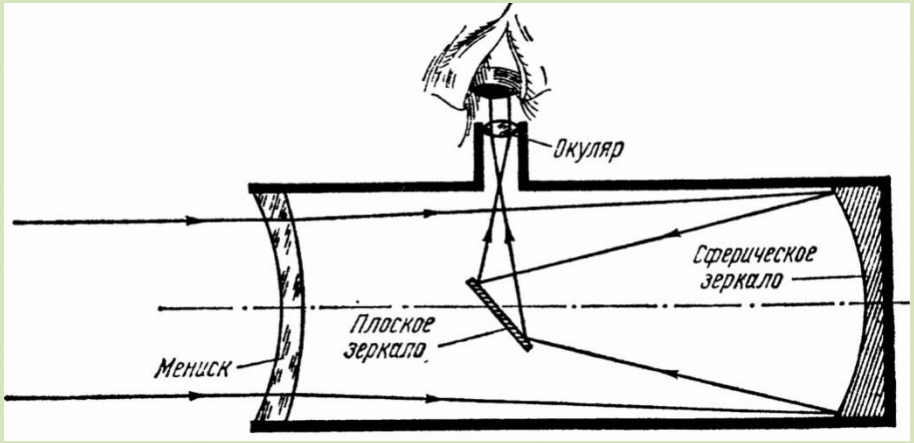
Телескопы

Что такое оптический телескоп?

- **Телеско́п** — прибор, с помощью которого можно наблюдать отдаленные объекты путем сбора видимого.
- Также существуют радиотелескопы, рентгеновские **телескопы**, гамма-**телескопы**.

- В переводе с греческого (tele) – далеко. (skopeo) – смотрю.

Почему с телескопом лучше наблюдать небо

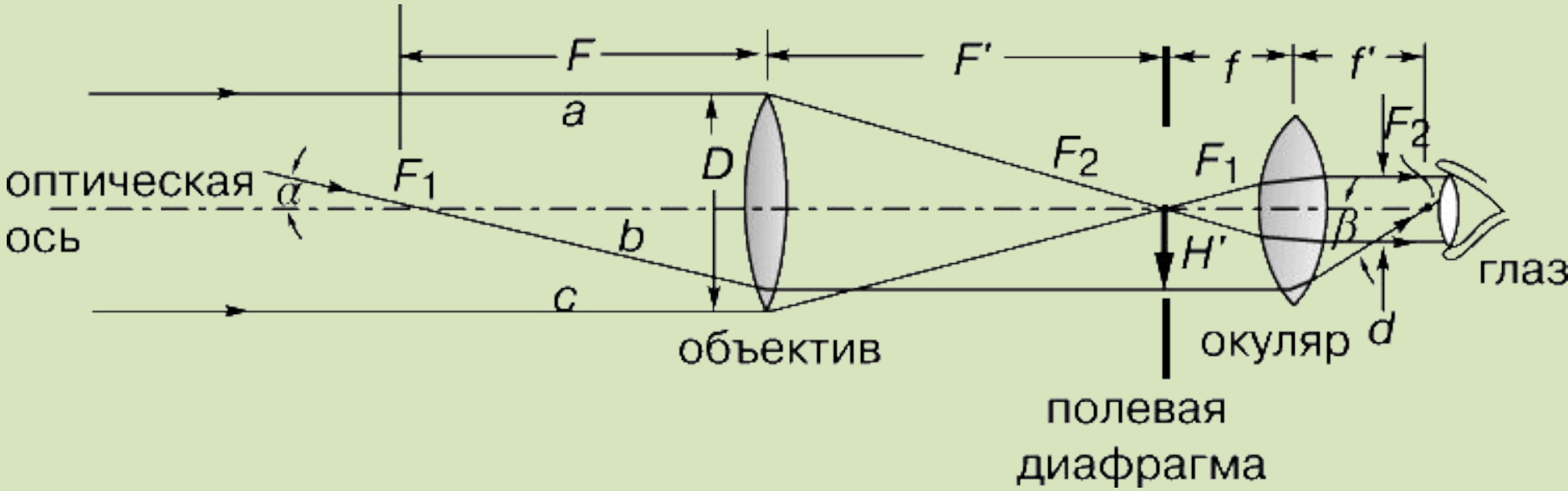


Диаметр зрачка человеческого глаза составляет 5-6 миллиметров, Диаметр телескопа практически неограничен. Телескоп может собирать все лучи света, которые попадают ему на объектив.

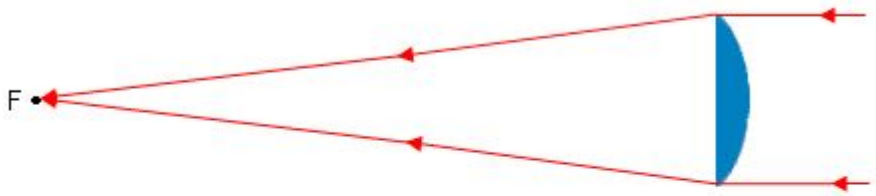
Самый большой телескоп с диаметром объектива 11,2 метра собирает в 5 миллионов раз больше света, чем глаз человека

световой поток $\Phi = ES = \dfrac{\pi D^2 E}{4}$.

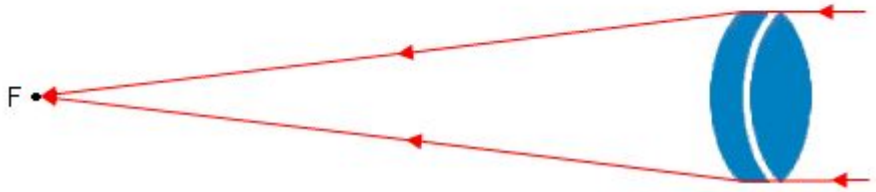
Увеличение телескопа $\Gamma = \dfrac{F}{f}$ *относительное отверстие* $A = \dfrac{D}{F}$.

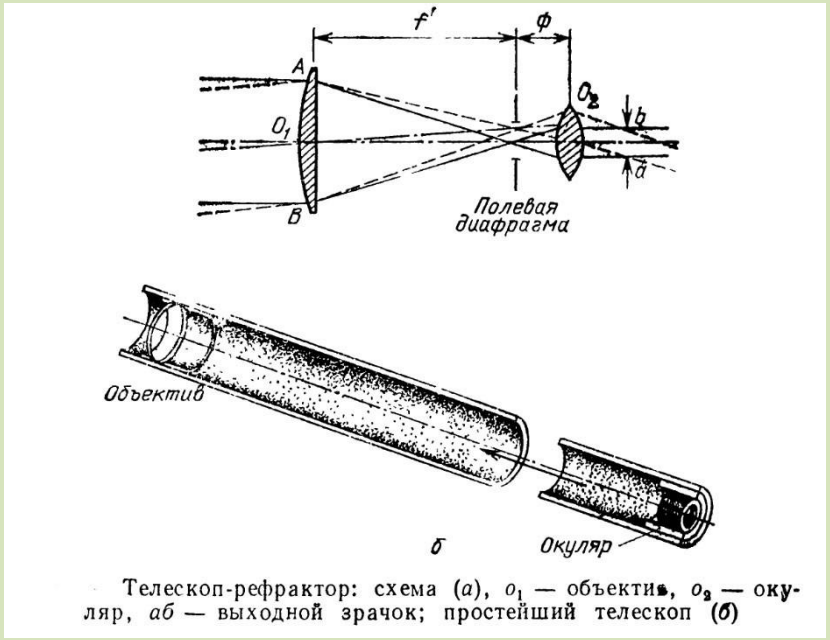


Простейший объектив-рефрактор

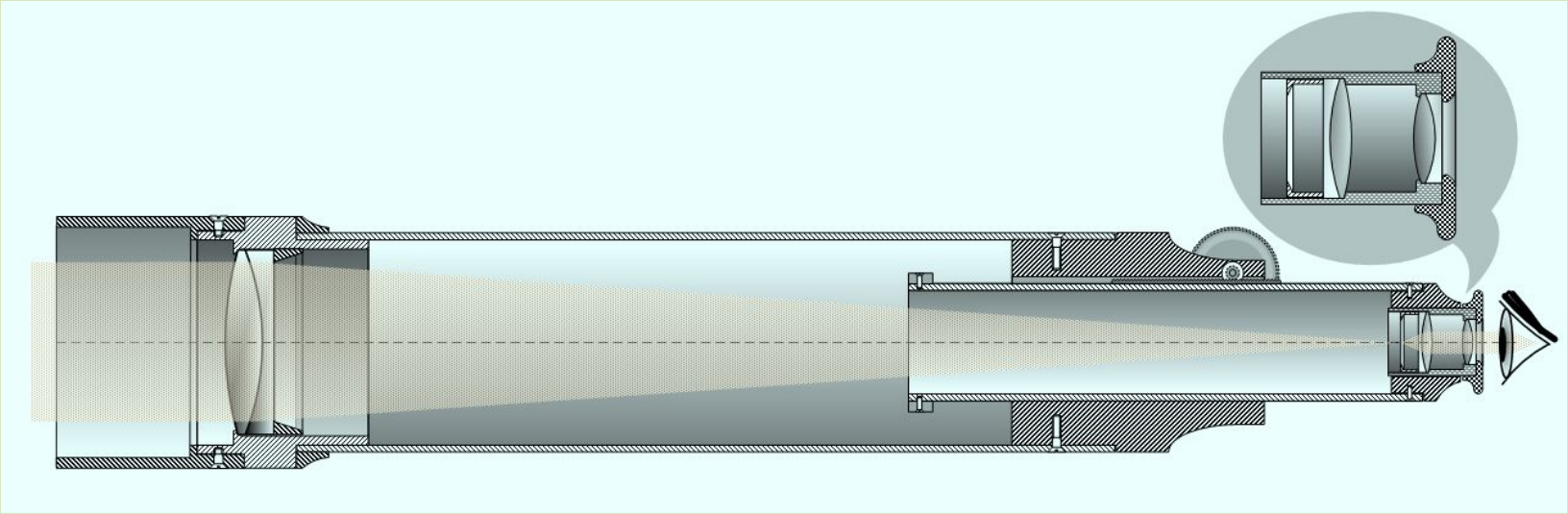


Объектив-рефрактор ахроматический

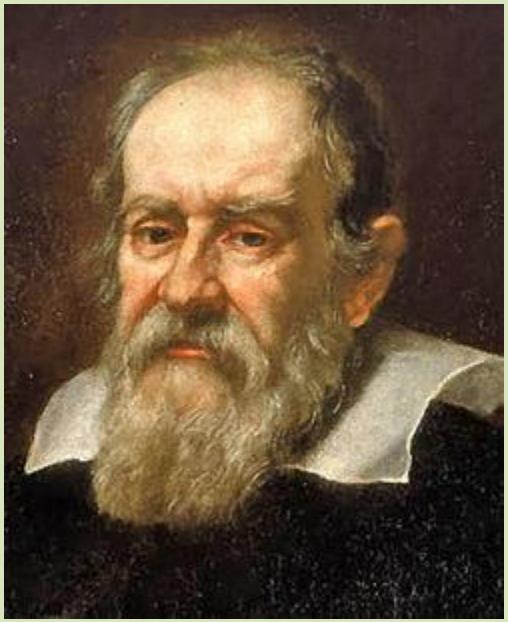


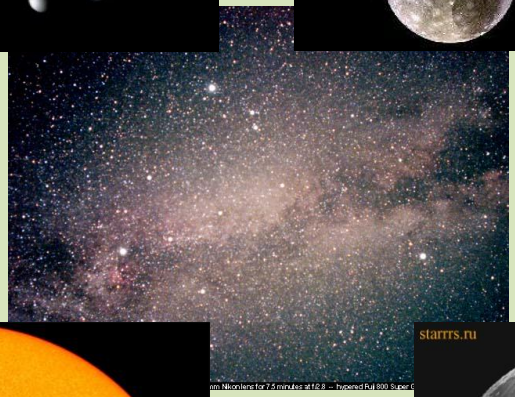


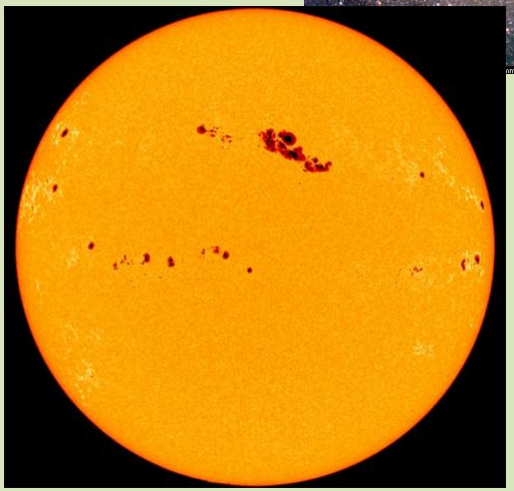
Телескоп-рефрактор: схема (*а*), o_1 — объектив, o_2 — окуляр, *аб* — выходной зрачок; простейший телескоп (*б*)



Галилео Галилей







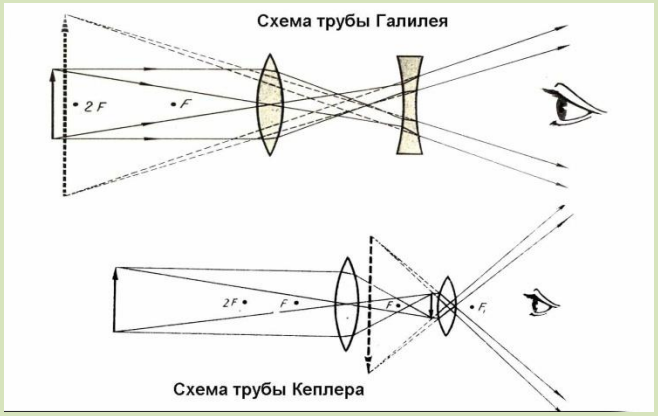
3 вида телескопов.

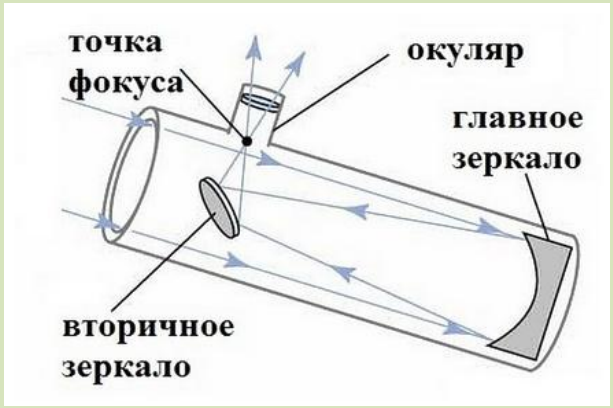
Есть 3 вида телескопов, которые различаются между собой разными типами объективов.

1 вид: Линзовые телескопы - рефрактор

2 вид: Зеркальные телескопы - рефлектор

3 вид: Зеркально-линзовый телескоп





Самые большие оптические телескопы

<u>Самый большой рефрактор.</u>
Рефрактор Кларка. Уильямс Бэй, США. Диаметр 1,02 метра

<u>Самый большой рефлектор.</u>
Большой южноафриканский телескоп. Сатерленд, ЮАР Диаметр 11,2 метра

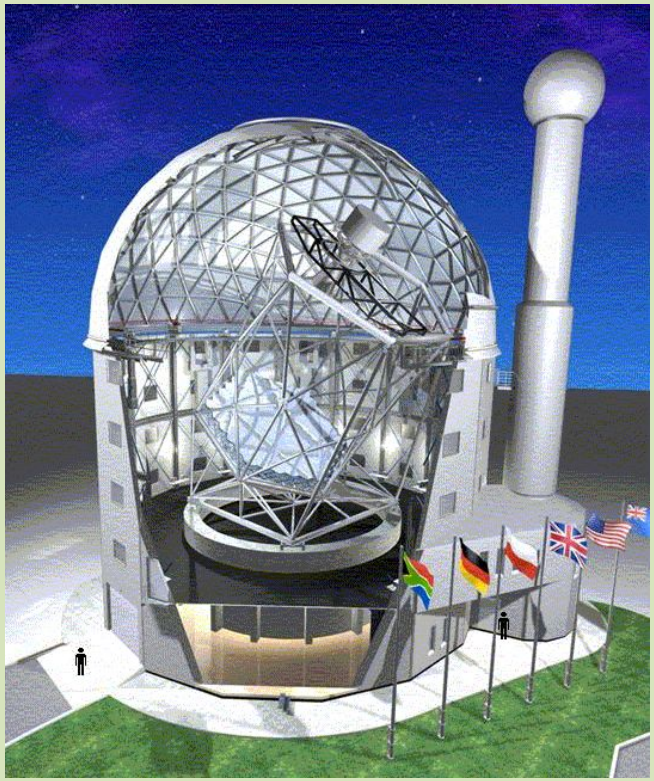
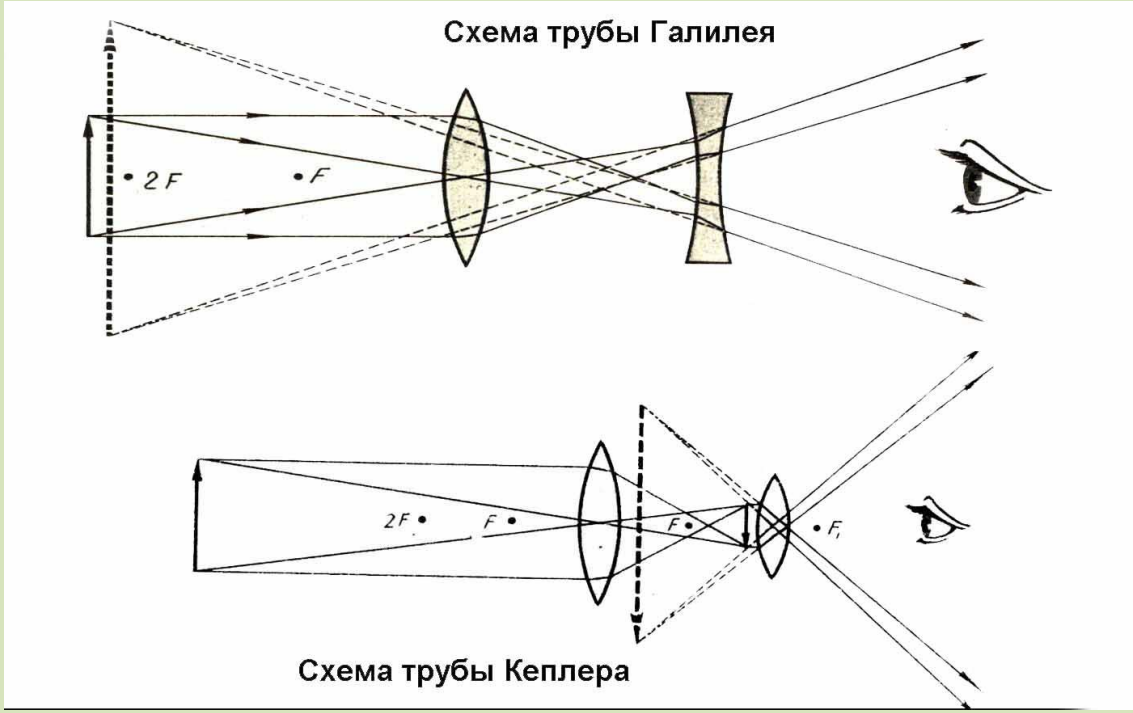


Схема линзового телескопа.



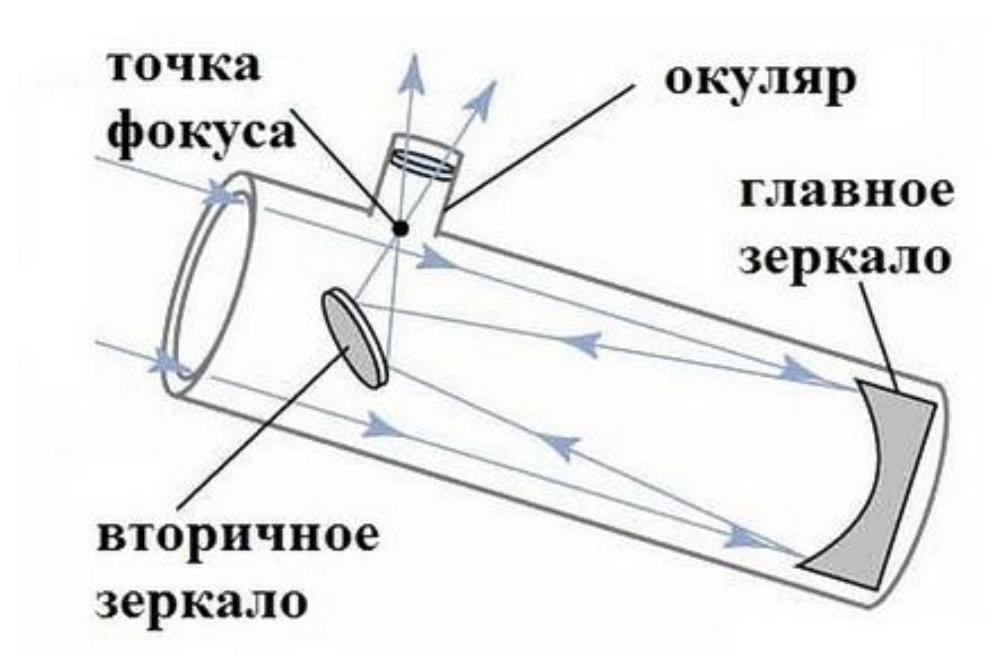
+

- В трубу не попадает пыль
- Не деформируется из-за температуры
- Не темнеет со временем

-

- В линзах поглощается свет
- Большие и тяжёлые
- Цветовые искажения

Схема зеркального телескопа.



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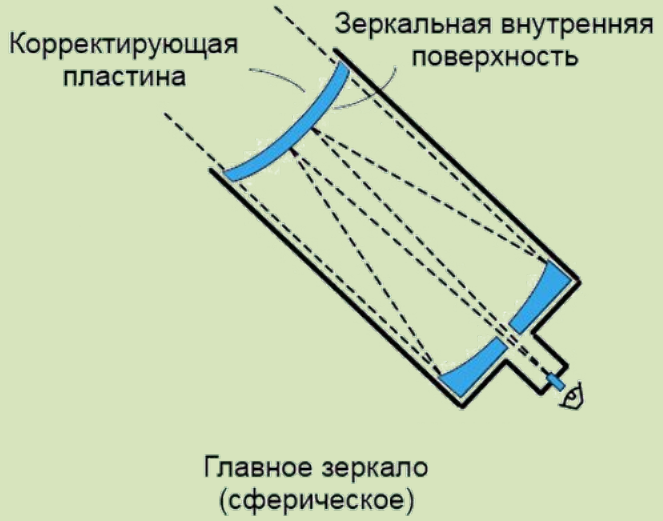
- Нет цветовых искажений
- Можно сделать большой и лёгкий телескоп
- Дешевле в изготовлении

-

- В трубу попадает пыль
- Зеркало тускнеет со временем

Схема зеркально – линзового телескопа.

Система Максутова-Кассегрена



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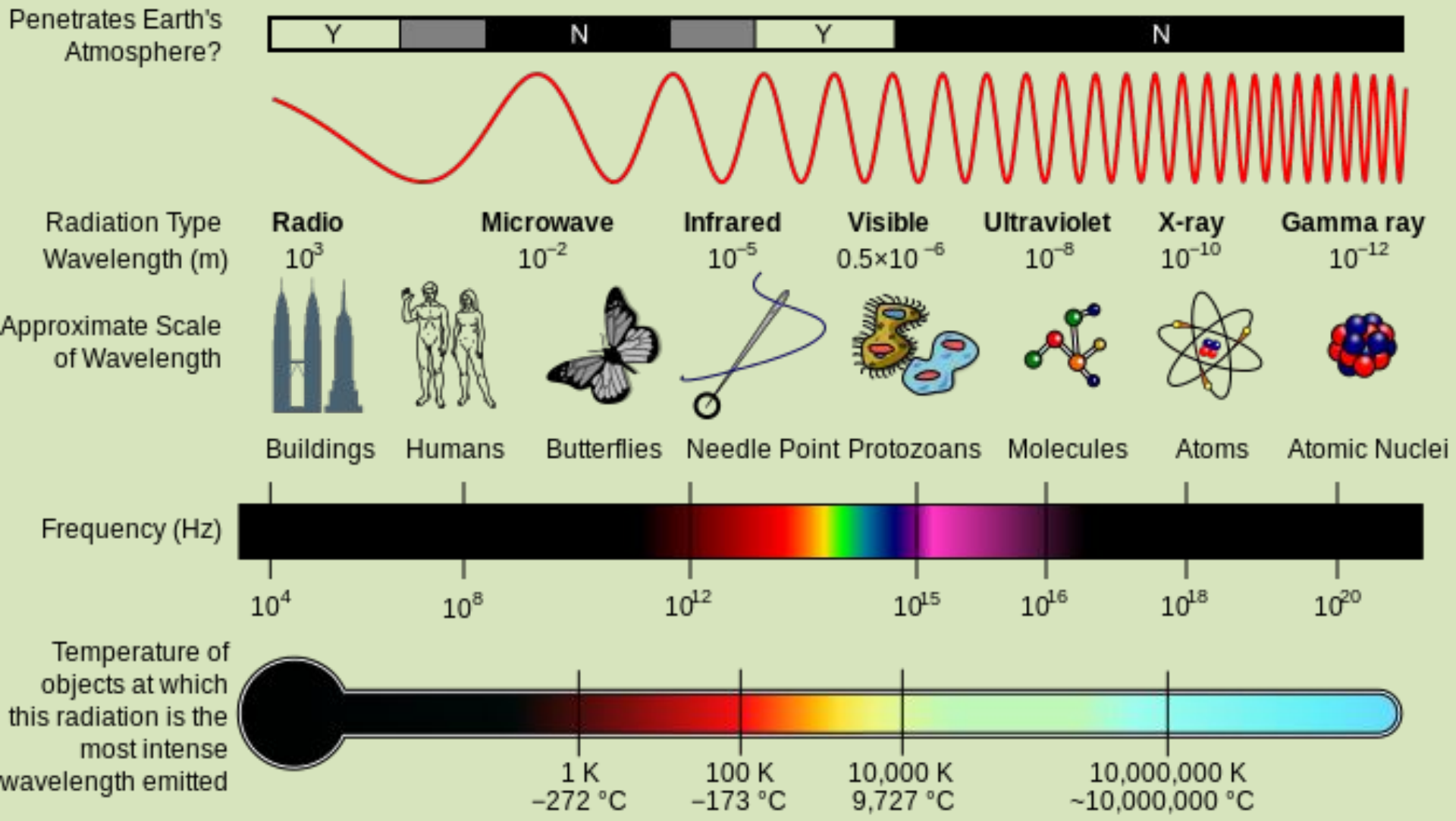
- Компактный
- Труба закрыта и внутрь не попадает пыль
- Нет цветовых искажений

-

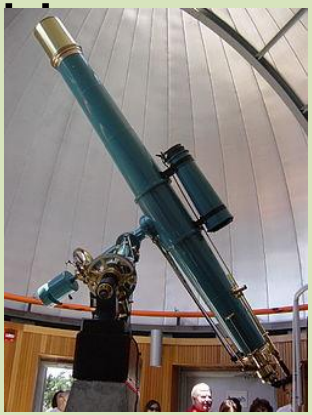
- Зеркало тускнеет
- Линзы поглощают часть света
- Долго остывает на холоде

Электромагнитный спектр



Существуют телескопы для всех диапазонов электромагнитного спектра:

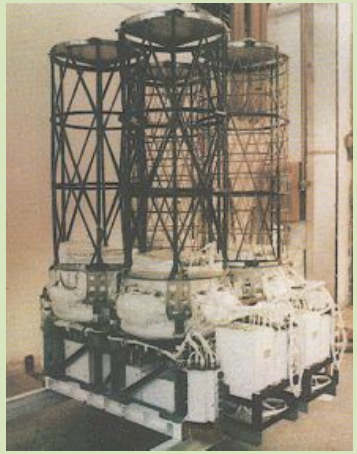
оптические телескопы



гамма-телескопы

радиотелескоп

рентгеновские телескопы

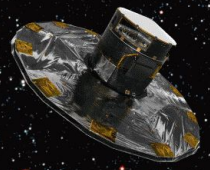


→ ESA'S FLEET ACROSS THE SPECTRUM

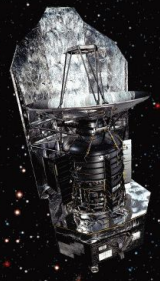
esa

Thanks to cutting edge technology, astronomy is unveiling a new world around us. With ESA's fleet of spacecraft, we can explore the full spectrum of light and probe the fundamental physics that underlies our entire Universe. From cool and dusty star formation revealed only at infrared wavelengths, to hot and violent high-energy phenomena, ESA missions are charting our cosmos and even looking back to the dawn of time to discover more about our place in space.

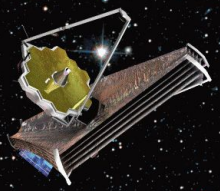
gaia
Surveying a billion stars



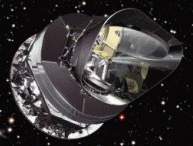
herschel
Unveiling the cool and dusty Universe



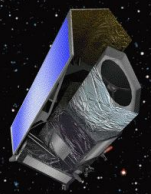
jwst
Observing the first light



planck
Looking back at the dawn of time

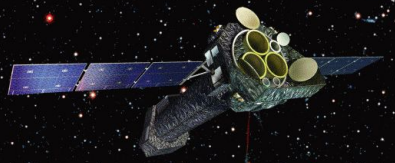


euclid
Probing dark matter, dark energy and the expanding Universe

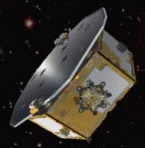


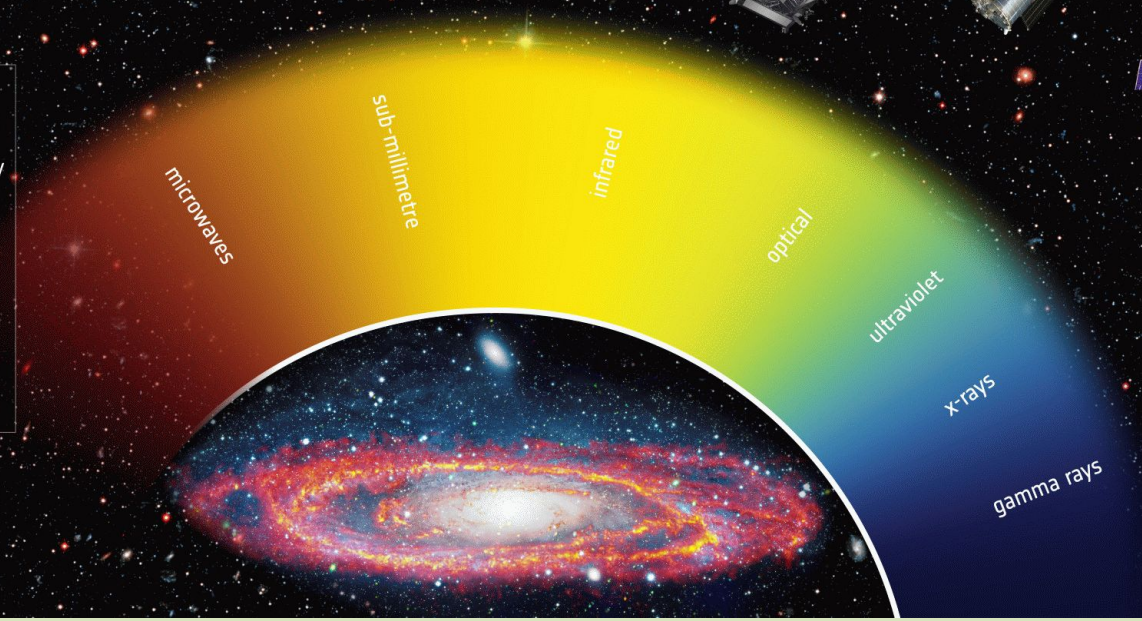
hst
Expanding the frontiers of the visible Universe

xmm-newton
Seeing deeply into the hot and violent Universe



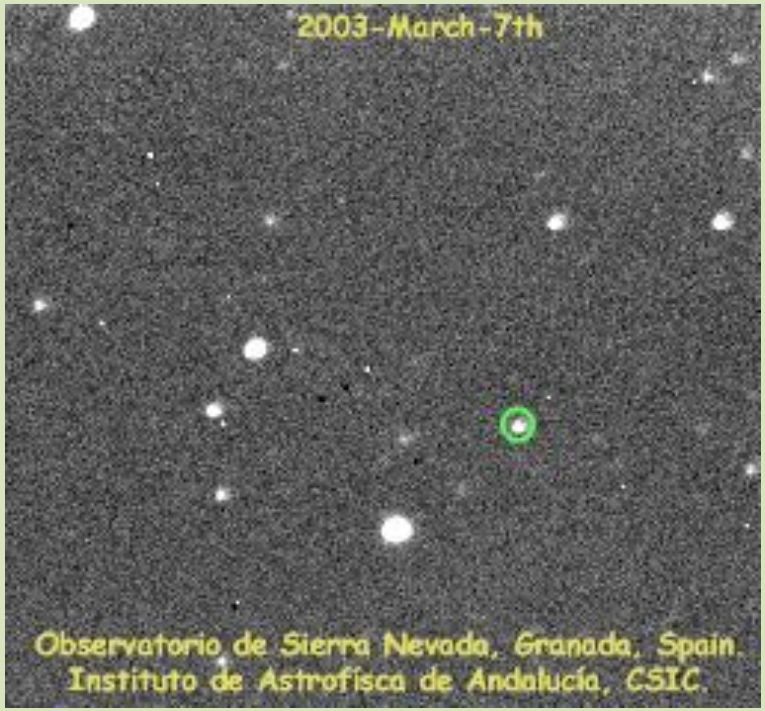
lisa pathfinder
Testing the technology for gravitational wave detection

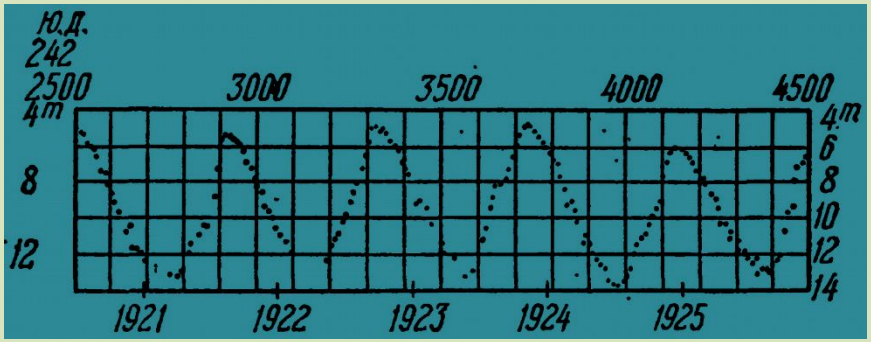




integral
Seeking out the extremes of the Universe


SN 2011fe
06 Feb. 2011
The Virtual Telescope Project (www.virtualtelescope.eu)


2003-March-7th
Observatorio de Sierra Nevada, Granada, Spain
Instituto de Astrofisca de Andalucía, CSIC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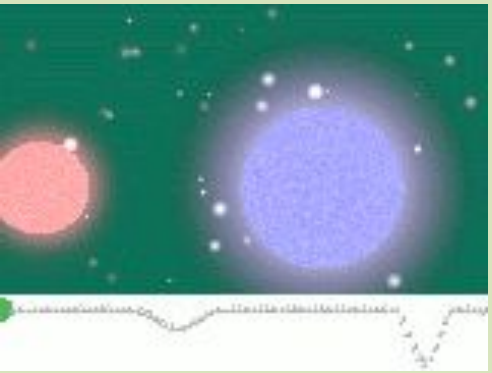
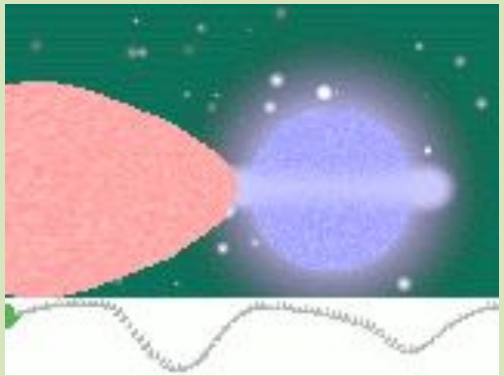
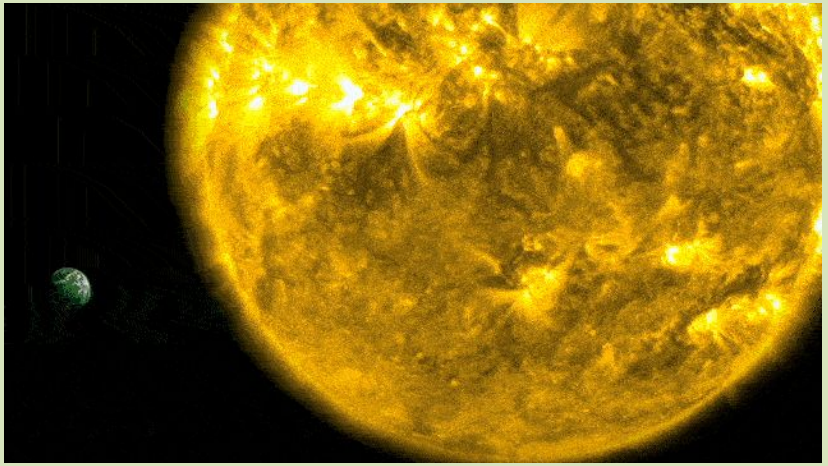
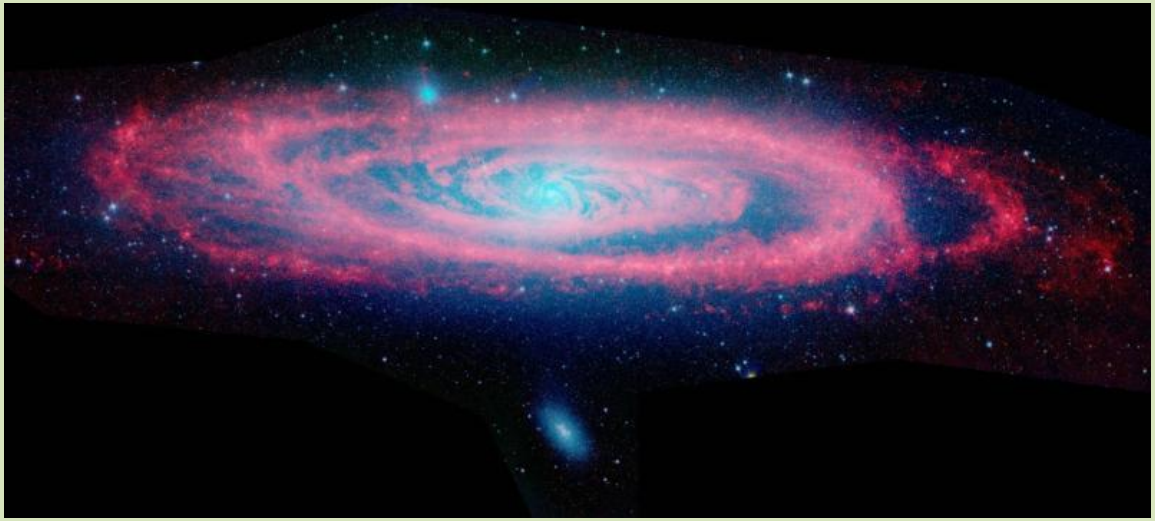
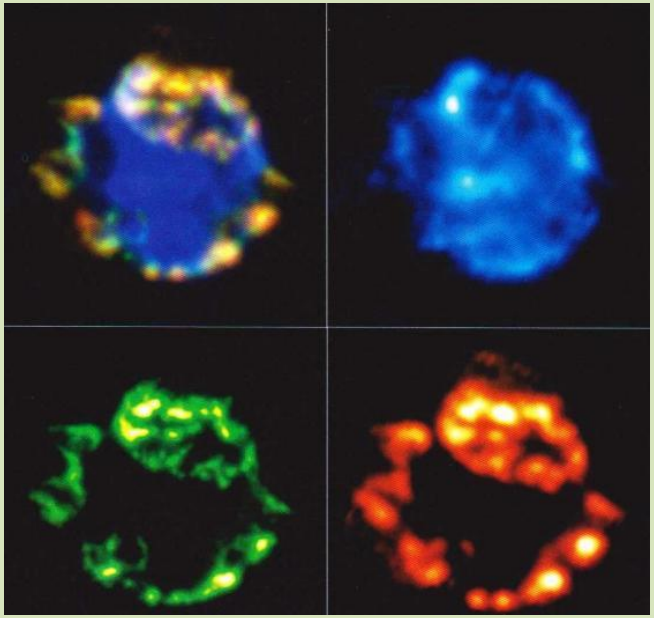


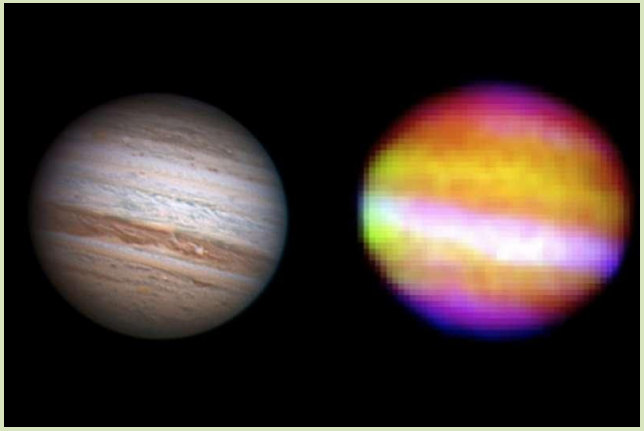




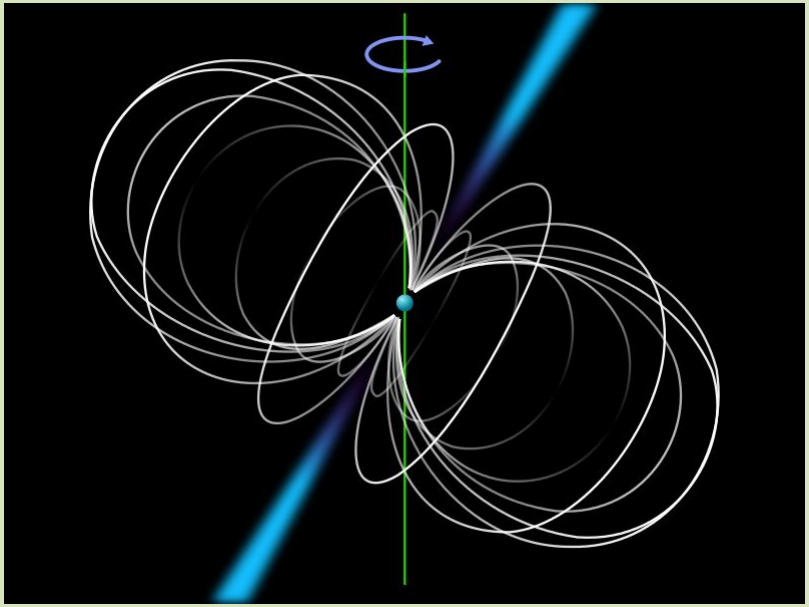
Инфракрасная астрономия

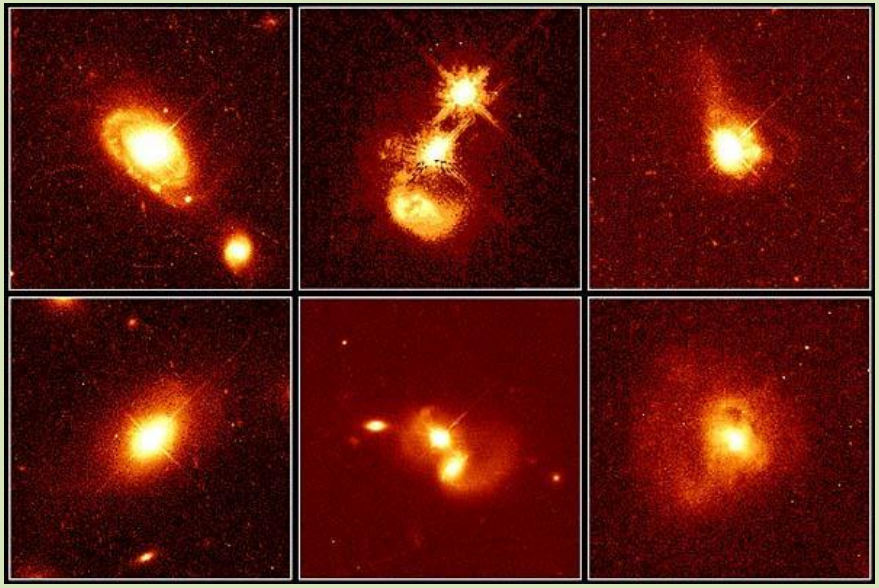


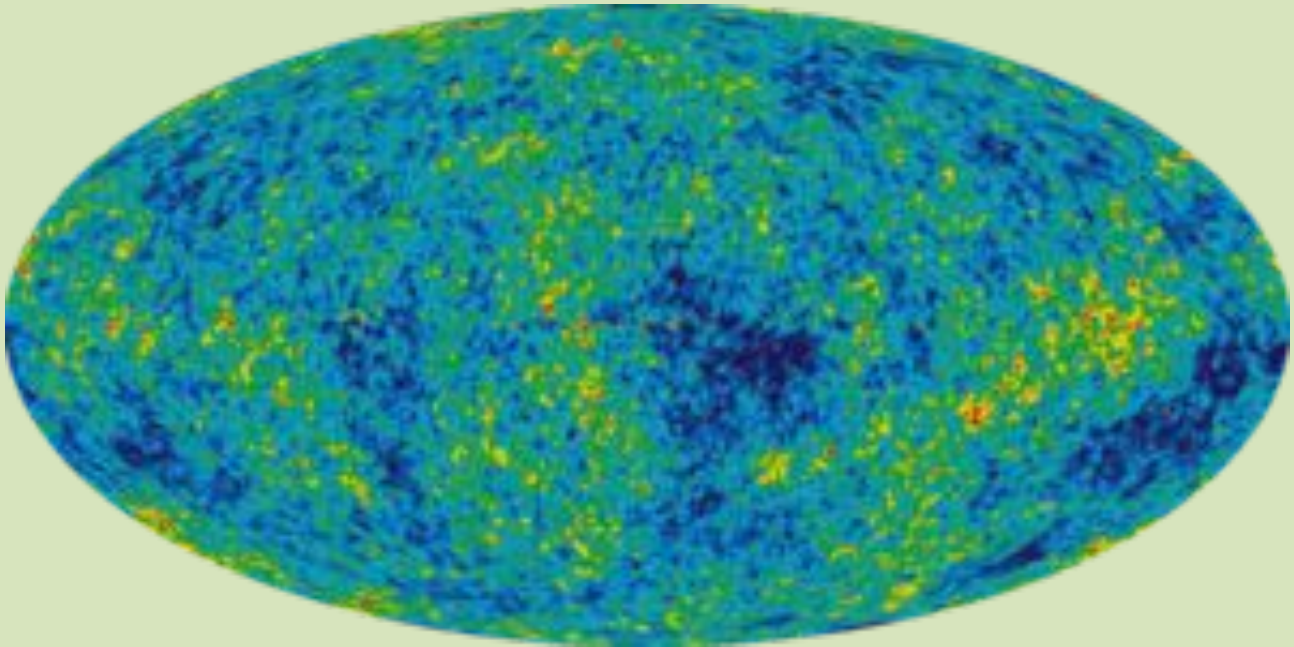


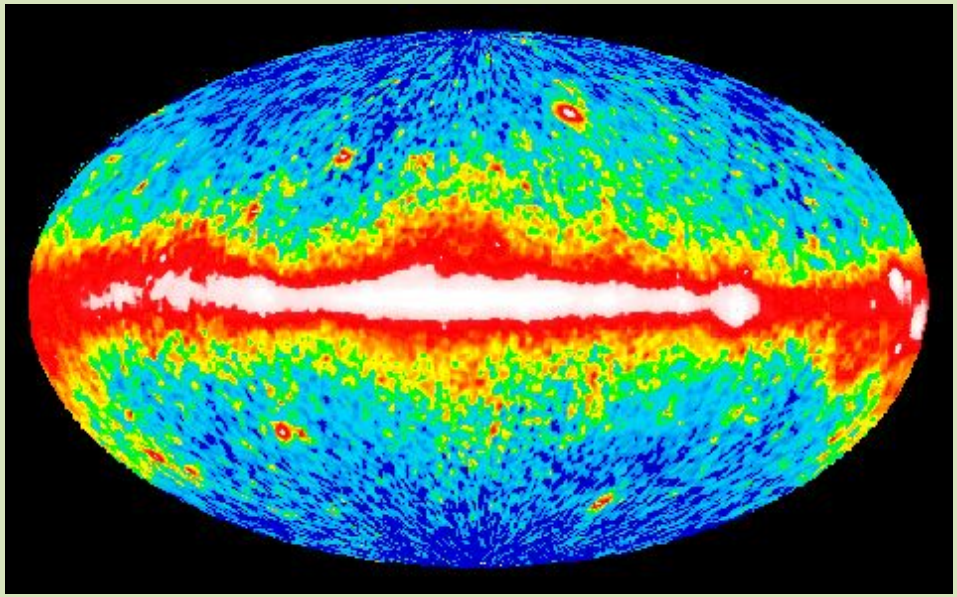


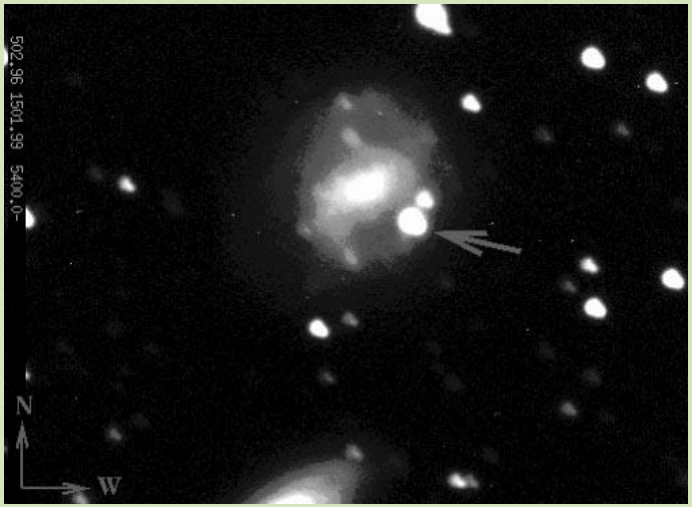
Радио







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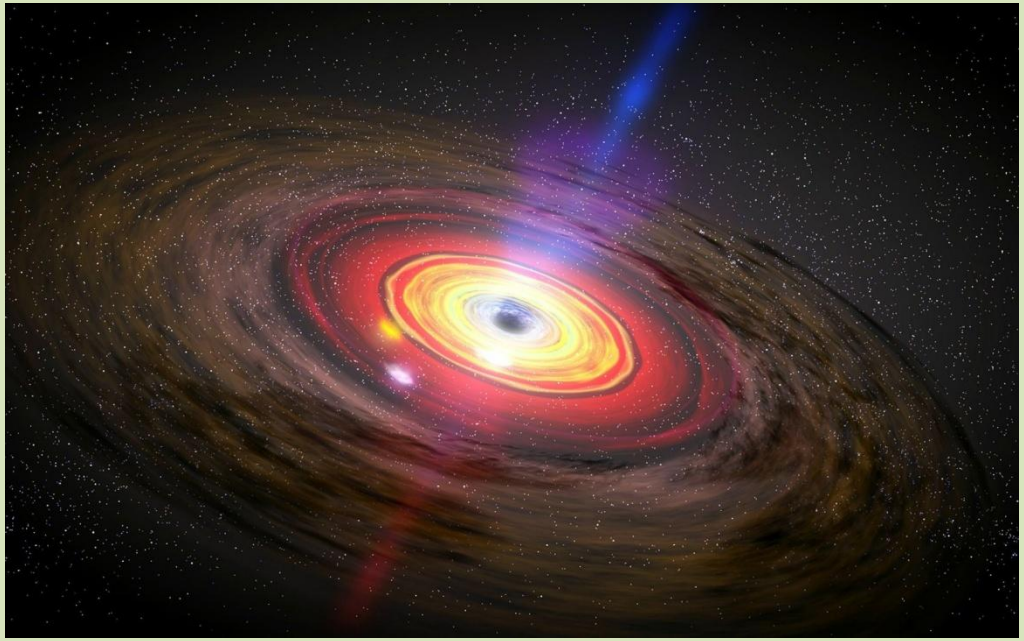

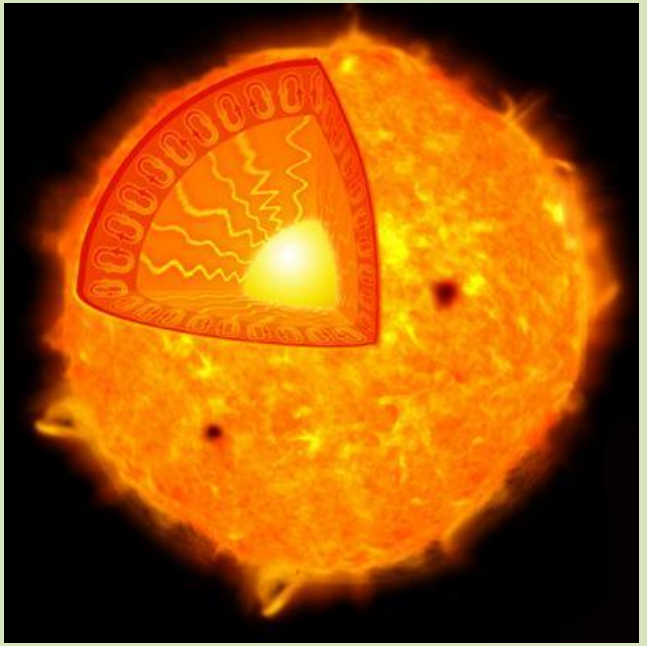

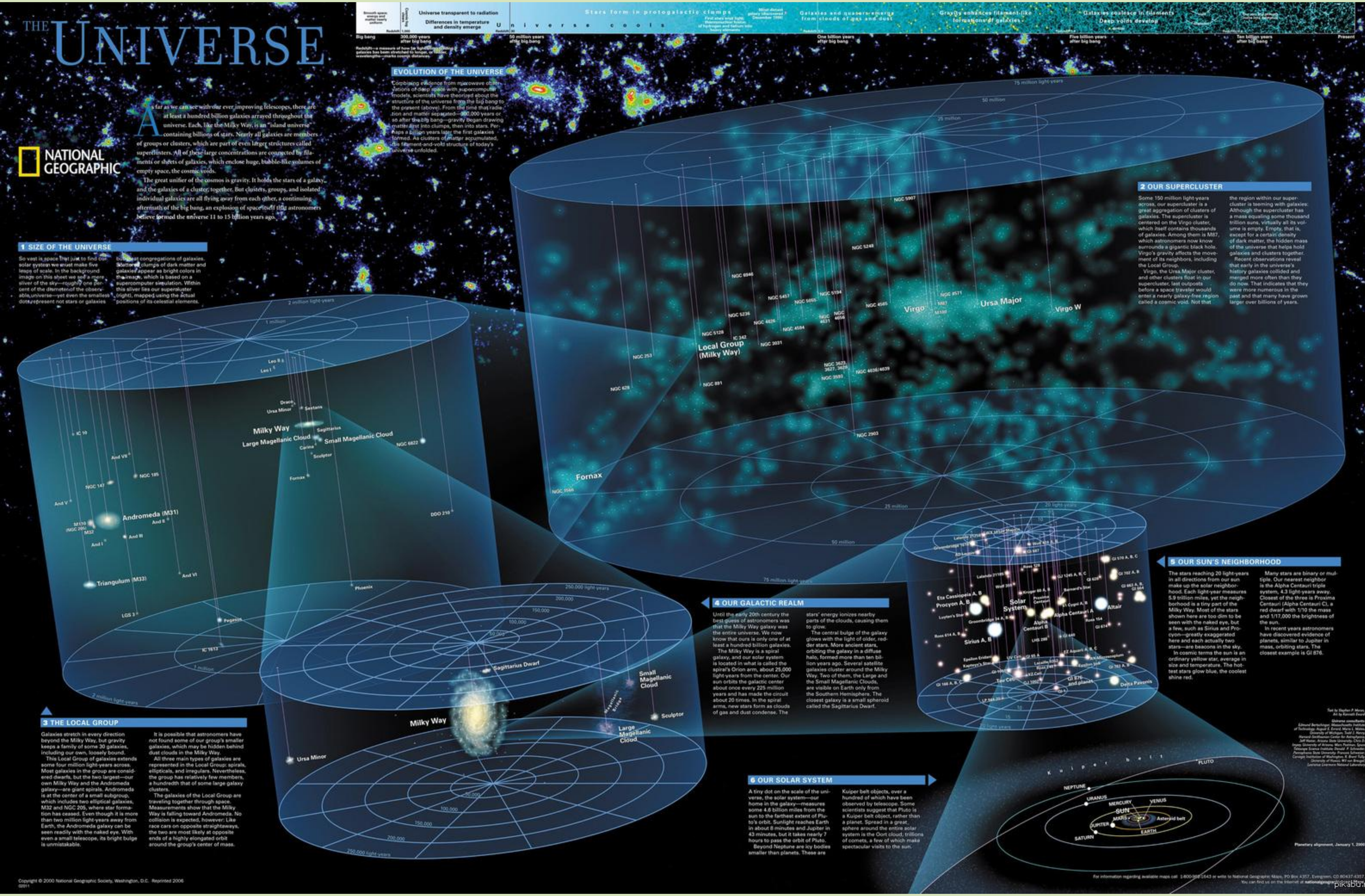
THE UNIVERSE
NATIONAL GEOGRAPHIC
As far as we can see with our ever improving telescopes, there are at least a hundred billion galaxies arrayed throughout the universe. Each, like the Milky Way, is an "island universe" containing billions of stars. Nearly all galaxies are members of groups or clusters, which are part of even larger structures called superclusters. All of these large concentrations are connected by filaments or sheets of galaxies, which enclose huge, bubble-like volumes of empty space, the cosmic voids.
The great unifier of the cosmos is gravity. It holds the stars of a galaxy and the galaxies of a cluster together. But clusters, groups, and isolated individual galaxies are all flying away from each other, a continuing aftermath of the big bang, an explosion of space itself that astronomers believe formed the universe 11 to 15 billion years ago.
Universe transparent to radiation
Differences in temperature and density emerge
Big bang
300,000 years after big bang
50 million years after big bang
One billion years after big bang
Five billion years after big bang
Ten billion years after big bang
Present
Stars form in protogalactic clumps
Galaxies and quasars emerge from clouds of gas and dust
Gravity enhances filament-like formations of galaxies
Galaxies coalesce in filaments
Deep voids develop
EVOLUTION OF THE UNIVERSE
Combining evidence from microwave observations of deep space with supercomputer models, scientists have theorized about the structure of the universe from the big bang to the present (above). From the time that radiation and matter separated—300,000 years or so after the big bang—gravity began drawing matter first into clumps, then into stars. Perhaps a billion years later the first galaxies formed. As clusters of matter accumulated, the filament-and-void structure of today's universe unfolded.
1 SIZE OF THE UNIVERSE
So vast is space that just to find our solar system we must make five leaps of scale. In the background image on this sheet we see a mere sliver of the sky—roughly one percent of the diameter of the observable universe—yet even the smallest dots represent not stars or galaxies but great congregations of galaxies. Scattered clumps of dark matter and galaxies appear as bright colors in the image, which is based on a supercomputer simulation. Within this sliver lies our supercluster (right), mapped using the actual positions of its celestial elements.
2 OUR SUPERCLUSTER
Some 150 million light-years across, our supercluster is a great aggregation of clusters of galaxies. The supercluster is centered on the Virgo cluster, which itself contains thousands of galaxies. Among them is M87, which astronomers now know surrounds a gigantic black hole. Virgo's gravity affects the movement of its neighbors, including the Local Group.
Virgo, the Ursa Major cluster, and other clusters float in our supercluster, last outposts before a space traveler would enter a nearly galaxy-free region called a cosmic void. Not that the region within our supercluster is teeming with galaxies: Although the supercluster has a mass equaling some thousand trillion suns, virtually all its volume is empty. Empty, that is, except for a certain density of dark matter, the hidden mass of the universe that helps hold galaxies and clusters together.
Recent observations reveal that early in the universe's history galaxies collided and merged more often than they do now. That indicates that they were more numerous in the past and that many have grown larger over billions of years.
75 million light-years
50 million
25 million
Local Group (Milky Way)
Virgo
Ursa Major
Virgo W
Fornax
2 million light-years
1 million
Milky Way
Large Magellanic Cloud
Small Magellanic Cloud
Andromeda (M31)
Triangulum (M33)
3 THE LOCAL GROUP
Galaxies stretch in every direction beyond the Milky Way, but gravity keeps a family of some 30 galaxies, including our own, loosely bound.
This Local Group of galaxies extends some four million light-years across. Most galaxies in the group are considered dwarfs, but the two largest—our own Milky Way and the Andromeda galaxy—are giant spirals. Andromeda is at the center of a small subgroup, which includes two elliptical galaxies, M32 and NGC 205, where star formation has ceased. Even though it is more than two million light-years away from Earth, the Andromeda galaxy can be seen readily with the naked eye. With even a small telescope, its bright bulge is unmistakable.
It is possible that astronomers have not found some of our group's smaller galaxies, which may be hidden behind dust clouds in the Milky Way.
All three main types of galaxies are represented in the Local Group: spirals, ellipticals, and irregulars. Nevertheless, the group has relatively few members, a hundredth that of some large galaxy clusters.
The galaxies of the Local Group are traveling together through space. Measurements show that the Milky Way is falling toward Andromeda. No collision is expected, however: Like race cars on opposite straightaways, the two are most likely at opposite ends of a highly elongated orbit around the group's center of mass.
250,000 light-years
Sagittarius Dwarf
Milky Way
Small Magellanic Cloud
Large Magellanic Cloud
Sculptor
Ursa Minor
4 OUR GALACTIC REALM
Until the early 20th century the best guess of astronomers was that the Milky Way galaxy was the entire universe. We now know that ours is only one of at least a hundred billion galaxies.
The Milky Way is a spiral galaxy, and our solar system is located in what is called the spiral's Orion arm, about 25,000 light-years from the center. Our sun orbits the galactic center about once every 225 million years and has made the circuit about 20 times. In the spiral arms, new stars form as clouds of gas and dust condense. The stars' energy ionizes nearby parts of the clouds, causing them to glow.
The central bulge of the galaxy glows with the light of older, redder stars. More ancient stars, orbiting the galaxy in a diffuse halo, formed more than ten billion years ago. Several satellite galaxies cluster around the Milky Way. Two of them, the Large and the Small Magellanic Clouds, are visible on Earth only from the Southern Hemisphere. The closest galaxy is a small spheroid called the Sagittarius Dwarf.
20 light-years
Solar System
Alpha Centauri
Sirius A, B
Procyon A, B
Altair
5 OUR SUN'S NEIGHBORHOOD
The stars reaching 20 light-years in all directions from our sun make up the solar neighborhood. Each light-year measures 5.9 trillion miles, yet the neighborhood is a tiny part of the Milky Way. Most of the stars shown here are too dim to be seen with the naked eye, but a few, such as Sirius and Procyon—greatly exaggerated here and each actually two stars—are beacons in the sky.
In cosmic terms the sun is an ordinary yellow star, average in size and temperature. The hottest stars glow blue, the coolest shine red.
Many stars are binary or multiple. Our nearest neighbor is the Alpha Centauri triple system, 4.3 light-years away. Closest of the three is Proxima Centauri (Alpha Centauri C), a red dwarf with 1/10 the mass and 1/17,000 the brightness of the sun.
In recent years astronomers have discovered evidence of planets, similar to Jupiter in mass, orbiting stars. The closest example is Gl 876.
6 OUR SOLAR SYSTEM
A tiny dot on the scale of the universe, the solar system—our home in the galaxy—measures some 4.6 billion miles from the sun to the farthest extent of Pluto's orbit. Sunlight reaches Earth in about 8 minutes and Jupiter in 43 minutes, but it takes nearly 7 hours to pass the orbit of Pluto.
Beyond Neptune are icy bodies smaller than planets. These are Kuiper belt objects, over a hundred of which have been observed by telescope. Some scientists suggest that Pluto is a Kuiper belt object, rather than a planet. Spread in a great sphere around the entire solar system is the Oort cloud, trillions of comets, a few of which make spectacular visits to the sun.
Kuiper belt
PLUTO
NEPTUNE
URANUS
MERCURY
VENUS
SUN
MARS
Asteroid belt
EARTH
JUPITER
SATURN
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