



# High Altitude Water Cherenkov

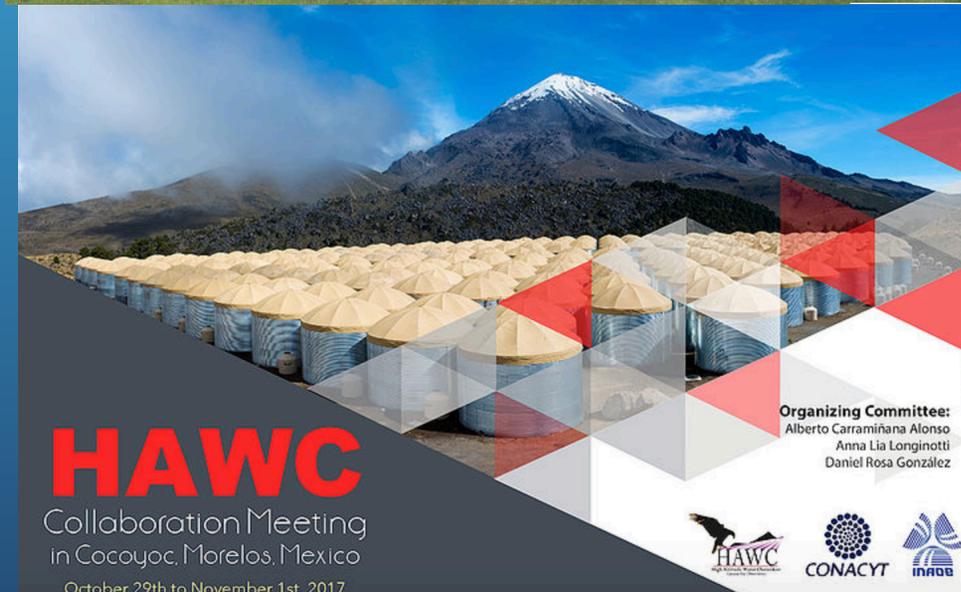
Ruben Alfaro, GSI IPPOG meeting May 2019

# HAWC Collaboration



High Energy Cosmic  
Gamma ray detector

14 Mex Institutions  
18 USA Institutions  
Recently joint  
MPIK Heidelberg Germany  
IFJ-PAN Krakow, Poland.



# HAWC Observatory



## Mapping the Northern Sky in High-Energy Gamma Rays

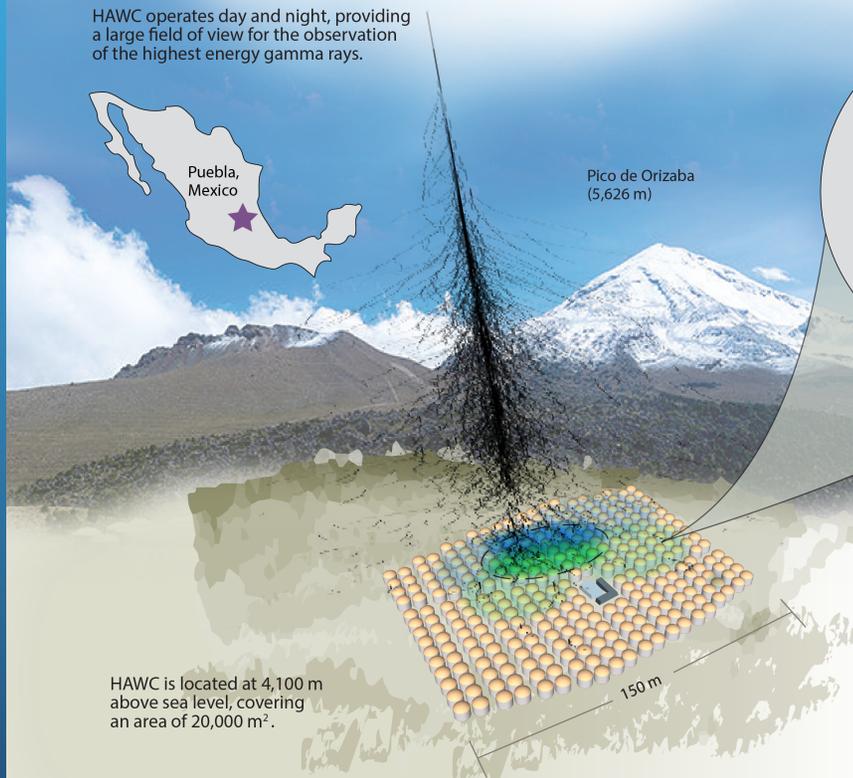
### HAWC Observatory

HAWC operates day and night, providing a large field of view for the observation of the highest energy gamma rays.



Puebla,  
Mexico

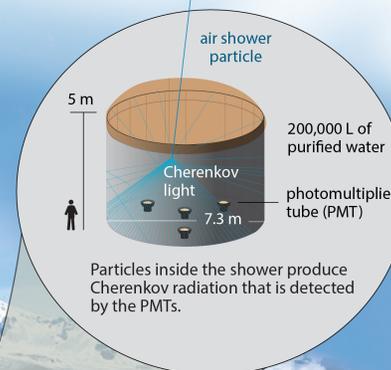
Pico de Orizaba  
(5,626 m)



HAWC is located at 4,100 m above sea level, covering an area of 20,000 m<sup>2</sup>.

### Water Cherenkov tank

HAWC comprises an array of 300 tanks that record the particles created in gamma-ray and cosmic-ray showers.

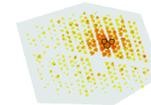


Particles inside the shower produce Cherenkov radiation that is detected by the PMTs.

### Gamma rays vs cosmic rays

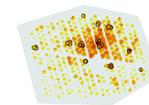
HAWC selects gamma rays from among a much more abundant background of cosmic rays.

gamma-ray shower



"hot" spots concentrate around the core

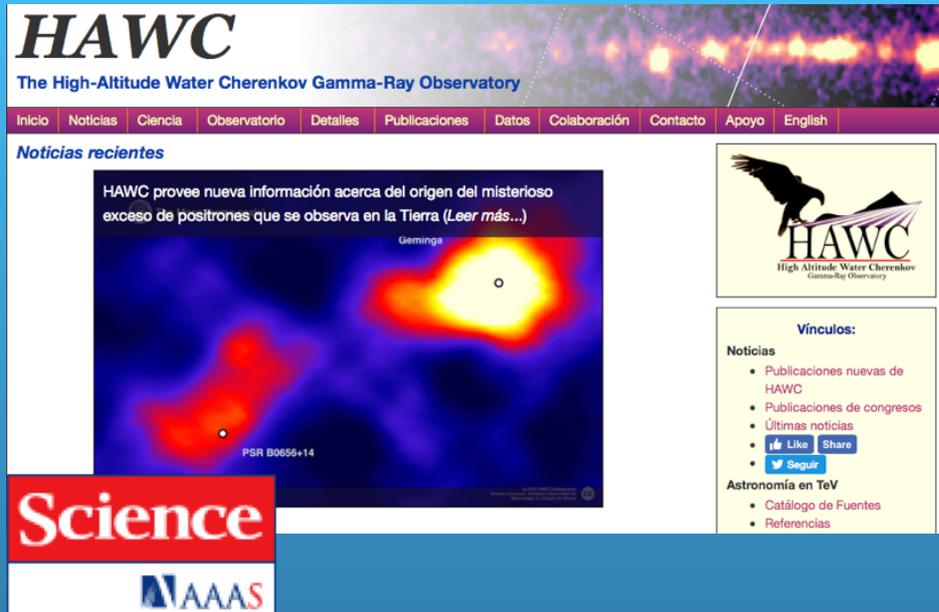
cosmic-ray shower



"hot" spots are more dispersed



# High impact science



**HAWC**  
The High-Altitude Water Cherenkov Gamma-Ray Observatory

Inicio Noticias Ciencia Observatorio Detalles Publicaciones Datos Colaboración Contacto Apoyo English

**Noticias recientes**

HAWC provee nueva información acerca del origen del misterioso exceso de positrones que se observa en la Tierra (*Leer más...*)

Geminga

PSR B0658+14

**Science**

**AAAS**

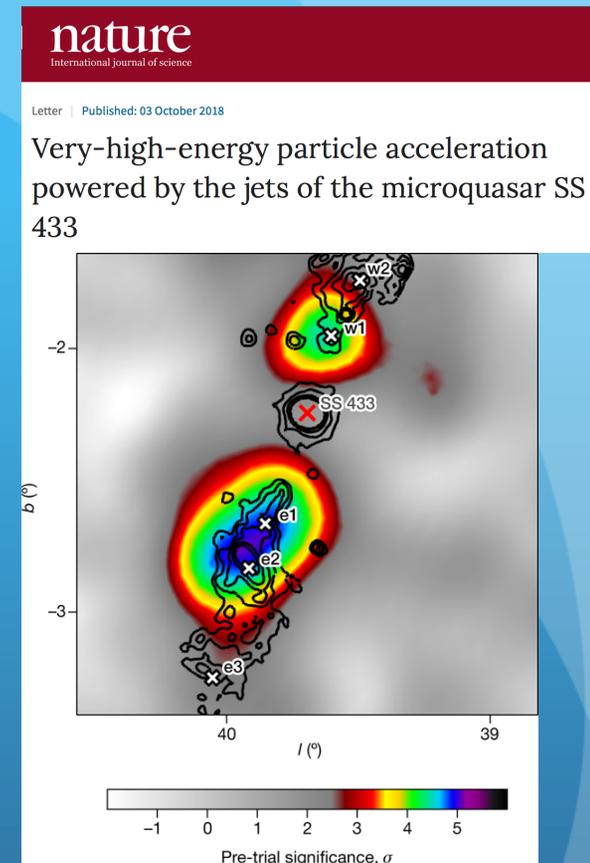
**Vínculos:**

**Noticias**

- Publicaciones nuevas de HAWC
- Publicaciones de congresos
- Últimas noticias
- Like Share
- Seguir

**Astronomía en TeV**

- Catálogo de Fuentes
- Referencias



Multi-messenger approach. HAWC has MoU with Many observatories as MAGIC, HESS ICE-CUBE, SWIFT, HESS, LIGO/VIRGO among others.

# News papers and media





- **Several videos**
- **Before HAWC (Spanish and English) Construction of HAWC**
- **Operation of HAWC**
- **They help to do a nice break-up in between talks**



### HAWC (English Version)

HV PROART

Short 3 minuts or  
Long 8 minutes



# Noche de las ESTRELLAS®

Annual Event  
all over the  
country

50 different  
locations all  
over Mexico



2018



2017



2016



2015



2014



2013



2012



2011



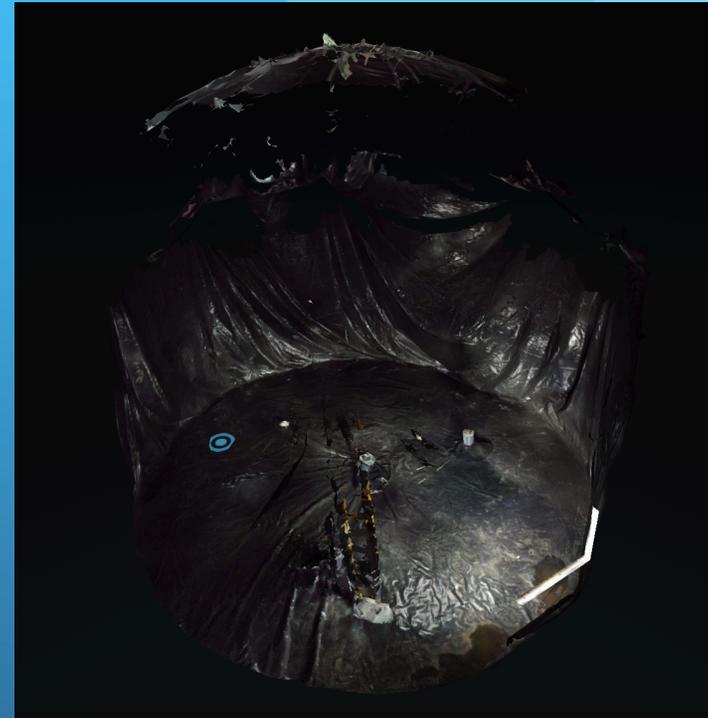
2010



2009



# Virtual Visits

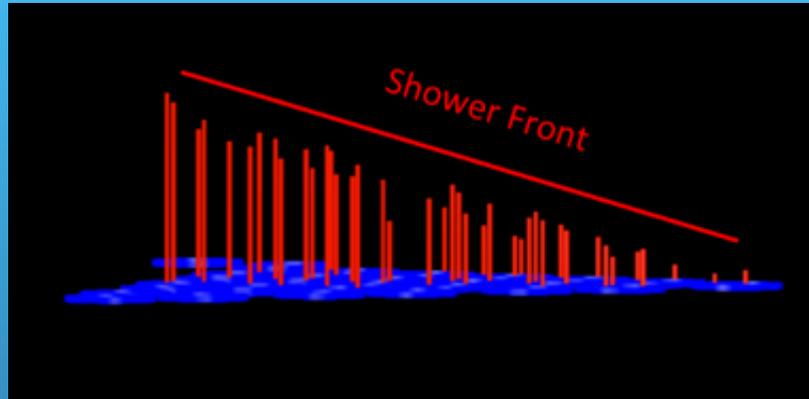


VR lens (versions for cardboard and Oculus)  
also through a web browser

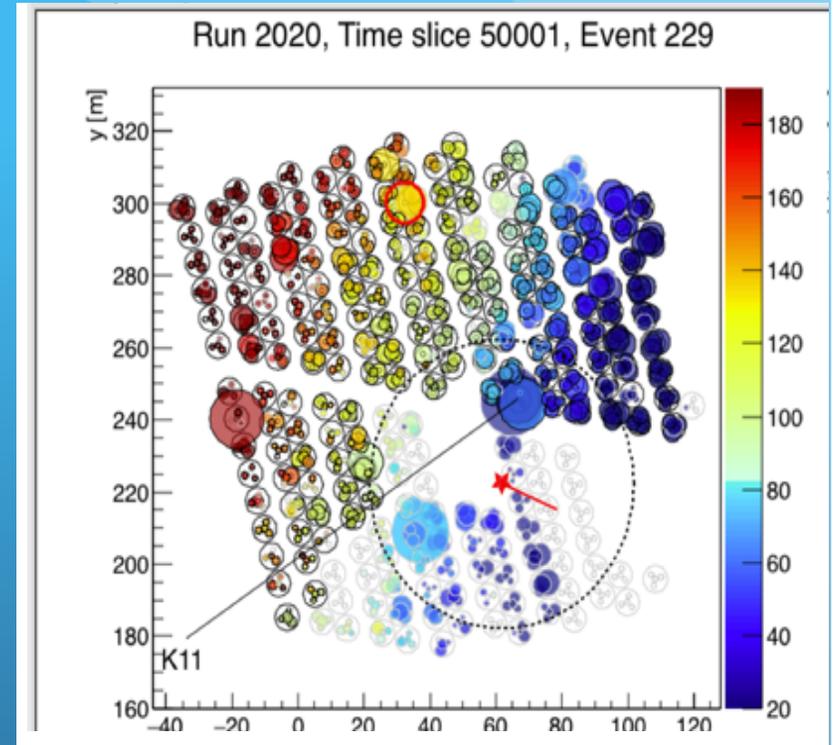
<https://my.matterport.com/show/?m=bgnLPCVtMgv&brand=0>

<https://my.matterport.com/show/?m=bgnLPCVtMgv&brand=0>

# Event Display

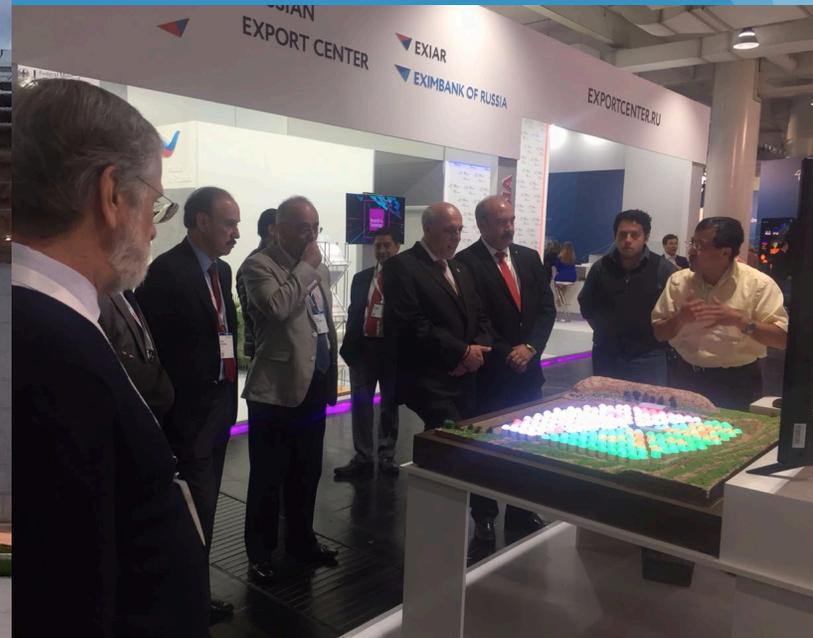


## Led event display



# Hannover Messe 2018

- Mexico was the Partner country.
- CONACYT asked us to do outreach during the Hannover Mess



# Outreach from elementary school



To High school

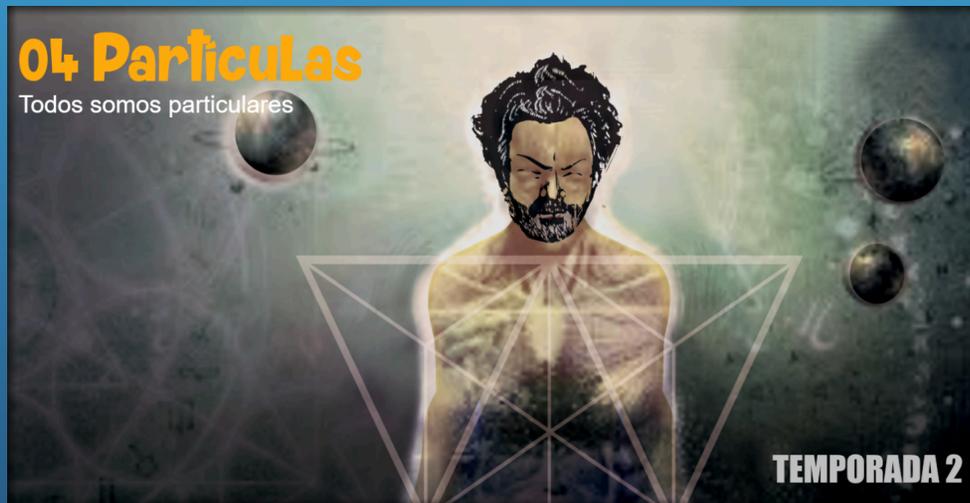


# Radio Comic

Radio-Comic: High quality sound with some animated images.

Target: young people. Anime style since it is very among Mexican teenagers (Samples available in YouTube)

One main character (Dr. Buhardilla) with 8 episodes, 4(Gravity, Cosmic Rays, Ionizing Raditaton, HAWC). Samples are already in youtube.



# HAWC public data access

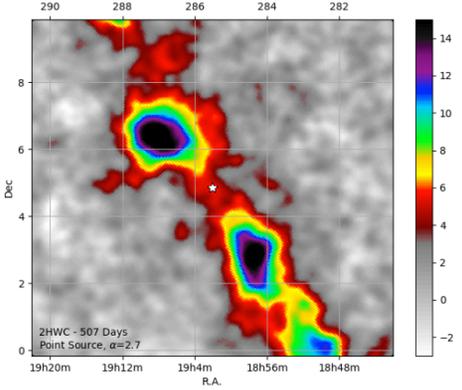


HAWC Observatory    Publications    Public Datasets    Resources

- Intro
- 2HWC Survey
- Geminga Paper
- IC170922 neutrino followup
- Lightcurves
- SS-433
- Crab Dataset

## 2HWC Survey

[Details](#)    [Catalog View](#)    [Coordinate View](#)

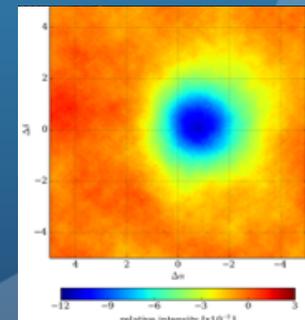
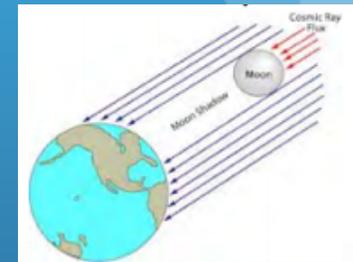
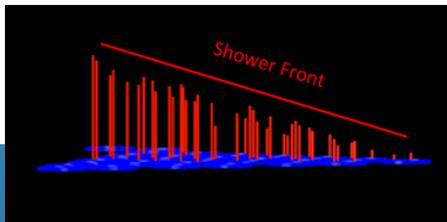
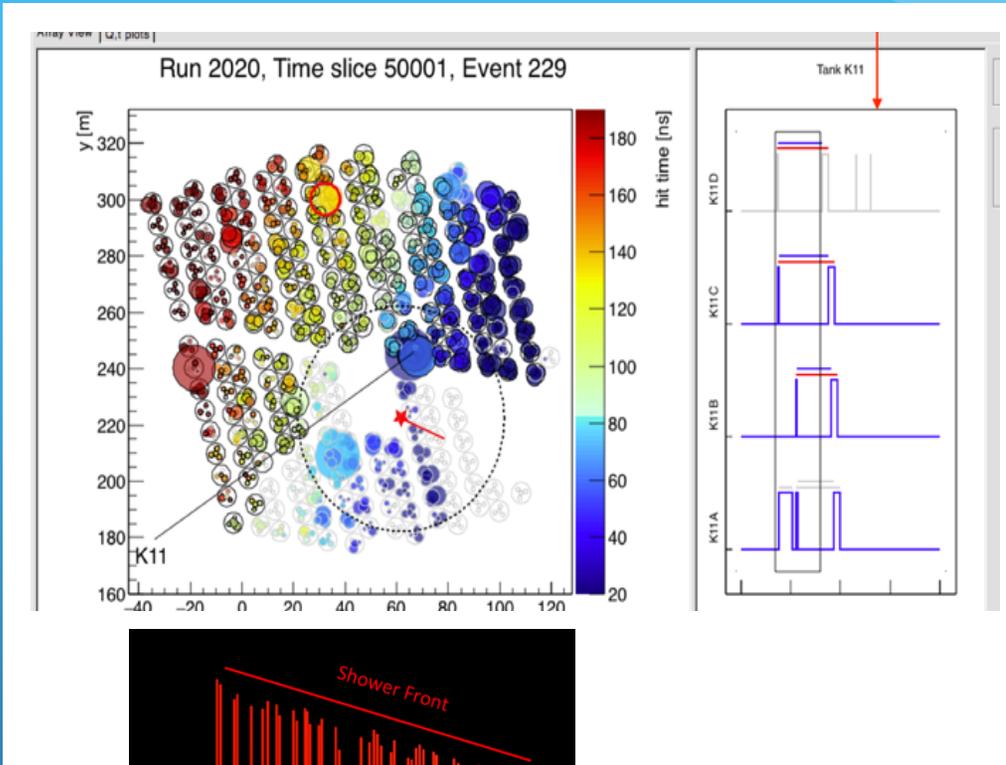


2HWC - 507 Days  
Point Source,  $\alpha=2.7$

RA (J2000 - Decimal):     Dec (J2000 - Decimal):    

Significance	5.637485	[sqrt(TS)]
Flux	9.580829e-15	[cm <sup>-2</sup> s <sup>-1</sup> TeV <sup>-1</sup> ]
Flux Upper	1.330019e-14	[cm <sup>-2</sup> s <sup>-1</sup> TeV <sup>-1</sup> ]
Flux Lower	6.042376e-15	[cm <sup>-2</sup> s <sup>-1</sup> TeV <sup>-1</sup> ]

Read the [Details](#) Tab for explanation of these numbers.



We are interested on developing a Master-class

# Summary

- HAWC is a world-class observatory.
- HAWC collaboration is committed with outreach and is interested on improving its outreach activities and span them.
- HAWC is interested on joining IPPOG
- It will be very helpful to get feedback and ex-change experiences with other colleagues.



High Altitude Water Cherenkov  
Gamma-Ray Observatory

Thanks