Summary of Scientific Results – 1999

This year was momentous for the National Astronomical Observatory of Japan (NAOJ) and the world of astronomy. The Subaru Telescope completed construction and began operations twenty years since its initial conception. The world-class telescope sits majestically with 12 other observatories on the summit of Mauna Kea, a 14,000-foot mountain on the Island of Hawaii. Along with three other large 8-10 meter class telescopes, Subaru has transformed the summit of Mauna Kea into one of the premier astronomical research locations.

The Subaru Telescope is named for the Pleiades star system, known to western astronomers as the Seven Sisters. The greatest feature of the telescope is its single-piece primary mirror, which at 8.3 meters (27 feet) across is the world's largest. Thanks to its large size, the light-gathering ability of Subaru surpasses that of the Hubble Space Telescope by more than tenfold and its field of vision is 75 times wider. Subaru is mainly used for observation in the optical and infrared wavelengths. Its mission is to explore as wide range of astronomical phenomena as possible, from the birth and death of individual stars to the collisions of large galaxies. With a suite of highly sophisticated instruments, Subaru unravels the most profound mysteries of the Universe.

On January 28, 1999, Subaru had its first observation, commonly referred to as "First Light". Images from this period included those of nearby Jupiter and Saturn, young stars forming within the Orion nebula, and the farthest known celestial entity, a quasar 14 billion light years in the distance. A spectacular beginning to this state-of-the-art telescope.

Observations at Subaru can be classified into two groups: one is imaging objects to investigate their structure and brightness, and the other is spectroscopy which spreads light into its constituent colors to study temperature, composition, and other physical characteristics. The early observations were completed with two instruments: the Subaru Prime Focus Camera, Suprime-Cam, and the Cooled Mid-Infrared Camera and Spectrometer, COMICS. Suprime-Cam is an 80 million pixel digital camera positioned at Subaru's prime focus to conduct efficient deep imaging of a large area of sky. With a very fast focal ratio of f/1.9 and a wide field of view (30 by 24 arcminutes) each image covers an area comparable to the size of the full moon. The faintest details visible in its images are about 1000 million times fainter than what can been seen with the unaided eye. Instrument COMICS is a camera and spectrograph taking advantage of the thin dry air on Mauna Kea to detect mid-infrared light from astronomical objects. COMICS observes in long infrared wavelengths (8 to 28 microns) and is used to study the evolution (birth through death) of stars and the formation of interstellar dust, the raw material for planets.

Later in the year, Subaru showed two distinct bodies when looking at Pluto and its companion Charon. Simultaneously, Subaru made the discovery of extraterrestrial solid ethane (C_2H_6), a leftover component of primordial material from when the solar system was formed or possibly a product of when ultraviolet light reacted with methane on Pluto. Further observations confirmed the existence of water ice on Charon and the lack of ice on Pluto. These findings lent support to a formation theory of the Pluto-Charon system similar to our Earth and Moon.

As the year passed, Subaru looked further into our Galaxy and confirmed the presence of two separate protostars in L1551-IRS5, a gaseous cloud 450 light years away. Because of the high resolution of the Subaru Telescope, two separate jets, within which the protostars are located, were distinguished from an earth-based telescope for the first time. Just a little further away, Subaru imaged the Ring Nebula M57 in great detail, allowing for a more thorough understanding of its nature. For the first time, the outer halo associated with M57 was clearly observed, showing that the structure of the planetary nebulae is considerably more complex than previously considered, which, in turn, provides a more detailed understanding of its nature.

One of the benefits of the large mirror on Subaru is that faint light from very, very far away can be detected. This year Subaru imaged galaxies close to 10 billion light years away at a time when the Universe was still young and less than half of its present size; sharp and bright details in these faint galaxies appeared as never before seen. These observations were conducted in the infrared wavelength because distant objects have their visible light redshifted into the infrared part of the spectrum due to the expansion of the Universe. These distant galaxies will be examined in greater detail through the observatory project called Subaru Deep Field. Specifically, the project will observe a one-degree wide field near the North Galactic Pole, and because it passes nearly directly over Mauna Kea, the Subaru Telescope is a prime candidate to study the galactic contents of this distant part of the Universe.