

## Summary of Scientific Results – 2003

This year at Subaru was filled with wondrous moments of discovery from new moons around our celestial neighbors to short-lived luminous wonders and onwards to galaxies found in the earliest years of the Universe. A new instrument came on-line to join a collection of world-class instruments and made a discovery immediately out-of-the-box. Subaru continues to impress and attract astronomers from around the world with its capabilities.

One of the truly unique events of 2003 was the closest approach of Mars in recorded history. On August 27<sup>th</sup>, Mars came closer to Earth than it had in 60,000 years, a short 34-½ million miles away. This event was captured not only with an infrared camera from Subaru but also a high-definition television camera. Other significant events within our Solar System included the discovery by Subaru of 21 new satellites around Jupiter and a new satellite around Saturn. This brought the total number of Jupiter's moons to 58 and the total for Saturn's moons to 31.

A new instrument called COMICS (Cooled Mid-Infrared Camera and Spectrograph) began operations this year. It observes in the mid-infrared, the longest wavelength among the Subaru instruments, and, as the name suggests, performs functions as an imaging camera and spectrograph. What is exciting about COMICS is that pretty much everything it observes will be a new discovery because of its sensitivity and the fact that mid-infrared technology is only a few years old. For instance, COMICS found the first direct evidence of crystalline silicates in a proto-planetary disk surrounding a Sun-like star. Previous research was limited to stars much more massive than the Sun.

In April of last year, Subaru presented research results from spiral galaxy NGC 4388 located within the Virgo Cluster. This year, astronomers began a challenging research program aimed at finding intracluster planetary nebulae, and are doing so by studying the overall properties of the Virgo Cluster. So far, they have detected an isolated compact HII region in the space between the cluster galaxies. This is a very different site for star formation than normally seen in galaxies and shows that stars can form in the "diffuse" outskirts of galaxies. The observation program plans to discover more of these objects and explore their properties.

Another galactic research project at Subaru called PISCES aims at obtaining a panoramic view of distant cluster formation and the galaxy evolution therein. Images were taken of Galaxy Cluster RX J0151.7-1357 using Suprime-Cam, showing details and qualities never before seen. Even though the central region of the cluster was located approximately 7 billion light years away, clear structure and galactic properties were visible, providing an opportunity to map out the total mass distribution of the cluster.

A few of the more wondrous phenomena in astronomy include supernova, hypernova, and gamma ray bursts. A supernova occurs when a star explodes releasing its energy at an intensity that may briefly outshine its host galaxy before fading from view. These are rare events, and on average, a supernova occurs about once every 50 years in a galaxy the size of the Milky Way. A first for astronomy occurred when Japanese astronomers at Subaru discovered 18 distant supernova at one time. The newly discovered supernova are located 4 to 7 billion light years away. A hypernova simply describes a supernova of a supermassive star 20 to 50 times that of the Sun, and a gamma ray burst (GRB) is the most luminous event in the Universe albeit very powerful and very short-lived (secs to mins). While studying gamma ray burst GRB 030329, astronomers confirmed that the after-glow spectra showed similarities to a hypernova. This was the first GRB to exhibit these characteristics.

Subaru continued to use its unique qualities to explore the distant regions of the Universe. Located approximately 12.5 billion light years away, astronomers discovered a minuscule galaxy that may be an early building block of larger galaxies found today. The petite galaxy is less than a hundredth the size of the Milky Way and has less than one percent of the mass of the Milky Way. At approximately the same distance, other astronomers observed large-scale structure and pattern to the Universe. And finally, not to be outdone, researchers involved in the Subaru Deep Field Project detected the most distant galaxy ever observed at 12.8 billion light years away. The previously most distant galaxy with a redshift of 6.56 (see May 2002 result) was also recorded at Subaru; the new distance champion has a redshift of 6.58 and was observed without the help of gravitation lensing.