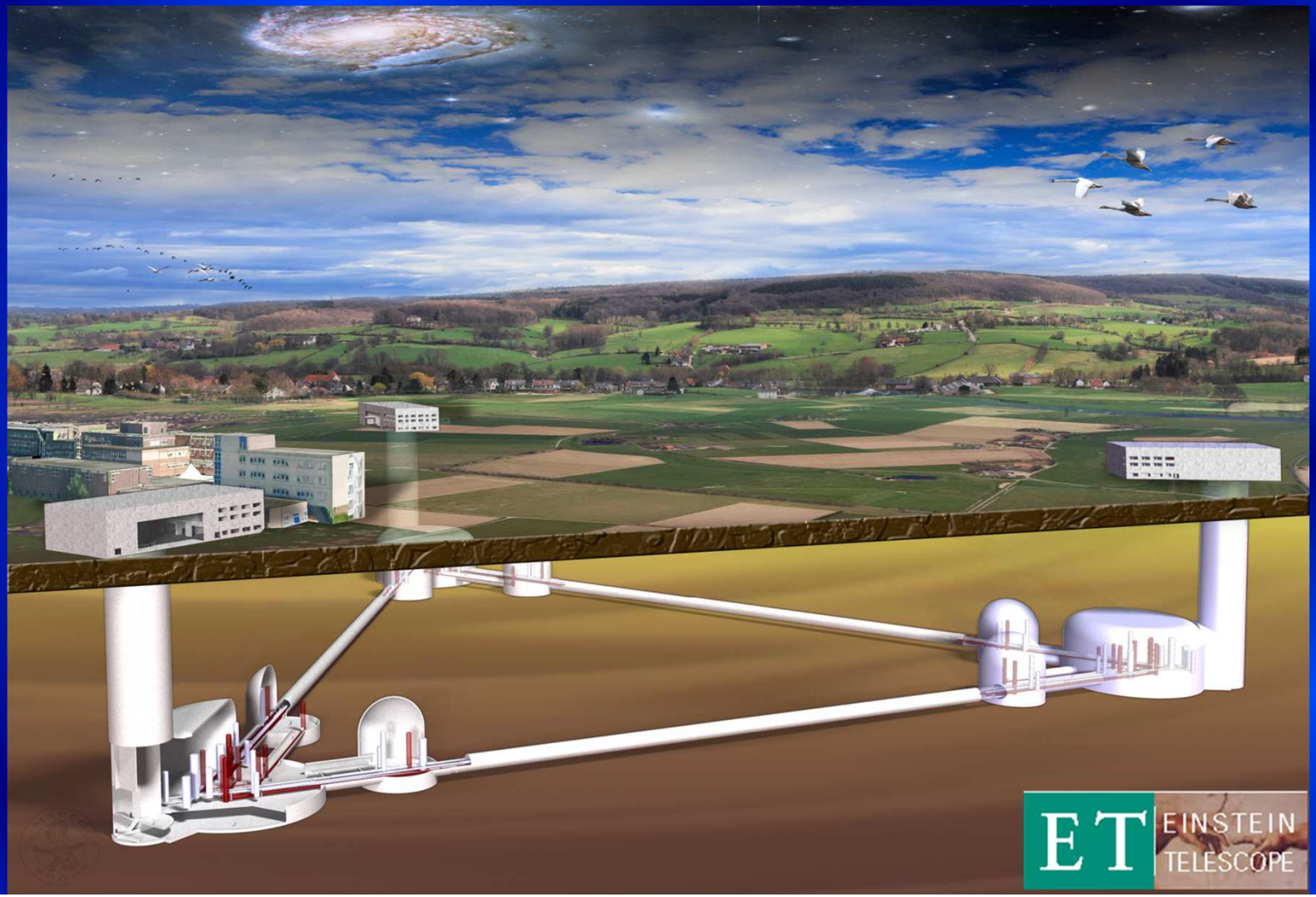
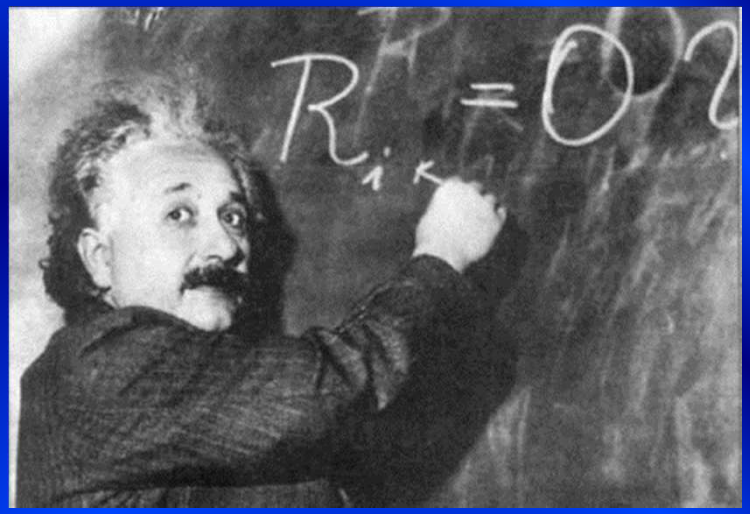
A NEW WAY TO EXPLORE THE UNIVERSE AND R&D OPPORTUNITIES IN CENTRAL EUROPE



The dark side of the universe

Current astrophysical observations, along with our cosmological model, raise the issue:

96% of the universe is dark composed by either dark energy or dark matter



- Future plans of CERN: study the dark part

  on a particle physics base (supersymmetric particles at LHC)

- The concept of the dark parts came up in GR:

  Natural to study them by gravitational wave (GW) observations

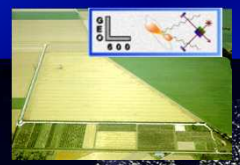
  - Deformations of the spacetime geometry, a stage on which all the "fields" and we all live, propagating with the speed of light.

Interferometric GW detectors

A worldwide network of detectors has been developed:

LIGO Hanford, 4 km:
2 ITF at the same site!

GEO, Hannover, 600 m



LIGO Livingston, 4 km

Virgo, Cascina, 3 km

indigo

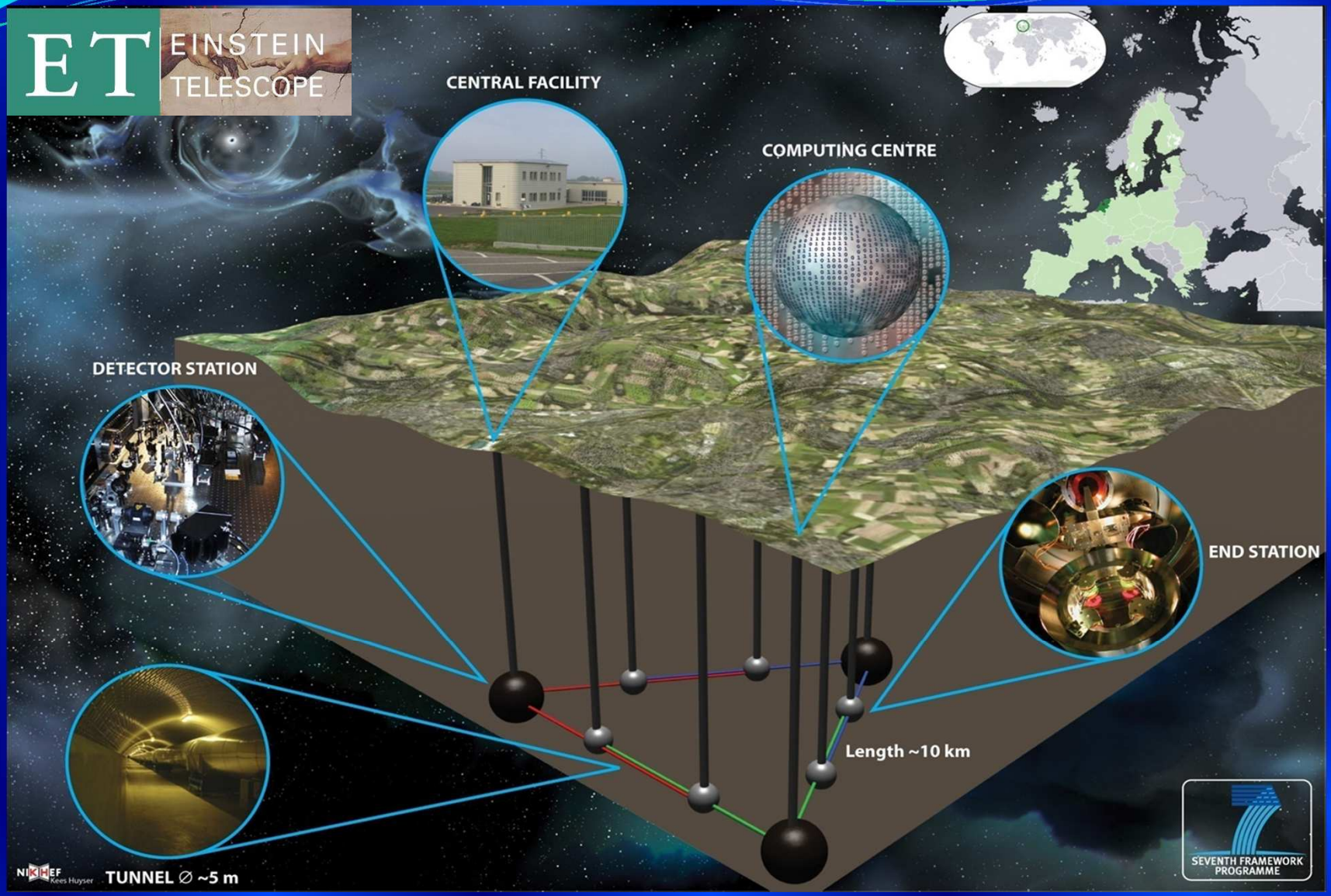
KAGRA, Kamioke,
3 km, 2.5 gen.

2017 → First direct detection of GWs → Nobel prize

→ GW astronomy: to study the dark 96%

aigo

European Gravitational Observatory



To reduce the gravity gradient noise and to achieve the desired precision an underground infrastructure is needed

Is this a new idea?

The usual steps of constructing a research infrastructure

- **Preparatory Phase – A 2008–11**

  Conceptual Design Study
  (Published on 20 May 2011, Cascina, Italy)
  Funded by EC FP7 by 3 M€

- **Preparatory Phase – B 2012–16**

  Aspera, Elites, GraWIToN

- 3rd ASPERA common call:
  The project officially started May 2013 and lasts for three years
  Essential R&D tasks in preparation for a technical design phase
  Funded by Aspera 1.2M€

- Elites: for 4 years, March 2012 – February 2016
  Focused on the common aspects of KAGRA and ET

- GraWIToN is a FP7 ITN (Initial Training Network)
  Starts February 2014 for 4 years, Funded by EC with ~ 3.7M€

- **Implementation Phase 2017–21**

  Supporting funds ??? and licenses

  The ESFRI list is going to be refreshed: 2016-17
  ET is an excellent candidate but feasibility report will require guaranties from involved States

- **Construction Phase 2022–26** (???)

  We have to be prepared in time!

http://www.et-gw.eu

The implementation phase could be financed by Horizon 2020 framework.

HORIZON 2020 – WORK PROGRAMME 2014-2015

European research infrastructures (including e-Infrastructures)

"Integrating gravitational wave research. This activity aims at integrating the communities of researchers studying gravitational waves and their astrophysical sources: both laser and atom interferometers with their extreme technological requirements; observations of gravitational-wave sources through electromagnetic waves and high-energy particles; numerical/theoretical studies of such sources. It should address also the computing and data handling needs of these communities."

The EU – GW community, preparing a joint proposal

- Expected amount of € per project:
  - In FP7, 9-10M€
  - In H2020, ? (rumors 8M€)

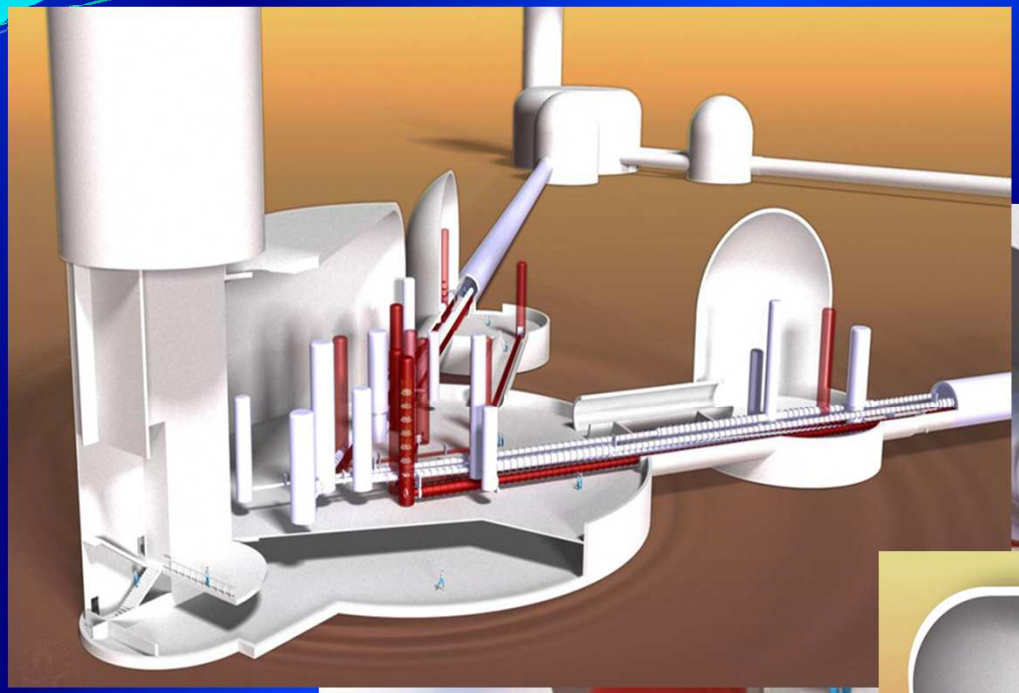
The community:

- EGO – European Gravitational Observatory: VIRGO detector, INFN & CNCR
- AEI – Albert Einstein Institute, Hanover: GEO600
- NIKHEF – National Institute for subatomic Physics, Amsterdam
- UNIGLASGOW – University of Glasgow
- UNICARDIFF – Cardiff University
- FSU – Friedrich-Schiller-Universität Jena
- POLGRAW – Polish Academy of Sciences (12 – 15)
- WIGNER RCP (since 2009) – Hungarian Academy of Sciences
  - (8 – 10) → HUNGRAW to increase our contribution

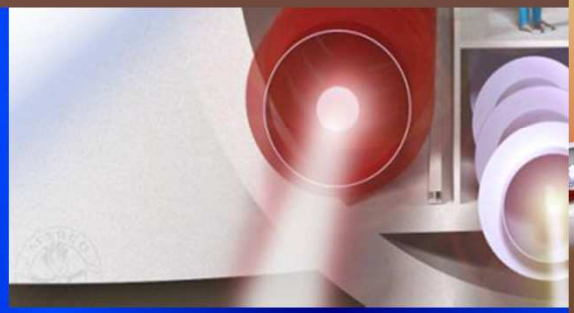
Germany
Netherlands
Russia
Poland
United Kingdom
Italy
France
Hungary

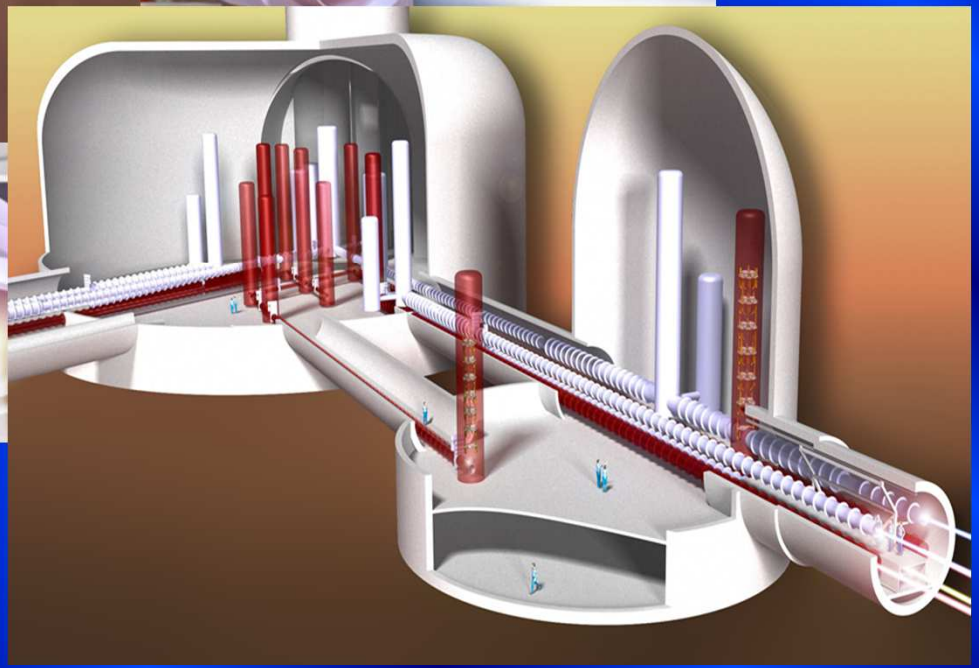
(250 – 300)

The conceptual design study contains a lot of details concerning the underground structures



The world's largest ultra high vacuum system hosted in an underground infrastructure



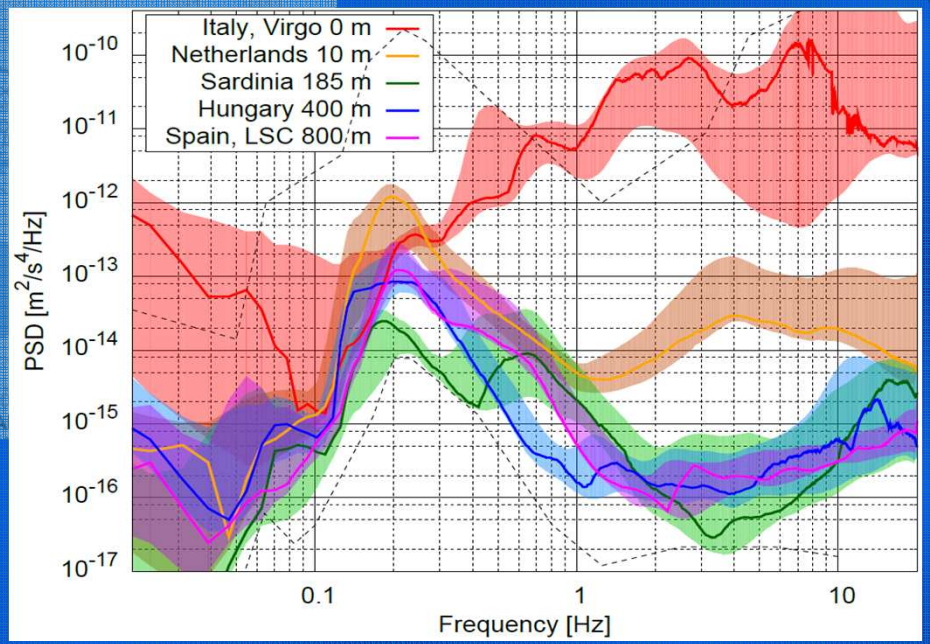


The full enterprise, with an overall cost slightly less than one billion €.
It will require a wide international cooperation.

Could it be a frontier research infrastructure for Central Europe?

ET EINSTEIN TELESCOPE

Mátra Hills, Hungary



A long term monitoring of the candidate sites will start soon. Poland (ET-group of Prof. Tomas Bulik, Univ. Warsaw) is already involved in the Mátra project.

http://www.et-gw.eu/

There are obvious impacts on science, industry, education and public outreach

!!! Many regions will compete for hosting it !!!

- **FINANCIAL FEASIBILITY:**
  - Structural funds can be used to create a RI - see e.g. ELI
  - Strong in-kind contributions (financed by structural funds) - see e.g. ESS
- **BENEFITS:**
  - Proposed lifetime is 50 years: ~ 2025 – 75
  - A cutting edge project brings here top technology and know how
  - Upgrades in each 4 – 5 years, the technology will always keep the frontier level
  - Maintenances, operation
  - Immediate benefits:
    - Mining: 30 Km tunnels in a location of a mine for zinc and lead, V~ 1,000,000 m^3
    - Constructions: tunnels and halls, buildings on ground level,…
    - Vacuum system: the needed amount of high quality steel is about 90,000 ton
- **By forming a stakeholder consortia we could share all the benefits:**
  - **~ 300 Millions Euro, ~ 30% of the construction costs would help in the decision**

    (CERN ~ 15 B€, LHC ~ 5 B€, the detectors at LHC ~ 1 B€ → ET comes out at ~ 1/15 CERN ↔ 50 years)

Proposal: Form a consortium to get this frontier RI here in Mátra Hills and share the benefits

The infrastructure

Thanks for your attention

Gyöngyös, 26 Augustr, 2014