A New Telescope for Ground-based THz Astronomy

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***Abstract*— In the spring of 2010, the Academia Sinica Institute of Astronomy and Astrophysics, and the Smithsonian Astrophysical Observatory, acquired the ALMA North America prototype antenna – a state-of-the-art 12-m diameter dish designed for submillimeter astronomy. Together with the National Radio Astronomy Observatory and the MIT-Haystack Observatory, the plan is to retrofit this antenna for cold-weather operation and equip it with a suite of instruments designed for a variety of scientific experiments and observations.**

The primary scientific goal is to image the shadow of the super-massive black hole in M87 in order to test Einstein's theory of relativity under extreme gravity. To do this, the highest angular resolution imaging is required, which can only be achieved by linking this antenna with others already in place to form a telescope almost the size of the Earth. For this reason, we are developing plans to install this antenna close to the peak of the Greenland ice sheet. This location will produce an equivalent north-south separation of almost 9,000 km when linked to the ALMA telescope in Northern Chile, and an east-west separation of about 6,000 km when linked to SAO and ASIAA's Submillimeter Array on Mauna Kea, Hawaii, and will provide angular resolution almost 1000 times better than that of the most powerful optical telescopes.

Of the many other opportunities that will become available to scientists using this telescope, astronomical observations in the partially transparent atmospheric windows between 200 and 300 microns wavelength will be possible for a significant fraction of the time. The Herschel Space Observatory has been making exciting astronomical discoveries in this wavelength range for the past two years. However, the liquid cryogens aboard Herschel will eventually run out, beyond which time no further observations will be possible. Access to the sky in this spectral range is limited to the driest, highest and coldest places on Earth, such as current observatory sites in Antarctica and Northern Chile. Atmospheric measurements made at Summit Station, close to the peak of the Greenland ice sheet, indicate that observations in the atmospheric windows down to 200 micron will be possible during the dry winter season. This new telescope will have ten times the collecting area of the Herschel dish, and will be able to capitalize on the pioneering work of the Herschel Space Observatory.

In this presentation, we will discuss our plans to retrofit the telescope for cold weather operation, the potential instrumentation for THz observations, and the projected schedule.