

Summary of Scientific Results – 2004

The outstanding qualities of the Subaru Telescope, including a wide field-of-view and sophisticated detection instruments, continue to attract astronomers from around the world to study the inner and outer portions of the cosmos. New discoveries are frequently being made that change our fundamental understanding of the Universe and its many components. Subaru leads the way into exploring these new-found frontiers.

Most people think that with a large 8.2m telescope, all of the astronomical research focuses on objects very, very far away. Subaru does like to study the cosmos as far back in time as possible, but we also like to take a new look at familiar neighbors in our Solar System. Comet LINEAR was expected to be a very bright comet as it approached Earth in May 2004, and, as such, was a convenient target for further inspection. Observations of the comet discovered water ice grains in its coma, the second discovery of water ice in any comet. This is significant because cometary nuclei are thought to be remnants of planetary sources that existed in the early Solar System. Just a little further away, Subaru obtained the first infrared spectrum of two of Jupiter's small inner moons. The data shows that Amalthea and Thebe formed in a low temperature environment, and may be two of the few remaining pieces of the material that formed the Galilean moons. Just past Jupiter is another colossal planet, Saturn. Subaru focused its gaze onto Saturn's giant moon of Titan to measure the distant winds raging on that strange world. In support of NASA's Cassini mission, Subaru acquired the direction and speed of winds on Titan to better understand the dynamics of its atmosphere before a robotic Huygen probe would be sent plunging into it.

An area of study for Subaru is the Milky Way galaxy and its inhabitants. One such resident is Beta Pictoris, the first star for which a circumstellar dust disc was discovered. At approximately 62 light years away, Beta Pictoris is surprisingly close and a nice known target to study. Japanese astronomers discovered small amorphous silicate grains in ring-like locations around the star. The team concluded that the grains are replenished by the collisions of planetesimals. Just a little further away in the constellation Auriga, another team of Japanese astronomers studied a protoplanetary disc surrounding star AB Aurigae using a super sharp resolution of 0.1 arcsecs. They discovered that the planetary nursery is not a featureless and smooth place, but a place where gas and dust swirl in a complex spiral pattern. This discovery evoked many theories and produced new goals into determining how the spiral structure formed and if planets can form in the spiral arms.

Two studies this year looked into dwarf irregular galaxies, one (Sextans A) found in the Antila-Sextans Group and the other (Leo A) found in our Local Group. Sextans A is located about 5 million light years away and has a mass of about

100 million stars, about one thousandth of the Milky Way. The oddness of the galaxy is found in the presence of a comparatively large amount of gas and dust for such a small galaxy and a high concentration of hydrogen gas. Leo A is an isolated and extremely gas rich dwarf irregular galaxy with a mass of 0.01% of the Milky Way. Astronomers are attempting to understand galaxy formation, and a deep imaging view of Leo A found for the first time that even small galaxies have a complex structure, indicating a complex history. As we discuss galaxy sizes, shapes, and their formation, this year Subaru also witnessed a large galaxy devouring a small companion galaxy. Gravity from a large elliptical galaxy is tidally tearing apart a nearby dwarf galaxy as it becomes stretched and thinned over 500 thousand light years. Eventually the stars and other material of the dwarf galaxy will be consumed by the larger galaxy.

One of the larger on-going projects at Subaru is the Subaru/XMM-Newton Deep Survey (SXDS), which provides a comprehensive characterization and population census of galaxies from the early Universe to the present. The survey area is 1.3 square degrees, which corresponds to a piece of the Universe 150 million times 150 million light years in area in the Universe 5 to 13 billion years ago. Subaru has stared at this field for over 200 hours revealing details that are a hundred million times fainter than what you can see with the unassisted naked eye. These observations are necessary to study how galaxies have changed over time. Some of the results indicate that bright and massive galaxies form and evolve differently than fainter less massive galaxies. More significant results are sure to follow.