Enabling Cosmic Rays worldwide
- The role of IPPOG -

My personal view

Charles Timmermans

IPPOG organized workshop

Workshop on

HIGH SCHOOL COSMIC RAY EXPERIMENTS

Centro Fermi — Roma 15-16 February 2017

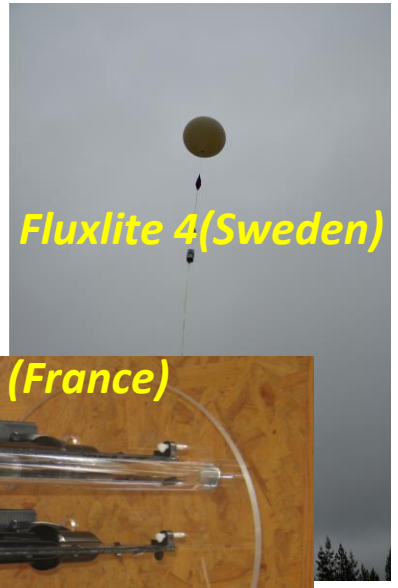
Workshop: Inventory of worldwide (Europe/US) activities

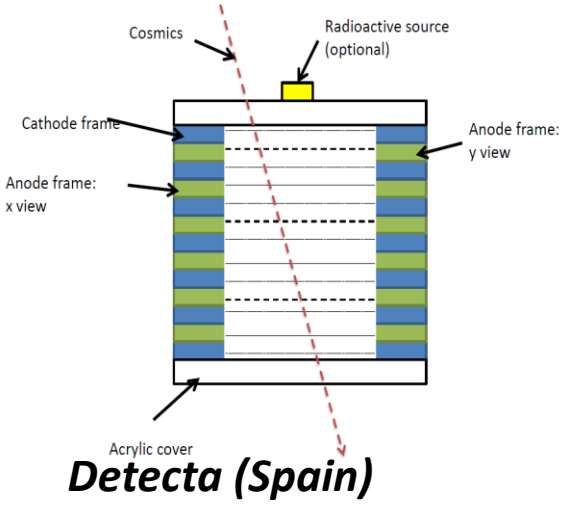
- Permanent Cosmic Ray setups
- Non-Permanent (classroom) activities
- Smaller units: spark chambers, cloud chambers, cosmic arch

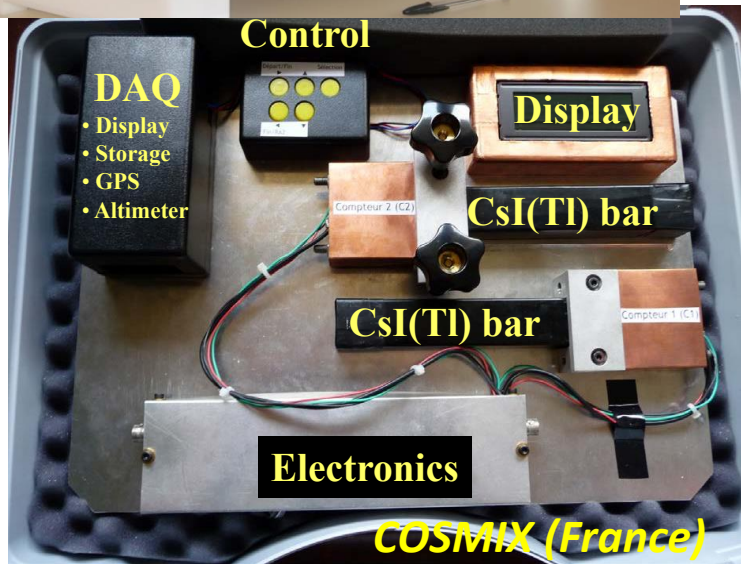
Permanent setups

Showers of Knowledge

Non-permanent setups







Combining experiments

CREDO

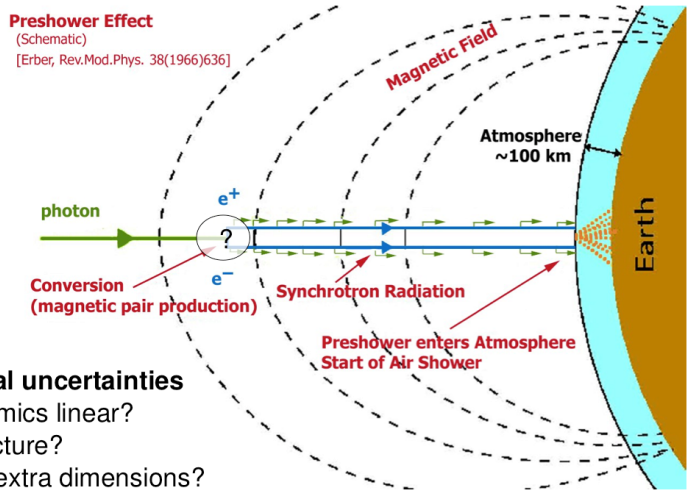
THE QUEST FOR UNEXPECTED

Scientific diversity: ASTRO/COSMO

(super-)preshower:

→ contains typically **(>1000)** 100 particles

→ created at around **(>10000)** 1000 km a.s.l.)



: **fundamental uncertainties**
- electrodynamics linear?
- photon structure?
- spacetime: extra dimensions?

→ dependence on E and $B_{\perp}$ (to be seen in data?)

Citizen science

From Wikipedia, the free encyclopedia

Citizen science (**CS**) (also known as **crowd science**, **crowd-sourced science**, **civic science**, **volunteer monitoring** or **networked science**) is scientific research conducted, in whole or in part, by amateur or nonprofessional scientists. Citizen science is sometimes described as "public participation in scientific resear participatory monitoring and participatory action research.[1]

CITIZEN SCIENCE **IS NOT** OUTREACH!

PUBLICATIONS!

CO-AUTHORS!

Is there a role for IPPOG here?

Combining experiments

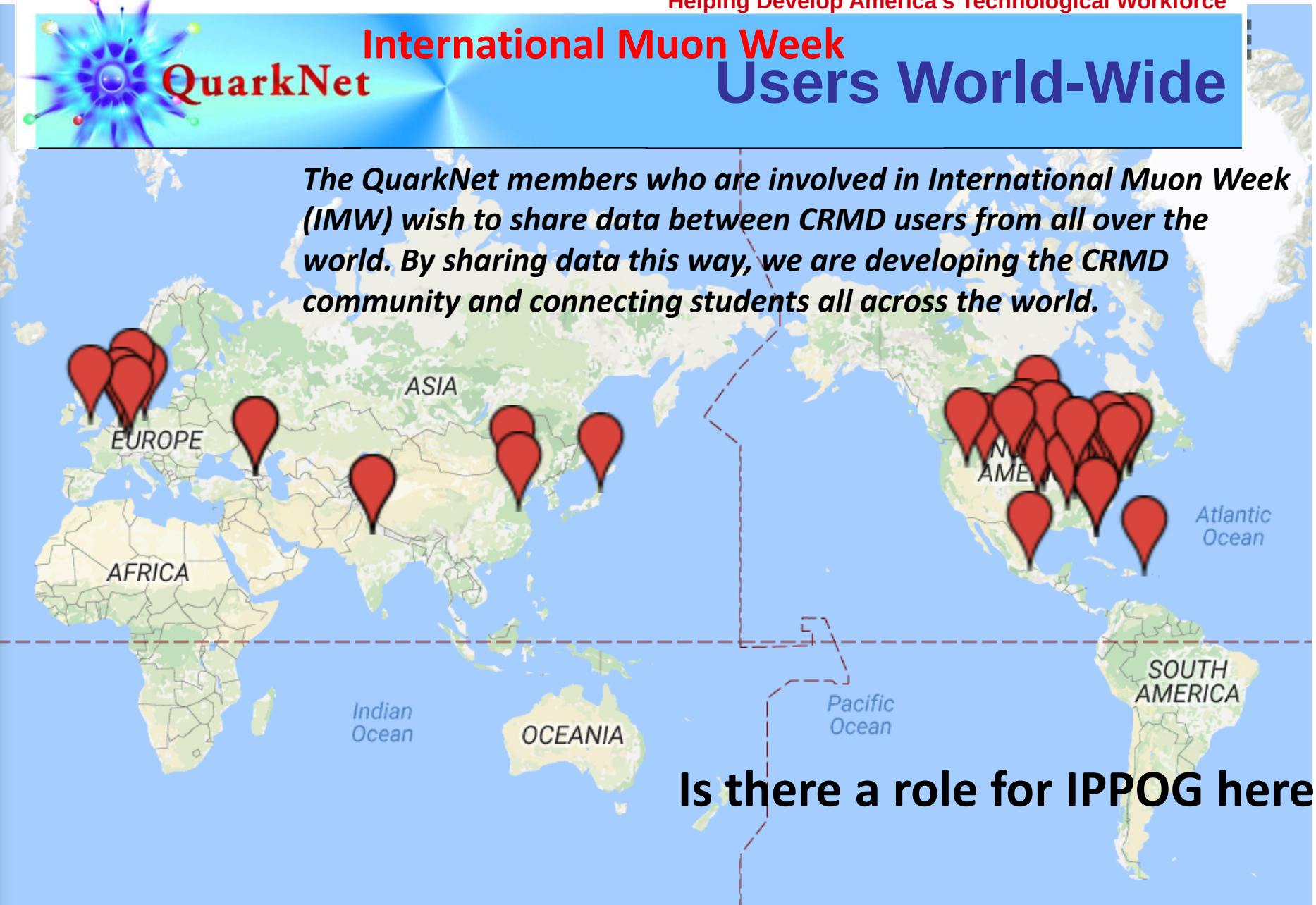
Helping Develop America's Technological Workforce

QuarkNet

International Muon Week

Users World-Wide

The QuarkNet members who are involved in International Muon Week (IMW) wish to share data between CRMD users from all over the world. By sharing data this way, we are developing the CRMD community and connecting students all across the world.



Is there a role for IPPOG here?

Combining experiments

First you need a Cosmic Ray detector
If you do not have a detector and want to join either
[QuarkNet for the U.S. or]
[Netzwerk Teilchenwelt for Germany]

Is there an additional role for IPPOG here?

QuarkNet

International Muon Week

Users World-Wide

Cosmic Rays:

Tantalizing questions on the home pages:

- What are they?
- Where Do they come from?
- Where do they get all that energy?
- How often do they arrive?
- How do we see them

Are not really addressed by the activity (likely in class)

IPPOG Vision 2015

Our international initiative will provide opportunities for teachers and their students to develop and expand their scientific research skills using **authentic experimental data**.

We plan **a web portal** as the entry point for an international network of our cosmic ray projects for education.

Cosmic ray studies are based on a classroom vision where teachers create learning environments that provide students with opportunities for engagement in science.

Teaching strategies emulate closely the way scientists build knowledge through **inquiry**. Students develop scientific knowledge and habits of mind to make sense of the world using **real experimental data**.

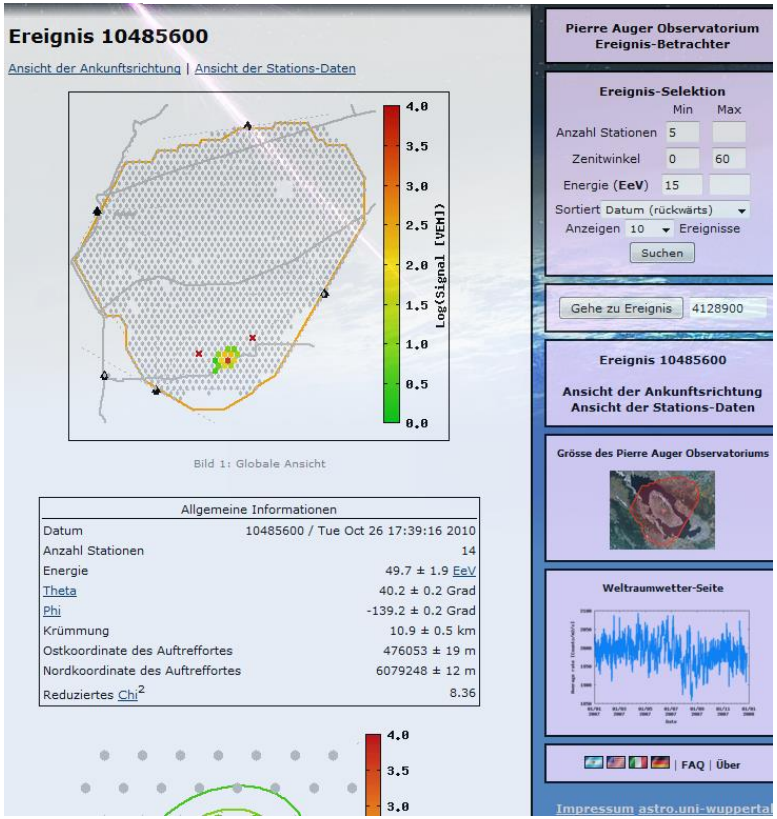
Depending on the project, resources include background information, data, analysis tools, educational scaffolding for student investigations, a place to post results and more.

While a detector is not required to participate in our projects, we provide access to detectors or information about how to build or purchase detectors.

My question to you: Is there a difference between this vision and (expansion of) the Quarknet cosmic ray programme?

In addition: Masterclasses using scientific data

IceCube MasterClass
AN AUTHENTIC ASTROPHYSICS RESEARCH EXPERIENCE



Address the questions:

COSMIC RAYS:

- What are they?
- Where Do they come from?
- Where do they get all that energy?
- How often do they arrive?
- How do we see them

Possible IPPOG Roles

- Scientific masterclass support (similar to LHC)
- Community building by organizing workshops as we did in Rome
- Supporting collaboration and outreach using the permanent setups (EEE, HiSPARC, Showers of Knowledge,…).

- International Muon Week seems to be handled well by Quarknet
- International Cosmic Day seems to be handled well by Desy and Quarknet