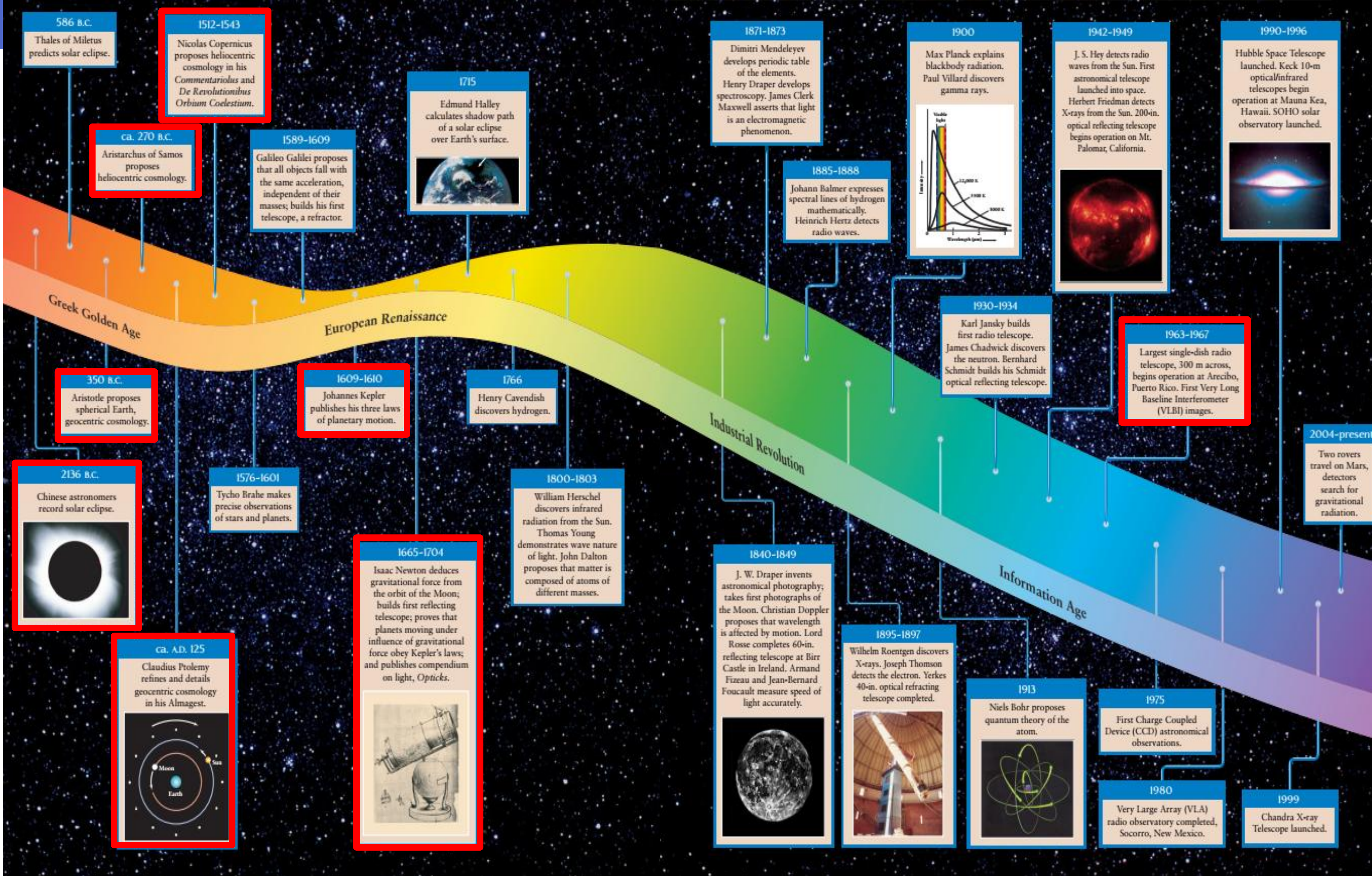
ASTRONOMÍA

Conceptos, avances y más…

Astronomía

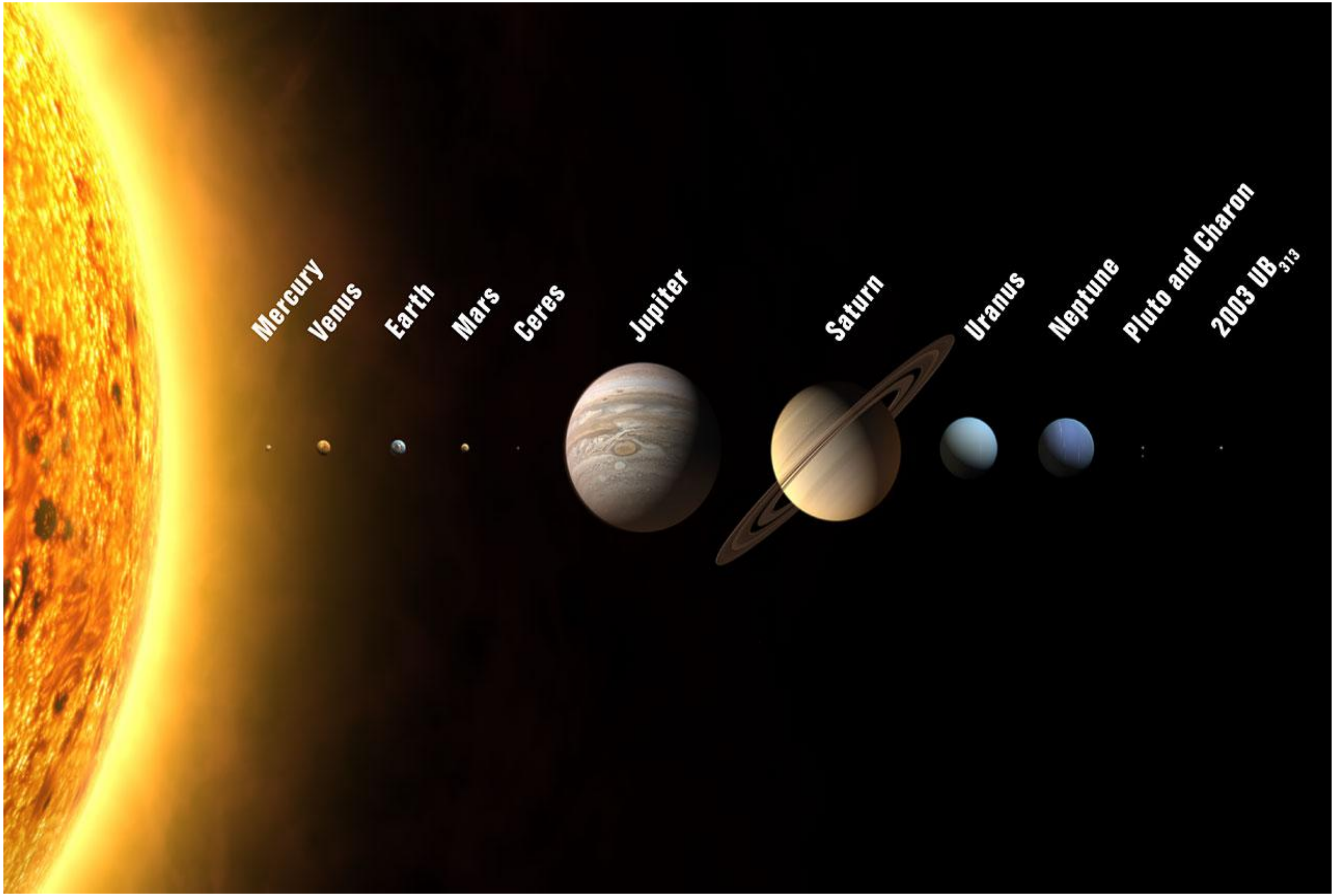
- Estudia el universo en su conjunto. Busca explicar el universo (composición, estructura, origen, evolución, etc.) basándose en conocimientos de matemática y de las leyes físicas y químicas.(1)
- Tiene por objetos de estudio, aquellos cuerpos que se observan en el cielo (cuerpos celestes).(1)
- Composición y comportamiento de los átomos, naturaleza y propiedades de la luz, respuesta de la materia y la energía a la fuerza de gravedad, generación de energía por fusión de partículas, la capacidad del carbón como base de la vida.(2)

(1) Barbosa, J. G. P. (2012). *Elementos de astronomía de posición*. Universidad Nacional de Colombia.
(2) Karttunen, H., Kröger, P., Oja, H., Poutanen, M., & Donner, K. J. (Eds.). (2007). Fundamental astronomy (Vol. 4). Berlin: Springer.



(4) Comins, N. F., & Kaufmann, W. J. (2000). Discovering the universe. *Discovering the universe. New York: WH Freeman, c2000.*

Astronomía



Planetas y planetas enanos[5]:

Mercurio

Venus

Tierra

Marte

Ceres

Júpiter

Saturno

Neptuno

Pluto

Eris (2003 UB_{313})

(5) https://www.iau.org

Astronomía

Velocidad de la Luz[4]:

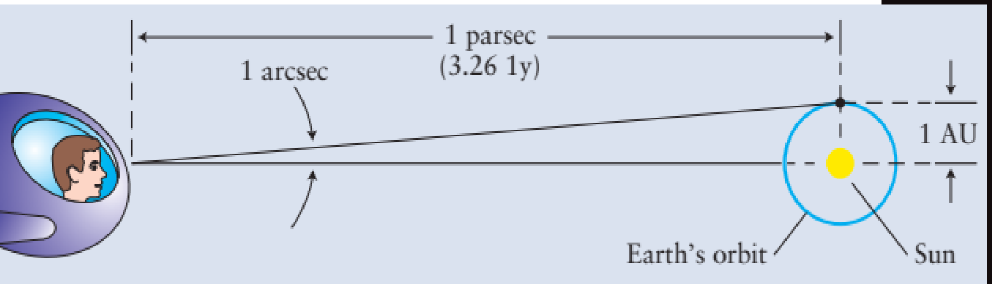
299792.458 km/seg

Tiempo de viaje de la luz solar a la Tierra[4]:

8m 17seg.

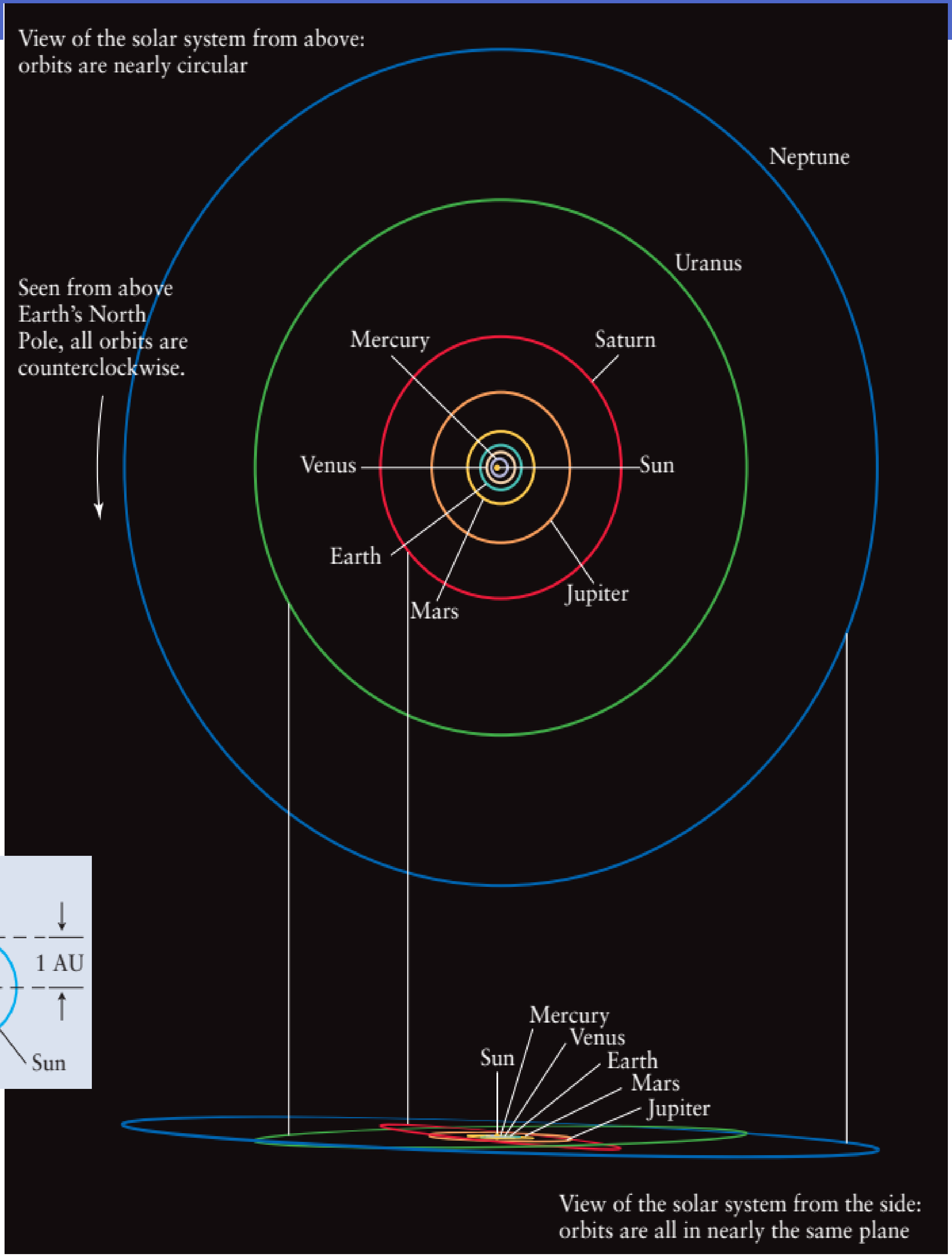
Tiempo de viaje de la luz en 1 parsec[4]:

3.26 años



1 AU[4]:

149597870.691 km



Planetas y planetas enanos[5]:

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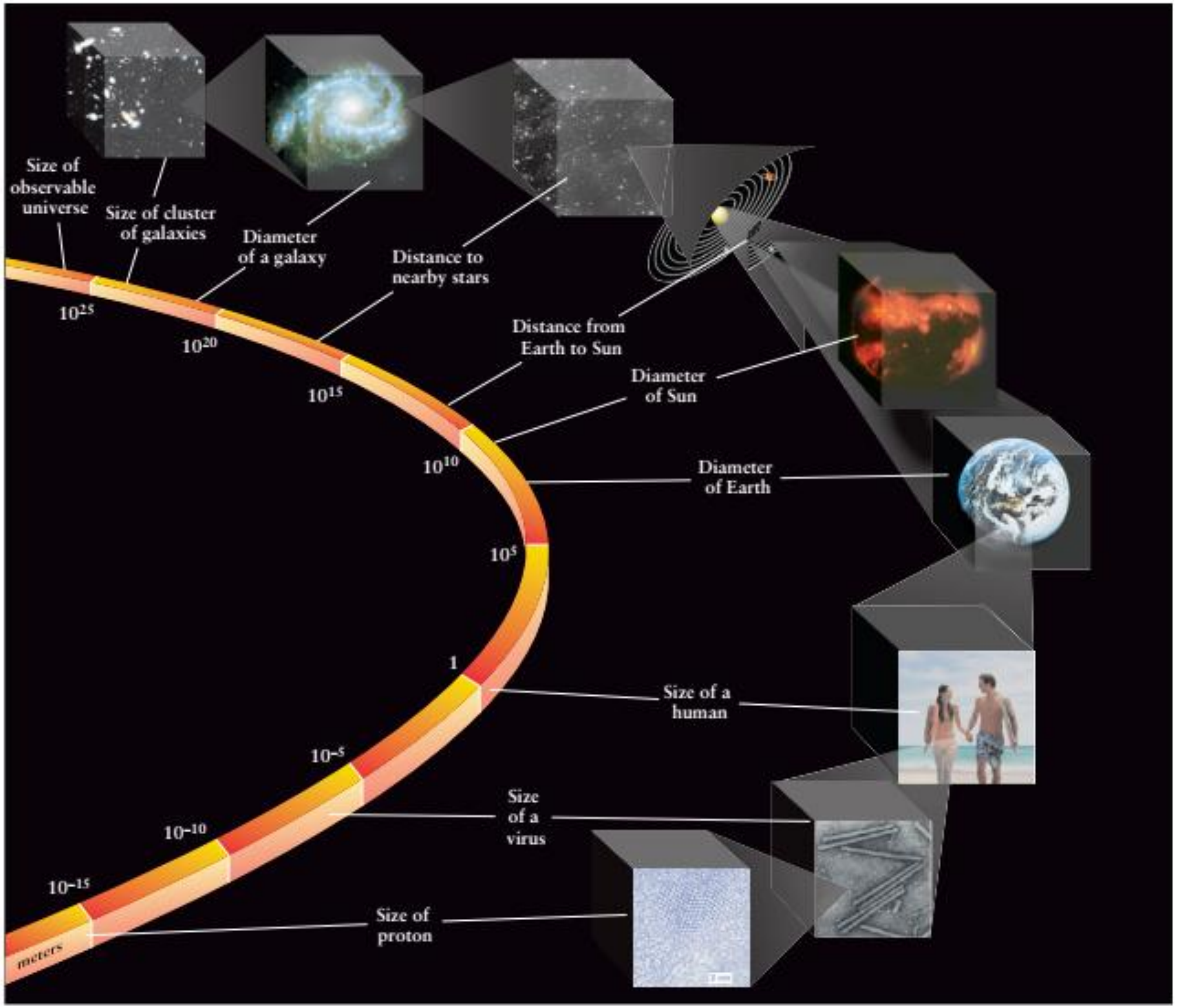
Astronomía



(4) Comins, N. F., & Kaufmann, W. J. (2000). Discovering the universe. *Discovering the universe. New York: WH Freeman, c2000.*

(5) https://www.iau.org

JOURNEY INTO THE
UNIVERSE
THROUGH TIME AND SPACE

"My suspicion is that the universe is not only queerer than we suppose, but queerer than we can suppose." J.B.S. HALDANE

WHEN PRIMITIVE MAN gazed at the void of heaven, his eye discerned at most a few thousand stars—a serene and limited universe. But now, far beyond the range of feeble sight, out on the limitless curve of space and time, science has revealed a universe of unimaginable size and inconceivable violence. Billions upon billions of stars—like our sun—burn with the energy of a thermonuclear furnace. Many die in explosions that litter the reaches of space with gas and dust from which new stars and planets are born.

And from the vastness beyond the congregations of stars comes the murmur, in microwaves, of the most cataclysmic event of all—the big bang of creation.

When time began—perhaps as long as twenty billion years ago—all mass and energy were compressed almost to infinite density and heated to trillions upon trillions of degrees. A cosmic explosion rent that featureless mass, creating a rapidly expanding fireball. It has been cooling and slowing ever since.

At first the universe was an impenetrable haze. During the first million years, temperatures dropped to 3000 kelvins (3000 degrees above absolute zero). Nuclei captured electrons, producing atoms that formed an unsettled gas of hydrogen and some helium. The universe cleared and everywhere blazed with light. Denser regions of gas, pulled together by their own gravity, resolved into stars collected in aggregations called galaxies. Today's universe continues to expand. The early radiation, cooled by the expansion to 3K, can be detected in every direction by radio telescopes—the remnant echo of the big bang.

But what came before the big bang, and how will it all end? Billions of years hence, will gravity overcome the expansion and pull all matter back into its primordial state—in a big crunch? And if the universe is closed, might another big bang follow, with another expansion? Or, as many astronomers now believe, will an ever expanding, or open, universe end in a whimper, its galaxies scattered irretrievably, their star fires spent and cold? For now, the questions are the domain of the philosopher as well as the astronomer.

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RICHARD J. DARLEY, SENIOR ASSOCIATE CHIEF
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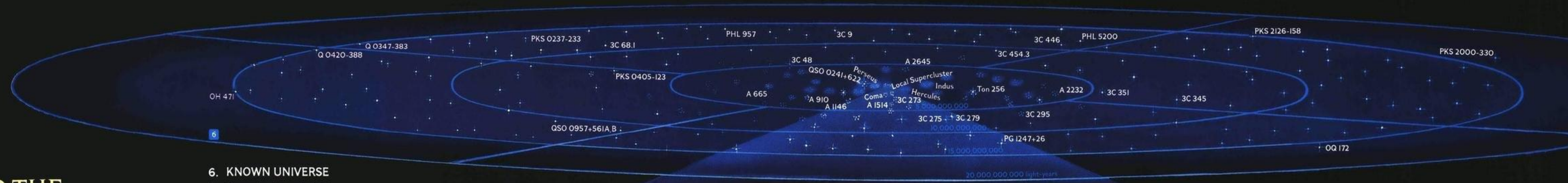
Principal Consultants: George O. Abell, Herbert Friedman



6. KNOWN UNIVERSE

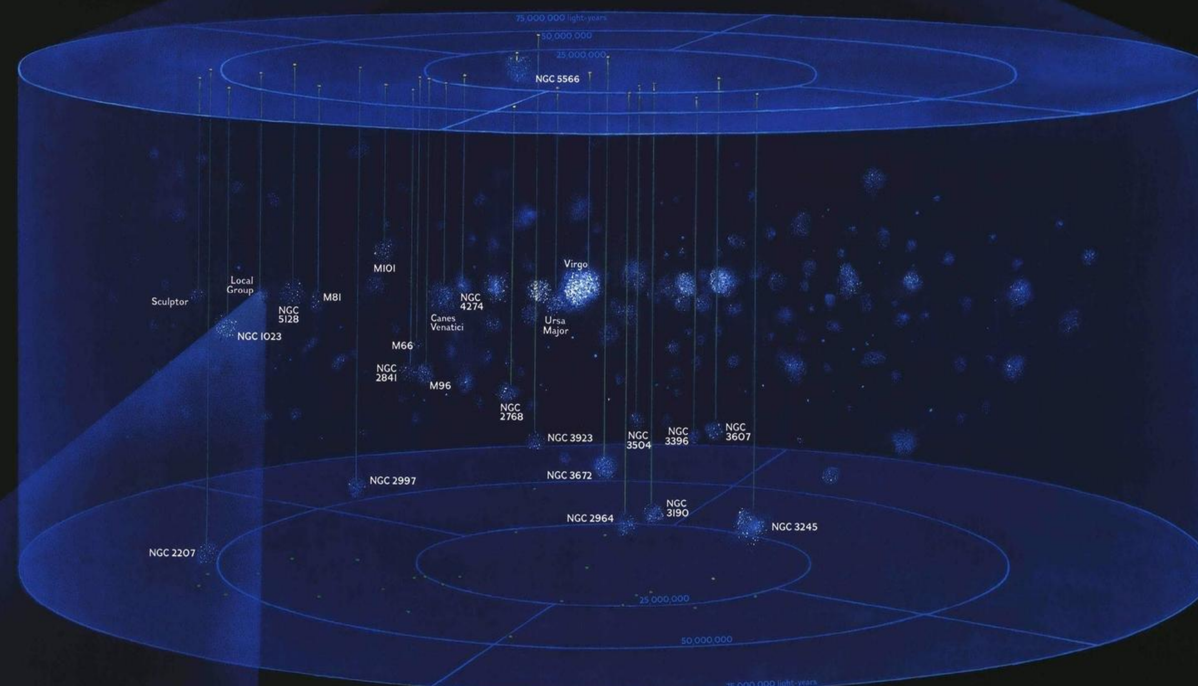
In whatever direction we look into deep space, we can detect clusters of galaxies and superclusters, all moving away from us. Toward the observable horizon, we see quasars—quasi-stellar objects—and the uniform glow of radiation from the big bang. There is no center; any observer anywhere would see this same effect. The universe is isotropic; that is, it looks the same in every direction.

Quasars, the most distant objects yet observed, are among the most curious and the most energetic. Each of the brightest quasars emits the energy of hundreds of galaxies from a volume far smaller than our Milky Way; each is probably the violent nucleus of a distant galaxy. The farthest quasars are rushing away from us at more than 90 percent the speed of light. Their light traveled billions of years to reach us. During that time they evolved, and what they are like today we have no way of knowing. To look at such objects is to see the universe as it was billions of years ago.

Superclusters
Clusters of Galaxies
Quasars

Cylinders (1 through 5), with grids measured in light-years, show increasingly large volumes of space. The grids help calculate the distance of celestial objects from an imaginary center, not from each other, while green drop lines help locate the relative positions of objects within the cylinders. The known universe (6) is projected on a flat disk with a radius of 20 billion light-years.

Letters and numbers refer to catalog listings, such as A 1514 in the Abell catalog of rich clusters. M stands for Messier, and NGC for New General Catalogue.



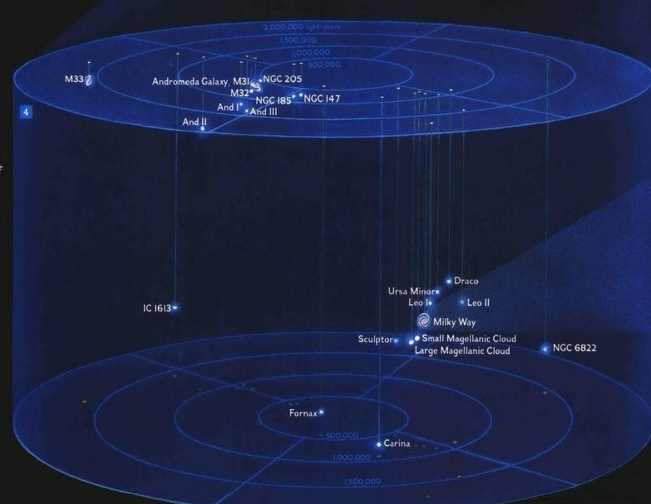
5. LOCAL SUPERCLUSTER

Clusters of galaxies—like fleets of ships—congregate in superclusters, the largest of celestial formations. Virgo, the closest rich cluster to our Local Group, is some 50 million light-years away, near the center of our local supercluster. It is considered rich because it has thousands of member galaxies.

Exciting new observations of superclusters have shown enormous volumes of relatively empty space, or voids, between superclusters. Some cosmologists speculate that the universe resembles a sponge in which the superclusters are interconnected, resembling thin filaments stretching between giant voids.

Astronomers calculate the masses of rich clusters as one way to estimate the density of matter in the universe. If that density is at or below a critical number, matter will fly apart forever in the expansion initiated by the big bang. If the density is greater, gravitational braking will slow the motion until the universe falls back together.

Clusters of Galaxies
Single Galaxies



4. LOCAL GROUP

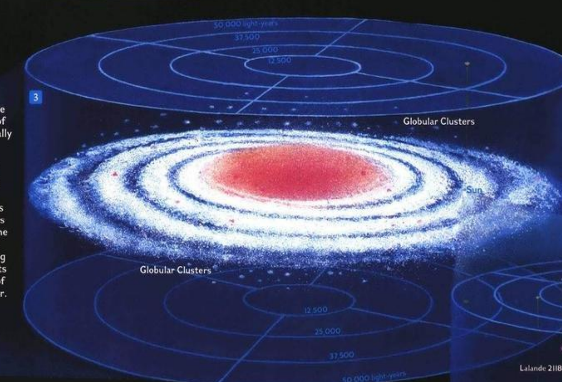
Beyond the Milky Way we have located galaxies in every direction. Our own is part of a loosely bound cluster of some 20 galaxies, called prosaically the Local Group. "Galaxies are to astronomy what atoms are to physics," astronomer Allan Sandage has said, and this group illustrates the variations.

The Milky Way, its sister Andromeda (M31), and the smaller M33 are fast-rotating spirals. Hundreds of star clusters and dust clouds lie within the Andromeda galaxy, itself once mistakenly identified as a nebula, or cloud, in the Milky Way galaxy.

NGC 205 is an elliptical galaxy, consisting mainly of old stars. The Large and Small Magellanic Clouds are irregular galaxies, described as haze in the southern sky by Magellan's crew in 1520. These member galaxies, all moving in random paths, are held together by gravity, even as the universe expands.

3. MILKY WAY GALAXY

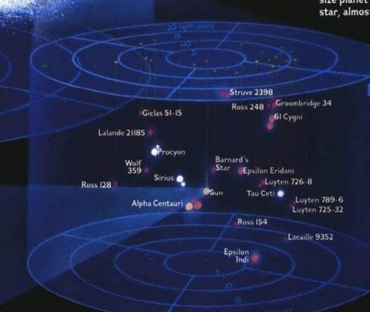
Our galaxy was thought to be the entire universe until discoveries in the 1920s. Today we know it is only one of billions of galaxies. It is a gravitationally bound, rotating congregation of hundreds of billions of stars. The central bulge glows with the light of older, redder stars. Globular clusters contain the galaxy's oldest stars—estimated at 10 to 15 billion years. Gas and dust condensing in the spiral arms are even now forming new stars. In one arm, our sun circles the galaxy center once every 230 million years, traveling at 220 km/sec. New evidence suggests the disk is enveloped by a large halo of very old stars and dark, unseen matter.



2. SUN'S NEIGHBORS

The sun is in universal terms an ordinary yellow star, shown here with its 20 closest neighbors. Distances are given in light-years—how far light travels in one year at almost 300,000 kilometers (186,000 miles) a second. Sunlight, for instance, takes a full 8 minutes to cross the 150 million km to our windows. That same light travels 5 more hours before reaching the planet Pluto. After about 4 years 4 months it touches Alpha Centauri, our nearest stellar neighbor, 4.3 light-years, or 40 trillion km, away.

Alpha Centauri is actually a multiple system with three stars locked by gravity in orbit around each other. Indeed many stars are binary or multiple. Single stars, though, seem more likely to have planetary systems like our own. The Space Telescope to be orbited soon would detect any Jupiter-size planet associated with Barnard's star, almost 6 light-years away.



APPARENT MAGNITUDE

- -26.8 (the sun) to +6, visible to the unaided eye.
- +6 to +10, visible with binoculars or a small telescope.
- +10 to+15, most are visible with a 20cm (8in) telescope.

Colors of stars indicate their temperatures from red to blue-white, the hottest.

1. SUN AND NEAR PLANETS

A vast cloud of gas and dust collapses some 4.6 billion years ago. Compression spawns a star in the hub of the rotating, disk-shaped mass, and our sun's thermonuclear furnace fires up. Various materials condense from the cooling disk, collide, and coalesce to form the planets and other features of our solar system. The three terrestrial, or earthlike, planets shown here are solid spheres with metallic cores. Earth and Venus possess atmospheres, but only earth's sustains life. When our middle-aged sun exhausts its hydrogen fuel, it will expand, devouring Mercury and Venus and turning the earth into a semimolten inferno.

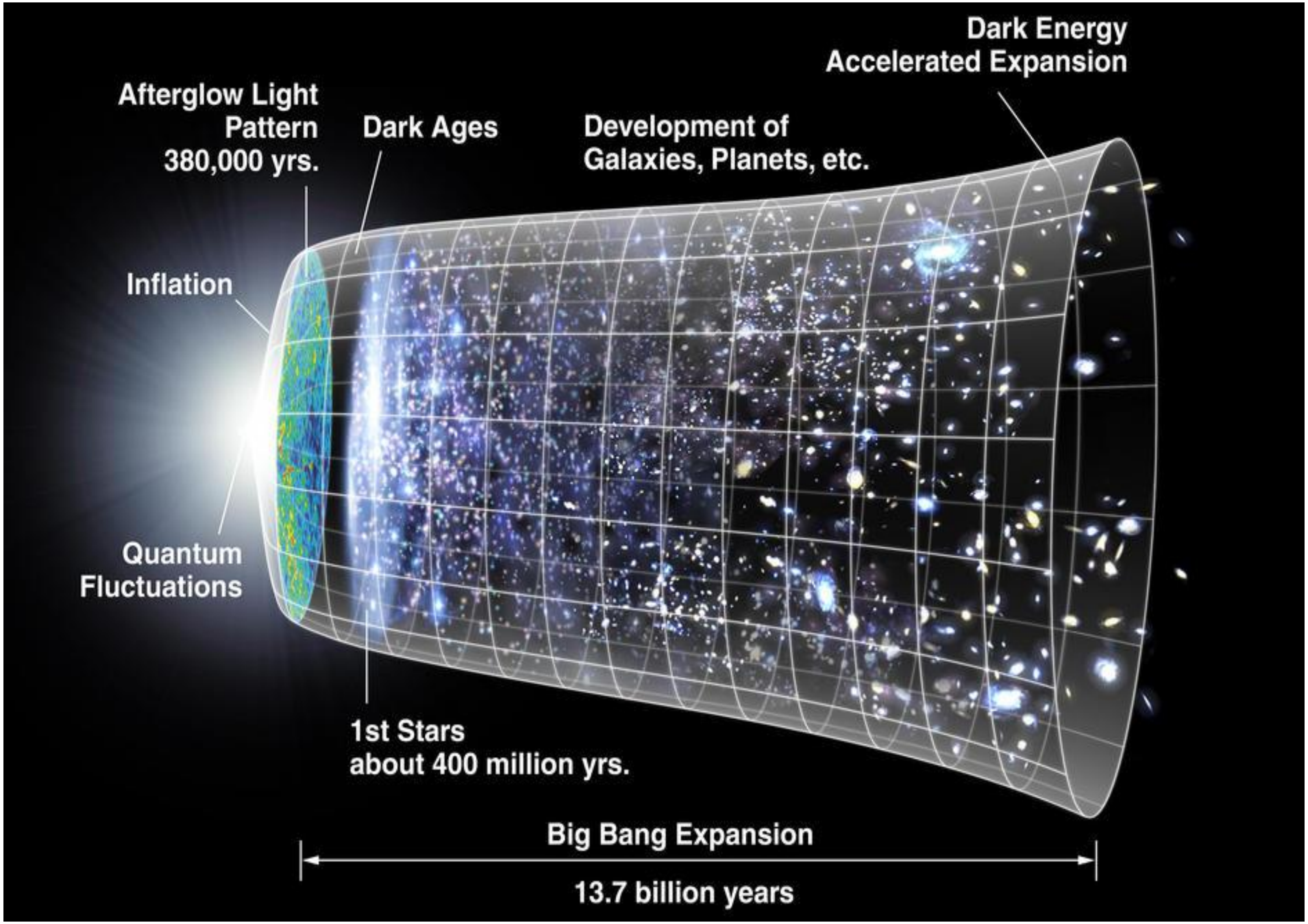
Supplement to the National Geographic, June 1983, Page 704A, Vol. 163, No. 6 · UNIVERSE/SKY SURVEY

For complete map list write to the National Geographic Society, Washington, D. C. 20036

Astronomía

(4) Comins, N. F., & Kaufmann, W. J. (2000). Discovering the universe. *Discovering the universe. New York: WH Freeman, c2000.*
(5) https://www.iau.org

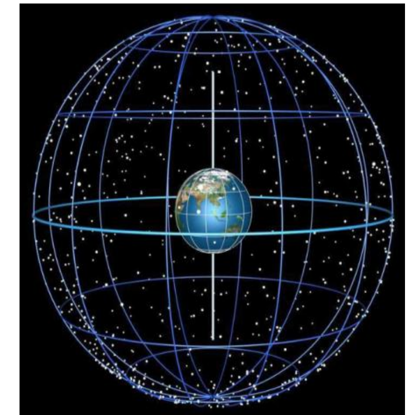
Astronomía

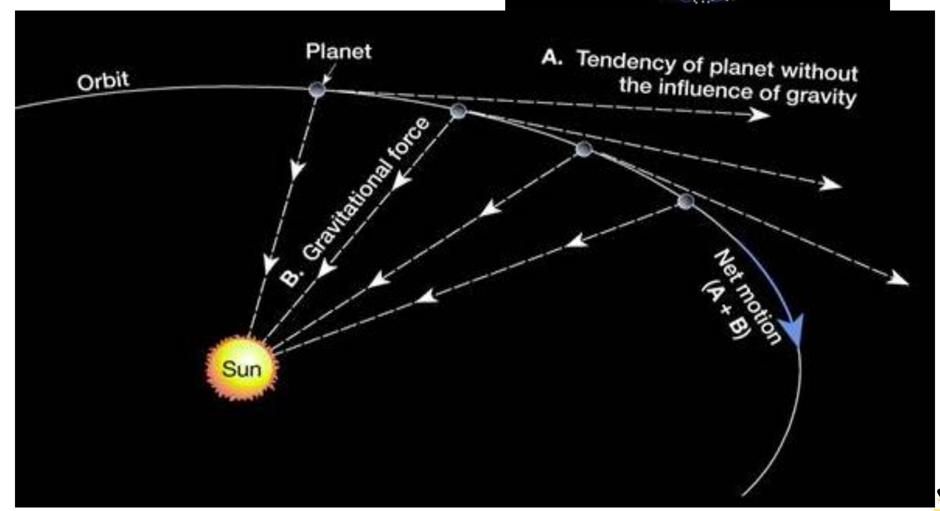


Fuente: https://www.jpl.nasa.gov

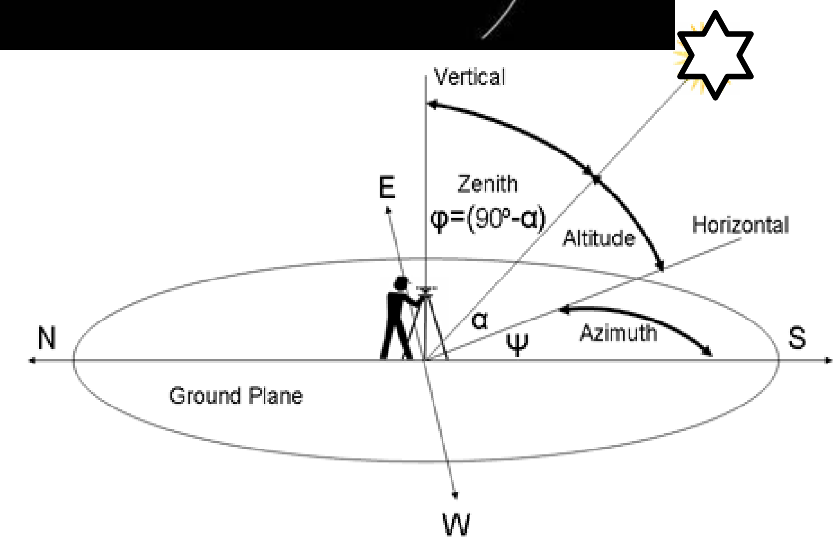
Astronomía

Astronomía esférica: estudia las posiciones de los cuerpos celestes sobre la superficie de la esfera celeste.[1]





Astronomía dinámica: estudia los movimientos de los cuerpos celestes desde el punto de vista físico-matemático.[1]



Astronomía geodésica: tiene por objeto la determinación de latitud, longitud de puntos sobre la superficie terrestre y acimut de direcciones sobre la Tierra, por observación de cuerpos celestes.[3]

(1) Barbosa, J. G. P. (2012). *Elementos de astronomía de posición*. Universidad Nacional de Colombia.
(3) Sevilla, M. J. (1984). *Astronomía Geodésica*. Facultad de Ciencias Matemáticas, Universidad Complutense de Madrid.

Astronomía

Observaciones: de acuerdo a la frecuencia (o longitud) de la onda electromagnética en la que se basa la observación.

Maxwell

$$\oint \vec{E} \cdot d\vec{A} = \frac{Q_{\text{enc}}}{\epsilon_0} \qquad \text{(ley de Gauss)}$$

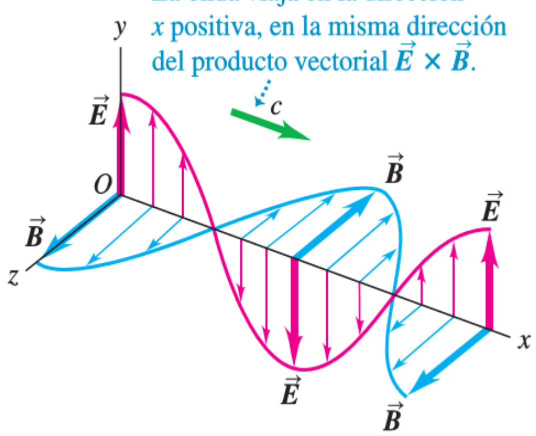
$$\oint \vec{B} \cdot d\vec{A} = 0 \qquad \text{(ley de Gauss del magnetismo)}$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 \left(i_C + \epsilon_0 \frac{d\Phi_E}{dt} \right)_{\text{enc}} \qquad \text{(ley de Ampère)}$$

$$\oint \vec{E} \cdot d\vec{l} = -\frac{d\Phi_B}{dt} \qquad \text{(ley de Faraday)}$$

-Carga puntual en reposo sólo produce campo eléctrico ($\vec{E}$)

-Carga puntual en movimiento produce campo eléctrico ($\vec{E}$) y magnético ($\vec{B}$)



$$y(x,t) = A\cos(kx - \omega t)$$

(6) Sears, F. W., Zemansky, M. W., Young, H. D., & Freedman, R. A. (2009). *Física Universitaria: Volumen 1*. Pearson.

Astronomía

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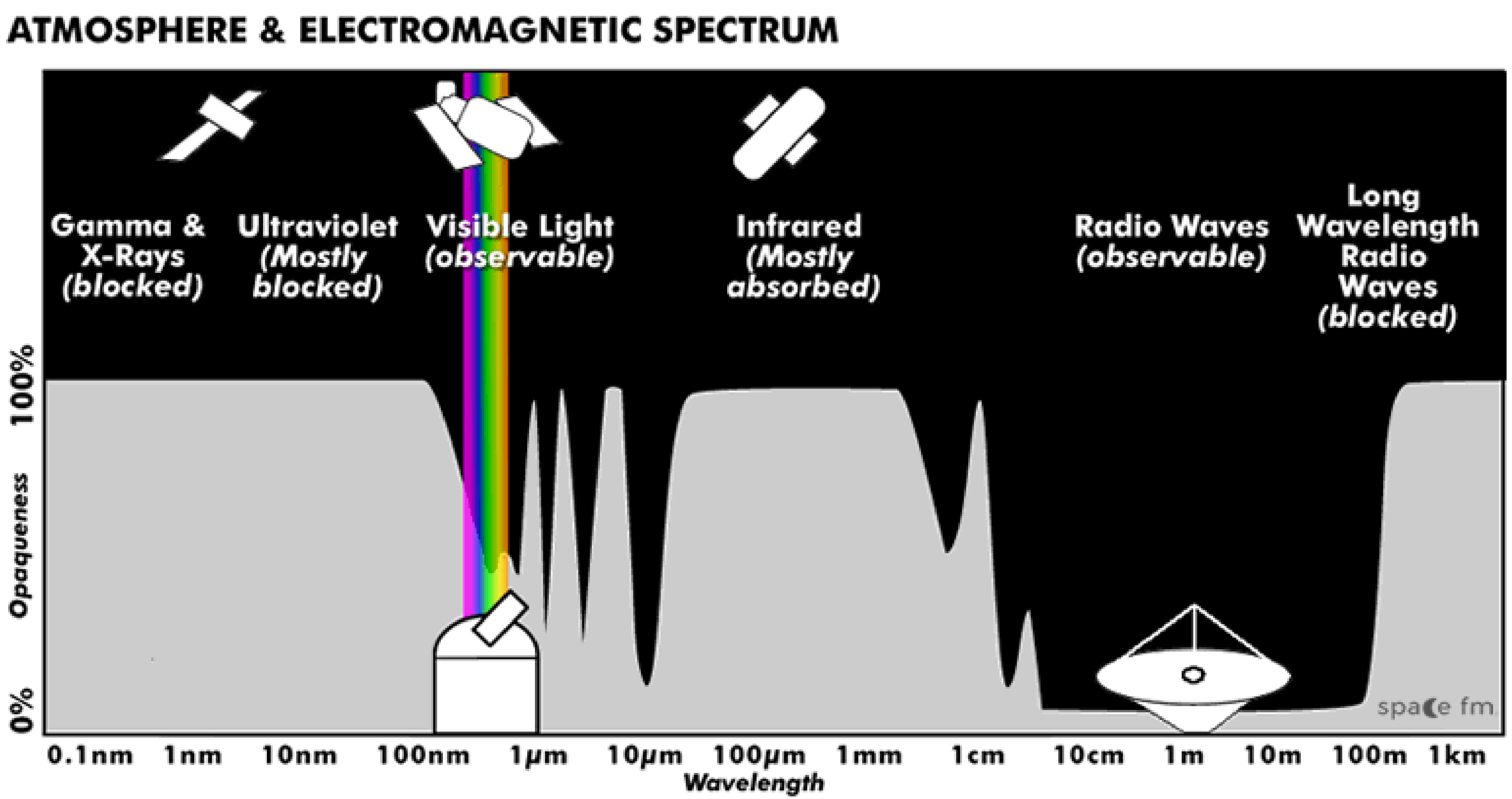

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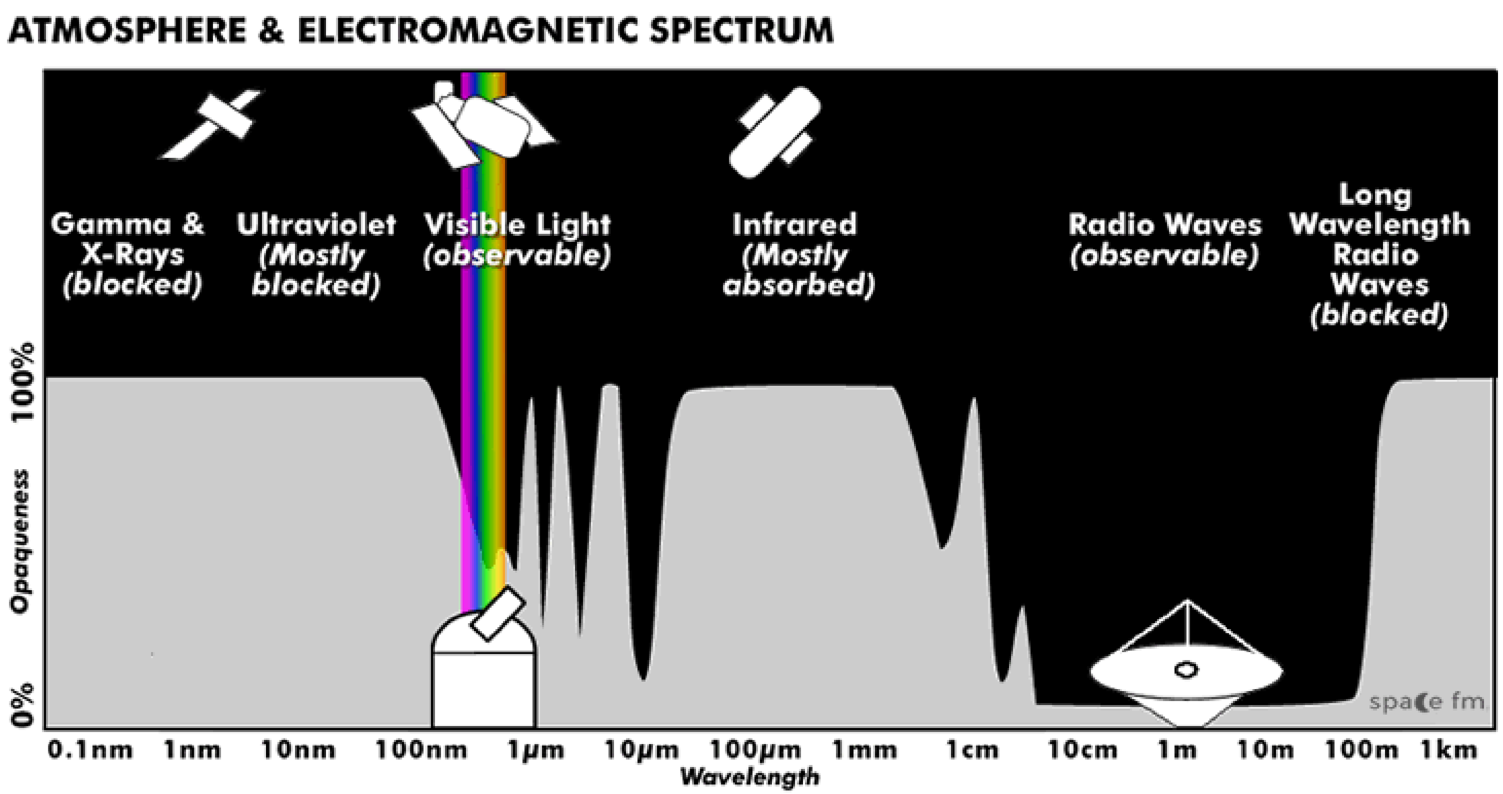

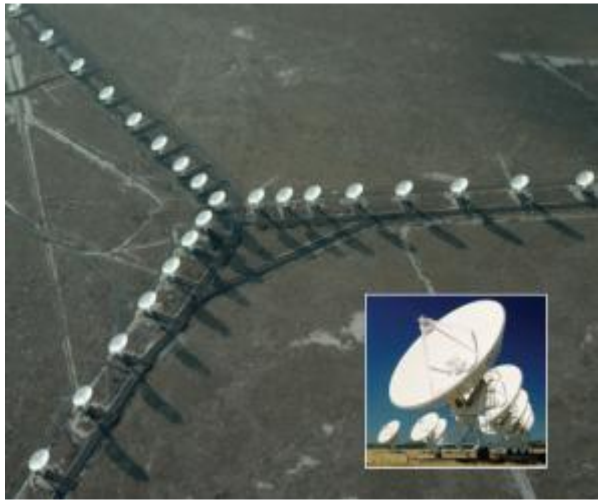

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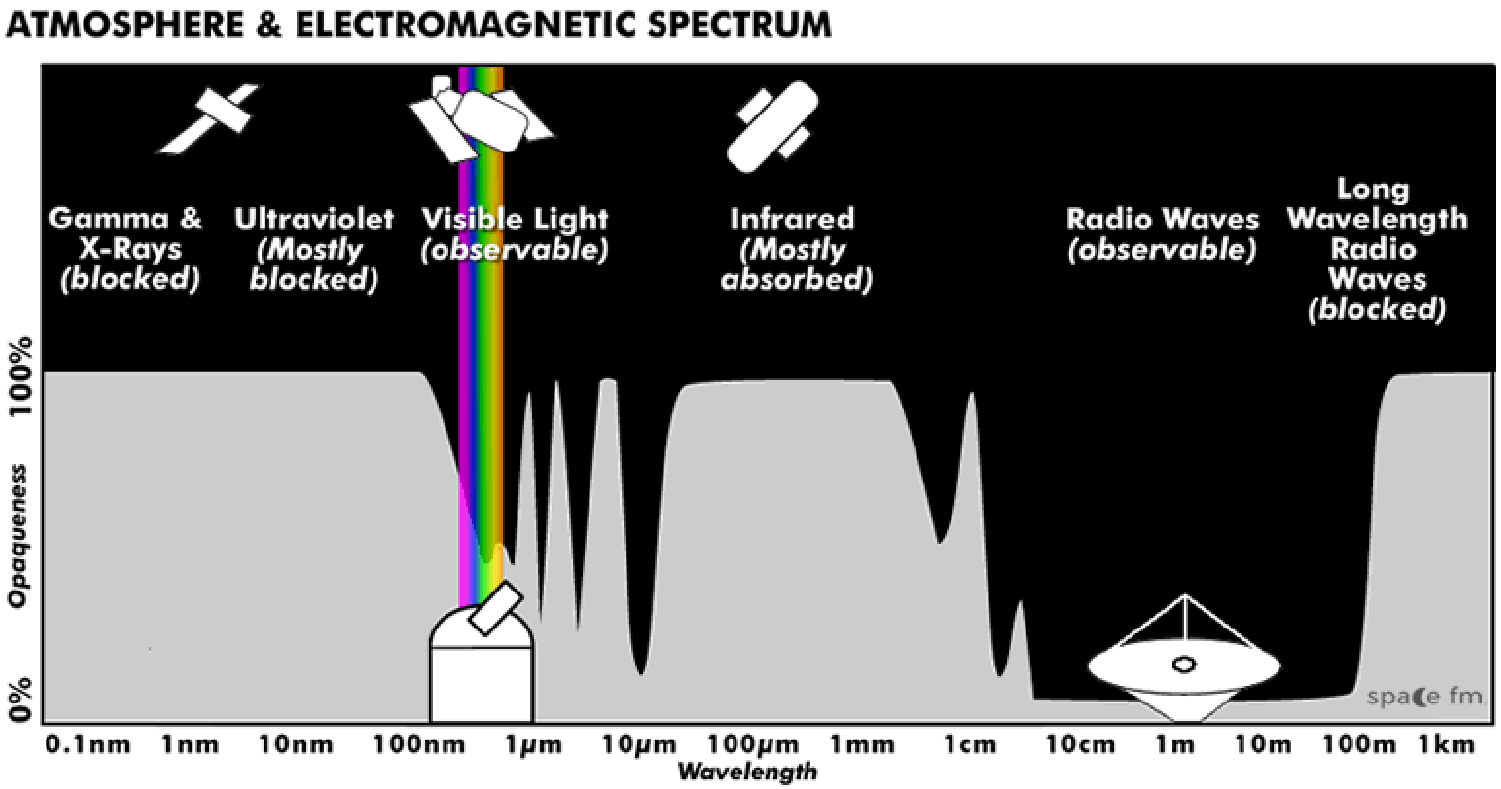

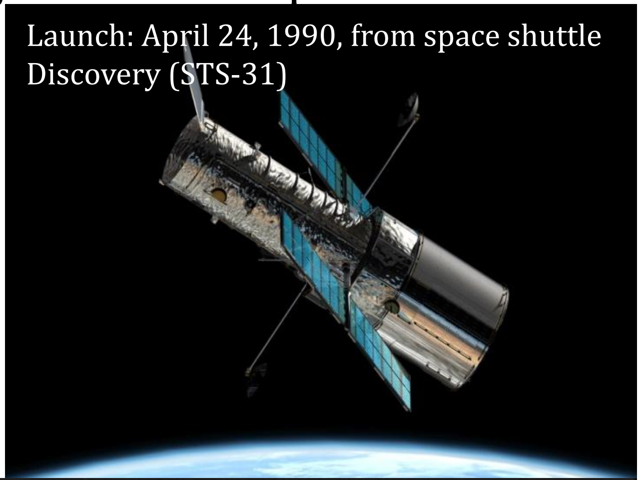

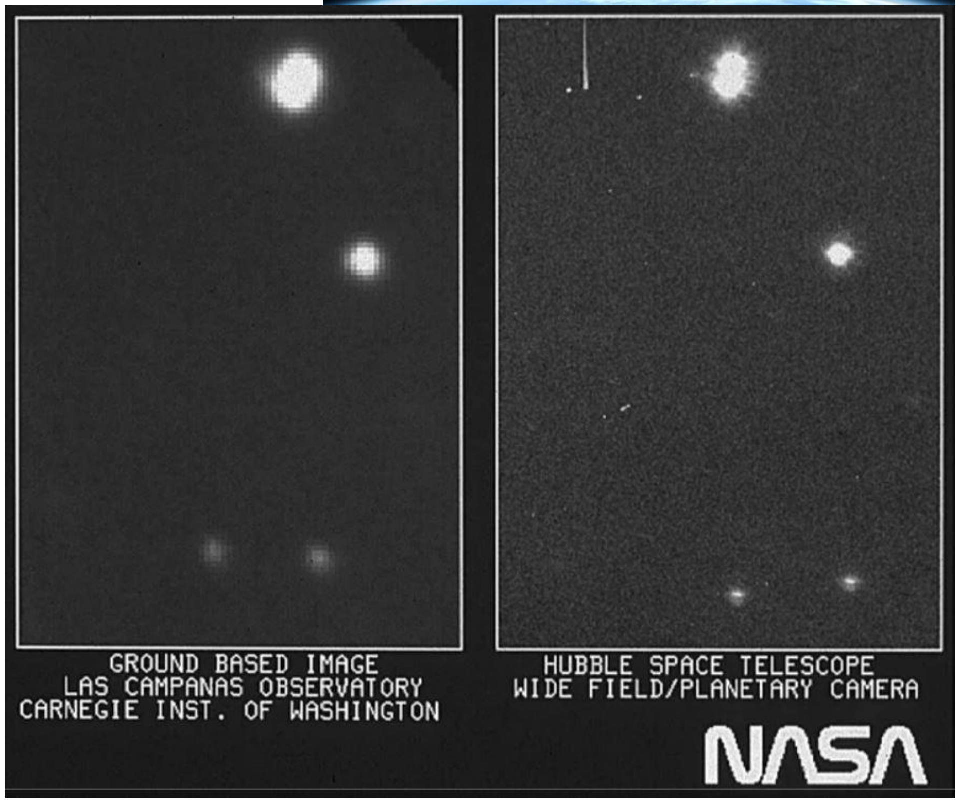

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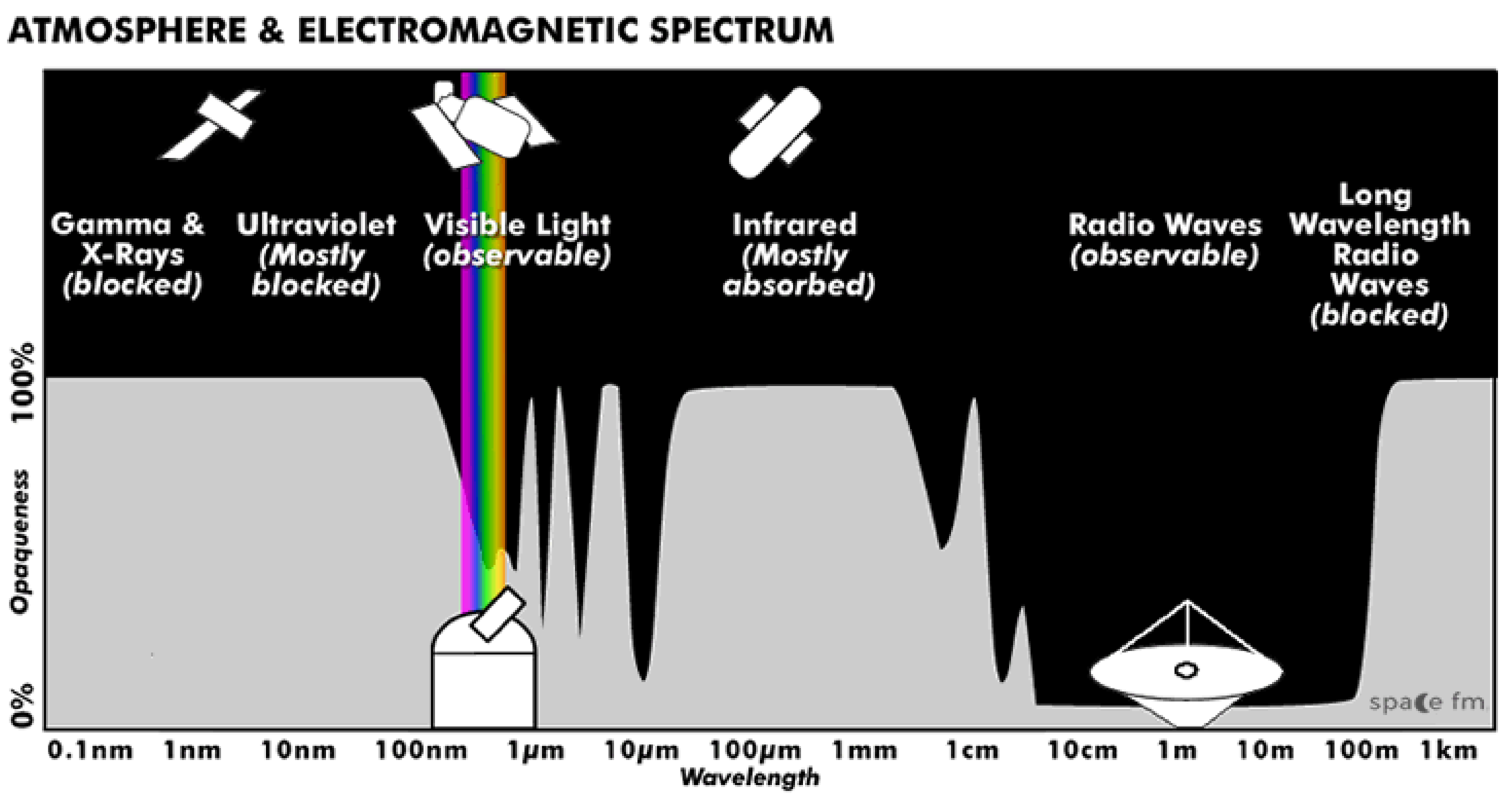

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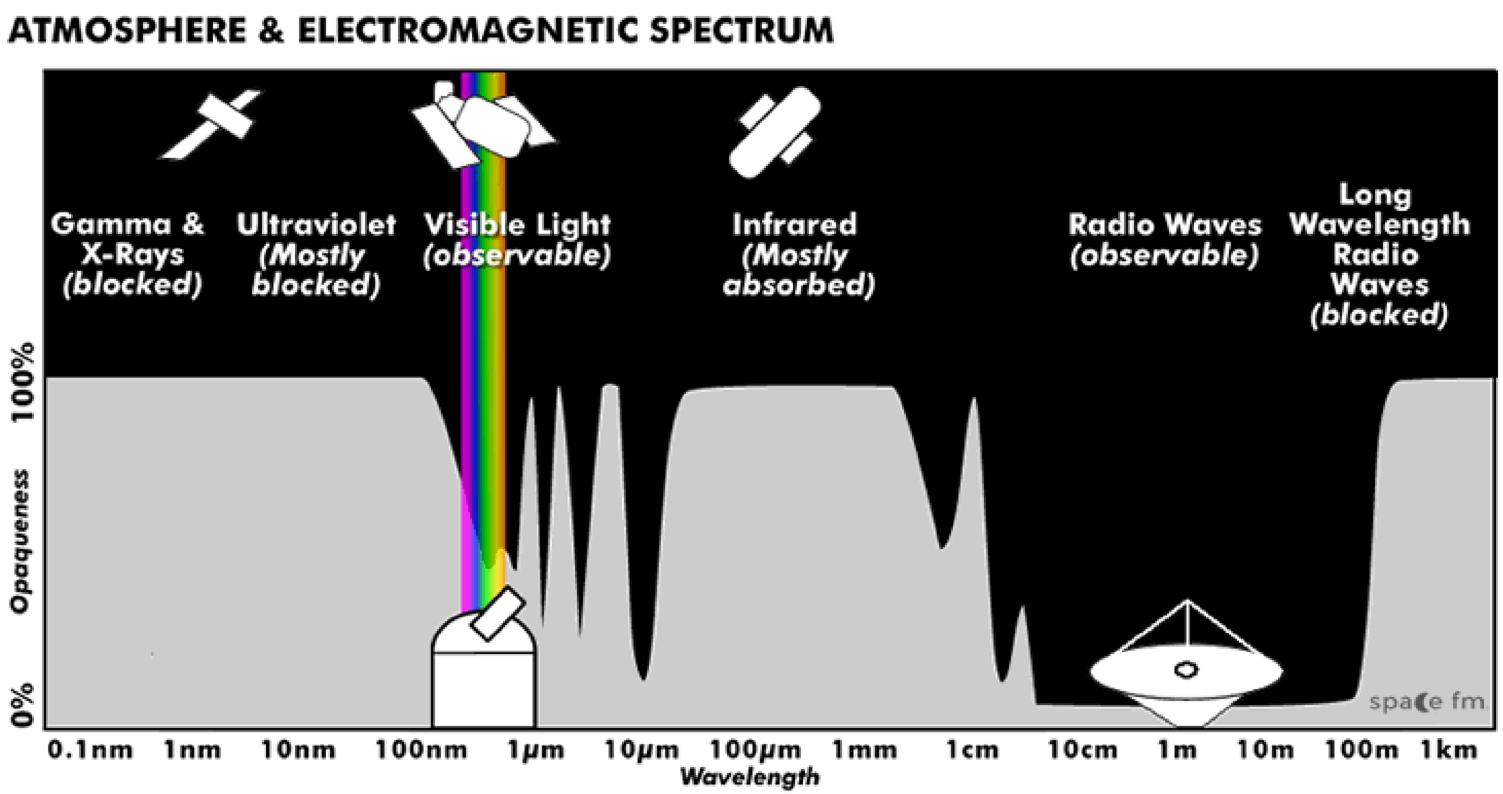
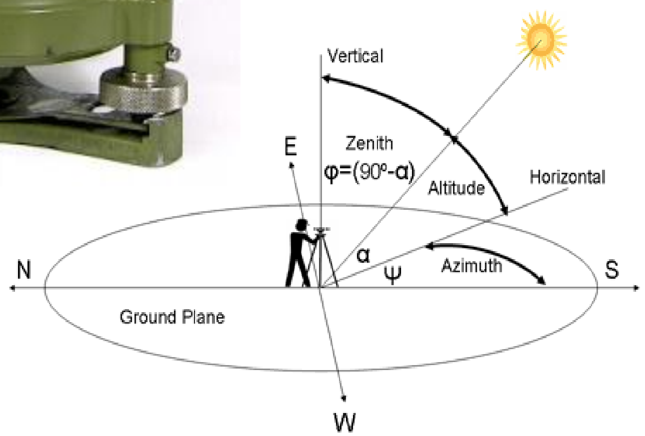


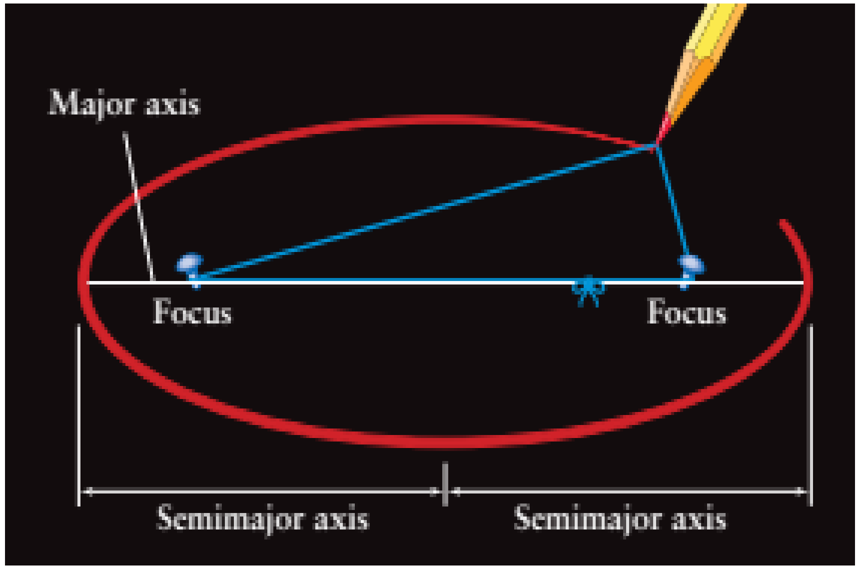


(4) Comins, N. F., & Kaufmann, W. J. (2000). Discovering the universe. *Discovering the universe. New York: WH Freeman, c2000.*

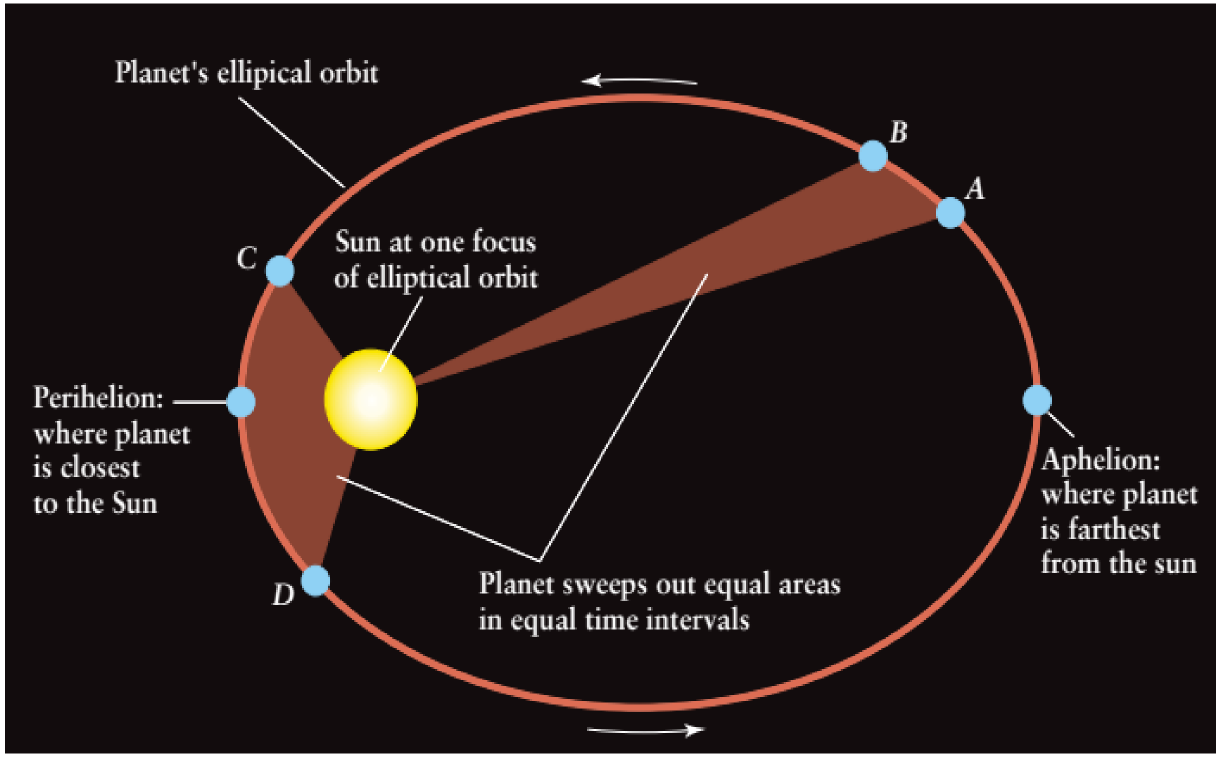
Astronomía

Leyes de Kepler[4]:

1.- La órbita de un planeta alrededor del Sol es una elipse con el Sol en uno de sus focos.



2.- Una línea que une un planeta y el Sol barre áreas iguales en intervalos de tiempo iguales.



3.- El cuadrado del período sideral de un planeta alrededor del Sol es directamente proporcional al cubo de la longitud del semieje mayor de su órbita.

$\mathbf{P^2 \propto a^3}$

	Sidereal period P (year)	Semimajor axis a (AU)	P^2	$= a^3$
Mercury	0.24	0.39	0.06	0.06
Venus	0.61	0.72	0.37	0.37
Earth	1.00	1.00	1.00	1.00
Mars	1.88	1.52	3.53	3.51
Jupiter	11.86	5.20	140.7	140.6
Saturn	29.46	9.54	867.9	868.3
Uranus	84.01	19.19	7058	7067
Neptune	164.79	30.06	27,160	27,160

(4) Comins, N. F., & Kaufmann, W. J. (2000). *Discovering the universe.* New York: WH Freeman, c2000.

Astronomía

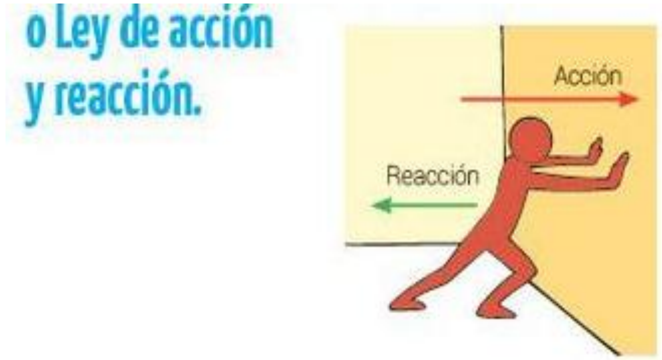
Leyes de Newton[4,6]: describen las propiedades fundamentales de la realidad física.

1.- La inercia es la propiedad de la materia que mantiene un objeto en reposo o en movimiento en línea recta a una velocidad constante, a menos que actúe sobre él una fuerza externa neta.

2.- La aceleración de un objeto es directamente proporcional a la fuerza neta que actúa sobre él y es inversamente proporcional a su masa.

Fuerza = masa x aceleración

3.- Siempre que un objeto ejerce una fuerza sobre un segundo objeto, éste ejerce una fuerza igual y opuesta sobre el primero.



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(6) Sears, F. W., Zemansky, M. W., Young, H. D., & Freedman, R. A. (2009). *Física Universitaria: Volumen 1*. Pearson.

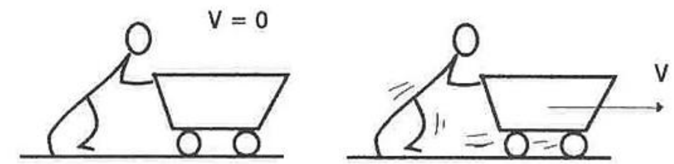
Astronomía

Trabajo y Energía[4,6]: describen las propiedades fundamentales de la realidad física.

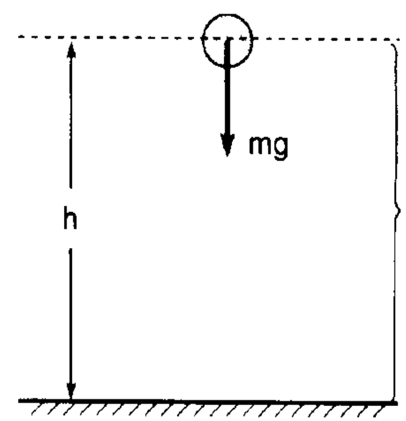
Trabajo: $W = Fd$

$$F = m * a = m * \frac{dv}{dt} = \frac{d}{dt}(m * v)$$

Energía cinética: $EC = {}^{1}\!/_{2}\, mv^2$

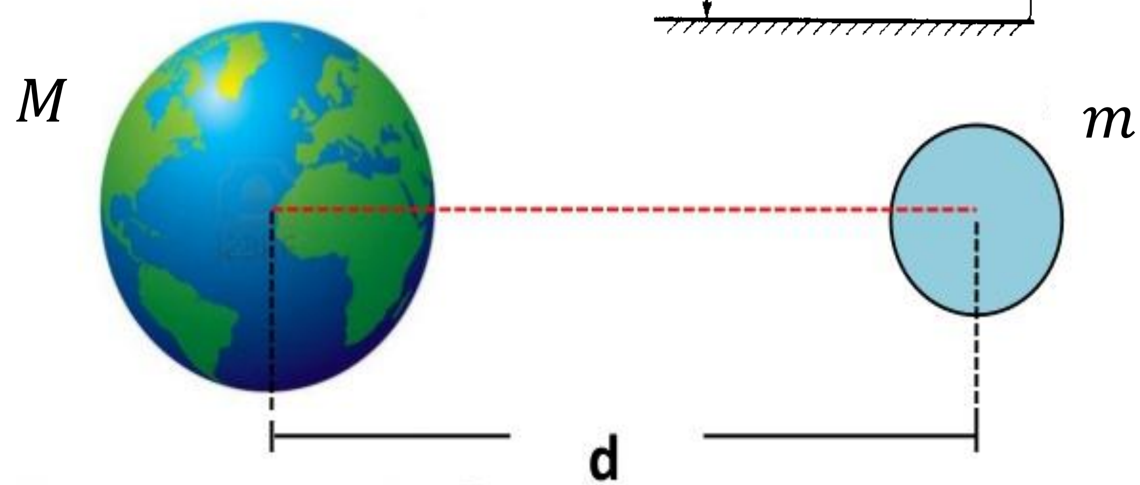


Energía potencial: $EP = Fd = mgh$



Energía potencial gravitatoria:

$$U = -\frac{GmM}{d}$$



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(6) Sears, F. W., Zemansky, M. W., Young, H. D., & Freedman, R. A. (2009). *Física Universitaria: Volumen 1*. Pearson.

Astronomía

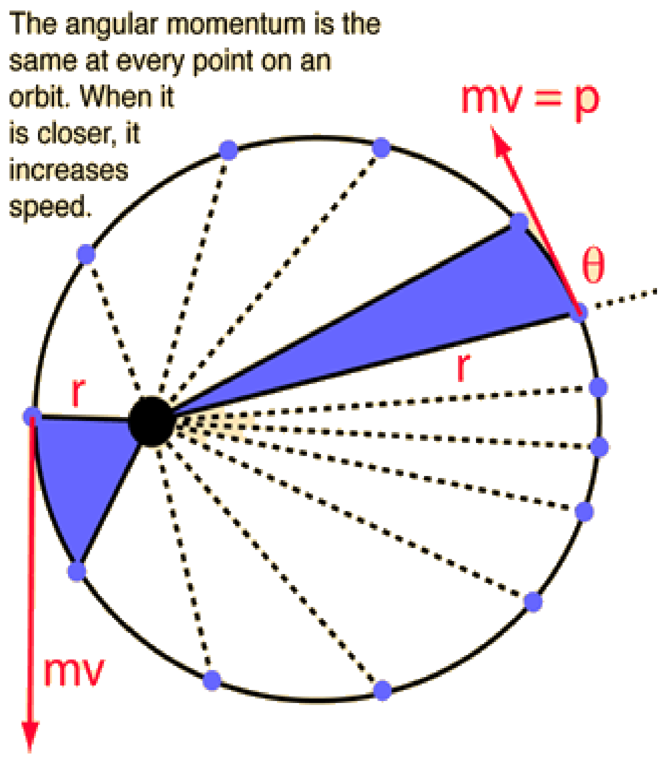
Momentos[4,6]: describen las propiedades fundamentales de la realidad física.

$$F = m * a = m * \frac{dv}{dt} = \frac{d}{dt}(m * v)$$

Momento lineal:

$$p = m * v$$

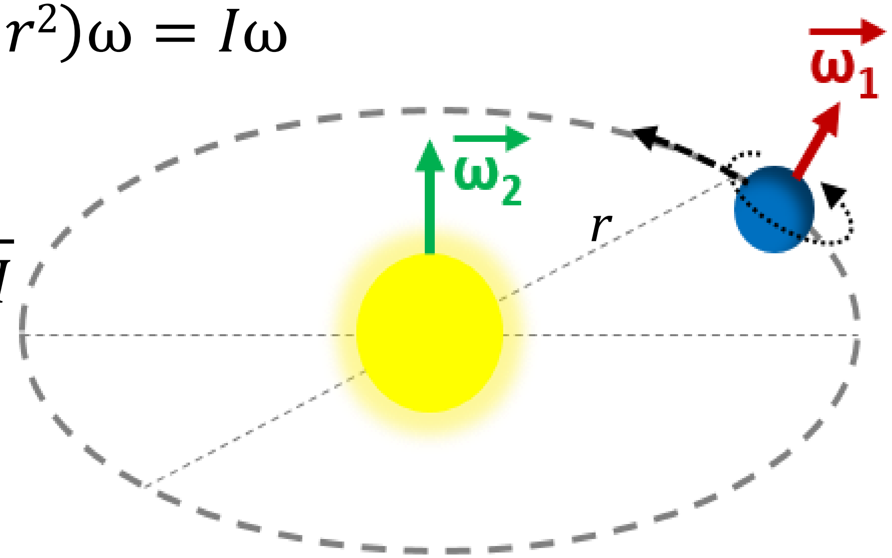
$$EC = \frac{p^2}{2 * m}$$



Momento angular:

$$L = (m * r^2)\omega = I\omega$$

$$EC = \frac{L^2}{2 * I}$$



Aplicación de la Primera Ley de Newton:

- Un cuerpo mantiene su ***momento lineal*** a menos que actúe sobre él una fuerza externa neta.
- Un cuerpo mantiene su ***momento angular*** a menos que actúe sobre él un torque externo neto.

(4) Comins, N. F., & Kaufmann, W. J. (2000). *Discovering the universe.* New York: WH Freeman, c2000.
(6) Sears, F. W., Zemansky, M. W., Young, H. D., & Freedman, R. A. (2009). *Física Universitaria: Volumen 1*. Pearson.

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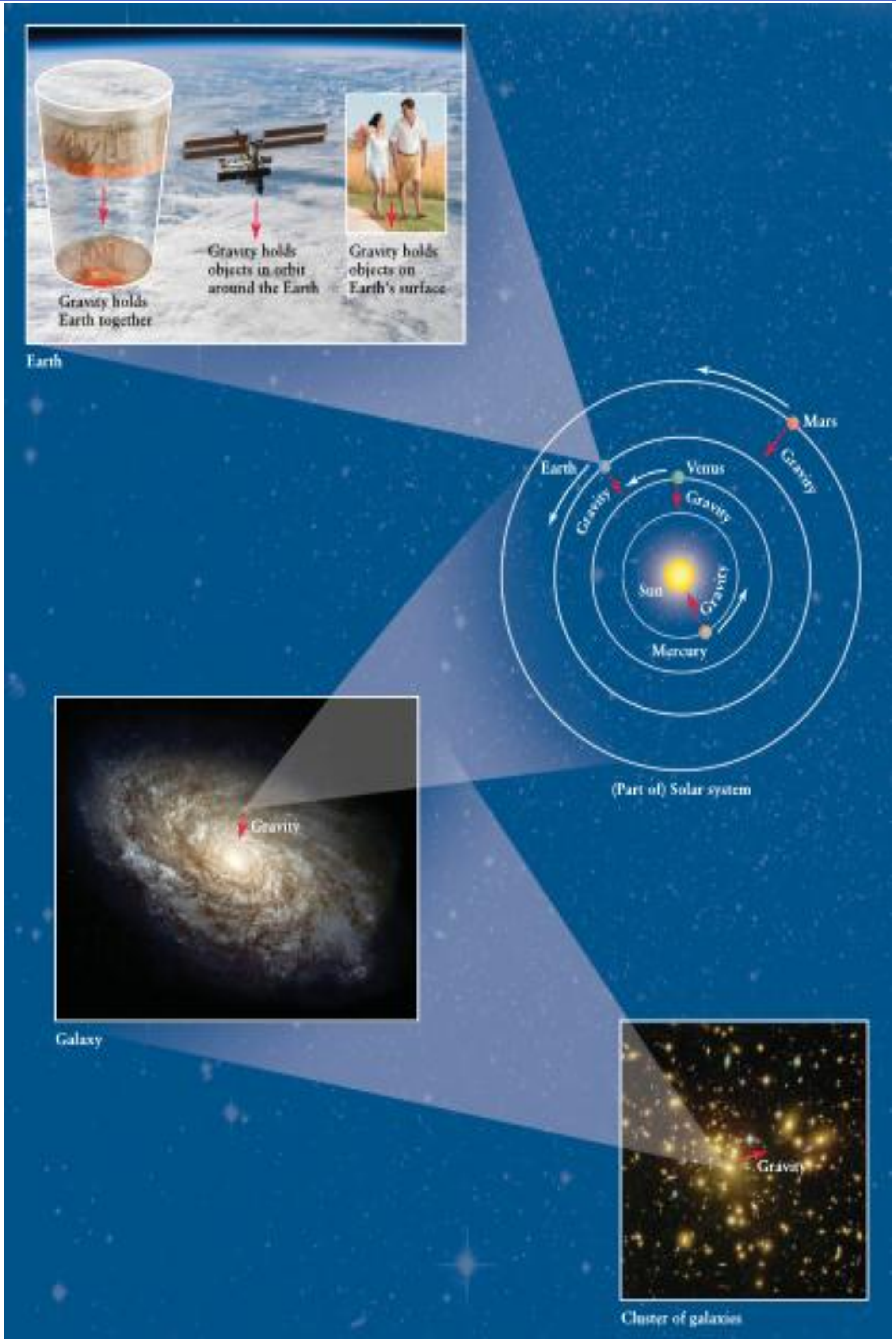

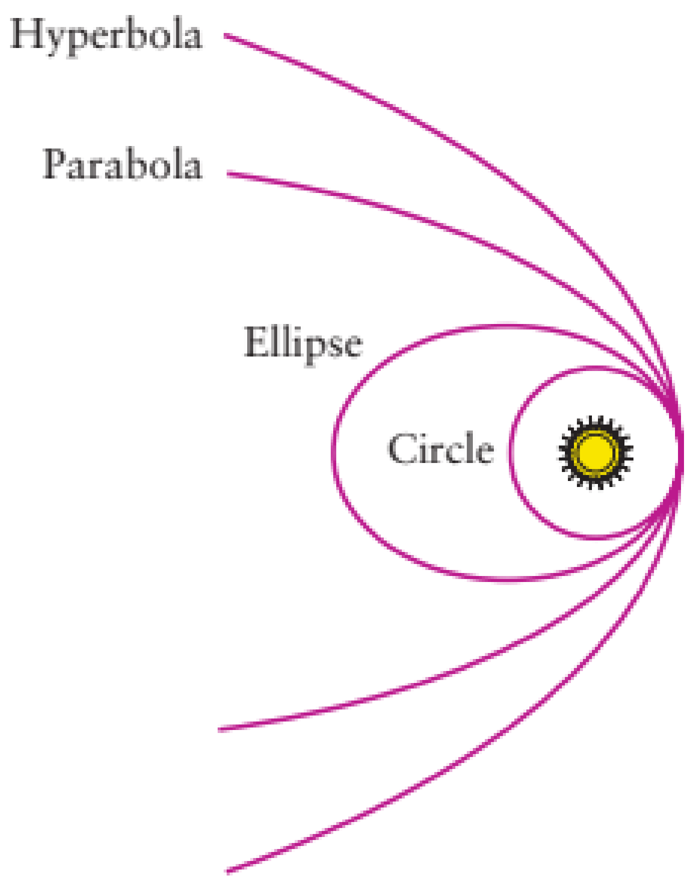

Fuente: Comins, N. F., & Kaufmann, W. J. (2000). Discovering the universe. *Discovering the universe. New York: WH Freeman, c2000.*