

series of "rockoons"—balloon-borne rockets—and found the first evidence of radiation belts surrounding Earth.

**1963:** Maarten Schmidt, an astronomer at the California Institute of Technology, identified the first of what he dubbed quasi-stellar objects, or quasars, which can emit thousands of times more energy than the entire Milky Way. Quasars are now thought to be the cores of distant galaxies harboring enormous black holes, and their stupendous energy output is probably caused by radiation released by matter falling into the black hole.

**1967:** Jocelyn Bell detected the first

pulsar, a discovery that won a Nobel Prize for her thesis adviser, Antony Hewish. Bell initially wondered if the regular 1-per-second radio pulses she had

picked up might be a signal from an extraterrestrial civilization. The pulses are now known to be generated by the rapidly spinning, extremely dense cores of burned-out stars.

**1968:** Project Vela, a secret U.S. mission that used satellites to monitor nuclear testing done by the Soviet Union, discovered the first gamma ray bursts. Astronomers now believe the bursts mark the explosions of massive stars.

**1971:** The first black hole, Cygnus X-1, an x-ray emitting object discovered in 1964, was determined to be a black hole.

**1972–1973:** The Pioneer 10 and Pioneer 11 spacecraft were launched in March 1972 and April

1973. The spacecraft made the first images of Jupiter's poles and returned close-ups of the Great Red Spot.

**1974:** Joseph Taylor and Russell Hulse discovered a binary pulsar system, with one pulsar orbiting the other at a rate approaching 10% of the speed of light. The orbit is so tight and the pulsars so compact that the entire binary system would fit within the sun. Gravitational waves emitted by the pulsars have enabled astronomers to rigorously test Ein-

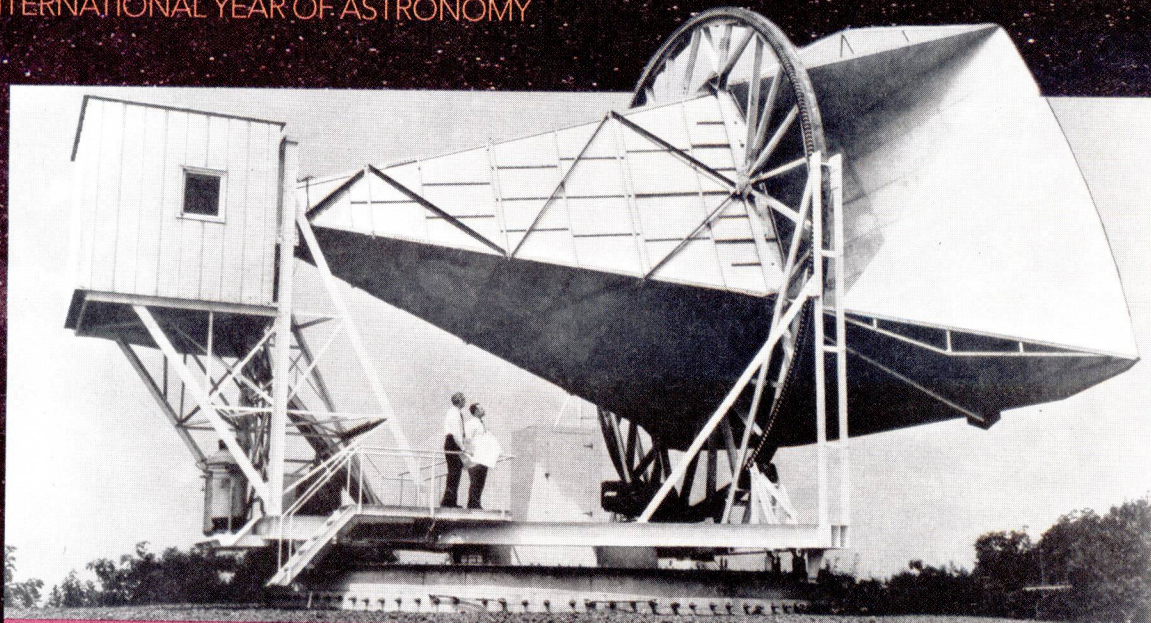
stein's general theory of relativity.



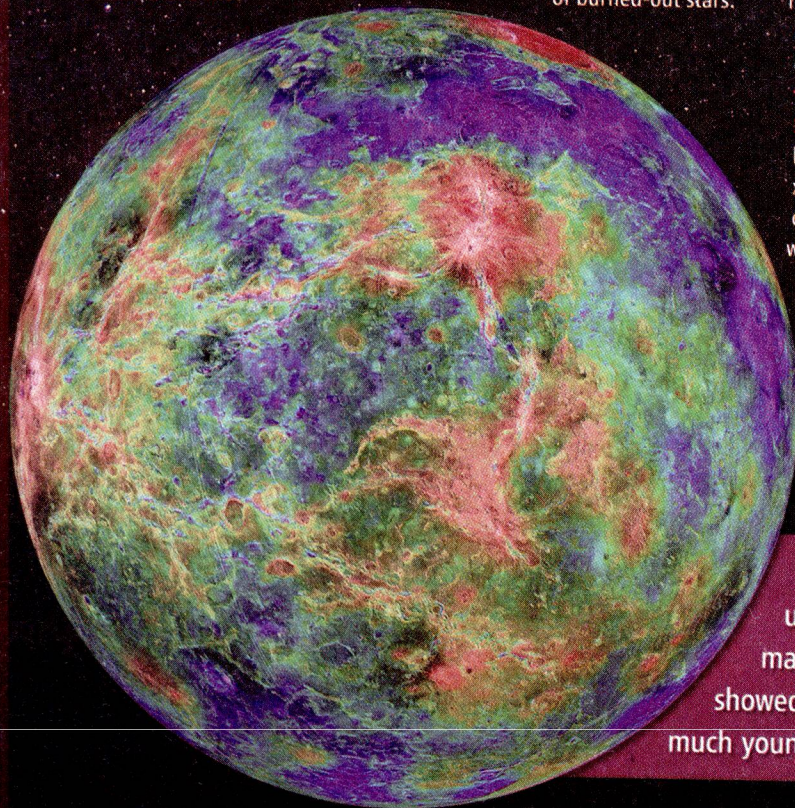
**1977:** The two Voyager space probes were launched and, over the next decade, produced spectacular images of the outer planets, including Saturn and its moons.

**1988:** Canadian astronomers announced the possible discovery of the first extrasolar planet around a star called Gliese 581; confirmation of the discovery came in 2003. Astronomers now believe that at least three planets orbit the star.

**1990:** The Magellan spacecraft used radar to make detailed 3D maps of the surface of Venus. They showed that the planet's surface was much younger than researchers expected.



**1964:** Arno Penzias and Robert Wilson discovered the cosmic microwave background radiation, the big bang's afterglow. At first they thought the signal was caused by heat released from pigeon droppings on the large horn of their radio antenna.







**1995:** Immense pillars of gas in this Hubble image of the Eagle nebula glow with the light from newborn stars.

**1990–present:** The Hubble Space Telescope has found dozens of gravitational lenses, parts of the sky where large concentrations of matter warp light, producing distorted images of distant galaxies.

**1992:** Aleksander Wolszczan, a Polish astronomer, made the first generally accepted discovery of extrasolar planets. The planets orbit a pulsar—the rapidly spinning remnant of a supernova—980 light-years from Earth.

**1994:** Between 16 and 22 July, comet Shoemaker-Levy 9,

which had been discovered just the year before, broke apart and collided with Jupiter.



**1995:** On 7 December, the Galileo spacecraft, launched in 1989, arrived at Jupiter and transmitted some 14,000 images of the planet and its moons back to Earth. Before plunging into Jupiter's

atmosphere in 2003, Galileo found evidence that a 100-kilometer-deep ocean of water may lie beneath the fractured, icy surface of Jupiter's moon Europa.

**1995:** For 10 consecutive days between 18 and 28 December, astronomers used the Hubble Space Telescope to make hundreds of exposures of a single, small region of the sky. The Hubble Deep Field image showed thousands of the youngest and most distant known galaxies.

**1998:** Observations of distant supernovas showed that the expansion of the universe is accelerating, driven by a mysterious "dark energy."

## 2000s

**2001:** The Wilkinson Microwave Anisotropy Probe spacecraft, launched on 30 June, surveyed the cosmic microwave background with unprece-

dent resolution, enabling cosmologists to calculate the age and composition of the universe.

**2003:** In October, astronomers announced the discovery of the largest structure in the universe: the Sloan Great Wall. It is an

enormous collection of galaxies 1.37 billion light-years in length located about a billion light-years from Earth.

**2005:** In November, the Spitzer Space Telescope captured the faint infrared glow left from the first stars in the universe.

**2008:** In September, a Keck telescope on Mauna Kea, Hawaii, and the Hubble Space Telescope captured the first optical images of planets orbiting other stars.

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**2004:** Since the Cassini spacecraft settled into orbit around Saturn on 1 July, it has discovered new moons and hydrocarbon lakes on Titan, and observed wonders such as this strange hexagonal structure at Saturn's north pole.

