Einstein Telescope

WP1 – Site selection and infrastructure

Ilias – ET meeting

Cascina, November 25, 2008

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Contents

Logistics for ET

Table 1.3-d: Summary of staff effort

Participant #	Short Name	WP1	WP2	WP3	WP4	WP5	Tot# Person Month
1	EGO	32	18	7	7	86	150
2	INFN	24	69	6	16	9	124
3	MPG	6	0	34	10	0	50
4	CNRS	4	28	43	22	0	97
5	UNIBHAM	0	0	34	8	0	42
6	UNIGLASGOW	0	41	34	8	1	84
7	VU	57	0	0	18	0	75
8	UNICARDIFF	0	0	0	47	0	47
Total		123	156	158	136	96	669

Table 1.3-e: List of milestones

Milestone number	Milestone name	Work package(s) involved	Expected date	Means of verification
WP1.1	Site requirements definition	WP1	M12	Report
WP1.2	Site noise evaluation	WP1	M18	Report
WP1.3	Site selection and evaluation procedure	WP1	M24	Report
WP1.4	Main infrastructure conceptual design	WP1	M33	Report

Table 1.3-b: Deliverable list

Del. no.	Deliverable name	WP. no.	Nature	Dissemi-nation level	Delivery date
1.1	Annual report containing a white book of the site requirements	WP1	R	PU	12
2.1	Annual report	WP2	R	PU	12
3.1	Annual report	WP3	R	PU	12
4.1	Annual report	WP4	R	PU	12
5.1	Annual report	WP5	R	PU	12
1.2	Annual report containing the required legal aspects	WP1	R	PU	24
2.2	Annual report	WP2	R	PU	24
3.2	Annual report	WP3	R	PU	24
4.2	Annual report	WP4	R	PU	24
5.2	Annual report	WP5	R	PU	24
1.3	Final Report	WP1	R	PU	36
2.3	Final Report	WP2	R	PU	36
3.3	Final Report	WP3	R	PU	36
4.3	Final Report	WP4	R	PU	36
5.3	Final Report	WP5	R	PU	36
5.4	Conceptual design delivery	WP5	R	PU	38

Contributors

1 – 32 EGO
(Paoli, Pasqualetti, Popolizio, Richard)

2 – 24 INFN: Pisa University (Cella - NN), Roma 2, Roma 3 (Plastino)

3 – 06 AEI Hannover (Grote – Seismicity, Ruediger)

4 – 04 CNRS (Vacuum)

7 – 57 Nikhef (Doets Engineer, Hennes – FEA NN, Rabeling pd, vdB)

Interested in LIGO activities
Interact with LSGT

ET- WG1: EU resources

Table 1.3-a: Work package list

Work package no.	Work package title	Type of activity	Lead participant no.	Person-months	Start month	End month
WP1	Site identification	RTD	7	123	2	34
WP2	Suspension requirements definition	RTD	2	156	2	33
WP3	Topology identification	RTD	3	158	2	33
WP4	Astrophysics issues	RTD	8	136	2	27
WP5	Management	MGT	1	96	1	38
	TOTAL			669		

Description of Resources and Budget

	Participant number (short name)	Method applied for Indirect Costs (Overheads) calculation	Personnel costs (€)	Durable Equipment costs (€)	Consumables (€)	Travel & Subsistence (€)	Other costs (€)	Total Direct Costs (without subcontracting) (€)	Indirect Costs (Overheads) (€)	Subcontracting costs (€)	Total costs (€)	Requested EU funding (€)
WP1	EGO	special flat rate	0			44334		44334	26600		70934	53200
	INFN	special flat rate	100833			0		100833	60500		161333	121000
	MPG	simplified	0			0		0	0		0	0
	CNRS	special flat rate	19000			0		19000	11400		30400	16500
	UNIBHAM	special flat rate	0			0		0	0		0	0
	UNIGLASGOW	special flat rate	0			0		0	0		0	0
	VU	simplified	167549			0	29867	197416	118450		315866	227000
	CU	special flat rate	0			0		0	0		0	0
	Grand Total		287382	0	0	44334	29867	361583	216950	0	578533	417700

- 44 kEuro travel
- 1 postdoc for 3 years (Rabeling), 1 postdoc for 2 years (INFN)
- 30 kEuro for external work

Logistics – meetings, etc

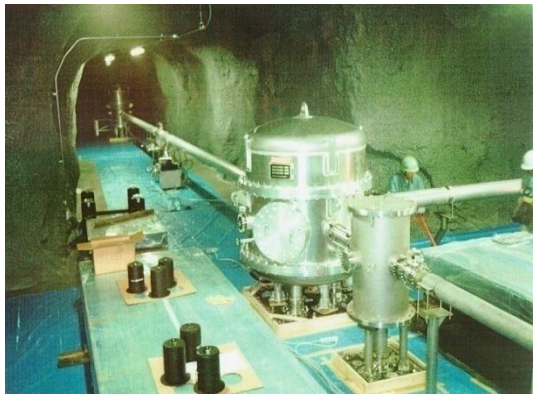
- Face 2 Face meetings
  - Every 3 months F2F
    - Alternate between collaborating institutes
    - Attach to *e.g.* Virgo / LSC – Virgo meetings
  - Next WG1 F2F meeting
    - Thursday, January 15, 2009
    - Gran Sasso
- EVO / phone meetings
  - Monthly
  - Day and time: first Friday each month, 3 pm CET
- Industry
  - Underground building COB Netherlands
    - Amsterdam, October 9, 2008
  - ASPERA R&D meets industry
    - Amsterdam, October 28, 2008
- Representative in each partner country
  - Legal issues, etc.
  - Costing issues: non-public material (committee)
- Reporting (December 2008 first ET internal report)

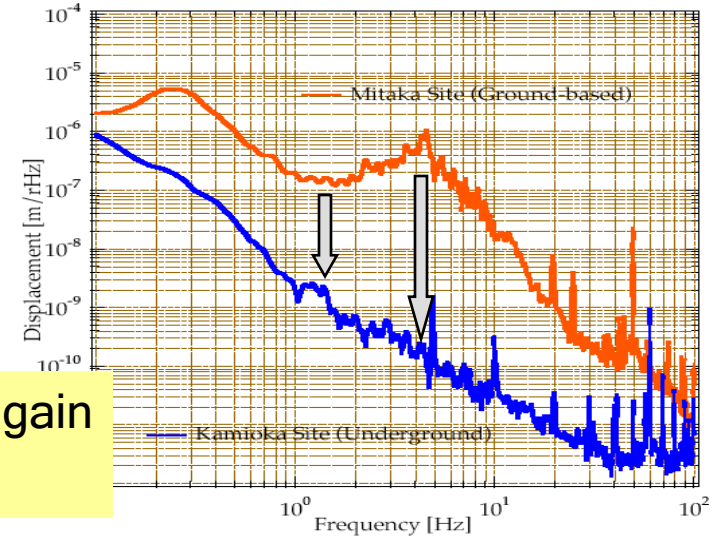
ET WP1 – Discussion and division of tasks

- Site issues
  - Seismic studies
  - Gravity gradient noise studies
  - FEA on seismic attenuation effects
  - Geological studies
- Infrastructure
  - Tunnels, caverns, buildings
  - Vacuum, cryogenics
  - Computing, etc.
- Logistics
  - Cost modeling
  - Legal issues

ET WP1 – Seismic data

- Site issues: seismic studies
  - Need data
    - Different sites
    - Short and long term data
  - Candidate sites can be all over Europe (world)
    - Need several participants
      - France
      - Germany – Hartmut Grote
      - Italy – Irene Fiori
      - UK
      - Netherlands – David Rabeling
      - etc.
    - Set up test site: continuous seismic data feed
      - Gran Sasso
    - Collaborate with
      - Activities in Homestake – Riccardo DeSalvo, Vuk Manic, Angelo Sajeva
      - Kamioka (LISM): Shuichi Sato
  - Complications
    - No funding for equipment
  - Existing data
    - Orfeus network
    - Studies for ILC, etc.

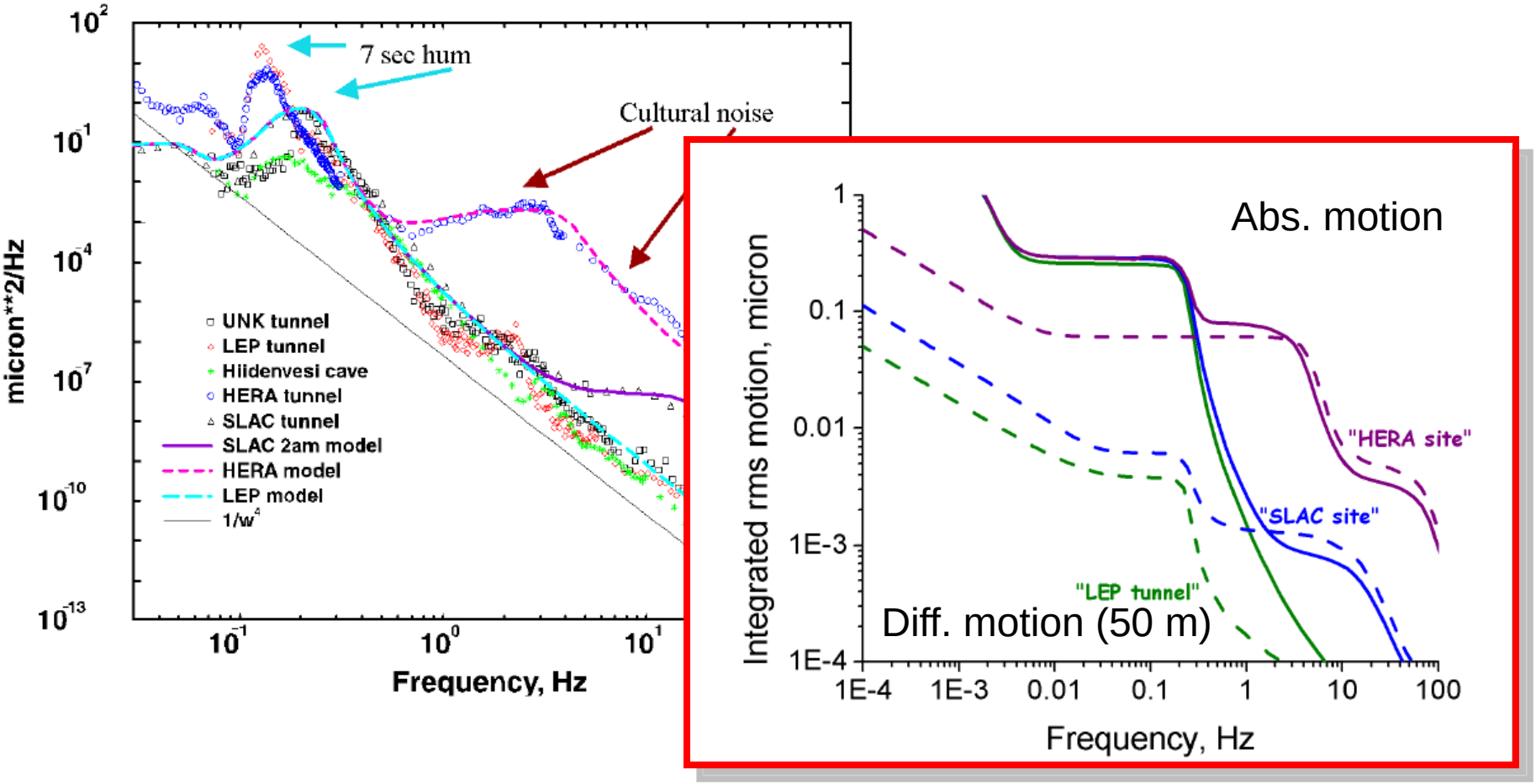




10^2 overall gain

10^3 at 4 Hz

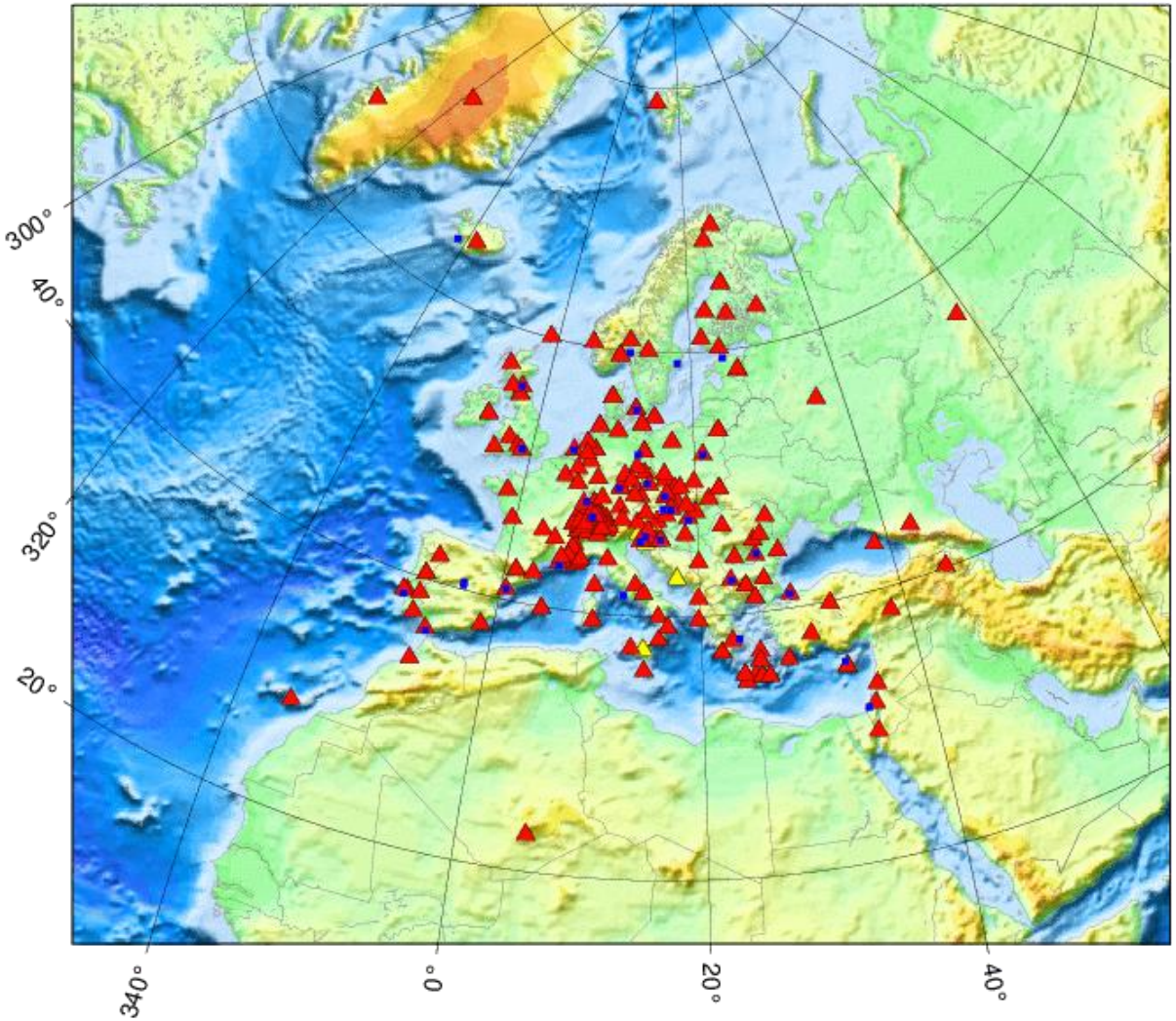
Seismic data



Power spectrum from ILC working group

Orfeus network

VEBSN station map
showing 193 stations

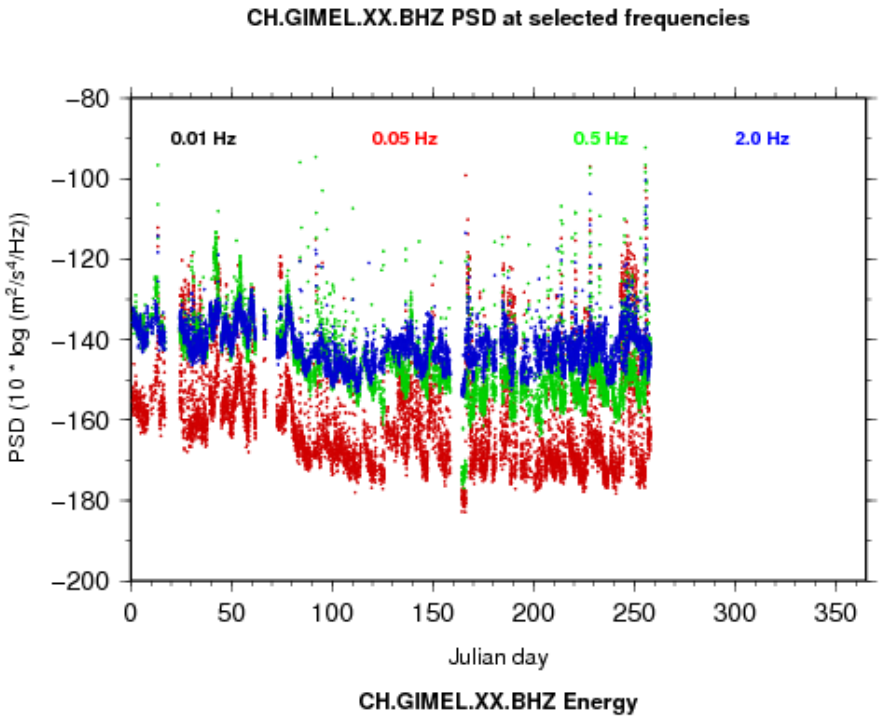


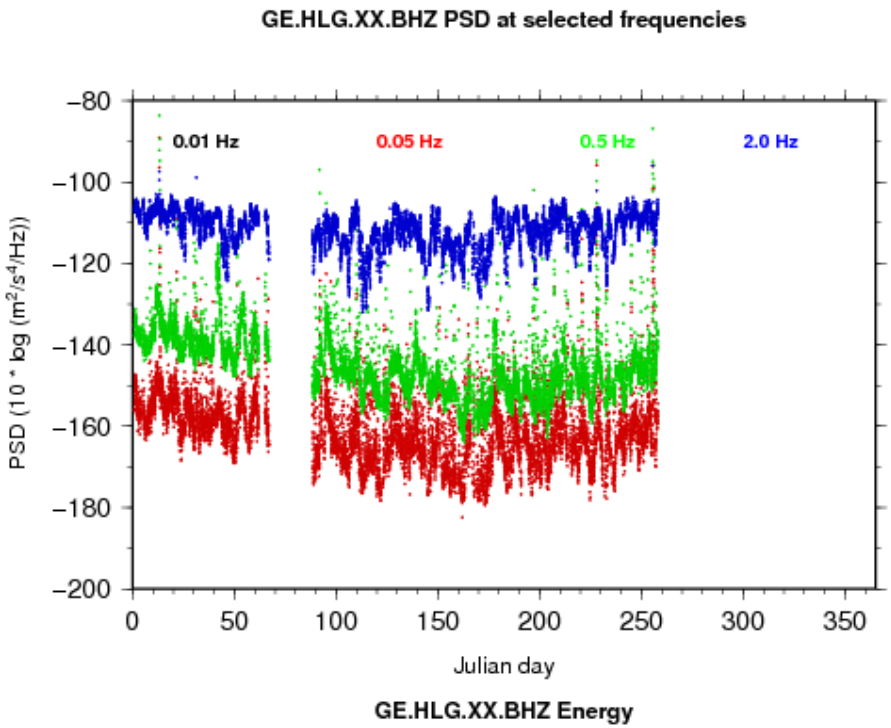
Orfeus network: examples

Near CERN

Near DESY

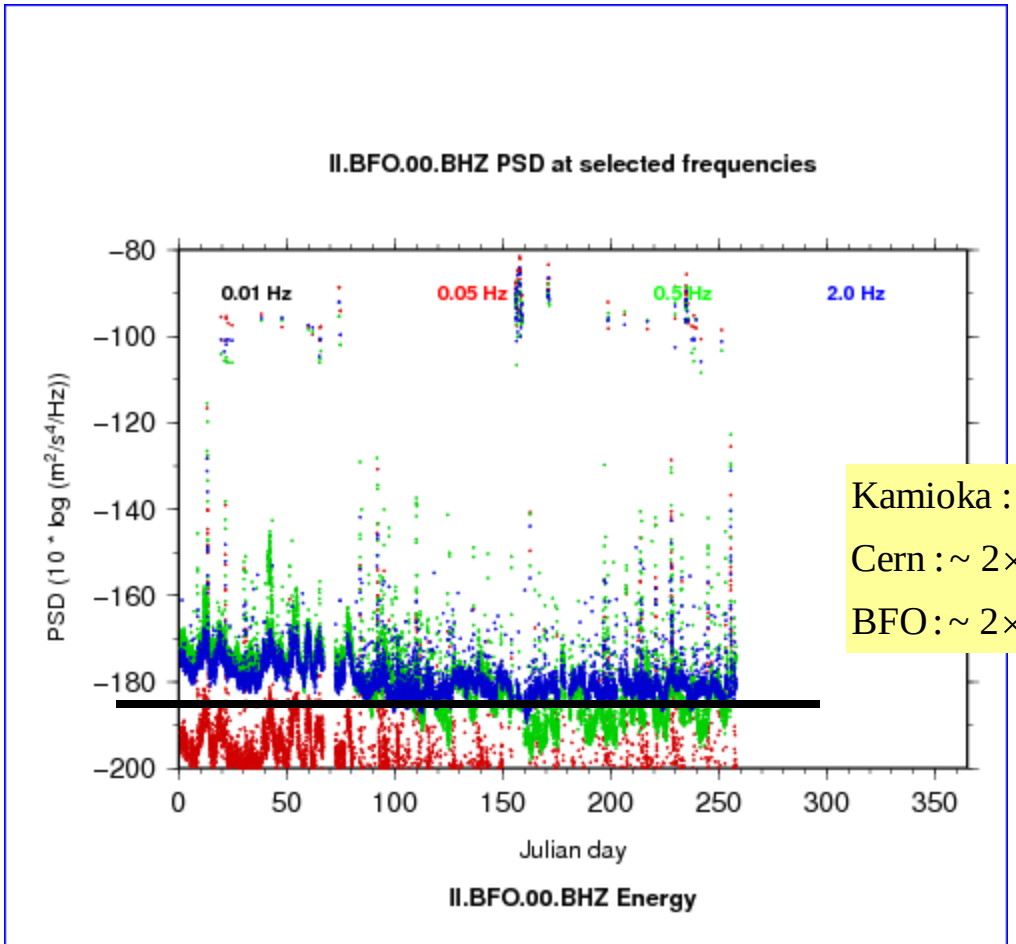
Acceleration constant yields displacement * $1/\omega^2$

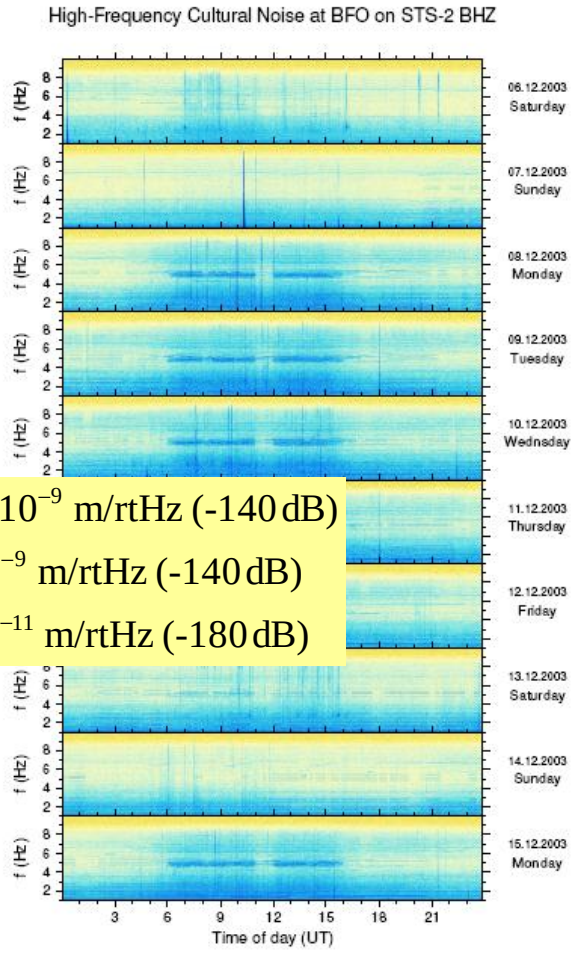




Black Forest Observatory

180 m underground
Gain about 2 orders





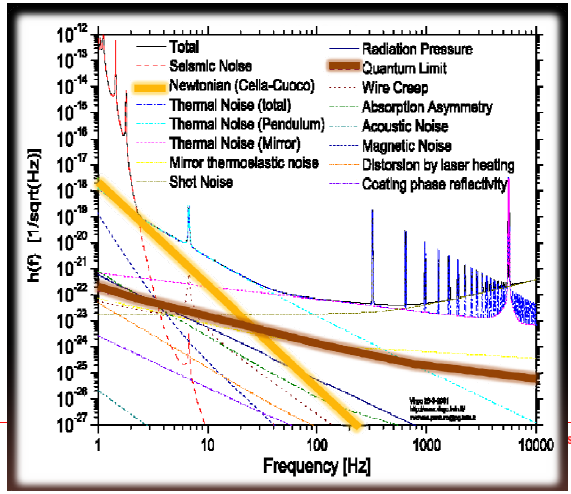
Kamioka : 2×10^{-9} m/rtHz (-140 dB)

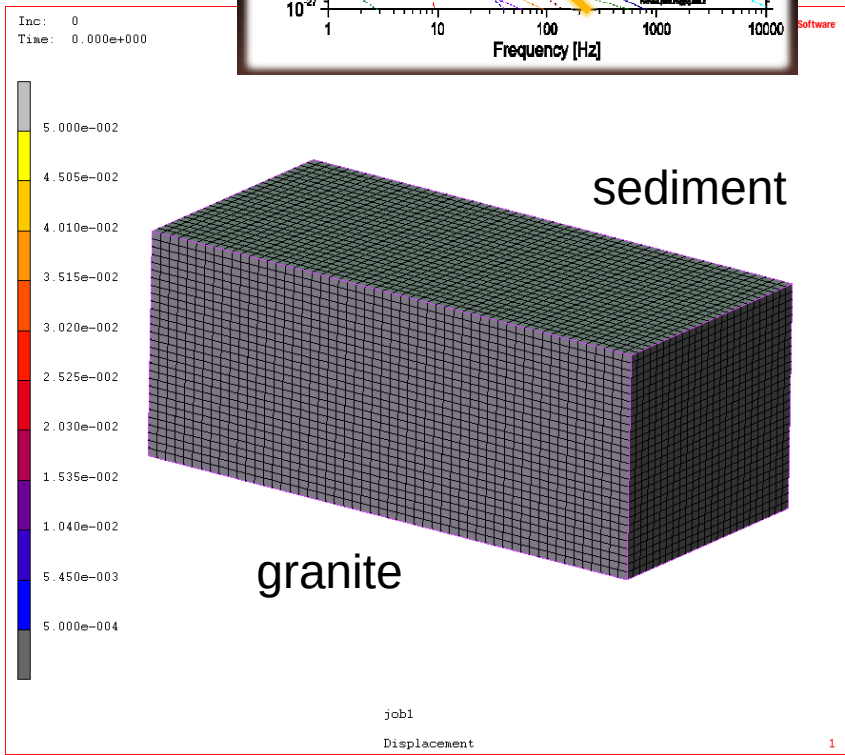
Cern : ~ 2×10^{-9} m/rtHz (-140 dB)

BFO : ~ 2×10^{-11} m/rtHz (-180 dB)

ET WP1 – Seismic studies and simulations

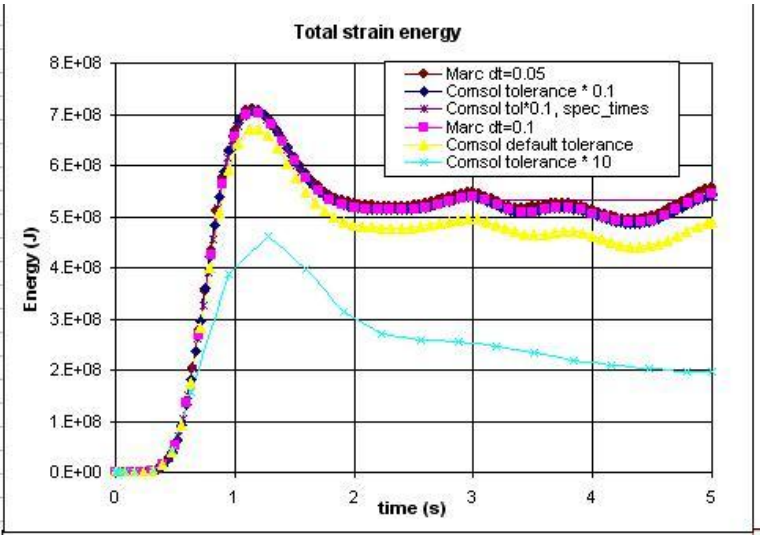
- Site issues: gravity gradient noise studies
  - Determine sensitivity at low frequency
    - Depth
    - Cavity size and shape
  - Analytical studies –Cella, Cuoco (Pisa)
    - Depth
    - Cavity size and shape
  - FEA studies – Eric Hennes, David Rabeling (Amsterdam)
    - Realistic geology
  - Subtraction procedure
    - Subtract influence of NN from data stream

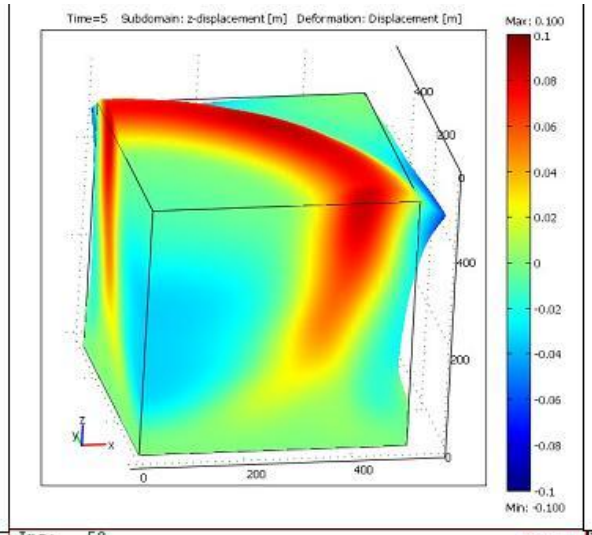


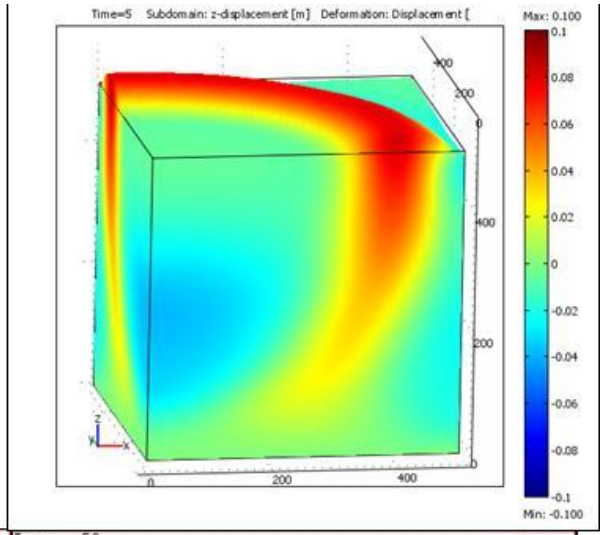


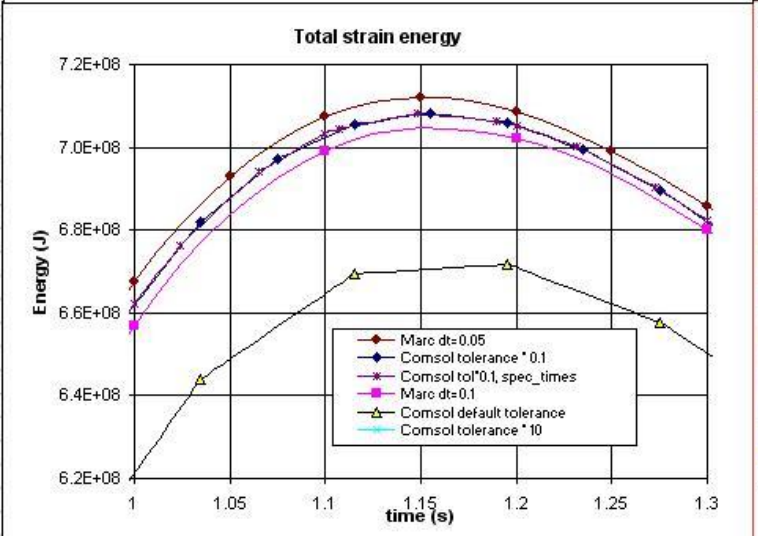
ET WP1 – FEA of seismic activity

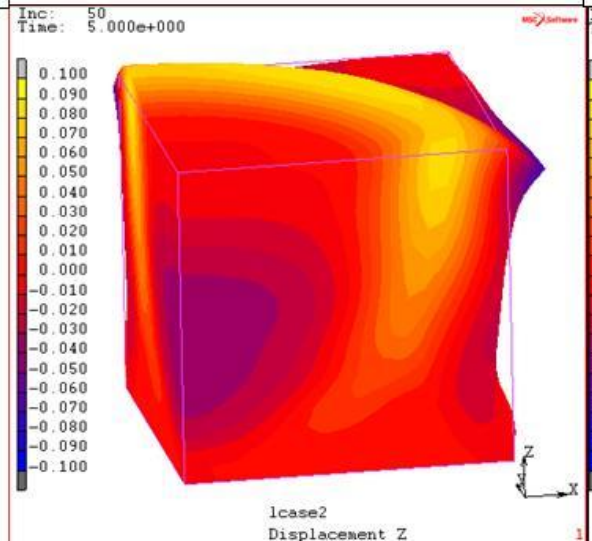
Eric Hennes (UvA) – Comparison of Comsol and MSC Marc

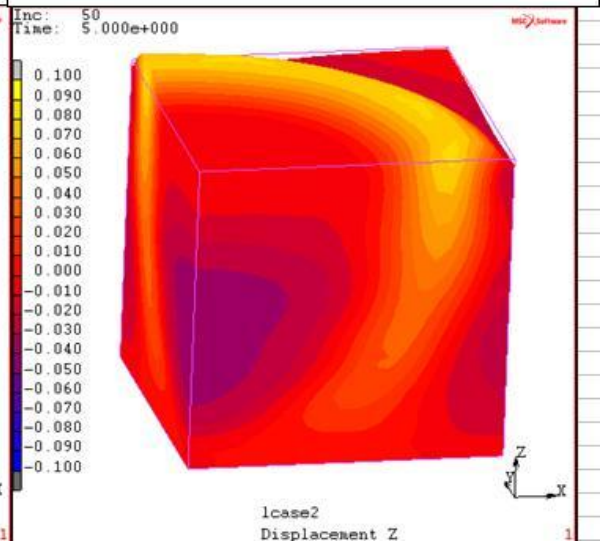




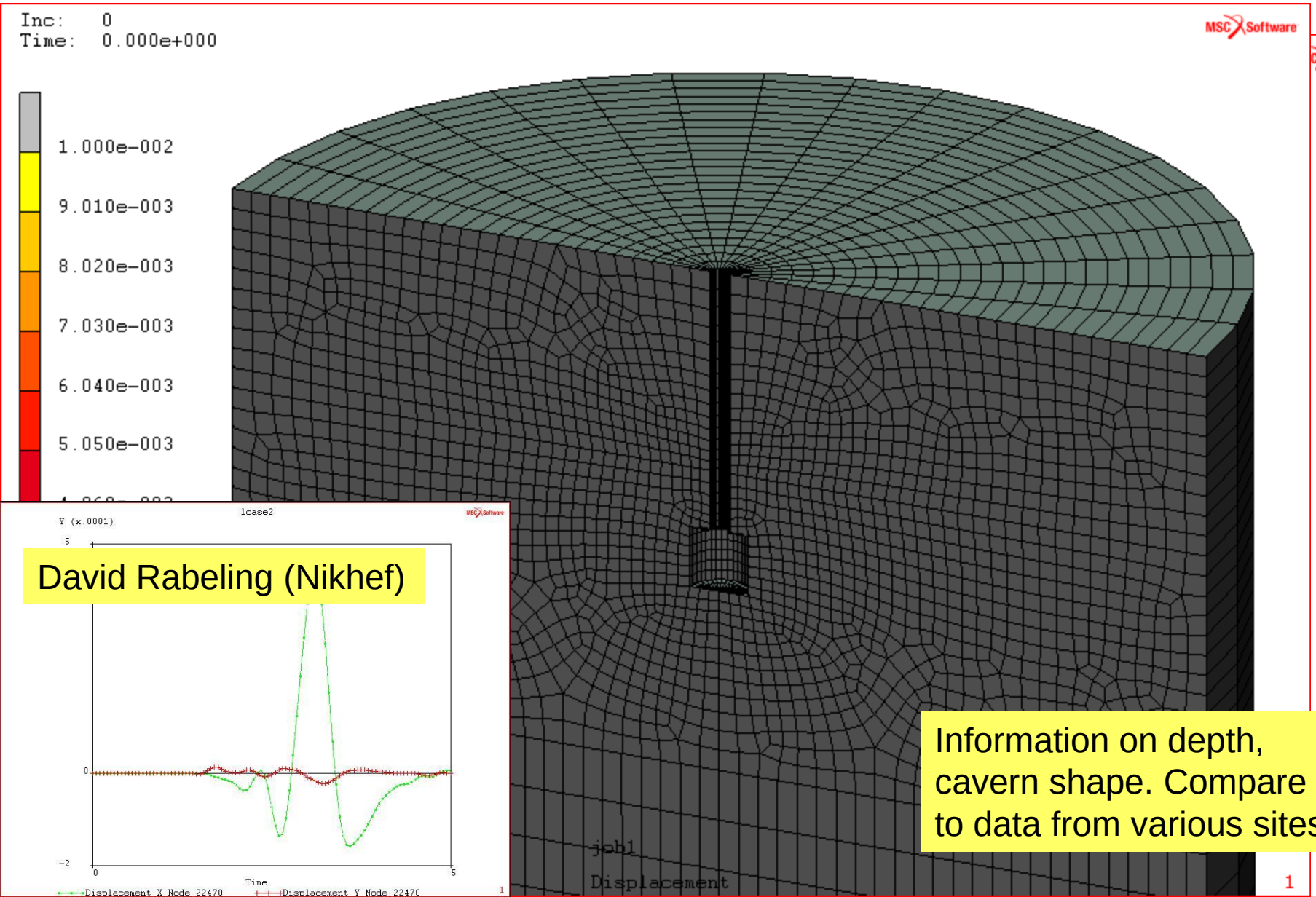








ET WP1 – FEA of seismic activity



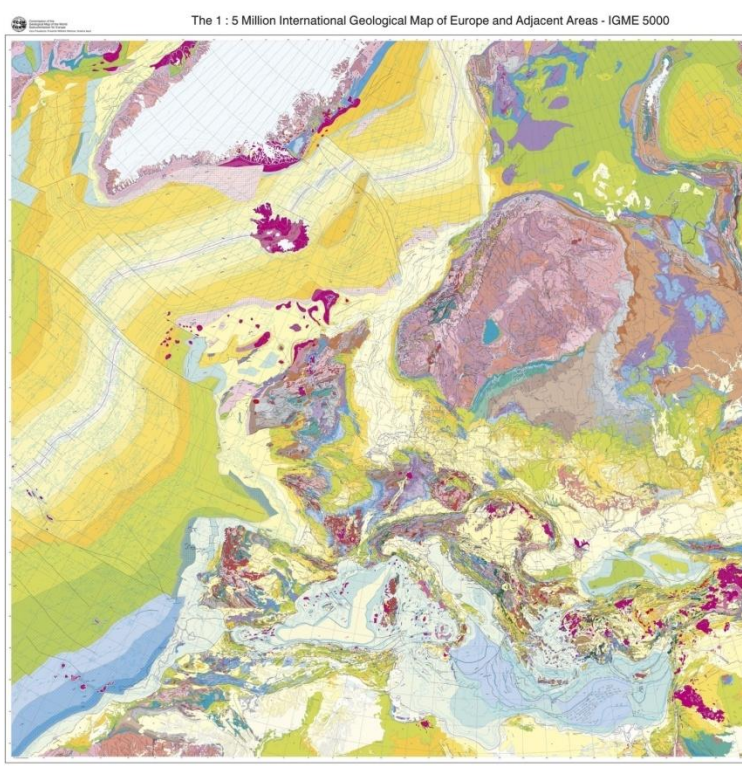
David Rabeling (Nikhef)

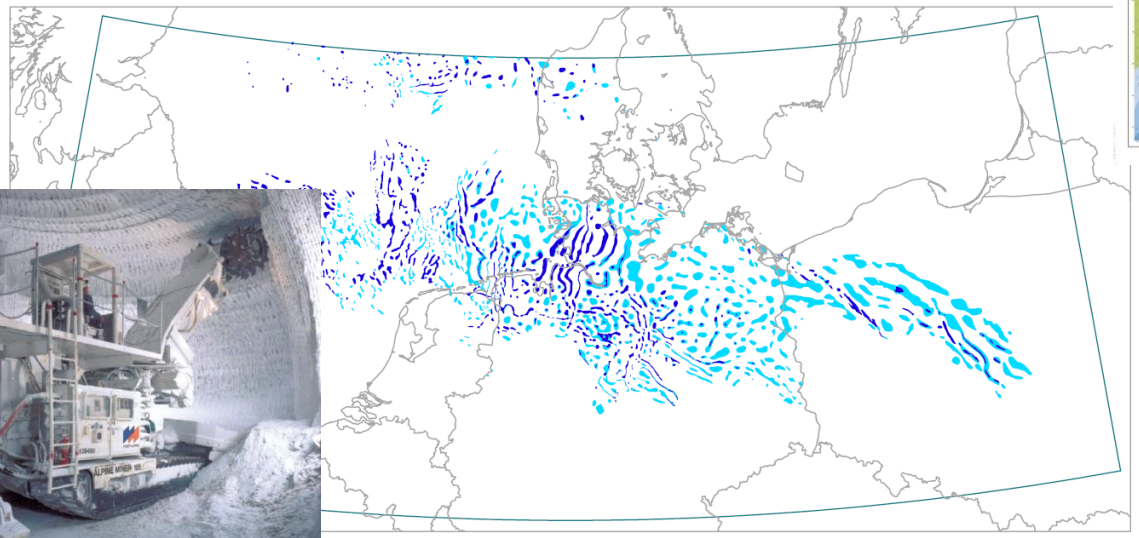
Information on depth, cavern shape. Compare to data from various sites

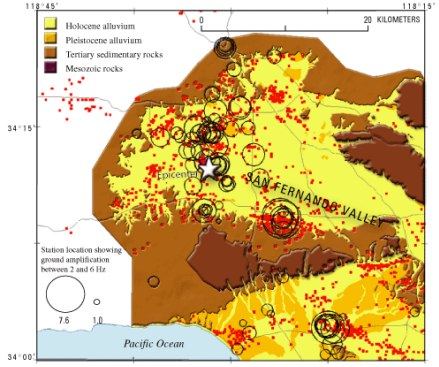
1

ET WP1 – Geological aspects

- Geology studies
  - Tunneling (cost): COB
    - Granite
    - Salt
    - Sediment
  - Seismic activity
    - NN noise
    - Amplification effects
- Expertise: Wolfango Plastino







Norway: prediction cost model

Norwegian University of Science and Technology

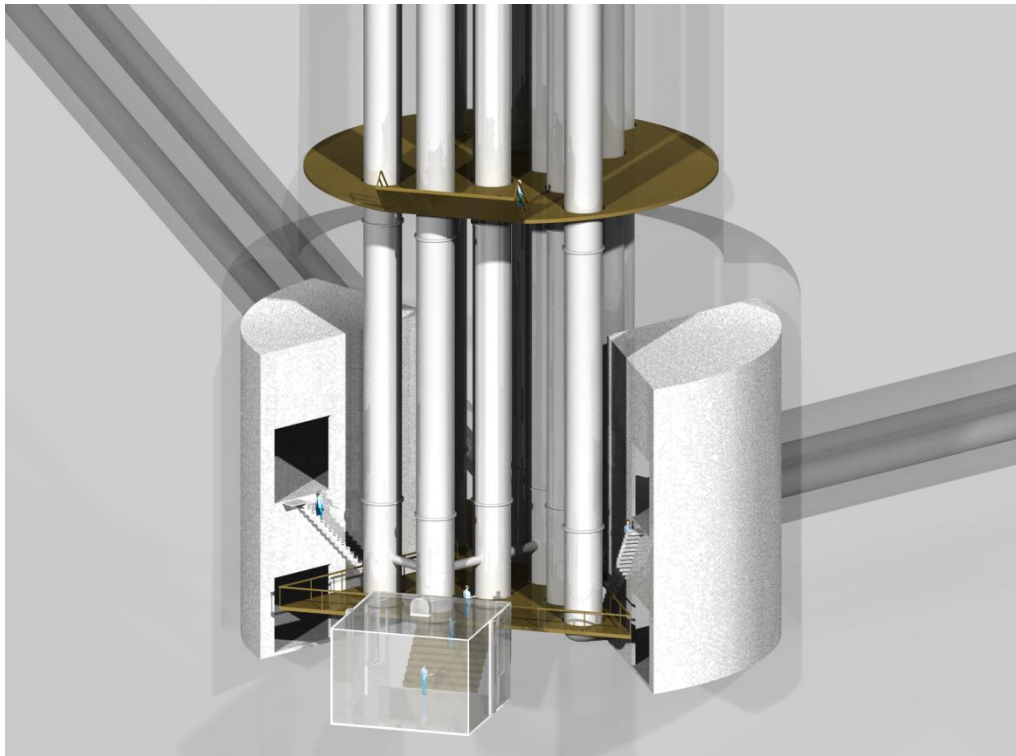
- Input parameters
  - Rock mass parameters
    - Fracture class
    - Drilling rate index
    - Abrasiveness (cutter life index)
    - Rock porosity
  - Machine parameters
    - Average cutter thrust and spacing
    - Cutter diameter, RPM, power
    - Net penetration rate (m/h)
  - Other parameters
    - Machine utilization, weekly advance rate
    - Excavation costs
- Examples
  - Holmestrand by-pass: 1.8 km, 65 m2, D&B, E 3700/m, E 57/m3
  - Hoyanger tunnel: 7.6 km, 65 m2, D&B, 70ME, E 9200/m, E 140/m3
  - Svartisen tunnel: 7.6 km, D = 6.25 m, TBM, E 4400/m, E 145/m3
  - Bergen dual tunnel: 3.5 km, D = 7.8 m, E 4600/m, E 96/m3

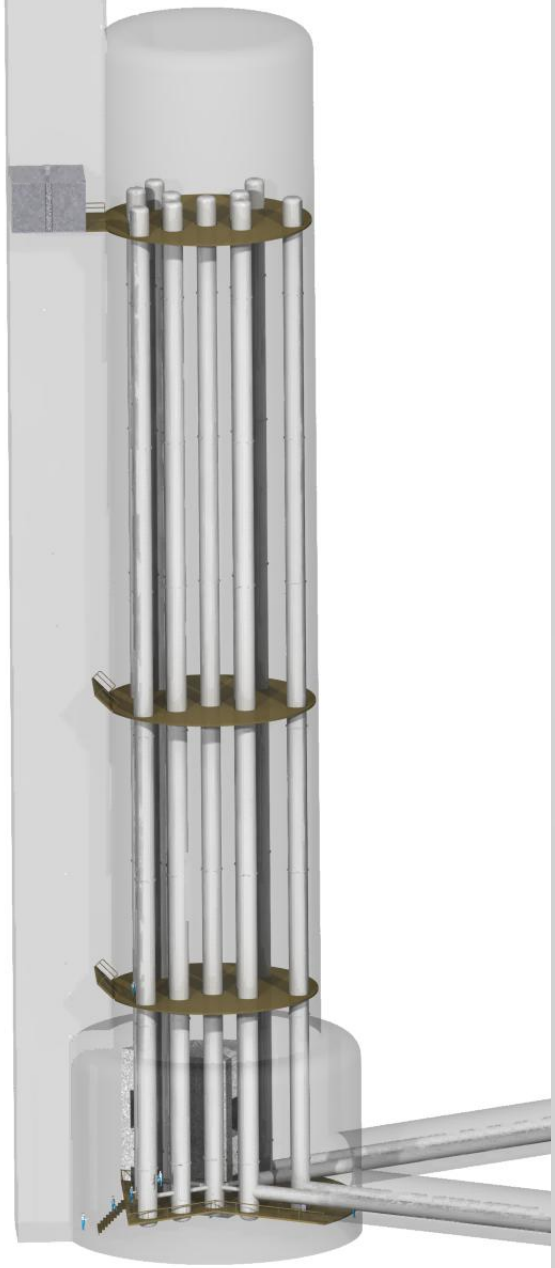
Built in 1980's
Corrected for inflation

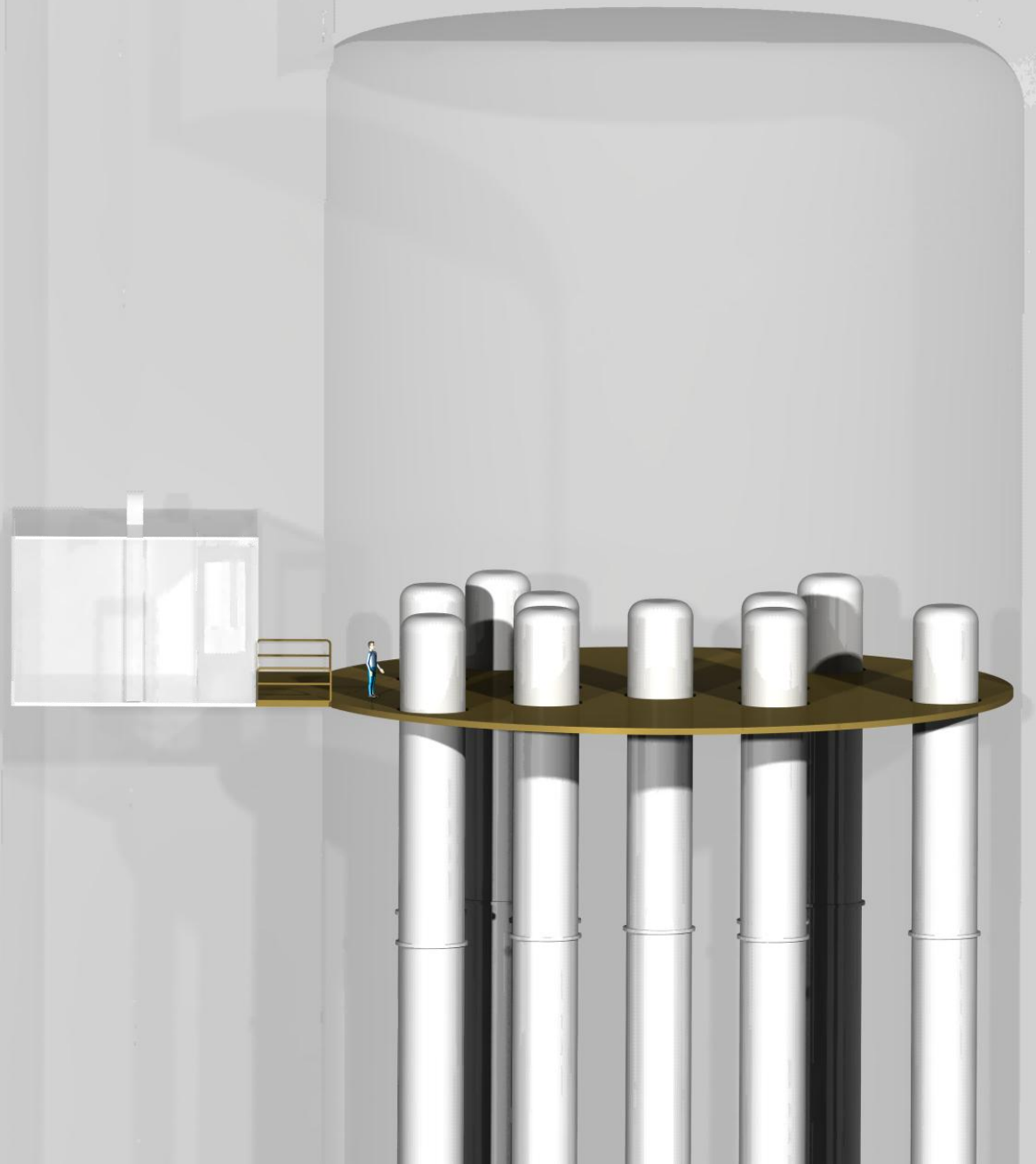
LCGT: 6 km, D&B, 35 M$

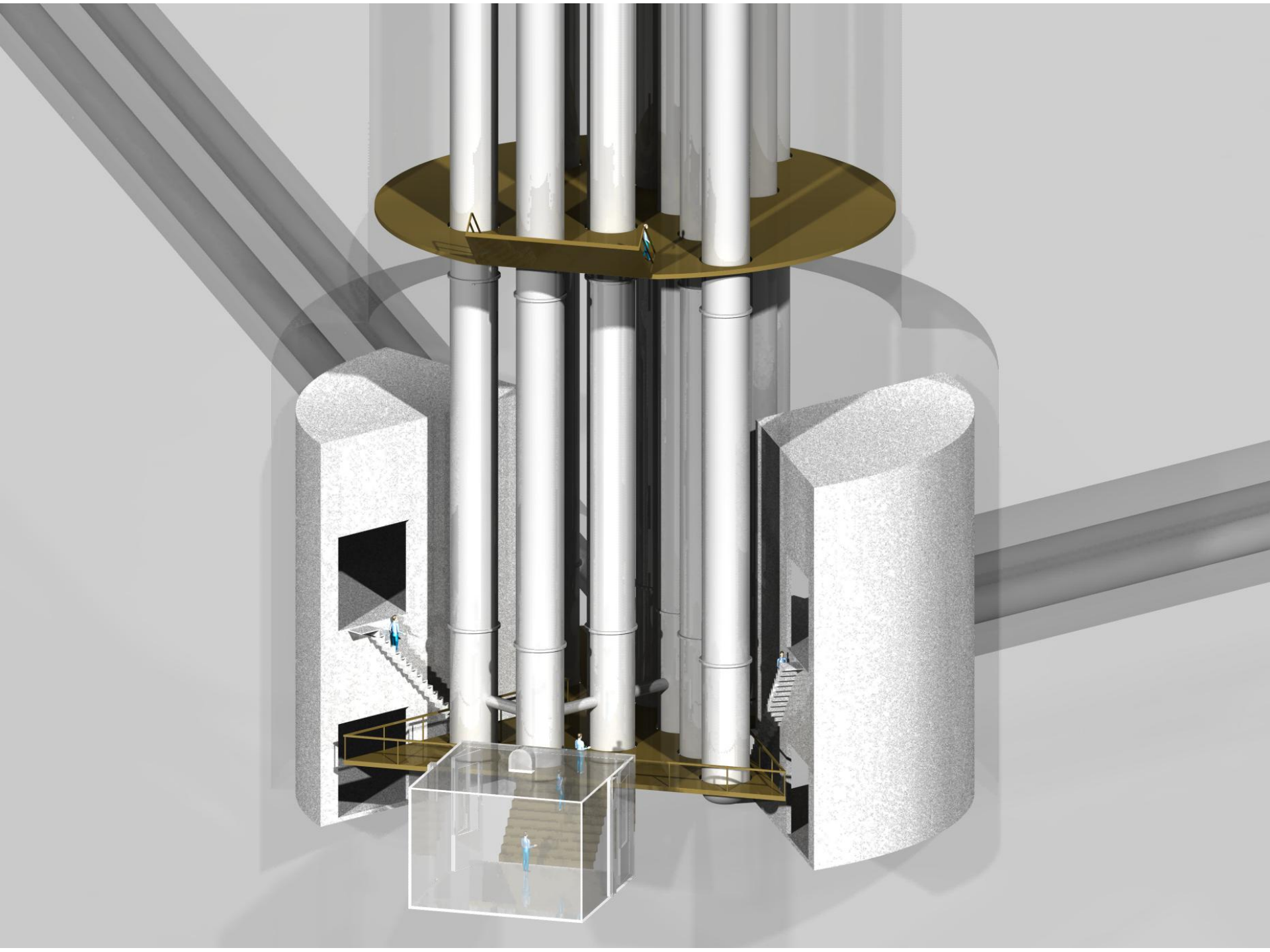
ET WP1 – Infrastructure

- Infrastructure – Martin Doets
  - Tunnels, caverns, buildings
  - Vacuum, cryogenics,safety systems
  - Computing, etc.
- Big cost items
  - Collaborate with industry
    - COB
    - Saes Getters Italy
    - Demaco Netherlands
- Input from WG2 & 3
  - Topology (Albrecht Ruediger)
  - Length of superattenuators
- Experience
  - Virgo, GEO, Gran Sasso, LIGO, etc.









Summary

- Site selection for 3rd generation ITF
  - Underground site
  - Seismic activity, gravity gradient noise
  - Numerous technical issues
- Collaborative design study
  - Interest expressed by
    - Caltech - LIGO
    - CNRS - Annecy
    - EGO
    - Florence
    - GEO600, AEI
    - Gran Sasso
    - Nikhef / VU
    - Pisa
    - Roma 1, 2, 3
  - Regular meetings
    - Next meeting at Gran Sasso (E. Coccia): Jan. 15, 2009

Contact me: jo@nikhef.nl

Other criteria

Site selection and evaluation

- Site availability and acquisition risk
  - Acquire land rights in reasonable time frame
- Scientific suitability
  - Various noise sources
- Construction suitability
  - Geological conditions (topography, hydrology)
  - Environmental considerations
  - Legal issues
  - Earthwork costs (local soil waste, labor costs)
- Operations suitability
  - Supporting technical infrastructure (local University support)
  - Nearby communities (travel time, schools, *etc*.)
  - Operation costs (power, utilities, *etc*.)
- Risks from environmental sources or future development
  - Future developments (noise sources)
  - Earthquakes, *etc*.