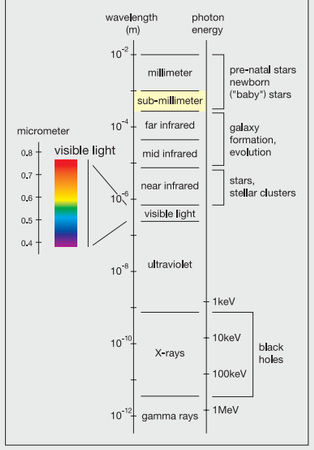
The construction of NANTEN2 and the future of the NANTEN project

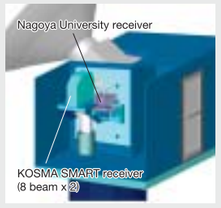
The NANTEN telescope has spent a productive 8 years observing millimeter waves at Chile's Las Campanas Observatory (altitude: 2400m). Now its next target will be the sub-millimeter universe. Sub-millimeter waves have wavelengths of between 300 and 1000 microns (0.3-1.0mm) and are the shortest wavelength radio band. But they are strongly absorbed by water vapour in the Earth's atmosphere, making observing them something of a challenge. In recent years the Atacama plateau, in Northern Chile (altitude: 4800m), has caught the attention of astronomers from all over the world. Its desolate landscape is reminiscent of the surface of the moon, but its thin air and clear, dry climate make it an ideal site for sub-millimeter astronomy. The NANTEN team, keen to take advantage of this, worked to upgrade the telescope to sub-millimeter level precision, and lost no time in relocating to Atacama. Here, the new and improved NANTEN became NANTEN2. With NANTEN2 we will be able to see warm gas clouds that had been invisible to the old telescope, taking us a big step closer to an understanding of such processes as star formation, and the violent activity of supernova remnants, and shedding light on the activity of the Galactic center.

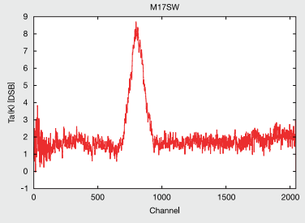
Reasearch topics, by wavelength



The opening of NANTEN2 on November 25, 2004

NANTEN2 houses an "8-eyed" receiver array, built in collaboration with German researchers.The world's only wide-field sub-millimeter telescope is only a short time from completion.





By October 2005 the bulk of the relocation operation was over, and the NANTEN team suceeded in observing their first signal from space. The scientific observing program is to begin shortly.

NANTEN2 Partners as of 2006

Nagoya University, Japan / Osaka Prefecture University, Japan
University of Cologne, Germany / Bonn University, Germany
Seoul National University, Korea / Swiss Federal Institute of Technology Zurich, Switzerland
University of New South Wales, Australia / University of Chile, Chile

Yasuo Fukui

Dr. Yasuo Fukui is a professor of Astrophysics at Nagoya University. Born in Osaka in 1951, he obtained his bachelors degree from the Astronomy department of University of Tokyo in 1974, and completed his doctorate at the same institution in 1979. He worked for a time as an associate professor at Nagoya University before taking up his current post. There, he and his team designed and built a small aperture radio telescope with the world's most sensitive superconductor receiver, and focussed their research efforts on understanding the mechanisms by which astronomical objects form. Over the intervening years he has been responsible for the discovery of many new pre-natal and "baby" stars, and has built an international reputation. In 1996 he masterminded the relocation of the NANTEN telescope (which was in Nagoya at that time) to Chile, and launched an ambitious program to study star birth in the Southern hemisphere. He is currently researching the mystery of giant star clusters in the Magellanic Clouds. Dr. Fukui has been the recipient of the Vainu Bappu Gold Medal, the Inoeu Academic Award, the Nissan Science Award, the Chunichi Culture Prize and the Hayashi Chushiro Award. He has also had an asteroid named after him: asteroid 7890 is called "yasuofukui".

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NANTEN
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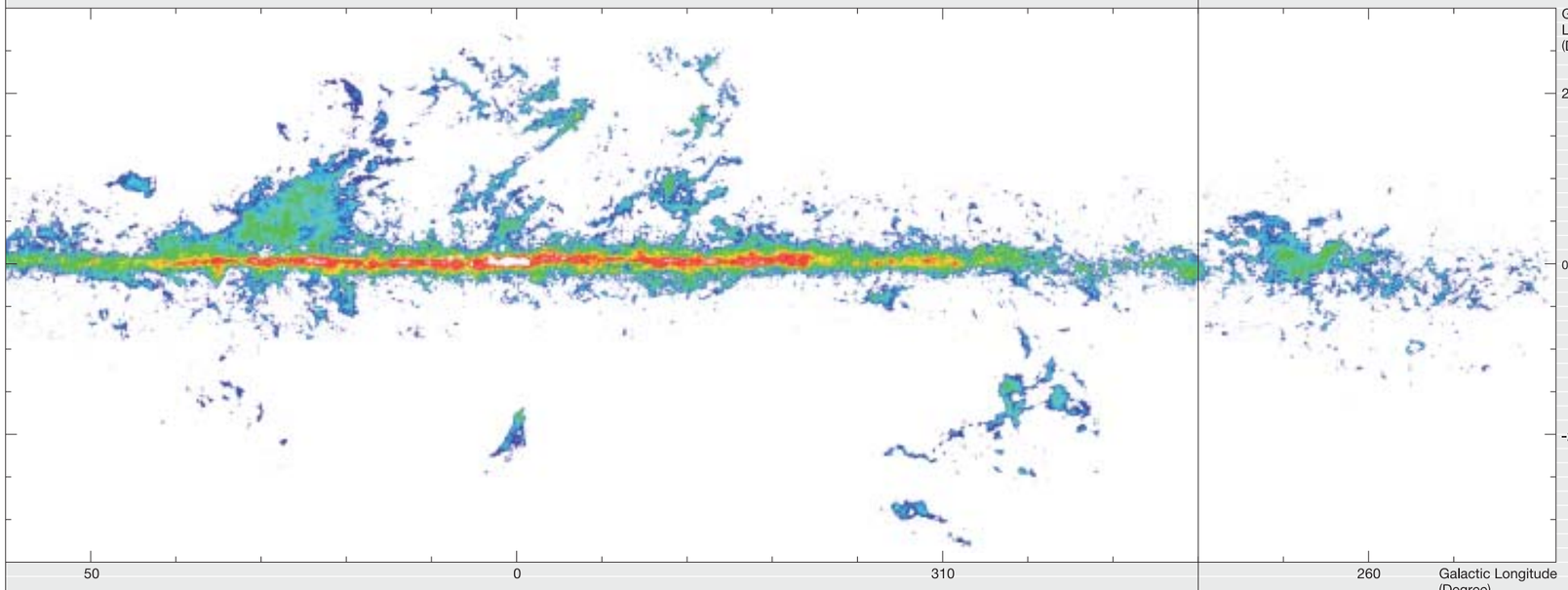
English

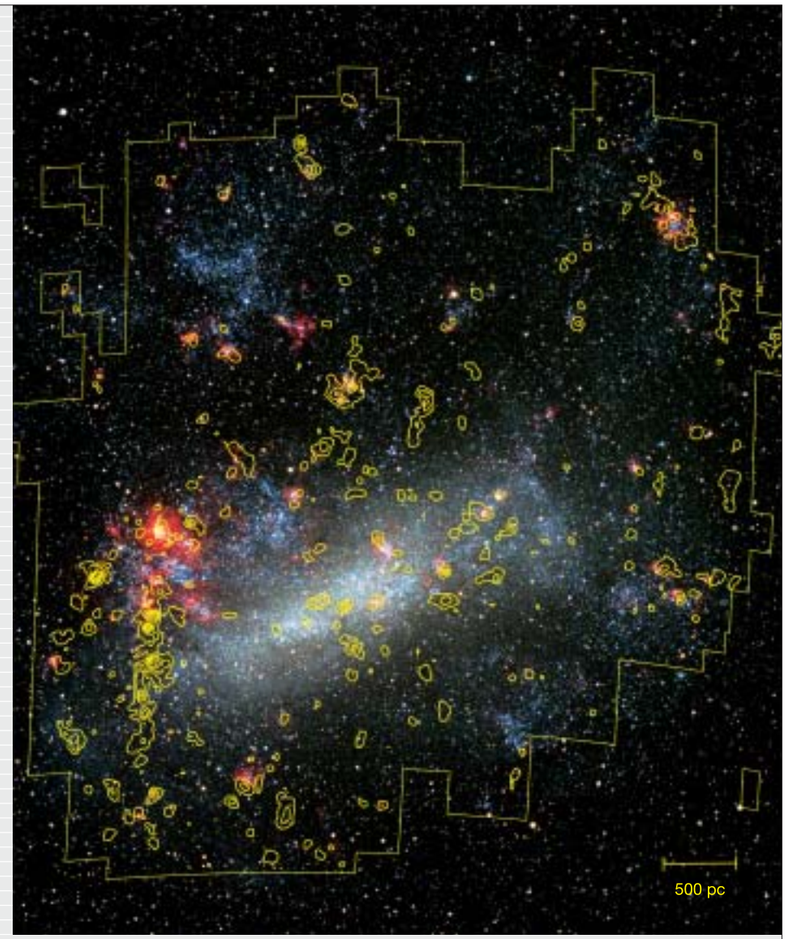
The Galaxy and Magellanic Clouds as seen by NANTEN

After 8 long years of observing with Nagoya University's NANTEN radio telescope in Chile, radio maps of the Galaxy and the Magellanic Clouds have finally been completed. They are the best of their kind to date, showing the structure of the emission with unprecidented clarity, and have resulted in the discovery of thousands of new molecular clouds.



The Large Magellanic Cloud

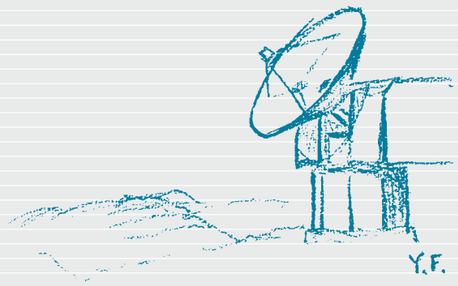
The Large Magellanic Cloud is the closest galaxy to the Milky Way. NANTEN observations have enabled us to map the distribution of almost 300 individual molecular clouds (yellow contours). An understanding of the star formation in the Large Magellanic Cloud will provide valuable clues to understanding star formation in the early universe.

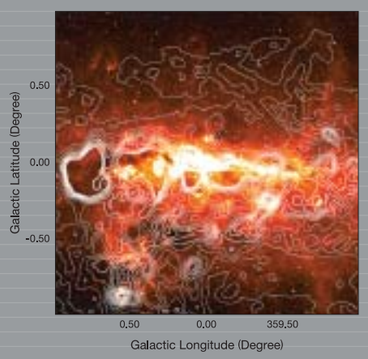


Our galaxy, the Milky Way, is an enormous disk of stars and gas, a hundred thousand light years across. Orbiting around it are our cosmic neighbours, the two small, irregular galaxies known as the Large and Small Magellanic Clouds. These three galaxies were born in our little corner of the universe, which itself began in the big bang almost 14 billion years ago. In 1996 the NANTEN team began an 8 year program of detailed observations of the Milky Way and the Magellanic Clouds. By observing radiation emitted from carbon monoxide molecules, they were able to produce intricate maps of the galactic gas. The long, thin shape in the above image is the Milky Way. It appears that way because we are observing the disk from within — in other words, exactly edge on. Since we are observing from the solar system, the sun is not visible on the image.

The NANTEN telescope observes 2.6mm radio waves (a rather short wavelength in radio terms). Looking at the Galaxy in visible light, we find we can only see regions relatively close to the solar system because light from more distant stars is blocked by gas and dust in the disk. However, radio waves from the gas itself pass right through, meaning that we can see right into the depths of the Galaxy; rather like taking an X-ray to see it's bones. At this very moment, stars just like our sun are being formed in dense clumps of gas, at the rate of around 3 stars per year.

For radio observations a high-precision parabolic dish antenna and a high-sensitivity receiver are essential. NANTEN's receiver utilizes superconductor technology and is one of the best of its kind in the world. The NANTEN team are firm believers in the principle that it's always best to design your own instruments, and the receiver was developed in-house at Nagoya university's instrumentation lab. In fact, most of the telescope parts were developed and built by staff and students at Nagoya university, before being shipped to Chile, installed on the telescope and finally used to make the radio maps you see here.



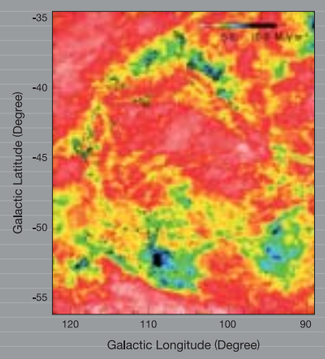


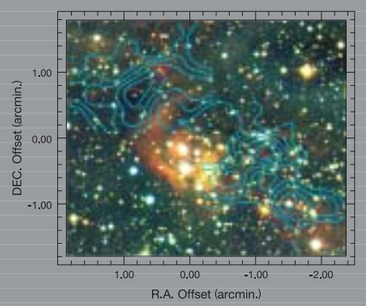
Shells of gas

Areas of space close to our solar system have the great advantage that they can be observed in detail. In the nearby gas towards the constellation of Pegasus, several circle-like structures have been discovered, each one with a bright star in their centers. There is a good chance that the gas structures we see were formed by the stellar winds from these central stars.

The Galactic Center

It is thought that the center of our Galaxy contains a black hole of 3 million times the mass of the sun. NANTEN observations have resulted in the discovery of a previously unknown cloud of gas moving towards the black hole. The white contours in the lower half of this image show this infalling gas cloud. If the cloud continues on its present course, it could be swallowed up in another 10 million years. This gives us an important clue to understanding the outbursts from black holes.





The Carina Giant Molecular Cloud

Carina is a constellation visible from the Southern Hemisphere, which is home to a giant cloud of molecular gas that is actively forming hot, massive stars. It is thought that when one star is born, the intense stellar wind compresses the surrounding gas, triggering the births of the next generation.

Supernovae

It is thought that supernovae occur in our galaxy about 3 times in every hundred years. This image is the remnant of a supernova that occured around the year 400AD. Using NANTEN, gas clouds surrounding the remnant have been discovered, and we have been able to begin investigating how these clouds are violently colliding with hot expanding gas. This is the kind of process by which cosmic rays are produced.