

Possible location of the underground laboratory in Poland for neutrino physics

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Motivation:

**Localisation of the future giant
detector for neutrino studies and
proton decay searches**

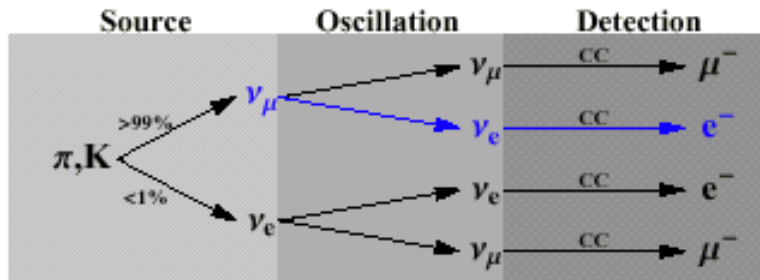
Water Cherenkov ?

Where to put 1 Mton
of water?



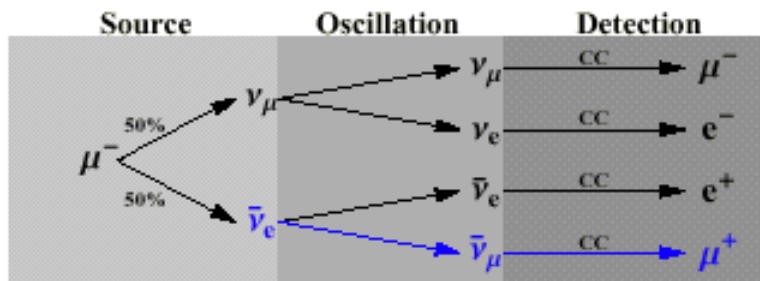
Sources of neutrinos

Superbeams



Conventional beams
of ν . high intensity

Neutrino Factories



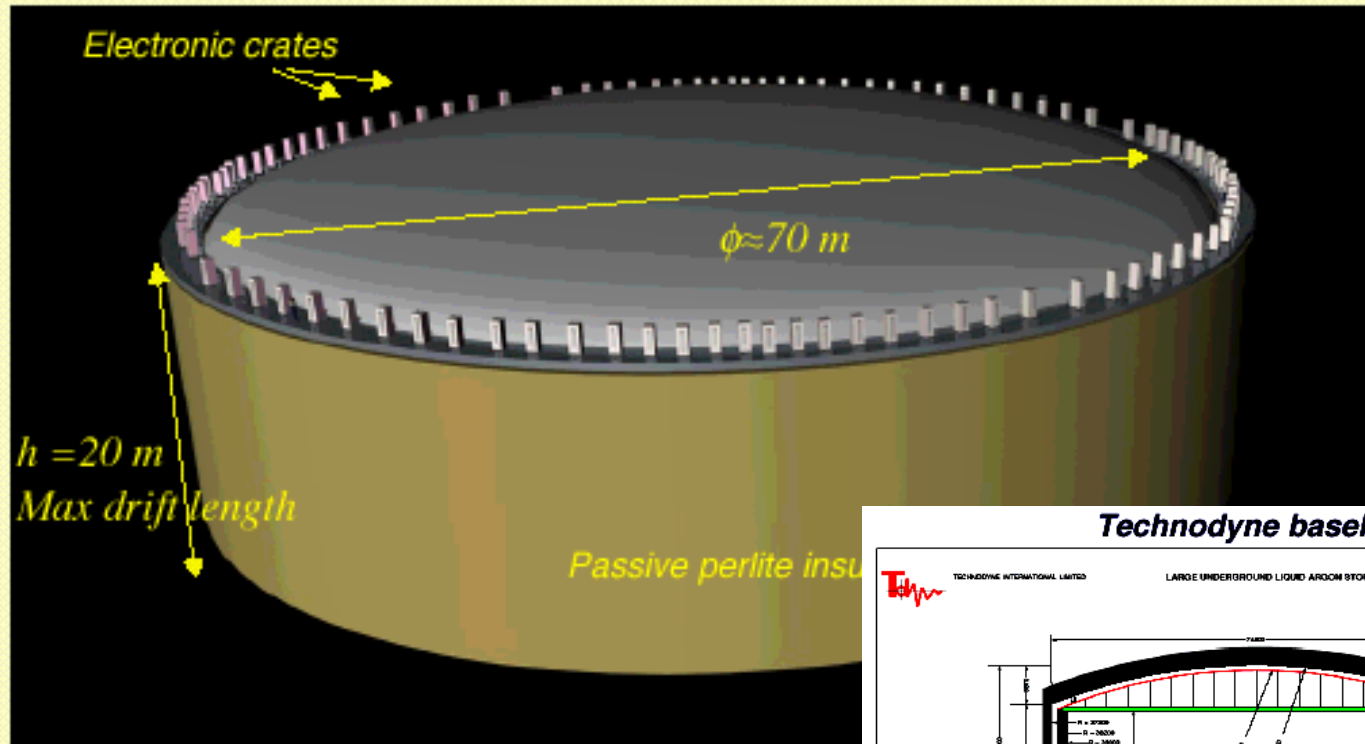
New type of accelerator:
neutrinos from decays of
accelerated muons

β beams
very fresh idea

New type of accelerator:
neutrinos (antineutrinos)
from accelerated ^{18}Ne (^6He)

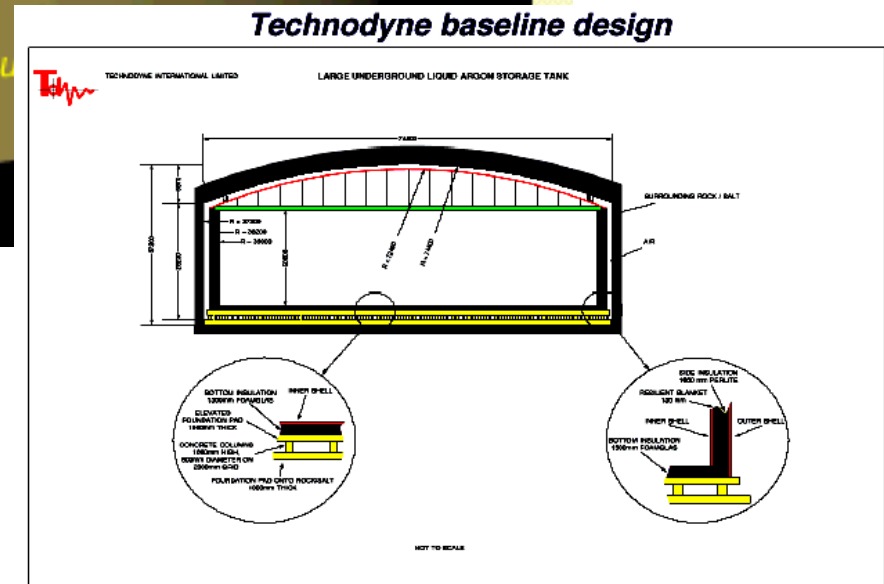
Alternative solution ?

A 100 kton liquid Argon TPC detector



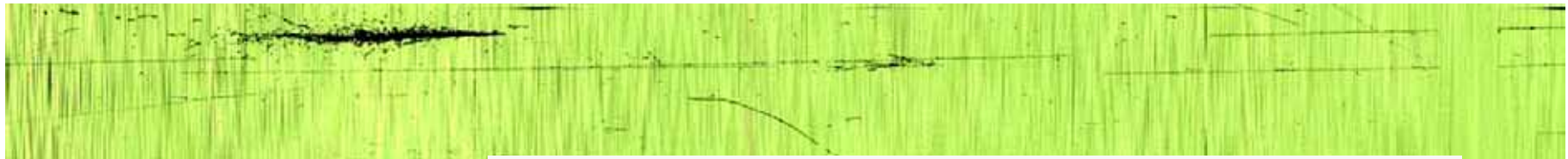
Original idea of A.Rubbia
hep-ph/0402110

A.Zalewska, Wrocław, 7.12.2005

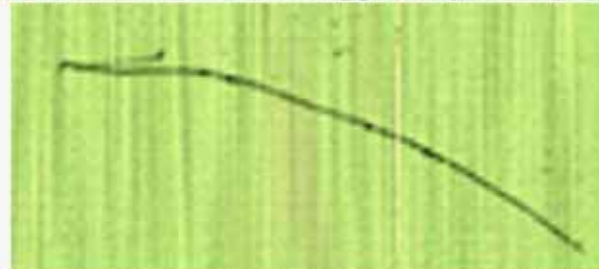
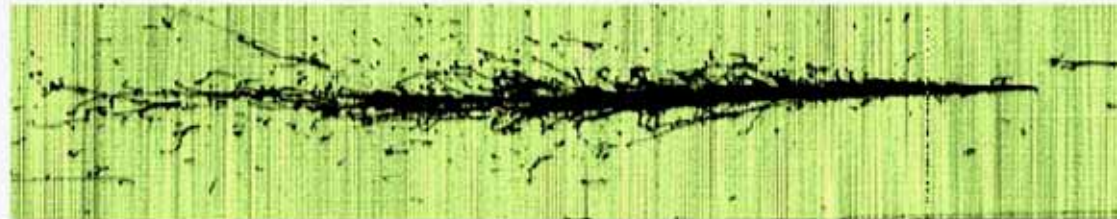


Why liquid argon detector?

Precise tracking, precise calorimetry - for many measurements its sensitivity is similar to that obtained with ten times bigger water Cherenkov detector, background free proton decays



Single event from the surface test data taken with the ICARUS liquid argon TPC



Polkowice - Sieroszowice

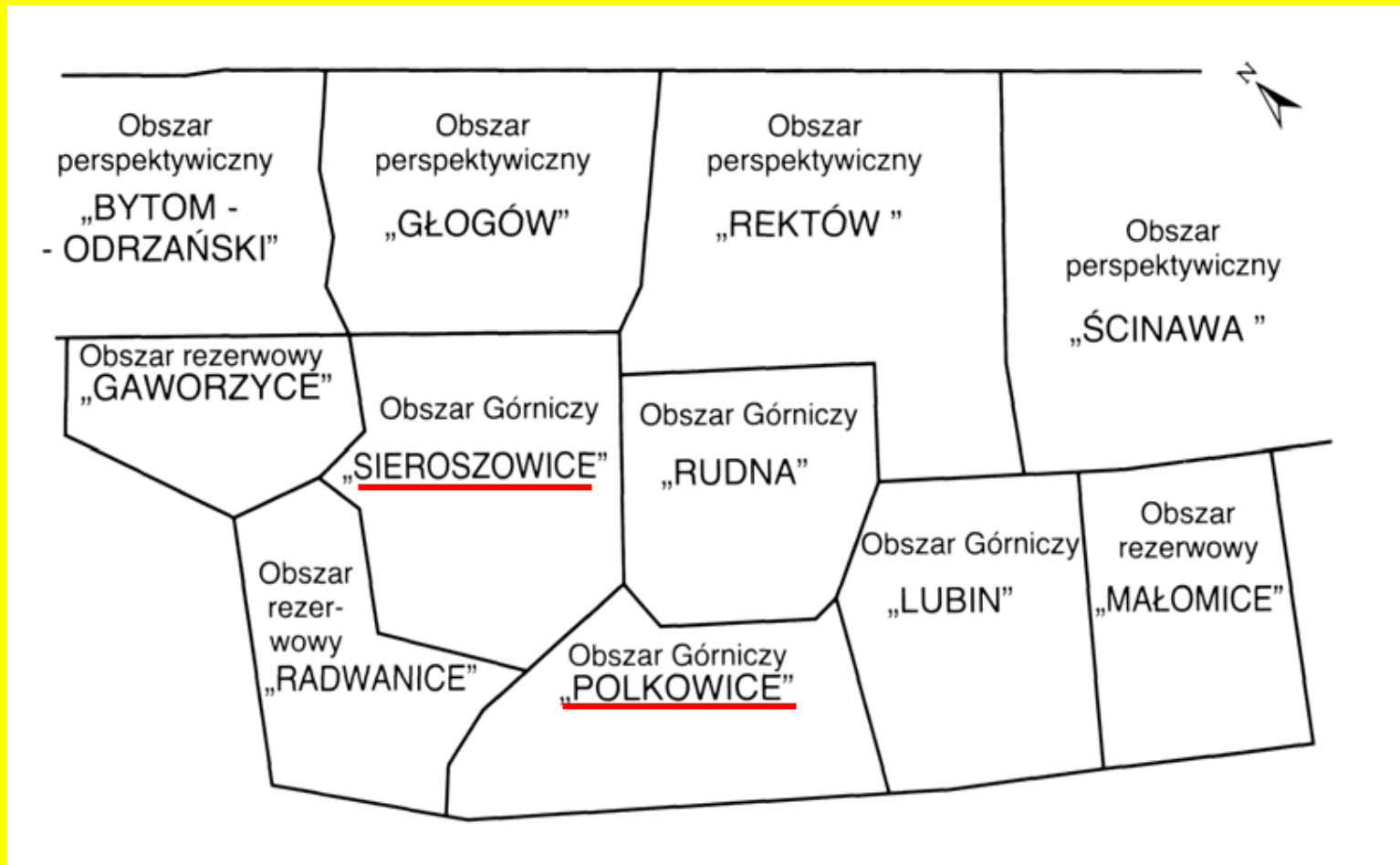
Not far from Wrocław



Possible underground sites in Europe ?



Region of Polish copper mines



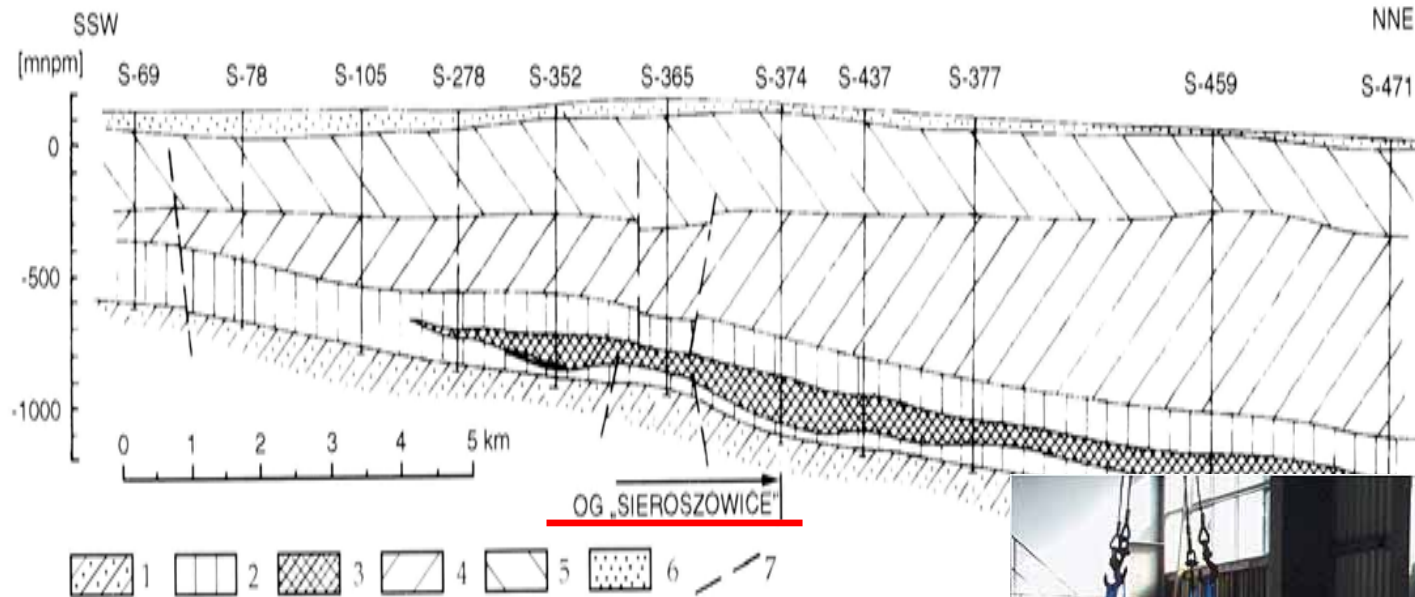


Copper - 6th position
in the world's exploitation
ranking

Silver - 2nd position



... But also salt mines



Przekrój geologiczny poprzeczny

1. Czerwony spągowiec; 2. formacja cechsztyńska; 3. pokład soli kamiennej trzeciorzęd; 6. czwartorzęd; 7. przypuszczalne dyslokacje uskokoowe



Sieroszowice mine - big salt cavern

Volume
(100x15x20) m³

depth ~950 m from
surface

salt layer ~70 m
thick

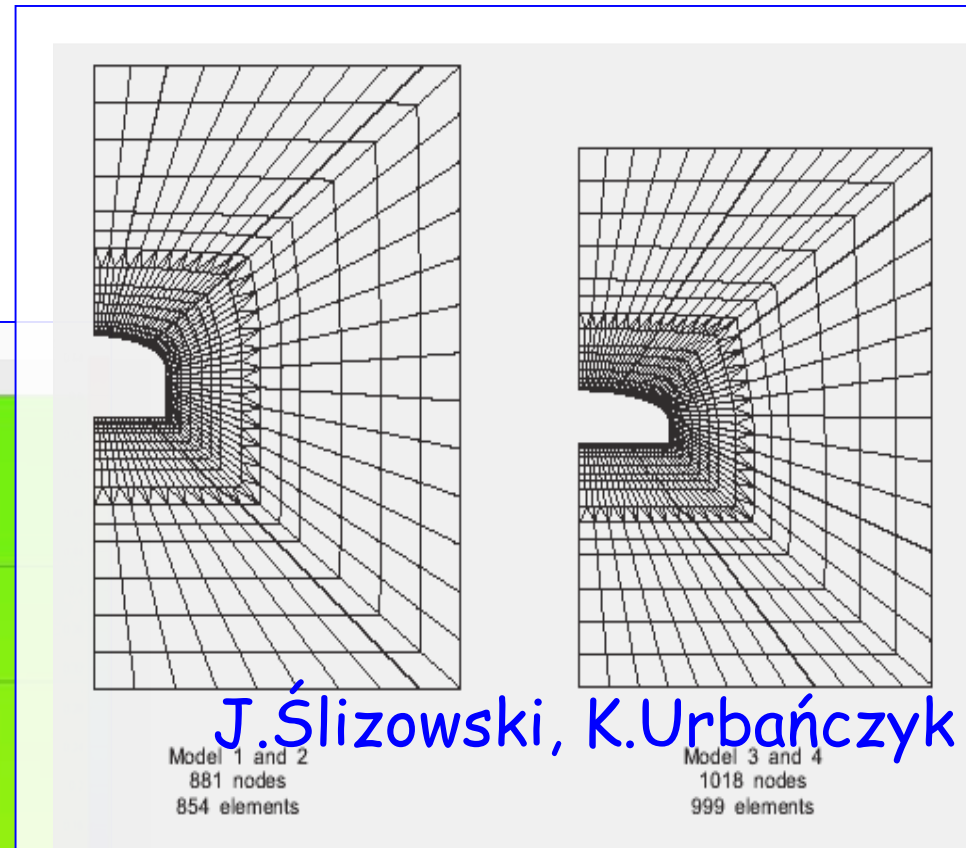
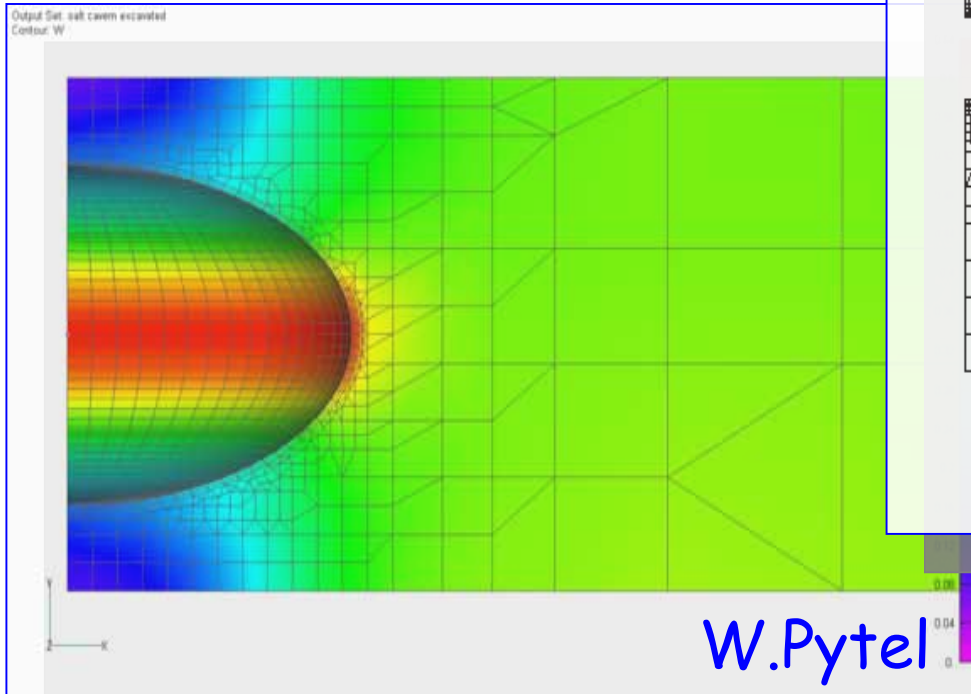
temperature ~35°C



Geomechanics

Could one dig a football yard at a depth of 950 m?

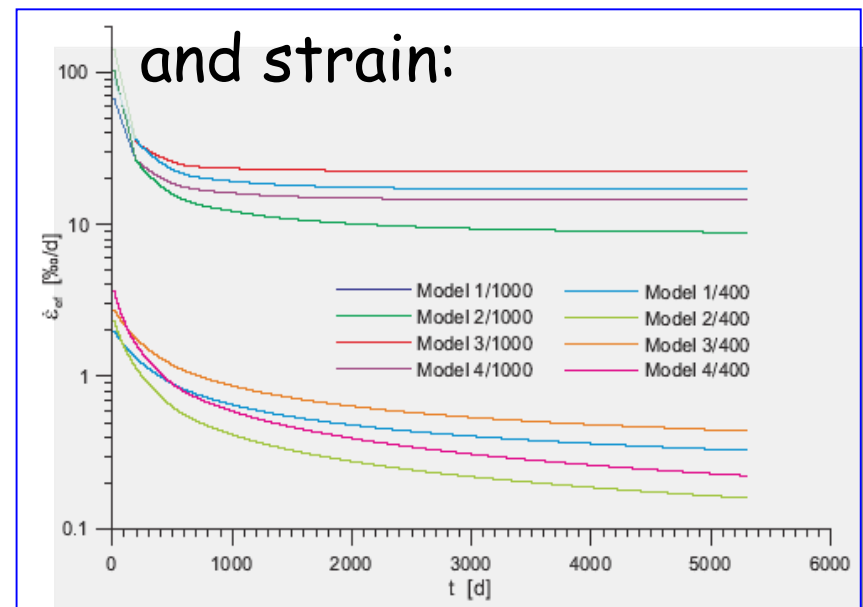
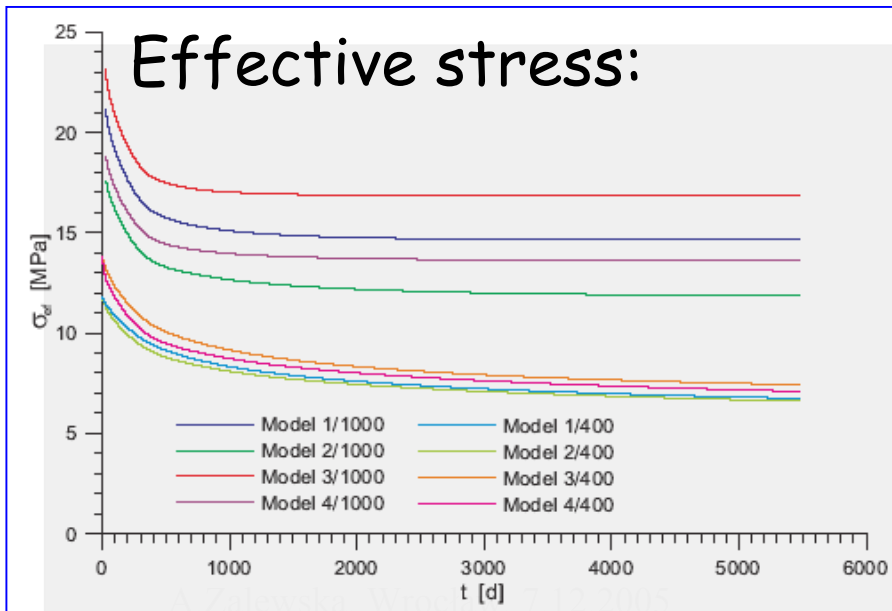
Requirement: a cavern with a diameter $\sim 100\text{m}$ and stable for 30 years



Two parallel geomechanical simulations

Results of the simulations

- The initial few years will be crucial
- A smaller chamber at 950 m or a big one at 750 m is definitely possible.
- Essentially stable, but a more detailed study is needed...



Very important

Wall movements for one of the existing chambers are monitored by staff of the mine



Natural radioactivity

α and γ spectrometry of salt

(J.W.Mietelski, E.Tomankiewicz, S.Grabowska)

Tabela 1. Wyniki stężenia substancji radioaktywnych w badanych próbkach soli z kopalni Sieroszowice.

Radionuklid	1	2	3	4
	<u>[Bq/kg]</u>			
^{238}U	0.40 ± 0.06	0.34 ± 0.05	0.10 ± 0.02	0.14 ± 0.02
^{234}U	0.38 ± 0.06	0.33 ± 0.05	0.14 ± 0.02	0.14 ± 0.02
^{230}Th	0.29 ± 0.05	0.34 ± 0.06	0.10 ± 0.03	0.19 ± 0.03
<i>Średnio sz. U</i>	<u>0.357</u>	0.337	0.113	0.157
^{232}Th	0.09 ± 0.03	0.08 ± 0.02	0.03 ± 0.02	0.11 ± 0.02
^{235}U	0.015 ± 0.006	0.015 ± 0.007	<0.005	0.008 ± 0.004
^{40}K	nd	nd	nd	<u>2.1 ± 0.3</u>

Dose measurements with TL detectors

Integration time: 8 months from the 23rd of March till the 22nd of November 2005



1.8 nGy/h, similar for all 11 sets of detectors
(for comparison- in Cracow at 1m under the surface it is 65 nGy/h)



M. Budzanowski
M. Puchalska

A. Zalewska, W



Radon measurements

Mostly due to a pumping of the external air through a ventilation system → aging of this air will be needed

Measurements of Radon from the salt are foreseen

Conclusions

Digging a big cavern in salt of the Polkowice-Sieroszowice mine is feasible but more detailed studies should continue

Natural radioactivity is very low

So:

-- Excellent (too good?) conditions for the big detector

But:

- Is 2000 m w.e. sufficient for measurements requiring very low background due to h.e. muons?
- Evaluation of neutrino fluxes from „neighbouring“ reactors is also needed

The Sieroszowice mine is certainly worth to check it