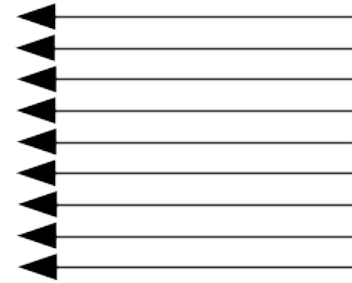


1st Anniversary: Summary and Vision

CREDO 
THE QUEST FOR UNEXPECTED



Piotr Homola

Institute of Nuclear Physics
Polish Academy of Sciences, Kraków, Poland

CREDO Anniversary Symposium, Kraków, 30.08.2017

Graphics Copyright: <http://copyright.web.cern.ch/>

Global multi-disciplinary motivation!

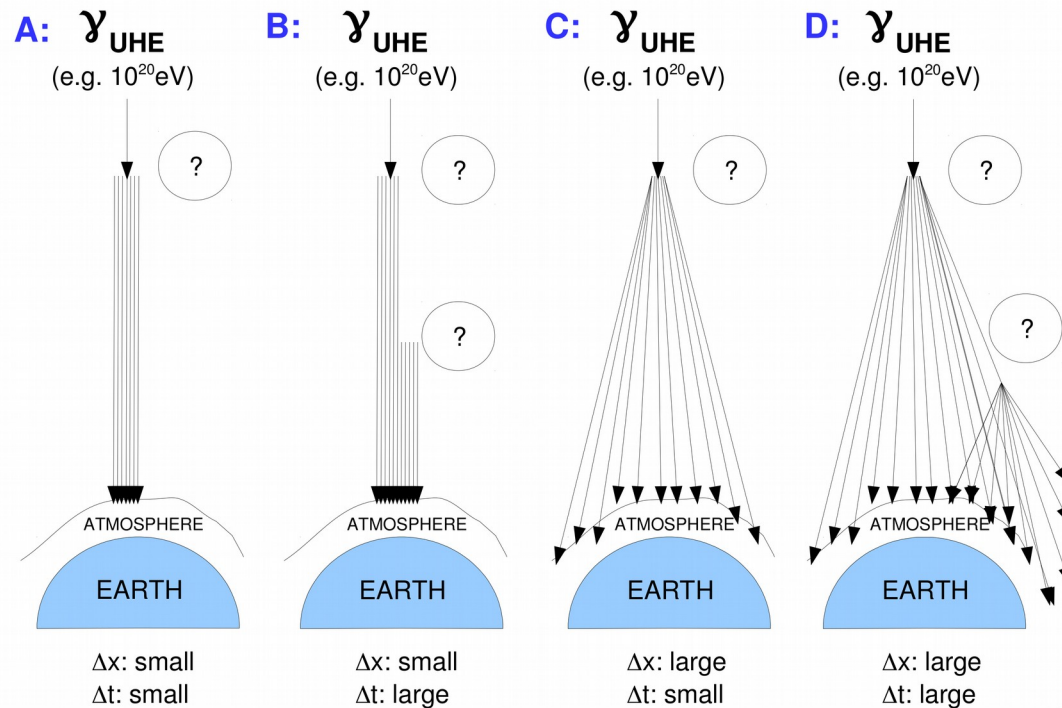
- **CREDO: a unifying, global** cosmic-ray project: **GeV – ZeV+**
→ completing the **closest accessible approach to GUT scale**
- Strong science motivation: **ASTRO** / **GEO** / **BIO** / **FISHING**
- Citizen science (OUTREACH 2.0 + REAL SCIENCE)
- **All particle detectors** are CREDO
(biggest + „high schools” + desktop + smartphone clouds)

CREDO

THE QUEST FOR UNEXPECTED

Scientific diversity: ASTRO/COSMO

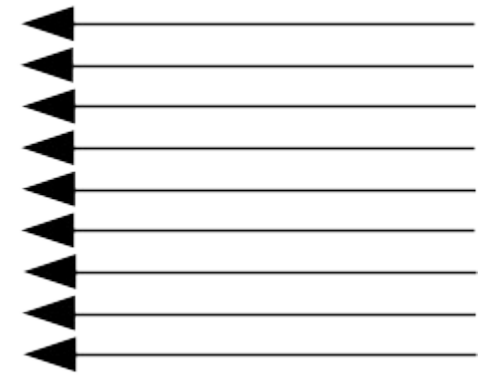
Classes of super-preshowers (SPS)



→ **millions of photons at $E > \text{TeV}$** , arriving simultaneously at the top of the atmosphere, **spread worldwide!**

Let us **hunt for coincidences!**

CREDO



THE QUEST FOR UNEXPECTED

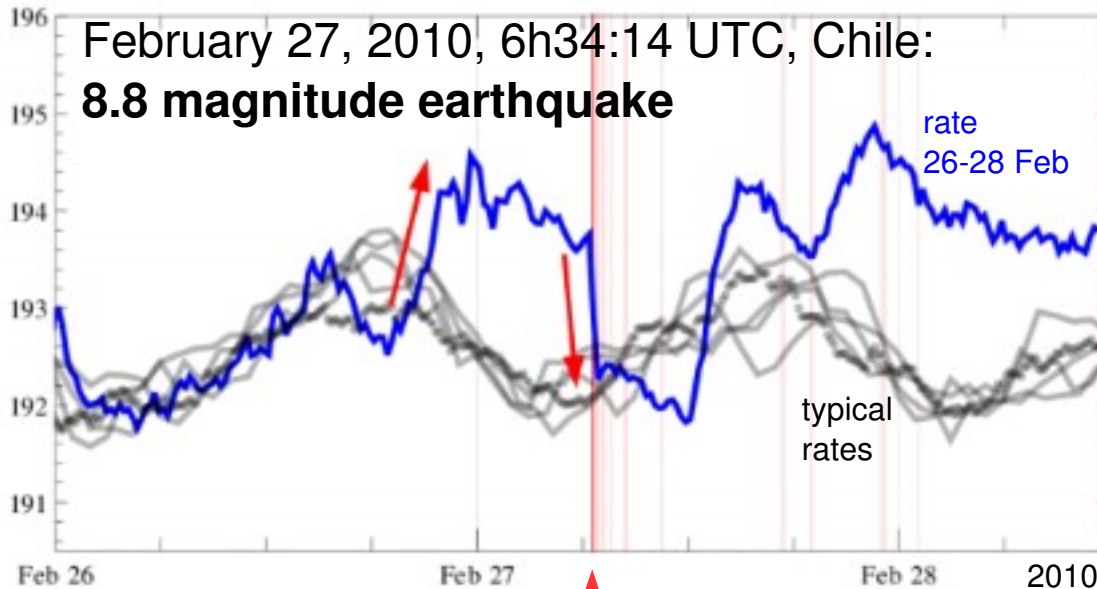
Scientific diversity: **GEO**

PAO sees earthquakes

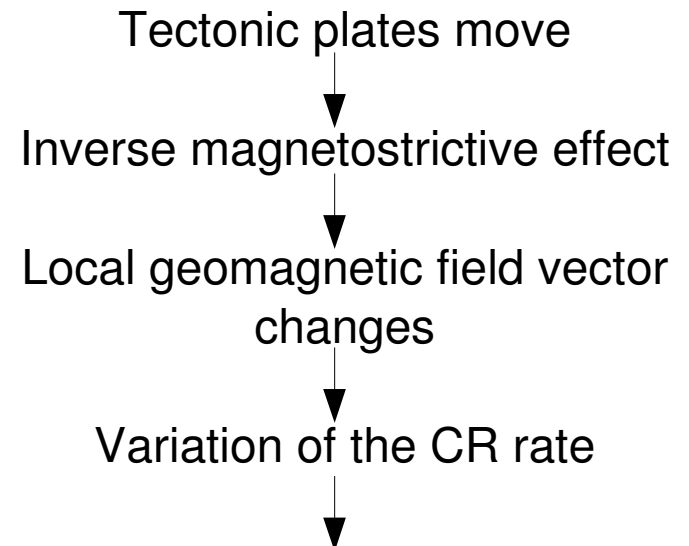
[by A. Saleh]

Pierre Auger Observatory

scaler rate [Hz]

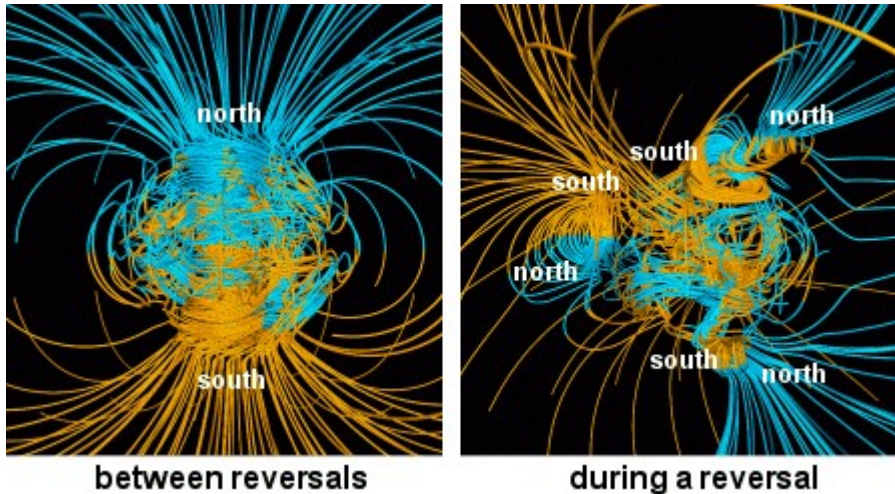


- Increase of CR before the earthquake
- Strong drop during the earthquake

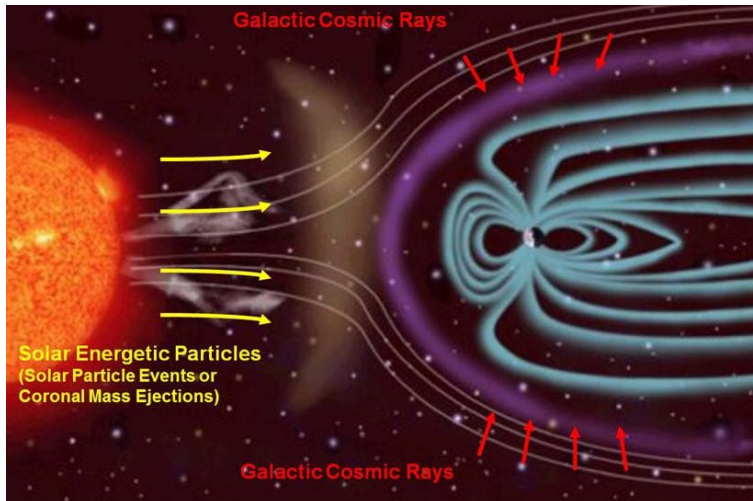


→ **CREDO-earthquakes task** [already existing]

Wikipedia: „Geomagnetic reversal”



Wikipedia: „Health threat from cosmic rays”



Earth outer core: Liquid (molten iron)
→ geomagnetism

↓
Impulse (tidal forces)
→ hydrodynamics: waves

↓
→ Mechanical wave upwards (slow, hours?)
→ Electromagnetic wave („instant”, ms)

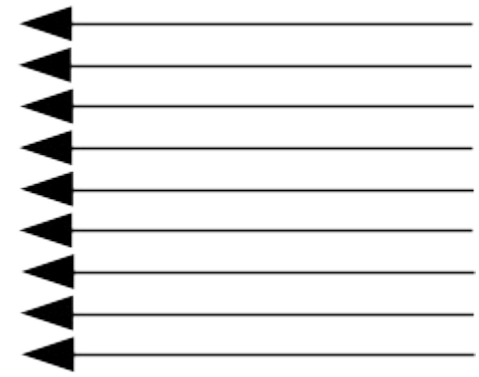
↓
Local geomagnetic field vector changes
AND seismic effect might occur!

↓
Variation of the CR rate!

↓
Earthquake precursors?

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Scientific diversity: **BIO**



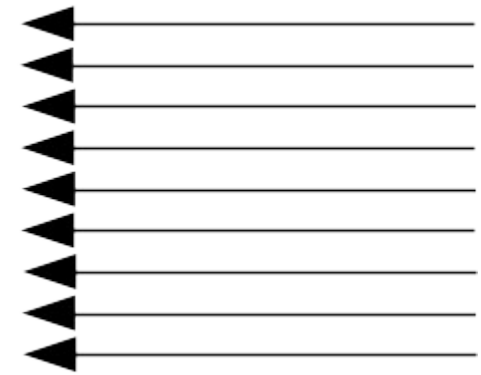
[Livescience.com, October 11, 2016]

On a Long Trip to Mars, Cosmic Radiation May Damage Astronauts' Brains

... and how can cosmic rays affect us on Earth?

Imagine a global network of cosmic ray detectors and global data on EEG...

CREDO



THE QUEST FOR UNEXPECTED

Scientific diversity: **FISHING**



Just cast the (global) cosmic-ray net and see which **truth** gets in...

Citizen Science: Science must be real

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 research", [participatory monitoring](#) and [participatory action research](#).^[1]

CITIZEN SCIENCE IS NOT OUTREACH!



PUBLICATIONS!

CO-AUTHORS!

New affiliation type: “amateur”

Mon. Not. R. Astron. Soc. **000**, 000–000 (0000) Printed 26 January 2016 (MN \LaTeX style file v2.2)

Planet Hunters X.

KIC 8462852 – Where’s the flux? ^{*}†

T. S. Boyajian¹, D. M. LaCourse², S. A. Rappaport³,
D. Fabrycky⁴, D. A. Fischer¹, D. Gandolfi^{5,6}, G. M. Kennedy⁷, H. Korhonen^{8,9}, M. C.
Liu¹⁰, A. Moor¹¹, K. Olah¹¹, K. Vida¹¹, M. C. Wyatt⁷, W. M. J. Best¹⁰, J. Brewer¹,
F. Ciesla¹², B. Csák¹³, H. J. Deeg^{14,15}, T. J. Dupuy¹⁶, G. Handler¹⁷, K. Heng¹⁸, S. B.
Howell¹⁹, S. T. Ishikawa²⁰, J. Kovács¹³, T. Kozakis²¹, L. Kriskovics¹¹, J. Lehtinen²², C.
Lintott²³, S. Lynn²⁴, D. Nespral^{14,15}, S. Nikbakhsh^{22,25}, K. Schawinski²⁶, J. R. Schmitt¹,
A. M. Smith²⁷, Gy. Szabo^{11,13,28}, R. Szabo¹¹, J. Viuhonen²², J. Wang^{1,29}, A. Weiksnar²⁰, M.
Bosch², J. L. Connors², S. Goodman², G. Green², A. J. Hoekstra², T. Jebson², K. J. Jek²,
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¹*Department of Astronomy, Yale University, New Haven, CT 06511, USA*

²*Amateur Astronomer*

³*Department of Physics, and Kavli Institute for Astrophysics and Space Research, Massachusetts Institute of Technology, Cambridge, MA 02139, USA*

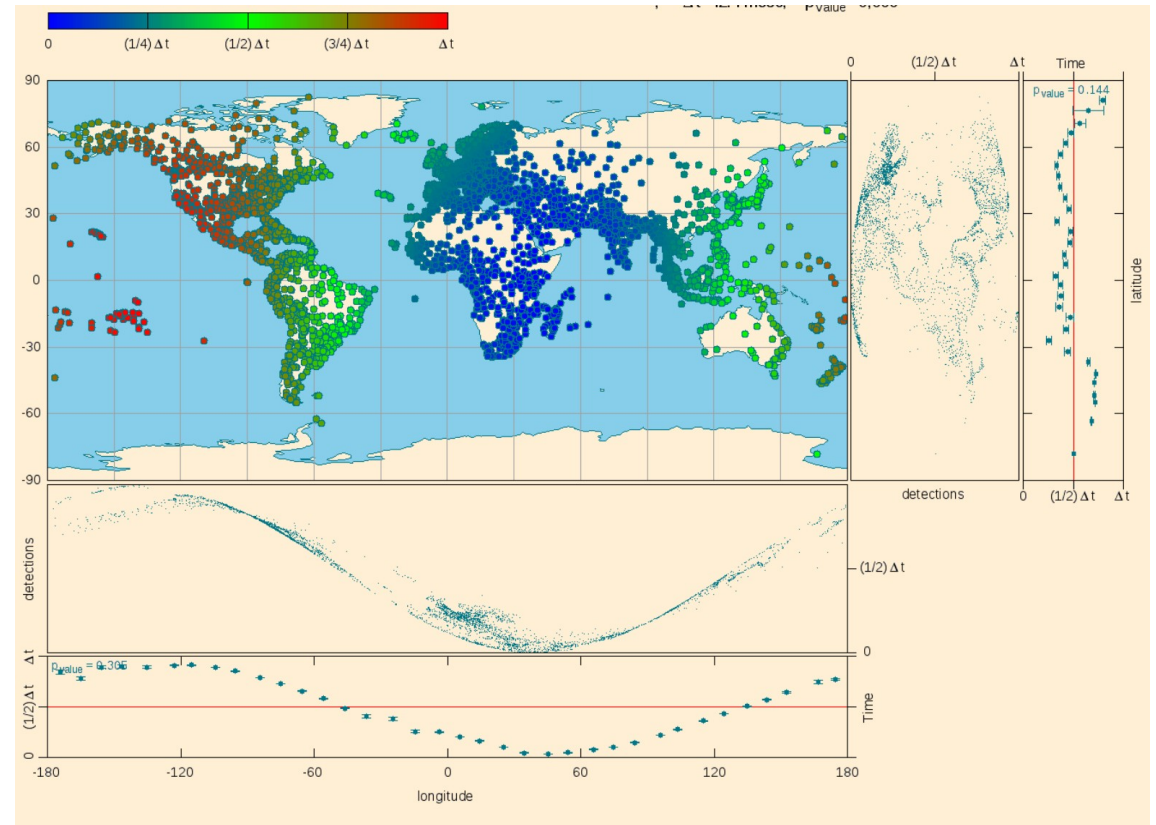
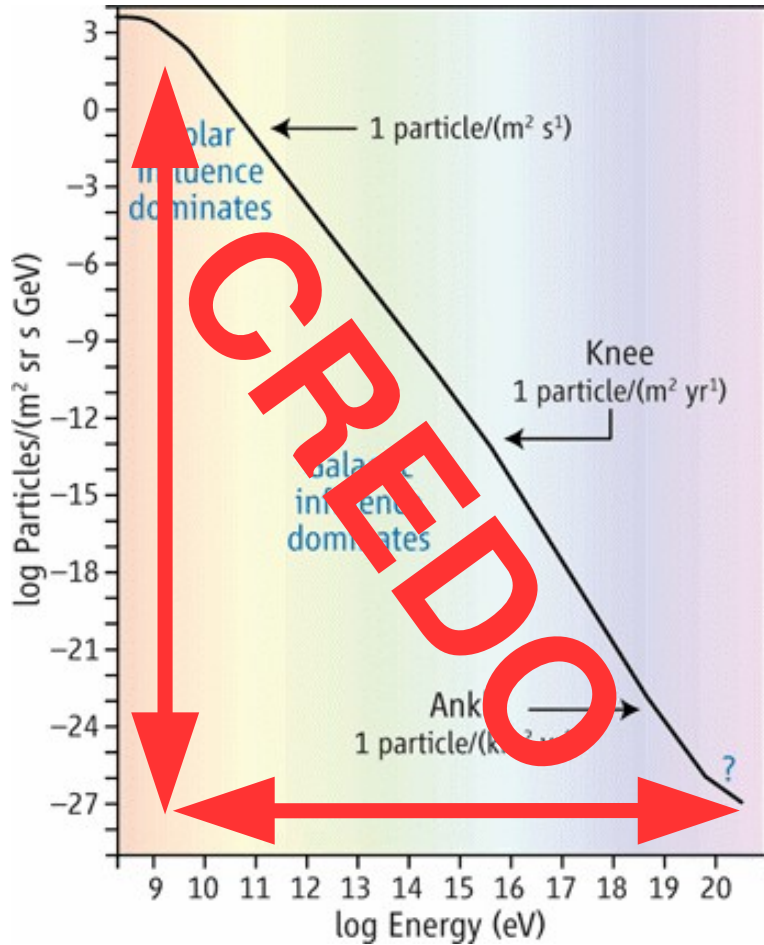
⁴*Department of Astronomy and Astrophysics, University of Chicago, 5640 South Ellis Avenue, Chicago, IL 60637, USA*

⁵*Dipartimento di Fisica, Università di Torino, via P. Giuria 1, I-10125, Torino, Italy*

⁶*Landessternwarte Königstuhl, Zentrum für Astronomie der Universität Heidelberg, Königstuhl 12, D-69117 Heidelberg, Germany*

1.SRJ 25 Jan 2016

Vision: the potential of the complete CR study



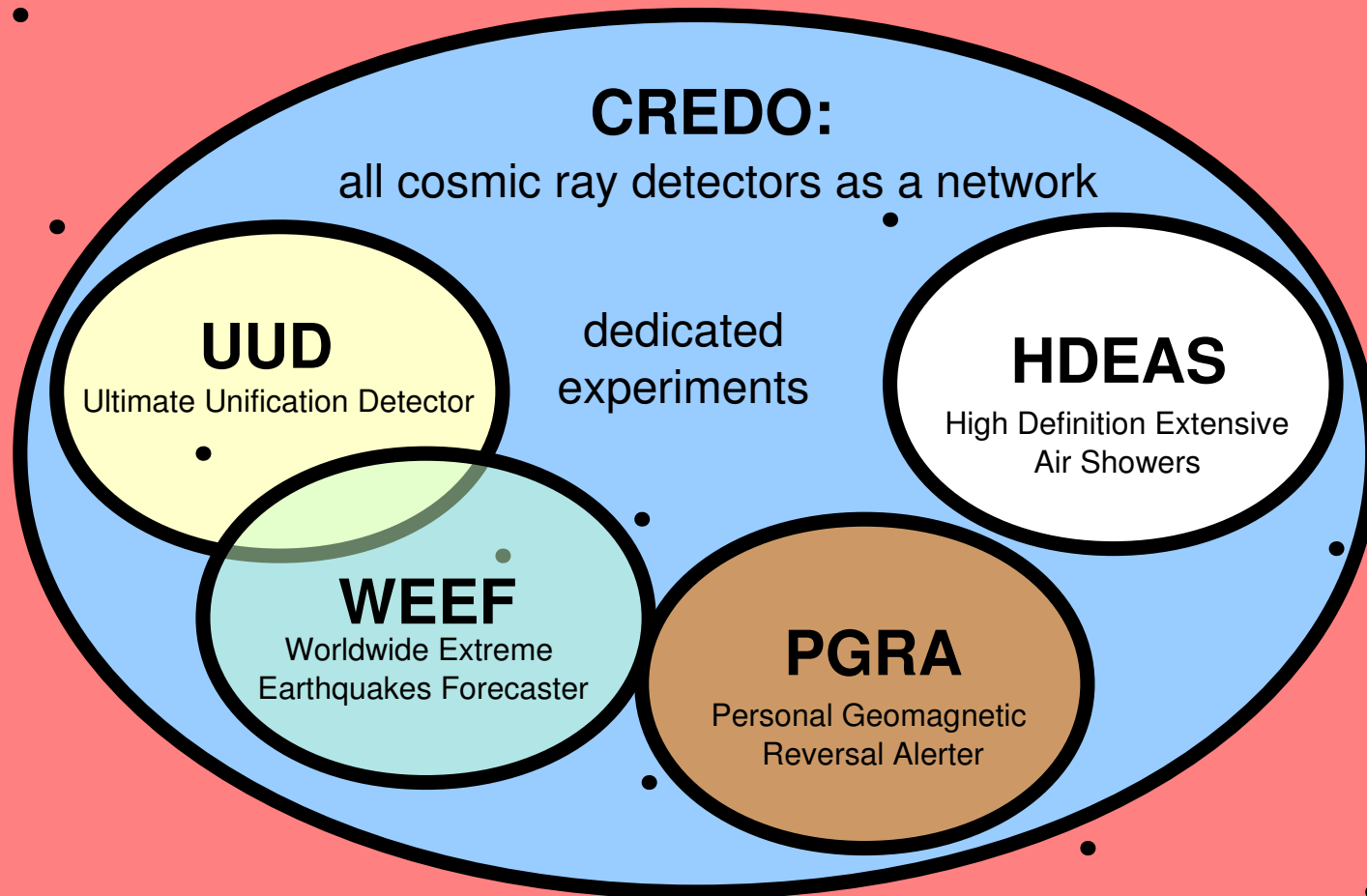
Would be a pity not to spot such a beauty...

Vision: organization of the complete CR study

Credit: P. Poznański

Organization: **Open Cosmic Ray Institute** (full exploration of the CR field)

→ remote employees, distributed offices, central management



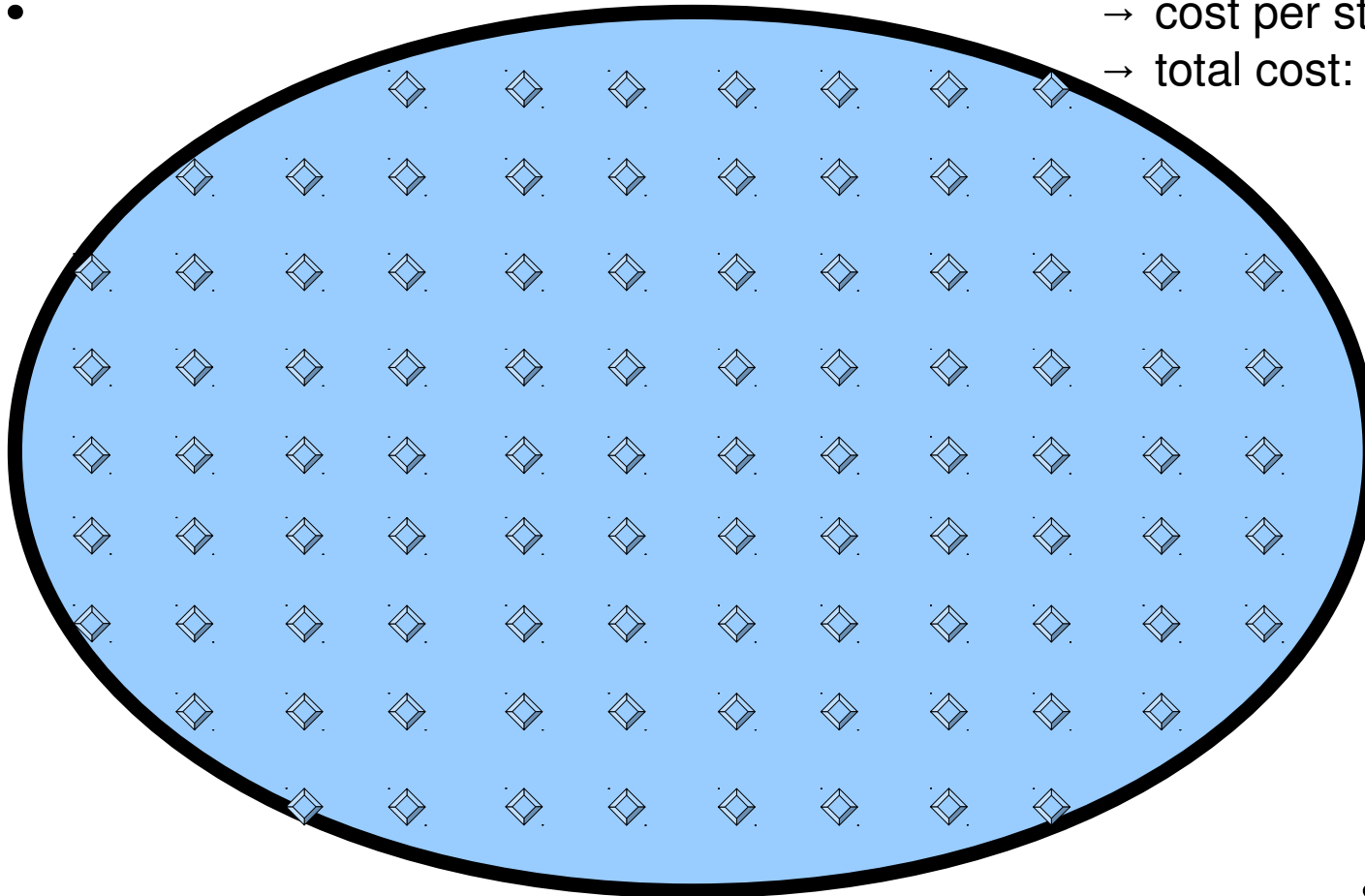
Vision: CREDO experiments

UUD

Ultimate Unification Detector

Ultimate Unification Detector

- target: $E > 10^{20}$ eV
- spacing: 10 km
- stations: ~5,000,000
- cost per station: < 1000 \$
- total cost: ~ 5 billion \$



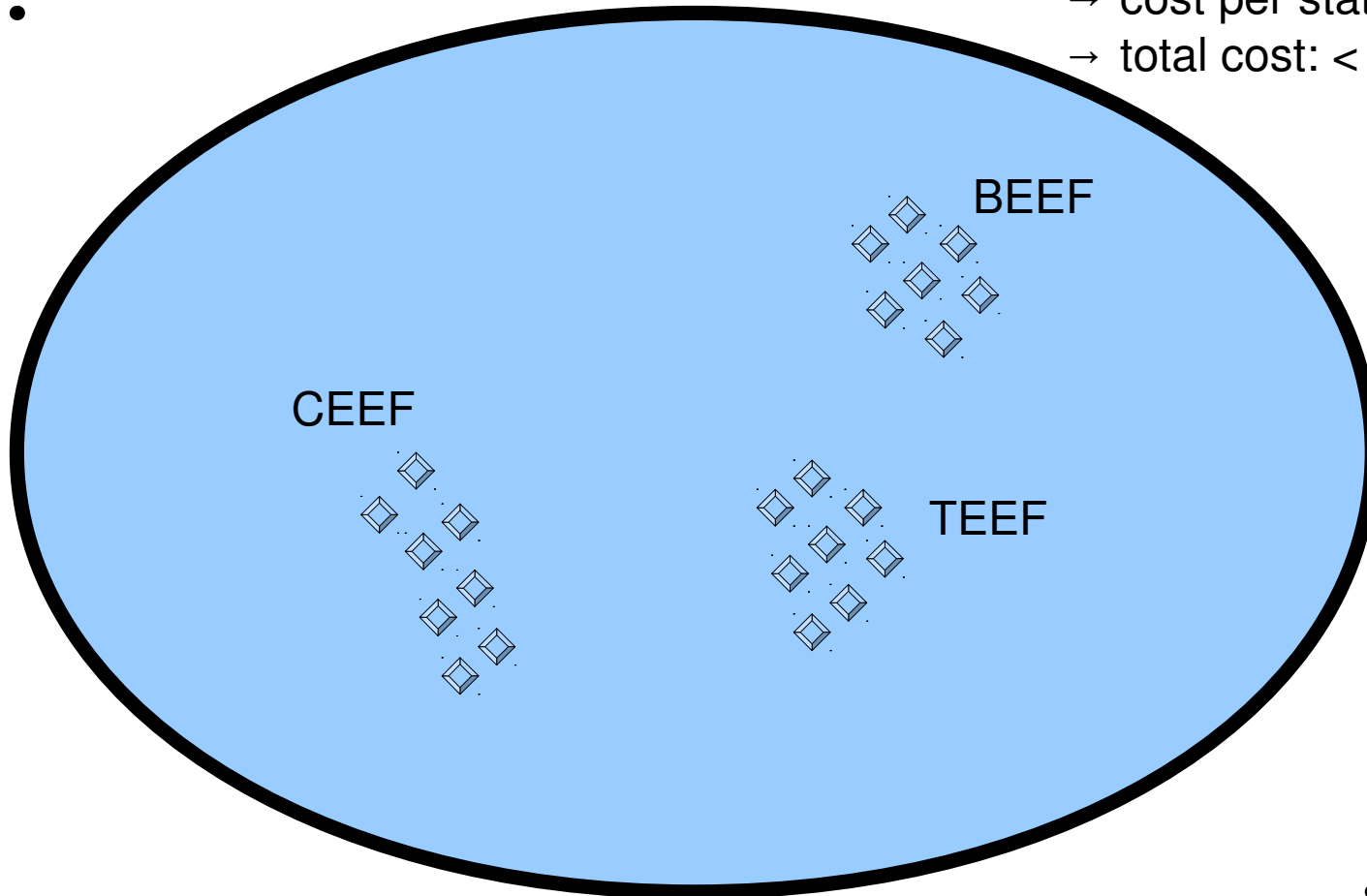
Vision: CREDO experiments

WEEF

Worldwide Extreme Earthquakes Forecaster

Worldwide Extreme Earthquake Forecaster

- target: CR background
- spacing: ~1 km / clusters
- stations: ?
- cost per station: < 2000 \$
- total cost: < 500 M\$



Vision: CREDO experiments

PGRA

Personal Geomagnetic
Reversal Alerter

Personal Geomagnetic Reversal Alerter

- target: CR background
- spacing: any
- stations: ?
- cost per station: < 100 \$
- total cost: private/individual



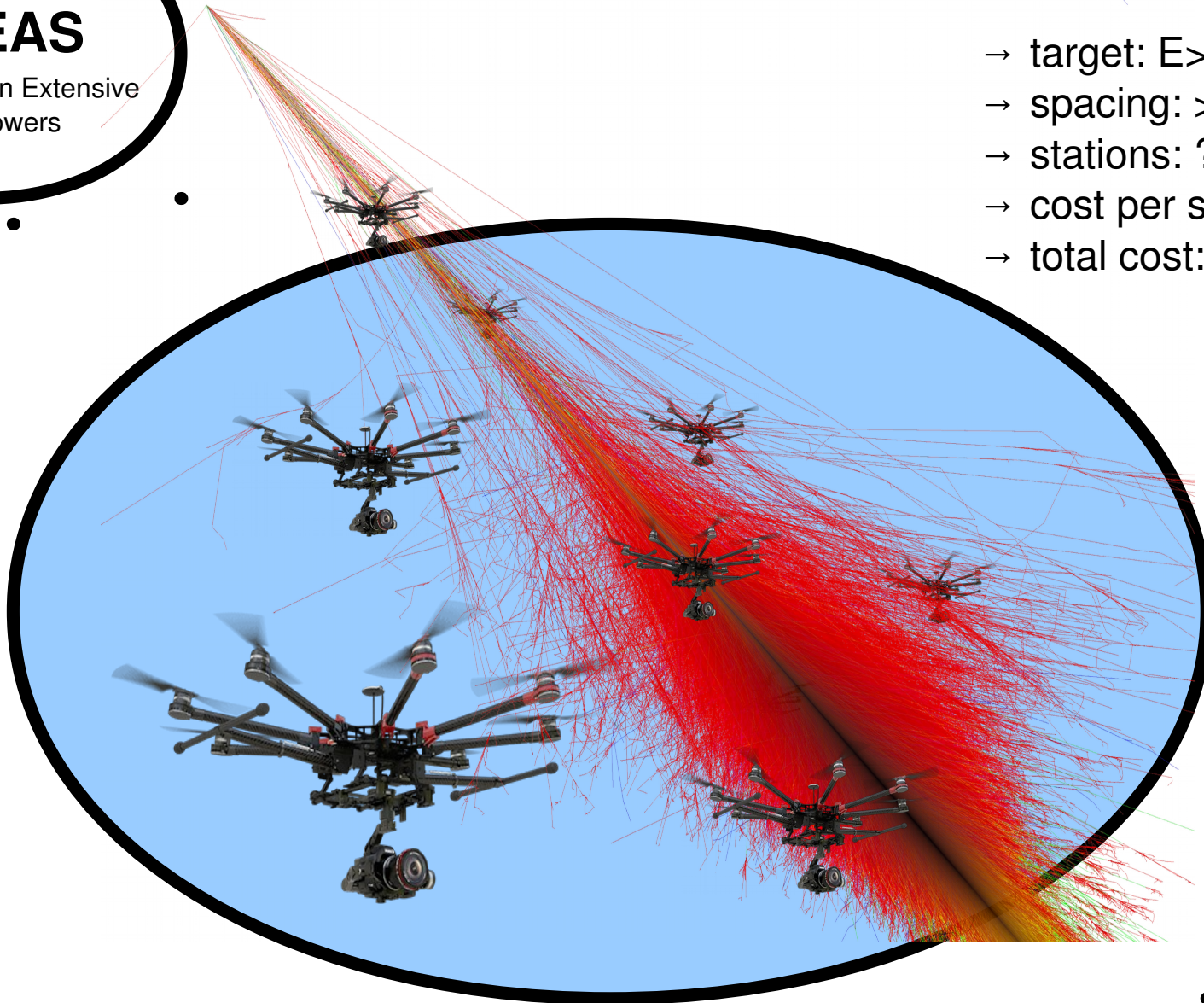
Vision: CREDO experiments

HDEAS

High Definition Extensive
Air Showers

High Definition Extensive Air Showers

- target: $E > 10^{15}$ eV
- spacing: > 1 m (3D)
- stations: ?
- cost per station: ?
- total cost: ~ 50 M \$



Visit credo.science...

credo.science

CREDO
THE QUEST FOR UNEXPECTED

„I do think CREDO has a unique capability of entering in and exploring a completely uncharted realm of science.” Mikhail V. Medvedev

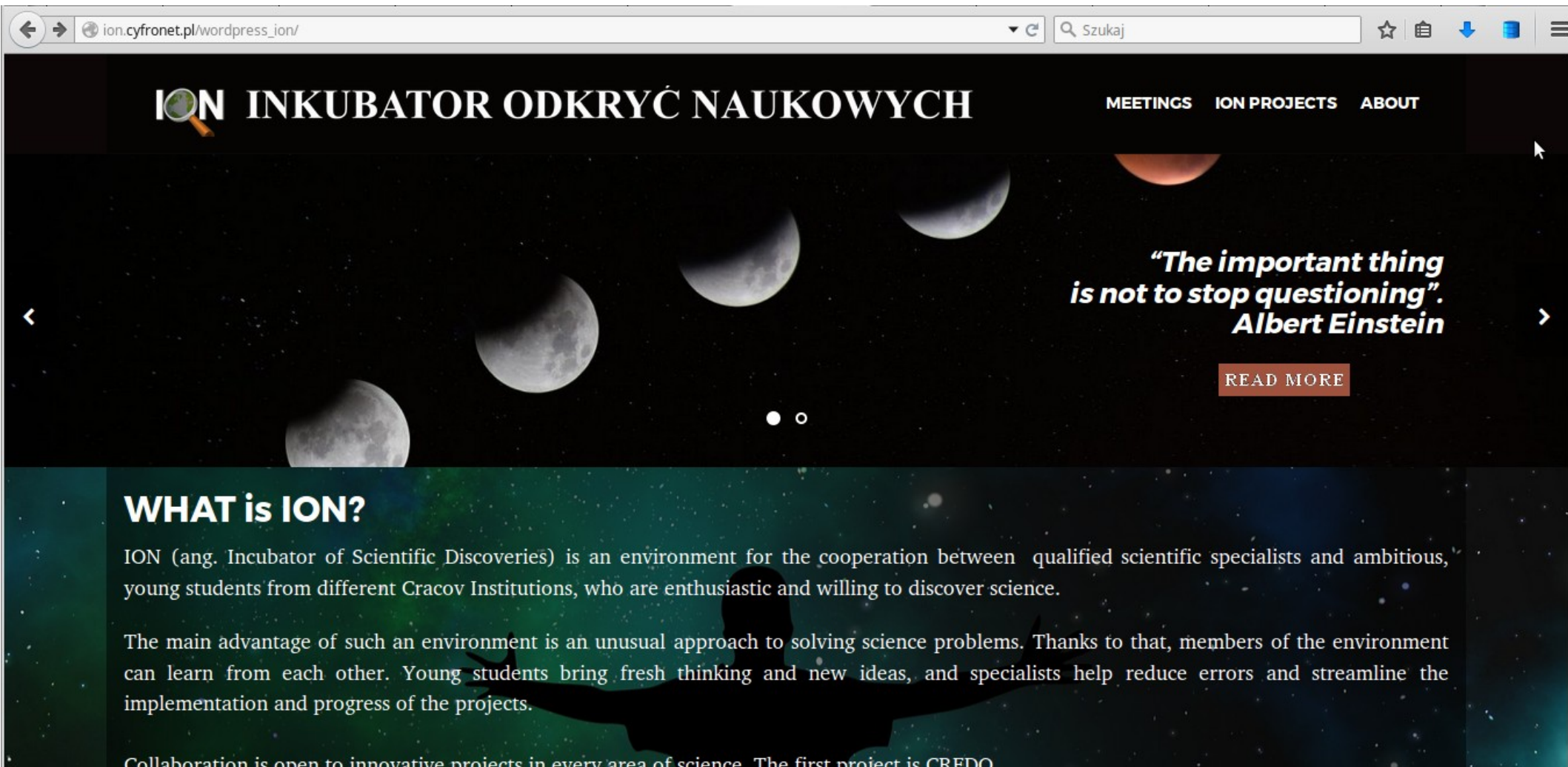
Cosmic-Ray Extremely Distributed Observatory (CREDO)

Enables a strategy for a global analysis of cosmic-ray data to reach the sensitivity to extremely extended cosmic-ray phenomena, we call them super-preshowers, invisible for individual detectors or observatories. So far, the cosmic-ray research has been oriented on detecting single air showers only, while the search for ensembles of cosmic-ray events induced by super-preshowers is a scientific terra incognita.

[Read More](#)

... and contribute to CREDO science.

Incubator of Scientific Discoveries



ion.cyfronet.pl/wordpress_ion/ Szukaj

ION INKUBATOR ODKRYĆ NAUKOWYCH

MEETINGS ION PROJECTS ABOUT

"The important thing is not to stop questioning".
Albert Einstein

[READ MORE](#)

WHAT is ION?

ION (ang. Incubator of Scientific Discoveries) is an environment for the cooperation between qualified scientific specialists and ambitious, young students from different Cracov Institutions, who are enthusiastic and willing to discover science.

The main advantage of such an environment is an unusual approach to solving science problems. Thanks to that, members of the environment can learn from each other. Young students bring fresh thinking and new ideas, and specialists help reduce errors and streamline the implementation and progress of the projects.

Collaboration is open to innovative projects in every area of science. The first project is CREDO

Begin your journey to the Nobel Prize early...