

Jarak dalam Astronomi

Mengukur Jarak dan Dimensi Kosmos

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Pengamatan Virtual Langit Malam, Observatorium Bosscha – 5 September 2020

Kredit: NASA/JPL-Caltech



Kredit: Evgeni Tcherkasski dari Pixabay

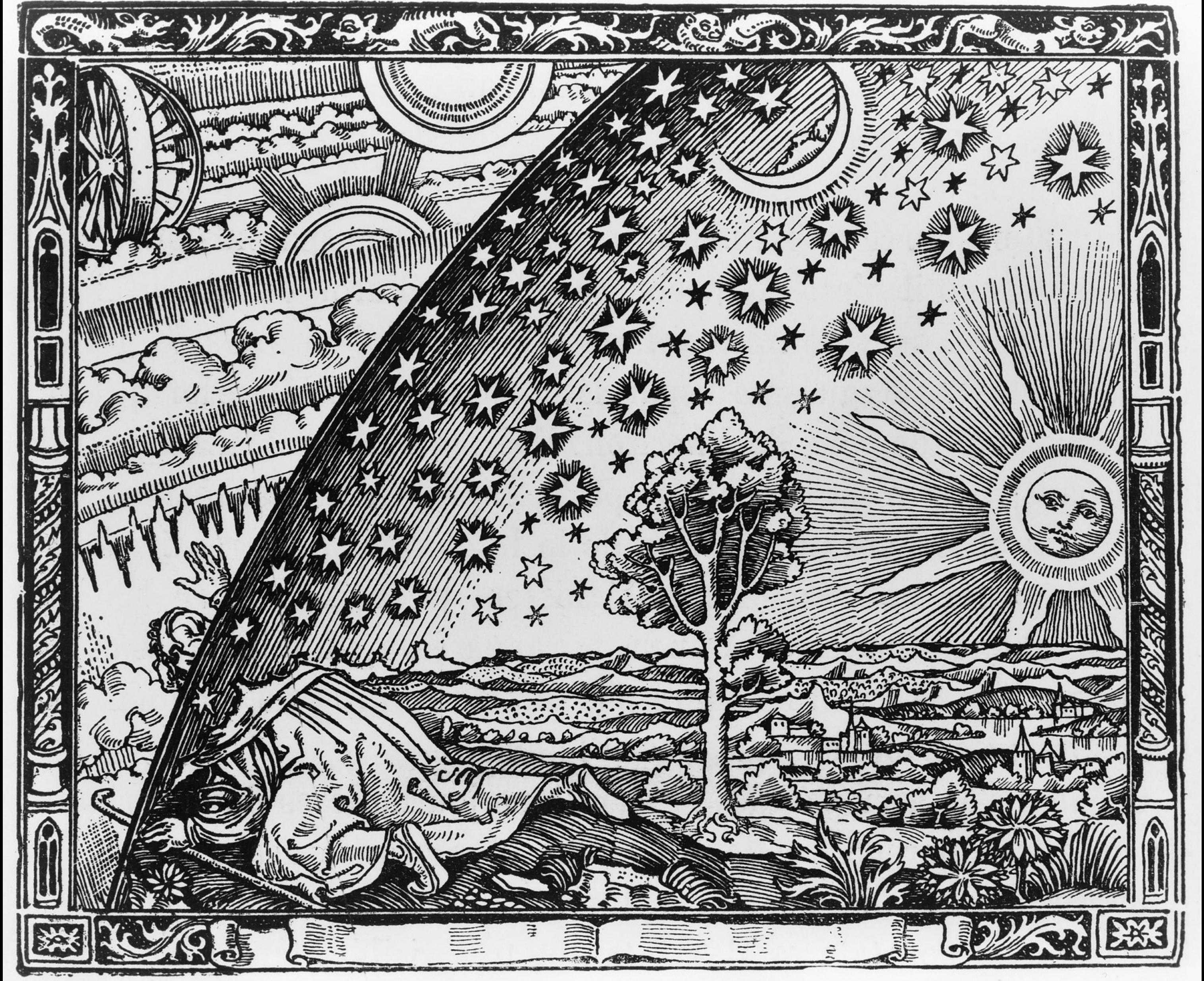
Astronomi mendorong
pertanyaan tentang alam
semesta

Mengenali pola keteraturan
alam

Sign

to

Science



Anonymous - Camille Flammarion, L'Atmosphère: Météorologie Populaire (Paris, 1888), pp. 163.

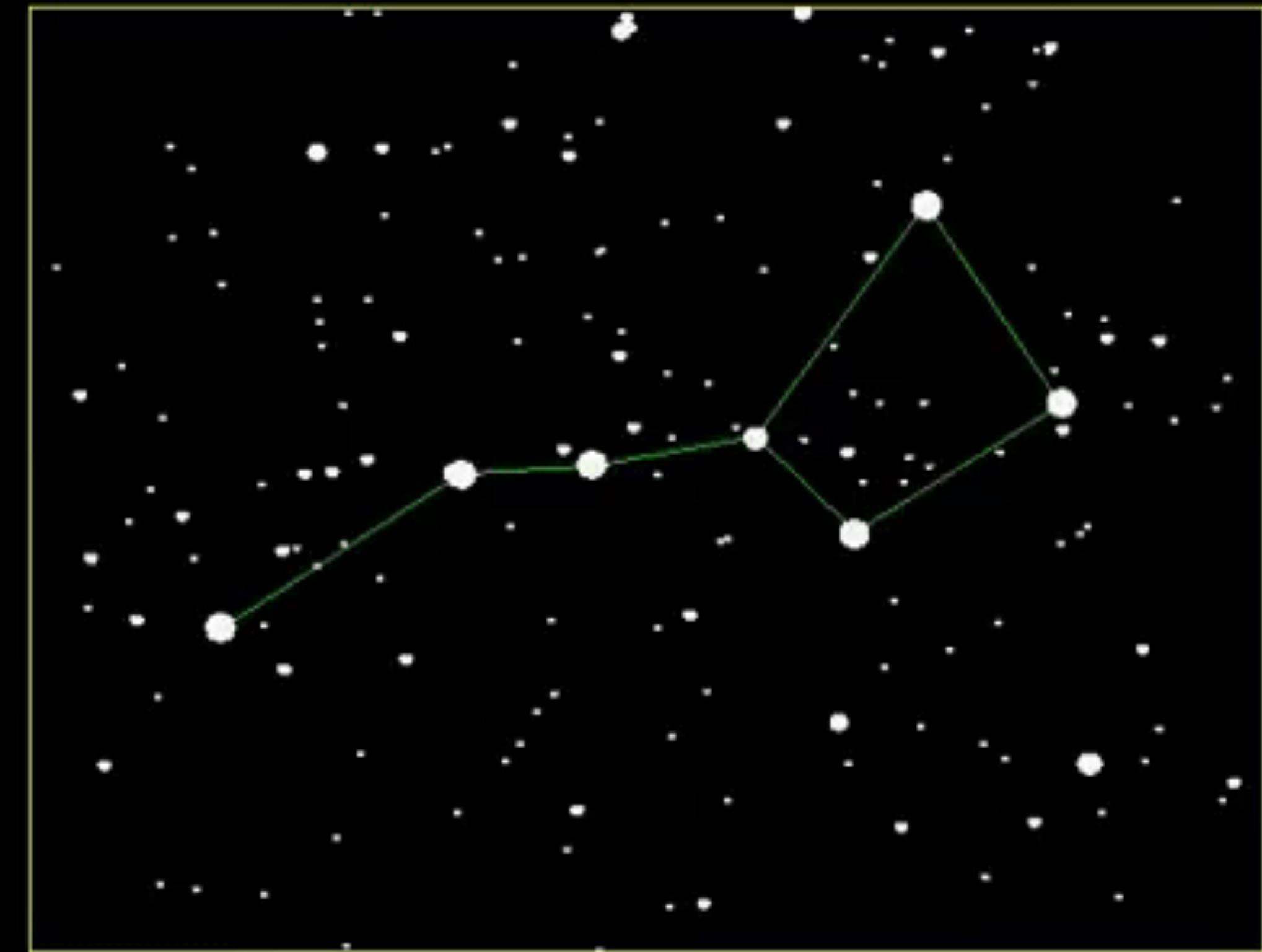
Semua objek di alam semesta itu bergerak!

Bintang Barnard



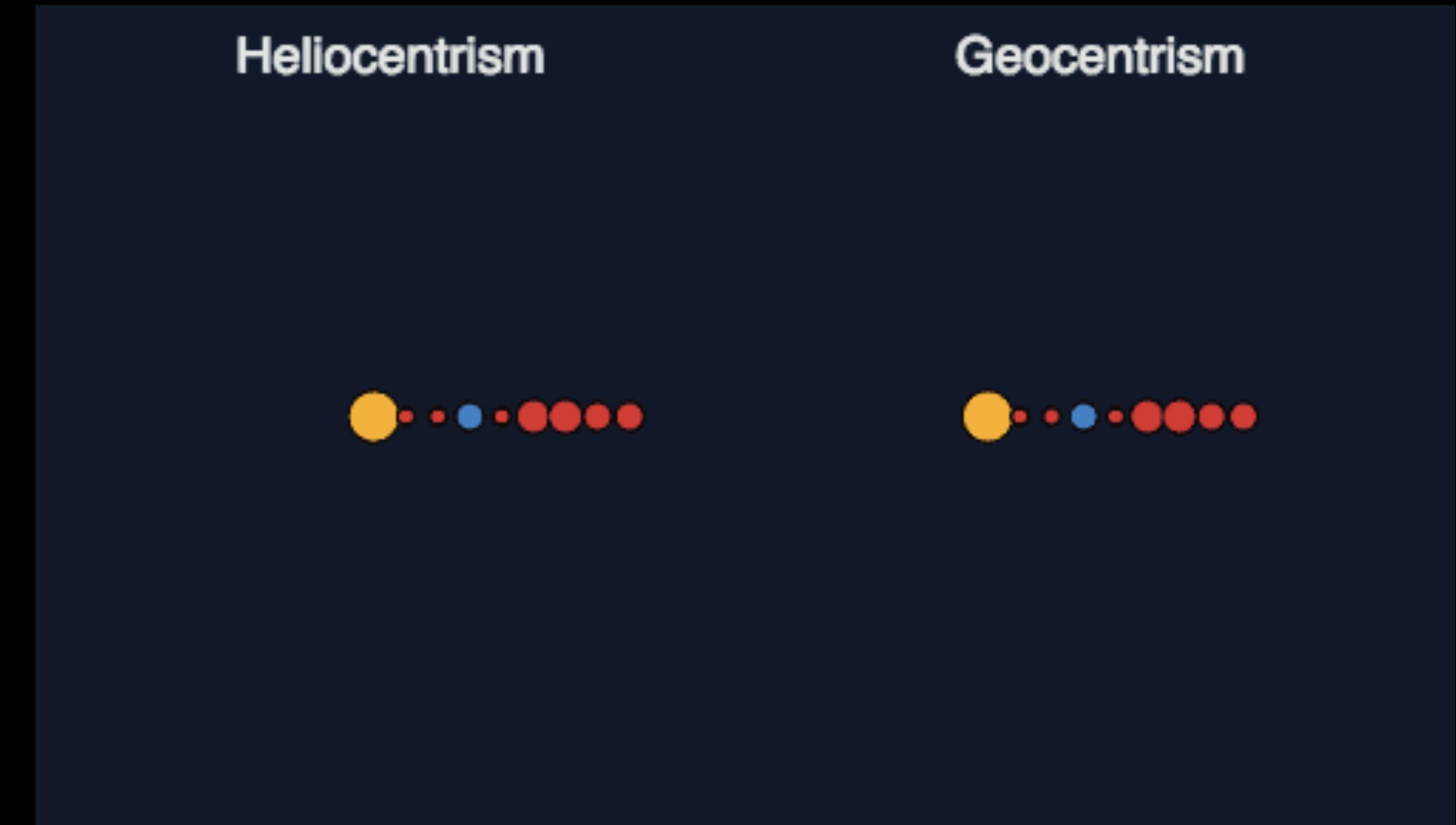
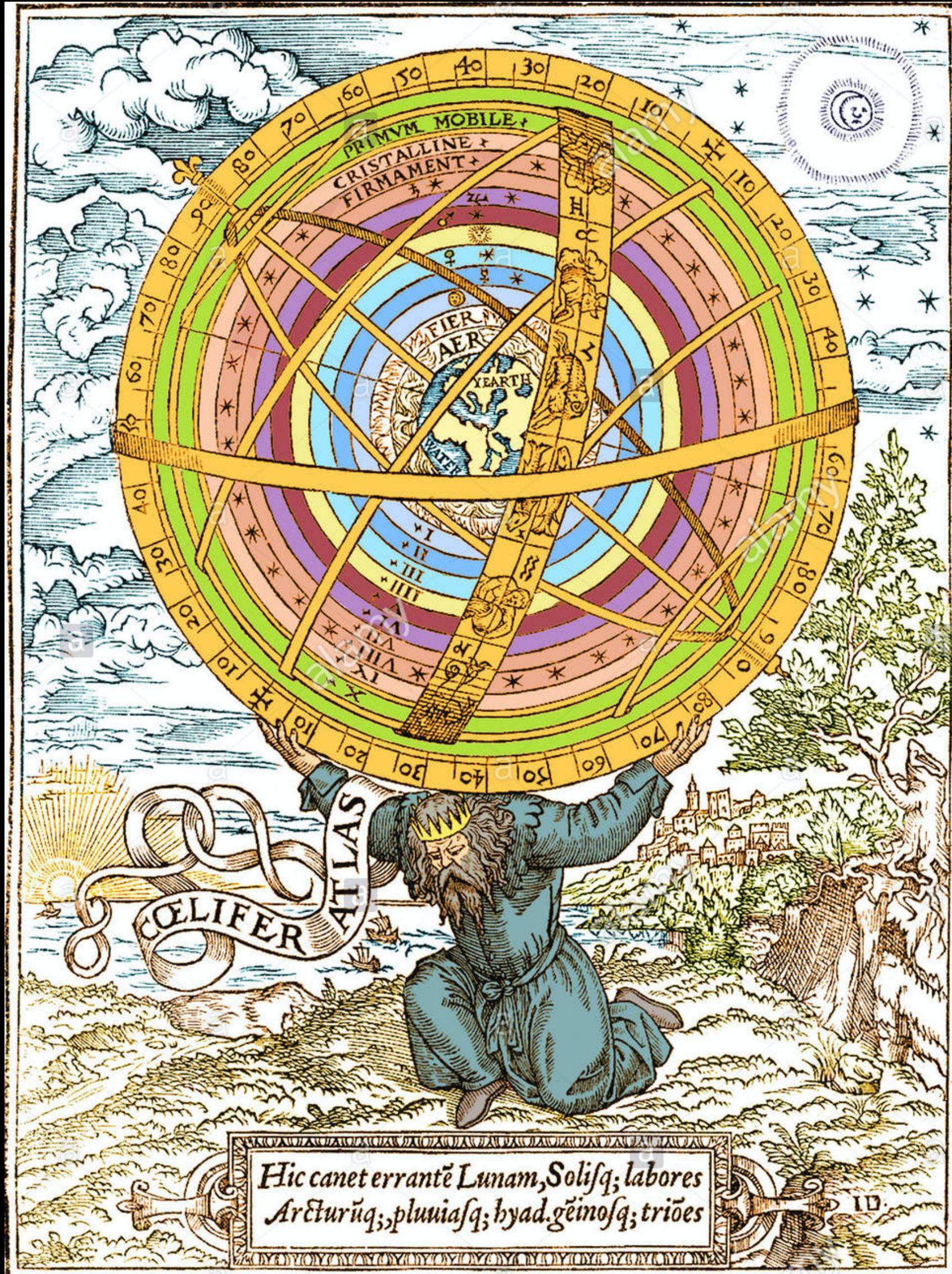
40000 BC

Ursa Major



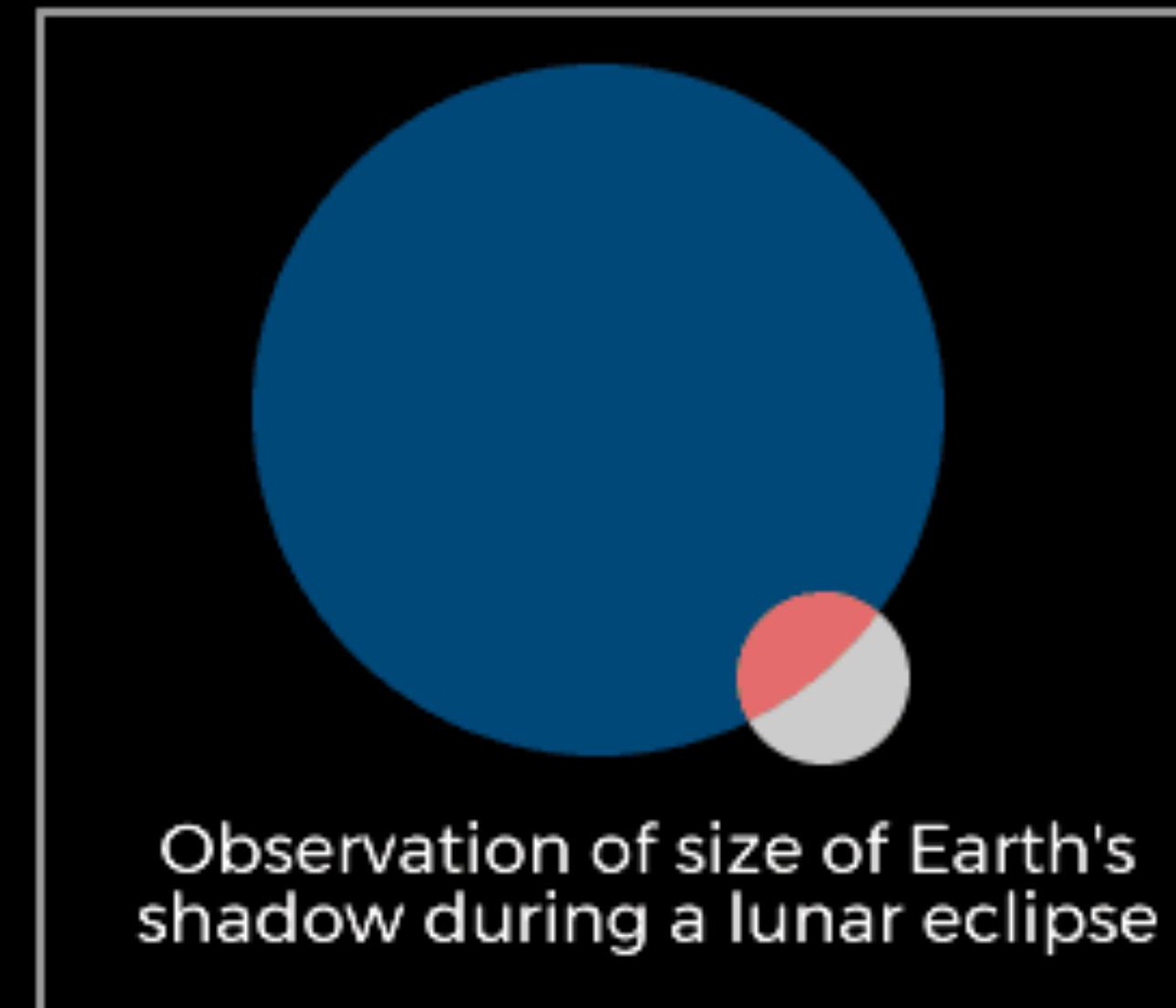
Faktor jarak mempengaruhi gerak semu di langit

Mengenali Posisi Diri di Alam Semesta

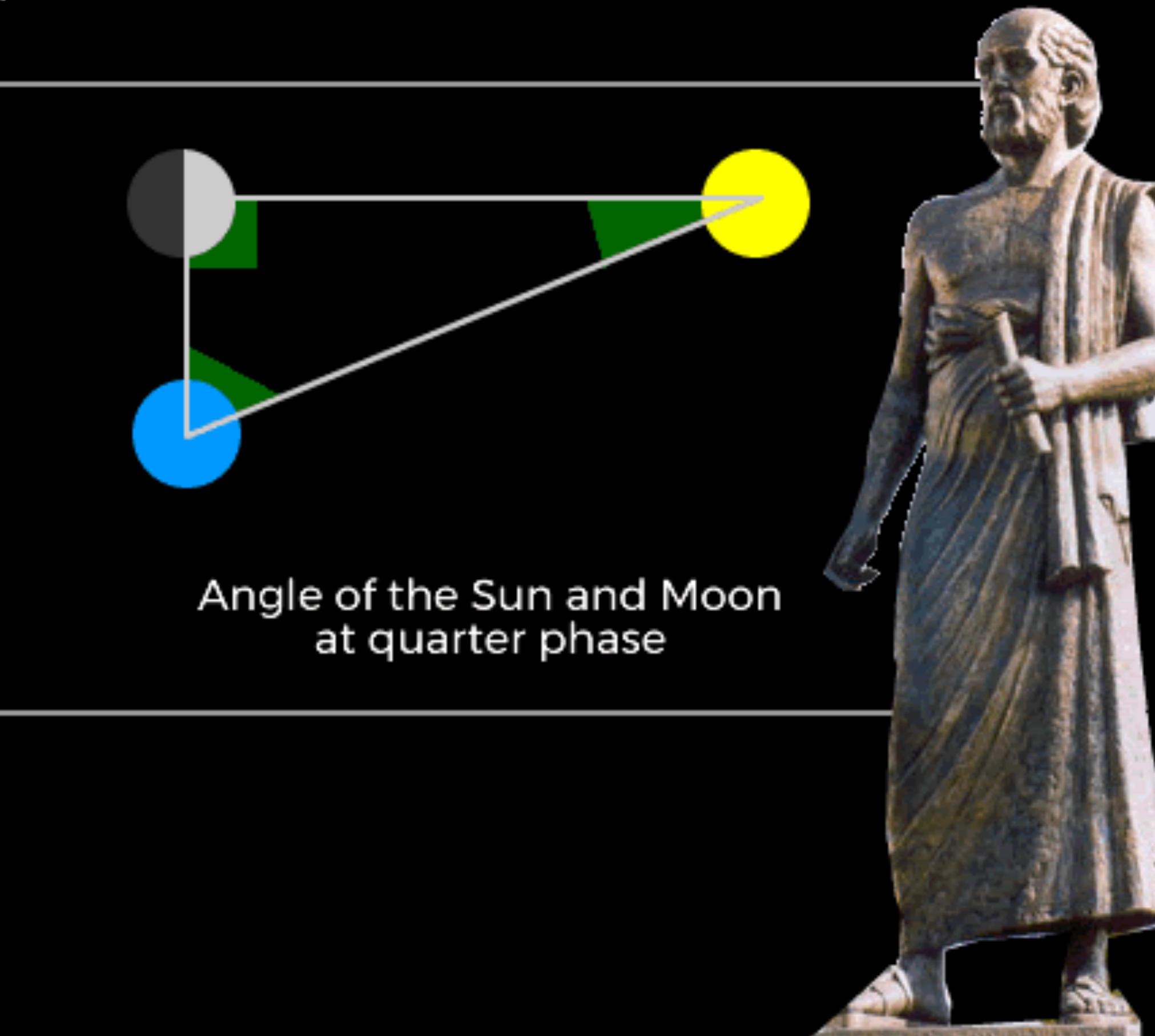


ARISTARCHUS

Size and Distances of the Moon and Sun



Mengenali “rumah” kita sendiri – Ukuran



space fm

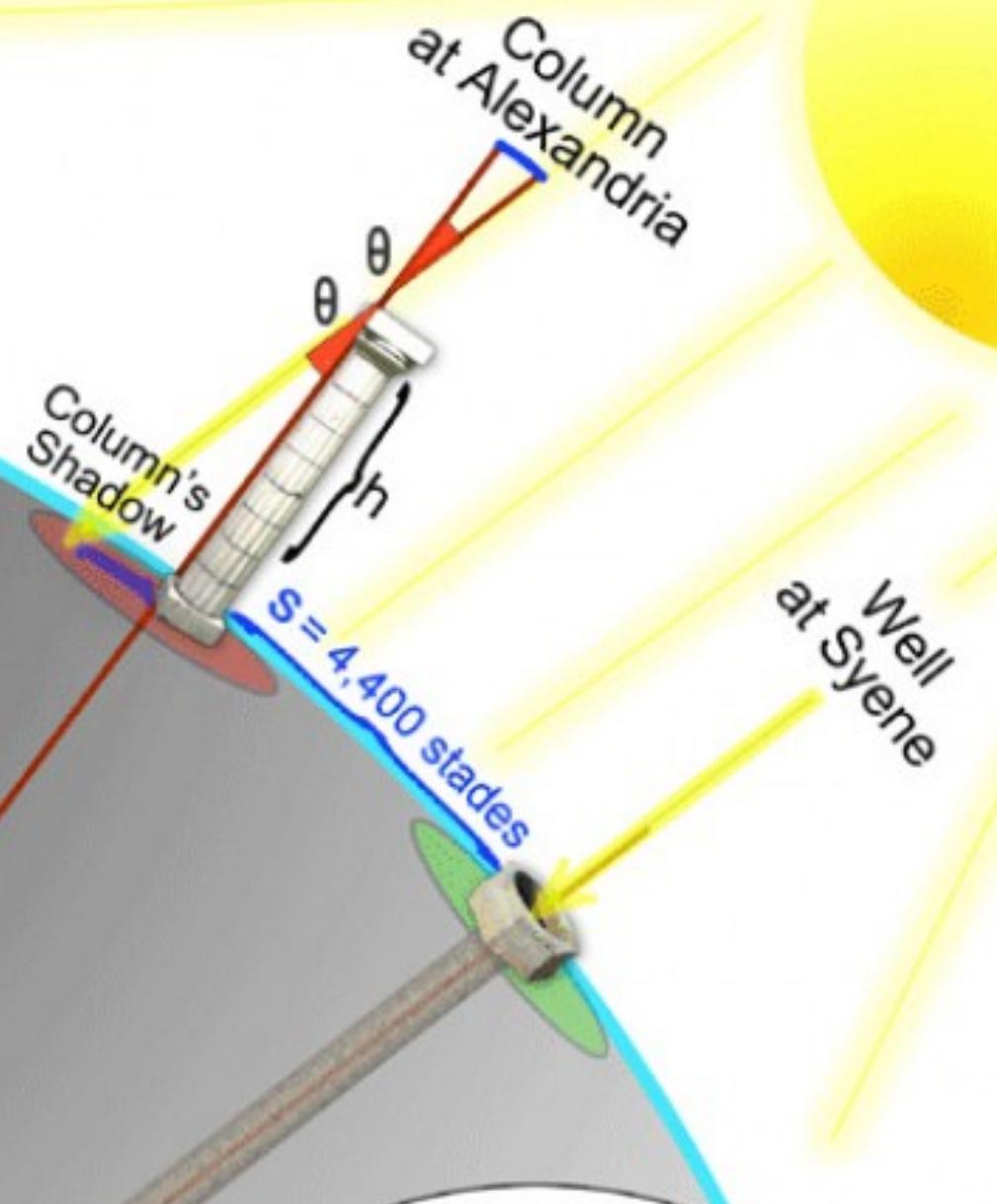
Seberapa dekat jarak bumi dengan bulan?

With h and s known,
you can solve for θ .

With θ known,
you can use the equation:

$$(360^\circ/\theta) \times (s)$$

... to measure the
circumference of the Earth.



Mengenali “rumah” kita sendiri – Ukuran

- Pythagoras mengajukan hipotesis bumi bulat untuk pertama kalinya sekitar tahun 500 SM.
- Sekitar tahun 240 SM, Eratosthenes melakukan pengukuran keliling bumi.



New Moon

—Waxing Crescent—

First Quarter

—Waxing Gibbous—

Full Moon

—Waning Gibbous—

Last Quarter

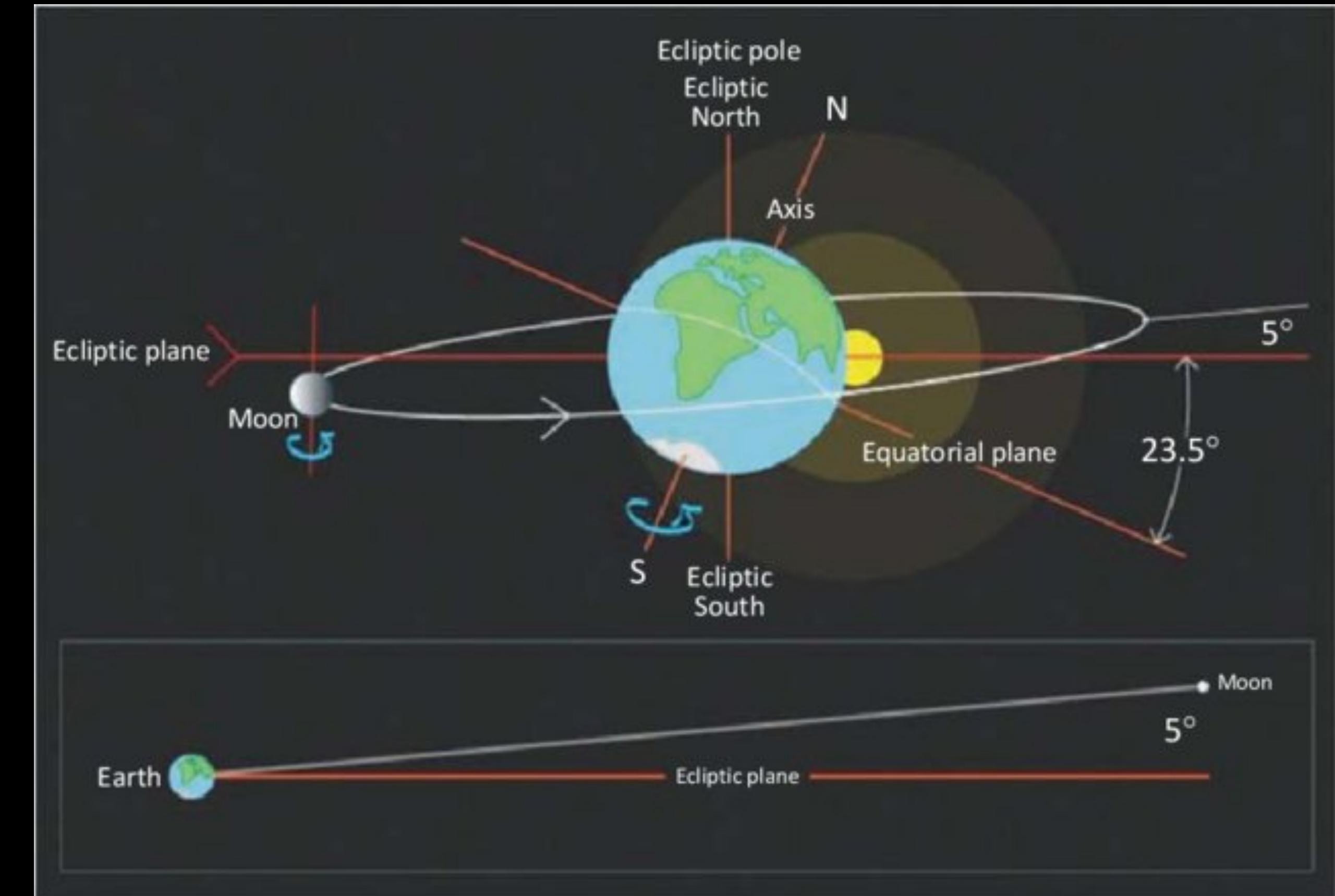
—Waning Crescent—

New Moon

Kredit: Orion 8, Wikipedia

Perubahan ‘wajah’ bulan dari waktu ke waktu

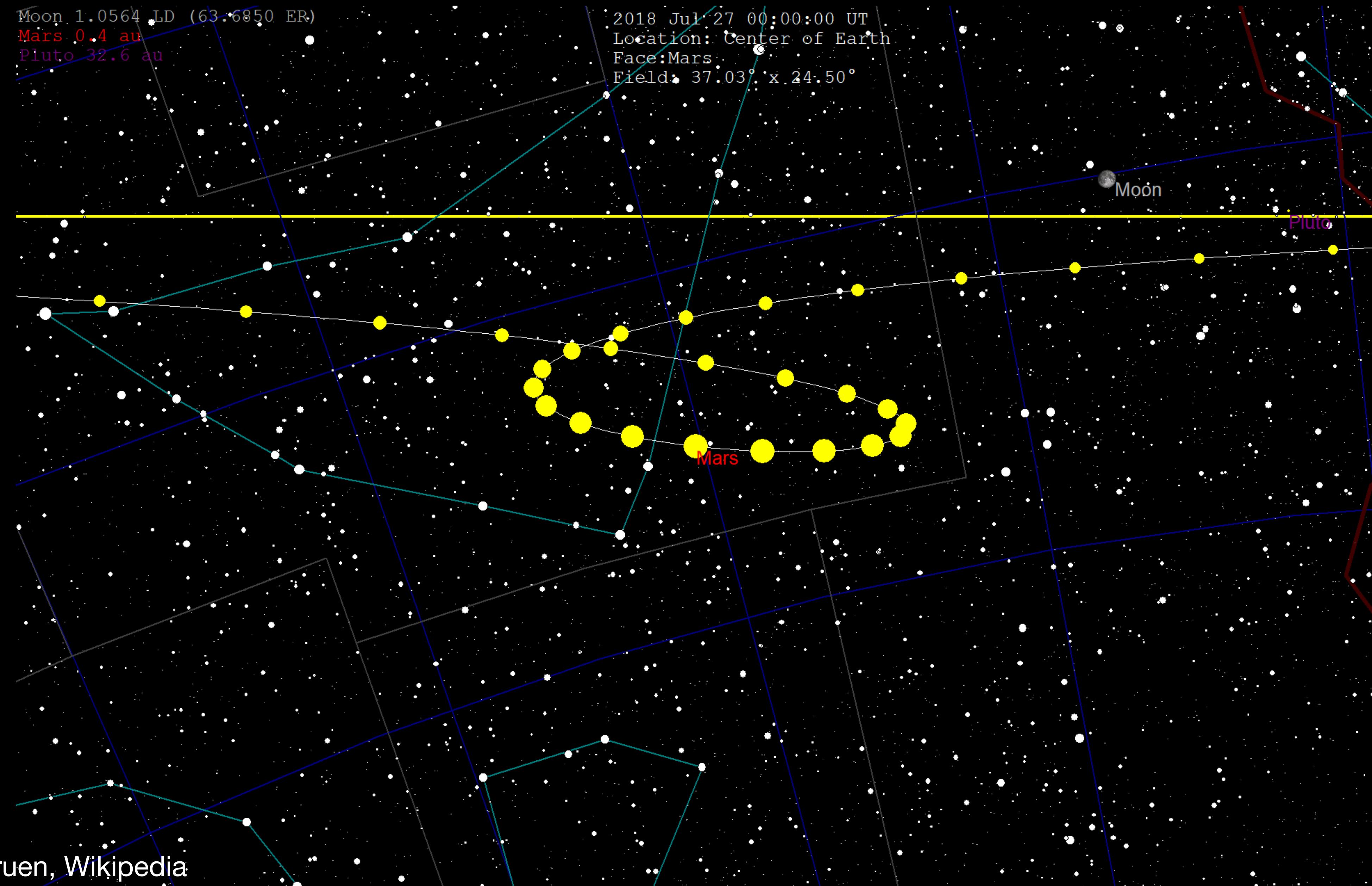
How the Moon Works Phases of the Moon



Kredit: Saraf et al. 2011, IJRS, 32, 24

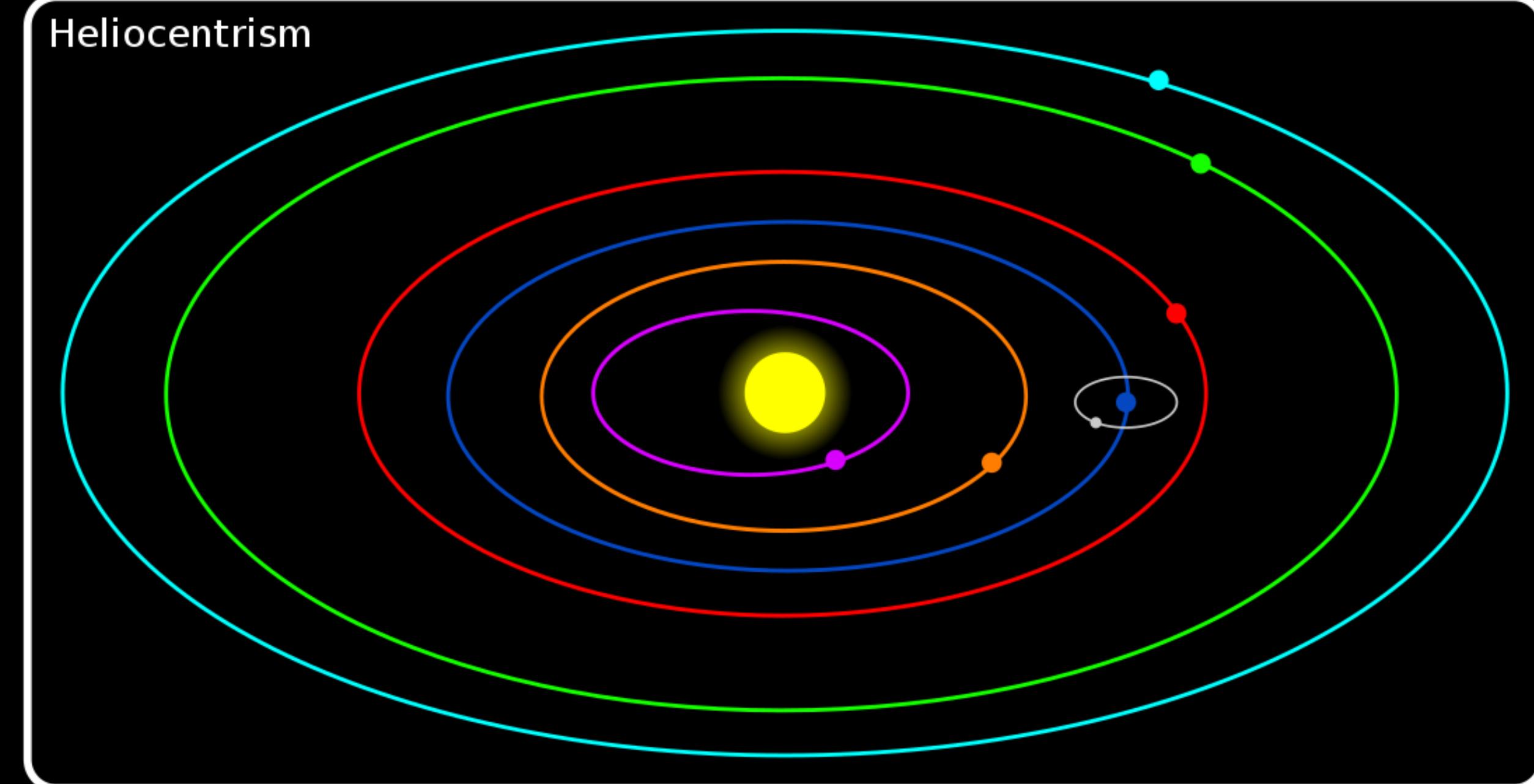
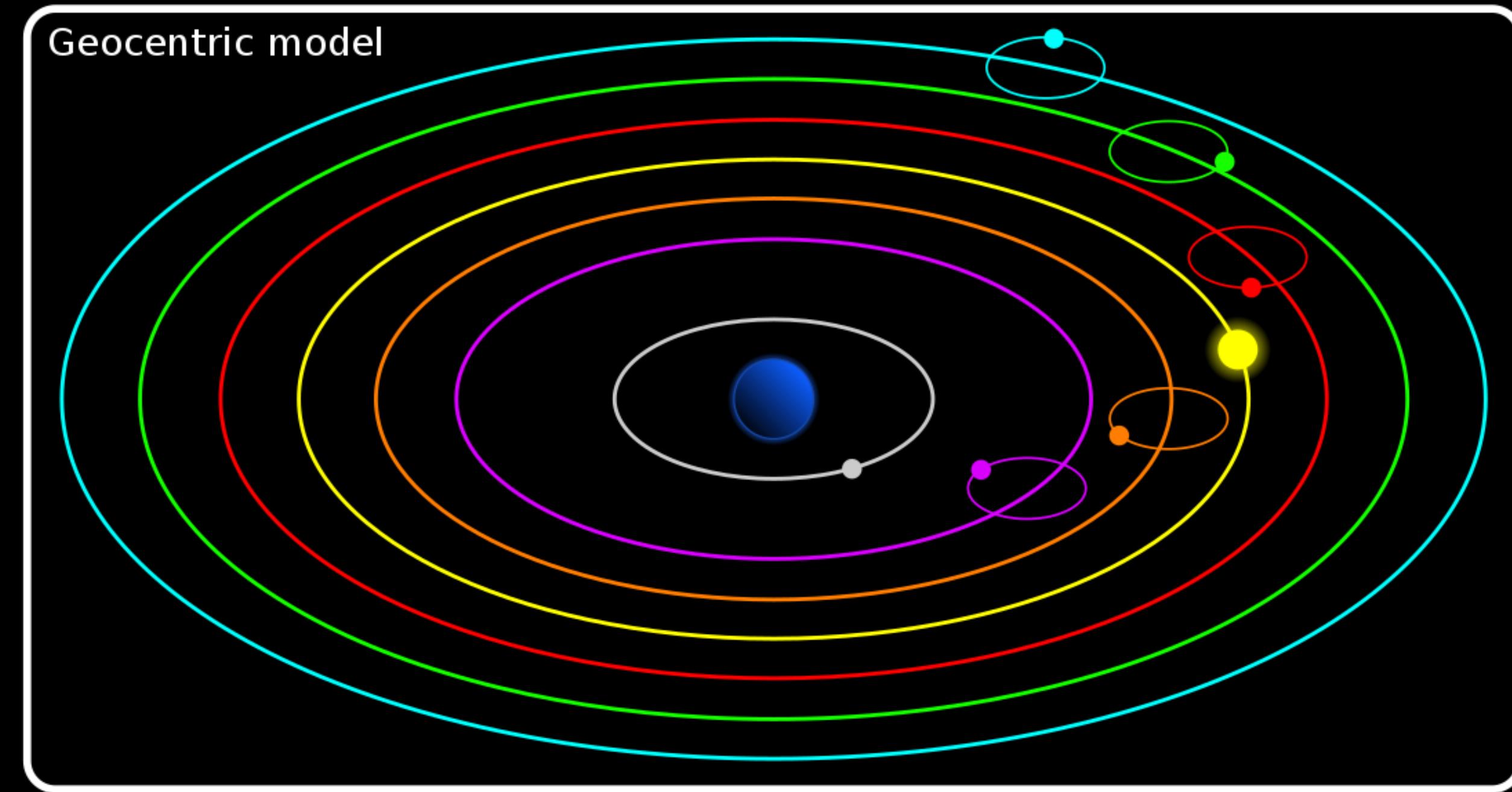
Bagaimana konfigurasi Matahari-Bumi-Bulan?

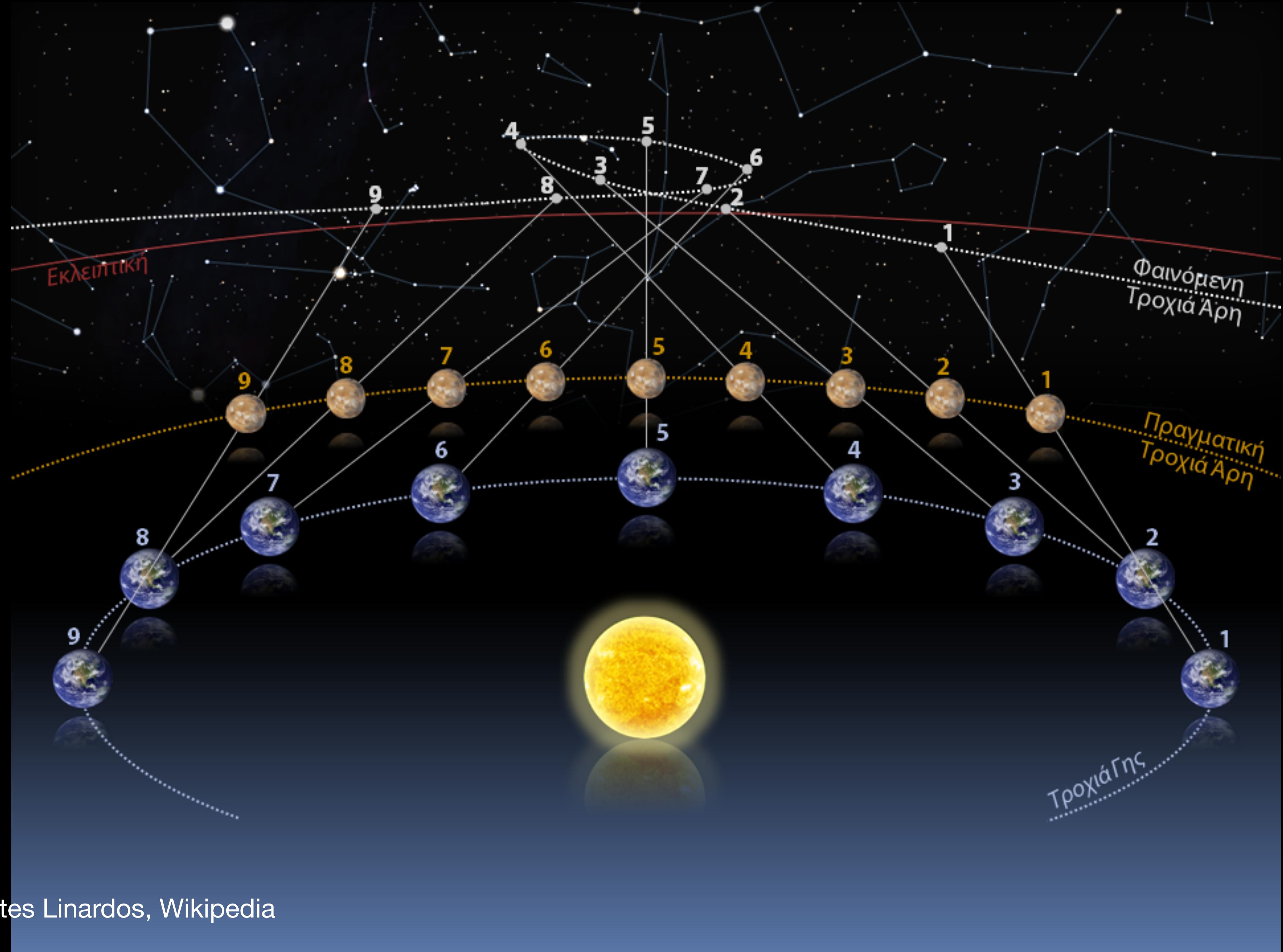
Menjelaskan “kerumitan” dengan mudah



Kredit: Tomruen, Wikipedia

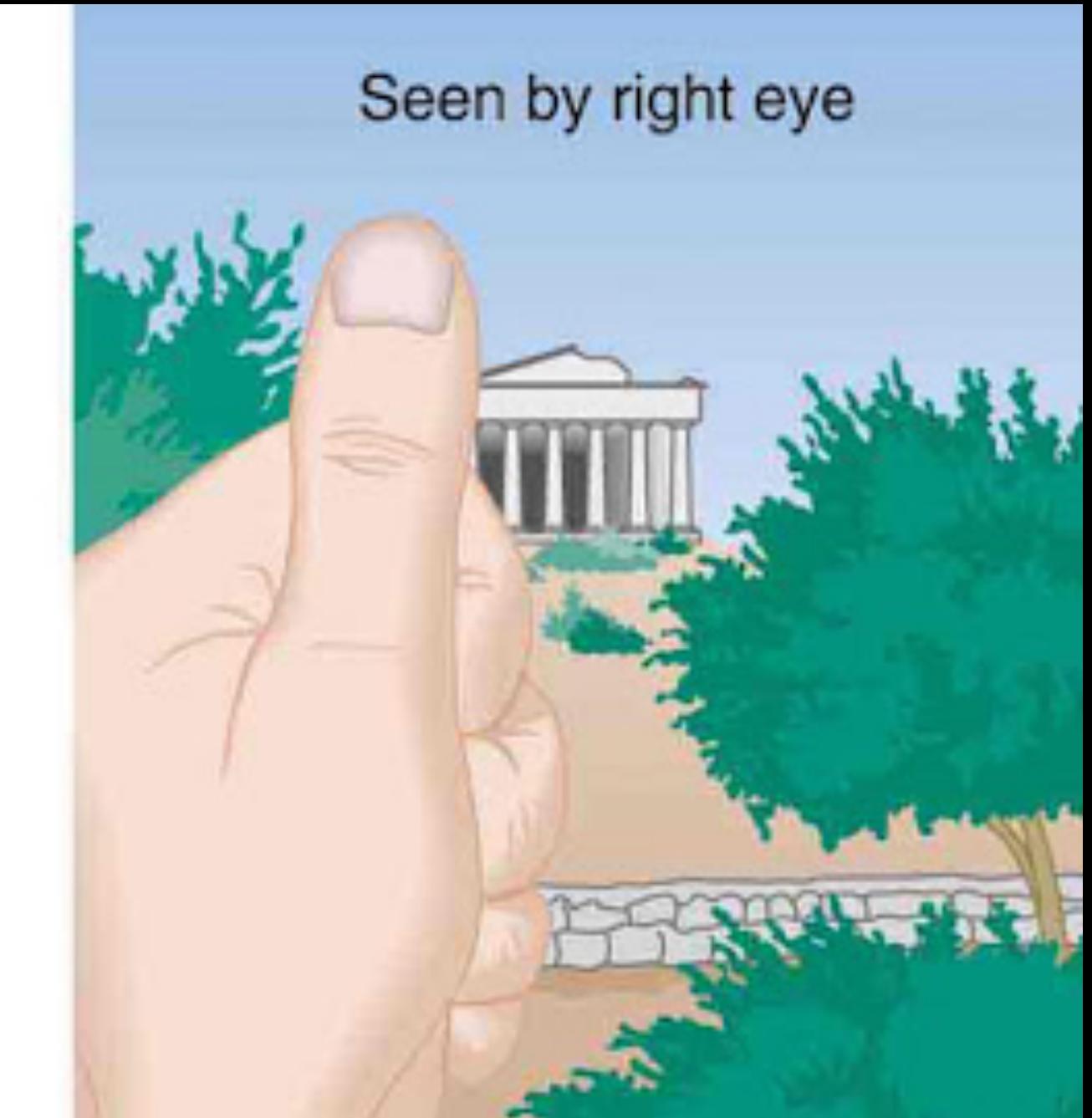
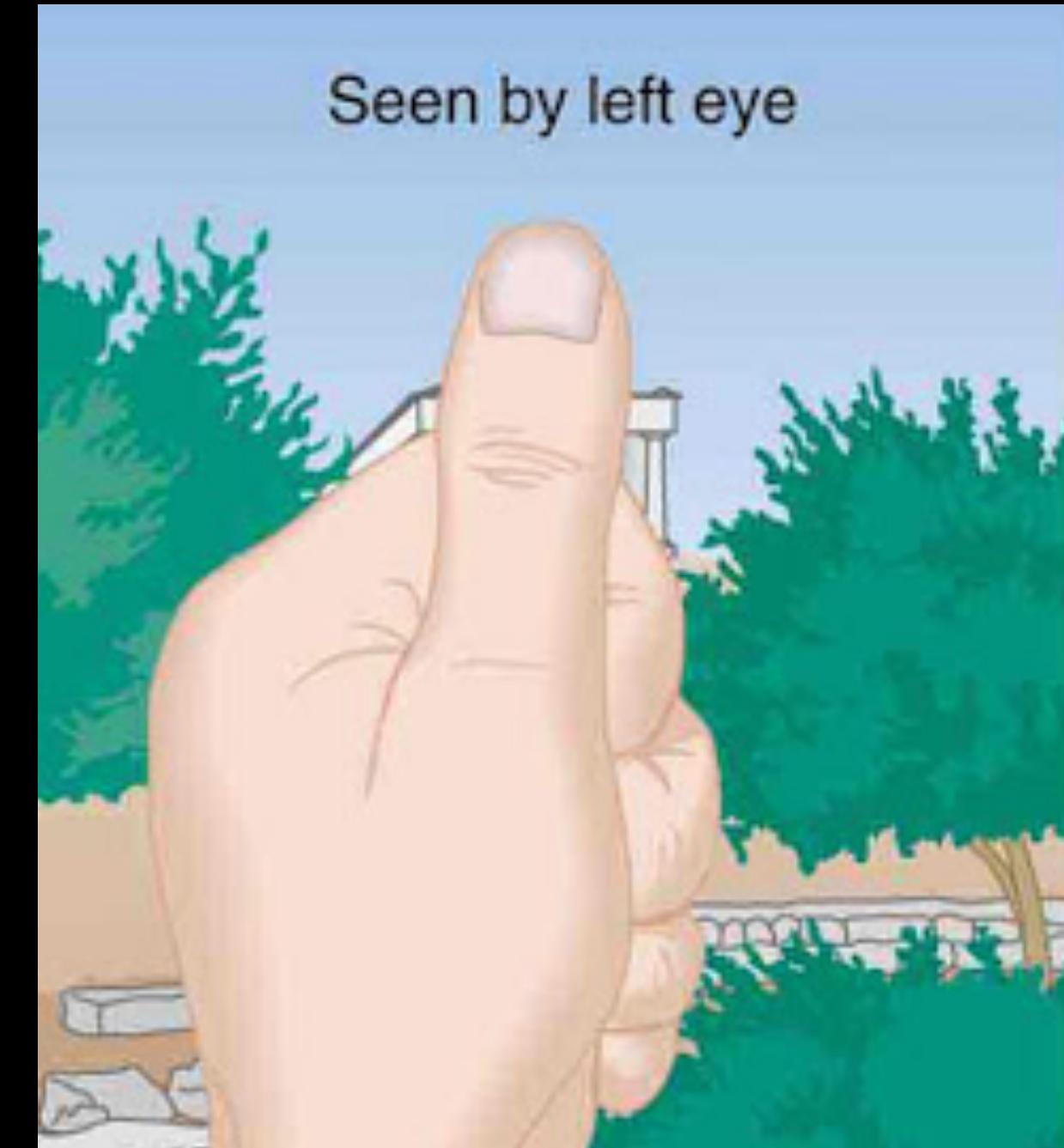
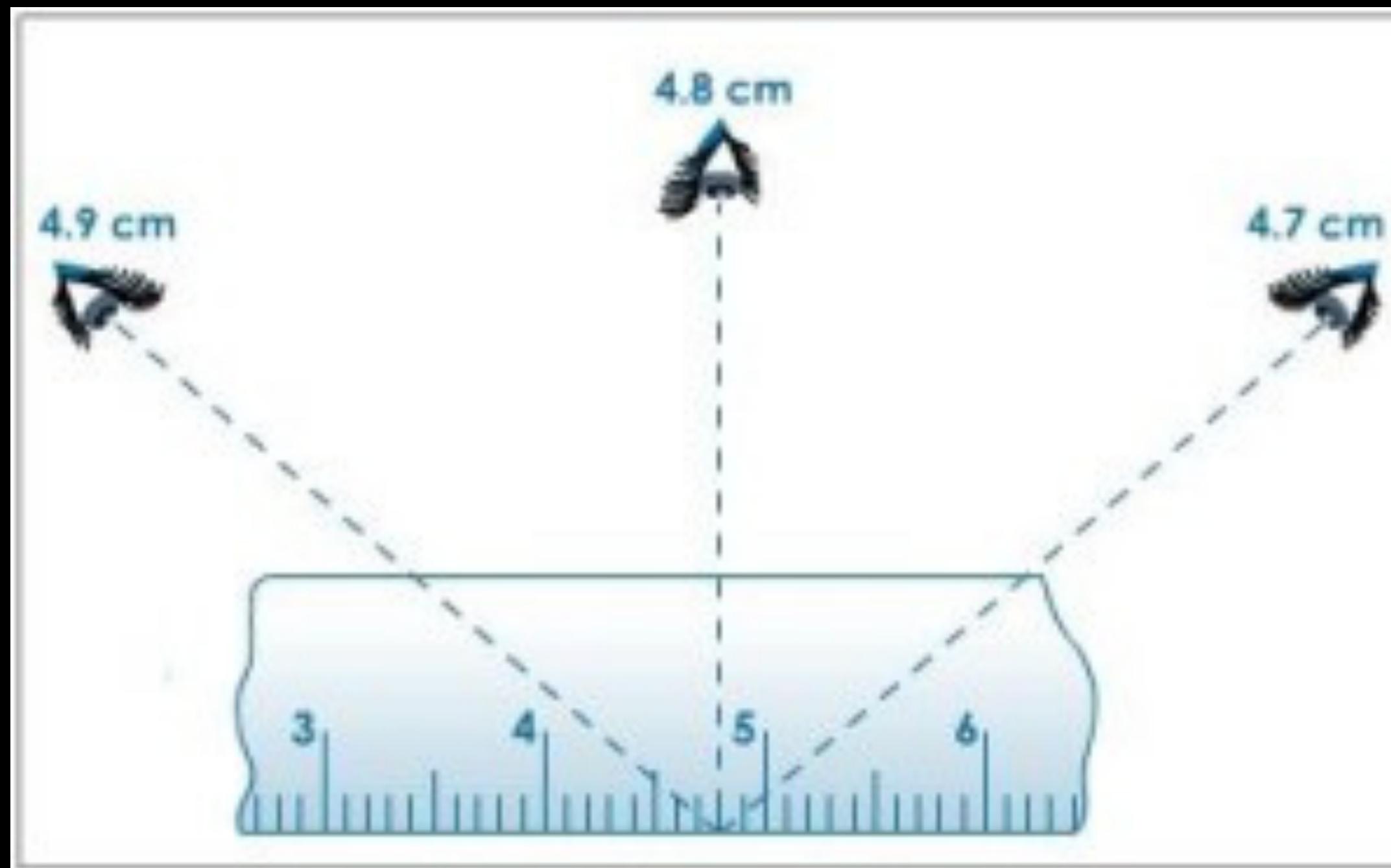
Earth
Moon
Mercury
Venus
Sun
Mars
Jupiter
Saturn



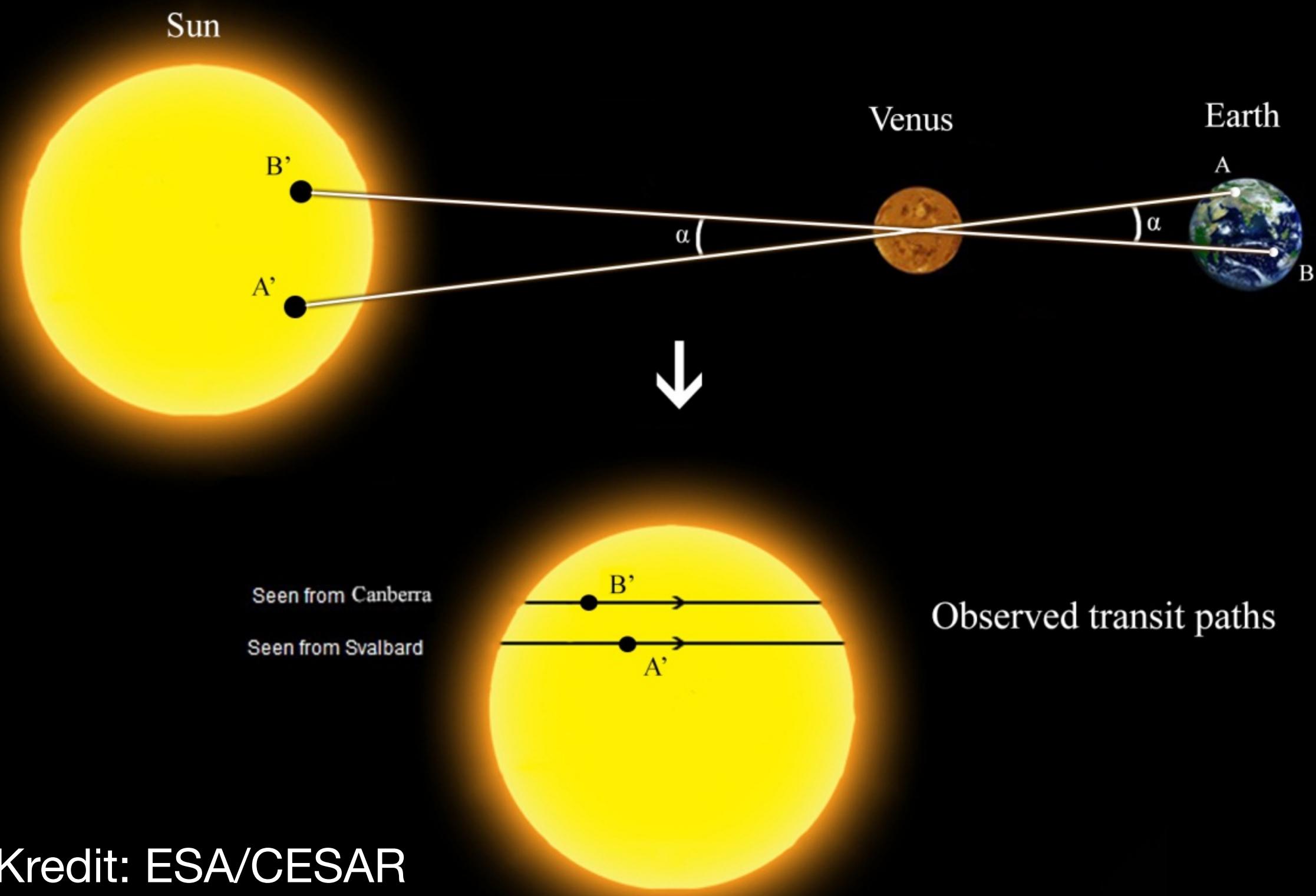


Kredit: Socrates Linardos, Wikipedia

Bergantung pada sudut pandang!



Penentuan Jarak Bumi - Matahari



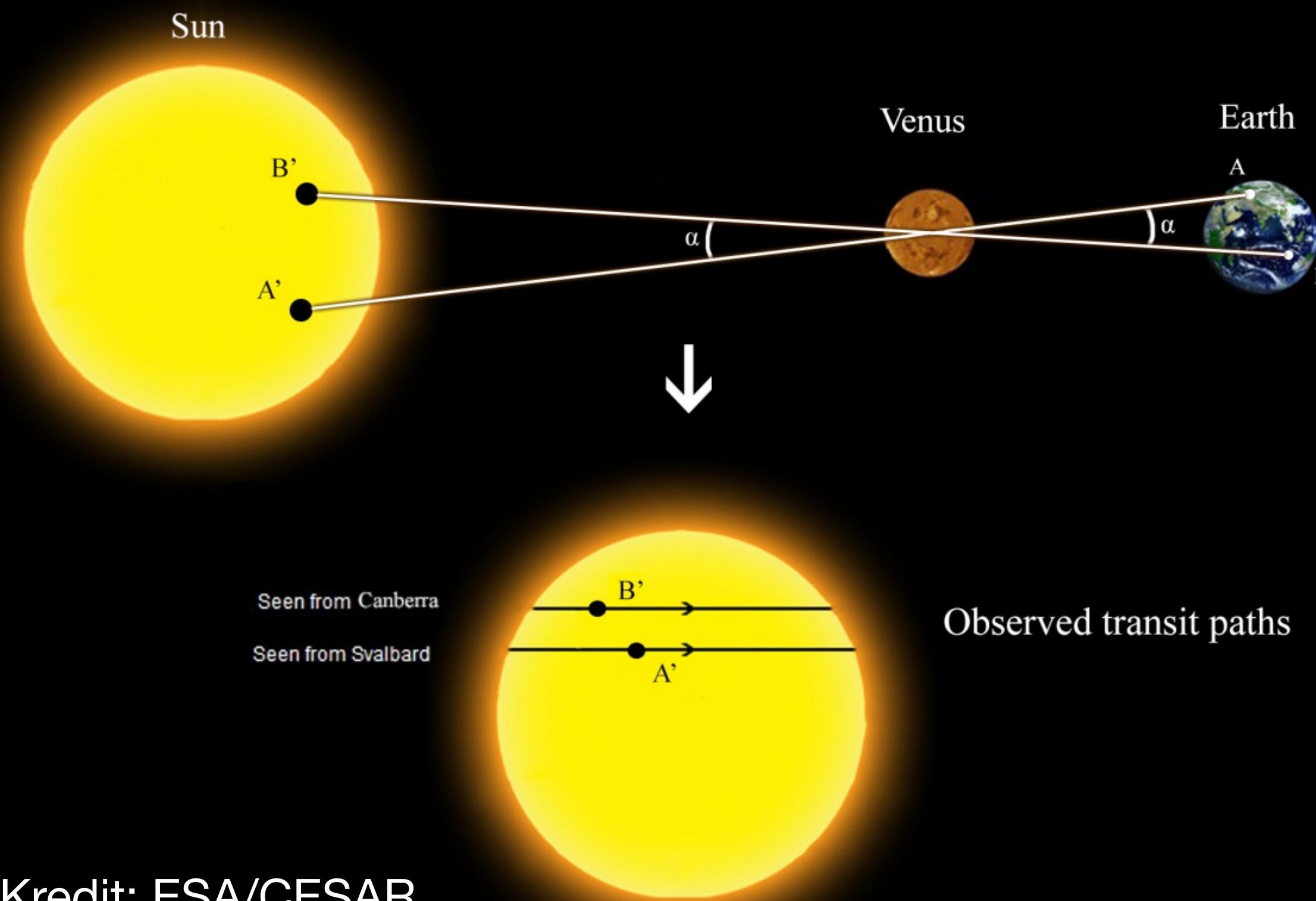
Kredit: SDO/NASA

Kredit: ESA/CESAR

1619, Astronom Jerman, Johannes Kepler
Jarak relatif planet-planet - Matahari

1716, English astronomer Edmond Halley
Menghitung Jarak Bumi - Matahari menggunakan transit Venus

Penentuan Jarak Bumi - Matahari



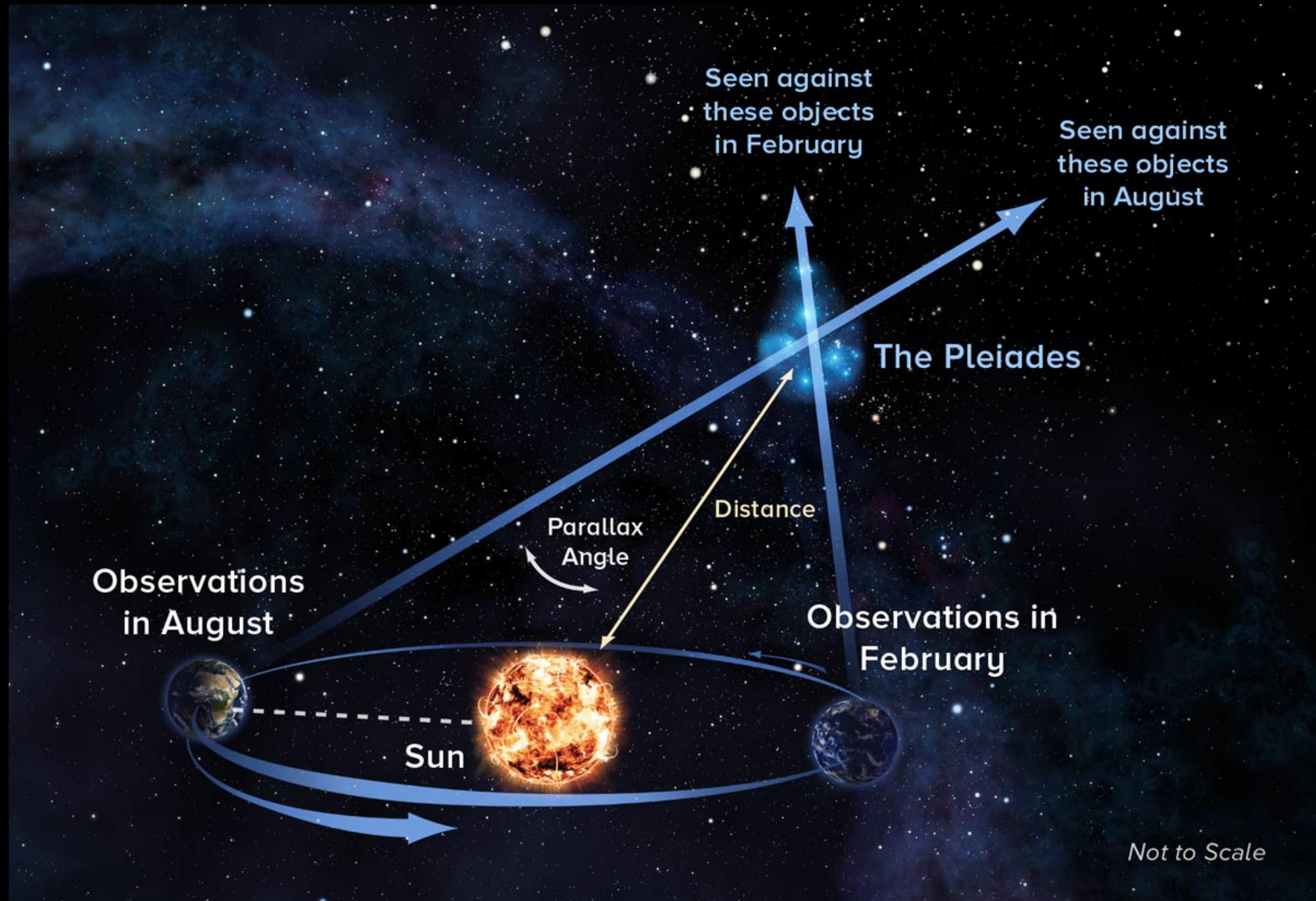
Kredit: SDO/NASA

Kredit: ESA/CESAR

1 satuan astronomi = 149 597 871 km

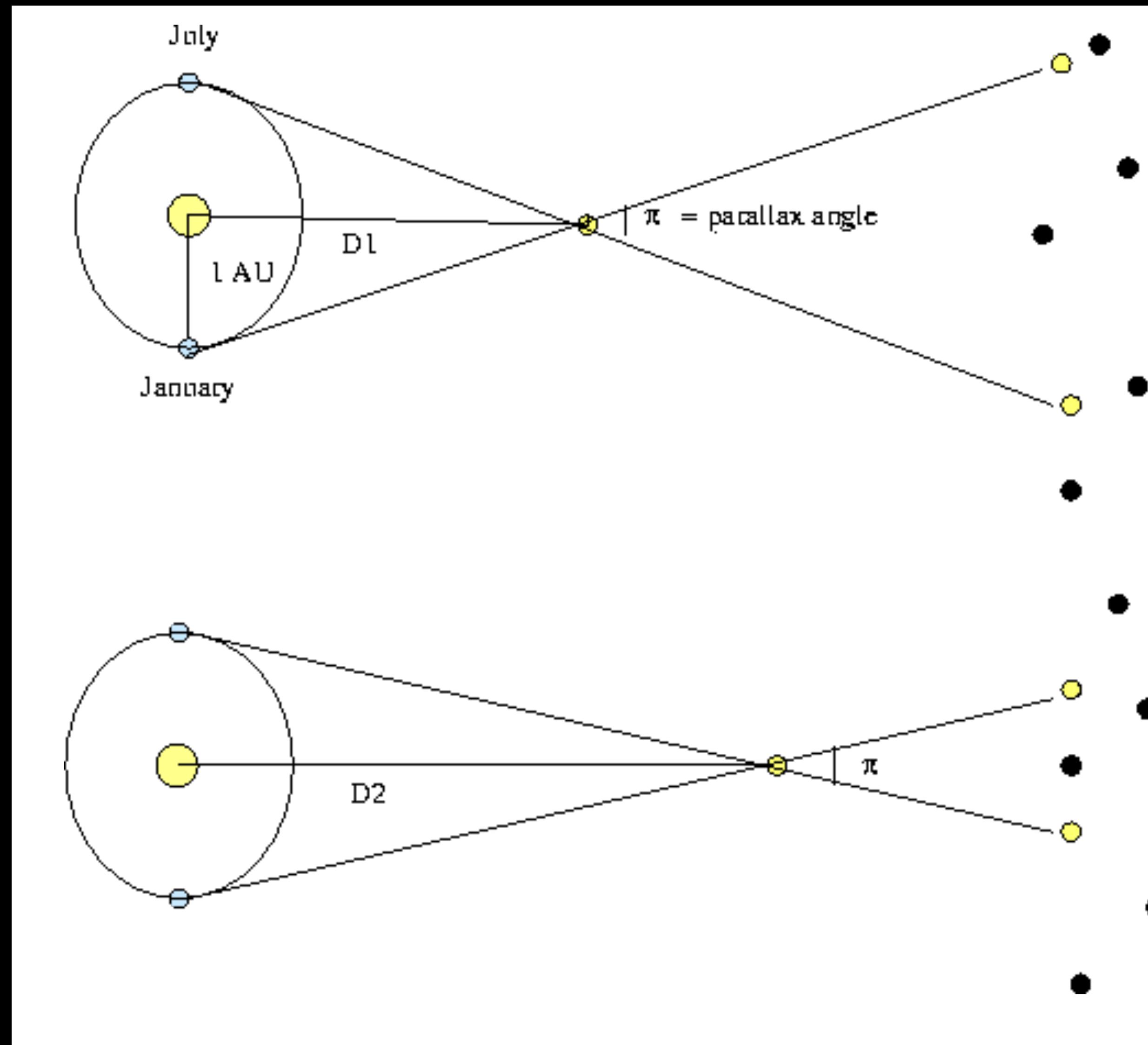
(astronomical unit = au)

Paralaks trigonometri bintang

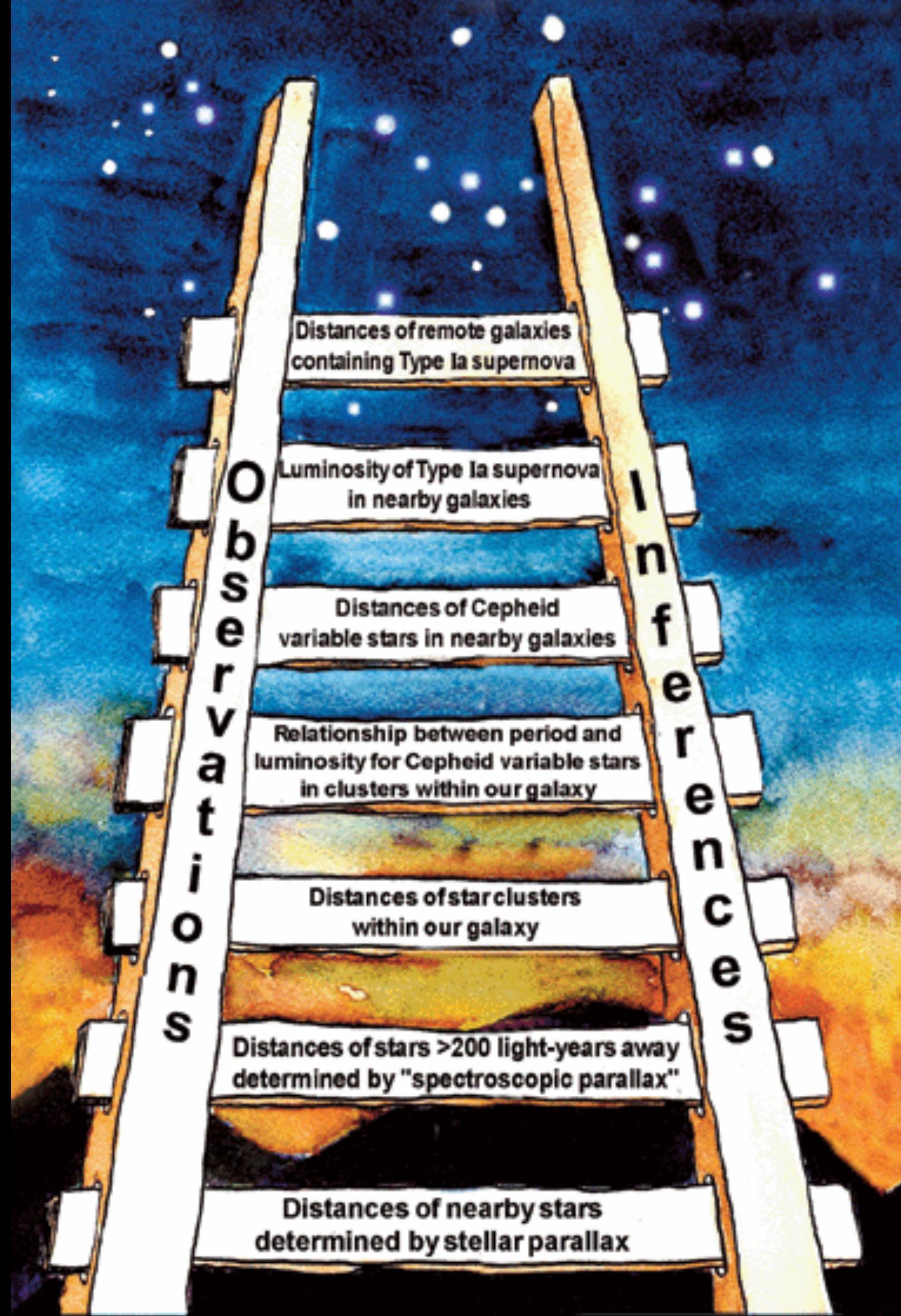


Kredit: Alexandra Angelich, NRAO/AUI/NSF

Limit metode paralaks trigonometri



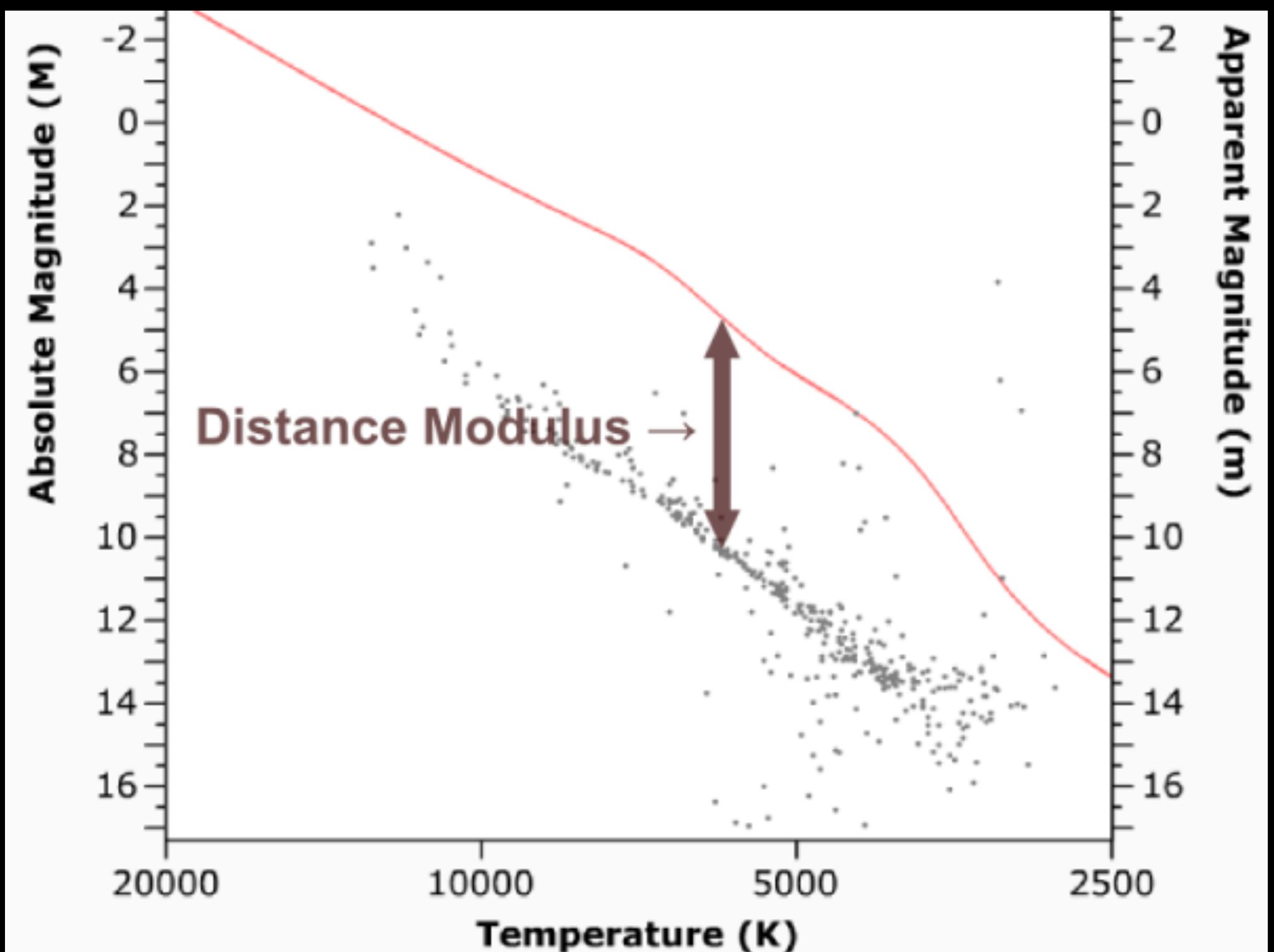
Pijakan tangga jarak pertama



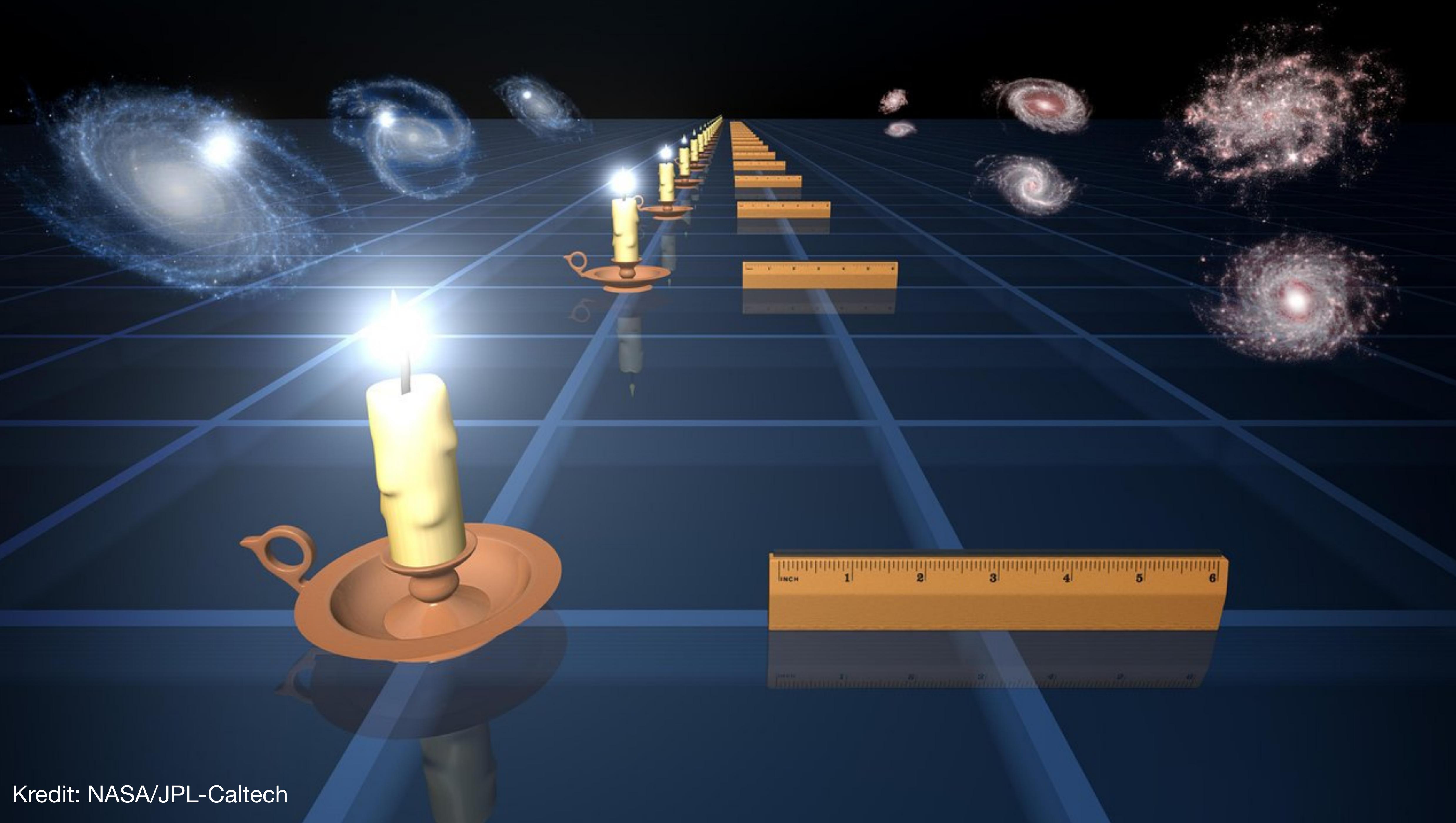
Pijakan tangga jarak berikutnya

Gugus Bola

Fitting Deret utama

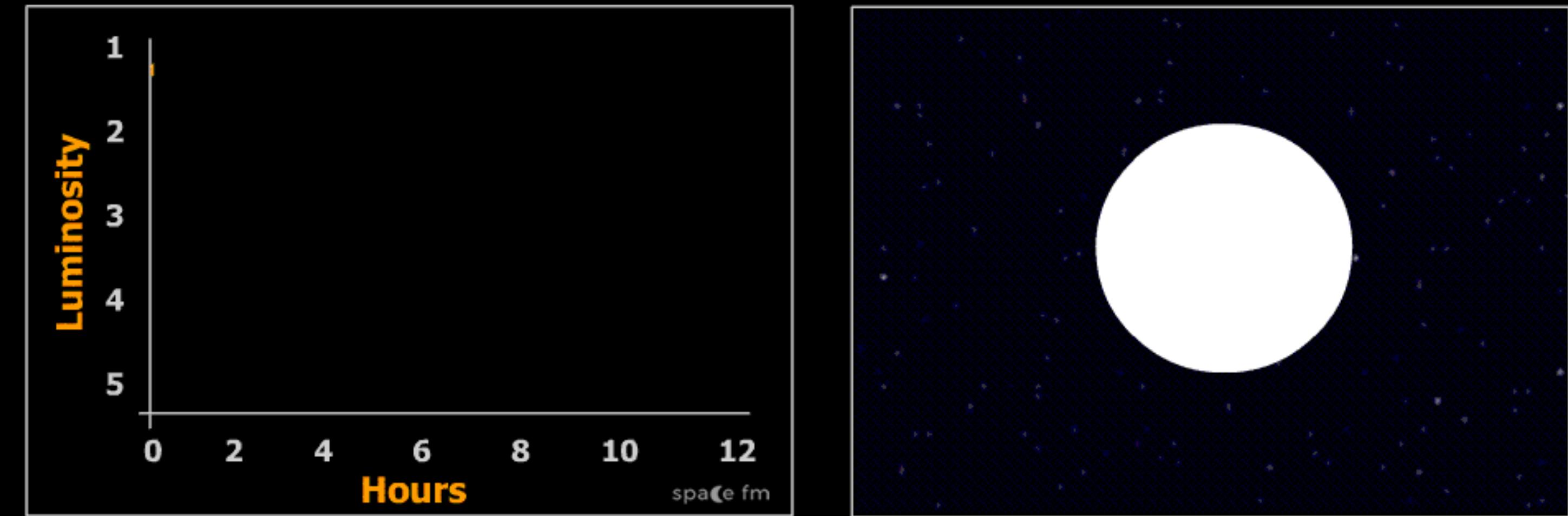
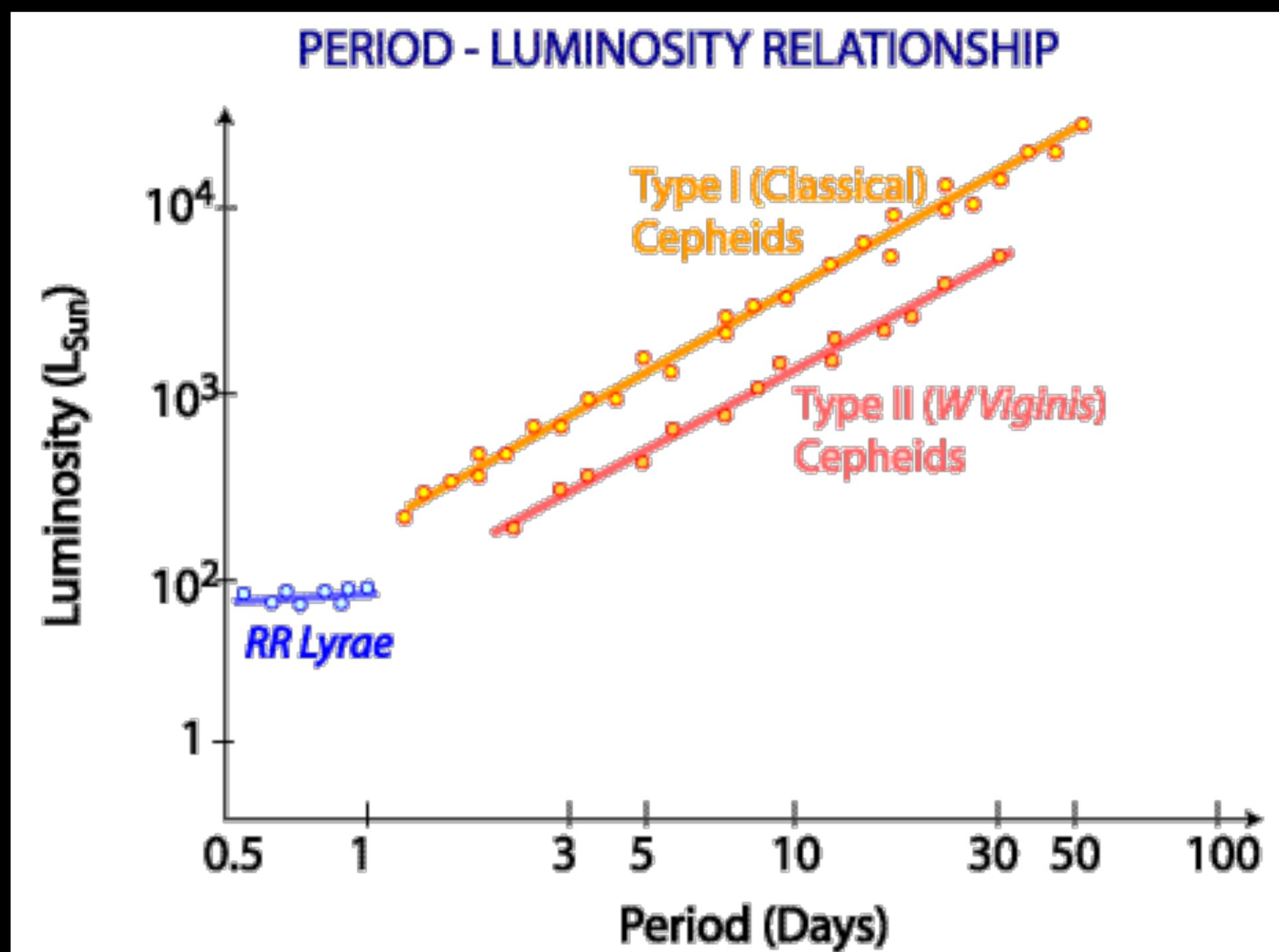


Kredit: M22, Jean-Charles Cuillandre, Hawaiian Starlight, CFHT

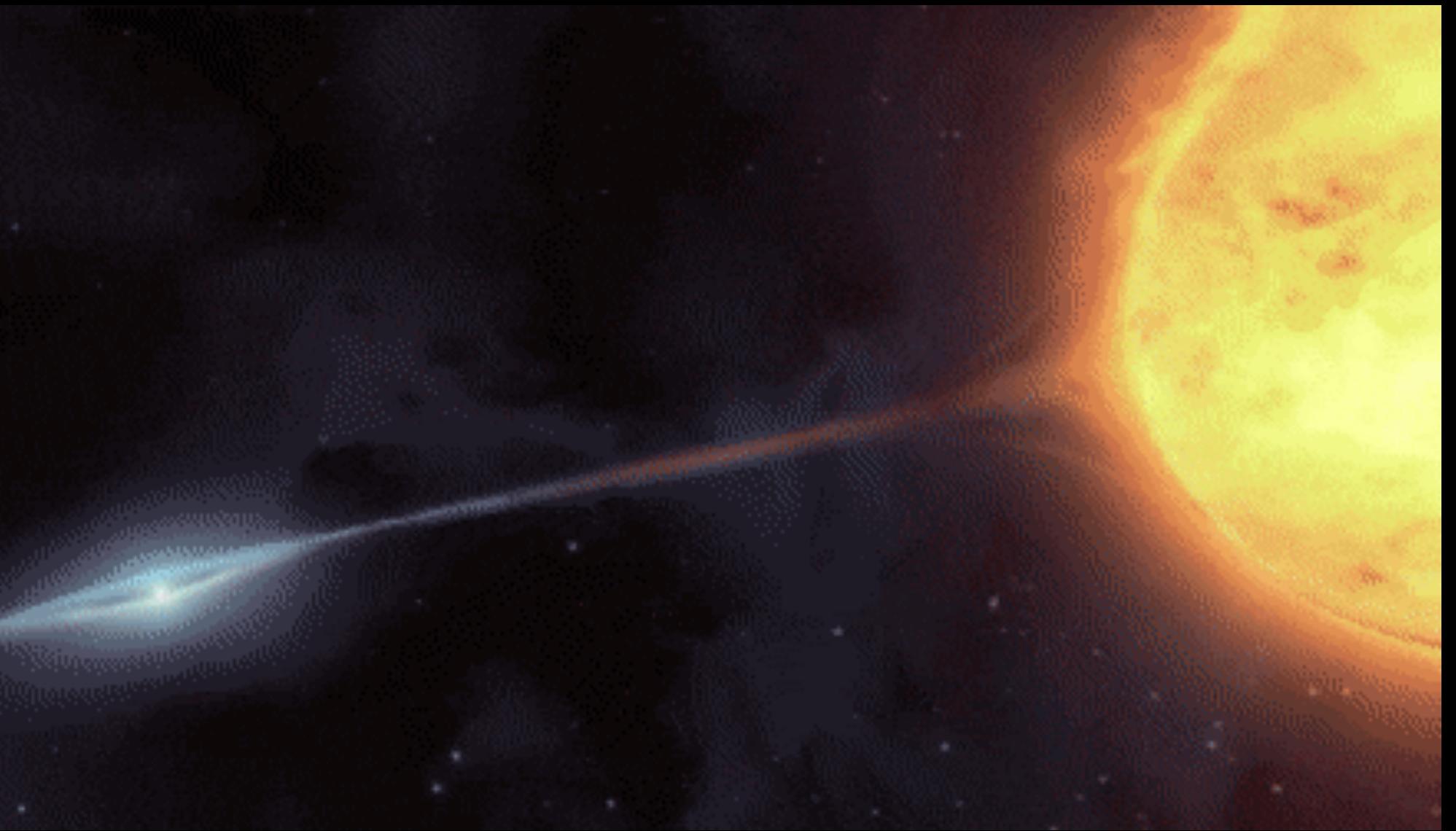
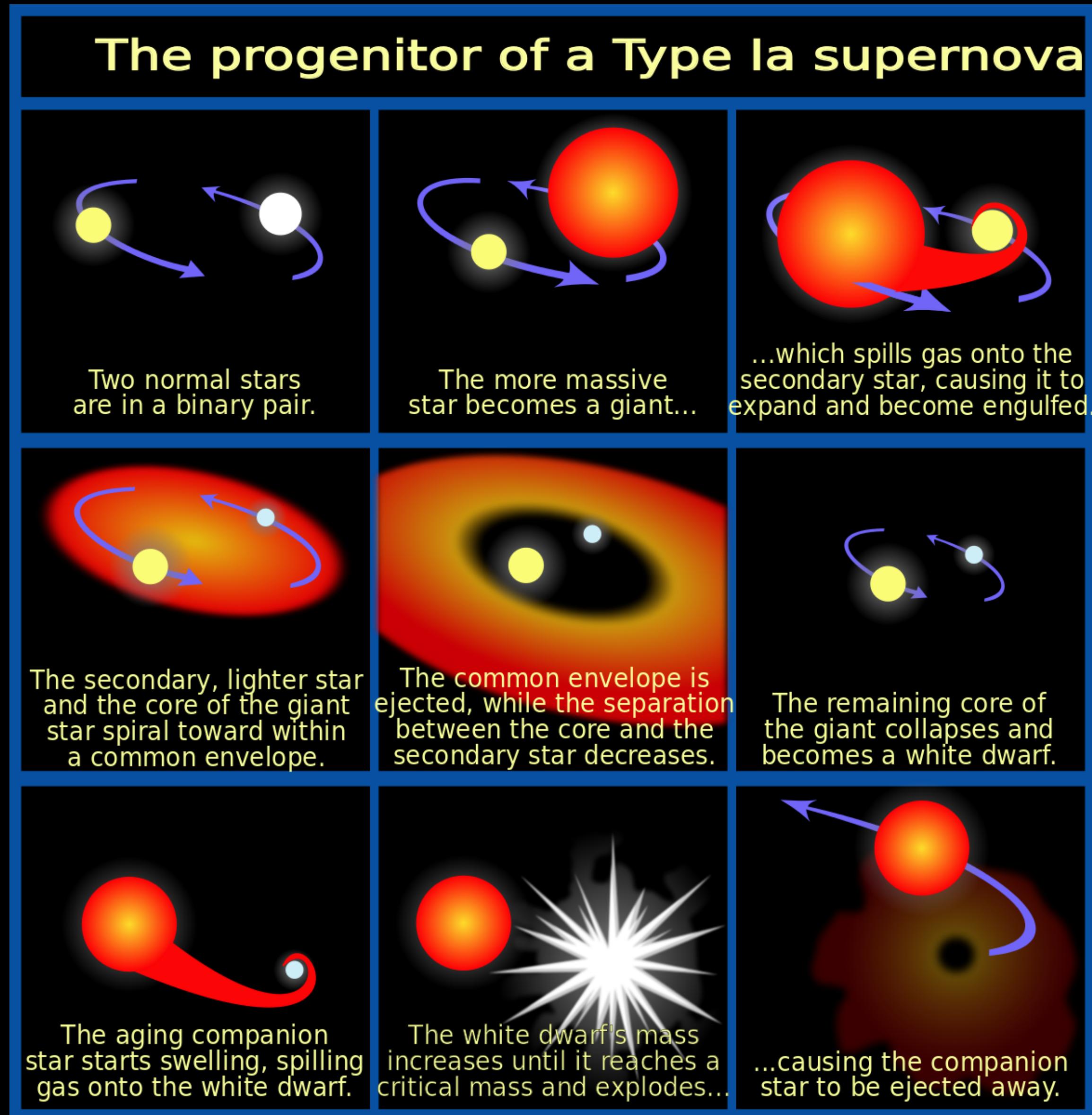


Kredit: NASA/JPL-Caltech

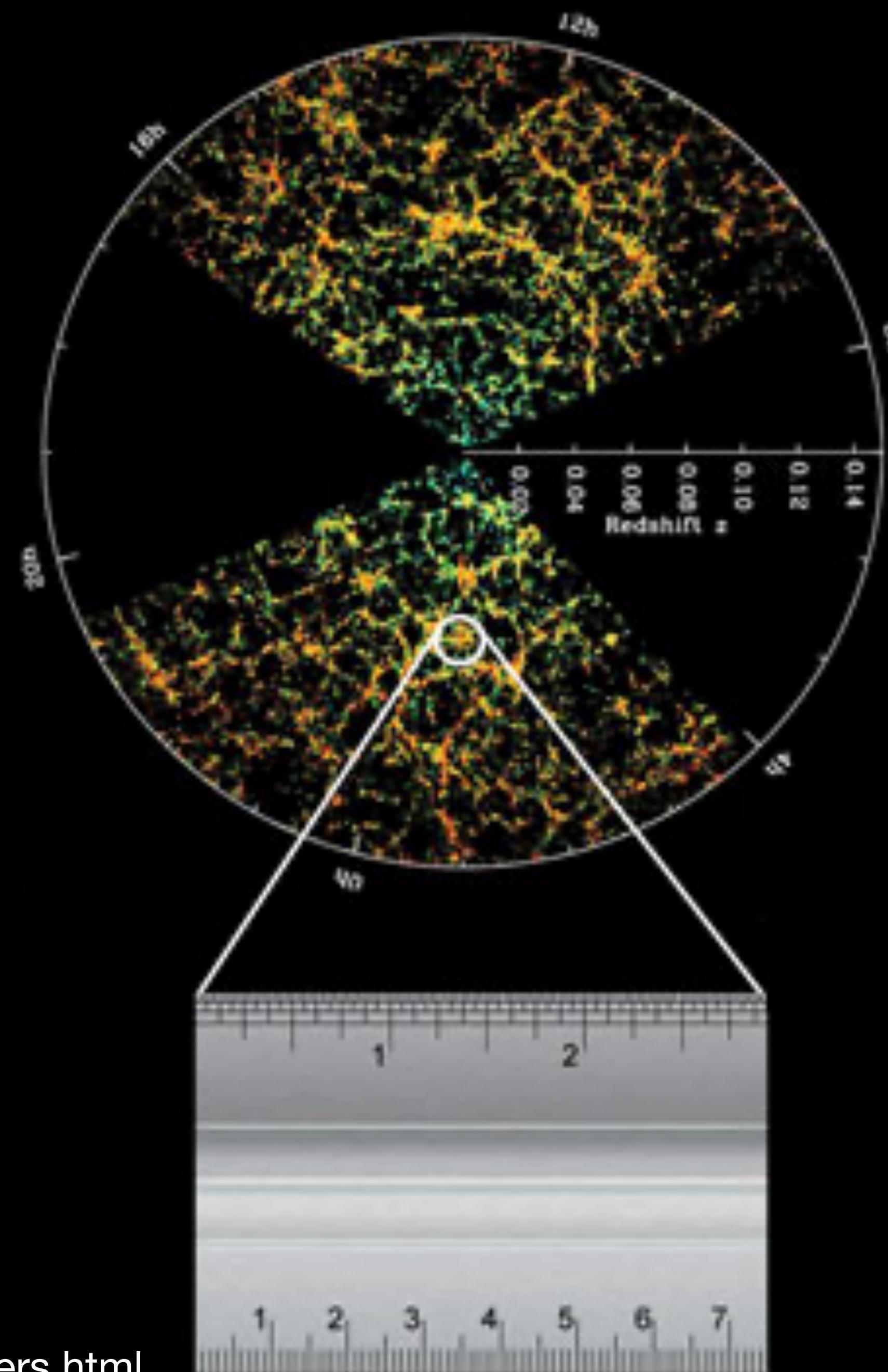
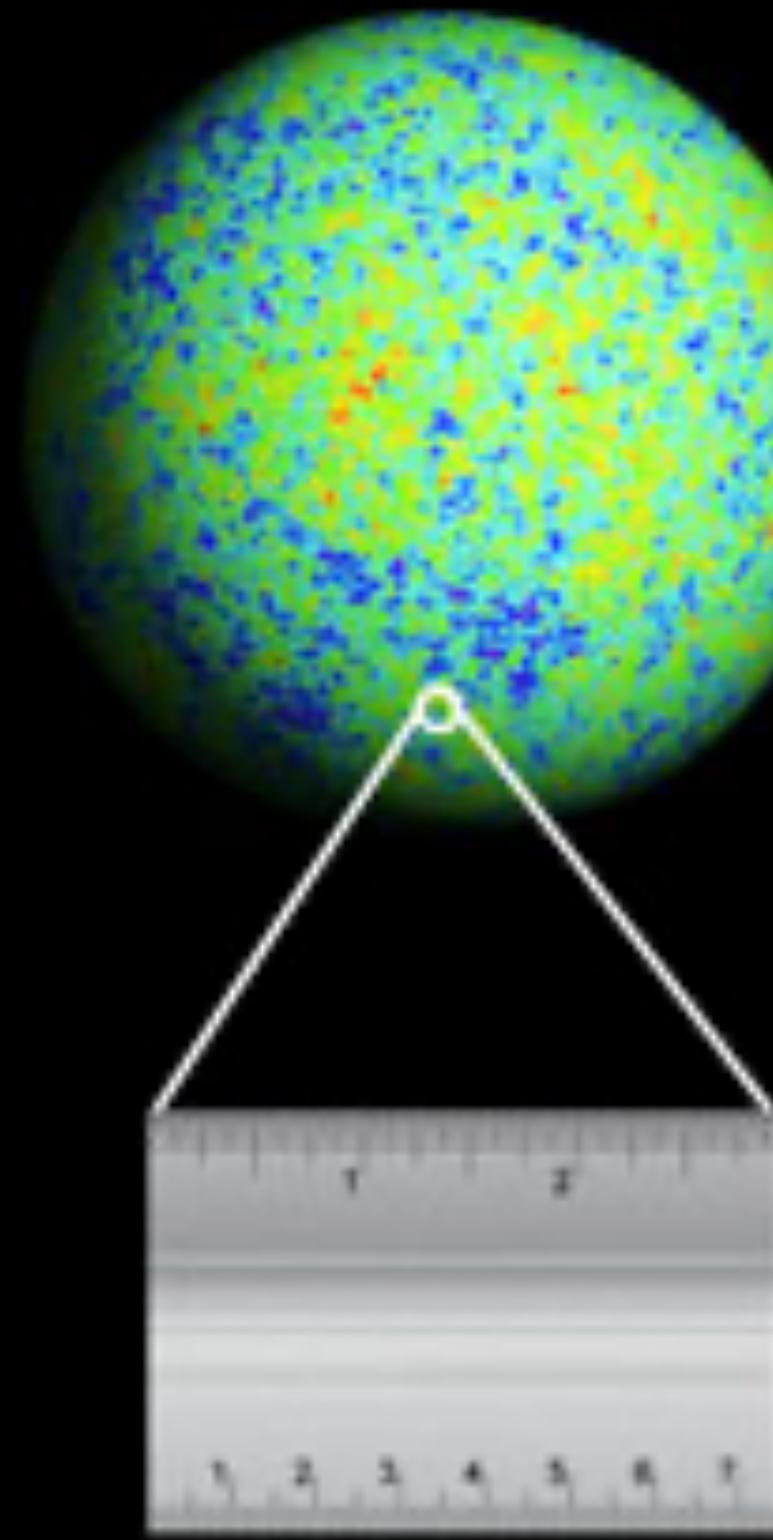
Bintang berdenyut, contoh: Bintang Cepheid



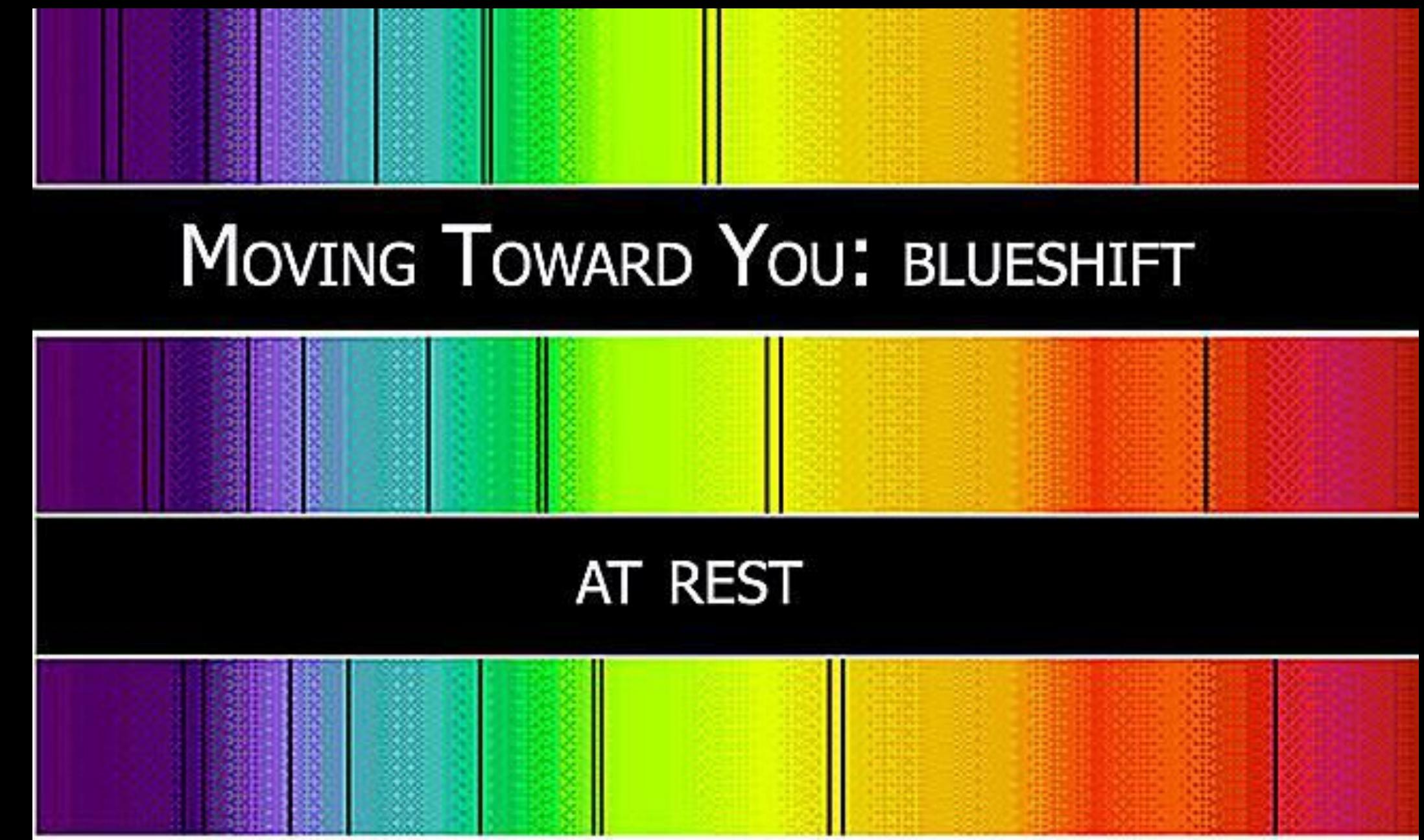
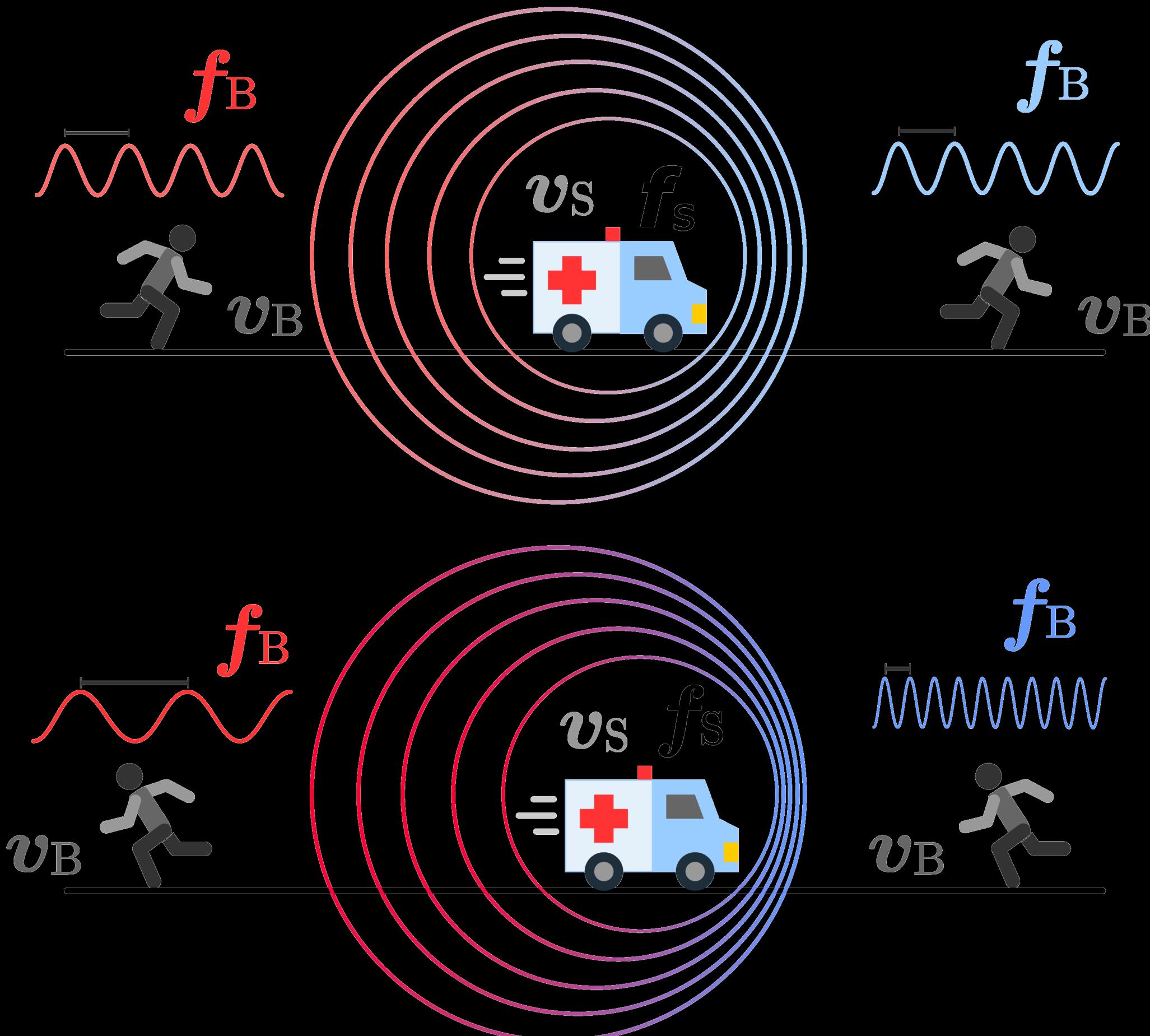
Ledakan bintang, contoh: Supernova tipe Ia



Standard ruler



Pergeseran merah

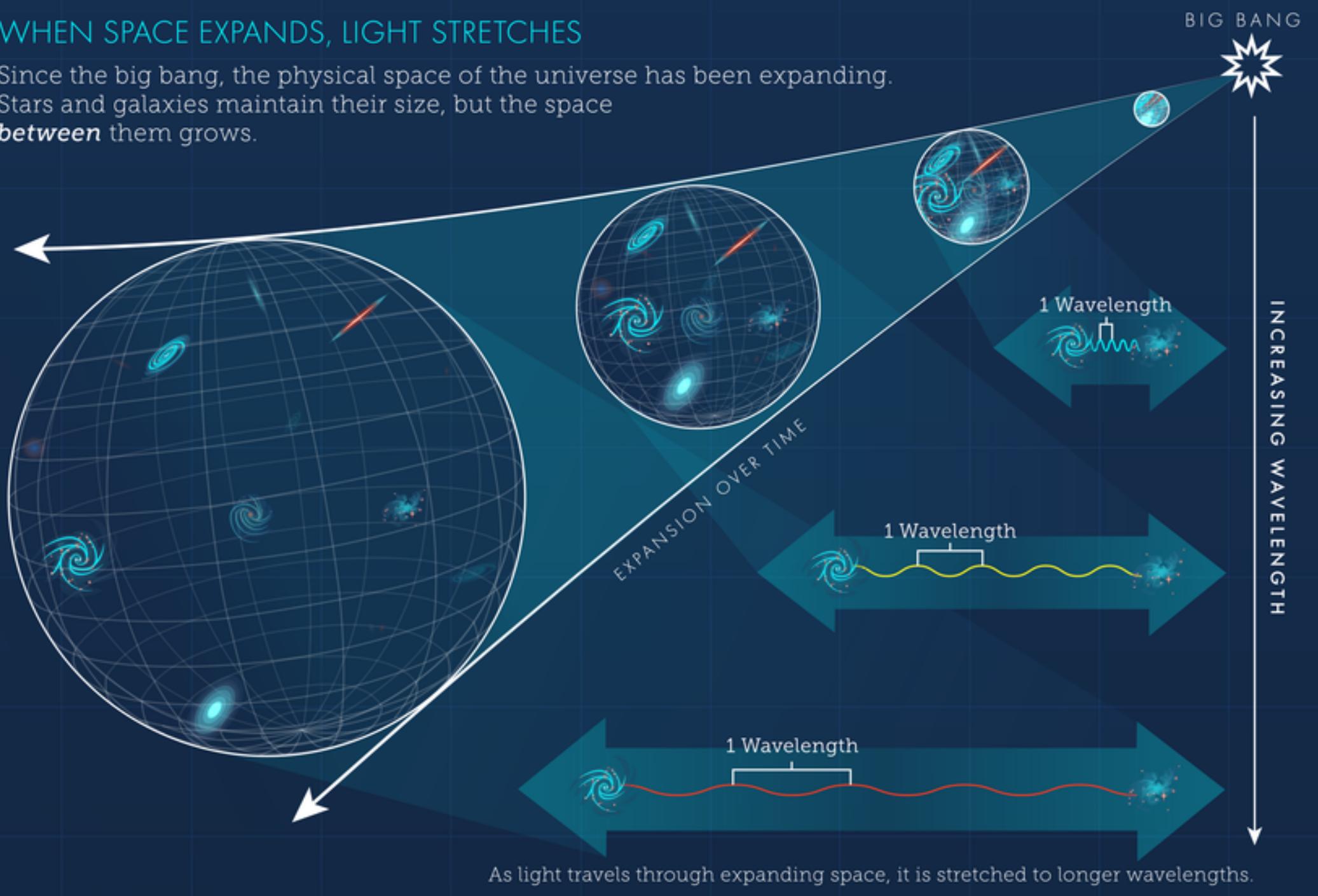


Kredit: Carolyn Collins Petersen

WHAT IS COSMOLOGICAL REDSHIFT?

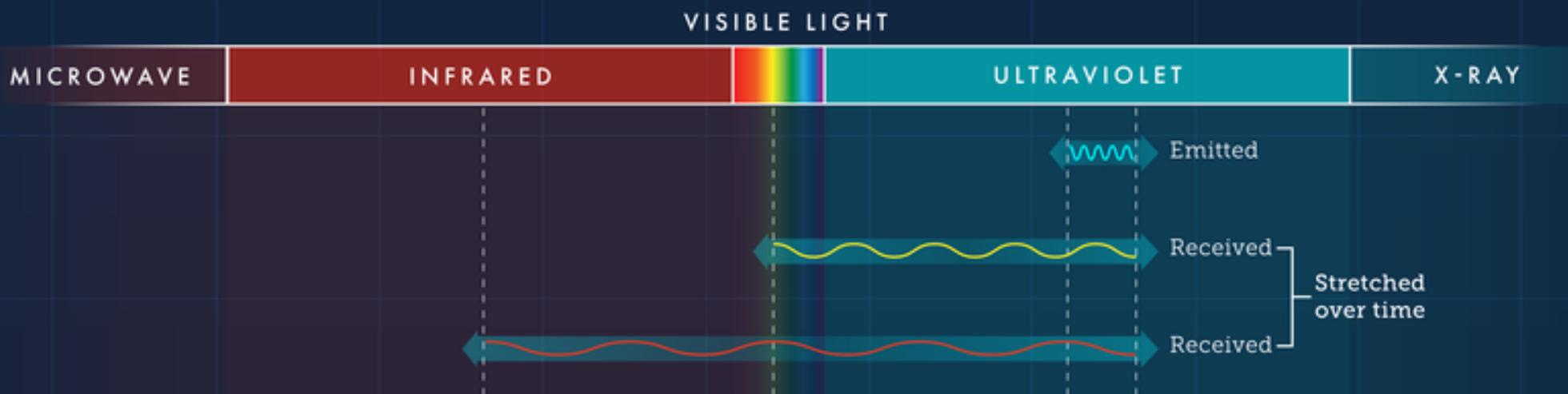
WHEN SPACE EXPANDS, LIGHT STRETCHES

Since the big bang, the physical space of the universe has been expanding. Stars and galaxies maintain their size, but the space **between** them grows.



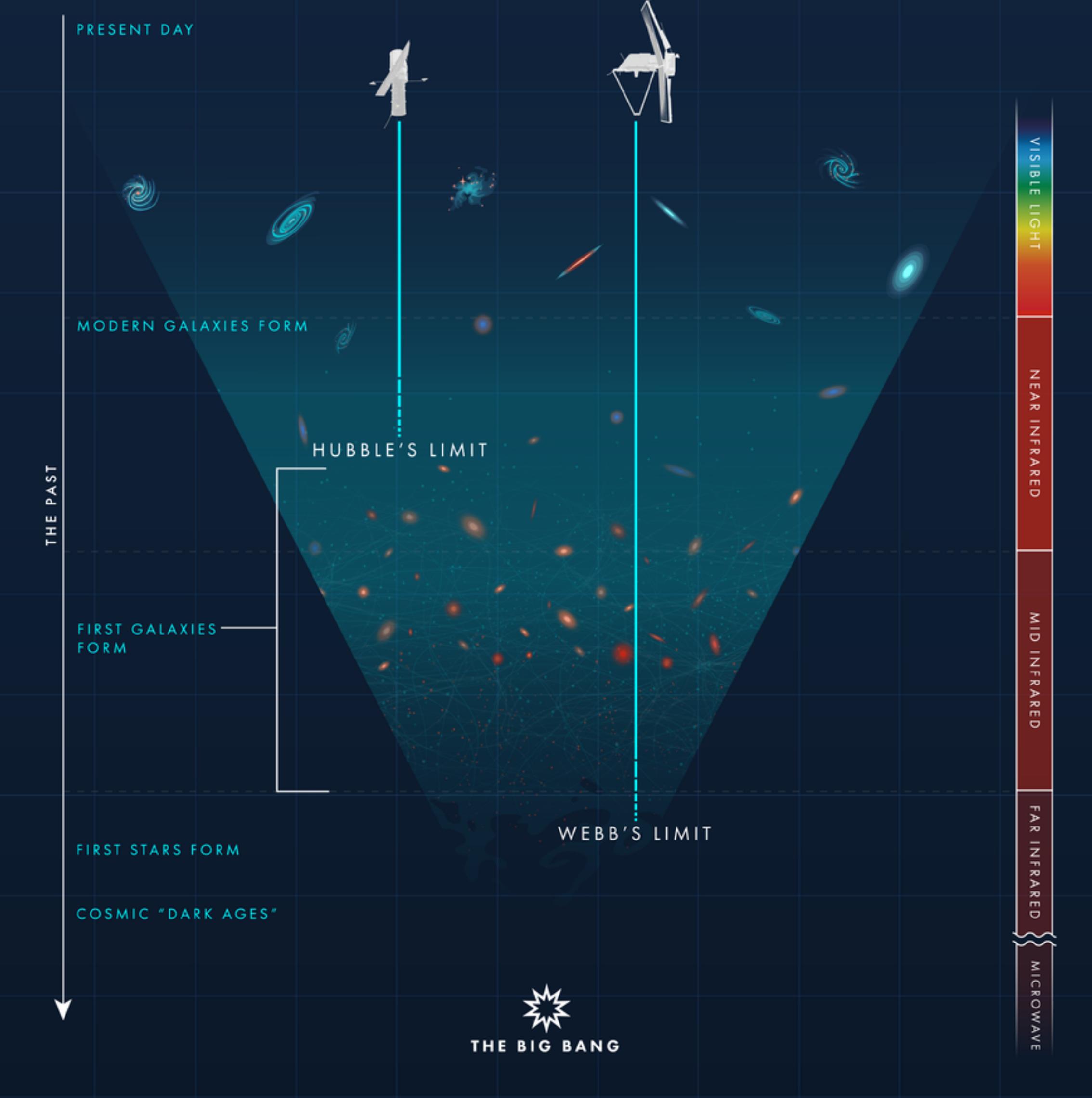
REDDER THAN RED

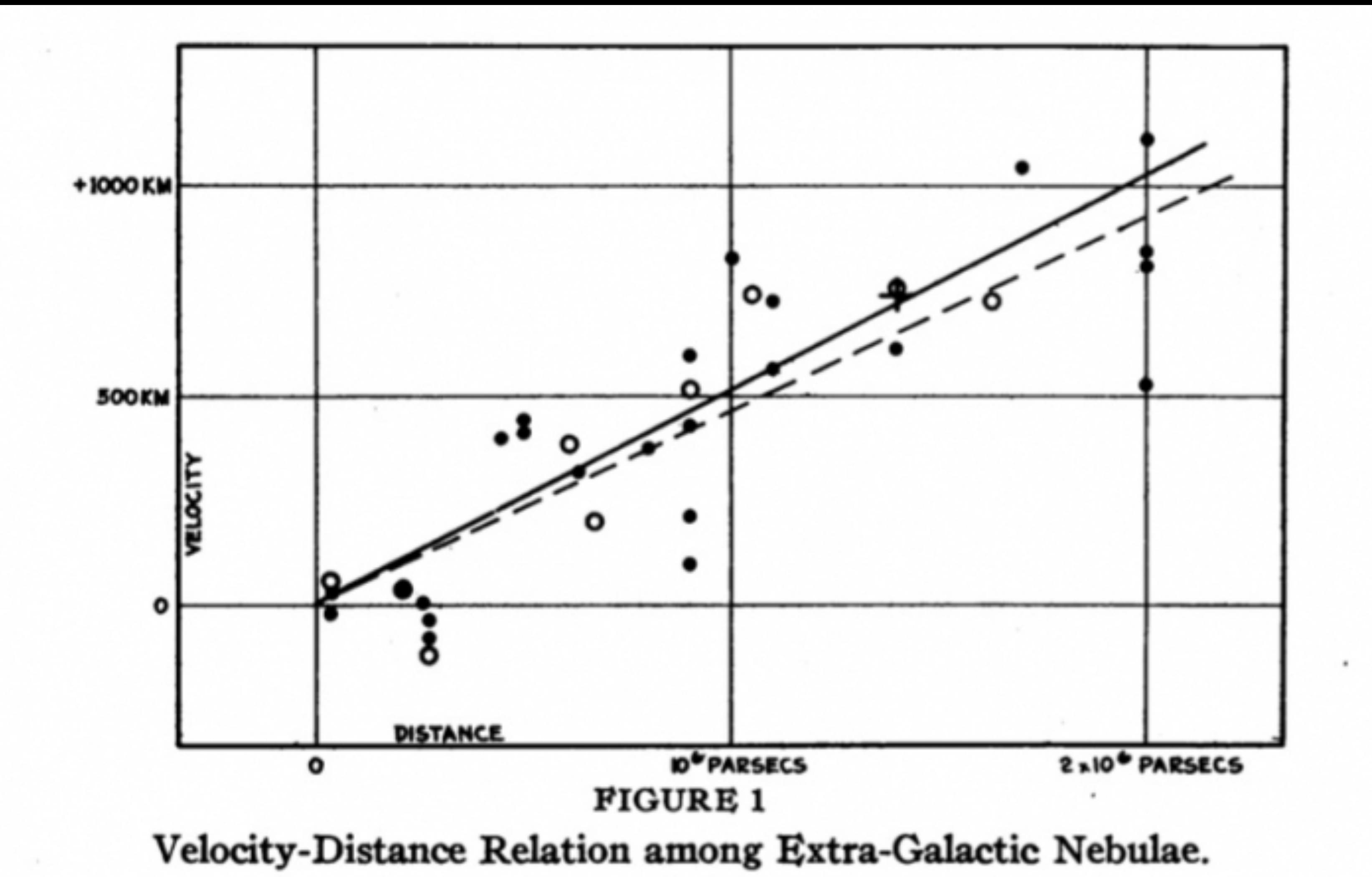
The longest visible wavelength is red. Beyond red are longer wavelengths that we can't see, starting with infrared. When light is stretched by the expansion of space, we say that it is **redshifted**—from its original wavelength to a longer, redder one.



SEEING THE PAST

Telescopes with **infrared** detectors allow us to see the ancient light of the first galaxies, which has been redshifted over space and time.

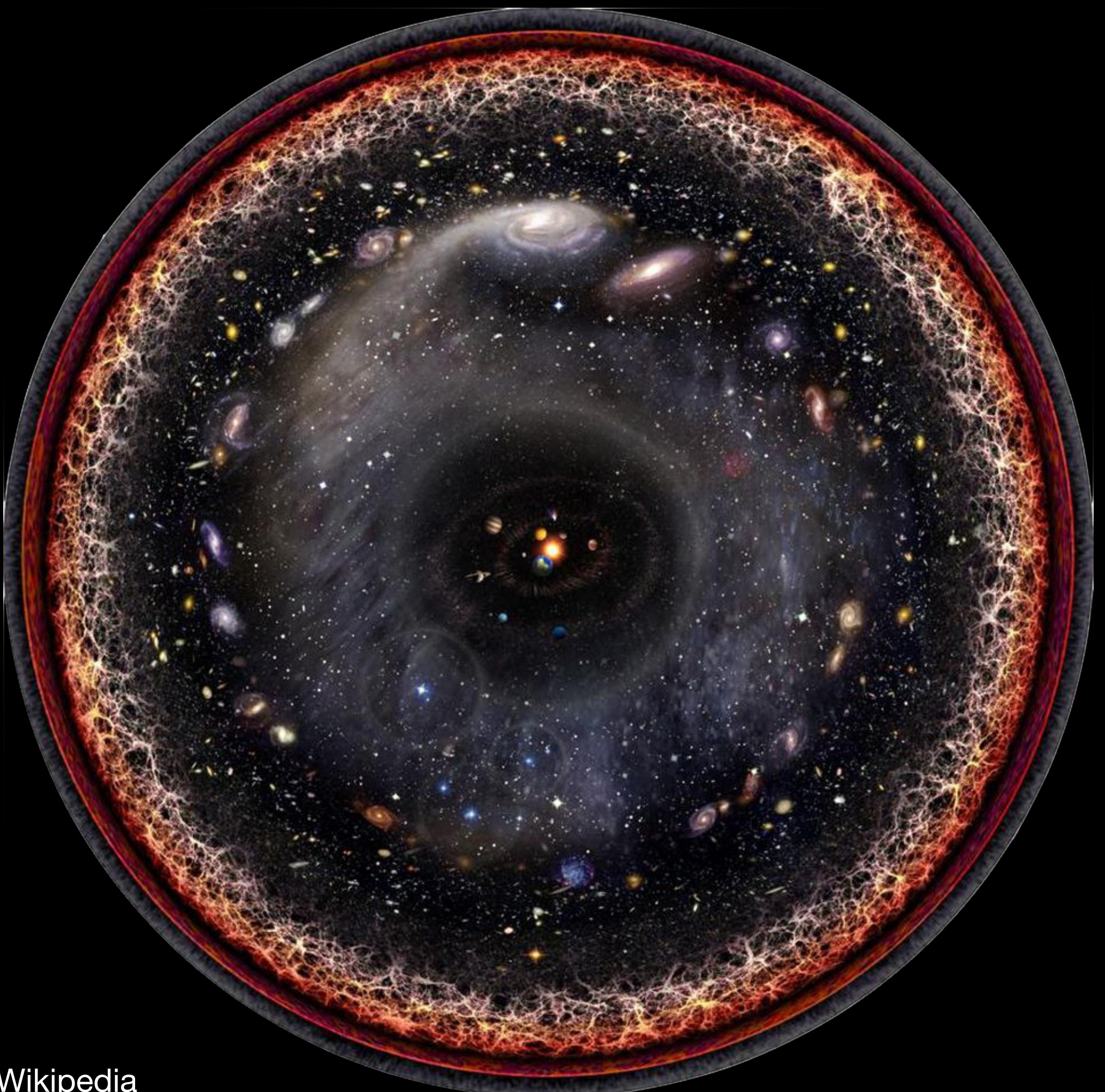




Cosmic Microwave Background



Kredit: WMAP



Kredit: Pablo Carlos Budassi, Wikipedia

Terima Kasih