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SOFIA/HAWC+: Mapping the Galactic Center Magnetic Field

Michael W. Werner[1], C. Darren Dowell[1], D. T. Chuss[2], M. R. Morris[3], and G. Novak[4] for the HAWC+ team

[1]Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109
email: Charles.d.dowell@jpl.nasa.gov

[2]Goddard Space Flight Center, 8800 Greenbelt Rd, Greenbelt, MD 20771

[3]UCLA Dept. Physics & Astronomy, 475 Portola Plaza, Los Angeles, CA 90095

[4]Northwestern University, 633 Clark St, Evanston, IL 60208

Abstract. Polarimetry of the far infrared emission from magnetically-aligned interstellar grains is one of the best ways of studying the magnetic field at the Galactic Center. We describe the HAWC+ instrument, under development for flight on SOFIA starting in 2015, which will provide a major advance in capability for these critically important measurements.

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Magnetic fields are a key ingredient of the Galactic Central Molecular Zone (CMZ), responsible for or tracing many of the well-known features within. Previous far-IR / submillimeter polarimetry of emission from magnetically-aligned dust has revealed a large scale toroidal geometry for the field in the densest molecular component of the CMZ, provided tentative evidence for a poloidal field in the lower density molecular gas, established a preliminary field model for the Circum-Nuclear Disk (CND), and highlighted the importance of dynamical events such as supernova shells and tidal shearing in shaping structures and the embedded field on cloud scales. However, these polarization mapping efforts are far from complete in surveying the CMZ, and they have also been limited by the previously available angular resolution. SOFIA and the HAWC+ instrument currently under development will offer a substantial increase in capability to overcome these limitations. HAWC+ is a multi-band polarimeter and camera operating at 50 to 220 microns, and its sensitive, state-of-the-art 64×40 detector arrays will allow widespread mapping of dust and magnetic fields in the CMZ with many thousands of resolution elements as small as 5 arcsec at the shortest wavelength band. This resolution is sufficient to resolve the clumpy substructure of the CND and the filament spacing of the Sickle cloud as well as to apply statistical methods to estimate the field strength in a variety of Galactic Center sites. On larger scales, the HAWC+ field of view of 60 arcmin^2 at the longest wavelengths is very well matched to the sizes of the structures to be imaged in the Galactic Center region. In an integration time of an hour, the minimum flux density for which HAWC+ can achieve $\sigma(P) < 0.3\%$ is 5-to-10 Jy/beam. HAWC+ measures and maps total intensity and linear polarization simultaneously. The spatial resolution and field of view will allow HAWC+ to go far beyond the pioneering studies of the polarization of the far infrared radiation from the Galactic Center led by Hildebrand et al. (1990) using the Kuiper Airborne Observatory.

HAWC+ is the first second-generation SOFIA instrument. It is being developed by a

multi-institution team led by Darren Dowell of the Jet Propulsion Laboratory and is an upgrade of the HAWC instrument developed for SOFIA by Al Harper of the University of Chicago and his colleagues. HAWC+ will be commissioned on SOFIA in mid-2015 and should be available to the SOFIA user community not long afterwards. For further information please contact Darren Dowell.

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References

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