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

(Galactic Processes, Billions of Miles, Billions of Years)
What’s a Cosmic Ray?

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?
What makes up an ERGO Detector?
What’s an ERGO Detector?

The ERGO “Pixel”

[Diagram showing the components of the ERGO detector: GPS Antenna, GPS Receiver, Timestamp Generator Logic, Crystal Oscillator, Ethernet Interface, Internet, and Muon Detector.]
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?

1935: First Accelerators 1,000,000 Volts

2010: the Large Hadron Collider 10,000,000,000,000,000 Volts
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
100,000,000,000,000,000,000,000 Volts
Where Do They Come From??

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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)