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Science with the Upgraded ultra-wideband Submillimeter Array (wSMA) in the Next Decade

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1 Extended Abstract

The Submillimeter Array (SMA) is located on Maunakea, Hawaii at an altitude of approximately 4000 meters. The array operations commenced in 2003. It consists of eight movable antennas each with a diameter of 6-meters. The baselines achieved range up to a maximum of approximately 500 meters which enables us to achieve an angular resolution less than 1 arcsecond. Current frequency coverage ranges from 180 GHz to 420 GHz using a set of four different receivers per antenna. The present correlator has a bandwidth of 8 GHz in each of two sidebands Pioneering observations with the SMA have provided new insights into a wide variety of astrophysical phenomena, including the formation and evolution of galaxies, stars and planets, and the nature of the supermassive black hole at the center of the Milky Way.

The SMA project is embarking on a staged upgrade that will increase its instantaneous bandwidth and dramatically improve its observational sensitivity and speed. The wSMA upgrade will provide a core receiver set providing dual-polarization observing bands covering the 345 GHz and 230 GHz atmospheric windows, each with 32 GHz of spectral coverage. Together with upgrades of the signal transport system and digital correlator, this brings a factor of 16 increase in instantaneous bandwidth from the original SMA capability. In effect, every wSMA observation of an astronomical source is an imaging spectral line survey, and an enormous amount of information can be extracted from such data in conjunction with physical, chemical and dynamical models. The wSMA speeds up observations to allow systematic, comparative studies of large numbers of spectral surveys for the first time. The wSMA also will be ideally suited for the study of sources in the time domain.

We expect that this upgrade, which should be complete in the next three years, will usher in a new era of discoveries in submillimeter astronomy in Hawaii. The wSMA will be complementary to ALMA and will be useful for observations that do not require the full sensitivity and angular resolution of ALMA as well as the study of objects in the northern sky that are not visible from the southern location of ALMA. In addition, the wSMA will continue to be a critical VLBI station for the Event Horizon Telescope (EHT). And lastly, the wSMA receiver design allows for the installation of additional instrumentation which can be used for developing innovational techniques.

In this presentation, I will present an overview of the instrument upgrades and focus on some of the key science cases.

References

[1] D. J. Wilner et al., “Science with the wideband Submillimeter Array: A Strategy for the Decade 2017 – 2027", SMA Memo No. 165, 2017