

CONTRIBUTIONS OF MANUEL SANDOVAL VALLARTA TO COSMIC RAY RESEARCH IN MÉXICO



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COSMIC RAY DISCOVERY



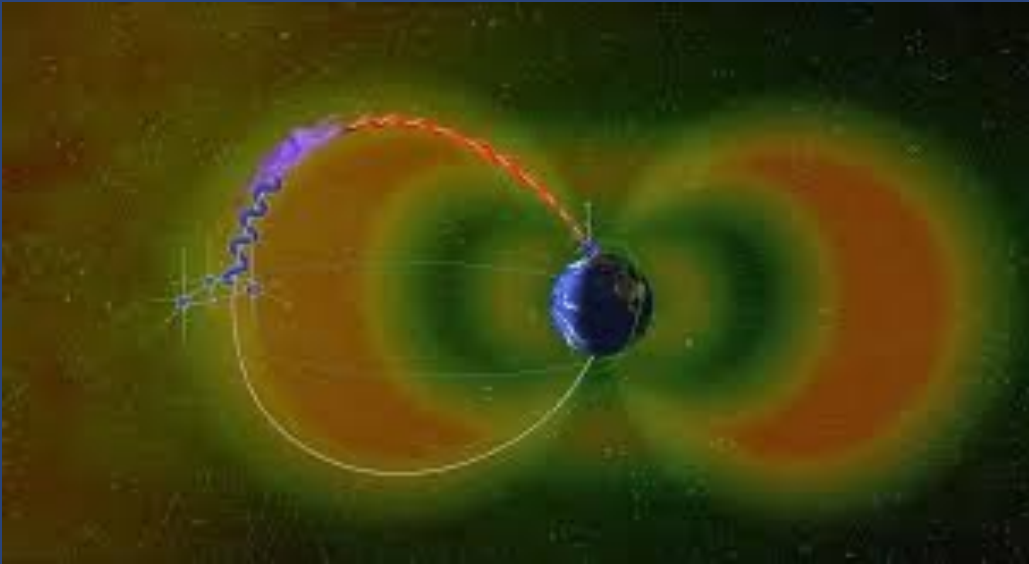
Victor Hess, balloon flights, 1908-1910

1912 Extraterrestrial origin of the radiation

1926 «Cosmic Rays» (R. Millikan)

Starting the 1930's there was a debate on the nature of cosmic rays.

The main controversy was whether they were photons or charged particles. Compton- Millikan controversy.



1932, A. Compton 7 groups to make measurements in diverse points on the Earth's Surface w/identical detectors.

The expedition includes Mexico. The visit is organised by MSV (Nevado de Toluca, Veracruz and Mexico City)

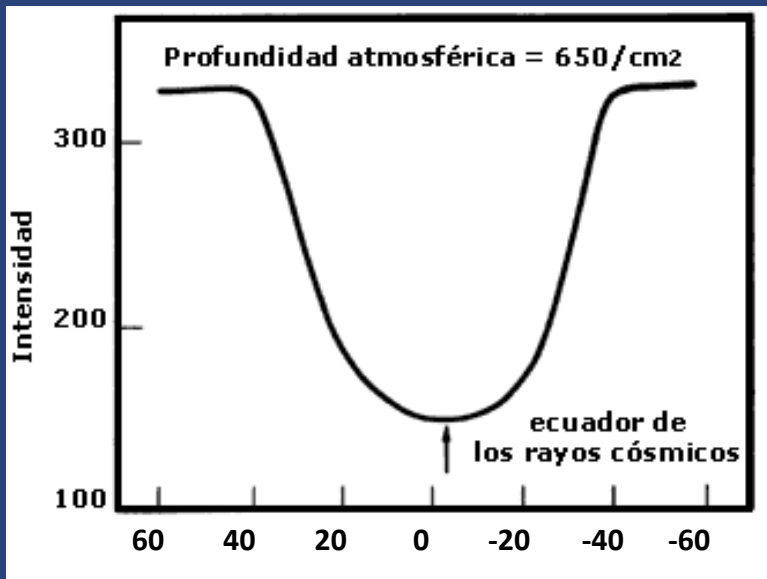
Compton established the existence of the "latitude curve".

At sea level, intensity at high latitudes is 14% greater than at the equator; at 2000m height 22% greater, and at 4360m 33% larger. This variation follows the geomagnetic latitude closer than the geographic latitude. (Phys Rev, 43, 387, 1933)

Cosmic Rays must be charged particles.

Manuel Sandoval-Vallarta and Georges Lemaître set themselves to study charged particle trajectories in the Geomagnetic Field. They produced a seminal paper in the cosmic ray field. **(Lemaître- Vallarta Theory)**

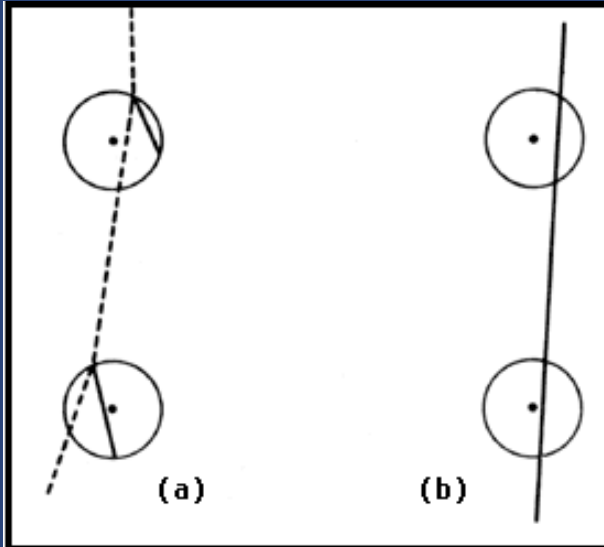
Considering the influence of the Geomagnetic Field in the trajectories of charged particles, we show that they follow the experimental variation of cosmic radiation with the geomagnetic latitude found by Compton et al. Cosmic Radiation must contain charged particles... For negative particles there must be a preference of particles arriving from the east, and inversely for positive particles. (Phys. Rev. **43**, 87, 1933).



In this paper it is also shown that that the latitudinal variation of the radiation may be attributed to particles (electrons or protons) with energies of the order of 10^{10} eV

With the advice of MSV and GL; A. Compton organized a new expedition to México. L. Alvarez y T. Johnson, students of Compton, performed In the roof of the Geneve Hotel, Mexico City, performed the experiment.

Cosmic Ray Telescope



It was concluded that the cosmic ray flux Was significantly greater from west directions Therefore cosmic rays are predominantly Positively charged particles.

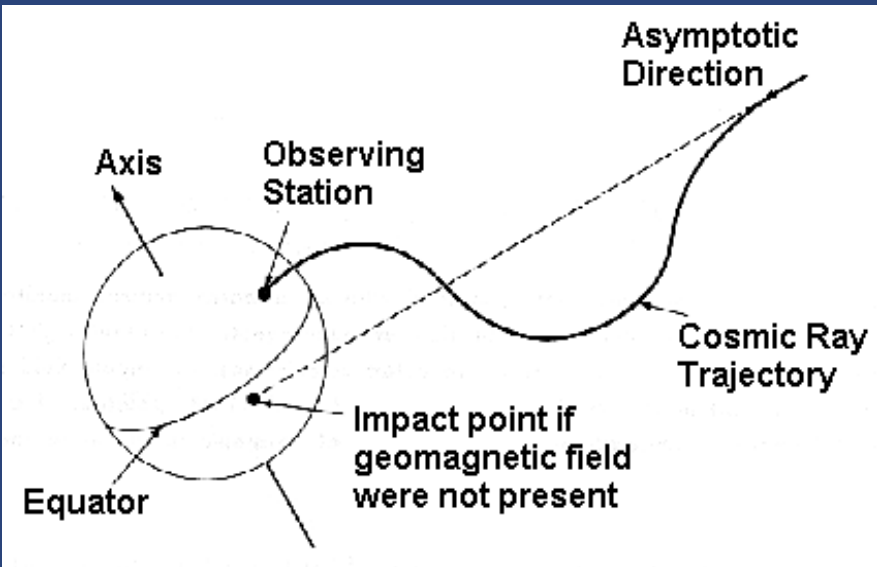
Later expeditions in several places in México and other places (always coordinated by MSV) confirmed the Latitude curve and the “east-west” effect.

After the expeditiions, a «cosmic ray meter» was installed in Teoloyucan, Edomex. It was operative between 1937 and 1941, Alfredo Baños, Joaquín Gallo and Alfredo Vaca were in charge.

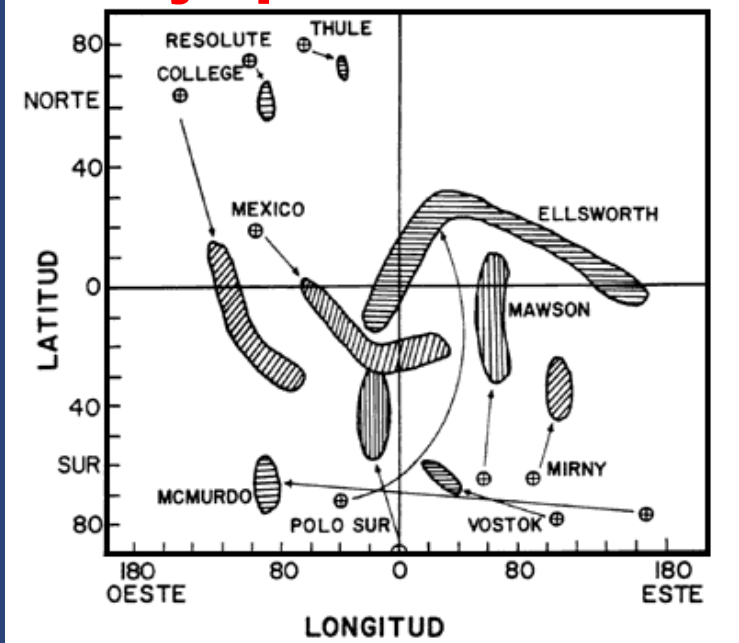
A cosmic ray telescope, worked for some time (1940) in the roof of the Mines Palace, Mexico City (Carlos Graef).

One of the consequences was the foundation of the Phisics Institute of UNAM in 1939.

In 1943 MSV creates in the Physycs Institute a group dedicated to the study of cosmic ray propagation in the Earth's Magnetosphere. Part of this group moves to the, Geophysics Institute in 1955.



Asymptotic Cones



1955

VI International Cosmic Ray Conference, Guanajuato

THE LEGACY



COSMIC RAY PAVILLION, UNAM Campus, Mexico City
Neutron Monitor

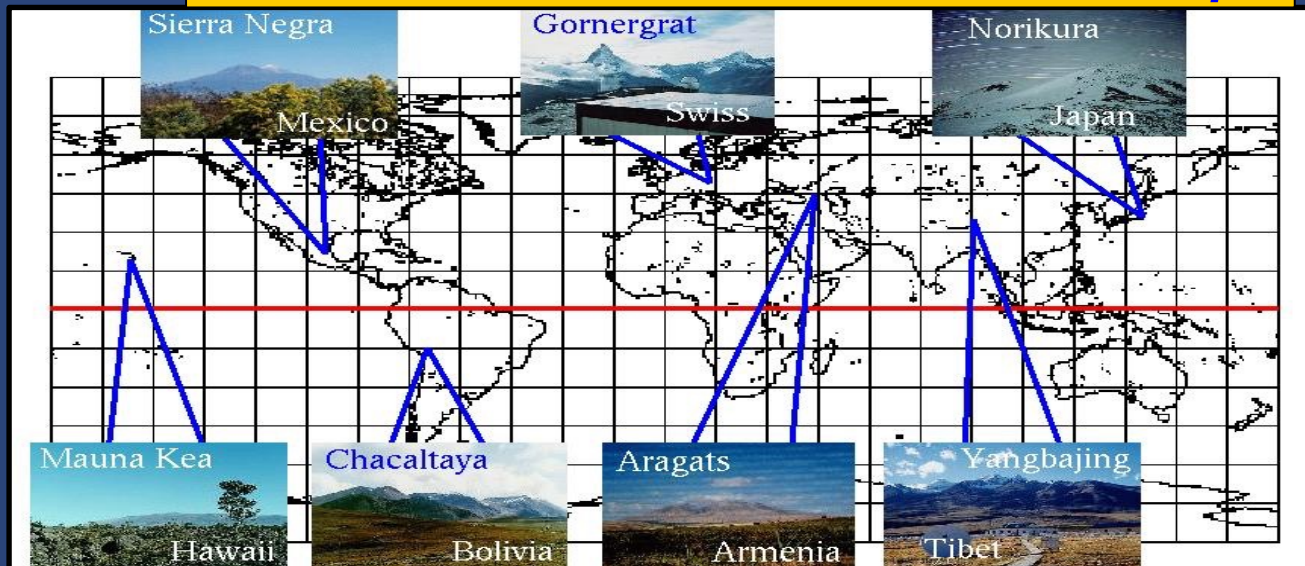
Donated by the Chicago University, 1957 y 1975.



In 1975, donated by the Calgary
University,
Super neutron monitor, 6NM-64.

www.cosmicrays.unam.mx

World Network of Solar Neutron Telescopes



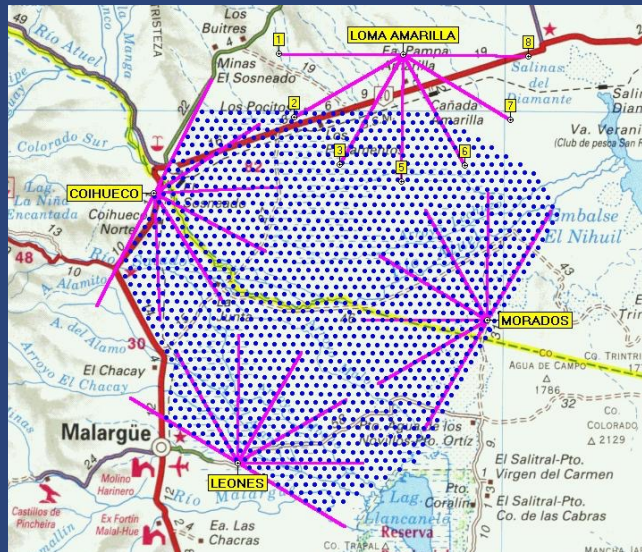
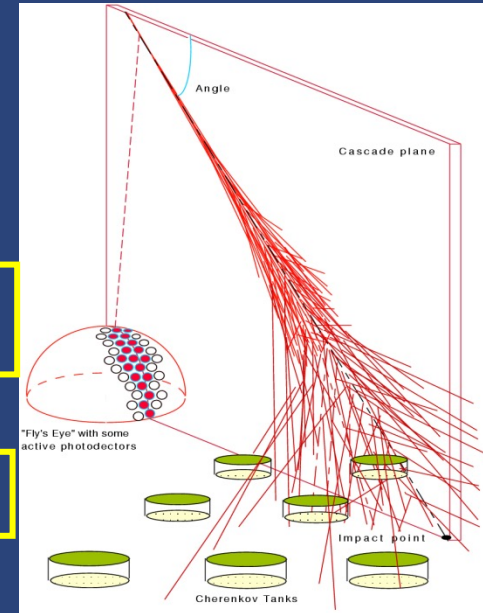
Sierra Negra, 2004

1996- A group under the leadership of Arnulfo Zepeda (CINVESTAV, UNAM, BUAP, UMSNH) is formed to contribute to the Pierre Auger Observatory.

The group is named after
Manuel Sandoval Vallart

Fluorescence →

WCD →



1600 Cherenkov detectors

4 fluorescence detectors

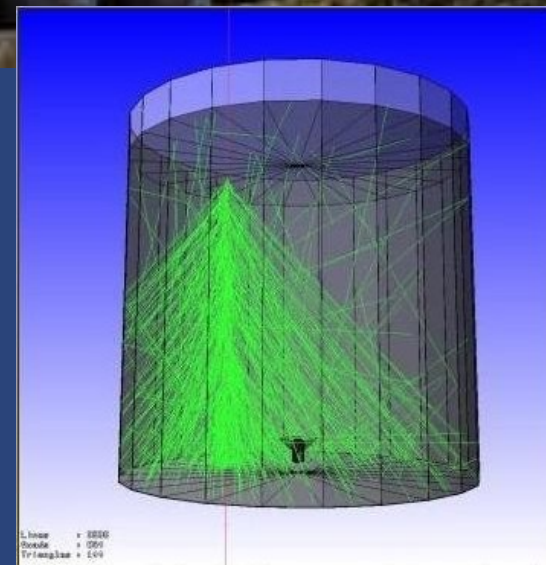
3000 km²

HAWC



Gamma ray Observatory (100 GeV- 100TeV)
In Sierra Negra, Pue. 4100m s.n.m.

**Proposal under the leadership of
Alberto Carramiñana
(INAOE, UNAM, CINVESTAV, BUAP, UMSNH, UG)
Gets the site for Mexico in 2007.**



Manuel Sandoval Vallarta publicó varios artículos acerca de sus investigaciones relacionadas con la teoría unificada del electromagnetismo y la gravitación propuesta por Einstein.



Foto: Instituto de Física, UNAM.

El profundo conocimiento que tenía el doctor Vallarta de la física atómica y de las matemáticas le permitieron comprender las innovadoras propuestas de la mecánica cuántica.

Imágenes: Shutterstock; diseño: Bárbara Castrejón, DGDC-UNAM

¡¡GRACIAS POR SU ATENCIÓN!!