Academia Sinica Press Release

Taiwan Astronomers Begin ALMA Early Science Projects

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Humanity's most complex ground-based astronomy observatory in northern Chile was opened for use by astronomers on September 30. Out of around 900 applications from astronomers around the world, Taiwan succeeded in leading 8 of the 112 projects accepted.

The Atacama Large Millimeter/submillimeter Array (ALMA), the largest and most advanced astronomical complex in the world situated at a 5,000-meter elevation site in northern Chile, was recently opened for its first round of scientific operations called ALMA Cycle 0 Early Science. There was fierce competition among the world's astronomers to gain access to the state-of-the-art facilities and successful projects were chosen based on their scientific value, regional diversity, and their relevance to ALMA's major science goals.

One of the Academia Sinica projects accepted by ALMA is led by Dr. Wei-Hao Wang, an Assistant Research Fellow of the Institute of Astronomy and Astrophysics, Academia Sinica (ASIAA). He and his collaborators will use ALMA to observe two gamma-ray burst host galaxies in the early universe. Gamma-ray bursts are the most energetic events in the universe. Some of the bursts are believed to originate in the catastrophic death of massive stars in distant galaxies. However, very little is known about the nature of the host galaxies.

"ALMA can detect the very faint submillimeter light from the gamma-ray burst host galaxies," said Dr. Wang. "This will help us to understand how fast the galaxies are forming young and massive stars, which is a fundamental property of a galaxy. Once we have clearer ideas about the connection between the properties of the host galaxies and the bursts, we can make better uses of gamma-ray bursts, to probe galaxies in the most distant and early universe," he said.

The other Academia Sinica project accepted by ALMA is led by Dr. Chin-Fei Lee, an Associate Research Fellow at ASIAA. His team will use ALMA to map a jet from a baby star in Orion, in order to measure its rotation and to confirm its roles in removing excess angular momentum in star formation for the first time. "ALMA is a

perfect tool to study the jets because of its unprecedented high angular resolution and sensitivity," he said.

Director of ASIAA, Distinguished Research Fellow Paul Ho, said he was delighted by the success of the members of his Institute and Taiwan astronomers in gaining access to the powerful observatory. He said Taiwan's success was the result of Taiwan's long term dedication and commitment to ALMA. "Taiwan's participation in the ALMA project is the culmination of the development of the radio astronomy program in Taiwan. Through the efforts of the astronomers and the engineers at the ASIAA, in the universities, and in the industrial companies in Taiwan, great contributions have been made in building instruments and developing the scientific programs," he said.

Taiwan joined the ALMA project in 2005 in collaboration with the ALMA-Japan team. In 2008 Taiwan also joined ALMA-North America team. "ALMA-Taiwan" which is based at ASIAA, participated in the construction of ALMA and has made many indispensable contributions. Working with local Taiwan industry, the team established the East Asian Front End Integration Center (FEIC). So far the center has delivered fifteen "front end systems" to Chile. "The front end system to a radio telescope is like the retina of the eye, which allows the telescope to really 'see' the sky," said ALMA-Taiwan Project Scientist, Dr. Liu, Sheng-Yuan, an Assistant Research Fellow at ASIAA. Several Taiwan-based engineers and researchers have also been either continuously posted in Chile or traveled there frequently to deliver hardware, software, and conduct scientific tests of the array.

Taiwan team, including ASIAA, Chung-shan Institute of Science and Technology, CoTech Inc. and Ke Chong Industry, was also in charge of making two Front End Service Vehicles (FESVs) for the complex. The FESV is a custom designed truck which transports and services ALMA's temperature-sensitive astronomical equipment. It can be lifted up to 6.5 meters high and work in severe high-altitude environments. The first Taiwan-made FESV was named *Mei-hua* (梅花), after the national flower of Taiwan. *Mei-hua* arrived in Chile at the end of August and successfully passed the test to serve at 5,000 meters. The second Taiwan-made FESV is named as *Lan-que* (藍鵲), after the Formosan blue magpie. *Lan-que* will finish its tests and be sent to Chile in the early December.

About ALMA

The Atacama Large Millimeter/submillimeter Array (ALMA) is an international astronomy facility which is a partnership between Europe, Japan and North America

in cooperation with the Republic of Chile. Upon completion it will be a 16-kilometer wide array of 66, ultra-precision millimeter/submillimeter-wave telescopes which will work as one giant telescope. At present, around a third of ALMA's eventual 66 radio antennas, with separations up to 125 meters rather than the maximum 16 kilometers, make up the growing array on the Chajnantor plateau in northern Chile, at an elevation of 5000 meters. When the whole array has been set up, it will provide angular resolution of 5 milli arc-second, giving 10 times sharper images than the Hubble Space Telescope, allowing us to observe the universe in the earliest time at high resolution.

Related websites:
http://www.almaobservatory.org/
http://www.nrao.edu/pr/2011/fesv/index.shtml

Media Contacts:
Dr. Chin-Fei Lee, Associate Research Fellow, Institute of Astronomy and Astrophysics, Academia Sinica, cflee@asiaa.sinica.edu.tw (Tel) +886-2-2366-5445
Ms. Pearl Huang, Office of Public Affairs, Central Office of Administration, Academia Sinica pearlhuang@gate.sinica.edu.tw
(Tel) +886-2-2789-8820 (Fax) +886-2-2782-1551 (M) 0912-831-188
Ms. Mei-Hui Lin, Office of Public Affairs, Central Office of Administration, Academia Sinica mhlin313@gate.sinica.edu.tw
(Tel) +886-2-2789-8821 (Fax) +886-2-2782-1551 (M) 0921-845-234

After its month-long journey from Taiwan, the first of two Front End Service Vehicles (FESV) is being tested at the ALMA Operations Support Facility in Chile. In this photo, the FESV cabin has raised to service the interior of a North American ALMA telescope. This first FESV is named *Mei-hua* after the Taiwanese plum blossom, a revered, winter-blooming flower. Taiwan is contributing 2 of the 25 12-Meter telescopes being delivered by ALMA-North America, and also integrating 22 of the front end receiver systems.

CREDIT: *Carlos Padilla, NRAO/AUI/NSF*