Mino in Japan:
The Infrared Telescope in Space

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JAPAN'S INFRARED TELESCOPE IN SPACE

I was serving at NASA-HQ as the Agency's Program Scientist and Program Manager. One of my projects was the *Infrared Telescope in Space (IRTS),* a modest-sized 15 cm diameter telescope to measure the cosmic background radiation and the Galactic infrared emission. After completion of its mission the IRTS was to be retrieved by the U.S. Space Shuttle and returned to Earth for data analysis.

In the early 1990s, the Japanese Institute of Space and Astronautical Sciences (ISAS) approached NASA seeking help to develop and operate the IRTS. NASA agreed to provide the Far-Infrared Photometer (FIRP) for the IRTS. The FIRP was to be built by the University of California at Berkeley. It was designed to observe the Universe at four wavelengths: 150, 250, 400 and 700 microns. In order to extract these faint signals from those of the interstellar dust and the extragalactic background, the entire FIRP had to be cooled to a temperature near absolute zero.

During the development of the spacecraft and its science instruments ISAS contacted me at NASA Headquarters and inquired about the possibility of sending an American scientist to Japan to help with operations and data analysis. For this opportunity I sought out the help of a young researcher who I quickly realized had enormous potential – and was fluent in Japanese – Dr. Minoru M. Freund, known as "Mino" to his friends and colleagues.

MINO'S ROLE ON IRTS

At that time, Mino had just completed his PhD at the Federal Institute of Technology in Zürich, Switzerland, working at temperatures close to absolute zero and had started a postdoctoral fellowship at the University of California (UC) at Berkeley. Mino's training and expertise in low-temperature physics would be a huge asset for the IRTS mission.

After joining UC-Berkeley, Mino analyzed the original design of the FIRP refrigerator due to Professor Lange. He determined that there was a design flaw that would most likely cause a thermal "short" during operation in space and prevent the FIRP from reaching sub-Kelvin temperatures on orbit. With only eighteen months left to the launch date, Mino designed a new Helium-3 refrigerator, built it and demonstrated that it worked under even the most demanding test conditions. Subsequently, when Mino's FIRP flew on the IRTS satellite, it achieved sub-Kelvin temperatures and maintained them, until the liquid helium supply was

exhausted after nearly five weeks. I feel that Mino did not receive enough credit for his herculean work.

The IRTS telescope was launched into low-Earth orbit from the Tanegashima Space Center in Japan on March 18, 1995. It surveyed the sky for nearly five weeks. It was later retrieved by the Space Shuttle *Endeavour* and returned to Earth.

MINO'S SCIENCE RESEARCH WITH IRTS

An interesting development in the post-operational phase of the IRTS mission is the extent to which Mino also became a key member of another team that developed the point-source extraction and calibration program for near-infrared sources imbedded into the extragalactic background light. A preliminary report of those results was presented at a conference a year after the IRTS mission, but it would take nearly a decade before the definitive results could be published in a peer-reviewed journal – a testament to the difficulty of dis-entangling the faint cosmic background emission from the various confounding sources such as far-away galaxies, dust in our own Milky Way and the zodiacal emission from dust within our Solar System.

By the time Mino had moved on to other intellectual pursuits, he had co-authored 26 IRTS-related papers from 1993 to 2005, including eleven in peer-reviewed journals.

FINAL THOUGHTS

Even before the final IRTS results were published, Mino had expanded his horizons and begun to explore new vistas. He would work as an astrophysicist at NASA's Goddard Space Flight Center from 1999-2002, developing new and sensitive detectors to image the celestial sky at far-infrared wavelengths. He spent 2002-2005 as a research physicist at the U.S. Air Force Research Laboratory in Dayton, Ohio, working to develop a nanotechnology research portfolio for the USAF. Finally, in 2006, he would come home – to the Bay Area and to NASA's Ames Research Center – to become Director of the Center for Nanotechnology and Advanced Aerospace Materials and Devices. Unfortunately, he was with us for too short a time following the discovery of a brain tumor on 2009 August 25.

With the strong and endearing support of his parents and of his colleagues and friends at Ames and around the world, Mino fought valiantly for more than two years, before succumbing on January 17, 2012 two weeks shy of his 50th birthday. During this difficult period, he maintained a vigorous fighting spirit, uplifting many through his online blog "A Little Detour", posthumously included in the 2019 book by Hisako Matsubara: ***Mino – a Young Scientist's Lifelong Journey through Outer and Inner Space***.

It was not until Mino's passing that I fully appreciated his extra-ordinary breadth of talent across the sciences and beyond – history, literature, religion and civilization. He was proficient in English, German, French and Japanese. He learned to play piano at a young age

and was interested in the history of music and composition. He became fascinated, and more than proficient, in art. While growing up in Germany, he began to draw the cityscapes of Cologne and landscapes along the Rhine River. He ventured to Paris and translated the City of Light into a series of remarkable ink drawings. In honor of his special talents, I end this contribution by including two of his sketches: the Notre Dame Cathedral in Paris, and the Kenkun Shrine in Kyoto, Japan.

To honor a true Renaissance man. Your enthusiasm, intellect and curiosity were admirable and infectious. You lived two lifetimes in your short time here. You'll be remembered by many for a long time.