

Philosophical welcome: towards a breakthrough in science

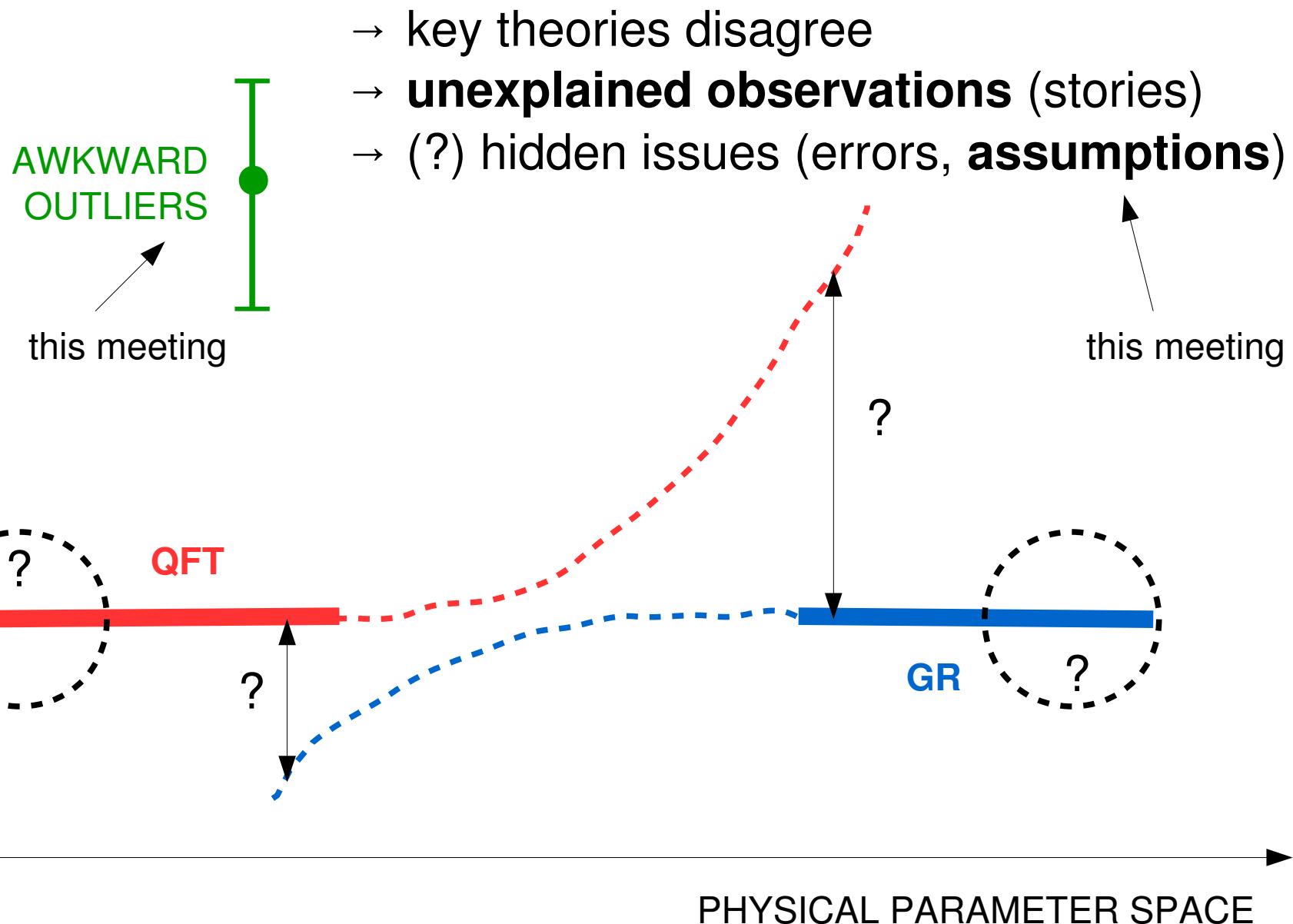
Piotr Homola

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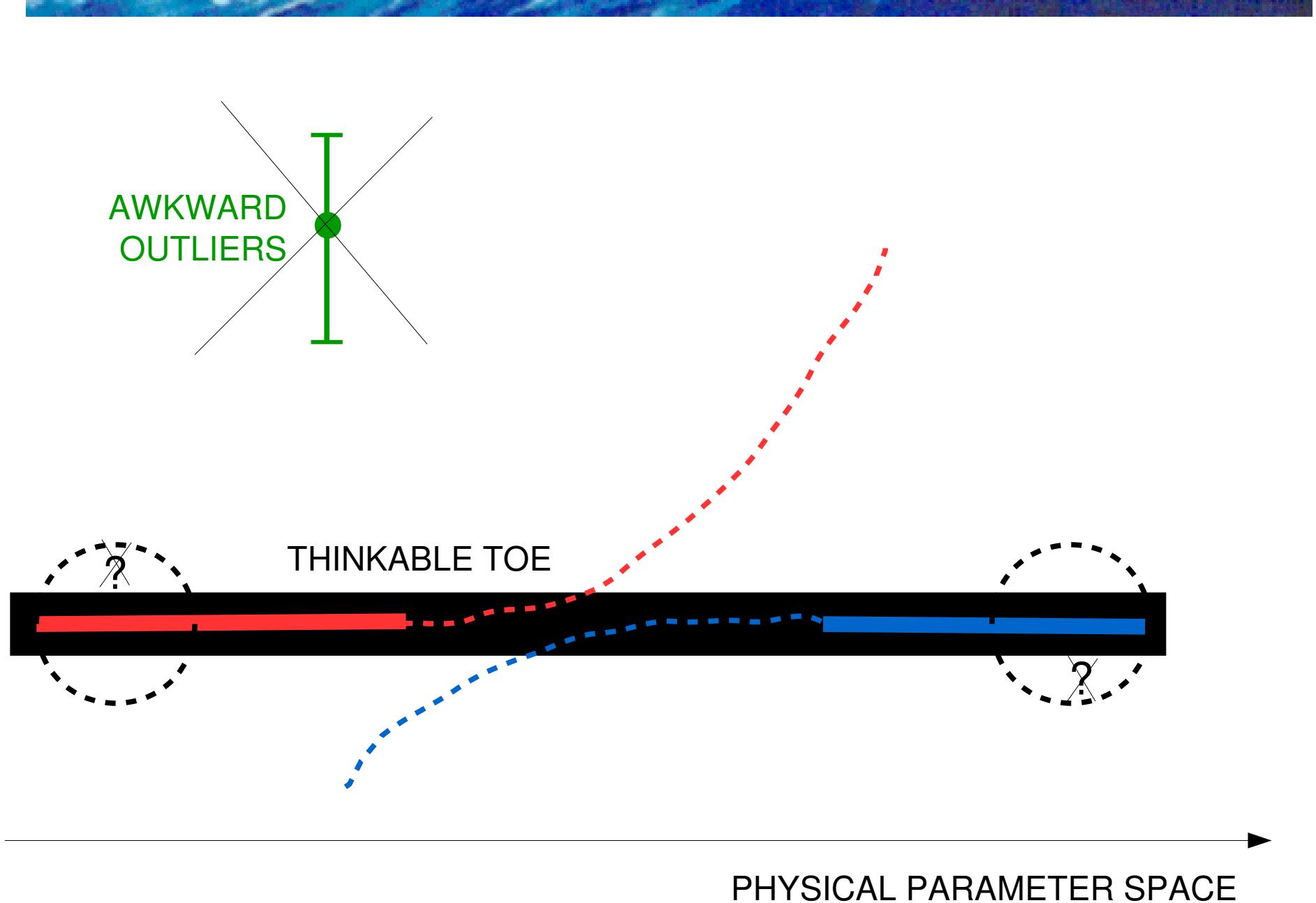
CREDO Inauguration, Kraków, 30 August 2016



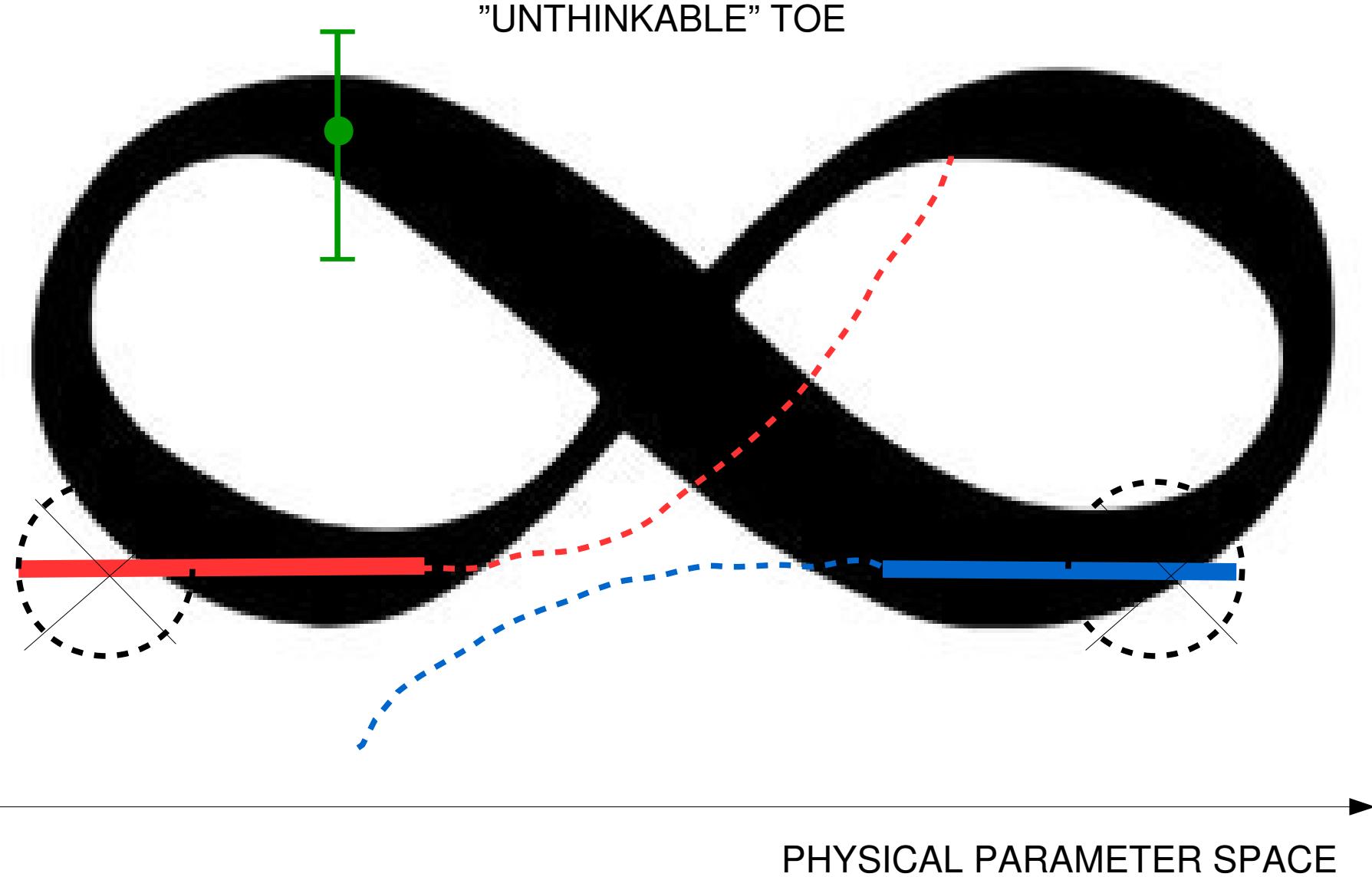
Understanding the Universe



Towards a unifying theory (TOE)



„there is no spoon...” [Matrix]



Experimental way to the ToE



Why finding TOE difficult?

We can do nothing:

- just too difficult

We can do something (**this meeting**):

- **challenge paradigm**
(eg. consider „awkward outliers“ more seriously: **verify „hidden assumptions“**, look for errors)
- **attract more talented people to science**
- **find more synergy**

Paradigm: (when) should one challenge it?

The screenshot shows two versions of the same Wikipedia page side-by-side.

English Version (Left):

- Page Title:** Paradigm
- Text:** From Wikipedia, the free encyclopedia
- Text (disambiguation):** For other uses, see [Paradigm \(disambiguation\)](#).
- Text (definition):** In science and philosophy, a **paradigm** /'pærədaɪm/ is a distinct set of concepts or thought patterns, including theories, research methods, postulates, and standards for what constitutes legitimate contributions to a field.
- Navigation:** Artykuł | Dyskusja | Czytaj | Edytuj | Historia i autorzy | Szukaj | Search icon

Polish Version (Right):

- Page Title:** Paradygmat
- Text:** [edytuj]
- Text (disambiguation note):** Ten artykuł dotyczy nauki. Zobacz też: [inne znaczenia tego słowa](#).
- Text (definition):** **Paradygmat** – w rozumieniu wprowadzonym przez filozofa Thomasa Kuhna w książce *Struktura rewolucji naukowych* (*The Structure of Scientific Revolutions*) opublikowanej w 1962 roku – to zbiór pojęć i teorii tworzących podstawy danej nauki. Teorii i pojęć tworzących paradygmat raczej się nie kwestionuje, przynajmniej do czasu kiedy paradygmat jest twórczy poznańczo – tzn. za jego pomocą można tworzyć teorie szczegółowe zgodne z danymi doświadczalnymi (historycznymi), którymi zajmuje się dana nauka.
- Navigation:** Strona główna | Losuj artykuł | Kategorie artykułów | Najlepsze artykuły | Częste pytania (FAQ) | Dla czytelników | O Wikipedii

Is the current scientific paradigm capable of providing new ideas / detailed theories?

Isn't it right time to challenge the paradigm?

Two strategies for a breakthrough in science

STRATEGY I

Develop a model of nature → build infrastructure to verify it → stay tuned to possible deviations from the paradigm → improve the model (example LHC)

- + thoroughly exploring the paradigm, technological progress
- what about the physics we can't imagine/model in advance? no guarantee, investments



„Naive” thinking towards an alternative strategy:

Grand unification could manifest at high energies → What are the highest energies available? Which infrastructure is available? What can one do with what is at hand?

STRATEGY II

→ take existing infrastructure and organize it optimally → look for unique signatures, consider also „data impurities” → tune analysis to identify non-random „strange” → think of a model
(example CREDO)

- + beyond the paradigm („planned” accidental discoveries), small investments
- no guarantee

Do natural sciences need philosophy?



Strategy development (when I and when II?) - **YES**

Data interpretation (signature or impurity?) - **YES**

Philosophical welcome message:

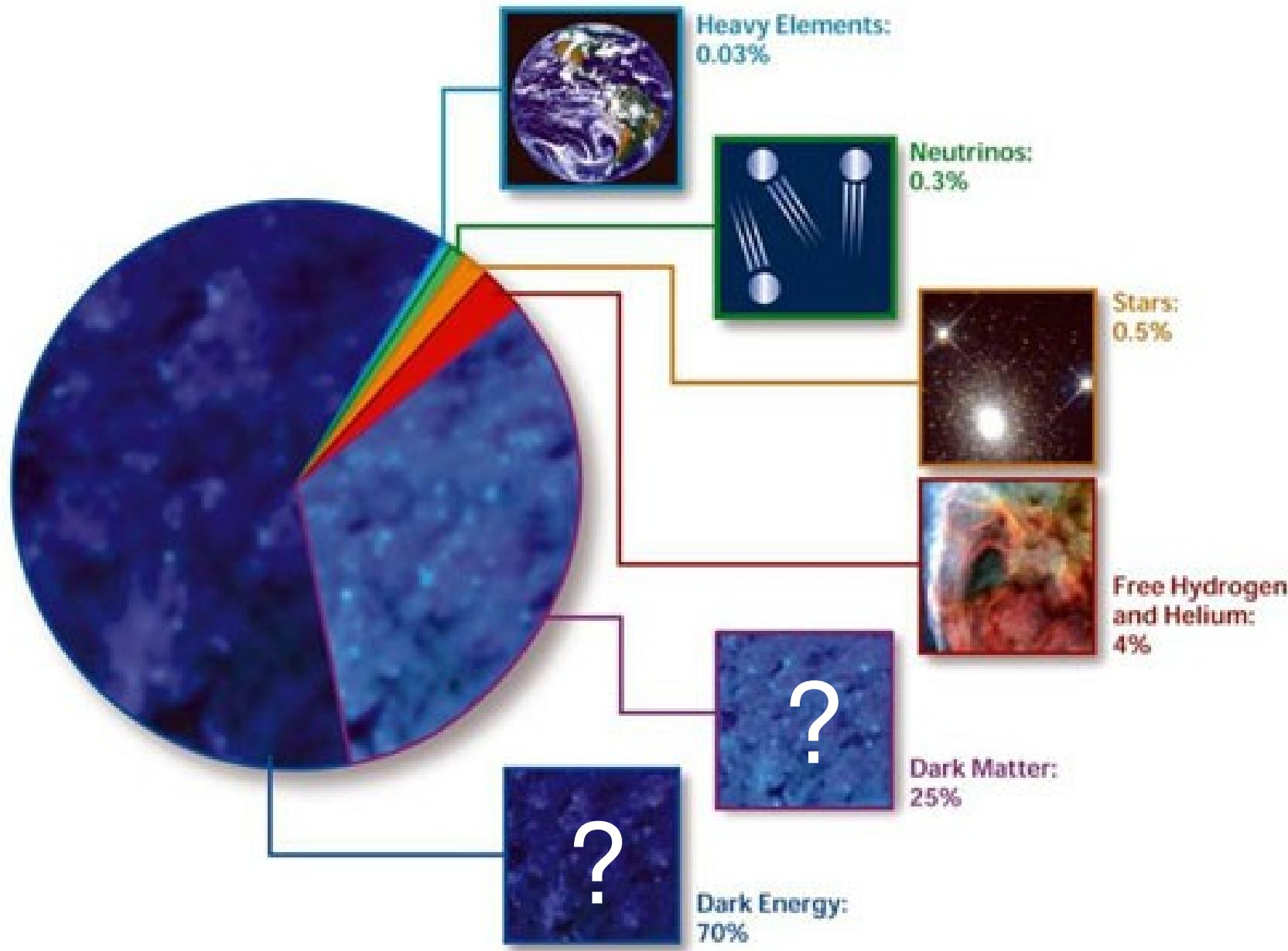
- "Philosophers: please help!"
- Proposal: consider new standard in natural sciences:
do it with philosophers (of science)

Take home philosophical wisdom:

„Assumptions are the killers to discoveries”

heard from Mikhail Medvedev [see his talk in the afternoon]

COMPOSITION OF THE COSMOS



UHECR - one mystery more

https://en.wikipedia.org/wiki/List_of_unsolved_problems_in_physics DuckDuckGo

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List of unsolved problems in physics

From Wikipedia, the free encyclopedia

Main article: *List of unsolved problems*

Some of the major **unsolved problems in physics** are **theoretical**, meaning that existing theories seem incapable of explaining a certain observed **phenomenon** or **experimental result**. The others are **experimental**, meaning that there is a difficulty in creating an experiment to test a proposed theory or investigate a phenomenon in greater detail.

Contents [hide]

- 1 Unsolved problems by subfield
 - 1.1 General Physics/Quantum Physics
 - 1.2 Cosmology and general relativity
 - 1.3 Quantum gravity
 - 1.4 High energy physics/particle physics
 - 1.5 Astronomy and astrophysics**
 - 1.6 Nuclear physics
 - 1.7 Atomic, molecular and optical physics
 - 1.8 Condensed matter physics
 - 1.9 Biophysics
- 2 Problems solved in recent decades

„Ultra-high-energy cosmic rays

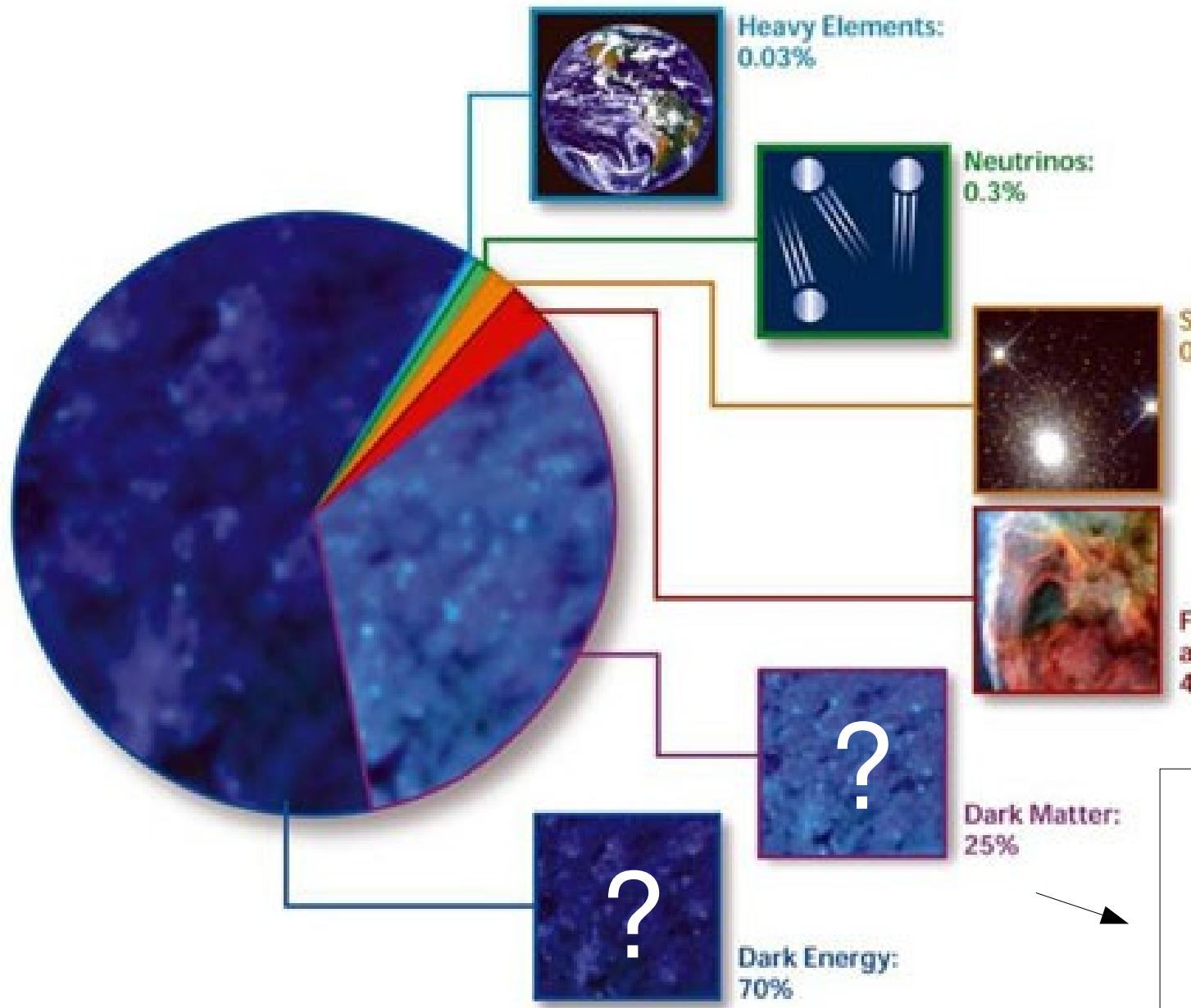
Why is it that some cosmic rays appear to possess **energies** that are **impossibly high**, given that there are no sufficiently energetic cosmic ray sources near the Earth? Why is it that (apparently) some cosmic rays emitted by distant sources have energies above the Greisen–Zatsepin–Kuzmin limit?”

?

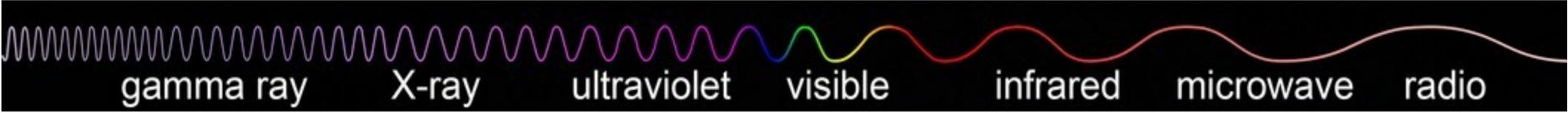
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COMPOSITION OF THE COSMOS

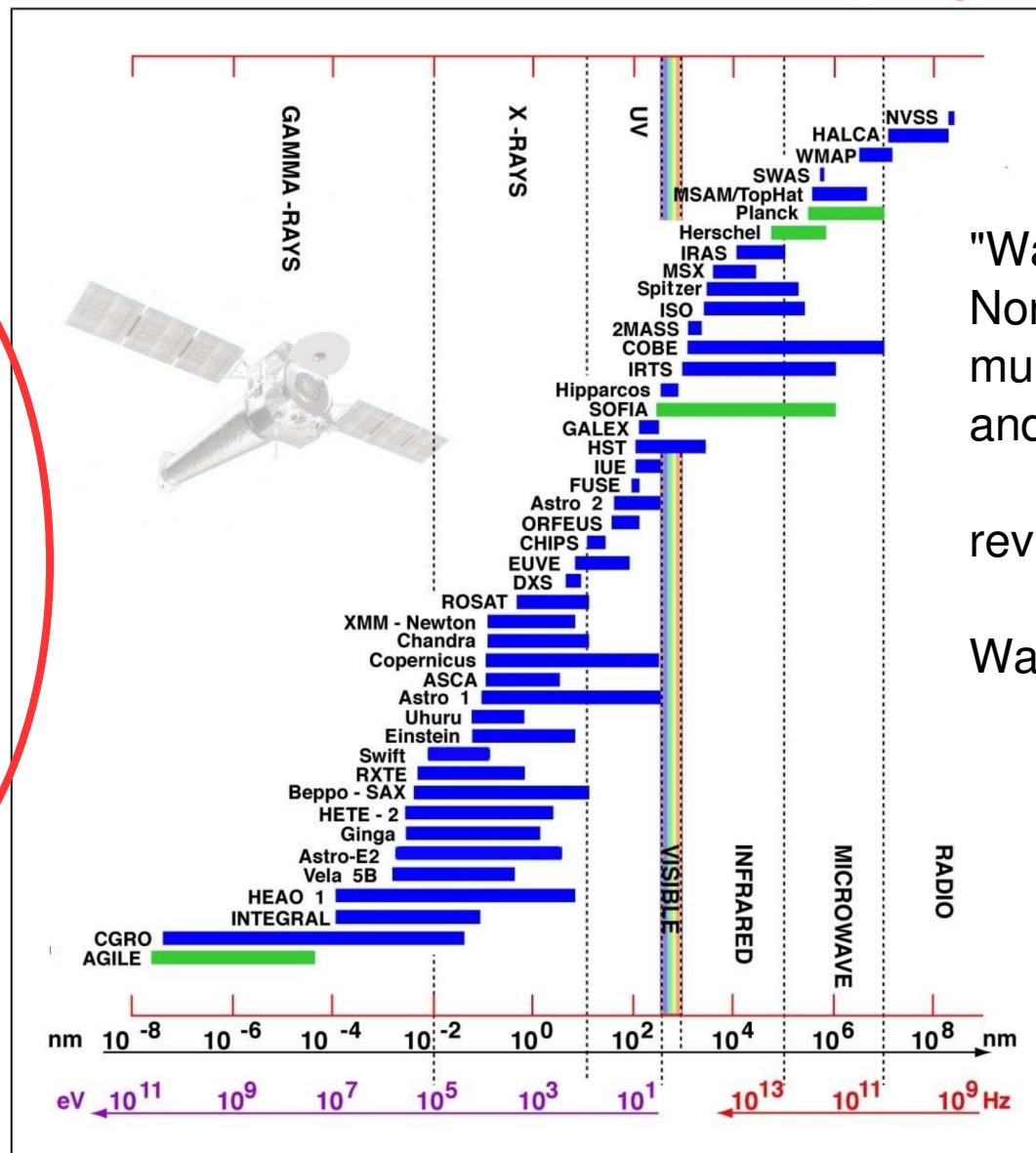


**indirect DM
search with
UHECR (γ_{UHE})!**



From gamma rays to radio

Why
nothing
here
???



"Warsaw Workshop on
Non-Standard Dark Matter:
multicomponent scenarios
and beyond",
review by C. Weniger
Warsaw, 2-5.06.2016

<http://nssdc.gsfc.nasa.gov/astro/astrolist.html>

Next breakthrough in science thanks to cosmic rays (UHECR)?

Particles coming to Earth from Space

1912. Electroscopes discharge faster with increasing altitude → rays of extraterrestrial origin: V. Hess (Nobel prize 1936).

1932. Discovery of antimatter (positron): C. Anderson (Nobel prize 1936).

1937. Discovery of muons: S. Neddermeyer and C. Anderson → particle physics begins.

1938. Extensive air showers (EAS)
→ $E > 10^{15}$ eV: P. Auger

1962. First EAS at 10^{20} eV: J. Linsley
→ what and why can have so huge energies???

.... high time for a next breakthrough in science?

