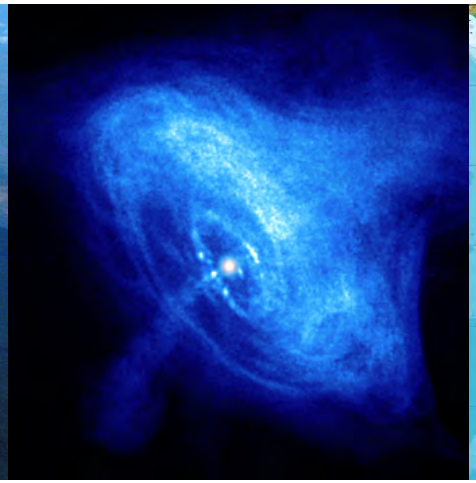




HAWC
High Altitude Water Cherenkov
Gamma-Ray Observatory

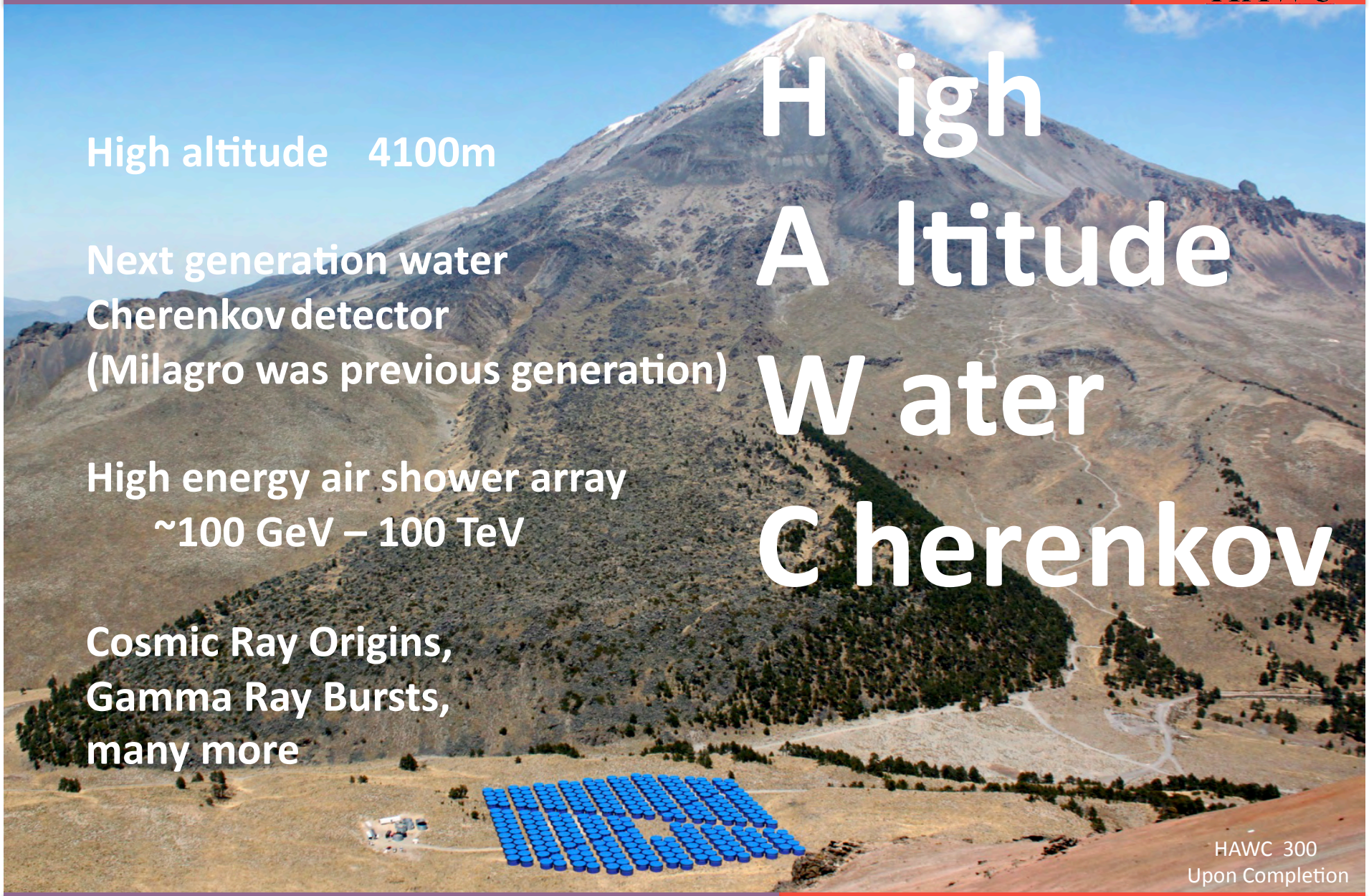
First light…

at HAWC Observatory's high altitude TeV gamma ray detector in Mexico

Daniel Fiorino for the HAWC Observatory
4 March 2012
Rencontres de Moriond


Aerial View of HAWC Site

The HAWC Observatory



High altitude 4100m

Next generation water Cherenkov detector (Milagro was previous generation)

High energy air shower array
~100 GeV – 100 TeV

Cosmic Ray Origins, Gamma Ray Bursts, many more

HAWC 300
Upon Completion

HAWC Equipment

Cherenkov Tanks

Corrugated Steel
4.0m tall, 7.3m wide
Target for Cherenkov light
4 photomultiplier tubes

Photomultiplier Tubes

900 Hamamatsu 8” bulb
Reused from Milagro
Sensitive to UV-optical blue
300 High quantum efficiency (~30%)
Lower energy threshold

Science Goals

Unbiased Skymap

Galactic Sources of Gamma Rays

Supernovae Remnants

- Crab Nebula (SN 1054)
  - Standard Candle… Recent Flares

Extended Objects (e.g. Molecular Clouds)

Galactic Plane

Extragalactic (z<0.1) Sources of Gamma Rays

Active Galactic Nuclei

- flaring
- multiwavelength campaign (Fermi-LAT)

Gamma Ray Bursts

- counterpart (Fermi-LAT/optical telescope alerts)
- assumptions of spectra, constrain EBL

Nearby Galaxies

- starburst galaxies (many SNRs)

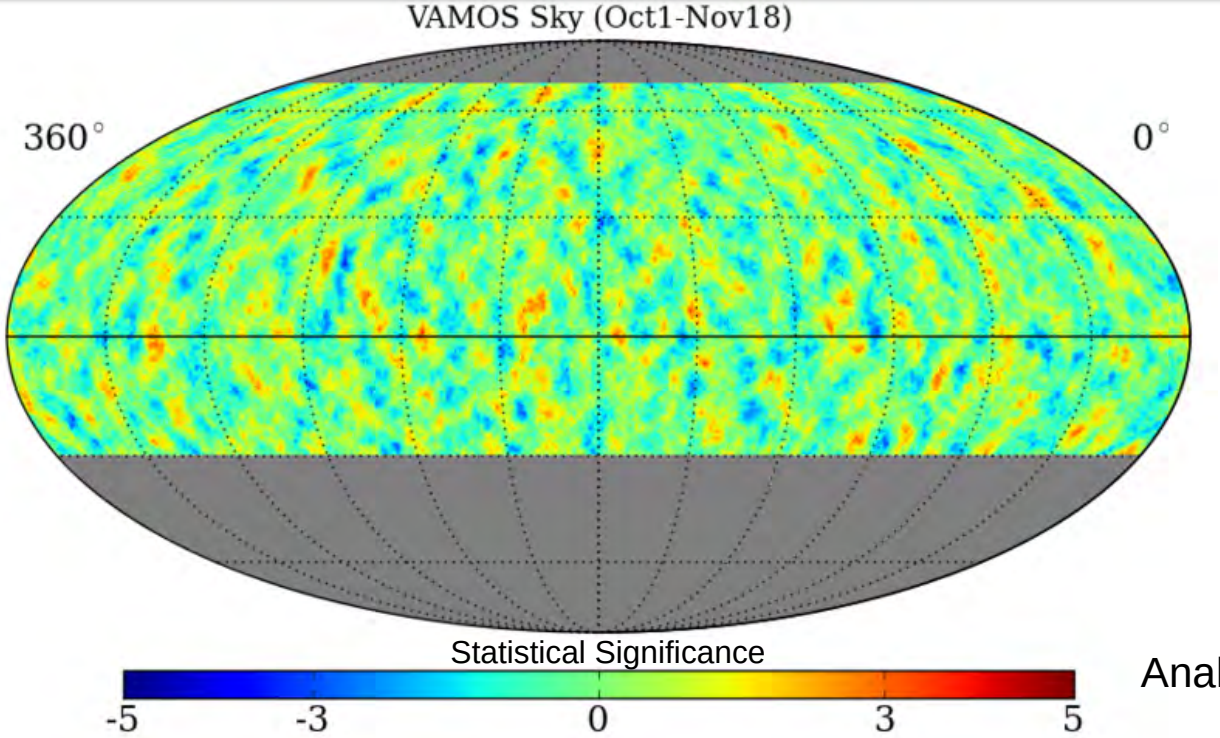
VAMOS – Test Array

Verification and Monitoring of Systems

- 7 Cherenkov tanks
- 3 months of data
- 7 photomultipliers per tank

Exceeded set milestones
Improved deployment technique
Online systems running
Analysis Chain → Skymap

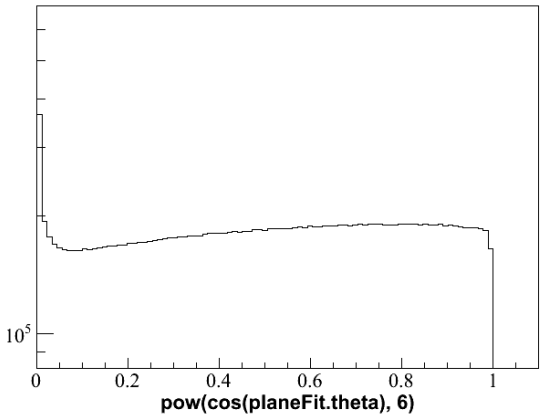
First Light

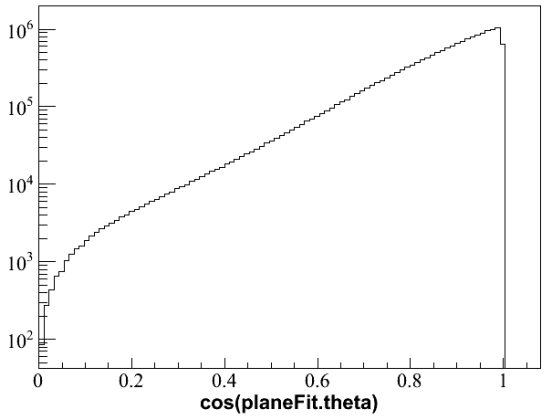


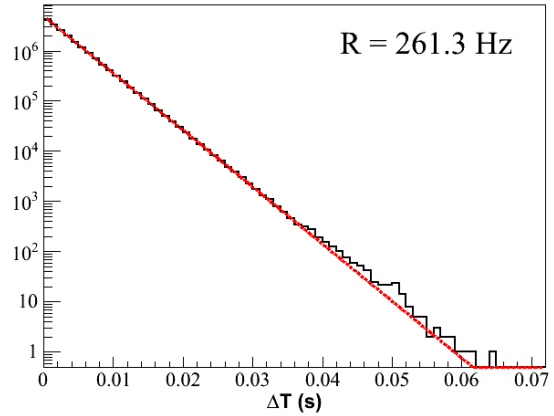
Skymap

- Compare data with background estimated using data
- "On source" vs. "Off source" comparison
- Li and Ma Statistics

Analysis by D. Fiorino (UW)







Analysis by Jim Braun (UMD)

Stay Tuned…

30 Tanks are scheduled to be operational this Fall (2012)

Site is leveled
Tank positions are laid out
Electronics ~ May 2012

Verify Cosmic Ray Rates
Zenith Alignment
Cosmic Ray Anisotropy?
Moon Shadow?

HAWC 100 Tanks
(> Milagro sensitivity)

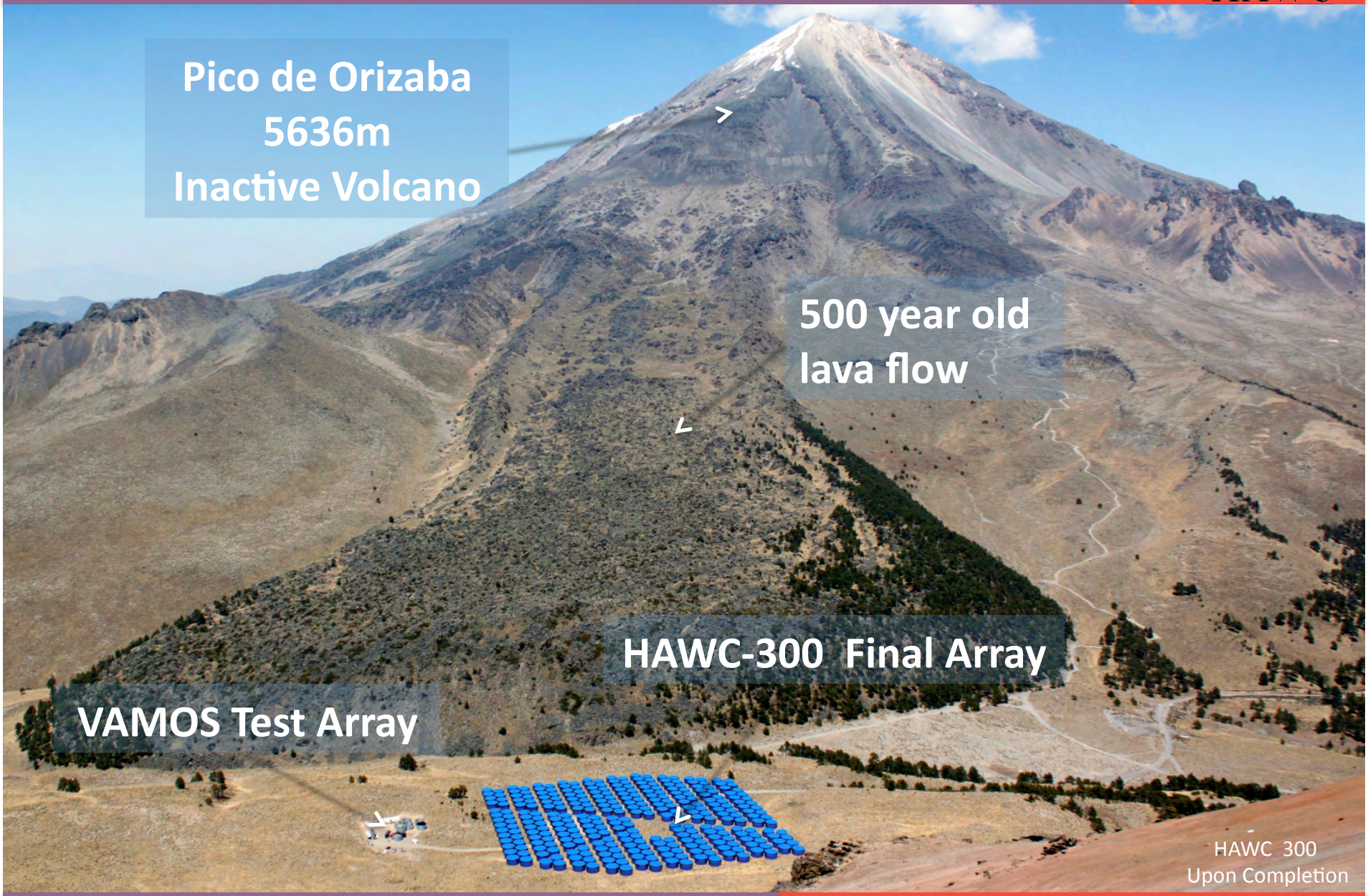

Thank You!

The HAWC Collaboration

Colorado State University
George Mason University
Georgia Tech University
Harvey Mudd University
Los Alamos National Lab
Michigan State University
Michigan Tech University
NASA/Goddard
Ohio State at Lima
Pennsylvania State University
University of California-Irvine
University of Maryland
University of New Hampshire
University of New Mexico
University of Utah
University of Wisconsin-Madison
Benemerita Universidad Autonomica de Puebla
Centro de Investigacion y de Estudios Avanzados
Universidad Autonoma de Chiapas
Universidad de Guadalajara
Universidad de Guanajuato
Universidad Michoacana de San Nicolas de Hidalgo
Universidad Nacional Autonoma de Mexico

HAWC
High Altitude Water Cherenkov
Gamma-Ray Observatory

The HAWC Observatory



HAWC Improves Upon Milagro

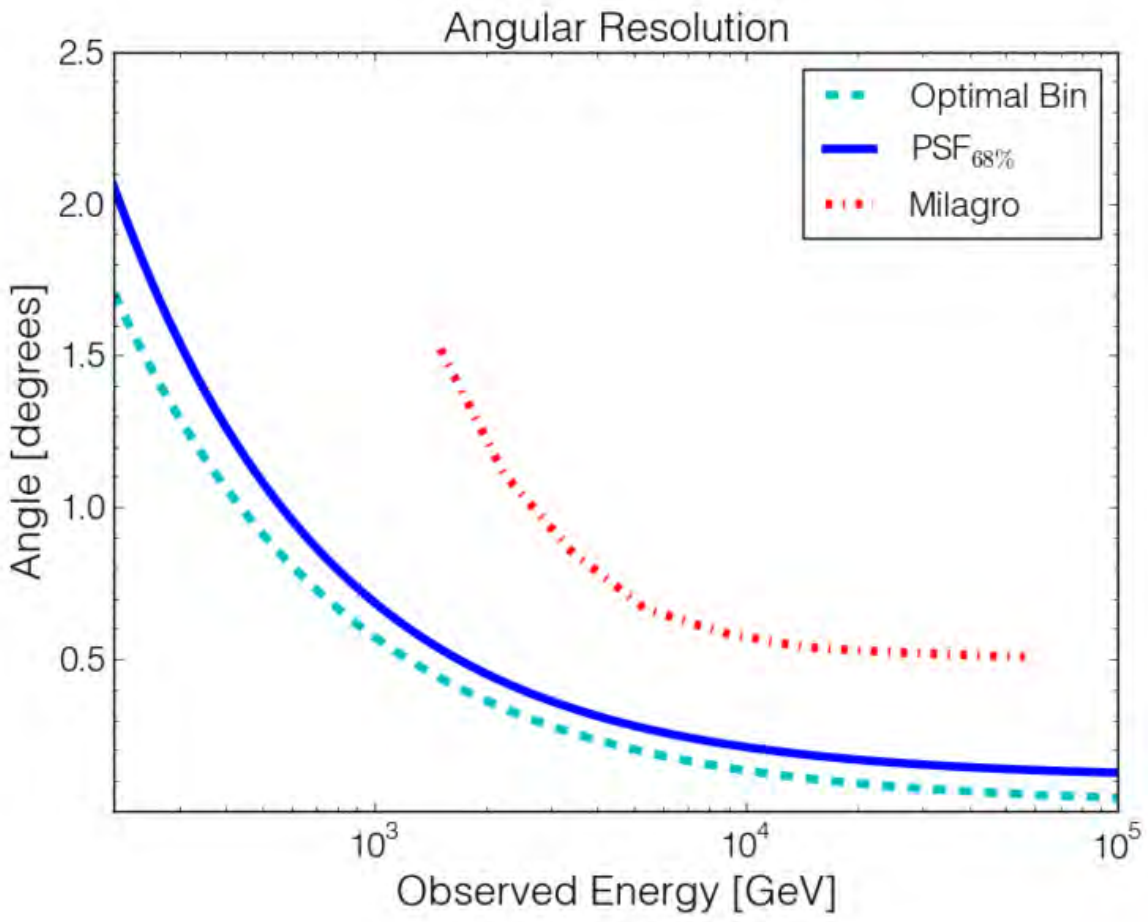
Water Cherenkov experiments provide unbiased information that no others can provide. HAWC is the logical next step.

Optically isolated tanks
- Better resolution (timing and charge)

Higher altitude
- Closer to shower maximum
- More particles, lower energy threshold

High quantum efficiency PMTs
- More Cherenkov light yield

Improved Angular Resolution



Error in reconstructing arrival direction

Simulated showers (CORSIKA) incident on simulated HAWC (GEANT4)

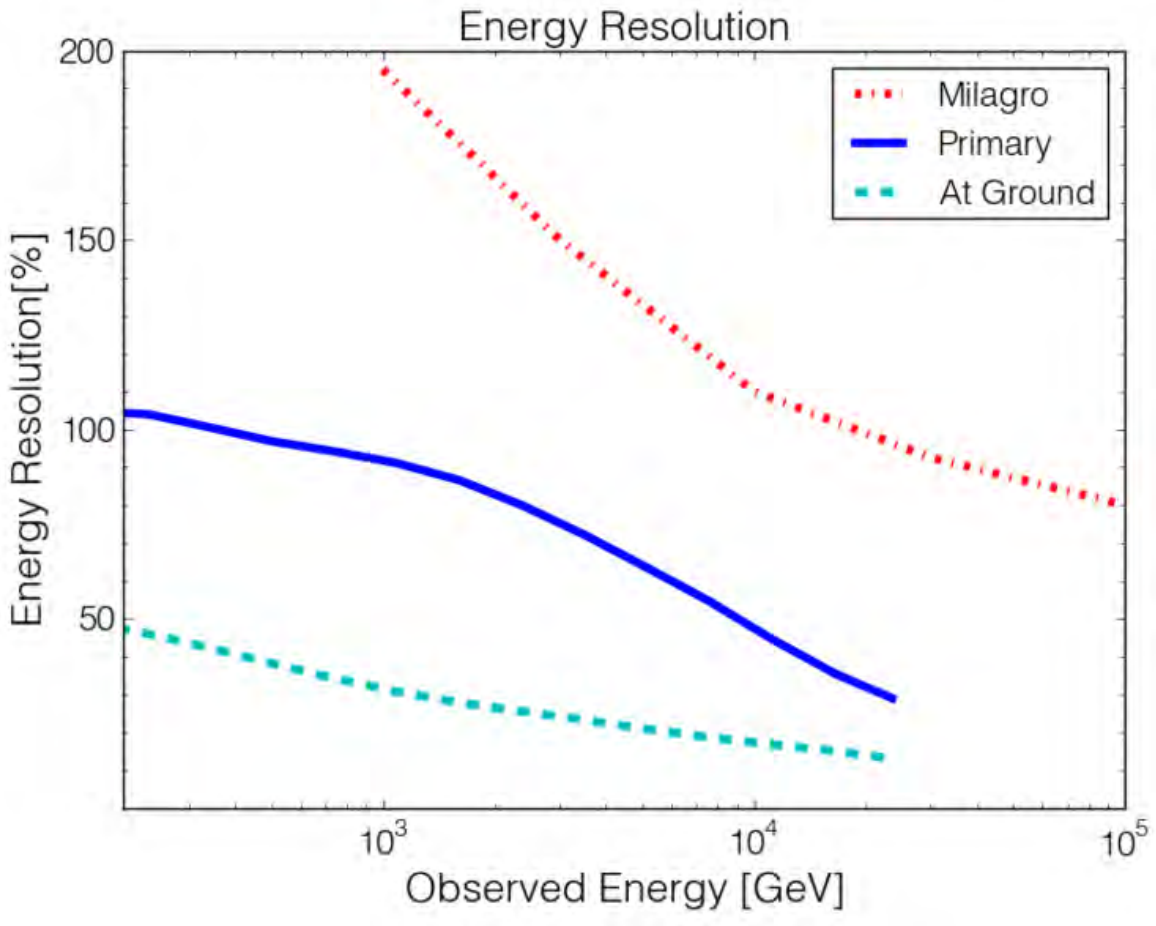
Competitive with imaging air Cherenkov telescopes at highest energies

Optical isolation

Dense sampling

PSF = Point spread function

Improved Energy Resolution



Error in reconstructing energy

Simulated showers (CORSIKA) incident on simulated HAWC (GEANT4)

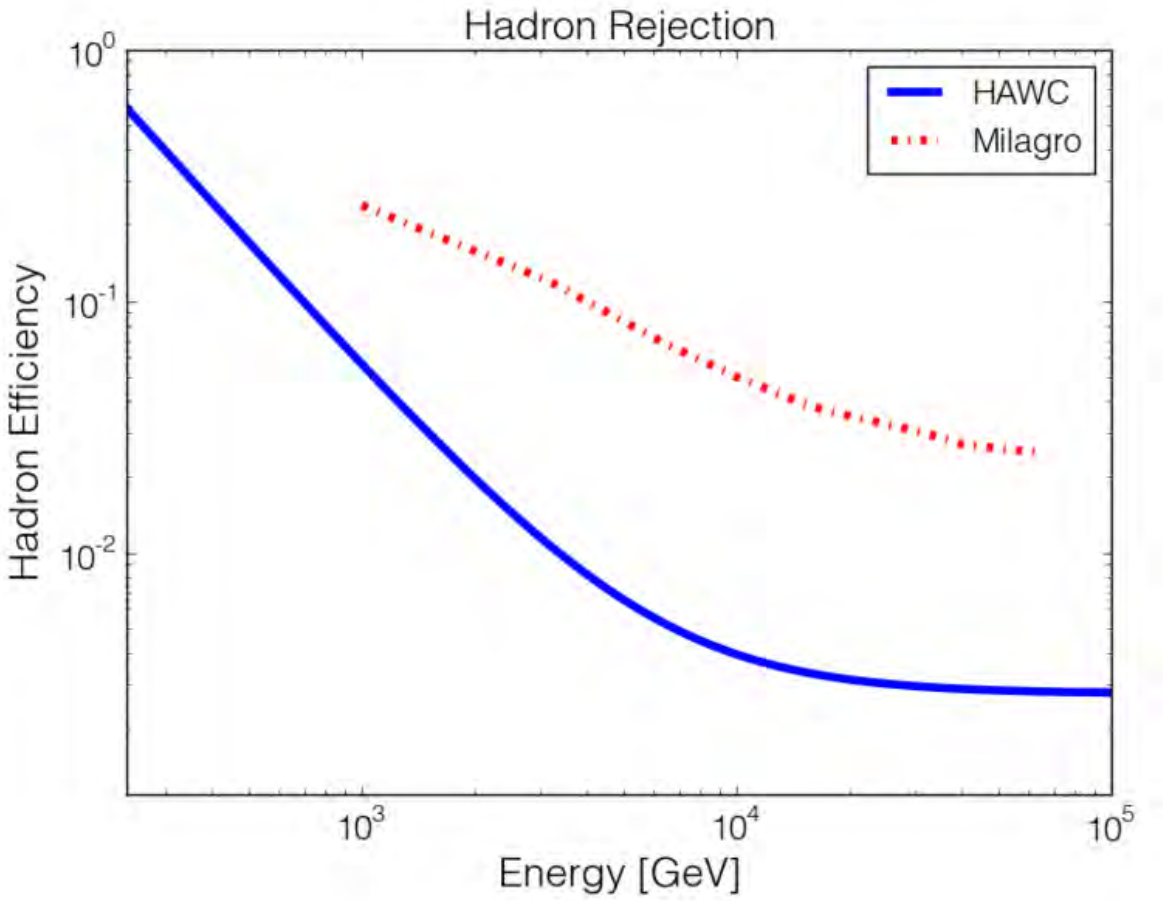
Improved source spectra over Milagro

Energy measured at ground is not a perfect indicator of primary energy

Primary
Actual error in estimating primary energy

At Ground
Energy resolution to energy at ground level

Improved γ/Hadron Separation



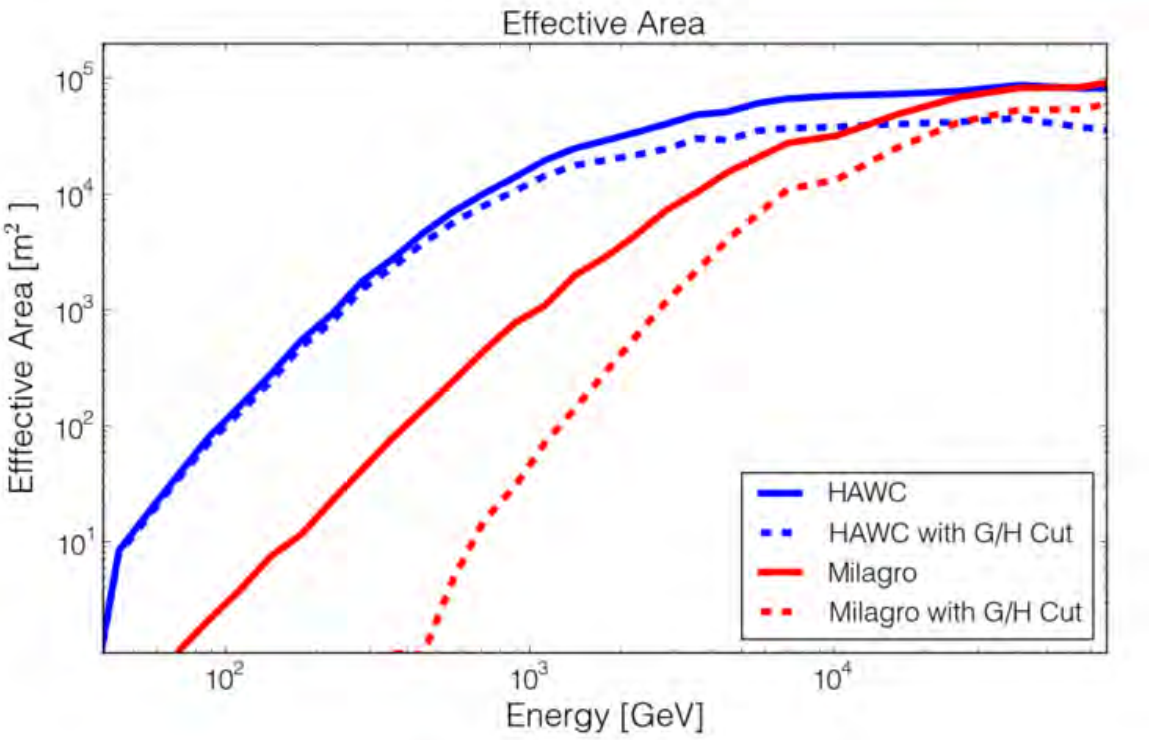
Error in determining species

Simulated showers (CORSIKA) incident on simulated HAWC (GEANT4)

Optical isolation

High quantum efficiency PMTs

Improved Effective Area



Effective area of detector of shower

Simulated showers (CORSIKA) incident on simulated HAWC (GEANT4)

Trigger on lower energy showers

Milagro had outriggers