Summary of Scientific Results – 2000

This year concentrated on finalizing the commissioning of the Subaru Telescope to provide the highest performance in the astronomical world. Performance verification tests were conducted and First Light events occurred on a wide-array of instruments. The adaptive optics system came on-line and Suprime-Cam demonstrated capabilities close to its theoretical maximum sharpness. To end the year, Subaru began Open Use operation and welcomed astronomers from around the world. Subaru has already left its mark on the new millennium.

During the second year of operation, the four focal units on Subaru were set up and calibrated, and the observational instruments went through test observations and tireless engineering to maximize their capabilities. The first-generation instruments, consisting of innovative cameras and spectrographs (FOCAS, CIAO, OHS, IRCS, and HDS) operating in optical or infrared light, all commenced observations. A brief description of each instrument system follows.

Four instruments (FOCAS, CIAO, OHS, and IRCS) experienced First Light in February 2000. One of these, the two-ton Faint Object Camera and Spectrograph, FOCAS, detects visible light in one of two modes (imaging and spectroscopically), and can automatically switch between modes via computer control. FOCAS can image directly or can obtain spectra of faint galaxies in order to estimate their physical parameters, such as temperature and density. On its first night of operation, FOCAS imaged the Cigar Galaxy M82, a mere 12 million light years from Earth.

Another instrument “seeing” for the first time in February was CIAO, a large Coronagraphic Imager with Adaptive Optics. CIAO observes near-infrared radiation of wavelength 0.9 to 5.5 microns, which is between visible light and middle-infrared. What makes this instrument unique from the two other near-infrared instruments (IRCS and OHS) is that CIAO has a mechanism called a coronagraph that is able to hide a star (and its brightness) under a circular black mask so that dim objects near that star may be imaged. The aims of CIAO are to observe star-formation regions and directly discover a planet around a nearby star.

Two weeks after CIAO received its first photons of radiation, the OH-Airglow Suppression Spectrograph (OHS) experienced First Light. OHS, a large instrument installed at the infrared Nasmyth focus, is designed to work with near-infrared radiation between 1 and 2 microns. OHS helps the detection of faint astronomical objects by removing background light caused by OH (hydroxyl) molecules in the Earth’s upper atmosphere. It is particularly useful for studying dim celestial objects at all other wavelengths, such as distant galaxies and brown dwarfs. The OH-suppressed light is fed from OHS into another instrument,

typically near-infrared camera and spectrograph CISCO, which then acts as the detector.

A brief three days later saw the Infrared Camera and Spectrograph (IRCS) achieve First Light. Mounted at the Cassegrain focus, IRCS can take both images and spectra in the wavelength range of 1 to 5 microns, commonly known as the “thermal infrared”. What makes IRCS unique is that it can image at longer wavelengths than OHS, over a wider field of view than CIAO, and offers higher resolution spectroscopy than both instruments. Among other projects, IRCS is used to search for brown dwarfs, investigate chemical reactions around stars, and study the dynamics of distant galaxies.

Mid-year at Subaru brought First Light for a large and heavy instrument mounted at the optical nasmyth focus, High Dispersion Spectrograph (HDS). As the name suggests, HDS observes objects in visible light between 0.3 and 1 microns and disperses/splits their light into 100,000 separate colors. With these qualities, HDS is used to study the chemical compositions of old stars in our Galaxy and distant clouds of gas to better understand their evolution. Its high precision also allows for the indirect detection of planets around other stars. A few days after First Light, HDS made observations of nearby comet LINEAR (C/1999S4), confirming Subaru’s ability to perform non-sidereal tracking and clearing the way for studying objects within our Solar System.

The end of 2000 brought two momentous events: First Light for the adaptive optics (AO) system and Open Use operations. The AO system allows for sharper imaging of celestial objects by monitoring atmospheric turbulence and compensating for the distortion. The AO system essentially removes atmospheric blur and provides image quality and clarity close to Subaru’s theoretical limit. With the telescope and instruments having completed their preliminary set-up and testing, Subaru began accepting applications and proposals from non-Japanese astronomers. The world-wide demand to conduct research at Subaru was overwhelming; the number of nights requested outbid the number of nights available by a factor of 6.2. Subaru was the new telescope with the best new instruments and everyone wanted to experience the wonderment; a lucky few were privileged to experience.