



The Cosmic Ray Extremely Distributed Observatory (CREDO) project

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Outline

- 1. Scientific motivation
- 2. Ultra High Energy Cosmic Rays (UHECR)
→ photons and cosmic ray ensembles (CRE)
- 3. UHECR detection strategy
- 4. CREDO (Cosmic Ray Extremely Distributed Observatory)
- 5. CREDO monitor
- 6. Summary and outlook

Scientific motivation

Problems we aim at:

Dark matter origin
UHECR puzzle



Theoretical explanation:

SHDM decay or annihilation
Topological defects

Key obstacle:

Non-observation
UHE photons



Main idea:

Cosmic ray ensembles (CRE)
(super-preshowers)

Basic tool:

Time clustering analysis



Outcome:

Maps to classify

Photons as UHECR: testing astrophysical scenarios

Bottom → Up: Astrophysical scenarios

Acceleration of nuclei (e.g. by shock waves)

+ “conventional interactions”, e.g. with CMBR

- sufficiently efficient astrophysical objects difficult to find
- small fractions of photons and neutrinos – mainly nuclei expected

Top → Down: Exotic scenarios (particle physics)

Decay or annihilation the early Universe relics

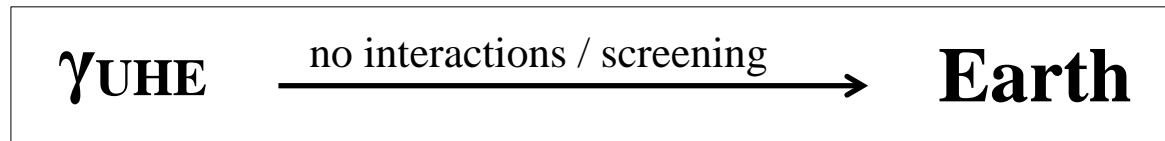
→ hypothetical supermassive particles of energies $\sim 10^{23}$ eV

→ decay to quarks and leptons → hadronization (mainly pions)

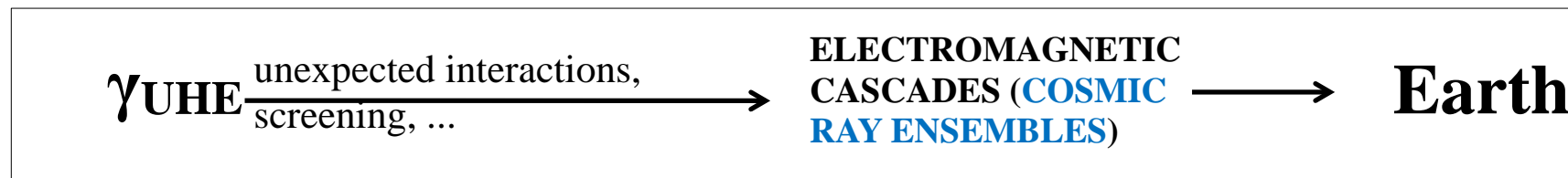
- large fraction of photons and neutrinos in UHECR flux

DARK MATTER!

Experimental evidence about γ_{UHE}



NOT OBSERVED

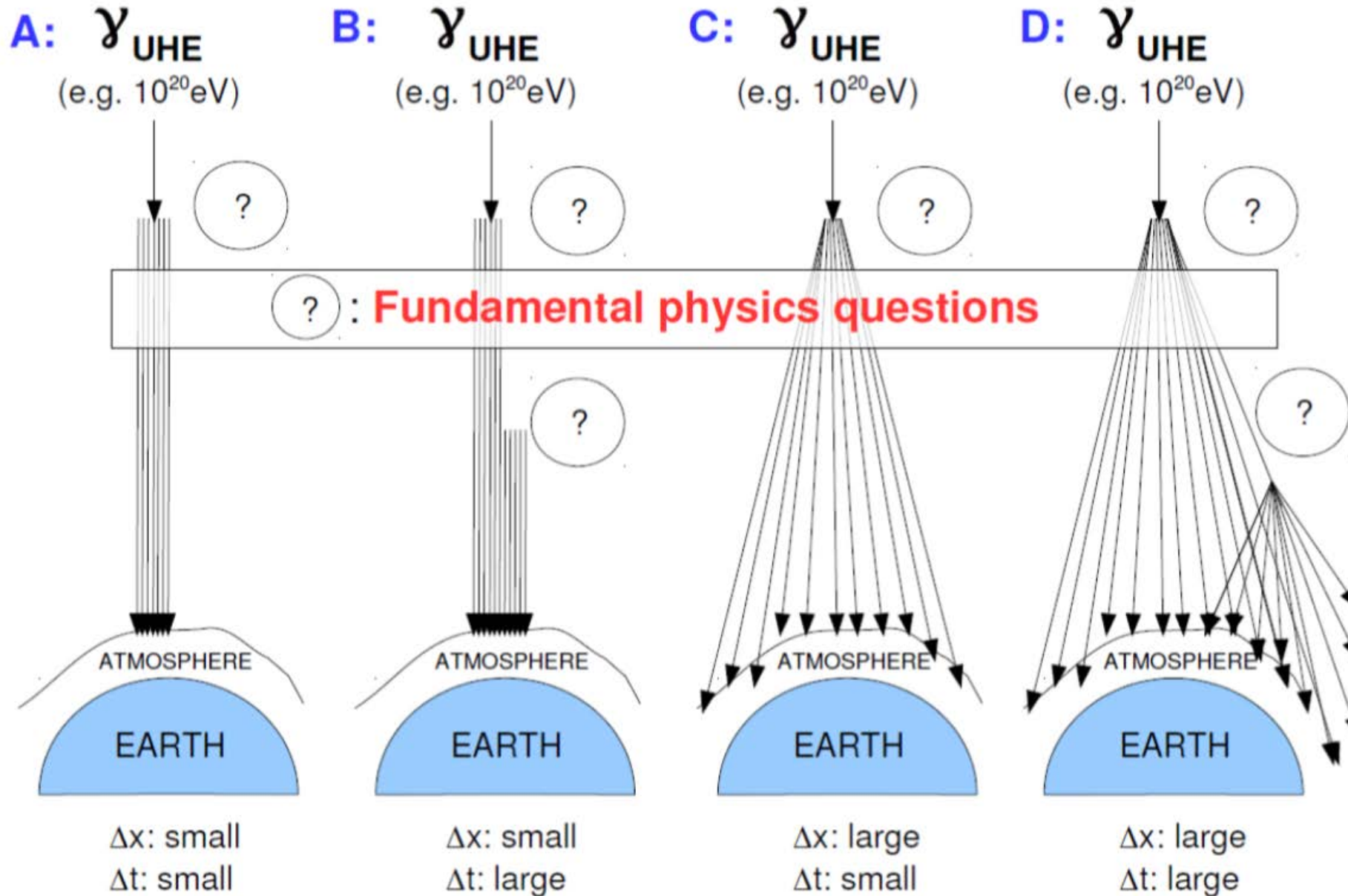


NOT TRIED SO FAR...

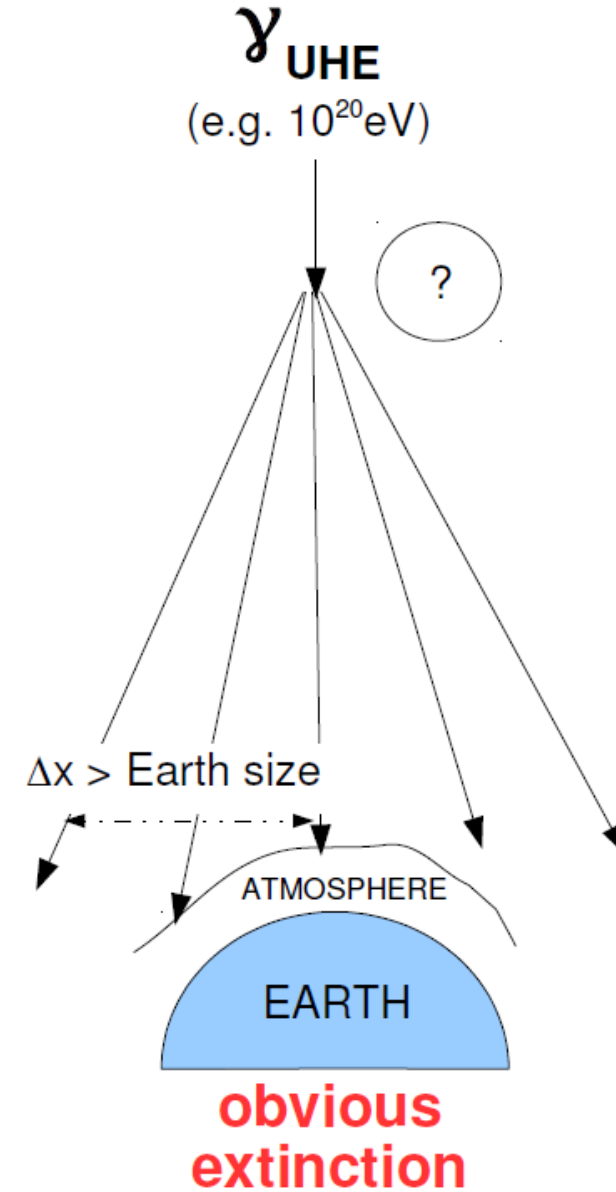
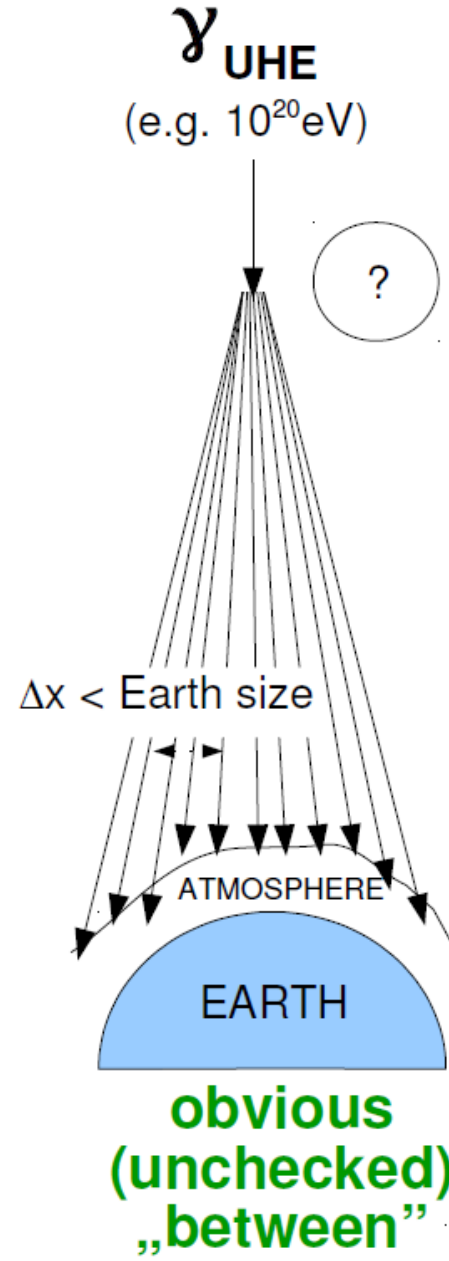
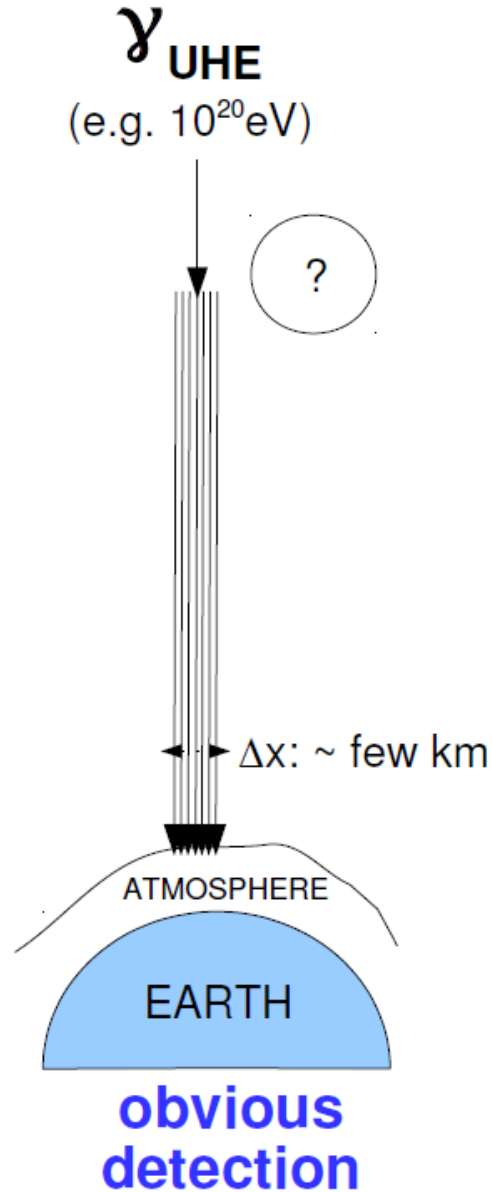


CREDO!

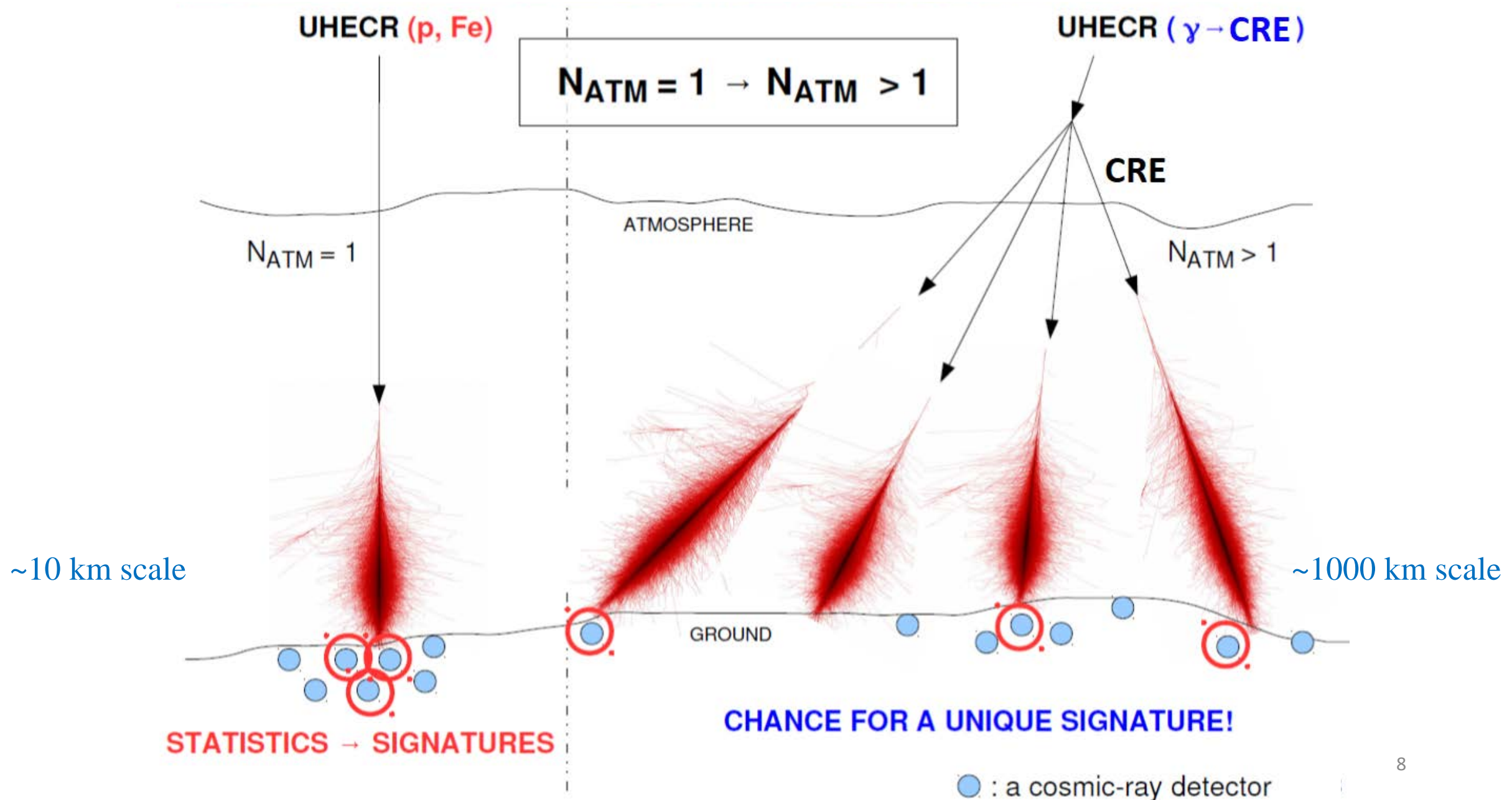
Classes of cosmic ray ensembles



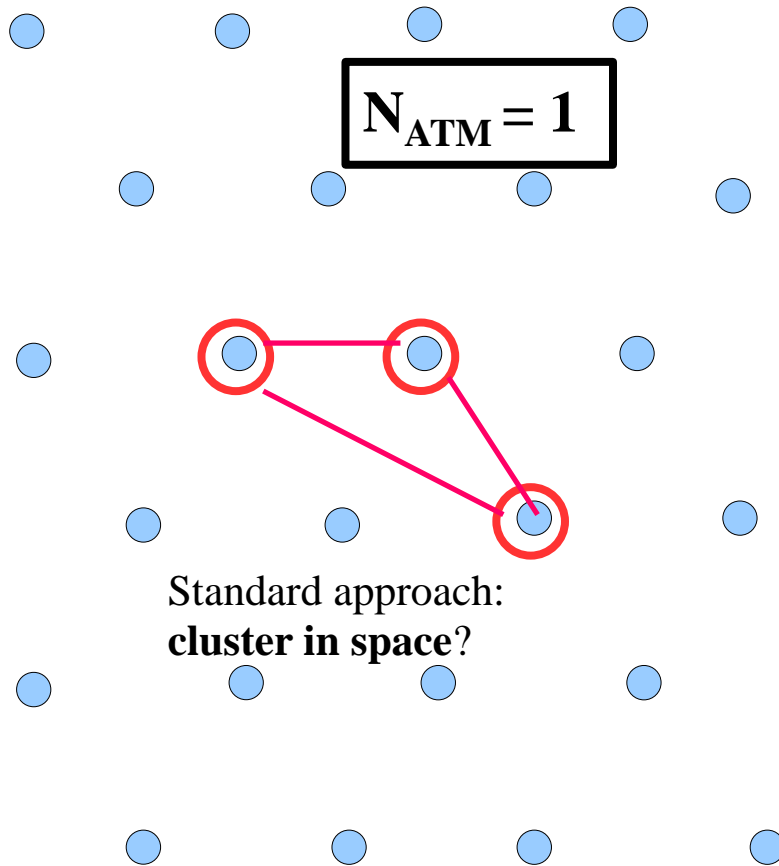
Cosmic ray ensembles on Earth: untouched ground



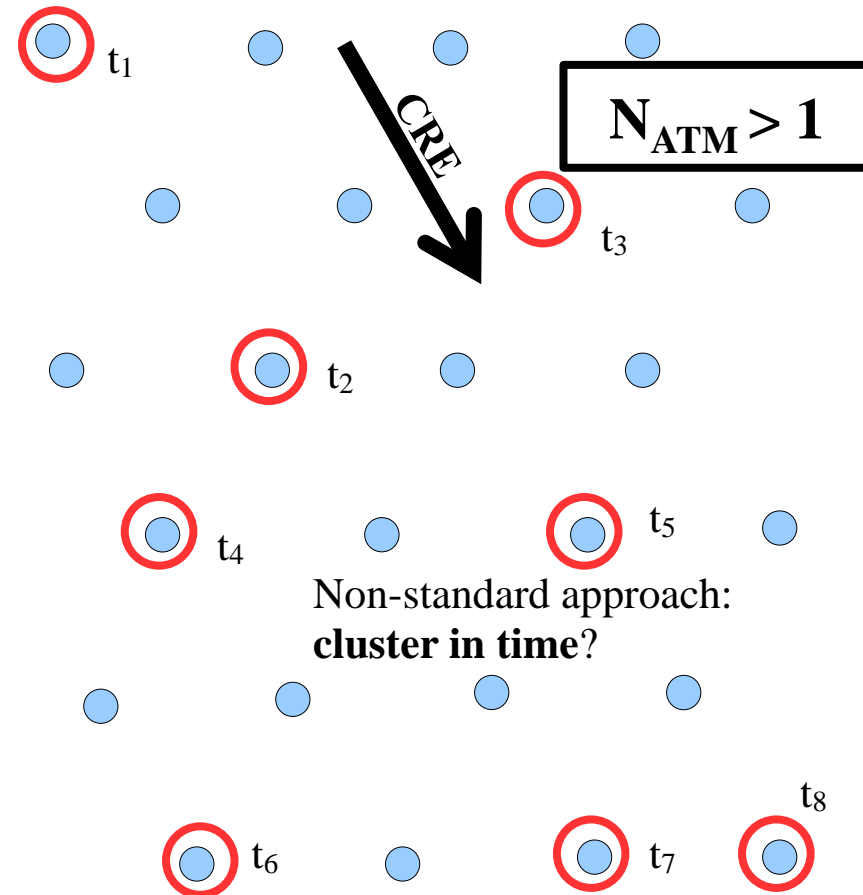
Generalized scheme of UHECR research



A chance for a **unique** cosmic ray ensemble **signature**



● : a cosmic-ray detector



- 1) $t_n - t_1 < \sim 1 \mu\text{s}$
- 2) $t_1 < \dots < t_n$,

CREDO: the quest for unexpected



Citizen science motivation

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]

Mutual benefit resulting from synergy!



Participants get opportunities:

- To educate themselves
- To do real science
- To feed their curiosity
- To become co-authors of a scientific paper

CREDO gets:

- Manpower
- Geographical expansion
- Popularization of its ideas and PR

CREDO: mission organized for cosmic ray ensembles

Cosmic-Ray Extremely Distributed Observatory



Central database/interface: access to everything for everybody

CREDO Monitor: a citizen science tool for “fishing”

Requirements:

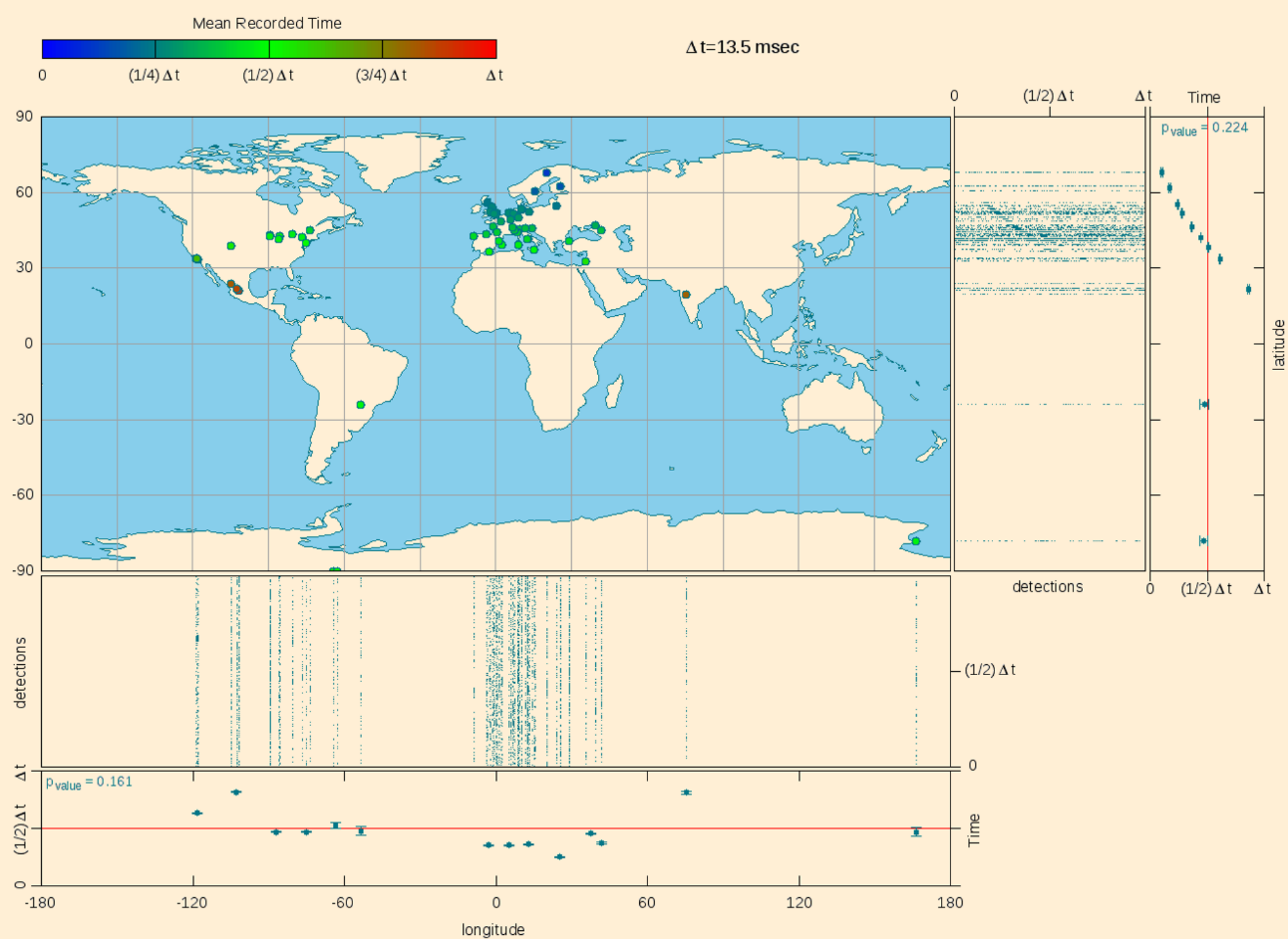
- Easy to get and to use
- Not boring
- Automated
- Functional

Expectations from the users:

- Training/tuning the algorithm(s)
- Helping the scientists
- Attracting new users of mobile/pocket detectors

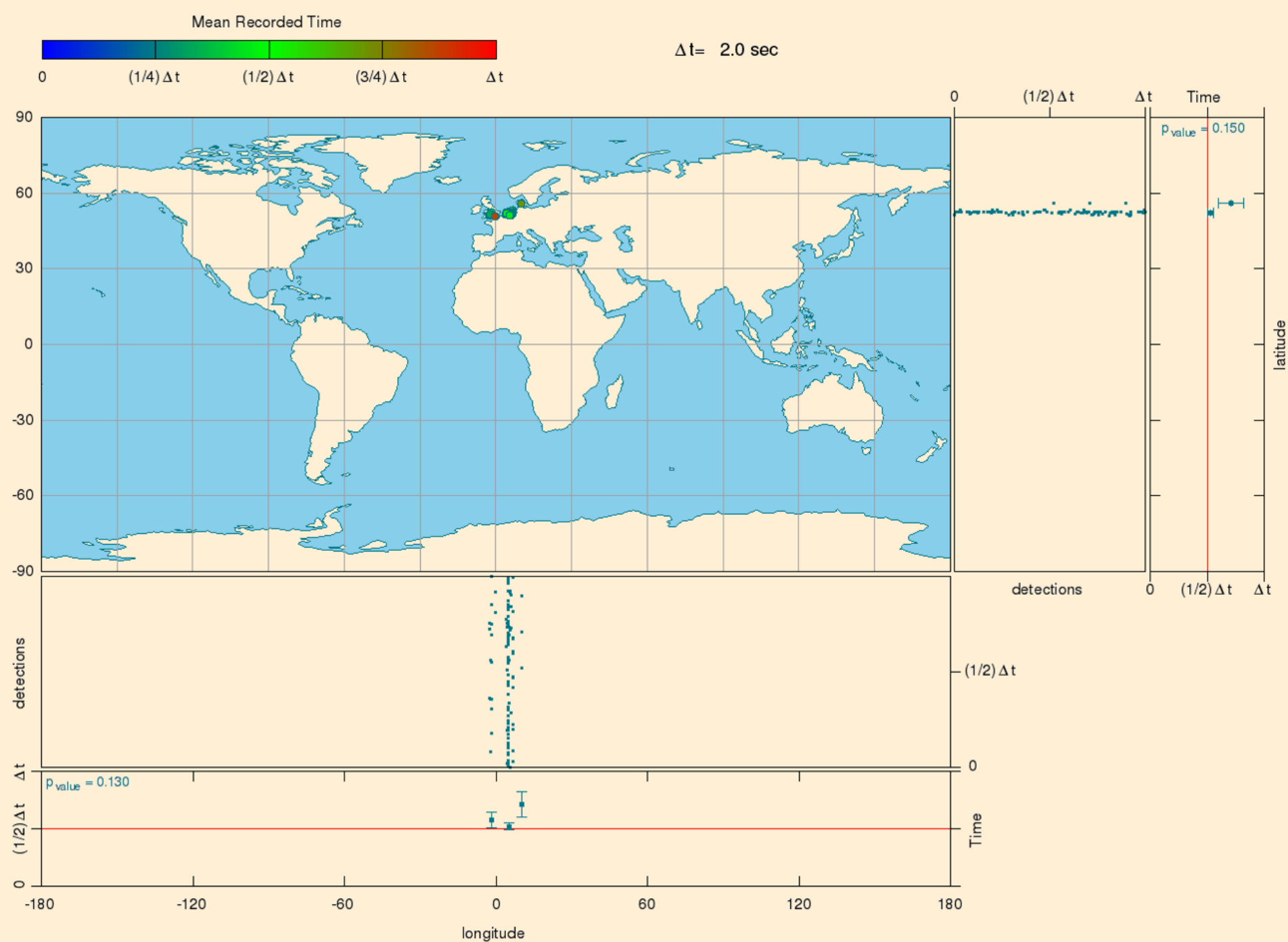
Data processing steps

- 1. Acquisition
- 2. Conversion to the convenient format
- 3. Sorting by time
- 4. Merging into final form (daily data sets)
- 5. Data analysis
- 6. Map production
- 7. Map sharing



How a CRE
signature
can look like

Simulation



Real data
analysis

Summary

Status

- CREDO monitor operating
- Time-clustering algorithm
- Real data processing
- Automated map production
- On-line access

Outlook

- + More sophisticated analysis
- + Mobile application
- + Connection to Dark Universe Welcome

Thank you for attention and visit us on
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Cosmic-Ray Extremely Distributed Observatory (CREDO)

ables a strategy for a global analysis of cosmic-ray data to reach the sensitivity to extremely extended cosmic-ray phenomena, them super-preshowers, invisible for individual detectors or observatories. So far, the cosmic-ray research has been oriented 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](#)