Summary of Scientific Results - 2006

Subaru Telescope completed another year of observations using sophisticated instrumentation that allowed for discoveries of significant import. Studies were completed within our Solar System and Galaxy, and, most impressively, at the edge of known space. Subaru also welcomed in a new and improved adaptive optics system that opened up portions of the sky never viewed before. These and other amazing events all took place at Subaru during 2006.

This year, the state-of-the-art adaptive optics (AO) system was upgraded and improved by a factor of ten. AO removes the twinkle and eliminates the blur from visible and infrared observations. The original system was made up of 36 elements, while the new system delivers sharper images because it uses 188 elements, allowing for the correction of more subtle distortions. The new system improves image resolution of fainter objects under worse weather conditions. The new AO system allows the telescope to operate at its theoretical resolving power. Concurrently with the new AO system, Subaru developed and installed a new laser guide star system that allows astronomers to create an artificial star anywhere in the sky. The new systems enable astronomers to study objects previously unobservable and do so with more detailed imaging and spectroscopy.

As with previous years, Subaru set milestones with the discovery of more satellites around Saturn. An astronomer from the University of Hawaii, who is the preeminent explorer of planetary satellites, used the Subaru telescope to find 9 new moons around Saturn. Along with this discovery, Japanese astronomers imaged comet Schwasmann-Wachmann 3 as it passed close by and crumbled into more than 50 pieces. Their study showed how dirty ice balls called comets fall apart, which, in turn, will enable astronomers to find out how comets stay together.

Some of the research conducted at Subaru focuses on stars within our own galaxy to better understand the formation and evolution processes of stars and planets. The investigation into proto-planetary disks around two nearby stars revealed some astonishing findings. Star Beta Pictoris, a scant 60 light years away, was studied with infrared polarization for the first time to achieve better resolution and higher contrast. The images suggested that the disk around Beta Pictoris contains planetesimals, asteroid or comet-like objects, that collide to generate dust that reflects starlight. Another team of astronomers found that star, HD142527, exhibited a shape never seen before in a proto-planetary disk; it has two banana-shaped arcs facing each other rather than the donut or spiral shape commonly seen. The odd shape may be explained by the presence of a dim companion star or possible planet. A study similar to these two aforementioned, is the exploration into another young star HD 141569A and its circumstellar disk, an area providing raw material for the creation of planets.

Astronomers found that the star has abruptly developed a hole at the center of its disk through photo-evaporation larger than the orbit of Saturn. When and how a disk dissipates has direct consequences on the probability of a planet forming around the nearby star.

An interesting phenomenon that captures everyone's imagination is a black hole. We know that one lays at the center of the Milky Way Galaxy and almost every other galaxy. New observations by a research group led by a Japanese astronomer discovered that active super-massive black holes can be completely surrounded by dust, obscuring their presence from detection in all directions. The group confirmed that this type of black hole could account for the bulk of the infrared luminosities from merged gas-rich spiral galaxies.

This year, as in previous, much focus was put into research towards the known edge of the Universe. One study, led to the discovery of a large number of galaxies that existed when the universe was less than a quarter of its current age. The team calculated how the life-cycle of stars and mergers of early galaxies lead to the formation of galaxies we see today. Another team, discovered three-dimensional filaments extending across 200 million light-years of space in galaxies that formed 12 billion years ago. These filaments are the largest known structures ever discovered, and are probably the progenitors of the most massive galaxies that exist today. Not to be outdone in distance, a Japanese astronomer found the eleventh most distant quasar currently known at 12.7 billion light years away. Quasars are rare events and consist of a huge outburst of gravitational energy from matter that is falling into a very massive black hole. Just a little further away, gamma-ray burst GRB 050904 was analyzed by Subaru to show that more than 80% of the hydrogen between galaxies was already ionized only 900 million years after the birth of the Universe. Finally, the most distant and earliest known galaxy, IOK-1, was observed by Subaru astronomers as it appeared 12.88 billion years ago. The discovery showed astronomers that we are viewing the reionization of the Universe, which indicates that we are excavating into the "Dark Ages" of the Universe when the first generation of stars and galaxies came into existence.