LAGUNA
WG5: Sites

Juha Peltoniemi

Presented in LAGUNA meeting

Zürich 12th October 2006

LAGUNA WG5: SITES

- Members:
  - Juha Peltoniemi (convener), Finland
  - Neil Spooner, UK
  - Luigi Mosca, France
  - Jan Kisiel/Agnieszka Zalewska, Poland
  - Representatives of other possible sites welcome
- Purpose:
  - Study the feasibility of very large excavations
  - Compare local conditions
  - Pre-select suitable sites
- Work closely with ILIAS-N2-WG1
  - And respective wg in ILIAS-next

Sites and experiments

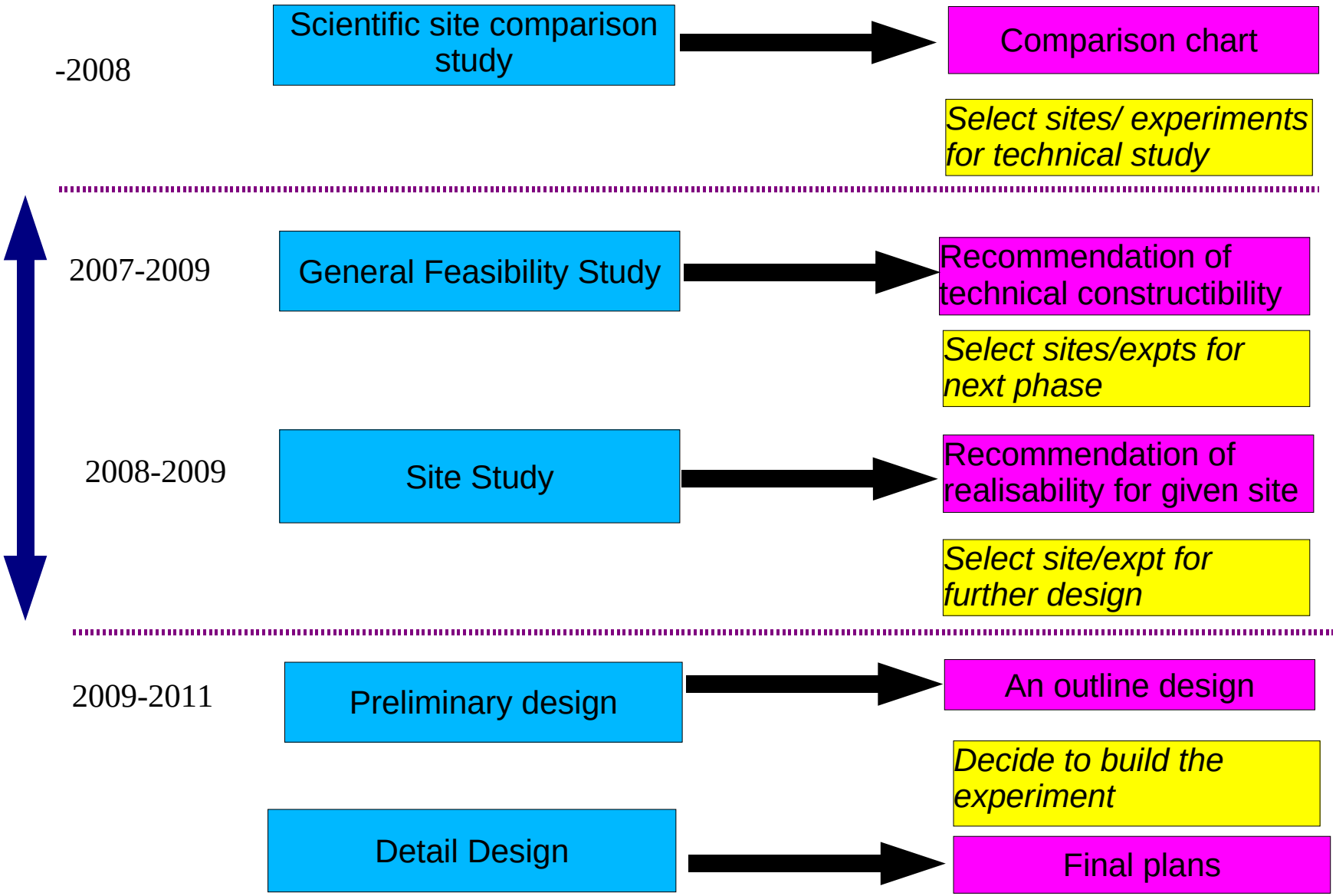
Site	Depth (m.w.e.)	Site type	Rock type	Liquid scintillator	Water Cherenkov	Liquid Argon
Pyhäsalmi	4000	Mine	Hard rock			
Frejus	4800	Tunnel	Hard rock			
Boulby	2800	Mine	Salt (hard rock?)			
Sieroszowice	2000	Mine	Salt&rock			
Gran Sasso	3000	Tunnel	Limestone (soft)	Not expressed interest to participate in this WG		
Canfranc	2000	Tunnel		Not expressed interest to participate in this WG		
Green Fields	5000	Own shaft	Hardest rock			

Pylos 4000 Deep see Out of scope for this WG

Included/interested
Probably/unknown
Excluded

Application must be written strategically as open as possible

Milestones and Work Packages:



1. Feasibility Study: General Layout

- Tasks:
  - Define the detailed requirements of the experiments
  - Investigate the possibilities to locate the experiments in the local bedrock
  - Make a preliminary prediction of the construction costs
  - Produce propaganda material
- Deliverable:
  - Recommendation of technical constructibility of the experiments in the considered sites
- Decision that needs this information:
  - Select the experiments/sites for the next phase

2. Feasibility Study: Site Study

- Tasks:
  - Investigation of the suitability of the rock of the considered site
  - Studies of the realisations of the experiments on the conditions of the sites
  - Prediction of costs
- Deliverable:
  - Recommendation of the realisability of the experiments in the chosen locations
- Consequtive decision:
  - Select the experiment/site for further design

3. Preliminary Design

- Tasks:
  - Investigation of the rockbed of the sites (sampling & analysis)
  - Process planning of experiments (interface expt-environment)
  - Architectural design
  - Rock construction planning (rock mechanics, rock removal,...)
  - Structure planning (foundations, supports, hooks, tanks, ...)
  - Planning of building technics (air, water, power, heat/cool, ...)
  - Equipment planning
- Deliverable:
  - An outline design, with an estimate of construction costs for each case
  - ”A conceptual design report”
- Consecutive decisions:
  - Select the experiment and the site to be done (first)
    - By this community
  - Fund and realise the experiment
    - By funding agencies

4. Detail Design

- Tasks:
  - As above in 3, but in full detail
- Deliverable:
  - Final construction plans
    - Call for tenders for the contract
- This phase typically done after final decisions
  - included for the construction costs
  - Not within this Design Study

Budget

- The budget prediction for the planning of the cavity:
  - Preliminary information from Finnish consults, not a bid.
  - Includes the design of the tank (like a fuel tank)

	MEMPHYS	GLACIER	LENA	TOTAL
Feasibility Study	0,50	0,35	0,25	1,10
Site Study	1,00	0,65	0,45	2,10
Preliminary Design	10,00	1,30	0,80	12,10
Detail Design	14,50	2,50	1,50	
TOTAL	26,00	4,80	3,00	

- Design of underground labs is expensive
  - Must be done very well
  - So far very large contingency
  - Well planned is half done
- Clearly cannot do parallel 3*5 studies to the end
  - Need to restrict after first and second phases to 1-3 studies
  - Total for 5 sites may not be 5 times above: Synergies achievable

Consult work

- Need to hire external consults for planning
  - Unrealistic to do it ourselves
- Consults may participate either as (if there is choice at all):
  - Partner: true costs, no profit
  - Subcontractor: European-wide call for tenders
- International coherence mandatory
  - Different consults must commit to co-operate
  - One common consult agency for all?
    - How to organise local conditions?
- To get better cost estimates, we have to define our goals and conditions very exactly.
- Previous studies:
  - Frejus pre-feasibility study for MEMPHYS: ca 100 kEUR
  - CUPP pre-feasibility study for smaller halls: ca 90 kEUR

Final remarks

- Budget request:
  - Mostly external contractors/non-scientific partners
  - May need some technical/scientific staff
  - Minor networking costs
  - Min 4 MEUR (already on the higher side)
  - Max >45 MEUR (beyond all realism)
  - Local contributions mandatory (at least 25 %)
- The proposed planning cost includes a tank:
  - As a traditional fuel tank, as it is usually integrated in rock
  - Anything beyond that is extra
  - Overlap with WG2

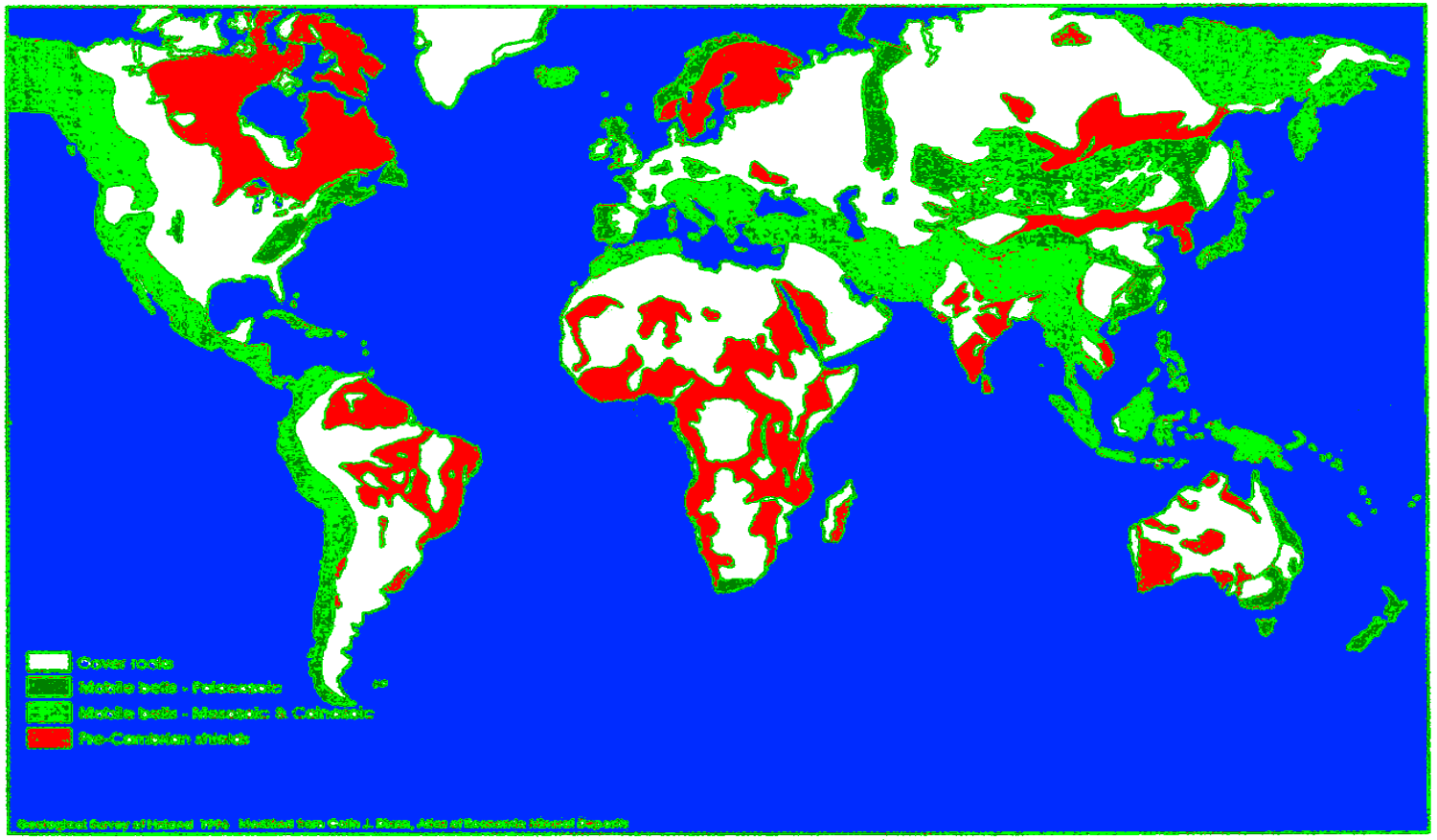
Old/reserve slides follow

Site selection issues

- Requirements to be defined
  - Background
    - Depth (muons)
    - Radioactivity
  - Size of cavities
  - Logistics
  - Services and supplies (e.g. Liquid argon)
  - Conditions in the depth
    - Temperature, humidity etc
  - (Distance to beam source)
- Properties of sites to be considered
  - Rock quality
    - Constructivity of large (and small) caverns
  - Access
  - Existing infrastructures
  - Co-operation with host infrastructure
    - Road tunnel, mine, ...

Bedrock zones in the Earth

- Red: very old bedrock, hard crystalline rock: usually very good
- Green: mobile belts (mountains etc), hard rock: fair/variable
- White: sedimentary covers (soft rock): often bad
- Local variations within each zone



Rock types

- Hard rock (e.g. Granites)
  - The hardness of the rock not a problem for excavation
  - The most stable environment
  - Possible to excavate very big caverns
  - Water tight deep (shallow parts wet)
  - U & Th contents vary, may be high
- Soft rock (sediments, limestone, sandstone etc)
  - Challenging environment
  - Water conductor
- Salt
  - Very low radioactivity (U&Th)
  - Very dry
  - Easy and fast to dig new caverns
  - Long terms stability of large caverns problematic
  - Very large stable caverns virtually impossible

Nuclear reactor background

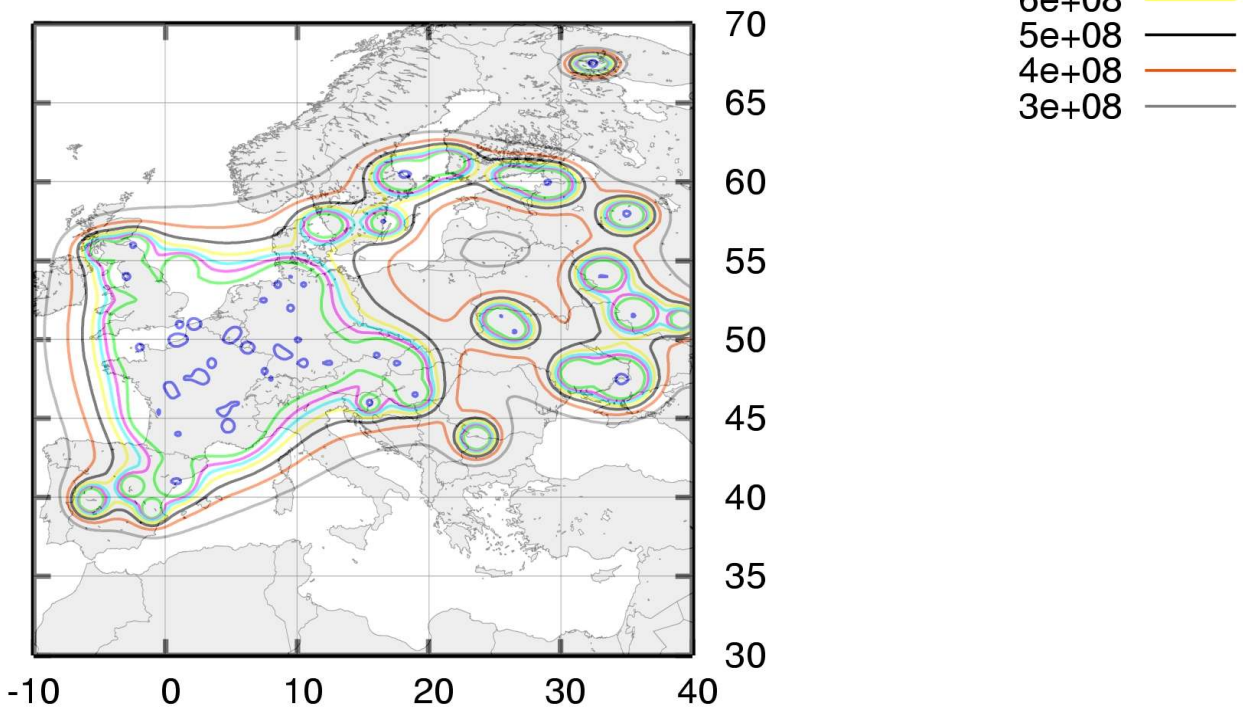
- Relevant mostly for LENA
- Reactor fluxes estimated globally
- Marine reactors irrelevant?

Location	ν (10^8 1/m^2 s)
Pyhäsalmi	40
Gran Sasso	54
Frejus	175
Canfranc	196
Boulby	190
Kamioka	408
Sudbury	100
Soudan	33
Pylos	12

2005

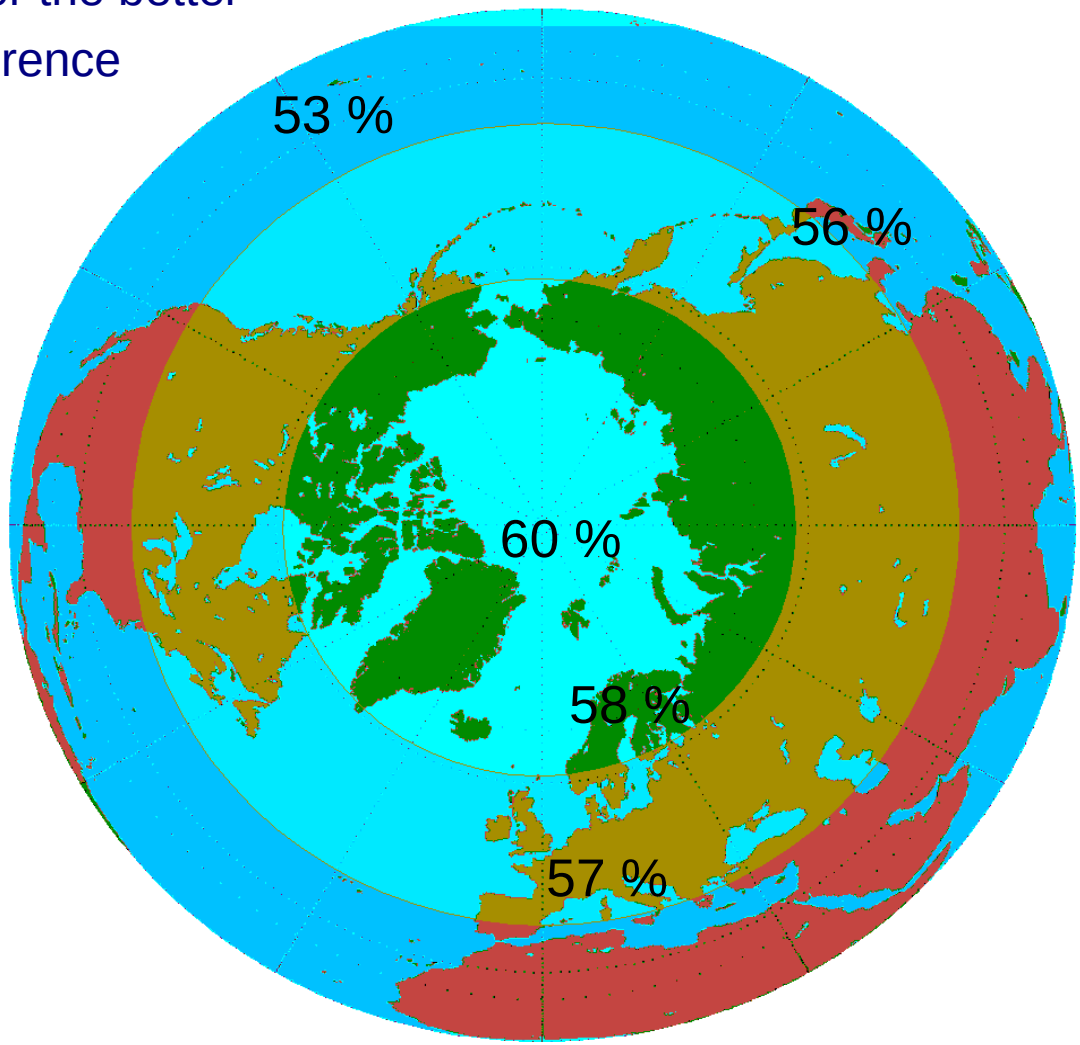
Reactor electron anti-neutrino flux density

Prediction for 2015



Galactic supernovae

- Possibility that the Earth shadows a galactic supernova
  - The norther the better
  - Small difference



Neutrino oscillation physics

- Suitable baseline may be important
  - Many detectors may reserve neutrino beams
  - Beam source (neutrino factory, betabeam, superbeam) not yet decided, and not to be decided in the near future
  - Optimal baseline still an open issue
- Not to include beam aspects to LAGUNA proposal
  - Separate projects and applications?