THE OBSERVATIONS OF THE VERY-HIGH-ENERGY GAMMA-RAY SKY BY HAWC

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15th International Conference on Topics in Astroparticle and Underground Physics, TAUP 2017
THE OBSERVATORY

Citlatépetl
Pico de Orizaba
5636 m.a.s.l.

97.3° W, 19.0° N

HAWC
4100 m.a.s.l.
THE OBSERVATORY

- 700 TB of data per year is produced and stored in 2 data centers: UNAM and University of Maryland.
- The data is reconstructed and analysed in real time using ~200 cores.

3 Hamamatsu R5912 (8’’)
1 Hamamatsu R7081 (10’’)

The Observatory: 3 Hamamatsu R5912 (8’’), 1 Hamamatsu R7081 (10’’)

- Light-tight bladder
- 200,000 L of purified water
- Photomultiplier tube (PMT)
- Air shower particle
- 5 m
- 7.3 m
- Cherenkov light
HAWC WIDE FIELD OF VIEW

FoV of 2 sr, we scan 2/3 of the sky per day

The Crab Nebula transits overhead of HAWC

The galactic center is at the boundary of the field of view

A.U. Abeysekara et al., APh, 50, 26A, 2013
HAWC SENSITIVITY

EQUATORIAL FULL-SKY TS MAP FOR POINT SOURCE ANALYSIS

Source model: power-law with index -2.7

\[ TS = 2 \ln \frac{L_{\text{max}}(\text{Source Model})}{L(\text{Null Model})} \]

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39 sources were detected, with 19 not associated with previously known TeV sources (association criteria $<0.5^\circ$ away).

GEMINGA

Point source hypothesis with spectral index -2.7

Extended source hypothesis disc of radius 2° and spectral index -2.7
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More about this source and dark matter related searches with HAWC in J. Linnemann’s talk (Thu. 16:00, C112)

LIGHTCURVES

Data from November 26, 2014 to April 20, 2016.

Blue lines mark distinct flux states identified via Bayesian block analysis.

TRANSIENTS EVENTS SEARCHES

• GRB searches:
  • Follow-up observations on alerts from satellites: Fermi-LAT, GBM and Swift
  • 64 GRBs has been analysed. No significant detection has been found but upper limits has been stablished
  • Online all-sky searches (~4 sec latency)

• Real-time flare monitor
  • Fully operational since January 2017
  • 187 targets (blazars): 46 from TeVCat and 141 from 2FHL
  • Detect events in time scales from 2 min to 10 hours
HAWC MULTI-MESSENGER: ICECUBE NEUTRINO TRIPLET

- On February 17 2016 IceCube detected three neutrino candidates within 100 s
- The position of the event entered HAWC’s field of view right after it happened
- HAWC observed a full transit ~6 hours:
  - 19:18 UTC 2016-02-17
  - 01:31 UTC 2016-02-18
- Search was performed using likelihood analysis for point sources with photon index -2.7
- Sky map for 500 GeV < E < 160 TeV

WHAT’S NEXT? OUTRIGGERS

• It will improve the determination of the core when it hits outside the main array

• Event reconstruction efficiency will improve by a factor 3-4 for $E > 10$ TeV

• 350 tanks of 2500 L
• Tank deployment is ongoing
SUMMARY

• HAWC has been operating with its 300 tanks configuration for >2 years

• HAWC is scanning 2/3 of the sky every day with a duty cycle >90%

• A first catalog of TeV gamma-ray sources has been published with 19 new sources

• HAWC provides a quasi-continuos monitoring of the gamma-ray fluxes of the most intense TeV sources: Crab Nebula, Markarian 501 and Markarian 421

• HAWC has MoUs with different experiments providing follow-up observations and also sending alerts

• The outrigger array is being built and it will improve HAWC observations