Smithsonian Institution News

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Smithsonian Astrophysical Observatory

Fact Sheet

The Smithsonian Astrophysical Observatory, founded in 1890, is a research center of the Smithsonian Institution. In 1955, the Observatory moved to Cambridge, Mass. and became affiliated with the Harvard College Observatory. In that era, the Observatory created the world's first satellite-tracking network, establishing the organization as a pioneer in space science research. In 1973, the Smithsonian and Harvard created the joint Harvard-Smithsonian Center for Astrophysics.

Key Areas of Research at the Center

Structure of the Universe—In 1988, SAO scientists created a 3-D map of thousands of galaxies by measuring galactic redshifts (which are related to galactic distances). This map unexpectedly revealed that the galaxies are not sprinkled randomly through space, but instead lie along the thin walls of enormous cosmic "bubbles," vast voids hundreds of millions of light-years in diameter.

Star Formation—SAO hosts a large group of researchers investigating star formation. That group studies how stars have formed throughout the history of the universe from the first generation to the present day. In June 2001, a team including SAO announced that it had found dusty disks surrounding newly formed brown dwarfs in the Orion Nebula. These results suggest that brown dwarfs share a common origin with stars and, like stars, may have planetary systems around them.

Planet Search—SAO astronomers were the first to discover a planet by looking for a star that dims as the planet crosses in front of it. This technique holds promise for finding the first Earth-sized planets around other stars. In addition, SAO theorists have predicted how to find planets in young stellar systems by looking for their wakes in dusty disks around newborn stars.

The Sun and Solar Weather—A high-resolution ultraviolet spectrograph developed by SAO was placed on the Solar and Heliospheric Observatory (SOHO) spacecraft to study the sun's corona and the solar wind. In late 2003, this instrument observed tremendous eruptions on the surface of the sun that sent energy and charged particles racing toward the Earth. The eruptions caused communications disruptions and sparked brilliant auroral displays seen as far south as Texas and Florida. SAO also has developed computer models that may one day help forecast these storms and warn astronauts.

Asteroid/Comet Study & Tracking—The formation of planets is a key part of the history of our solar system. "Leftovers" from this cosmic construction process—comets and asteroids—can provide

vital clues to the earliest epochs. SAO scientists formulated the modern theory of cometary composition and structure. They also determine and refine asteroidal and cometary orbits to watch for potential impactors.

Space-based Observatories

Chandra X-ray Observatory—NASA's Chandra X-ray Observatory is the most sophisticated X-ray observatory ever built, providing images 25 times sharper than previous pictures. When launched in 1999, Chandra joined the Hubble Space Telescope as one of NASA's "Great Observatories." Chandra observes X-rays from high-energy processes taking place throughout the universe, allowing more detailed studies of black holes, supernovae, and dark matter. Chandra is operated by SAO from a control center in Cambridge.

Spitzer Space Telescope—NASA's Spitzer Space Telescope, launched in 2003, is the fourth and last of NASA's "Great Observatories." Spitzer collects infrared radiation from the youngest and most distant galaxies in the universe, as well as from cold and dusty regions within the Milky Way. Spitzer's Infrared Array Camera, developed by SAO scientists, was the first instrument to directly detect light from a planet orbiting a distant star. It also has discovered miniature solar systems forming around tiny brown dwarf stars.

Submillimeter Wave Astronomy Satellite—This satellite was designed to study the chemical composition of interstellar gas clouds. Launched in 1998 and now operated from Cambridge, it looked for emissions primarily from molecules of water, oxygen, and carbon monoxide. In 2005, the satellite awakened from hibernation to observe the Deep Impact probe hit Comet Tempel 1. Material excavated in that impact showed that the comet's surface was drier and dustier than theorists predicted.

Ground-based Observatories

Submillimeter Array (SMA)—The world's first submillimeter array, dedicated in November 2003, consists of eight 6-meter (20-foot) diameter movable antennas located on Mauna Kea, Hawaii. The SMA makes high-resolution observations in the little-explored submillimeter region of the electromagnetic spectrum. The SMA was designed to study star-forming regions, molecular clouds, quasars, and active galactic nuclei. It has a maximum resolution 30 times better than any existing submillimeter facility, comparable to the Hubble Space Telescope's optical resolution. The SMA is a collaboration between SAO and the Institute of Astronomy and Astrophysics of the Academia Sinica of Taiwan.

Fred Lawrence Whipple Observatory—Located 35 miles south of Tucson, Arizona at Mount Hopkins, the Fred Lawrence Whipple Observatory is the largest field station of SAO. The observatory's facilities include a highly sensitive 10-meter (33-foot) gamma-ray telescope and the 1.3-meter (51-inch) PAIRITEL robotic telescope, which quickly points to and observes dramatic, unexpected events such as supernovae and gamma-ray bursts. Whipple Observatory also is home to three members of the HAT network of robotic telescopes, as well as 1.5-meter (60-inch) and 1.2-meter (48-inch) reflector telescopes.

MMT Observatory—The MMT, located on the summit of Mount Hopkins, initially consisted of a system of six 1.8-meter (72-inch) telescopes on a single mount. It was converted to house a single 6.5-meter (21-foot) mirror possessing more than twice the light-gathering power of the original MMT and able to view an area of sky about 400 times larger. Its state-of-the-art instruments include Megacam, a 6-megapixel camera capable of taking stunning astronomical portraits, and Hectospec, a spectrograph that can analyze light from 300 galaxies at once. SAO operates the MMT jointly with the University of Arizona.

South Pole Telescope—A new 10-meter (33-foot) telescope currently is being constructed at the South Pole. The telescope is designed to conduct large-area surveys of faint, low contrast millimeter and submillimeter emission Because of its exceptionally cold and dry atmosphere, the South Pole is arguably the best ground-based site for observations at submillimeter wavelengths. This telescope will help scientists learn about the mysterious dark energy phenomenon that is speeding up the expansion of the universe.