Slanic Project
Romanian underground laboratory

R. Margineanu

Horia Hulubei National Institute of R&D for Physics and Nuclear Engineering, Magurele, ROMANIA

romulus@ifin.nipne.ro

ILIAS CoMaG, 22-23 Nov. 2007,
Zaragoza, Spain

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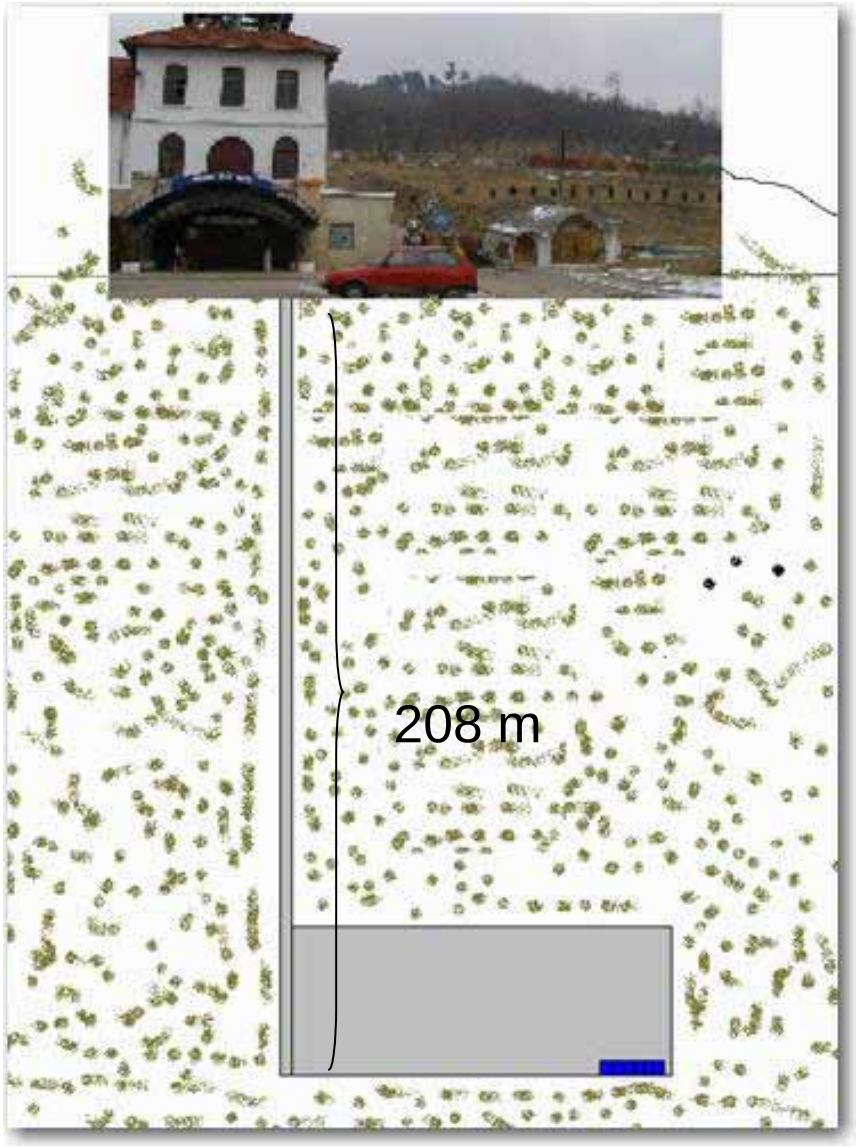
Romania is rich in natural deposits of salts, mainly encountered in the sub-Carpathian region which have been exploited since ancient times housing many active and in conservation salt mines, the last ones representing ideal locations for low background radiation laboratories.

The radiological mapping of three salt mines was initialy performed using a high resolution gamma spectrometer and an Eberline FH40G dosimeter indicated that **Unirea** salt mine from **Slanic Prahova** town as the best location.



The Unirea salt mine environment:

temperature: 12.0 -13.0 ^{o}C

humidity: 65-70 %

excavated volume: 2.9 million m^3

floor area: 70000 m^2

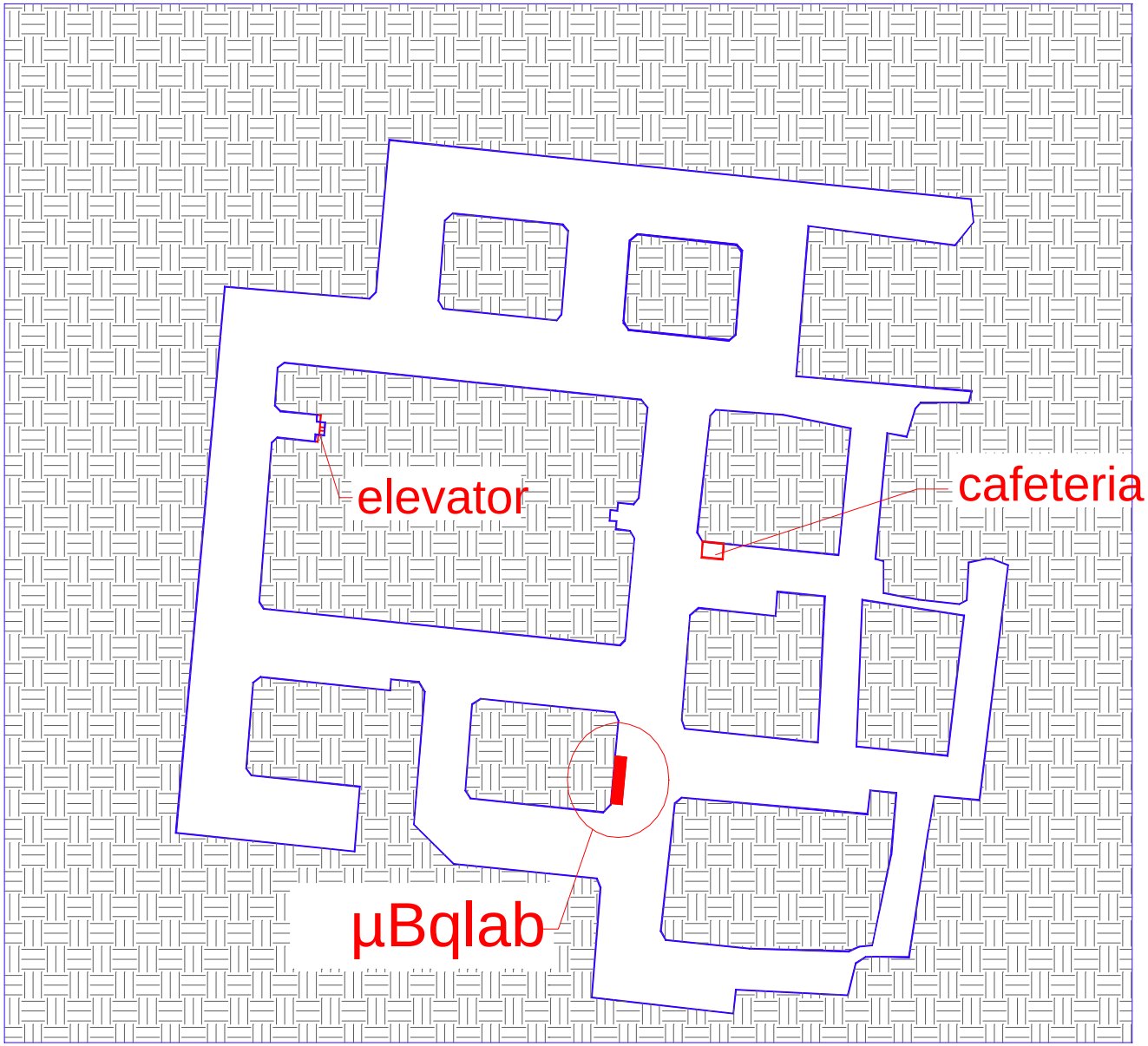
average high: 52-57 m

Salt lens dimensions:

Length: 5km

Width: 3km

Thickness: 0.5km



UNIREA salt mine gallery

The construction of low-background radiation laboratory started in January 2006 and ended in April 2006.

A high resolution gamma-ray spectrometer equipped with a GeHP detector 22.8 rel. eff. was put into the laboratory in October 2006.

A TLD reader and a portable high resolution gamma-ray spectrometer equipped with a GeHP detector 35.4 rel. eff. for whole body counter were introduced in the underground lab. in November this year.

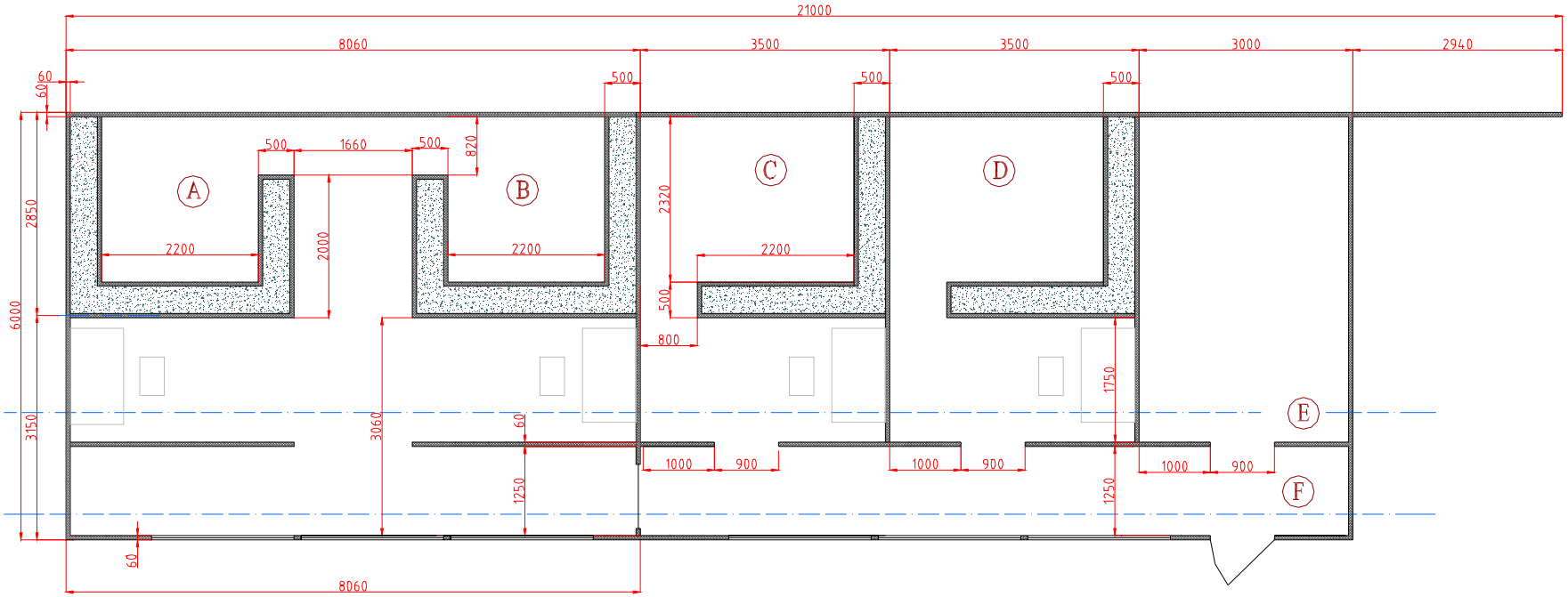
microBq laboratory realization stages:

I. – conception, design, constructor selection, material selection;

II. – material conditioning, transportation and construction;

III. – leveling the mine floor under laboratory using granulated salt,

IV. – measurement systems purchasing



UNDERGROUND LABORATORY

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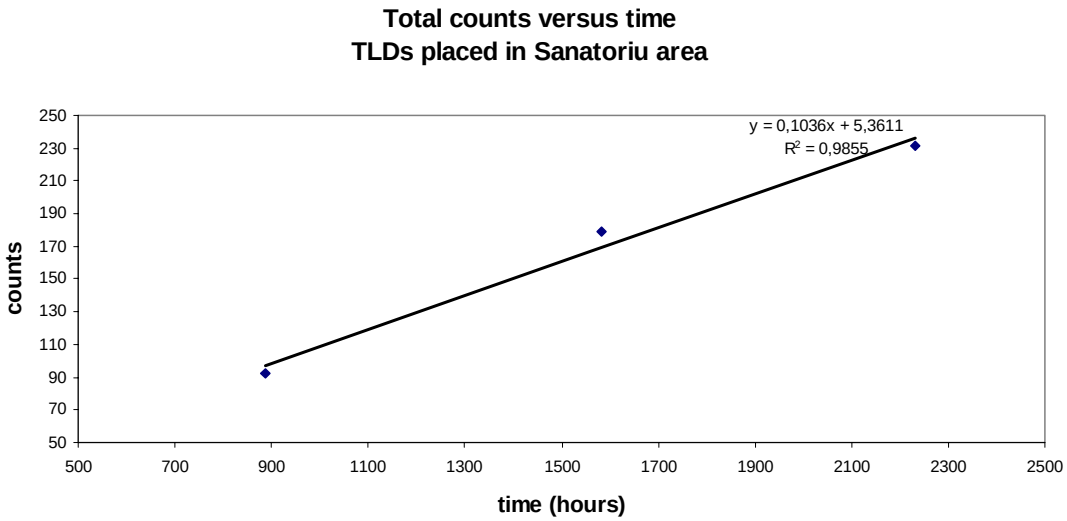
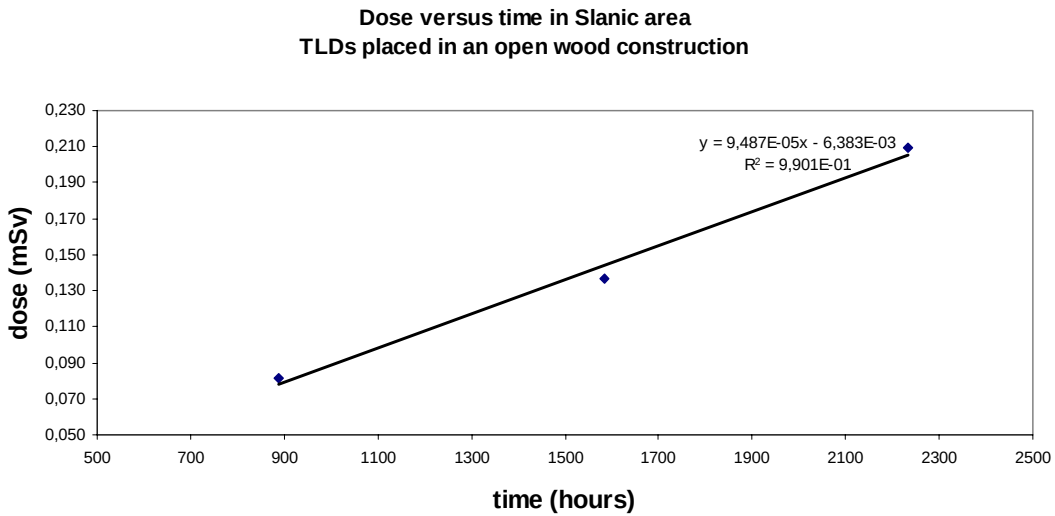
The goal is the setting up of an underground laboratory for:

- high resolution gamma ray spectrometry
- whole body counter
- radiation metrology

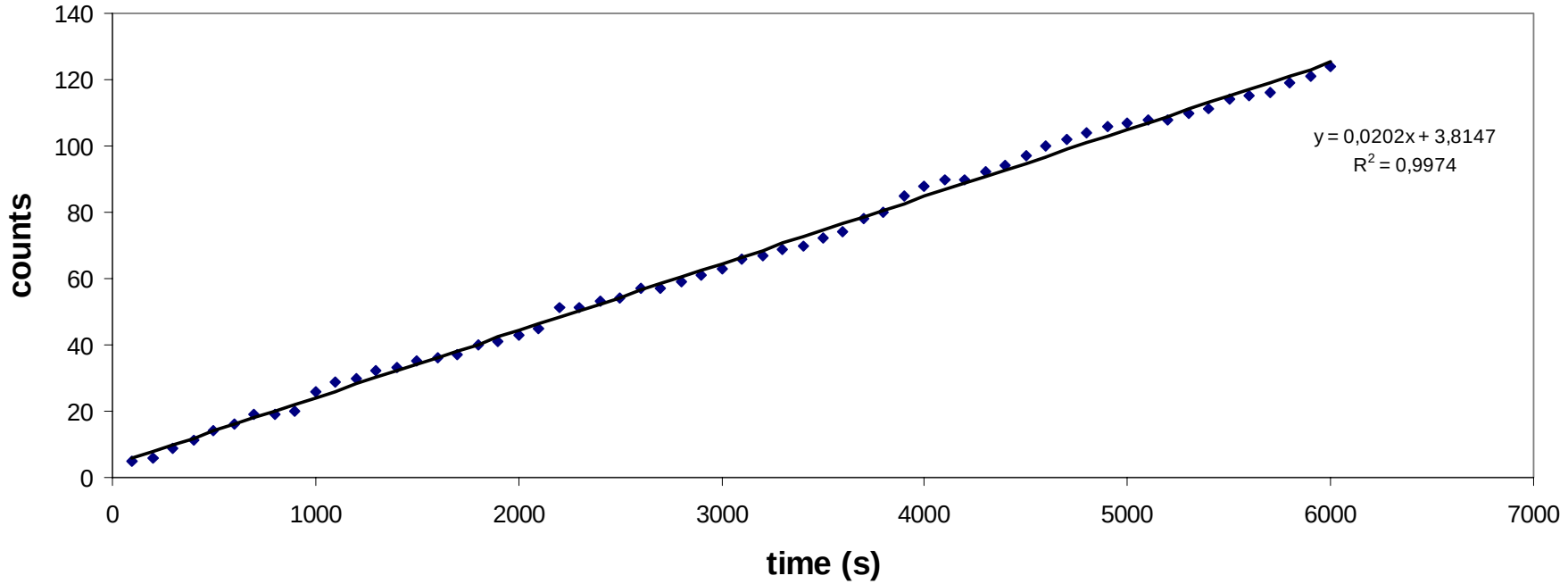


dose rate: 0.2 – 2.0 nSv/h

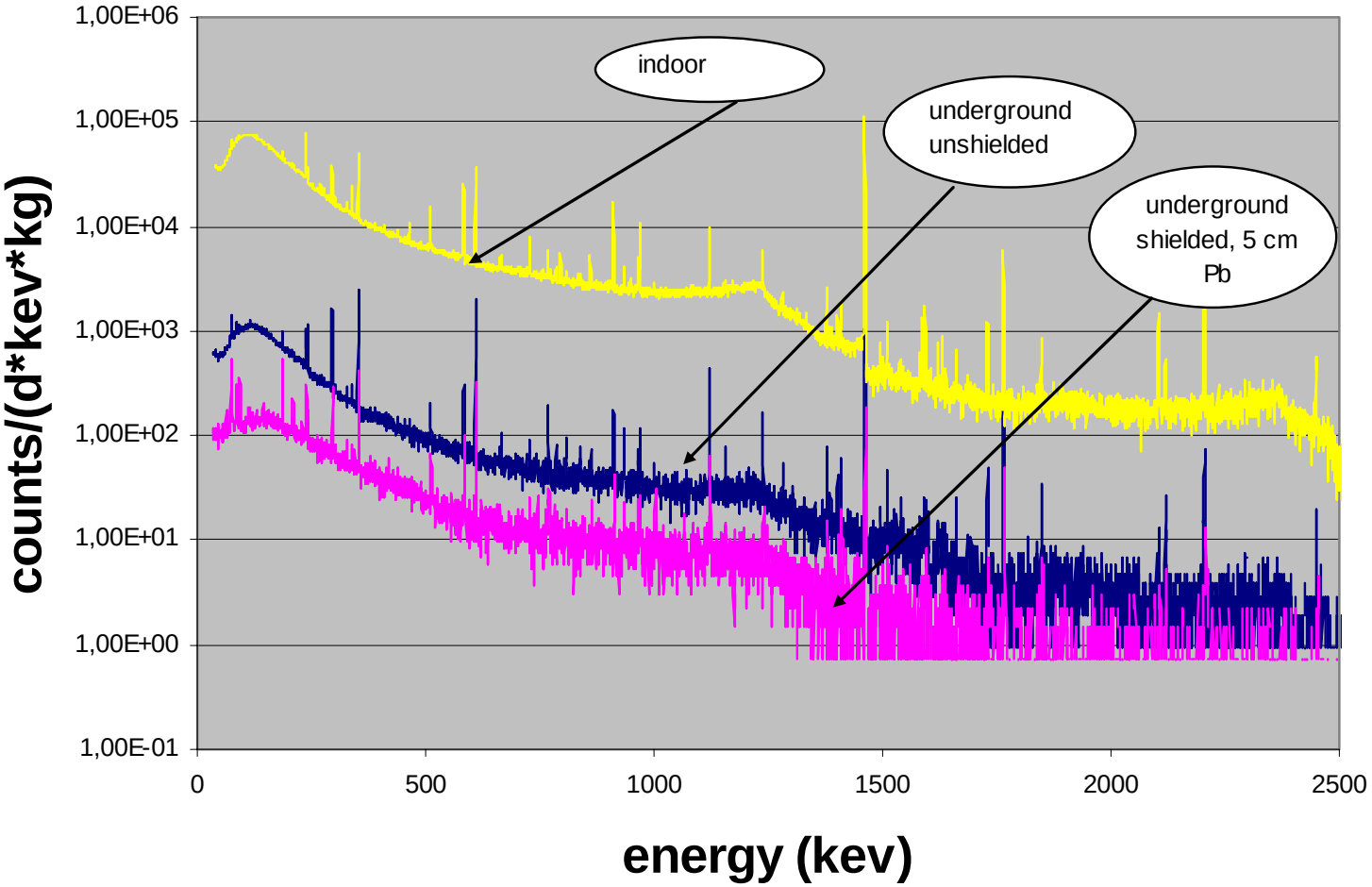


dose rate: 82 – 94 nSv/h

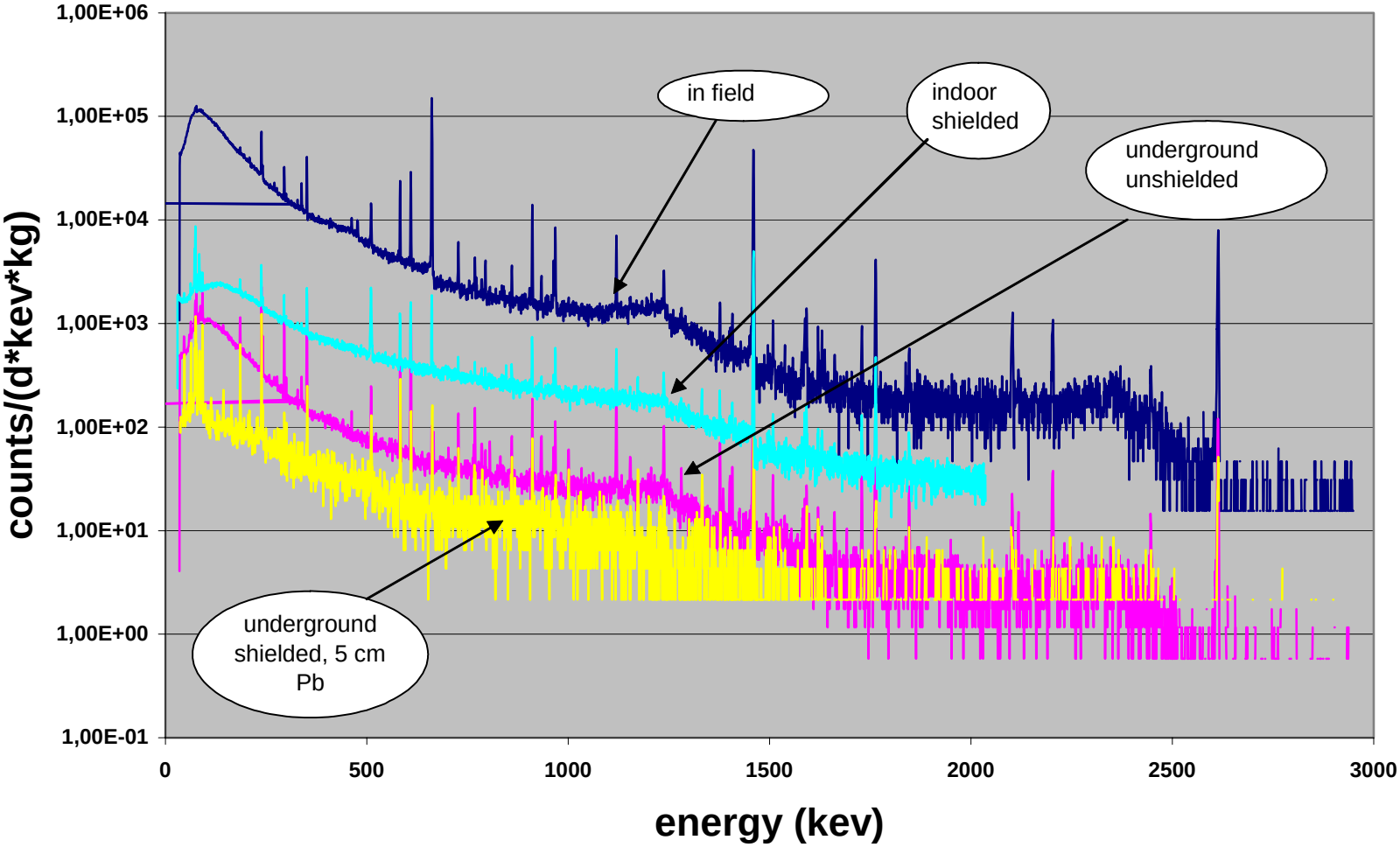
Fig. 5, Counts vs. time,
sanatoriu area - Slanic Unirea salt mine
measurement performed with a doseratemeter Eberline FH40-10



Background spectra collected with a CANBERRA GeHP detector with 22.8% rel. efficiency



Background spectra collected with an ORTEC GeHP detector with 33% rel. efficiency



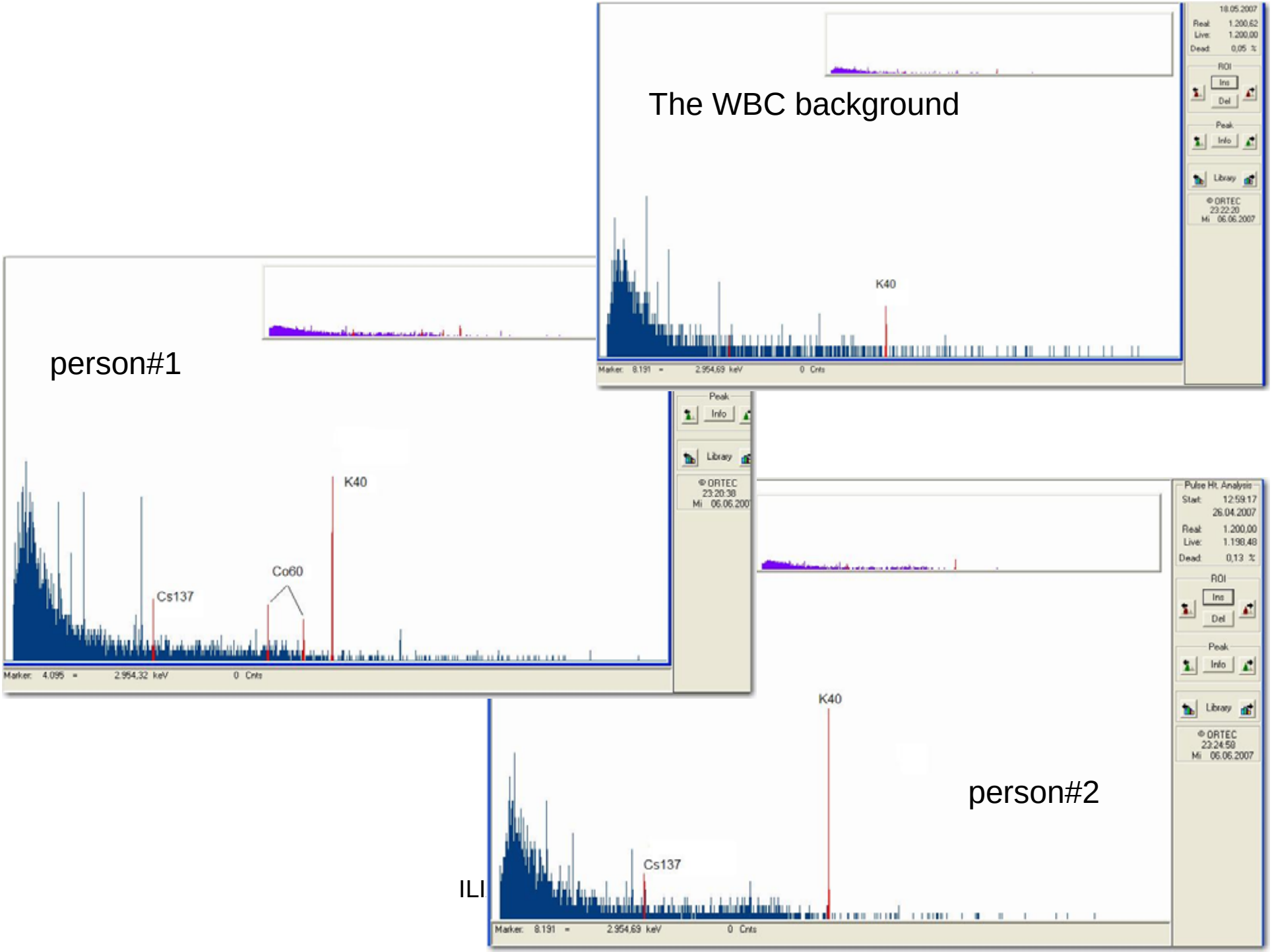
Gamma ray peaks in the background spectrum, collecting time=267500 s, ORTEC detector, 33% rel. eff., underground unshielded

Isotope	Energy (k	cps		Isotope	Energy (k	cps
Pb-210	46,52	0,0025		Pa-228	911,23	0,0024
Pb-212	77,11	0,0201		Bi-214	934,05	0,0009
U-228	92,29	0,0132		Ac-228	968,90	0,0020
Ra-226	185,99	0,0072		Bi-214	1120,28	0,0041
Ac-228	209,40	0,0004		Bi-214	1155,19	0,0004
Pb-212	238,63	0,0273		Bi-214	1238,11	0,0016
Tl-208	277,36	0,0024		Bi-214	1280,96	0,0004
Pb-214	295,22	0,0134		Bi-214	1377,65	0,0011
Ac-228	328,00	0,0004		Bi-214	1407,98	0,0011
Pa-228	338,32	0,0011		K-40	1460,75	0,0158
Pb-214	351,99	0,0207		Bi-214	1509,19	0,0005
Pa-228	463,00	0,0008		Bi-212	1620,56	0,0003
Tl-208	510,72	0,0028		Bi-214	1661,28	0,0003
Tl-208	583,14	0,0064		Bi-214	1729,60	0,0007
Bi-214	609,32	0,0194		Bi-214	1764,51	0,0037
Bi-214	665,45	0,0014		Bi-214	1847,44	0,0005
Bi-212	727,17	0,0011		Tl-208	2103,47	0,0004
Bi-214	768,36	0,0017		Bi-214	2118,54	0,0003
Pb-214	785,95	0,0008		Bi-214	2204,12	0,0009
Bi-214	806,17	0,0004		Bi-214	2447,71	0,0004

Neutron activation analyses of salt from UNIREA salt mine

Element	Neutron activation analyses
Uranium	<1ppm
Kalium	ND
Thorium	ND

Whole body counter


The WBC background
K40
person#1
K40
Co60
Cs137
ILI
K40
Cs137
person#2

Ongoing project

Determination of beta emitters from agro-ecosystems in underground laboratory

From Sept 2007 to August 2010

Goals:

Liquid scintillation beta spectrometry in underground laboratory for measuring of Tritium, C14, Pb210, Be7, Cs137 etc. in samples

Radioanalytical procedures for separation of Tritium, C14, Pb210, Be7

Projects to be submitted in February 2008:

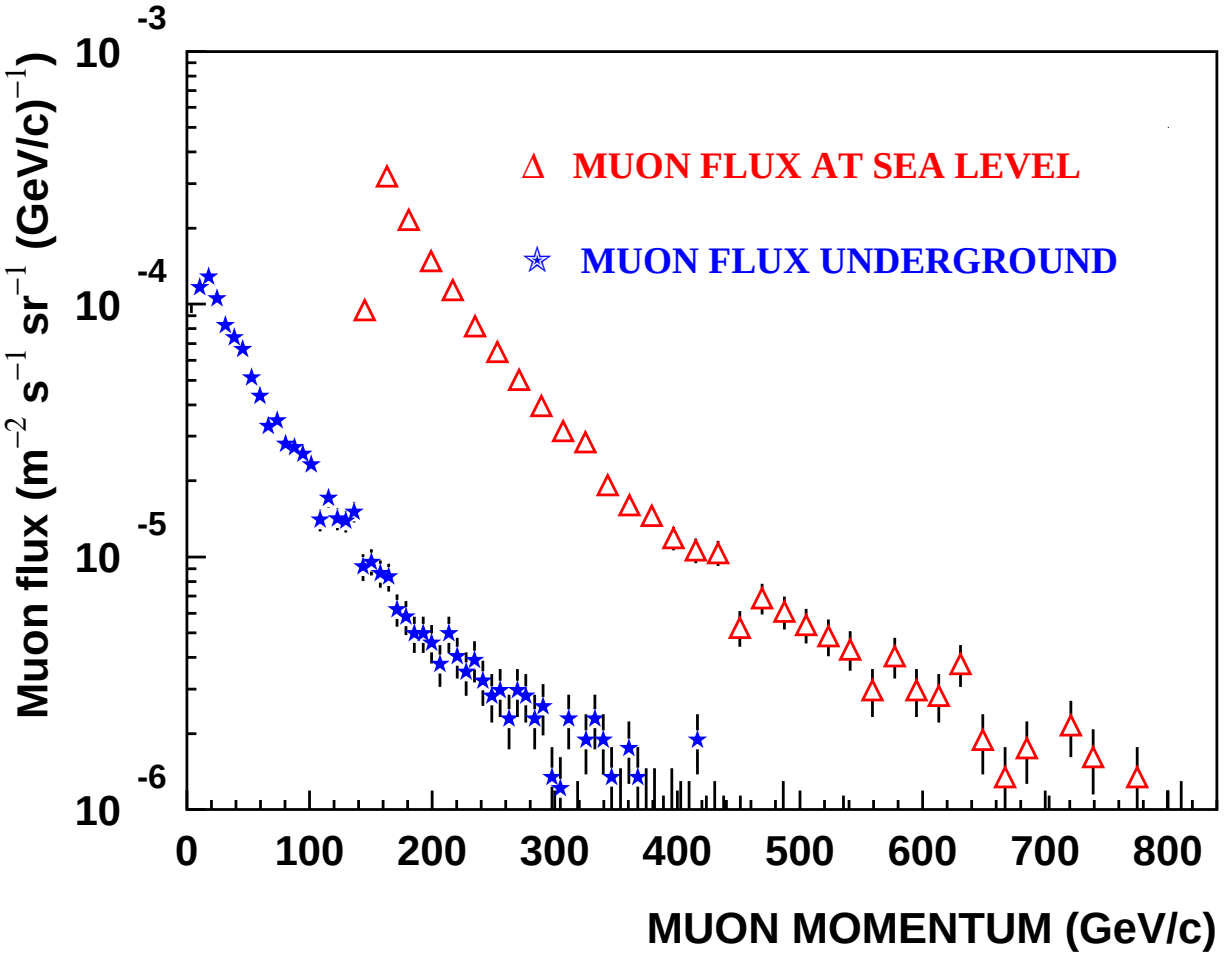
- Radiation metrology in ultralow radiation background
- Muon detection in underground
- Gamma emitting radionuclides in human body

Gamma emitting radionuclides in human body

- calibration procedure
- human body phantom construction
- validation of WBC results

WILLI – UG (Under Ground)

Simulations performed with MUSIC (MUon Simulation Code)
VKudryavtsev, Nucl. Instrum. and Meth. in Phys. Res. A(505) (2003) 688-698



- **Propagation of muons through solid rocks – NaCl 2.2 g/cm^2**
- **Energy cut-off: aprox: 200 GeV**
- **Rate:**
  Surface: 1 muon / m2s
  UG: 0.3 muon / m2min
- **Possibility to investigate the hadronic interaction models at very high energy**

LAGUNA project

- IFIN-HH could give support to external users by offering:
- measurement time,
- scientific projects of external users to be developed in Slanic salt mine
- testing the behavior of different systems and equipment in low radiation background

WP1 – Management, coordination for Slanic Salt Mine

WP2 – Underground infrastructure and engineering prefesability for Slanic Salt Mine:

- **Local conditions:**

-potential for large cavity

-access to surface

- **Geological studies**

- **Promising features:**

- large volume cavern

- radio purity of the rock

- constant temperature

- rock stability

- **Potential problems:**

- salt aerosols

- limitation of object size to be carried by elevator

WP6 – Science impact and outreach

- evaluation of sources of background, cosmogenics and natural radioactivity

-simulations of muon and neutrino flux

-simulations of the detector response

- education

Other research plans: Neutrino detection using radio antennas

Advantages of radio detection

- Low attenuation
  - → clear signals from large detection volumes
- High duty cycle + full-sky coverage
  - → good statistics in less time
- Naturally shielded

Previous studies performed by P. Gorham et.al., Nucl. Inst. Meths. A 490 (200

We plan to perform attenuation length measurements in Slanic salt mine

→ estimation of propagation losses


IFIN-HH/DFVM
µBq


THANK YOU FOR YOUR ATTENTION!