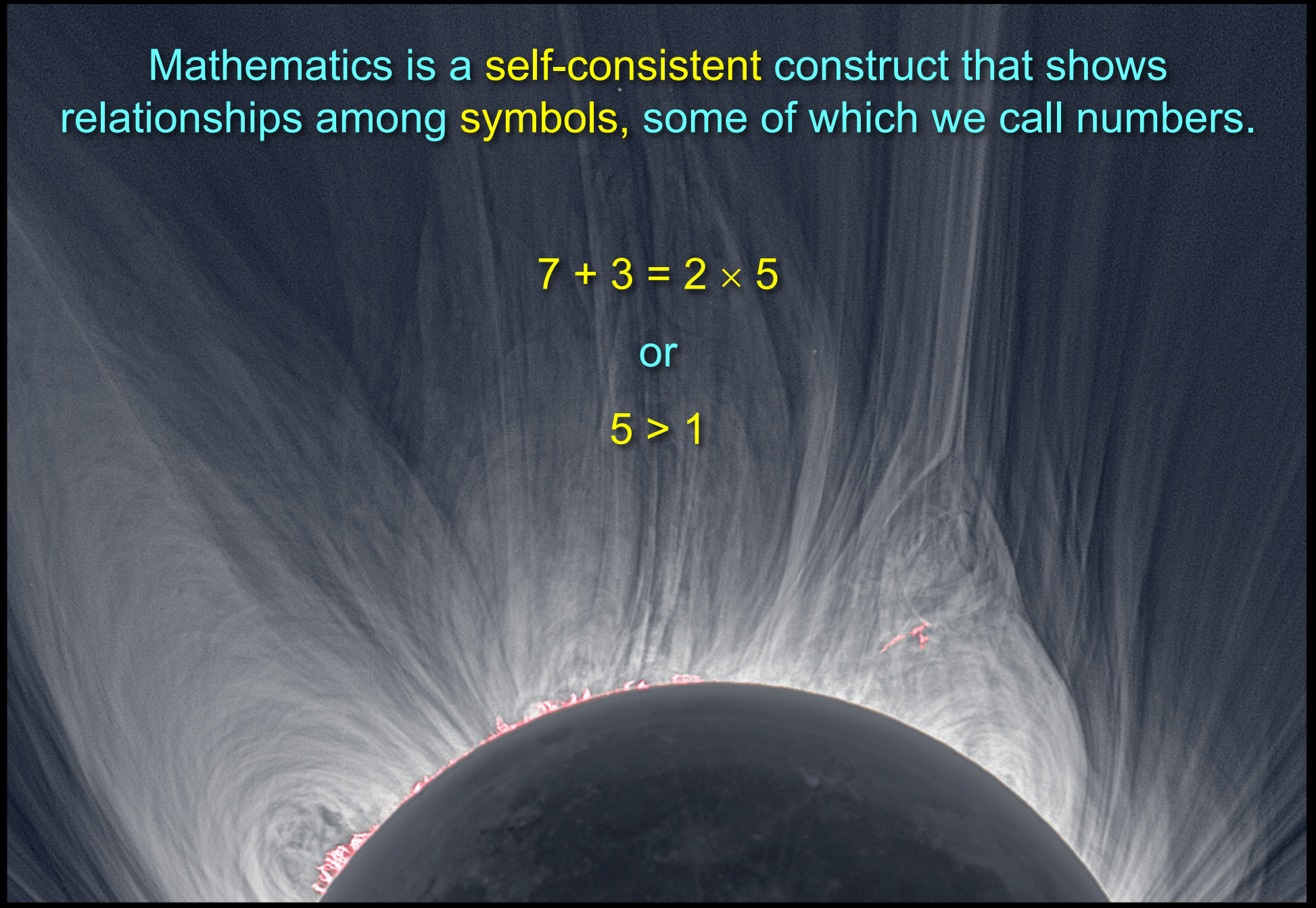
We can only know what we can measure!




MATHEMATICS is the language of science.
But what is it, really?

Mathematics is a self-consistent construct that shows relationships among symbols, some of which we call numbers.




Mathematics is a self-consistent construct that shows relationships among symbols, some of which we call numbers.
7 + 3 = 2 × 5
or
5 > 1

Mathematics exists only in the human imagination.

Two objects do not need to exist in order for 1 + 1 = 2

The operative ideas here are:

SELF-CONSISTENT

and

DOES NOT REQUIRE THE UNIVERSE TO EXIST

Mathematics can be used to DESCRIBE physical laws.

However, PHYSICAL LAWS cannot be predicted from Mathematics.

For example:

You can start with measurements of the motion of planets, and then use mathematics to show the relationships of planet mass, distance, and speed, and thus derive the existence of gravity.

But you cannot start with Mathematics and derive gravity.

So, scientists use mathematics to understand relationships among physical quantities

Science NEEDS mathematics to describe physical phenomena, but mathematics does not need physics for anything

However, often times mathematicians discover new insights, and hundreds of years later, physicists find that those abstract ideas describe PHYSICAL PHENOMENA!

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For example, in the 1500's mathematicians started playing with an "imaginary" number:

$$\sqrt{-1}$$

400 years later, physicists found that the mathematics of imaginary numbers describe Quantum Mechanics.

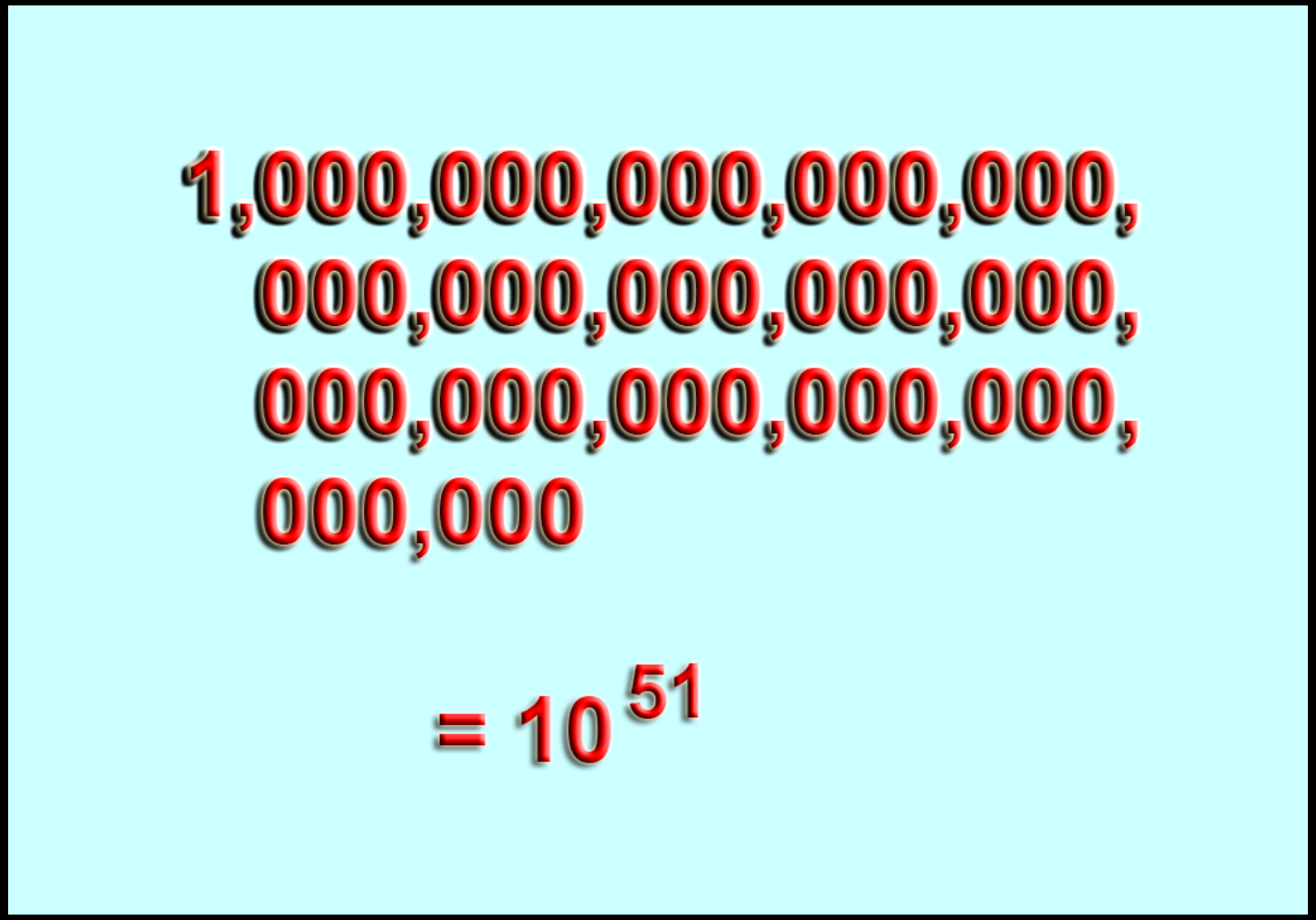

What does this say about the nature of NATURE?

What does this say about the nature of NATURE?

It says that the fundamental rules that govern the universe are hard-wired into the human brain.

Numbers in Astronomy

On a piece of paper, write the number 1 and then write 51 zeros behind the one



Scientific Notation

Powers of Ten

$$2 = 2.0 \times 10^{0}$$

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Scientific Notation

Powers of Ten

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$$20 = 2.0 \times 10^{1}$$

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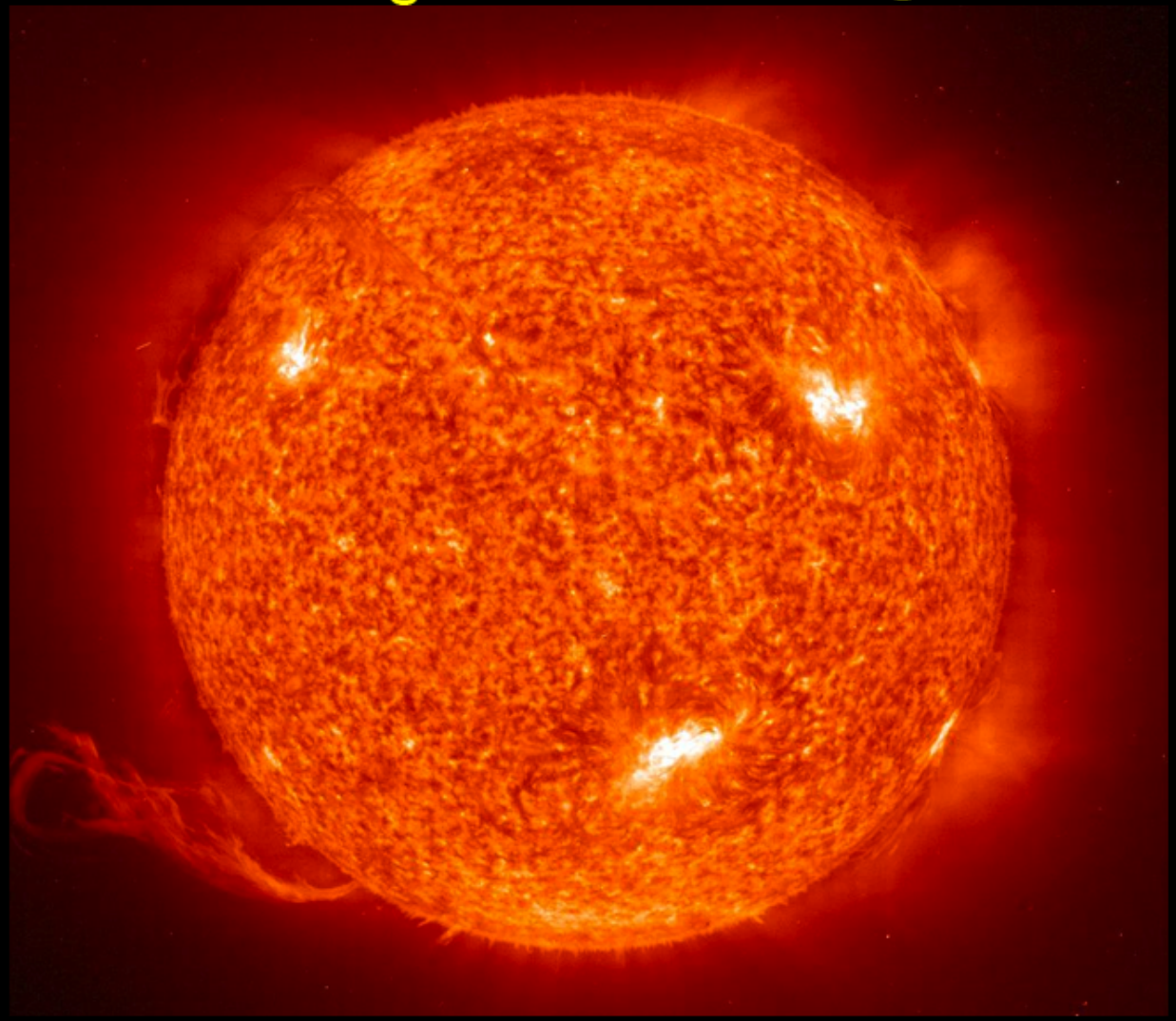
$$2{,}000 = 2.0 \times 10^{3}$$

$M_E = 6 \times 10^{24}$ kg

$M_S = 2 \times 10^{30}$ kg



Let's try a few examples

Write each of the following in **scientific** notation

- 20000
- 260
- 1430

$2 = 2.0 \times 10^{0}$

$20 = 2.0 \times 10^{1}$

$200 = 2.0 \times 10^{2}$

$2{,}000 = 2.0 \times 10^{3}$

Write each of the following in **standard** notation

- 5×10^{2}
- 6.4×10^{5}
- 1.13×10^{4}

Scientific Notation

Powers of Ten

$$2 = 2.0 \times 10^{0}$$

Scientific Notation

Powers of Ten

$$2 = 2.0 \times 10^{0}$$

$$0.2 = 2.0 \times 10^{-1}$$

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$$0.02 = 2.0 \times 10^{-2}$$

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Scientific Notation

Powers of Ten

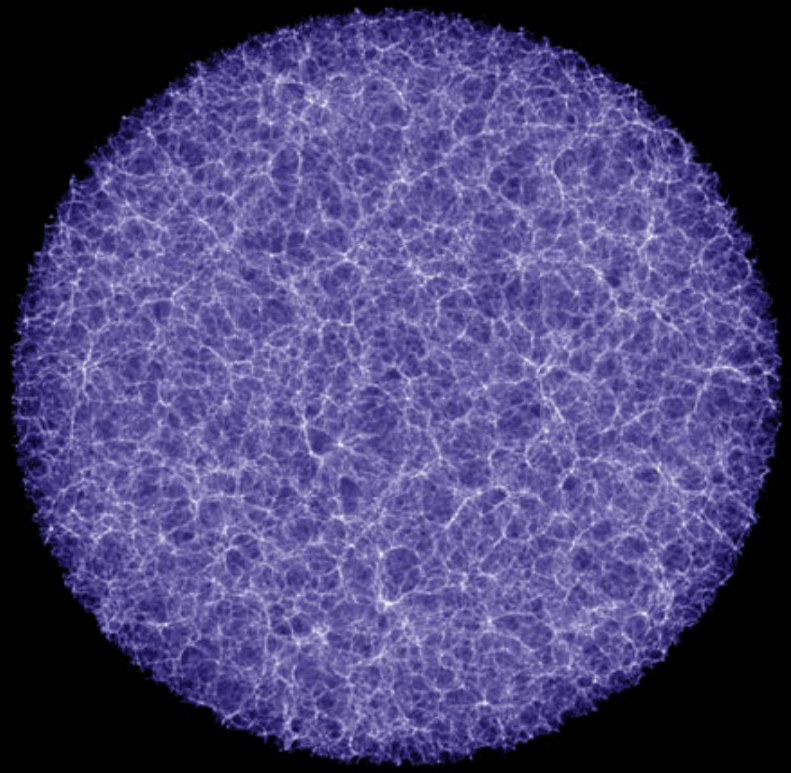
$$2 = 2.0 \times 10^{0}$$

$$0.2 = 2.0 \times 10^{-1}$$

$$0.02 = 2.0 \times 10^{-2}$$

$$0.002 = 2.0 \times 10^{-3}$$

Diameter of Helium atom is
1.40×10^{-10} m



Let's try a few examples

Write each of the following in scientific notation

- 0.50
- 0.026
- 0.00013

$2 = 2.0 \times 10^{0}$

$0.2 = 2.0 \times 10^{-1}$

$0.02 = 2.0 \times 10^{-2}$

$0.002 = 2.0 \times 10^{-3}$

Write each of the following in standard notation

- 5.0×10^{-2}
- 9.83×10^{-5}
- 2.1×10^{-6}

Where are we in the Universe, our Cosmic Address?

First we have to understand something about:

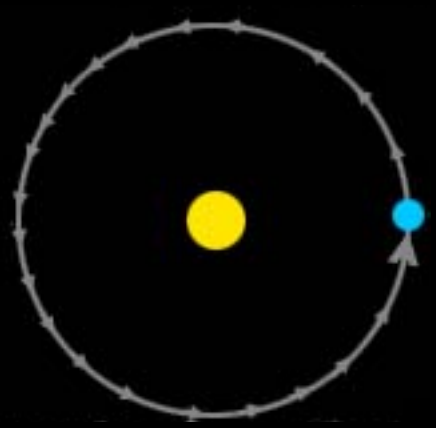
- **our motion in the universe**
- **distances in the universe**

Motion RIGHT NOW as you sit in your chair:

Earth rotates:	½ km/s	1,100 mph

Motion RIGHT NOW as you sit in your chair:

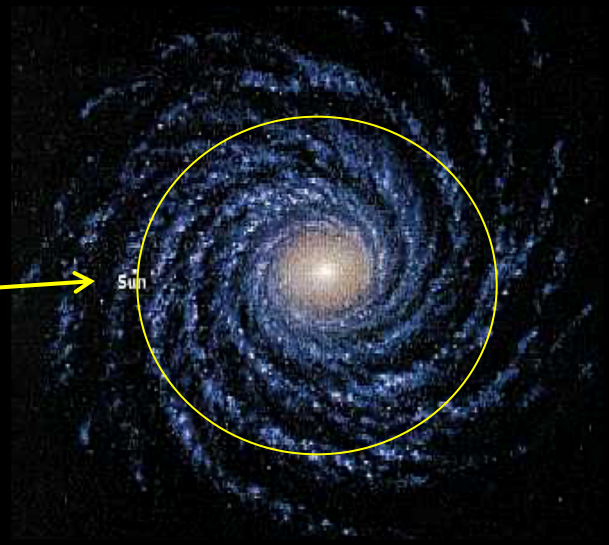
Earth rotates:	½ km/s	1,100 mph
Earth orbits Sun:	30 km/s	67,000 mph



Motion RIGHT NOW as you sit in your chair:

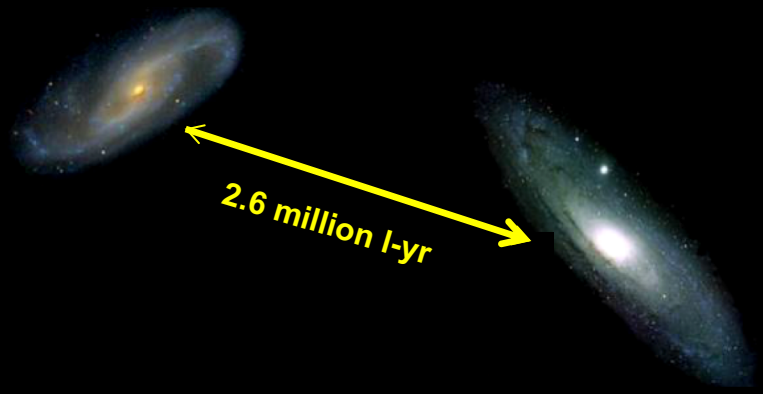
Earth rotates:	½ km/s	1,100 mph
Earth orbits Sun:	30 km/s	67,000 mph
Solar system orbits MW:	**200 km/s**	**450,000 mph**

one trip around Milky Way every 250 million yrs



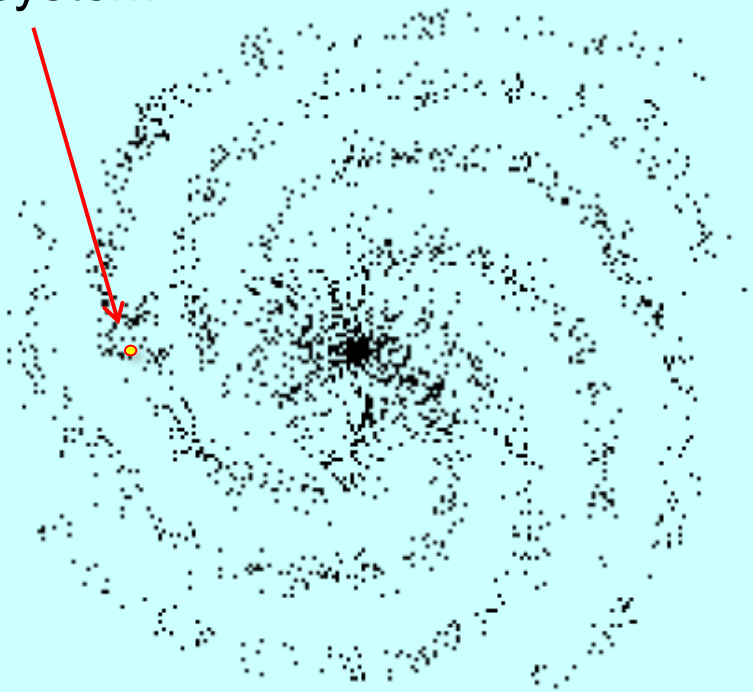
Motion RIGHT NOW as you sit in your chair:

Earth rotates:	½ km/s	1,100 mph
Earth orbits Sun:	30 km/s	67,000 mph
Solar system orbits MW:	200 km/s	450,000 mph
MW toward Andromeda:	300 km/s	675,000 mph

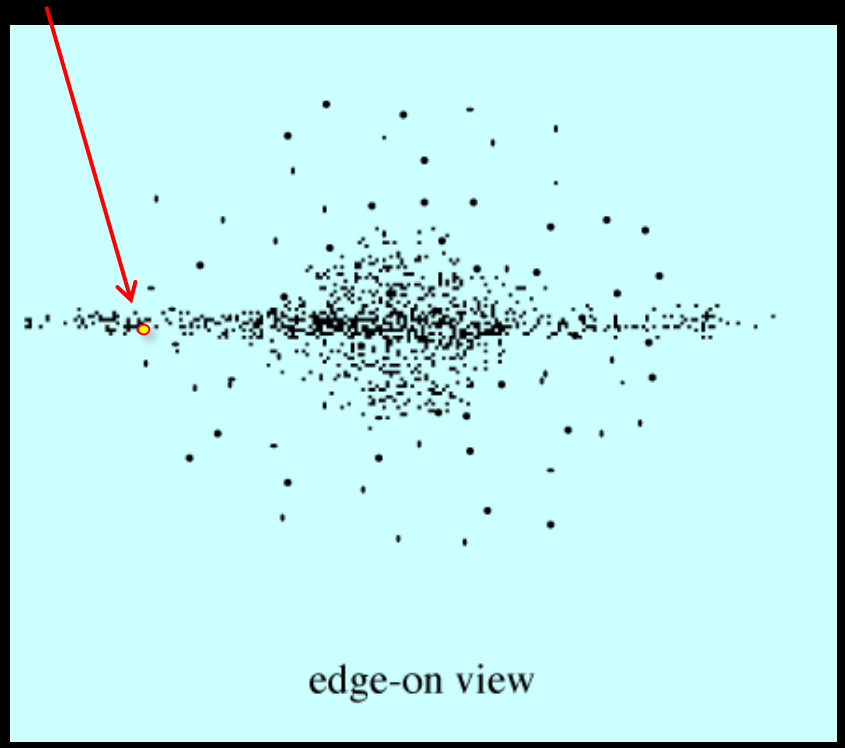


solar system

face-on view



Our Milky Way Galaxy has ~ 300 billion stars



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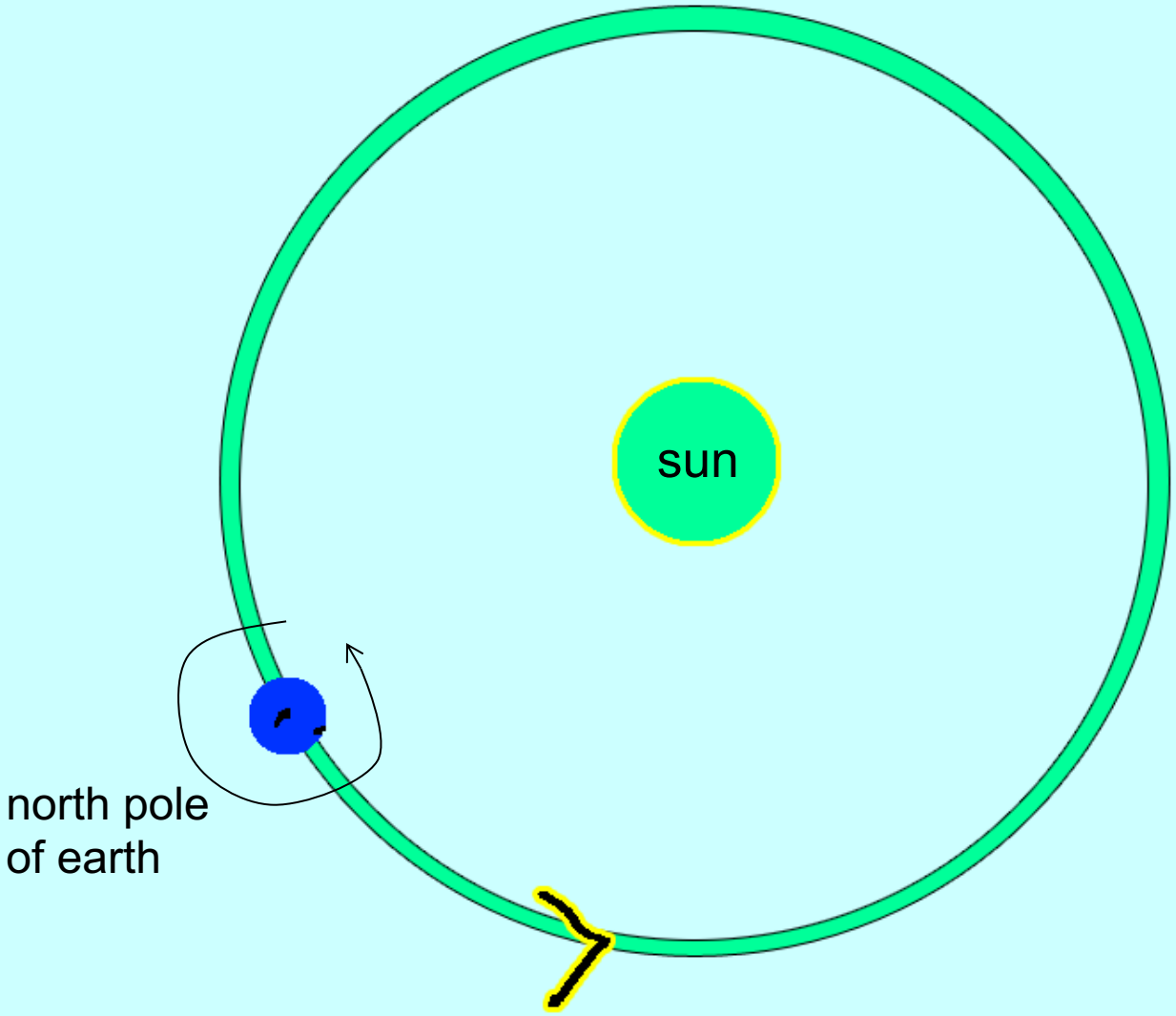
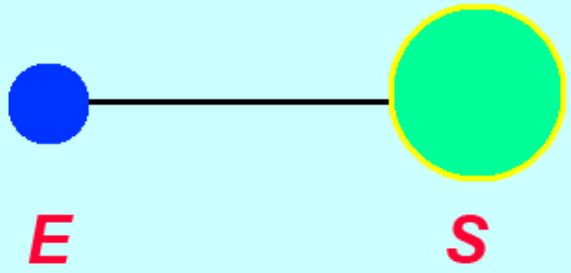


Our rotation and orbit are **counterclockwise**

93 million miles =

1 Astronomical Unit (AU)



How Far is it from VSU to Atlanta?

How Far is it from VSU to Atlanta?

3.5 hours

3.5 freeway-speed hours

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3.5 hours

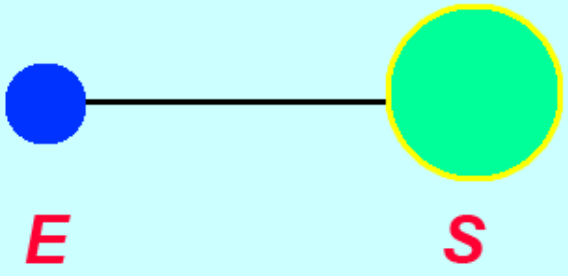
3.5 freeway-speed hours

We use the speed of light:

c = 300,000 km/s

93 million miles =

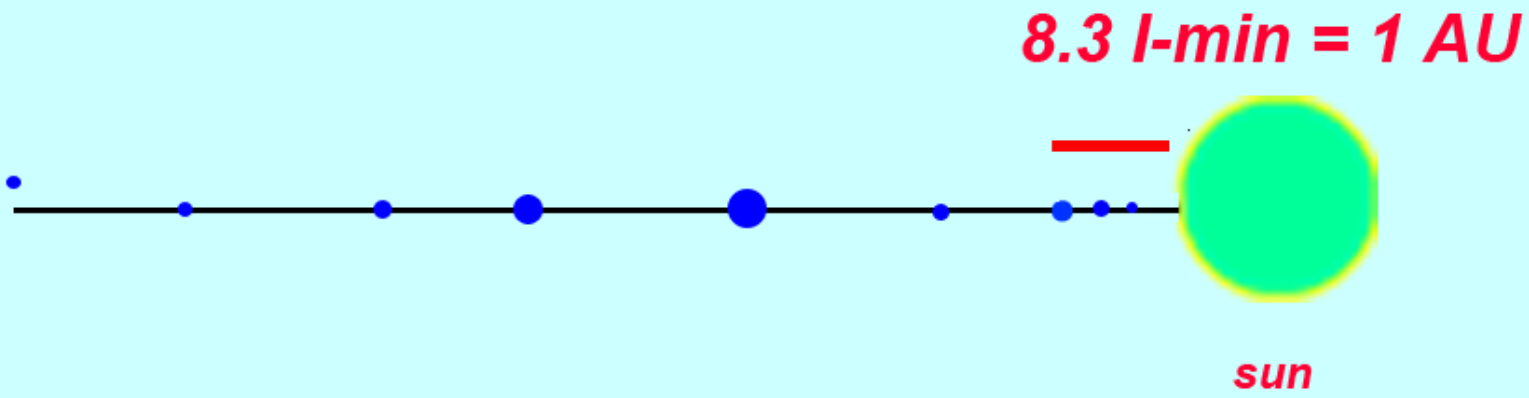
1 Astronomical Unit (AU)



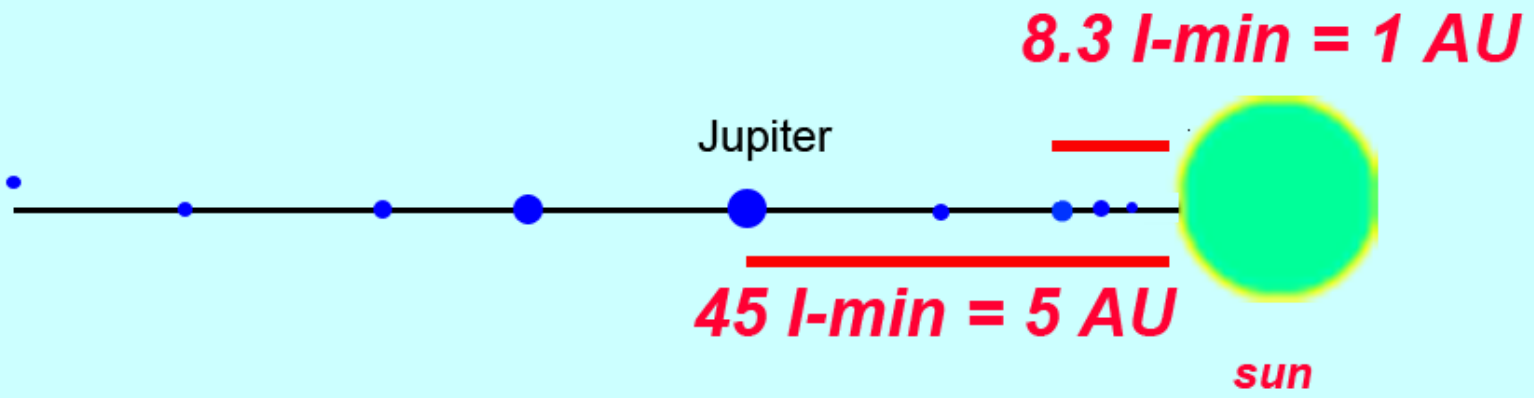
= 8.3 light-speed minutes

shorten "light-speed minutes" to "light-minutes" or "l-min"

edge-on view of solar system



Planets go around the Sun in a plane called the ECLIPTIC



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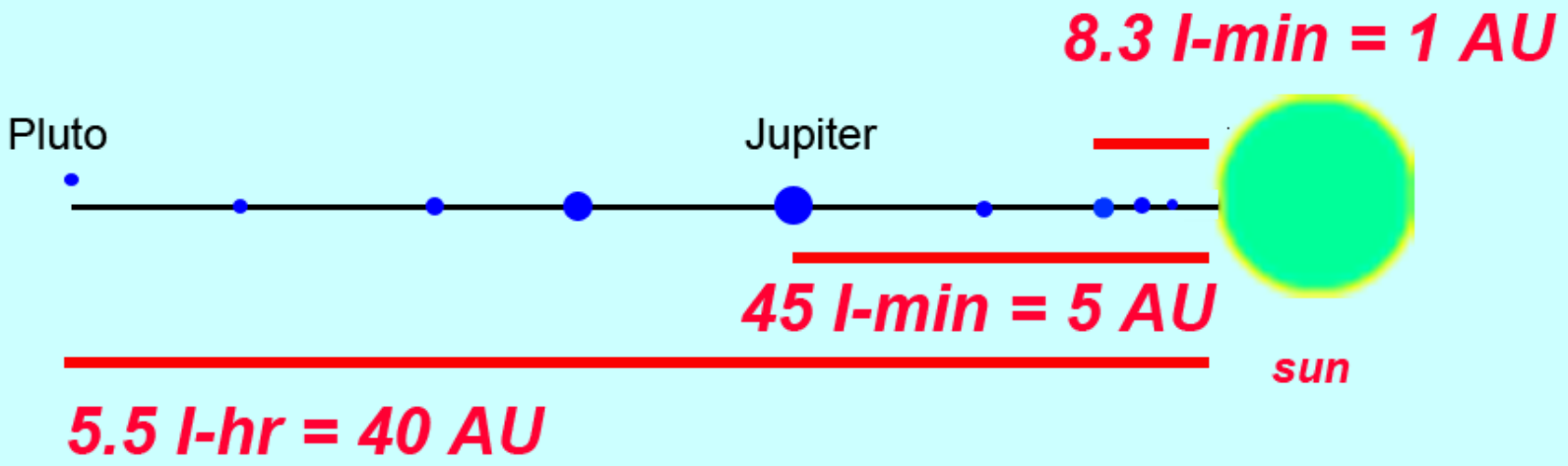
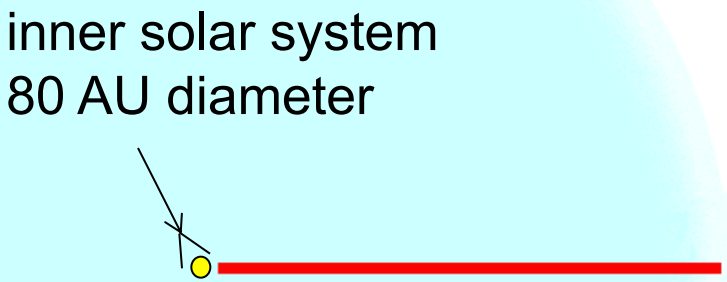
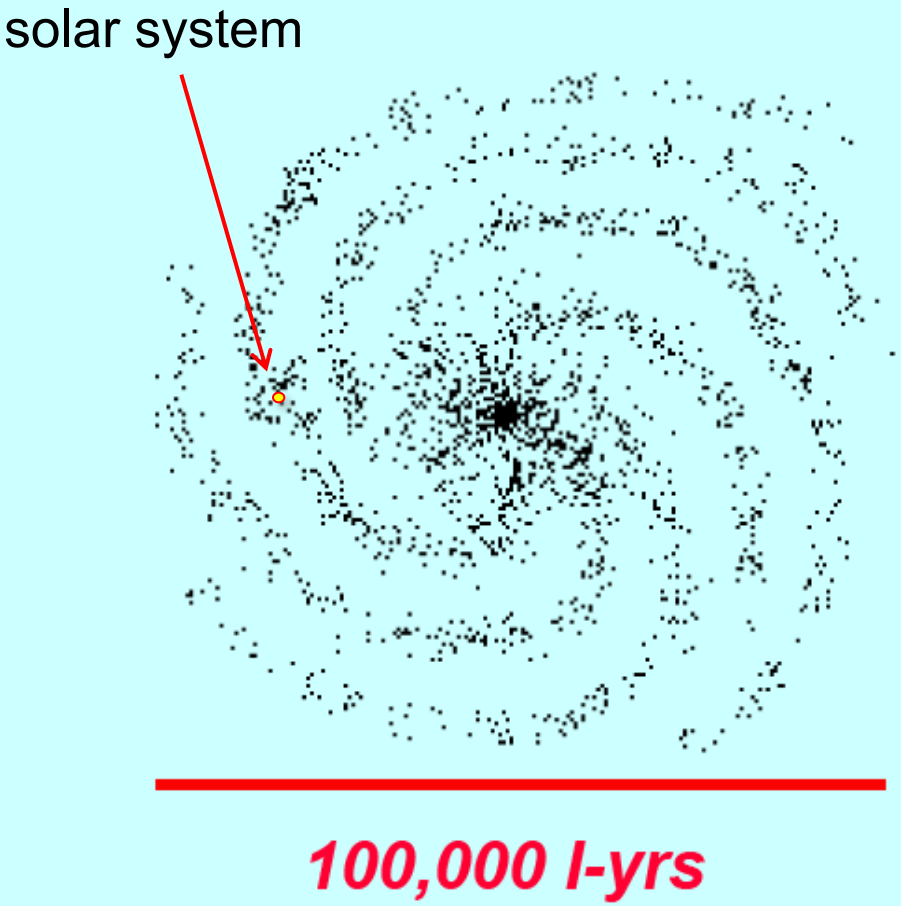


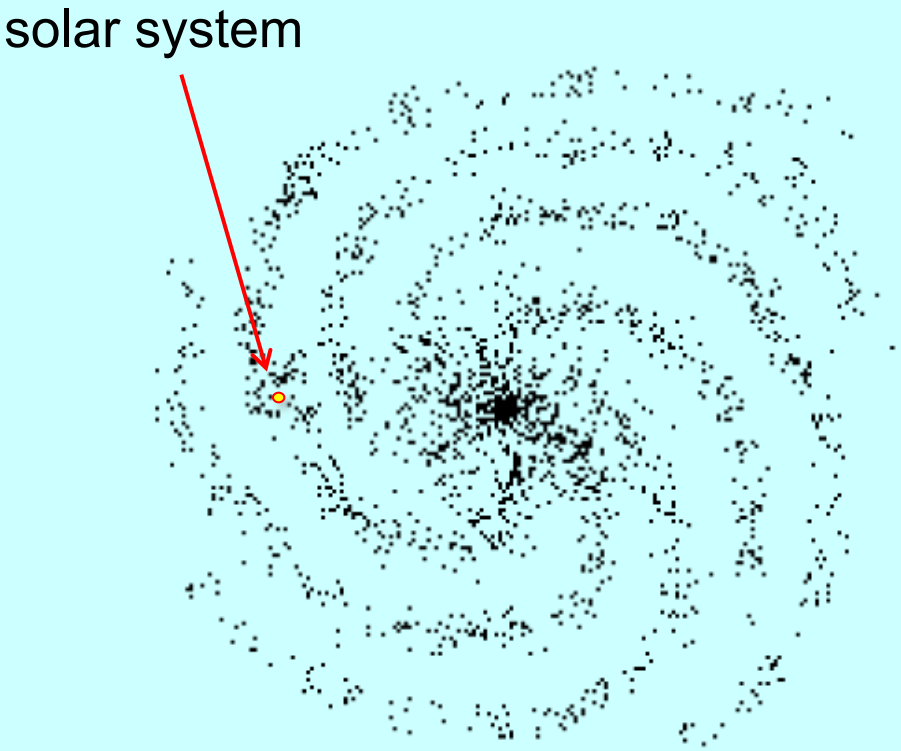
Planets go around the Sun in a plane called the ECLIPTIC

Oort Cloud




solar system
100,000 l-yrs

DON'T PANIC!!

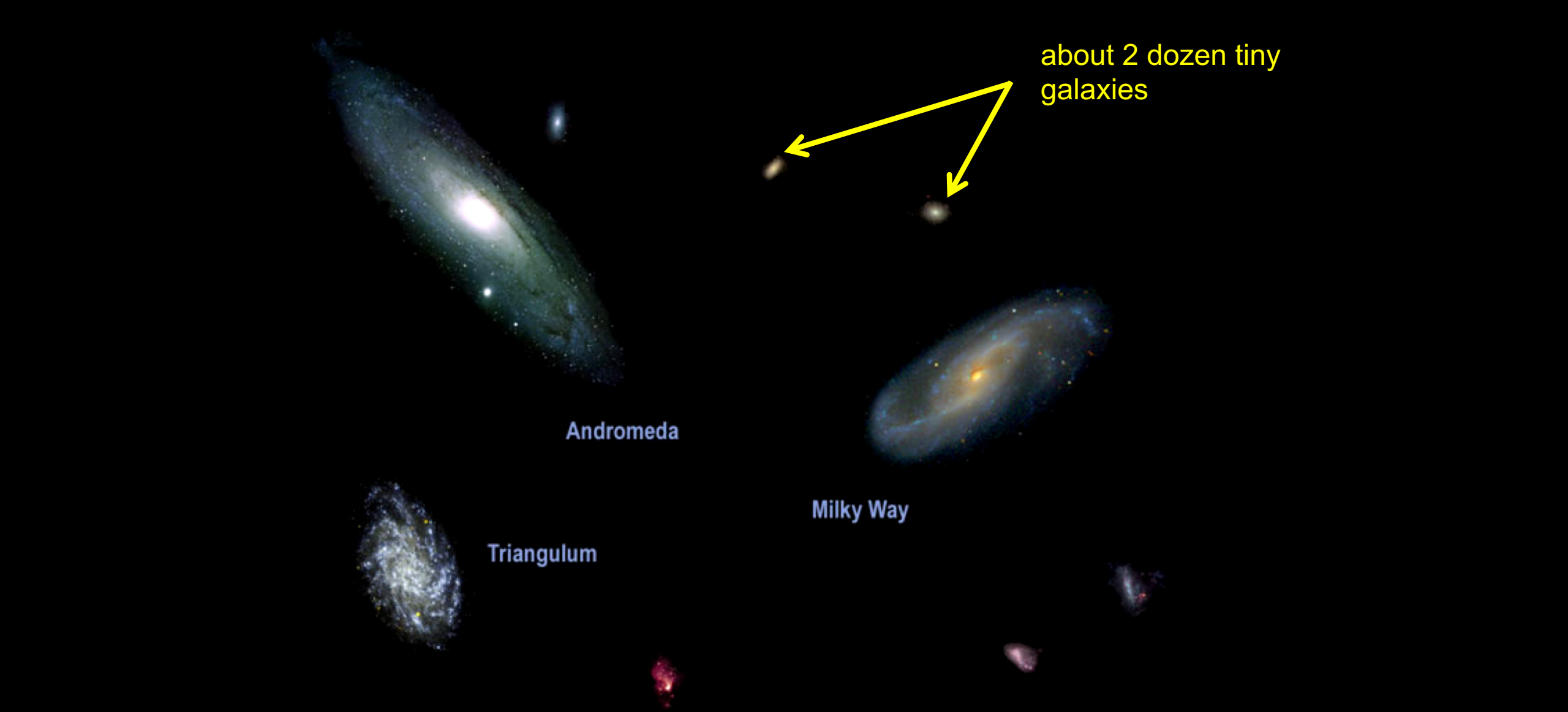


The only number you need to know is the speed of light, $c = 3 \times 10^5$ km/s

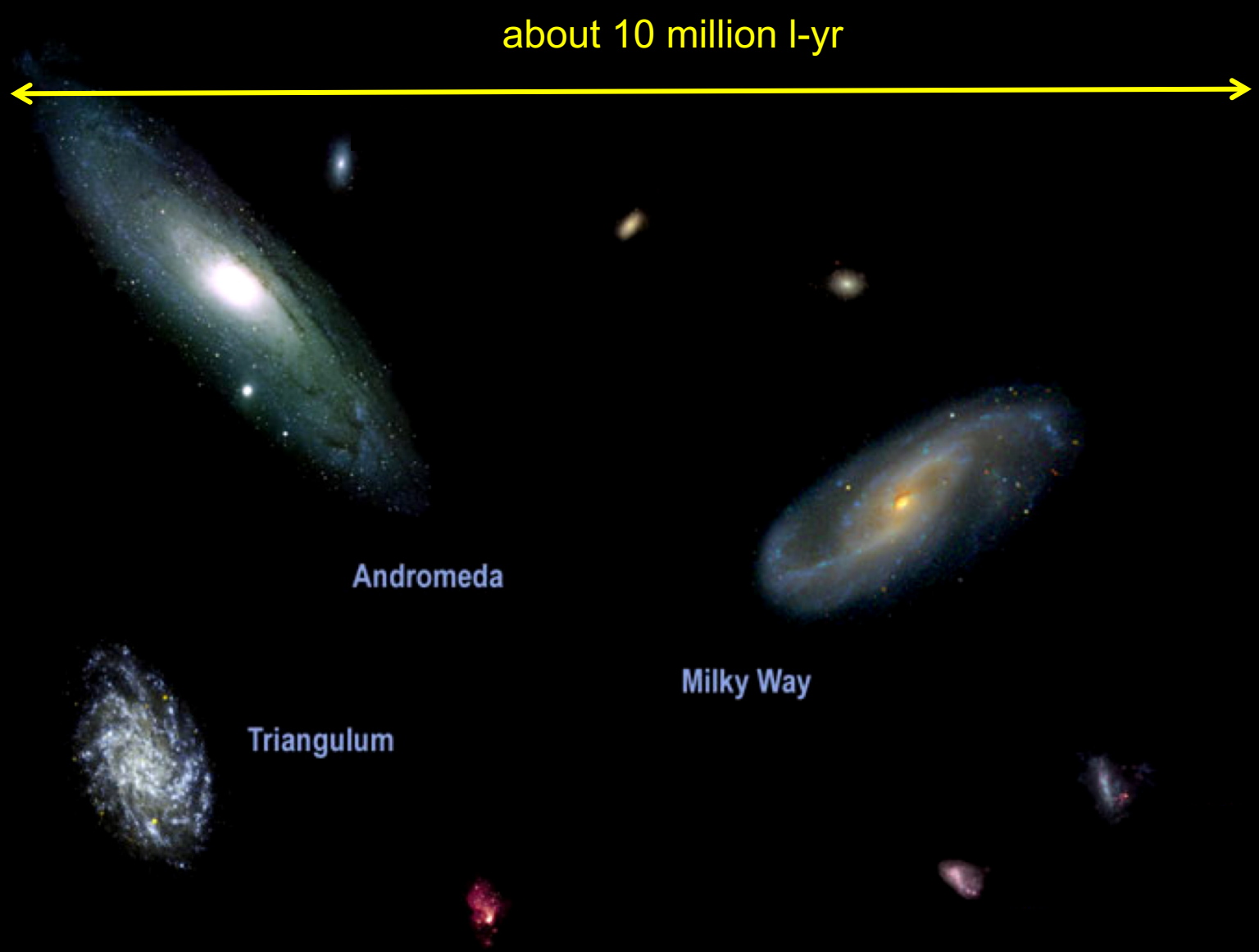
Where are we in the Universe, our Cosmic Address?

In the Universe stars are clumped into various shapes we call galaxies

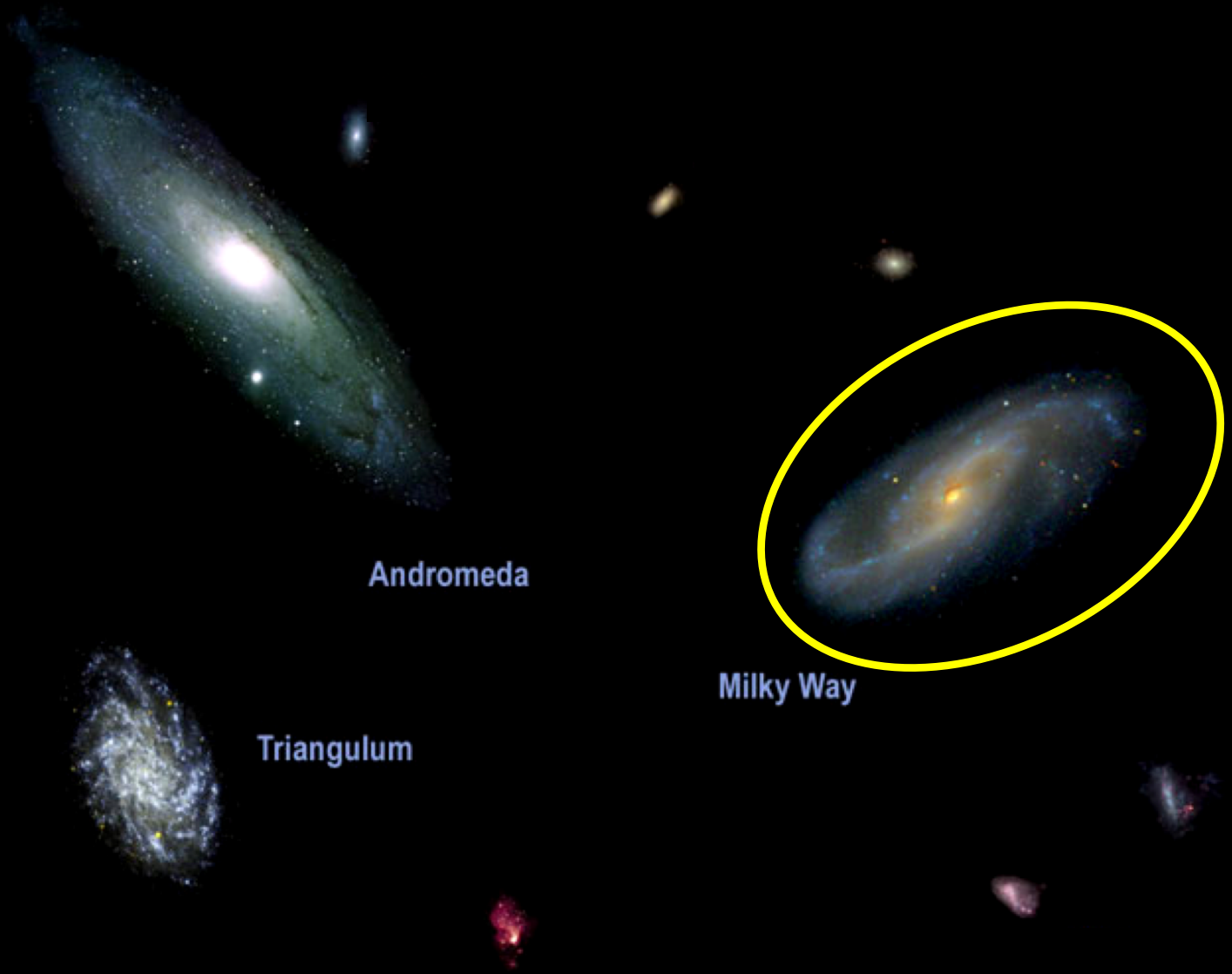
Galaxies are clumped into clusters. We're not far (50 million l-yr) from the Virgo Cluster of Galaxies



We live in the LOCAL GROUP Cluster

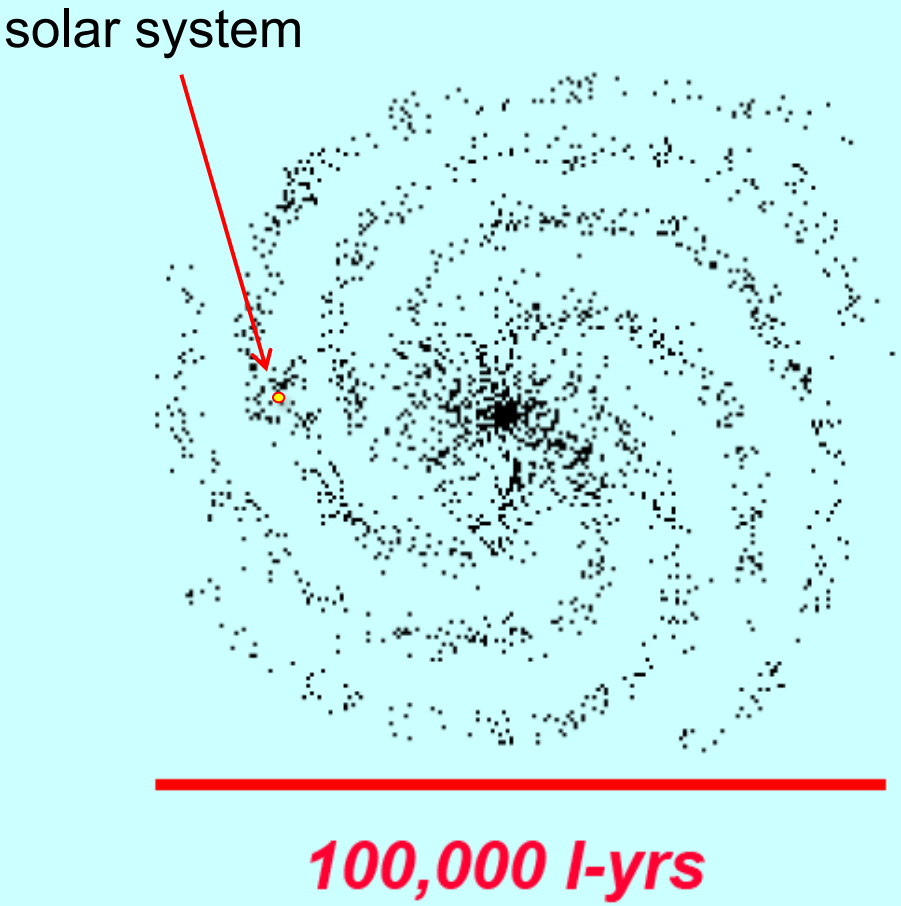


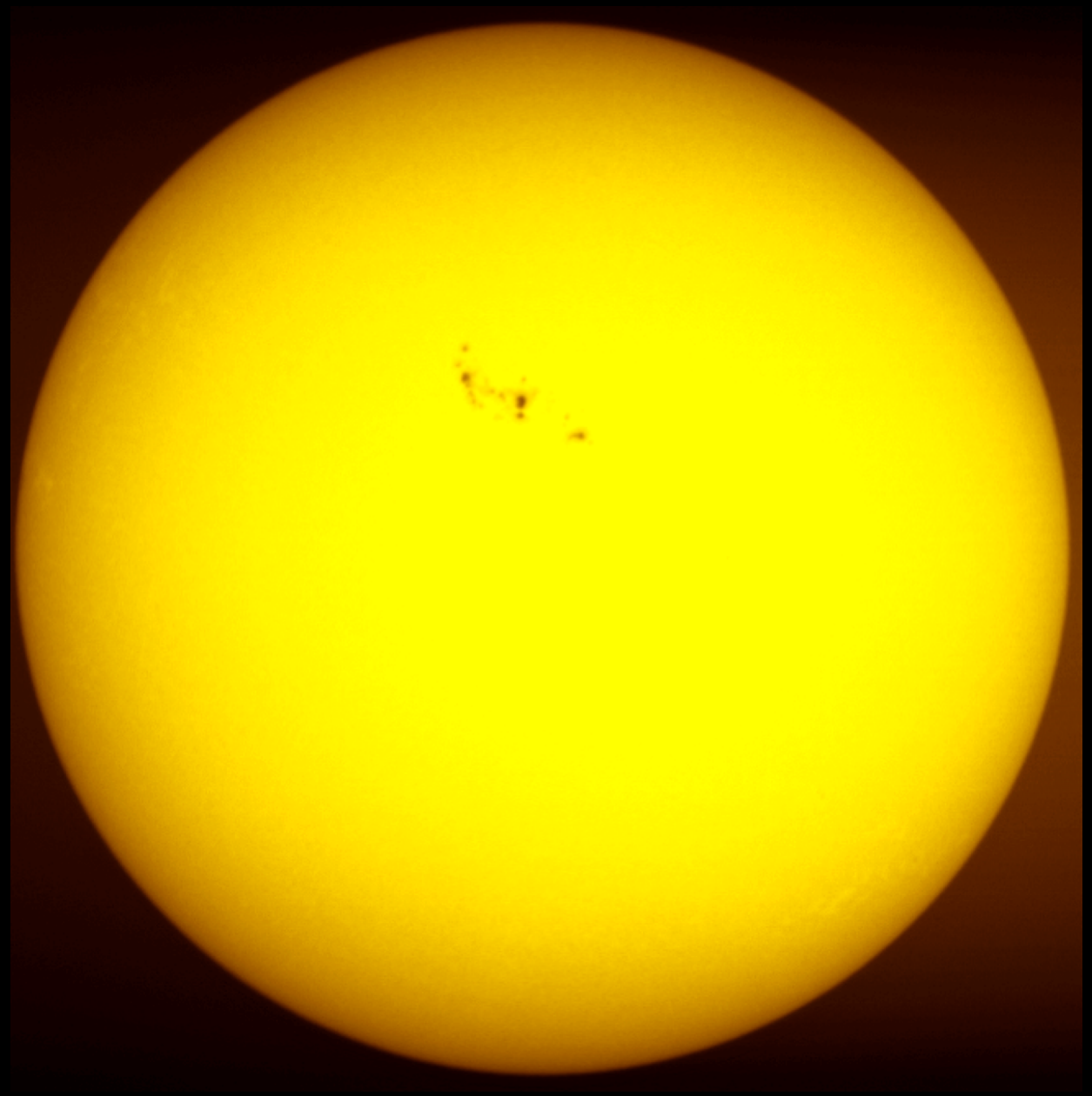
We live in the **LOCAL GROUP** Cluster



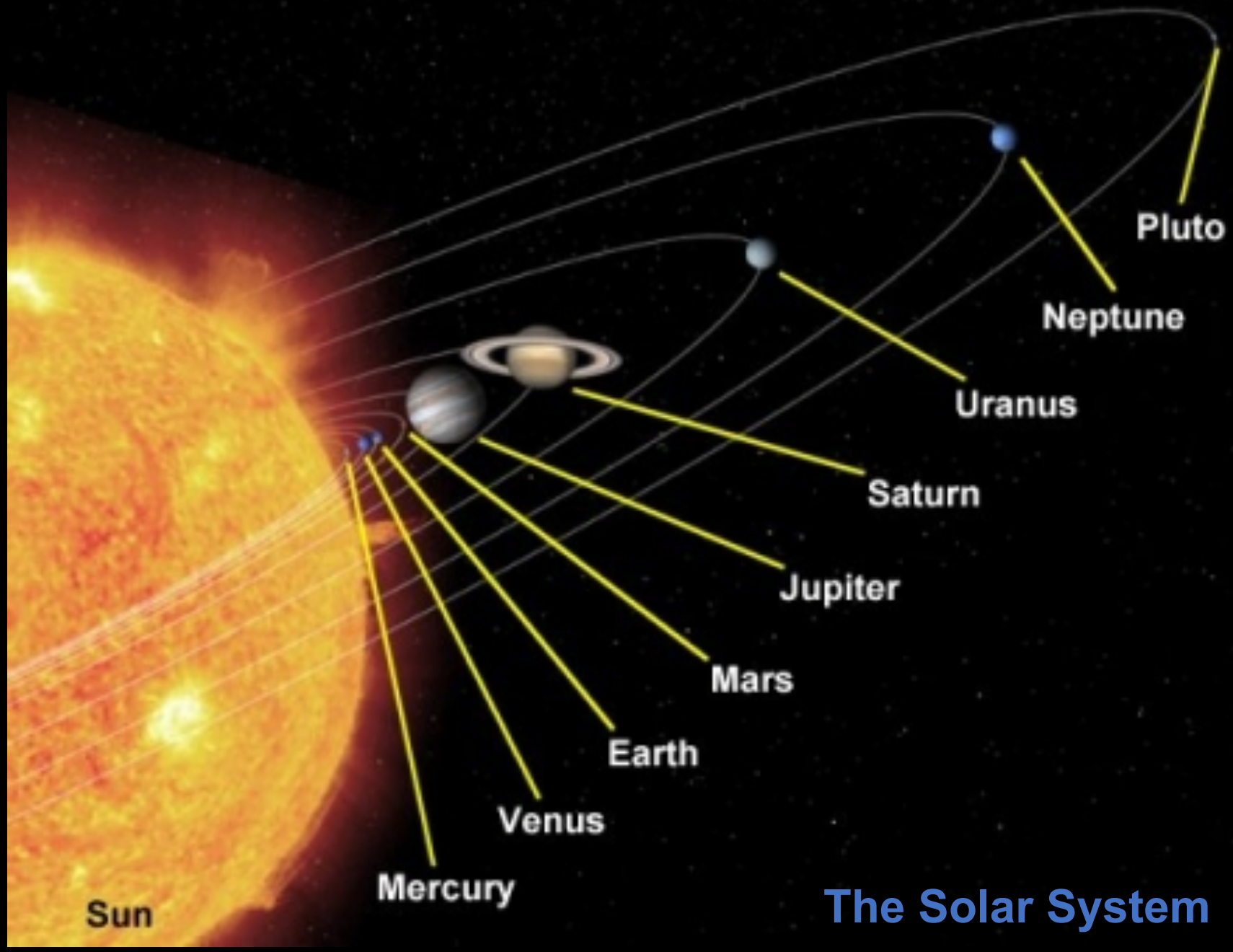
Our Galaxy, the Milky Way


Andromeda
2.6 million l-yr
Triangulum
3 million l-yr


solar system
100,000 l-yrs



Our Star, the Sun



The Solar System

Earth, 3rd Rock from the Sun

So our Cosmic Address:

Near the **Virgo Galaxy Cluster**

In The **Local Group**

In **Milky Way Galaxy**

By a star, **Our Sun**, 2/3 from the Galactic Center,
in the disk

On a planet, **Earth**, the 3rd planet from the Sun

But since everything is moving, we'd still be hard to find