

# What If Kids Ran the World's Biggest Telescope?

**Cosmic Ray Exploration  
for Fun, Excitement, and Wonder**

# *Jill Tarter's TED 2009 Wish*

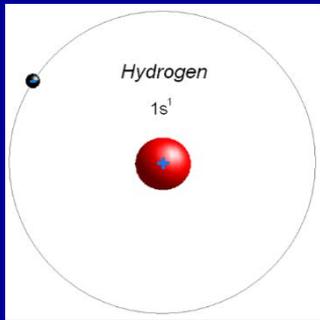
*"I wish that you would empower Earthlings everywhere to become active participants in the ultimate search for cosmic company."*



# Cosmic Rays from Space Hitting the Earth



# What's a Cosmic Ray?

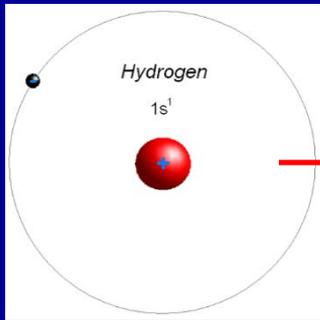


80% of Cosmic Rays are Protons

Starting with a Hydrogen Atom---  
The Proton Gets Loose

# What's a Cosmic Ray?

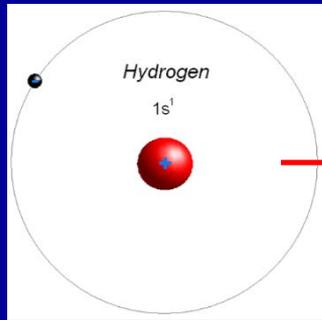
Somehow, the Proton gets *Wildly* accelerated



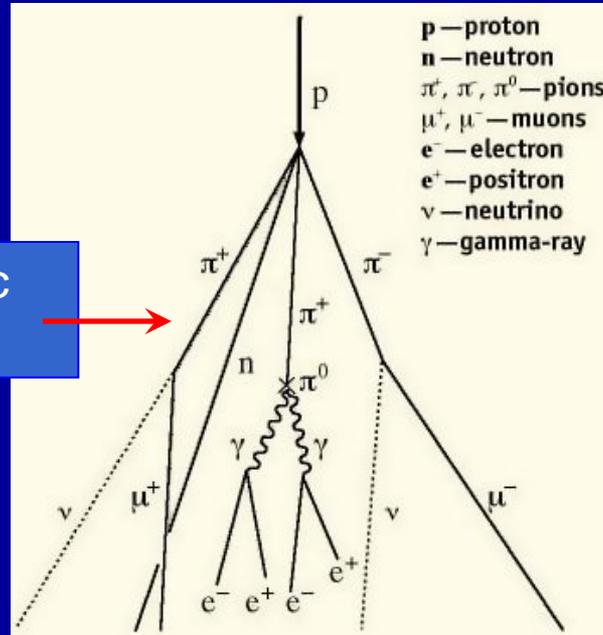
Some Magic  
Happens

(Galactic Processes, Billions  
of Miles, Billions of Years)

# What's a Cosmic Ray?

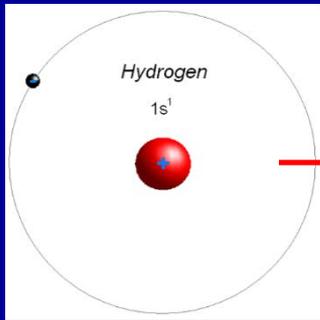


Some Magic Happens

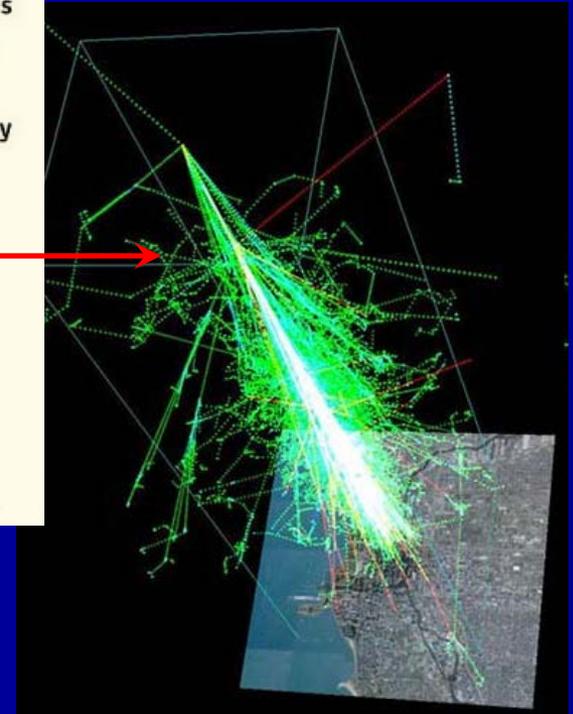
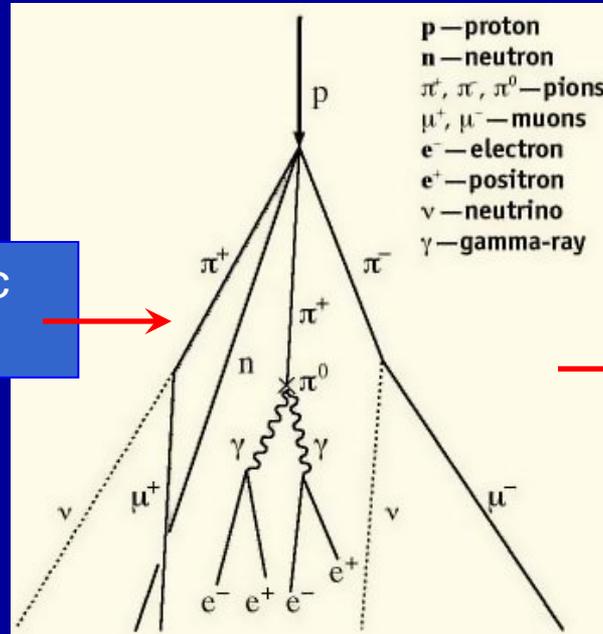


**The Cosmic Ray Hits the Atmosphere:  
Pions, Muons, Gamma Rays,  
Electrons, and a Bunch of Stuff is  
generated!**

# What's a Cosmic Ray?



Some Magic Happens

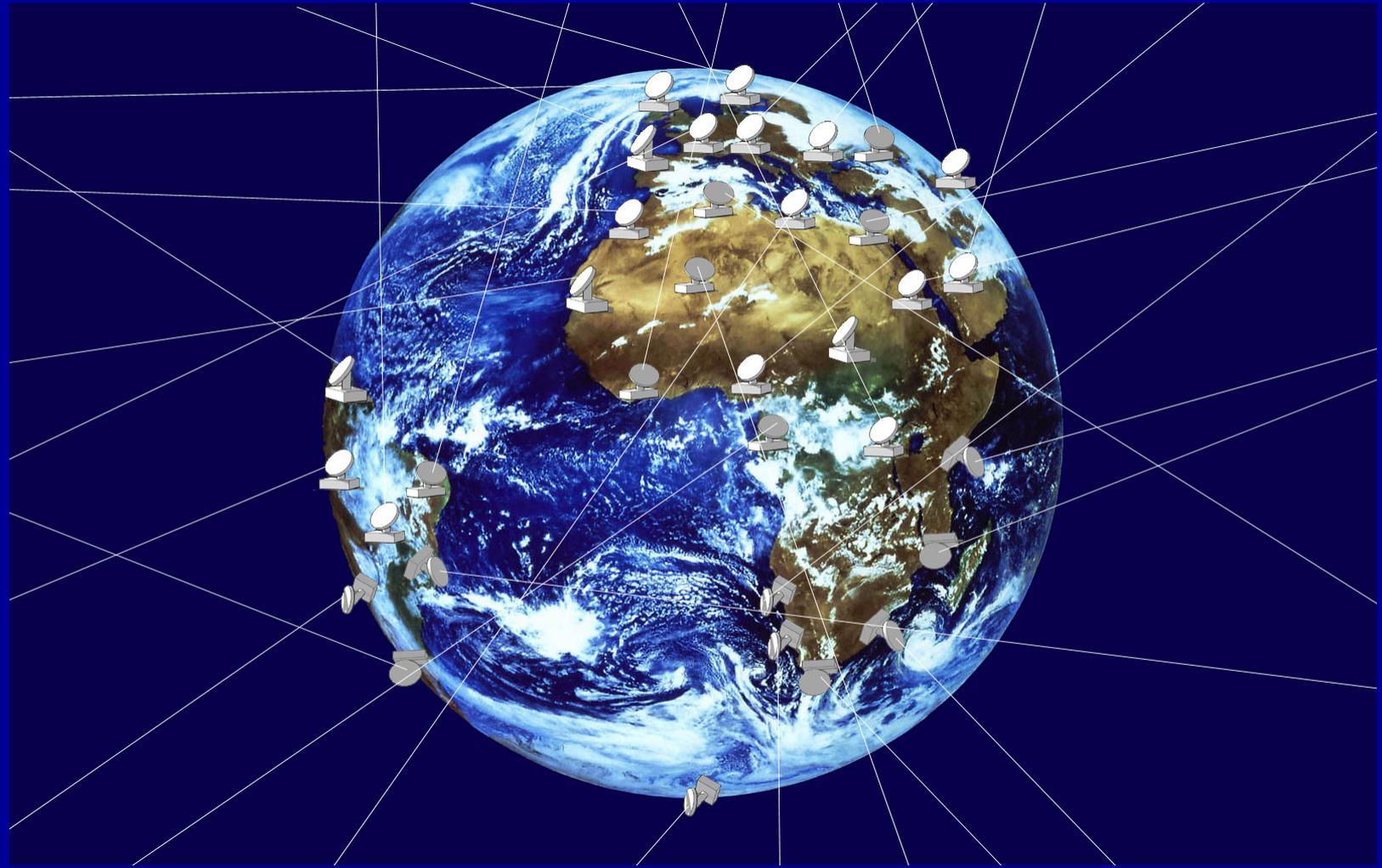


An "Extended Air Shower" Occurs

What's the  
ERGO Project  
?

# ERGO

Energetic Ray Global Observatory

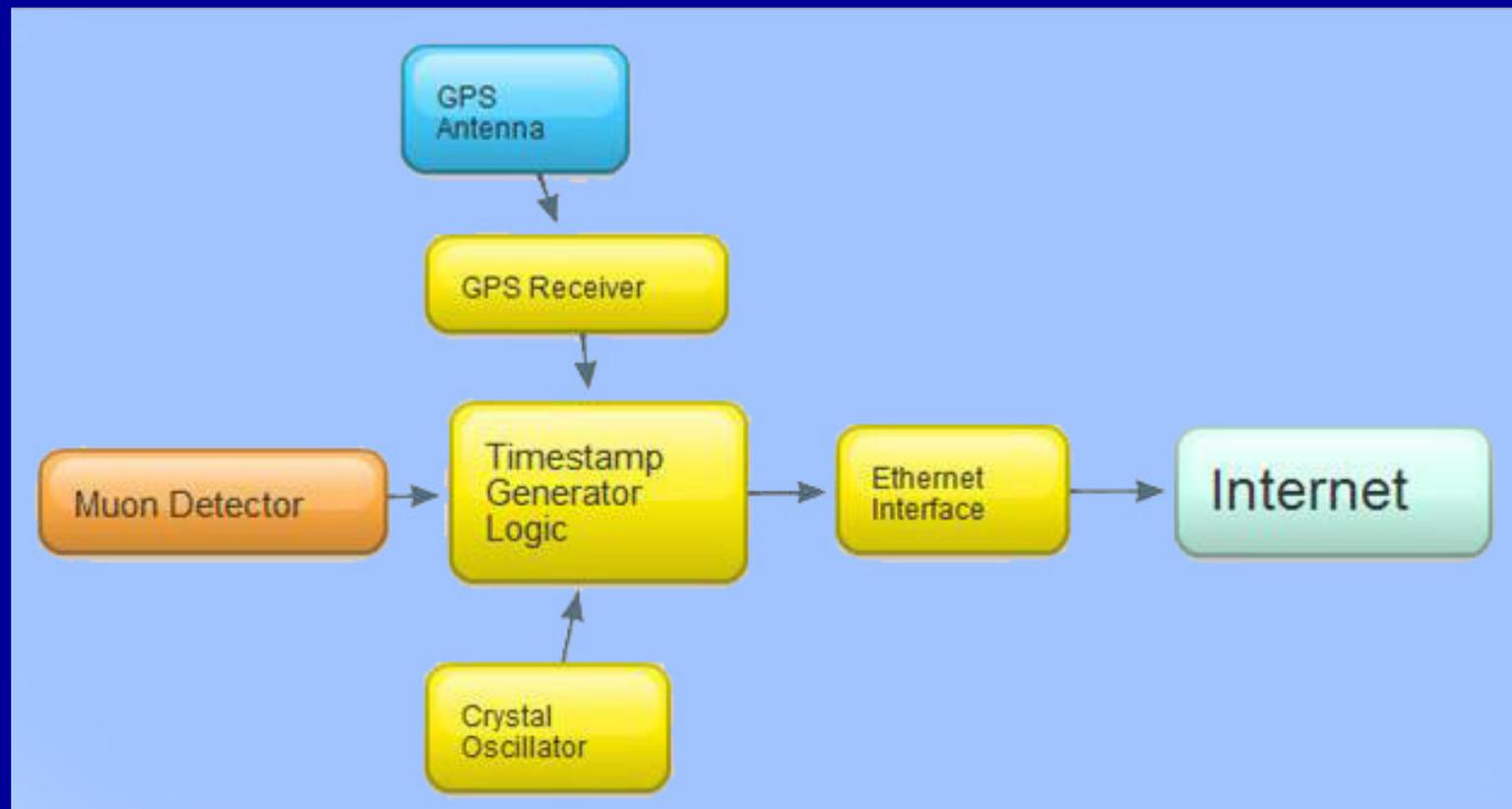




What makes up an  
ERGO Detector?

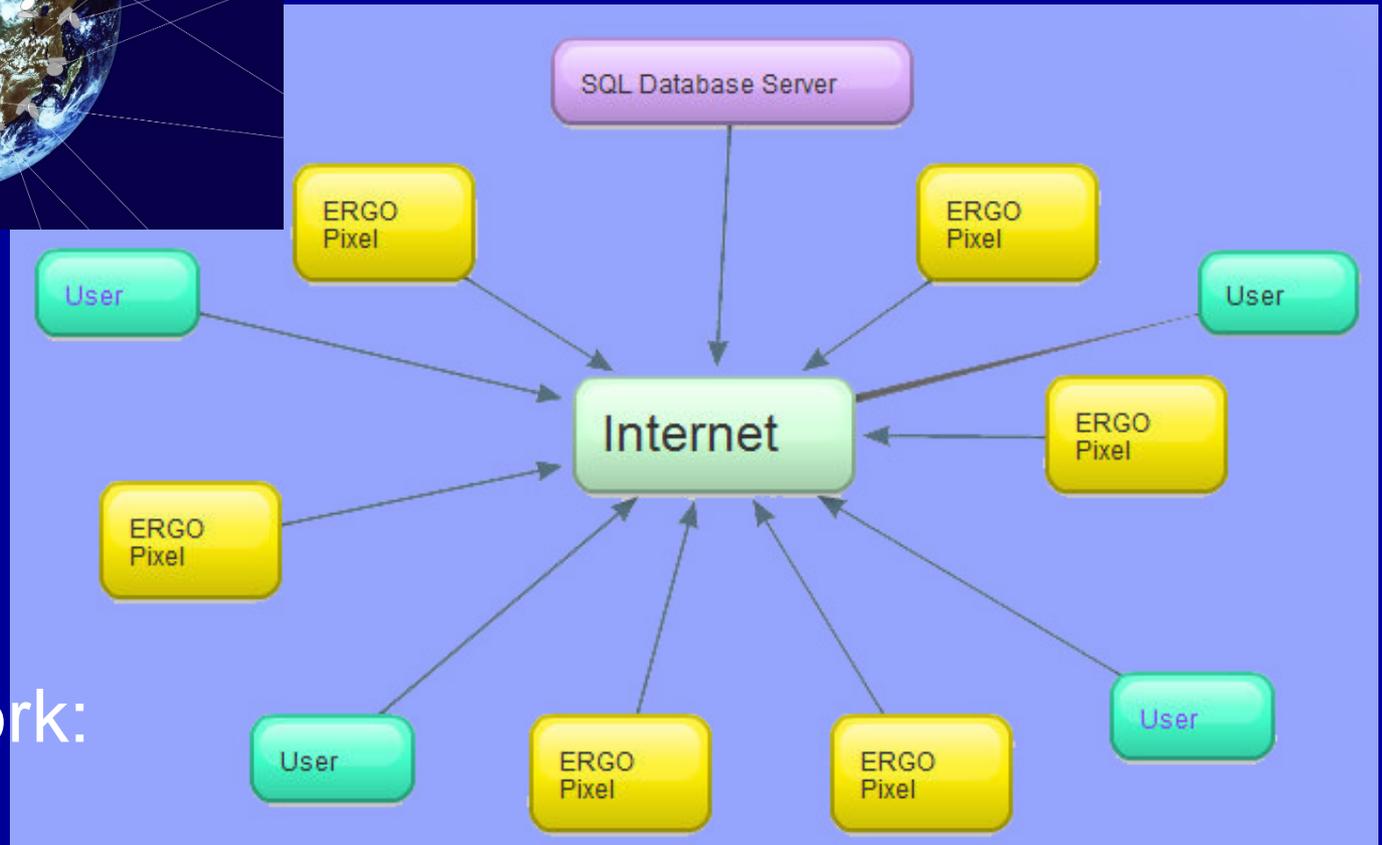
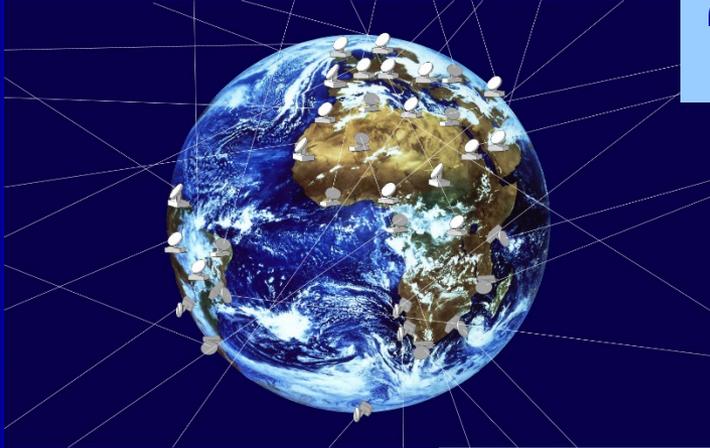
# What's an ERGO Detector?

## The ERGO "Pixel"



# A Giant Telescope?

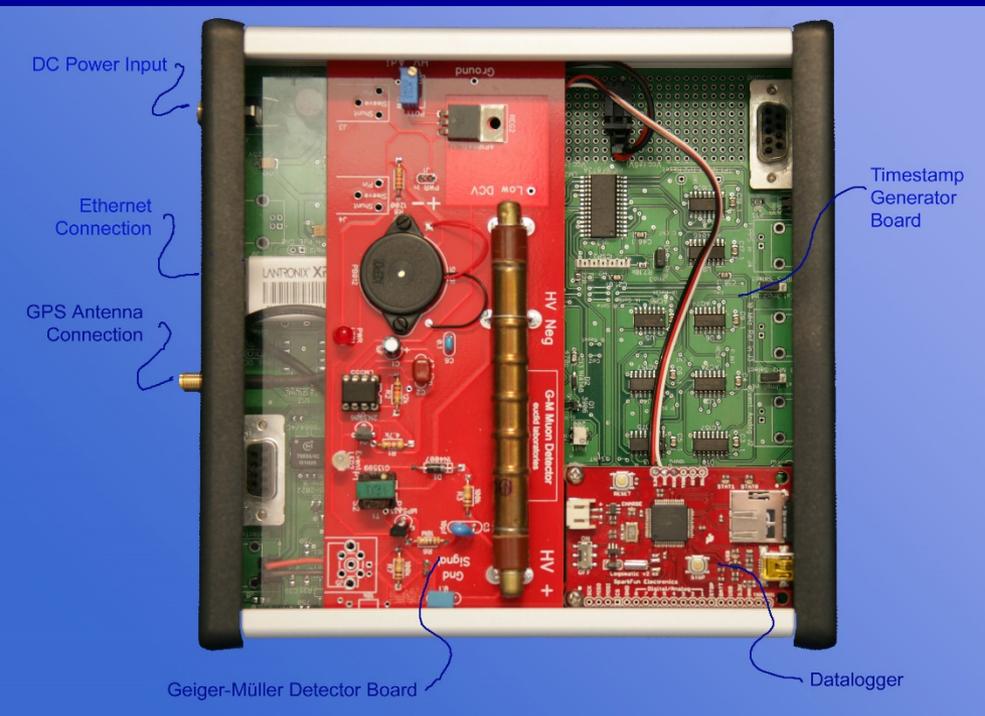
“To See Far”



The Network:

# What's Inside The Pixel?

## The Original ERGO Instrument With Geiger-Müller Detector



## The Timestamp Generator



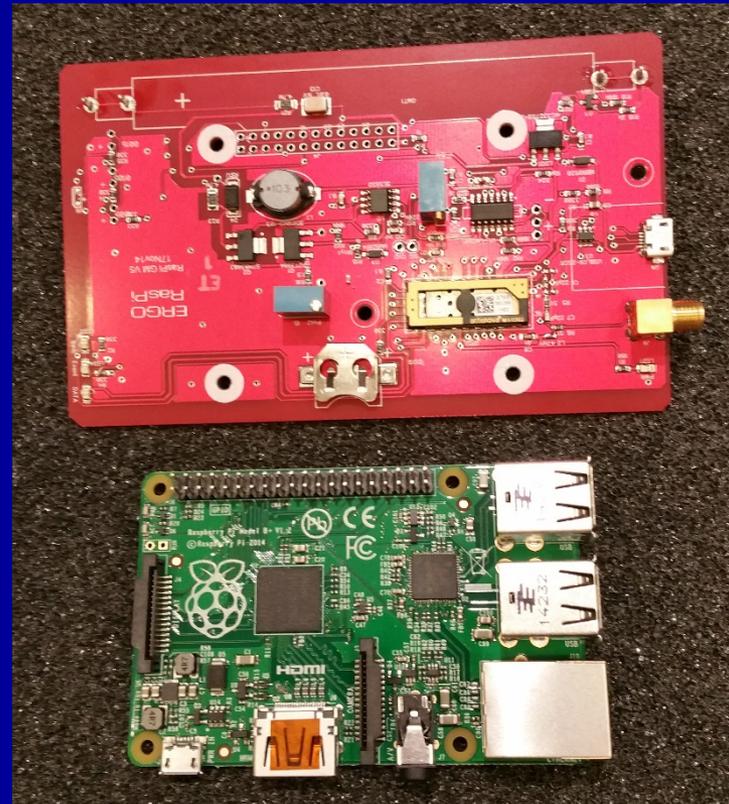
# What's Inside The New Raspberry Pi Pixel?

The New, Cheaper, Better ERGO Pixel

Inside:

A Raspberry Pi board

Our Custom Detector/Geiger Board



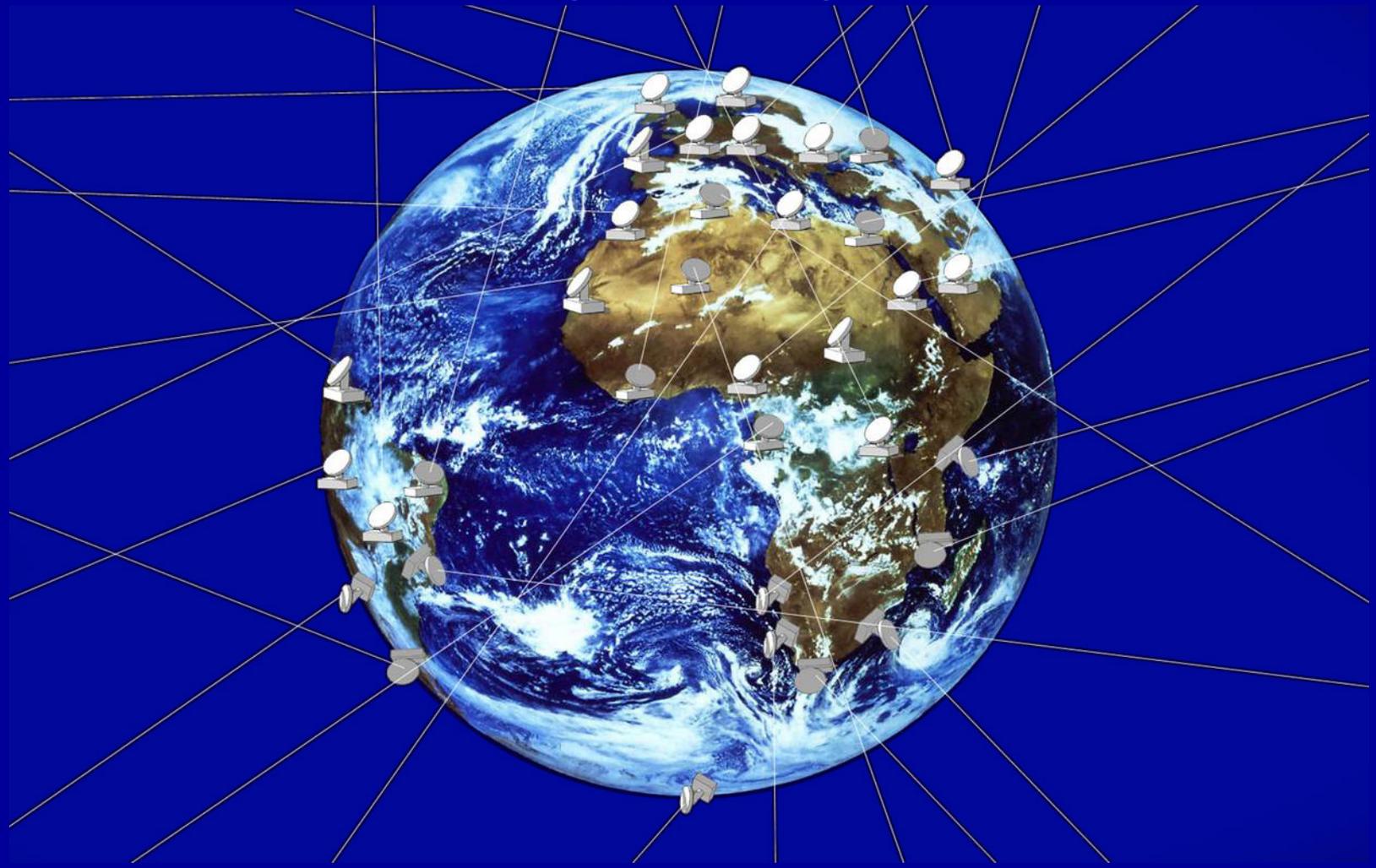
# What Do We Need Now?

- **Students** interested in learning about science *by doing science*
  - *Building ERGO Pixels (100 in progress for this summer)*
  - Analyzing data to look for patterns in time and location
  - Making contacts with schools and colleges to host an ERGO
  - Code-writers:
    - Web-based apps for data retrieval
    - Enhancing the ERGO RasPi resident software
- **Teachers** interested in an exciting, real-science project for their class
  - Math, Physics, Engineering, Manufacturing

# What's Next?

- **Build up 100 ERGO RasPi Pixels**
  - *Machine enclosures*
  - *Laser-cut end panels*
  - *Add connectors to boards*
  - *Test the finished Pixels*
  - *Package them, ready to ship*
- **Find hosts for these new Pixels**
- **Work on analysis of existing data**  
*(>100,000,000 events)*
- **Explore ways to make it easy to get an ERGO**
- **Keep kids excited about doing real science**
  - *Rocket and balloon launches*
  - *Field experiments to mountains and mines*

Now: 120 Pixels Deployed,  
40 Are Typically Online



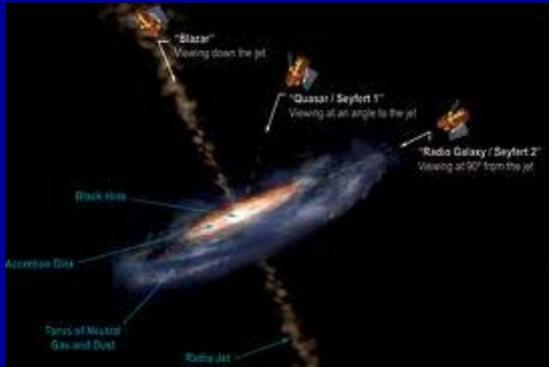
# Project Goal: 1000 Pixels



Now, for the *Fun* Stuff...

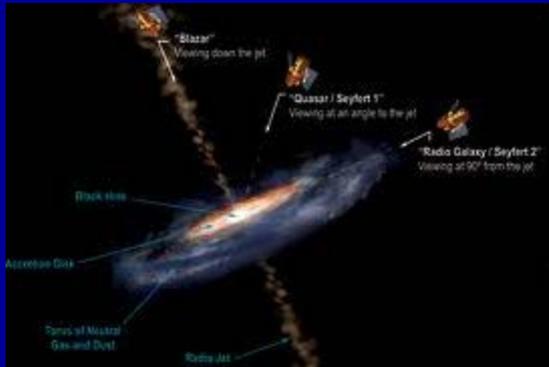
Where Do They Come From??

# Where Do They Come From??



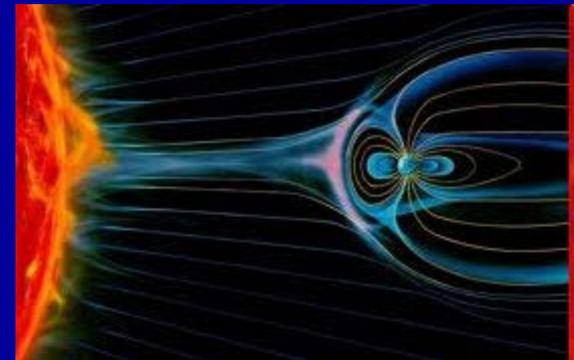
Black Holes and  
Active Galactic  
Nuclei?

# Where Do They Come From??

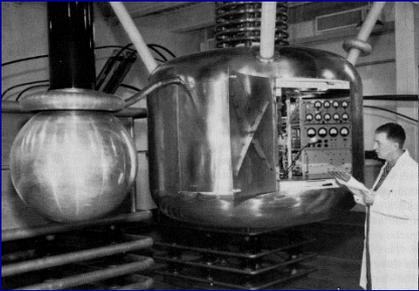


Black Holes and  
Active Galactic  
Nuclei?

Astrophysical  
Magneto-  
Gravitational  
Interactions?



# What If?

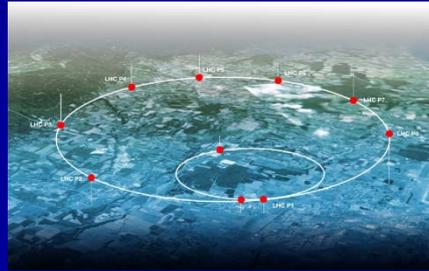


1935: First  
Accelerators  
1,000,000 Volts

# What If?



X  
10,000,000  
→



1935: First  
Accelerators  
1,000,000 Volts

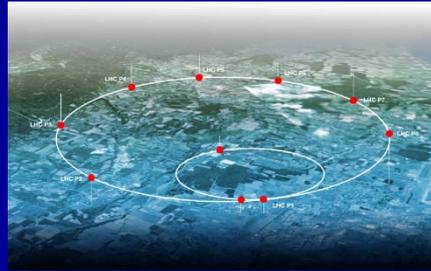
2010:  
the Large Hadron Collider  
10,000,000,000,000 Volts

# What If?



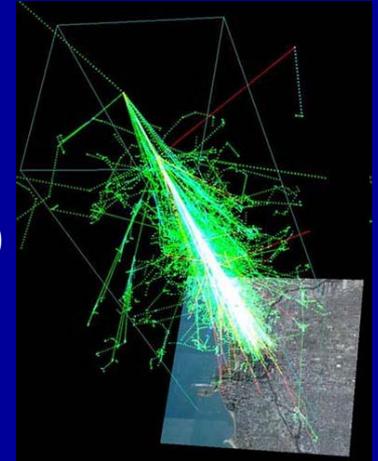
1935: First  
Accelerators  
1,000,000 Volts

X  
10,000,000  
→



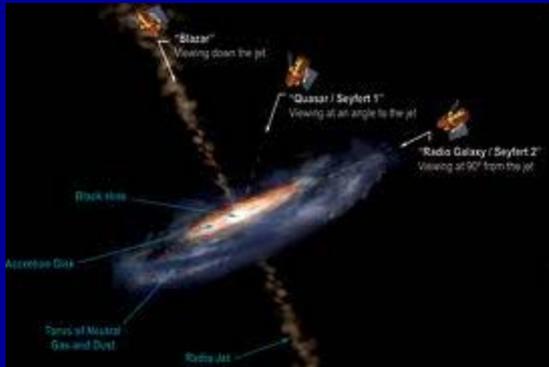
2010: the LHC  
10,000,000,000,000 Volts

X  
10,000,000  
→



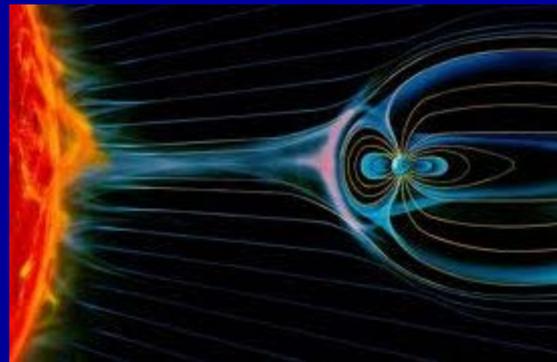
Cosmic-ray  
Air Shower  
100,000,000,000,000,000,000 Volts

# Where Do They Come From??

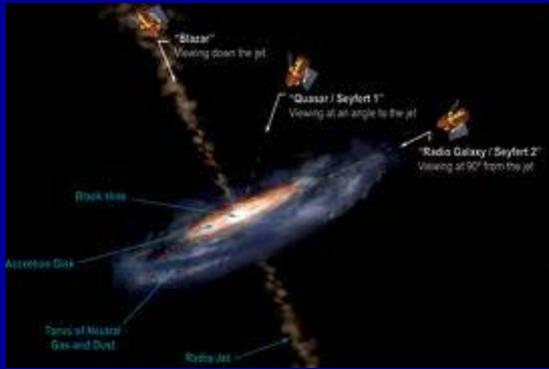


Black Holes and  
Active Galactic  
Nuclei?

Astrophysical  
Magneto-  
Gravitational  
Interactions?

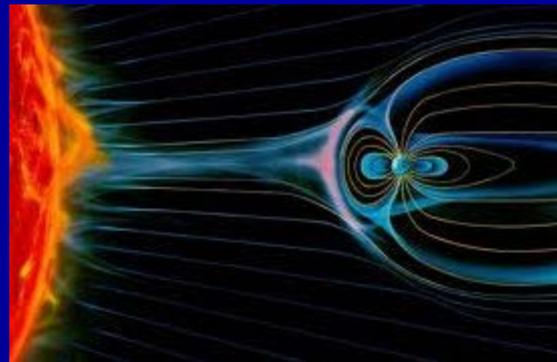


# Where Do They Come From??



Black Holes and  
Active Galactic  
Nuclei?

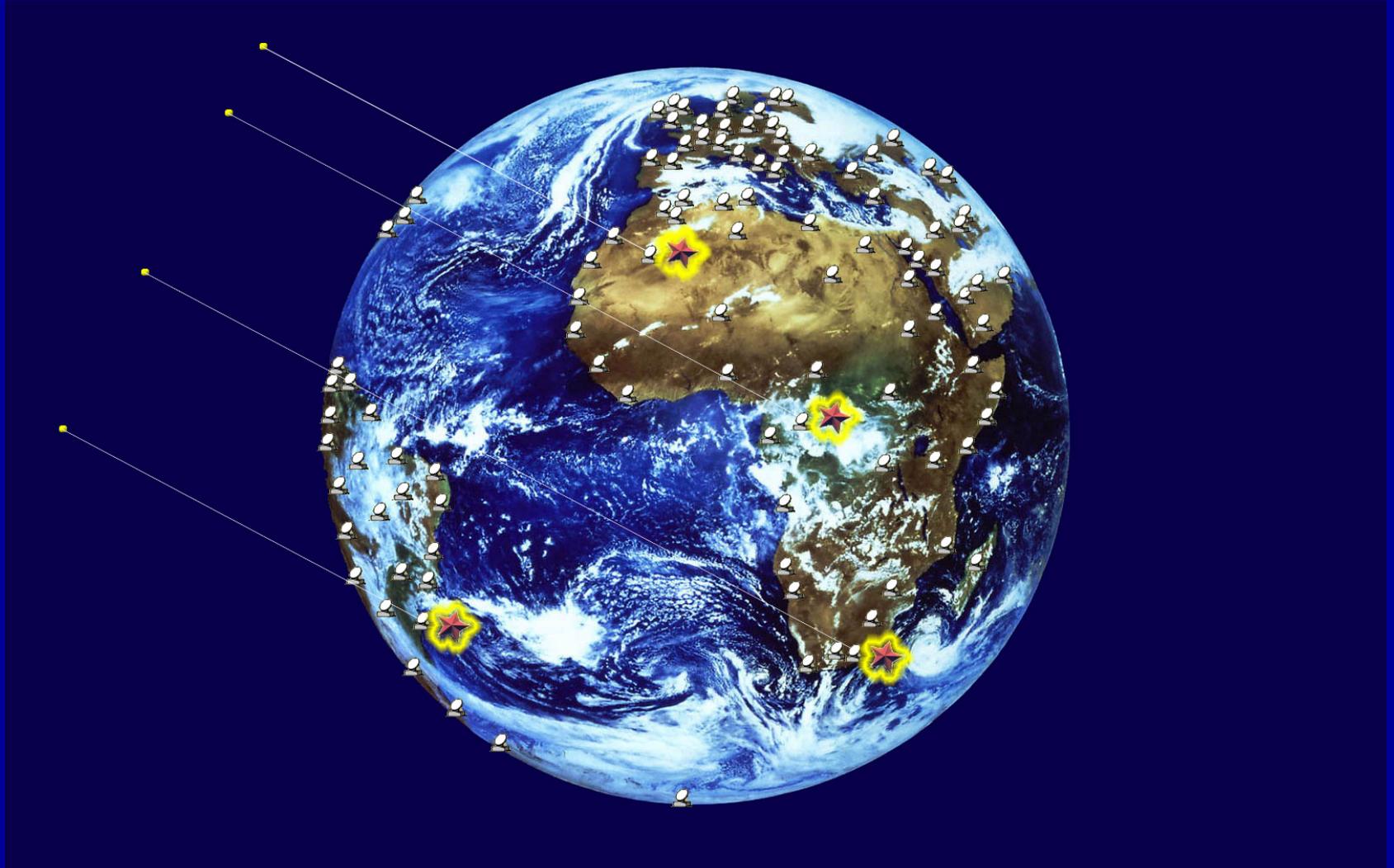
Astrophysical  
Magneto-  
Gravitational  
Interactions?



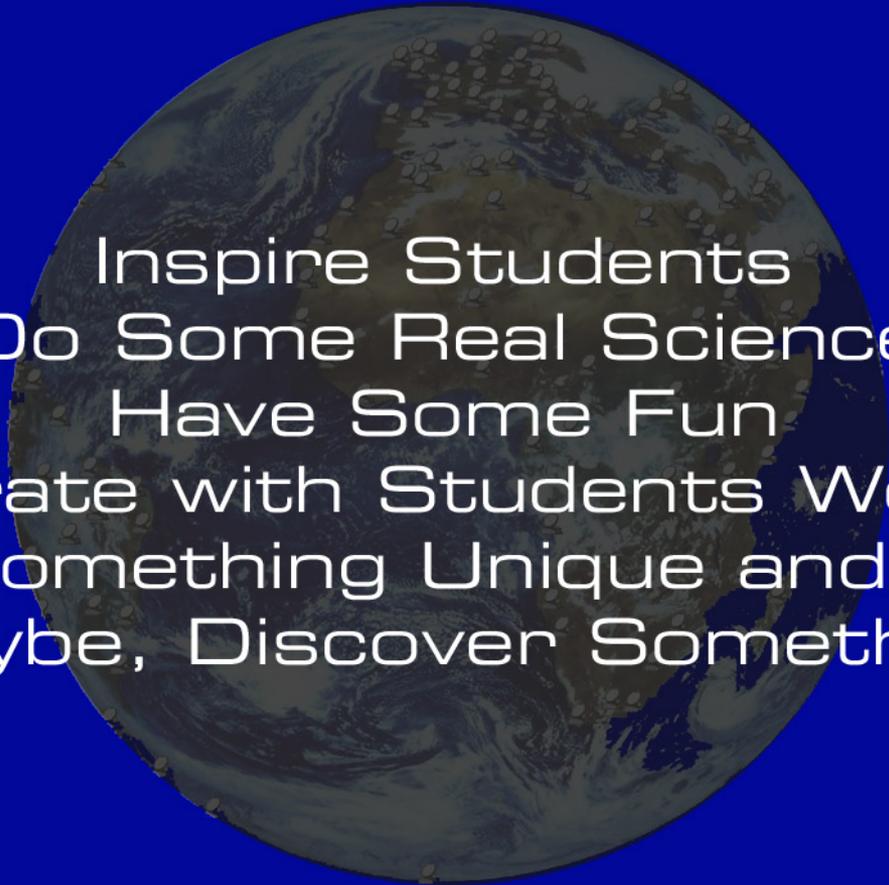
Little Green Men?

Maybe There are *Pulses* of  
Protons?

# Maybe There are *Pulses* of Protons?



# Project Goal: (really)



Inspire Students  
Do Some Real Science  
Have Some Fun

Collaborate with Students Worldwide  
Build Something Unique and Useful  
(Maybe, Discover Something)