HAWC+: High-resolution Airborne Wideband Camera Plus

Facility Class, Far-Infrared Camera and Polarimeter

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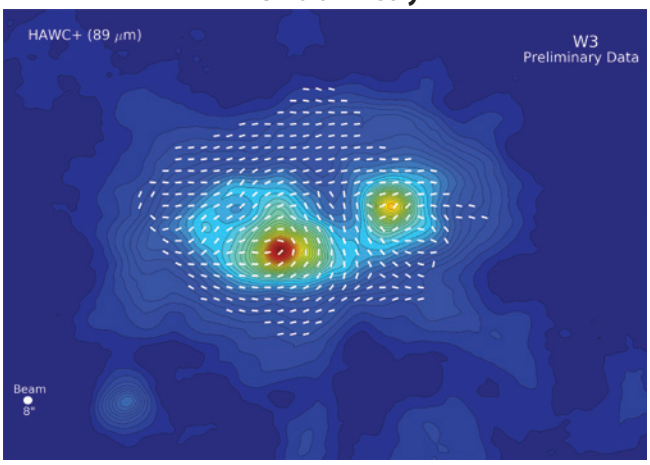
Star Forming Region W3

The structure of the far-infrared polarization in the W3 star forming region, as observed by HAWC+ at a wavelength of 89 µm. Each line segment represents the orientation of polarization at that location overlaid on an image of the total intensity at the same wavelength. Vectors represent the electric field direction. For clarity, only one-quarter of the polarization measurements are shown and the line segments are set to a fixed length. The polarization is caused by the partially oriented radiation from elongated dust grains that are aligned with the magnetic field in the cloud. *(HAWC+ Team)*

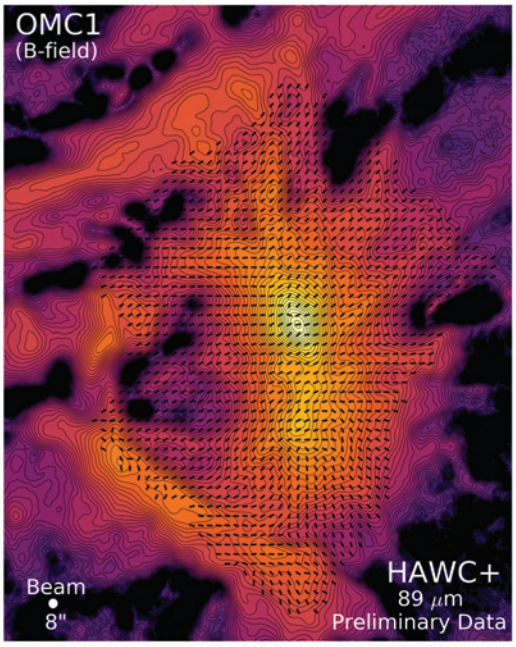
W3 Polarimetry



Star Forming Region Orion

HAWC+ performed polarization measurements at 89 µm to capture the structure of the magnetic field in the Orion star forming region. Each line segment represents the orientation of the magnetic field at that location, overlaid on an image of the total intensity at the same wavelength. The total intensity image has a pixel scale of 1.5 arcsec per pixel and the polarization results were smoothed to a scale of 8 arcsec per pixel to produce statistically independent vectors in this HAWC+ observing band. For clarity, the line segments are set to a fixed length. *(HAWC+ Team)*

Orion Polarimetry

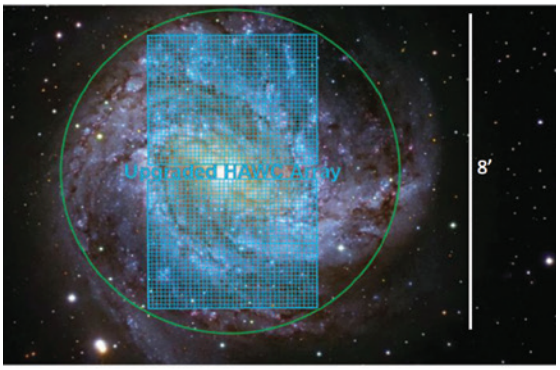


Specifications

HAWC+ offers both total intensity imaging and imaging polarimetry in five bands ranging from 50 to 240 µm. Nod match chop observing mode is used for imaging polarimetry and a number of efficient scan modes are available for total intensity imaging.

For all observing modes, a wire grid reflects one component of linear polarization and transmits the orthogonal component to two comounted detector arrays. A single detector array provides a field of view (FOV) of 32x40 pixels for imaging polarimetry and the two detectors combined yield a 64x40 pixel FOV for total intensity imaging. The detectors are designed to deliver background-limited observations with high quantum efficiency for all the HAWC+ continuum bands.

64x40 HAWC+ Array Footprint



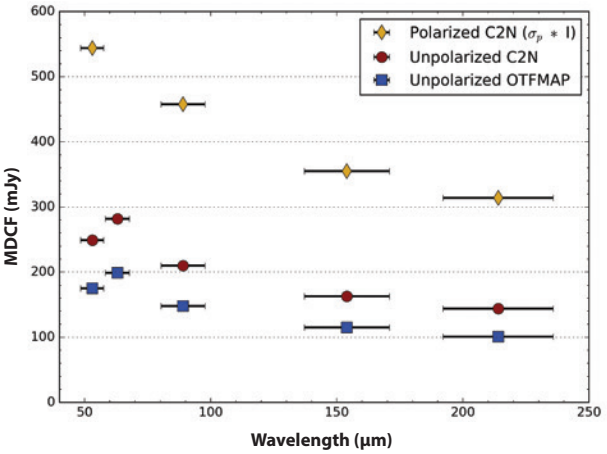
Footprint for total intensity imaging observations using the 64x40 pixel array in Band E. A 32x40 pixel FOV is available for imaging polarimetry observations.

Instrument Parameters for Bands A–E

Band/ Wavelength	Δλ	Angular Resolution	Total Intensity FOV (arcmin)	Polarization FOV (arcmin)
A / 53 µm	8.70	4.85" FWHM	2.8 x 1.7	1.4 x 1.7
B[a] / 63 µm	8.90	10.5" FWHM	4.2 x 2.7	2.1 x 2.7
C / 89 µm	17.00	7.8" FWHM	4.2 x 2.7	2.1 x 2.7
D / 154 µm	34.00	13.6" FWHM	7.4 x 4.6	3.7 x 4.6
E / 214 µm	44.00	18.2" FWHM	8.4 x 6.2	4.2 x 6.2

[a]Band B (63 µm) will be offered as shared-risk during Cycle 9.

HAWC+ Sensitivity



Sensitivity estimates in units of the Minimum Detectable Continuum Flux (MDCF) into a single beam. Values take into account all expected overheads. For polarization, the plotted data show the polarized intensity *p x I*, where *p* is the fractional polarization.

Predicted Performance for Continuum Imaging and Polarimetry

Instrument Parameter	Band A	Band B[f]	Band C	Band D	Band E
NESB[a] (MJy sr^{-1} h$^{1/2}$)	18.8	11.4	6.3	1.6	0.8
MDCF[b] (mJy)	250	400	300	260	230
Mapping Speed[c]	0.0027	0.0290	0.029	1.10	7.0
MDCPF[d] (Jy)	80	150.0	50	50	50
MIfP[e] (MJy sr^{-1} h$^{1/2}$)	28,000	17,000	6,000	2,000	1,300

[a]Noise Equivalent Surface Brightness for S/N=1 into a single beam.
[b]Minimum Detectable Continuum Flux for a point source with S/N=4 in 900s.
[c]Real scan rate required to achieve a given NESB. Units: arcmin^2 h^{-1} (MJy sr^{-1})$^{-2}$
[d]Minimum Total Continuum Flux for a point source required to measure the polarization fraction to an uncertainty level of σ_p< 0.3% with a SNR (in the polarization fraction)≥4 in 900s
[e]Minimum total Intensity required to measure Polarization to an uncertainty level $\sigma_p \leq$ 0.3%. All chop/nod and polarization overhead values have been applied to this value.