DID YOU KNOW THAT YOU HAVE

AN INTERGALACTIC PARTICLE DETECTOR RIGHT IN YOUR POCKET?

Install CREDO Detector app for Android and hunt for the deeply hidden treasures of the Universe.

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CREDO THE QUEST FOR UNEXPECTED · Visegrad Fund · Politechnika Krakowska im. Tadeusza Kościuszki · CYFRONET · INSTITUTE OF TECHNICAL AND EXPERIMENTAL PHYSICS CTU IN PRAGUE · WIGNER

Wolfram's Everything

Piotr Homola

Institute of Nuclear Physics PAN

CREDO Week, Discoverology Workshop, 1.10.2018

credo.science → YouTube

- animacja
- tutorial

- tunel czasoprzestrzenny:
https://www.youtube.com/watch?v=OTs45NsKeZU&feature=youtu.be&t=50m35s
- Rynek trailer: https://vimeo.com/288433113/d52afd465d

Po co?
Credo.science/plots

Cosmic-Ray Extremely Distributed Observatory*: nowe możliwości badawcze w astrofizyce cząstek i nie tylko

Piotr Homola□

take home:
$N_{ATM} >= 1$!

□) Institute of Nuclear Physics
Polish Academy of Sciences, Kraków, Poland
*) http://credo.science

CREDO w Szkole, IFJ PAN, Kraków, 3.10.2018

Dziwny jest ten Wszechświat (?)

Przykład zdziwienia: jesteśmy zbudowani ze światła???

G. Zanderighi, PHOTON 2017, CERN

Conclusions

- the photon content of the proton start to matter both for precision physics and LHC searches
- distribution of photons in the proton depends on the **non-perturbative QCD** physics of the proton
- but **perturbative calculations** allow us to deduce the photon density from measured (non-pert.) proton structure functions
- photon PDF determined using data with 1-2% precision
- LUXqed_plus_PDF4LHC15_nnlo_100 set available from LHAPDF (plus additional plots and validation info available from http://cern.ch/luxqed)

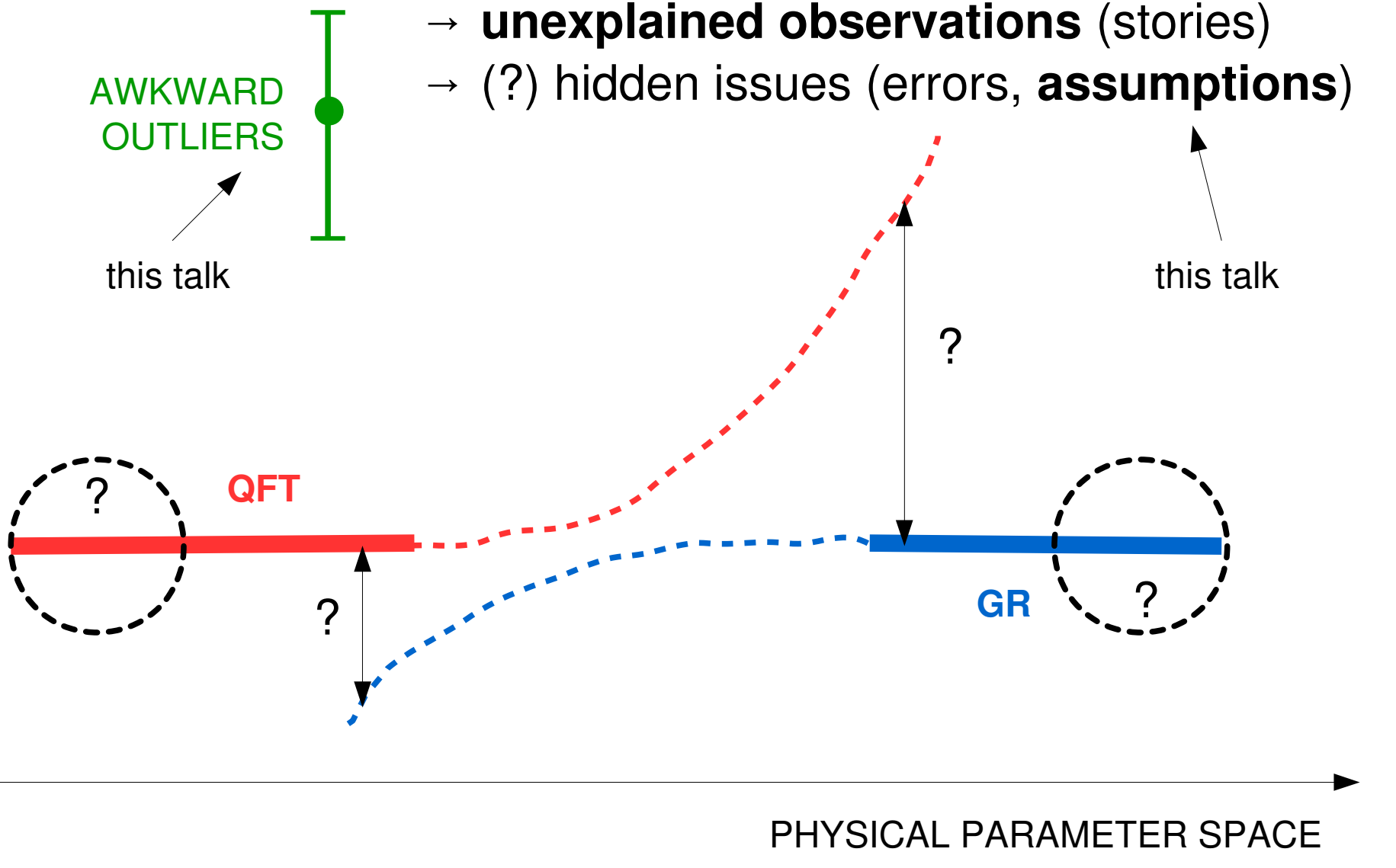
"If you think about it, it's awesome: we are made of protons, and protons are, in some part, made of light... And now we know how much of it."

blog post by Tommaso Dorigo

26

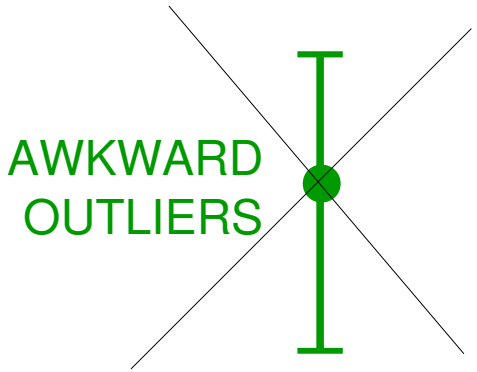
Understanding the Universe

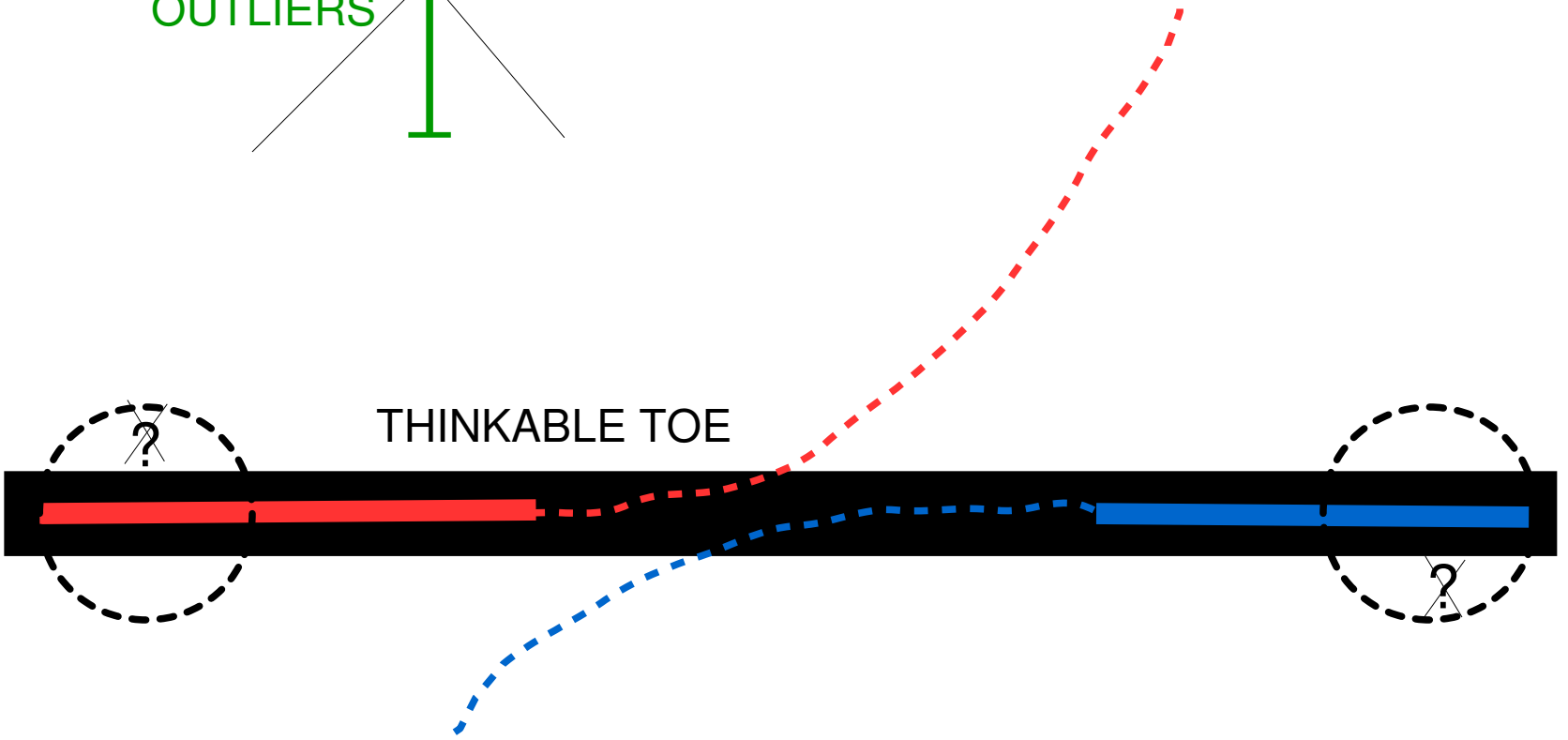
→ key theories disagree
→ **unexplained observations** (stories)
→ (?) hidden issues (errors, **assumptions**)



Ways towards a unifying theory (TOE): bottom → up

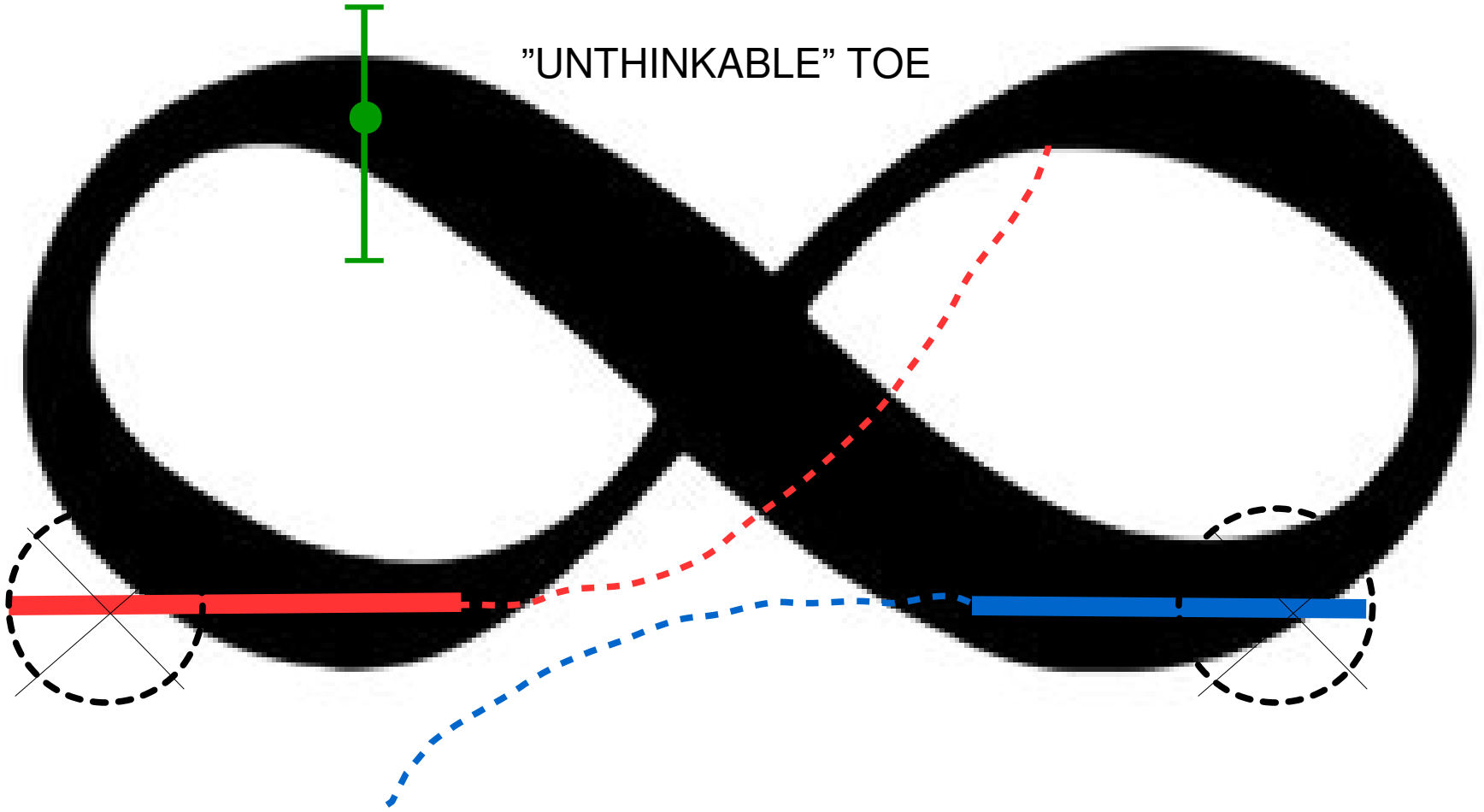
Thinking **bottom → up**:
understanding a bigger picture based on the known ingredients



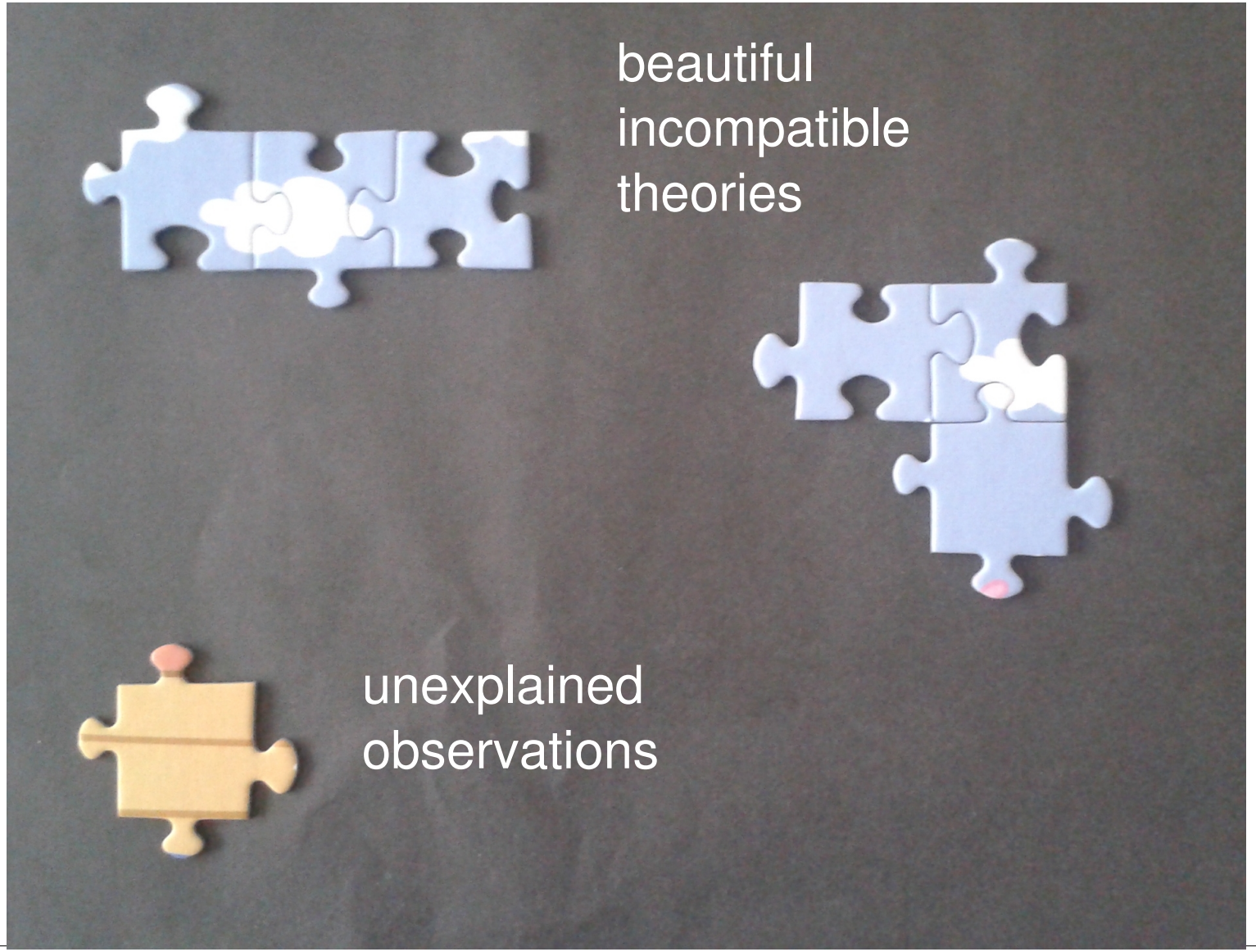


Ways towards a unifying theory (TOE): top → down

Thinking **top → down**:
understnad a bigger picture assuming hypothetic objects/laws



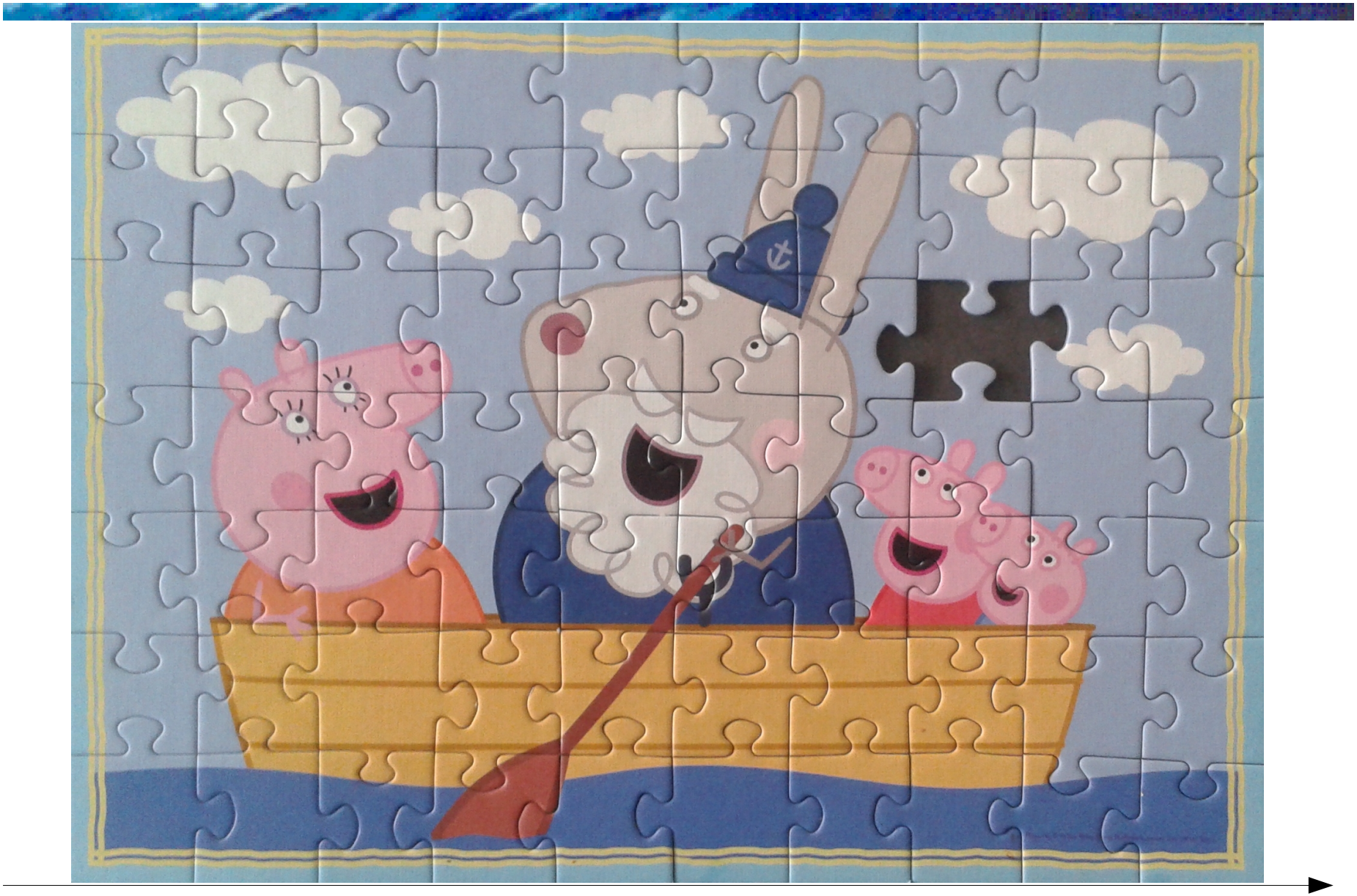
Understanding the Universe



PHYSICAL PARAMETER SPACE

Many discoveries remain to be made?

Understanding the Universe



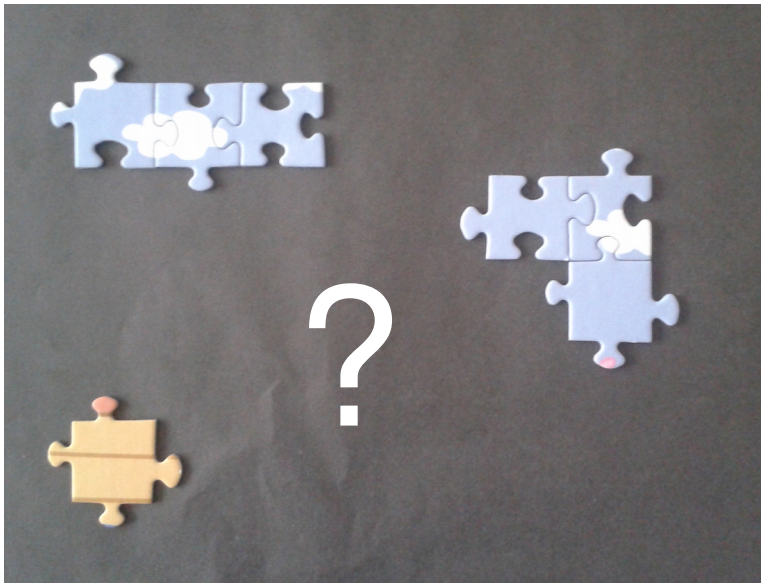
PHYSICAL PARAMETER SPACE

… or very few?

Jak popularyzować naukę?

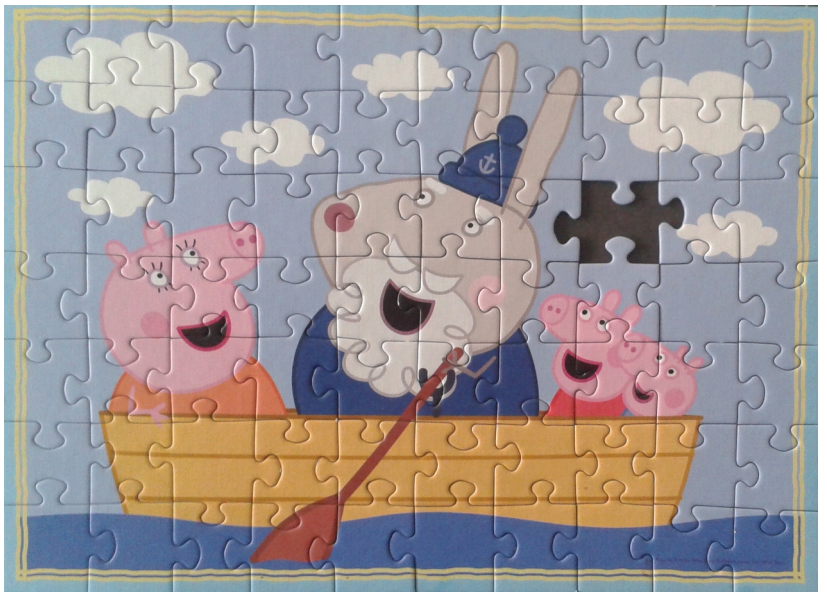
Więcej niewiedzy niż wiedzy?
Obszar niewiedzy rośnie
szybciej niż obszar wiedzy?

a)



Więcej wiemy niż nie wiemy?
Wiemy prawie wszystko?

b)



Popularyzacja nauki:

→ świadomość dostępnych zasobów wiedzy

→ **świadomość niewiedzy (wyzwań, zagadek)**

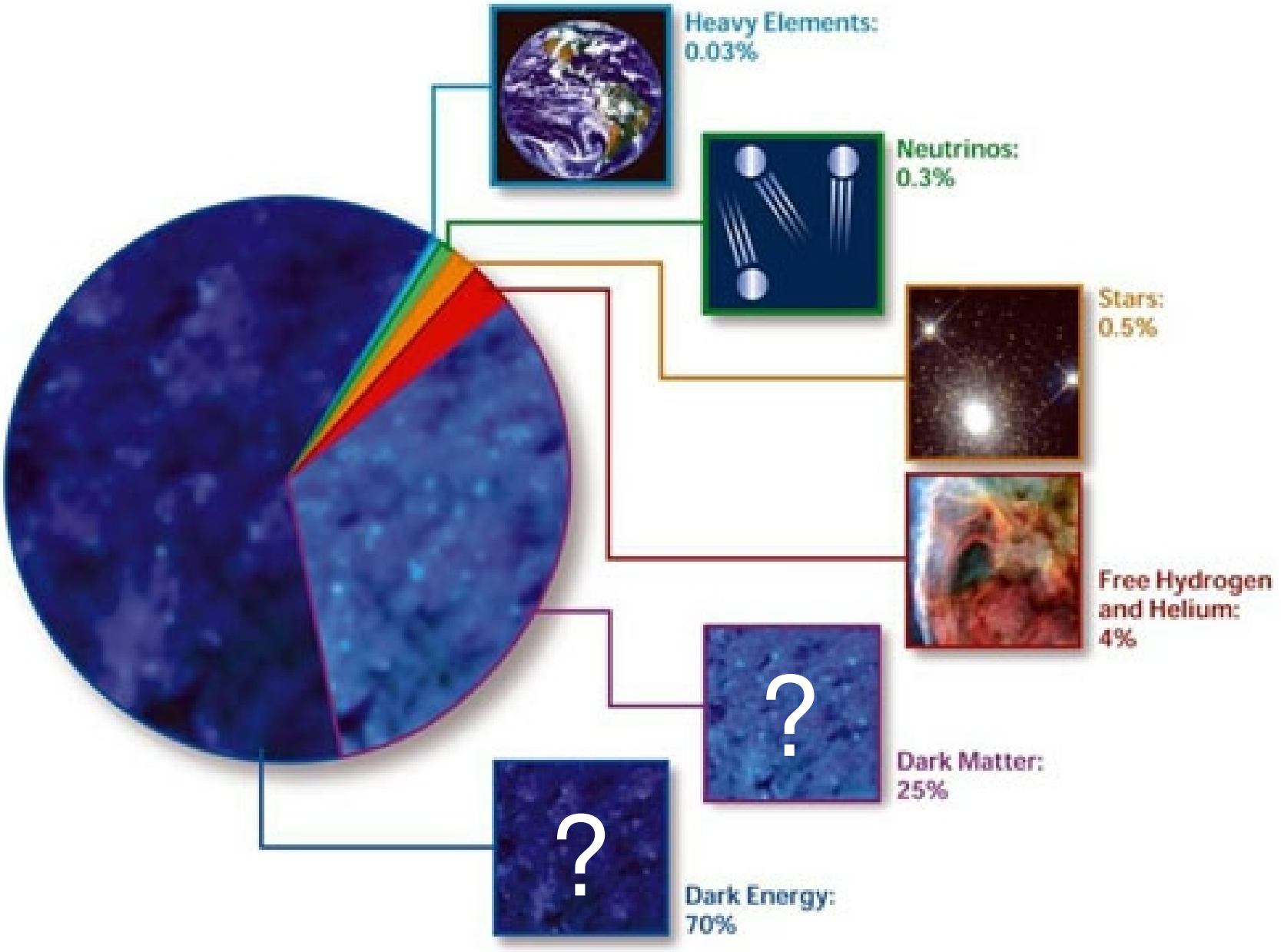
brakuje popularyzacji NIEWIEDZY?

zwłaszcza jeśli żyjemy w świecie typu a) …?

Popularyzacja niewiedzy = ocean wyzwań!

Motivation: Experimental Quantum Gravity

COMPOSITION OF THE COSMOS



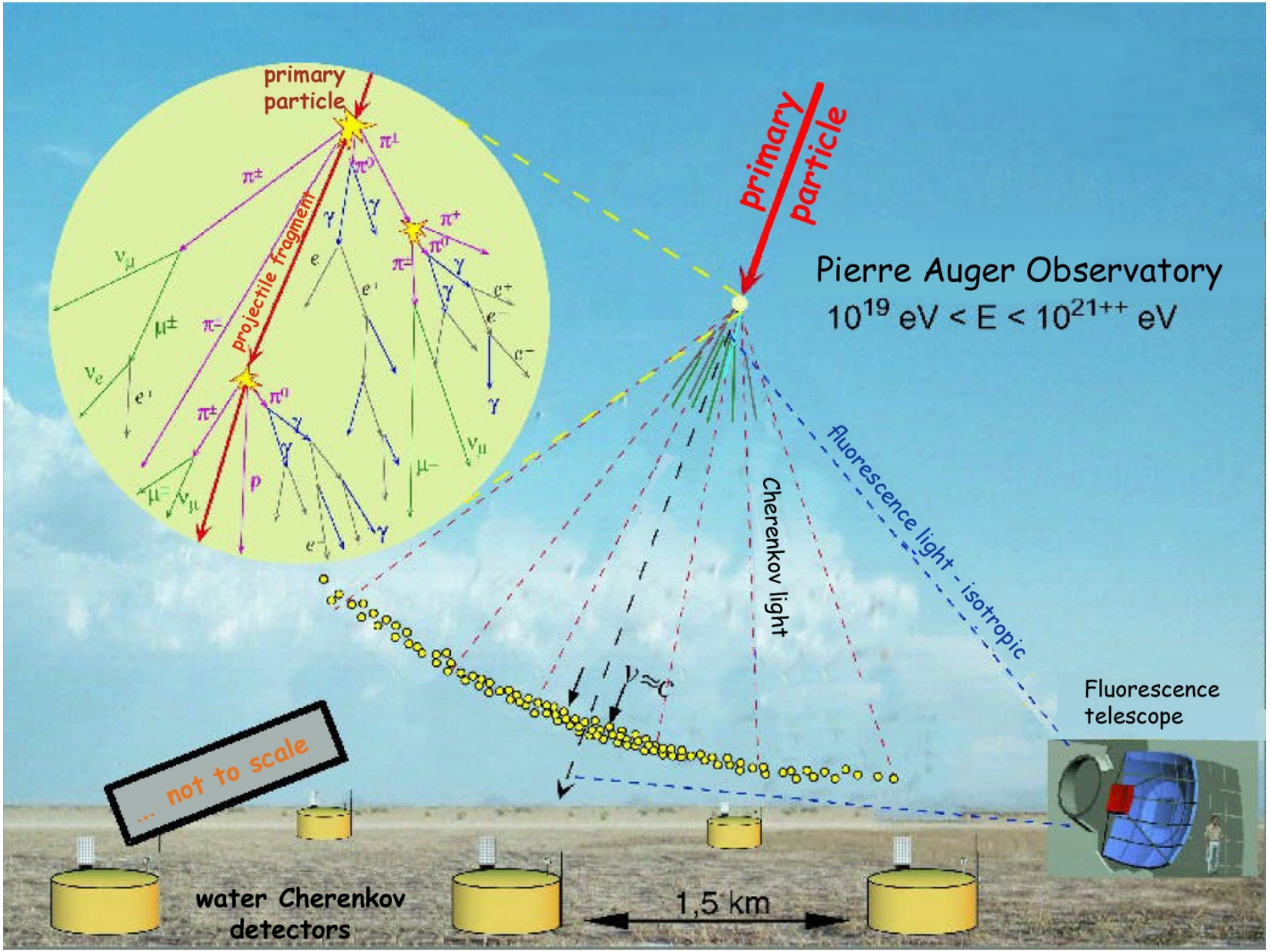
http://certificate.ulo.ucl.ac.uk/modules/year_one/NASA_cosmology/goals5.html

UHECR - one mystery more

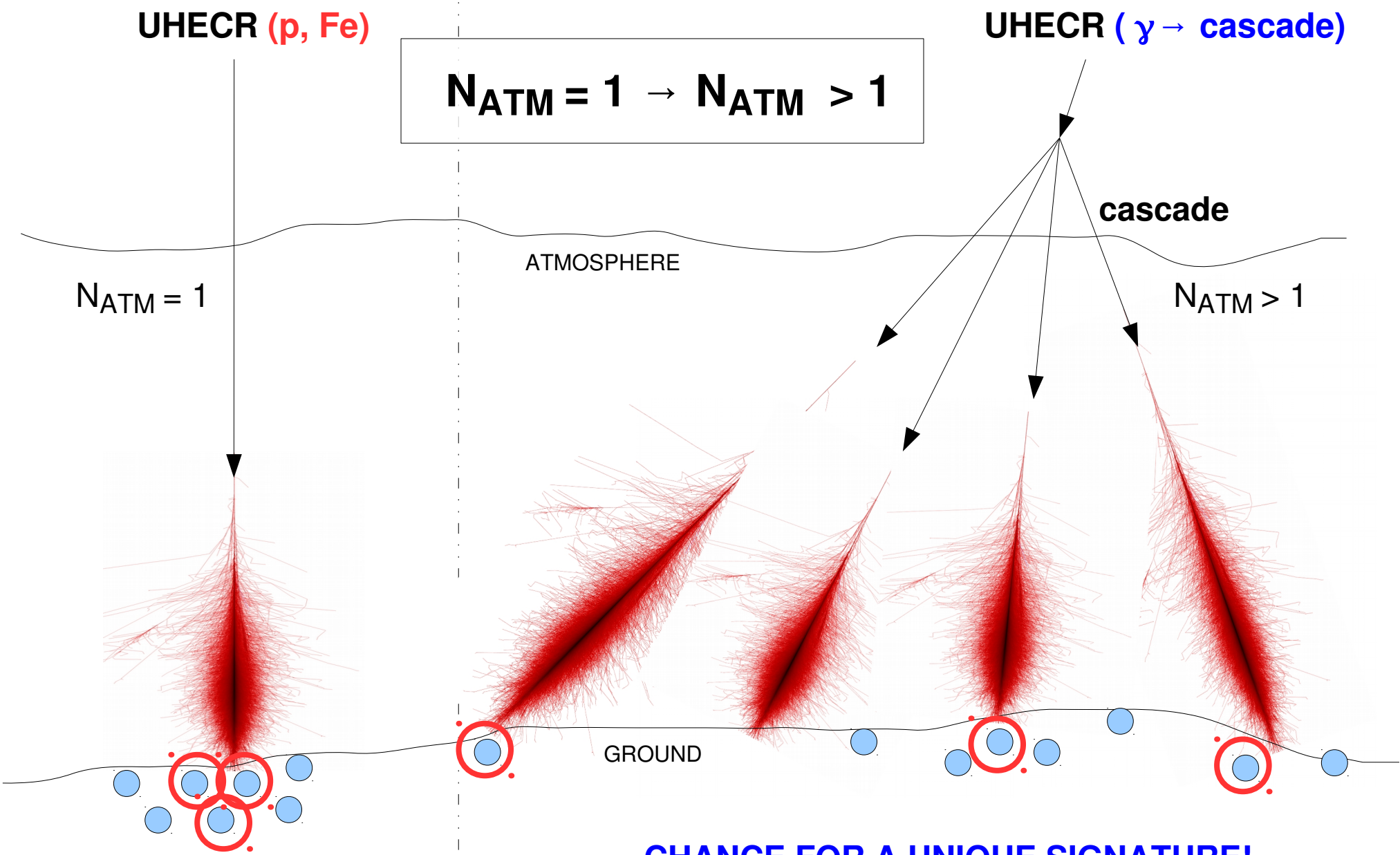
„Ultra-high-energy cosmic rays

Why is it that some cosmic rays appear to possess **energies** that are **impossibly high**, given that there are no sufficiently energetic cosmic ray sources near the Earth? Why is it that (apparently) some cosmic rays emitted by distant sources have energies above the Greisen–Zatsepin–Kuzmin limit?”

State-of-the-art detection of cosmic rays: $N_{ATM} = 1$



Generalized detection of cosmic rays: $N_{ATM} >= 1$



$N_{ATM} > 1$ motivated by data! (1)

VOLUME 50, NUMBER 26 PHYSICAL REVIEW LETTERS 27 JUNE 1983

Possible Observation of a Burst of Cosmic-Ray Events in the Form of Extensive Air Showers

Gary R. Smith, M. Ogmen, E. Buller, and S. Standil
Physics Department, University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada

(Received 7 April 1983)

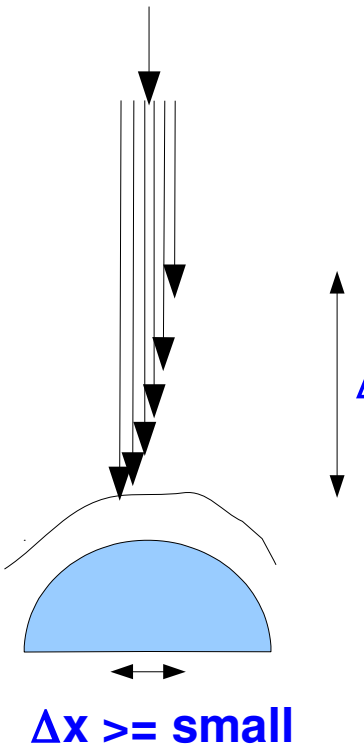
A series or burst of 32 extensive air showers of estimated mean energy 3×10^{15} eV was observed within a 5-min time interval beginning at 9:55 A.M. (CST) on 20 January 1981 in Winnipeg, Canada. This observation was the only one of its kind during an experiment which recorded 150 000 such showers in a period of 18 months between October 1980 and April 1982.

PACS numbers: 94.40.Pa, 96.Rc, 95.30.-k

Forgotten (!) treasure (?) no. 1

PH: Correlated cosmic rays?

$N_{ATM} > 1$?



Year = 1981
N_{obs} = 32
N_{exp} = 1
E = $3x10^{15}$eV

$N_{ATM} > 1$ motivated by data! (2)

VOLUME 51, NUMBER 25 PHYSICAL REVIEW LETTERS 19 DECEMBER 1983

Observation of a Burst of Cosmic Rays at Energies above 7×10^{13} eV

D. J. Fegan and B. McBreen
Physics Department, University College Dublin, Dublin 4, Ireland
and
C. O'Sullivan
Physics Department, University College Cork, Cork, Ireland
(Received 14 Sept[illegible] 1983)

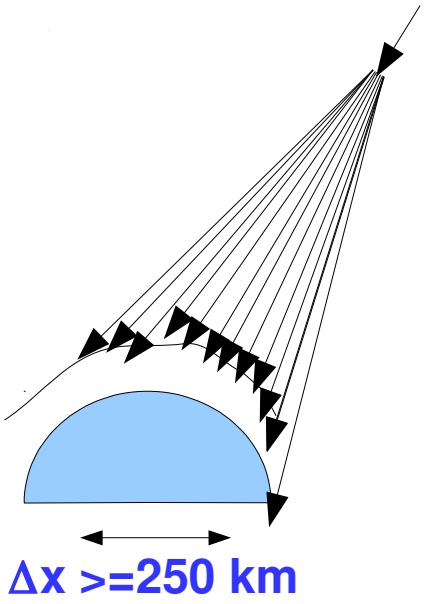
The authors report on an unusual simultaneous increase in the cosmic-ray shower rate at two recording stations separated by 250 km. The event lasted for 20 s. This event was the only one of its kind detected in three years of observation. The duration and structure of this event is different from a recently reported single-station cosmic-ray burst. The simultaneity of the coincident event suggests that it was caused by a burst of cosmic gamma rays. There is a possibility that this event may be related to the largest observed glitch of the pulsar in the Crab Nebula.

PACS numbers: 94.40.Pa, 95.85.Qx, 97.80.Jp

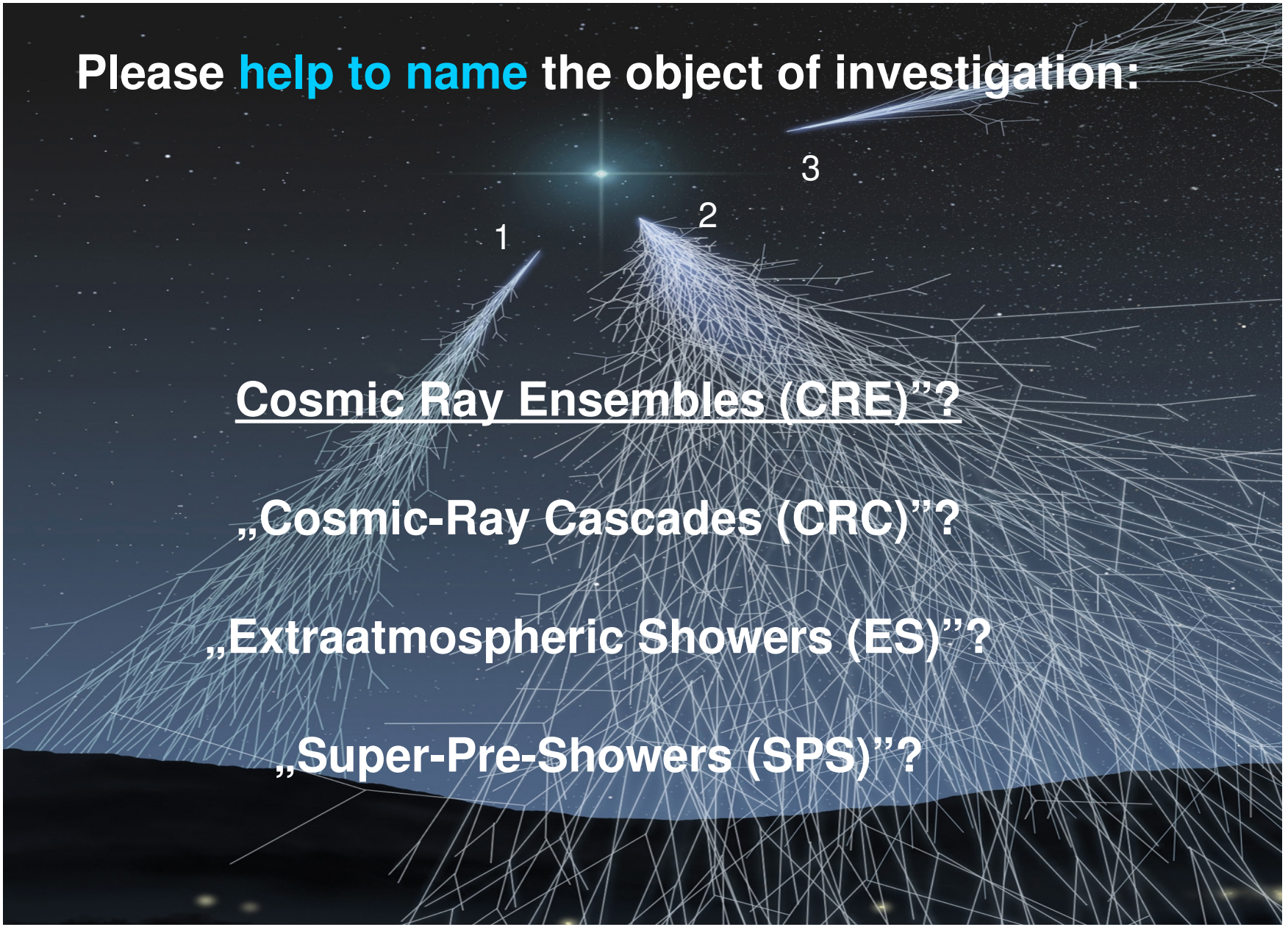
Forgotten (!) treasure (?) no. 2

PH: Correlated cosmic rays?

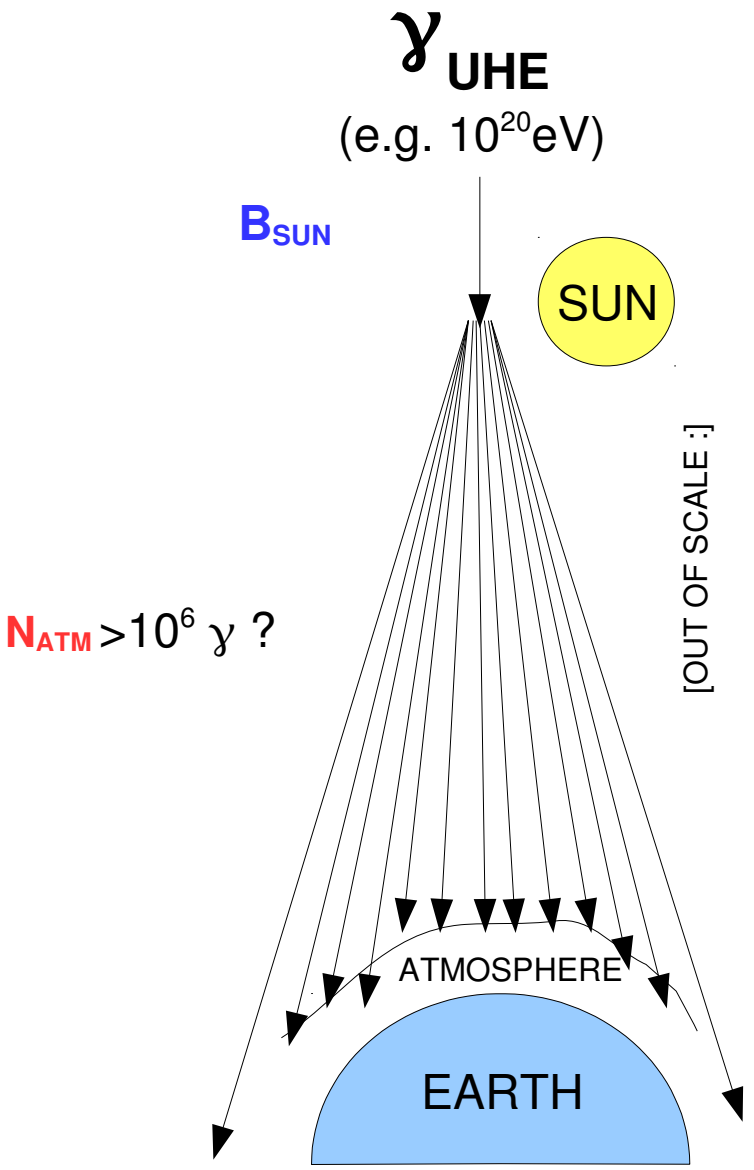
$N_{ATM} > 1$?



$N_{ATM} > 1$: new subfield of astroparticle physics!

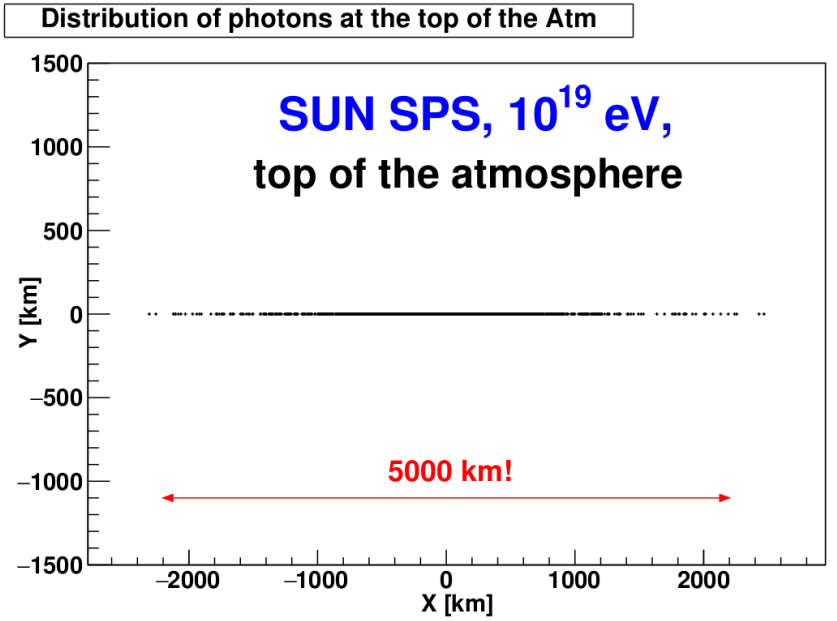


Super-preshowers (SPS) from the vicinity of the Sun



→ First calculations: W. Bednarek 1999
low energies not treated: extent ~ tens of km

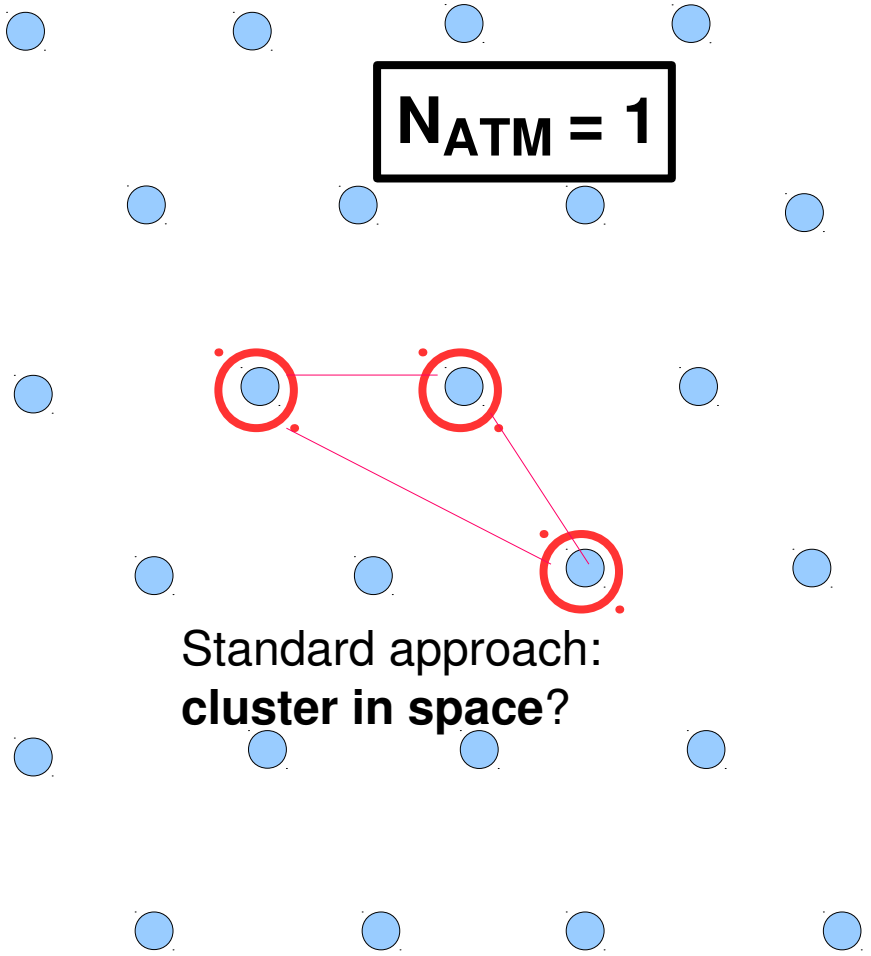
→ N. Dhital, 2017
complete energy spectrum: extent
~ thousands of km



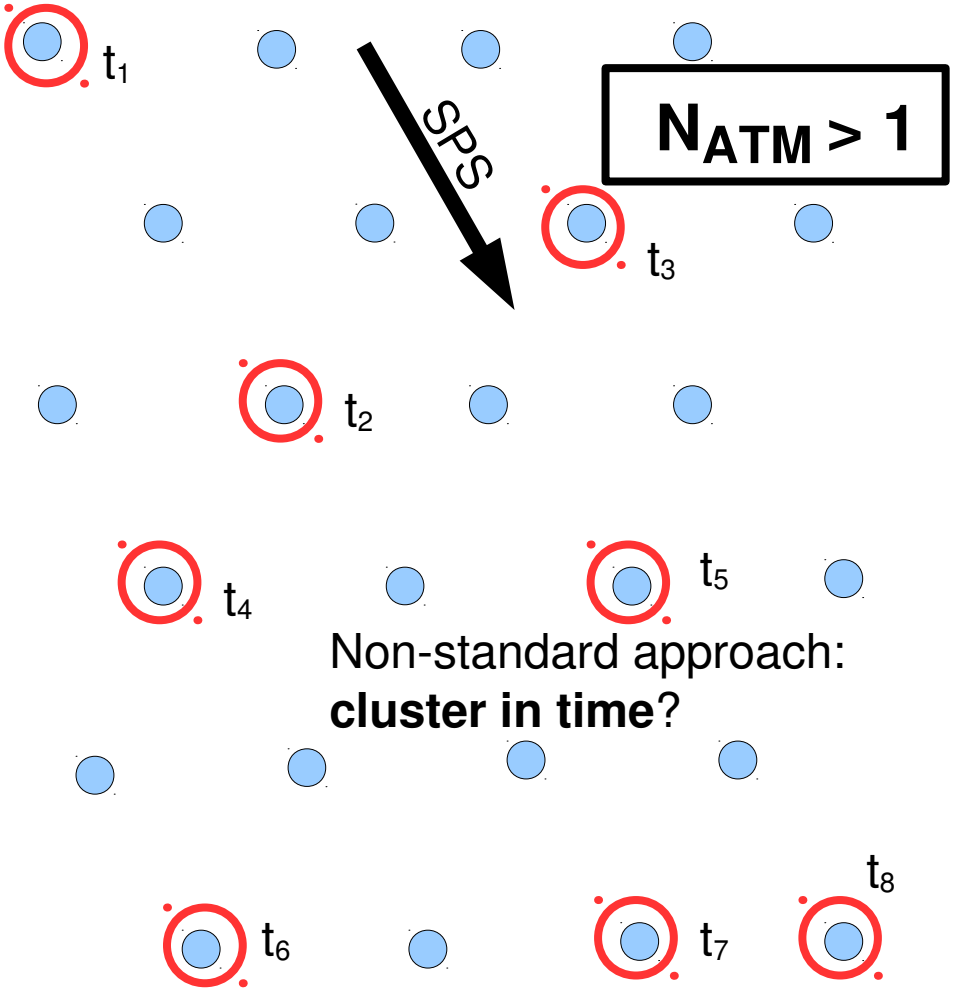
Distribution of photons ($E > 10^{13}$ eV) at the top of the atmosphere.
$E_\gamma = 10$ EeV, Impact parameter $= 2.5 R_S$.

$N_{ATM} > 1$ → observable (line even 10000 km wide), **not yet tried**

A chance for a unique CRE signature



Standard approach:
cluster in space?



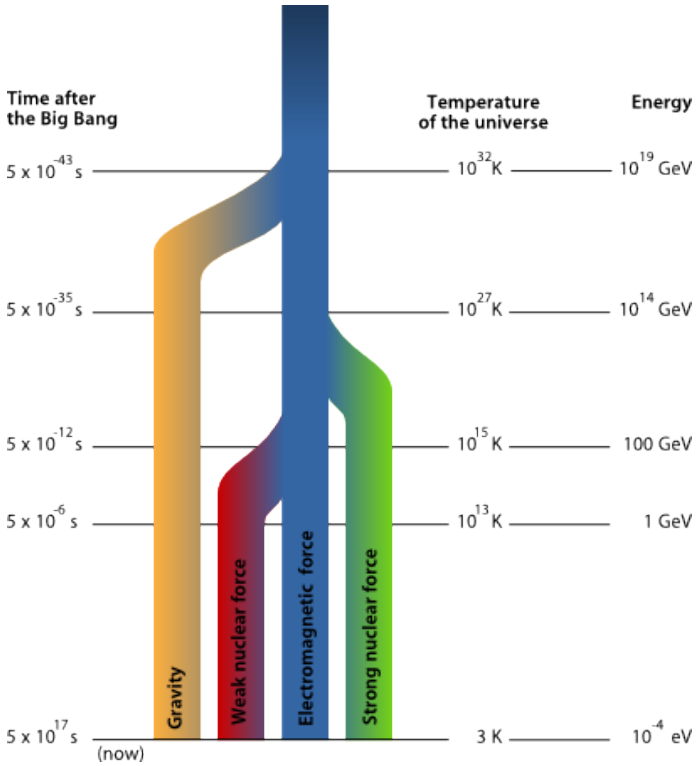
Non-standard approach:
cluster in time?

1) $t_n - t_1 <$ ~1 μs
2) $t_1 < \ldots < t_n$,

: a cosmic-ray detector

N_{ATM} >= 1 mission (briefly)

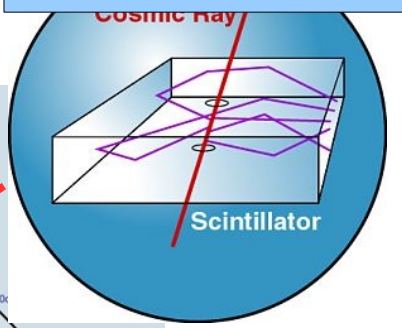
Scenarios AND Fishing



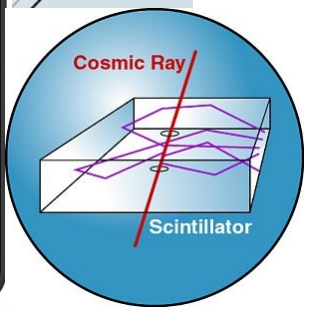
CREDO: the first $N_{ATM} >= 1$ observatory

Cosmic-Ray Extremely Distributed Observatory

Status March 2016: „an idea"

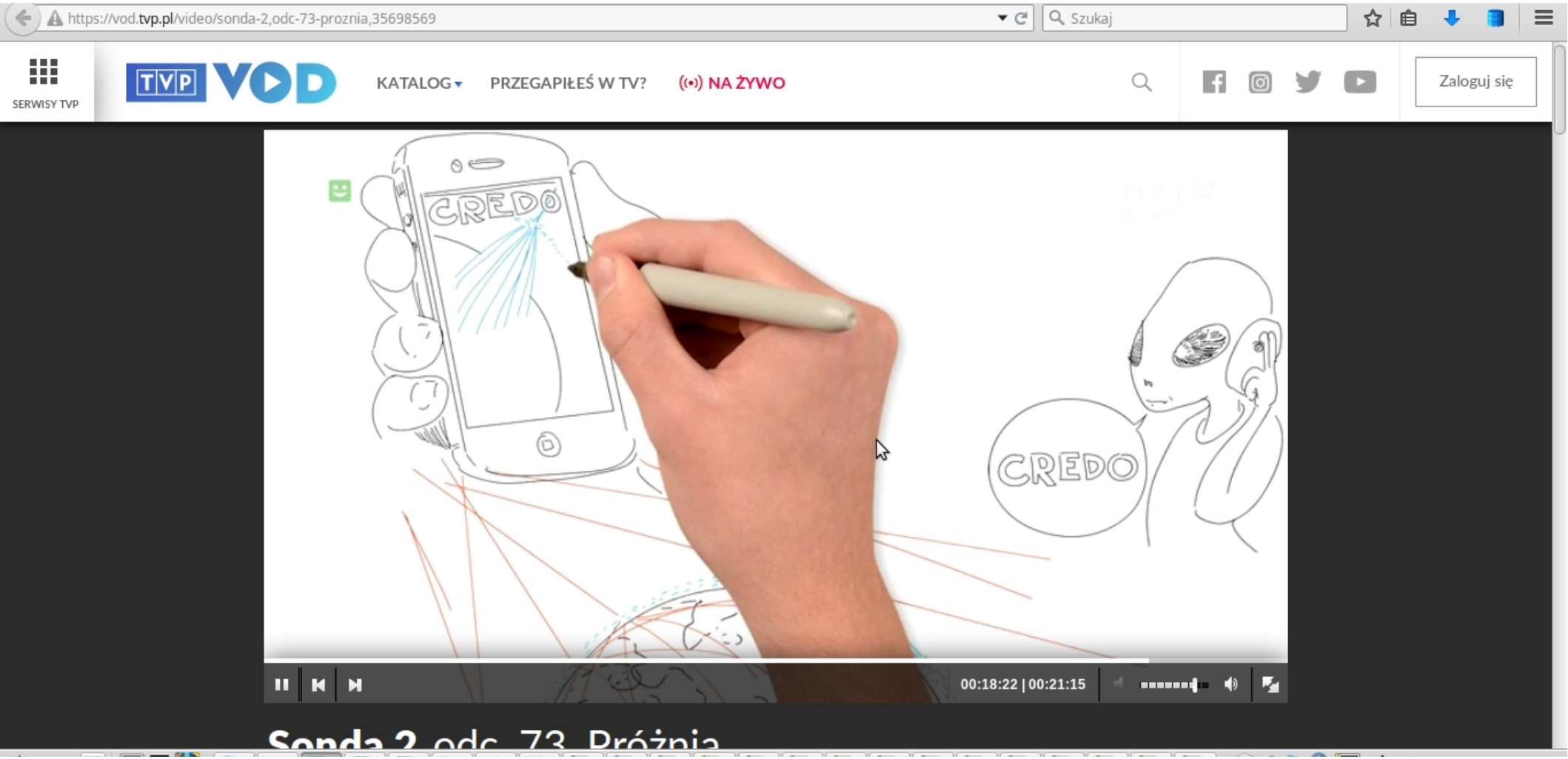


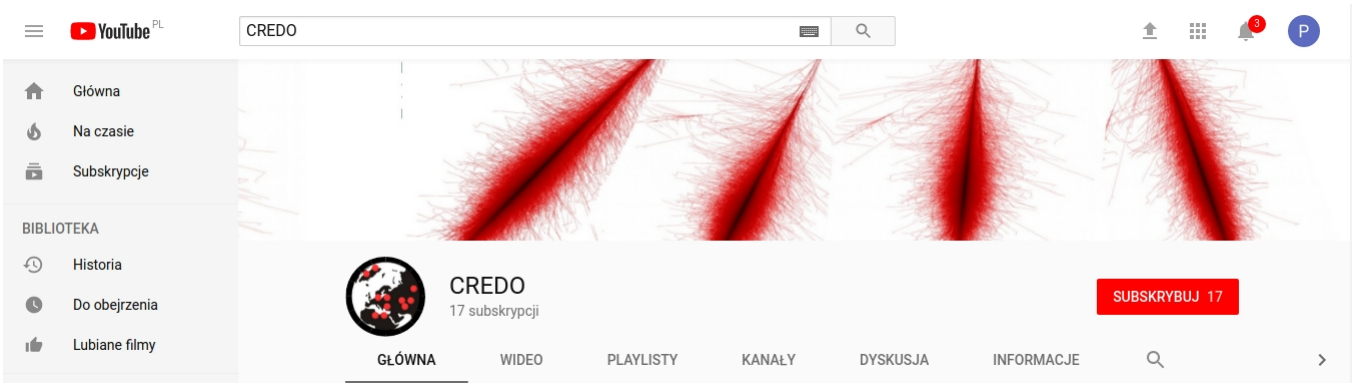
DATABASE/
INTERFACE



Central database/interface: access to everything for everybody

TVP1: Sonda 2, 11.02.2018

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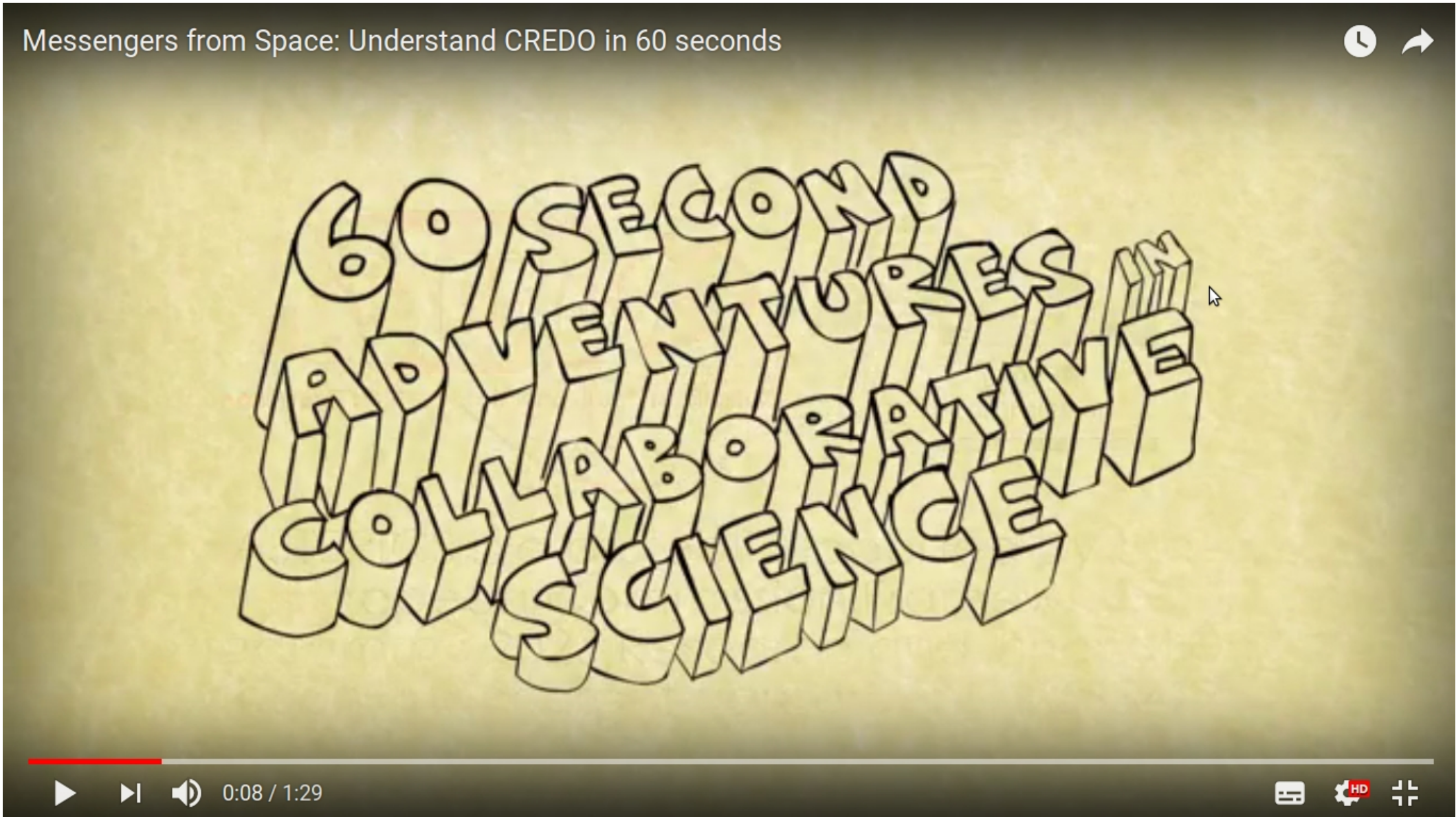

Messengers from Space: Understand CREDO in 60 seconds
60 SECOND ADVENTURES IN COLLABORATIVE SCIENCE
0:08 / 1:29
HD

Citizen Science! But ... science must be real

Citizen science

From Wikipedia, the free encyclopedia

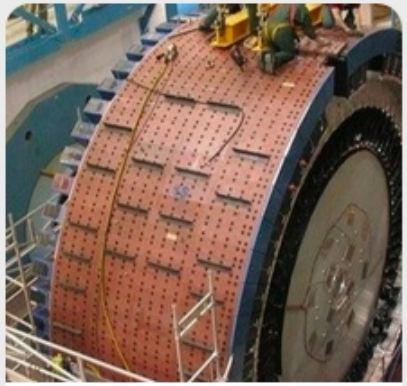
Citizen science (**CS**) (also known as **crowd science**, **crowd-sourced science**, **civic science**, **volunteer monitoring** or **networked science**) is scientific research conducted, in whole or in part, by amateur or nonprofessional scientists. Citizen science is sometimes described as "public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

CITIZEN SCIENCE **IS NOT** OUTREACH!

PUBLICATIONS!

CO-AUTHORS!

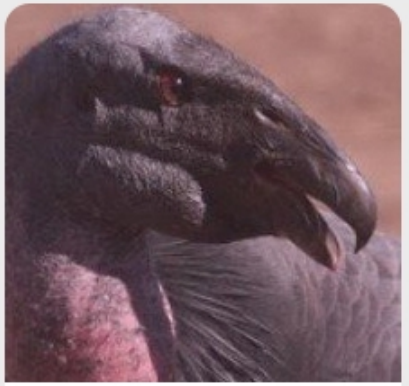
Citizen science: where to start? Zooniverse.org

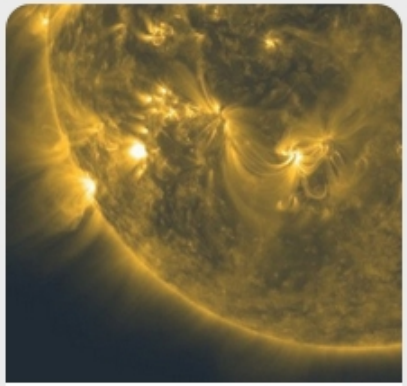

HIGGS HUNTERS


PENGUIN WATCH


CHICAGO WILDLIFE WATCH


FLOATING FORESTS

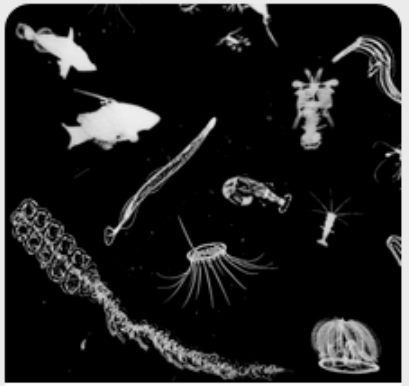

CONDOR WATCH


SUNSPOTTER


DISK DETECTIVE


OPERATION WAR DIARY


RADIO GALAXY ZOO


PLANKTON PORTAL

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. Boyajian[1], D. M. LaCourse[2], S. A. Rappaport[3], D. Fabrycky[4], D. A. Fischer[1], D. Gandolfi[5,6], G. M. Kennedy[7], H. Korhonen[8,9], M. C. Liu[10], A. Moor[11], K. Olah[11], K. Vida[11], M. C. Wyatt[7], W. M. J. Best[10], J. Brewer[1], F. Ciesla[12], B. Csák[13], H. J. Deeg[14,15], T. J. Dupuy[16], G. Handler[17], K. Heng[18], S. B. Howell[19], S. T. Ishikawa[20], J. Kovács[13], T. Kozakis[21], L. Kriskovics[11], J. Lehtinen[22], C. Lintott[23], S. Lynn[24], D. Nespral[14,15], S. Nikbakhsh[22,25], K. Schawinski[26], J. R. Schmitt[1], A. M. Smith[27], Gy. Szabo[11,13,28], R. Szabo[11], J. Viuho[22], J. Wang[1,29], A. Weiksnar[20], M. Bosch[2], J. L. Connors[2], S. Goodman[2], G. Green[2], A. J. Hoekstra[2], T. Jebson[2], K. J. Jek[2], M. R. Omohundro[2], H. M. Schwengeler[2], A. Szewczyk[2]

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