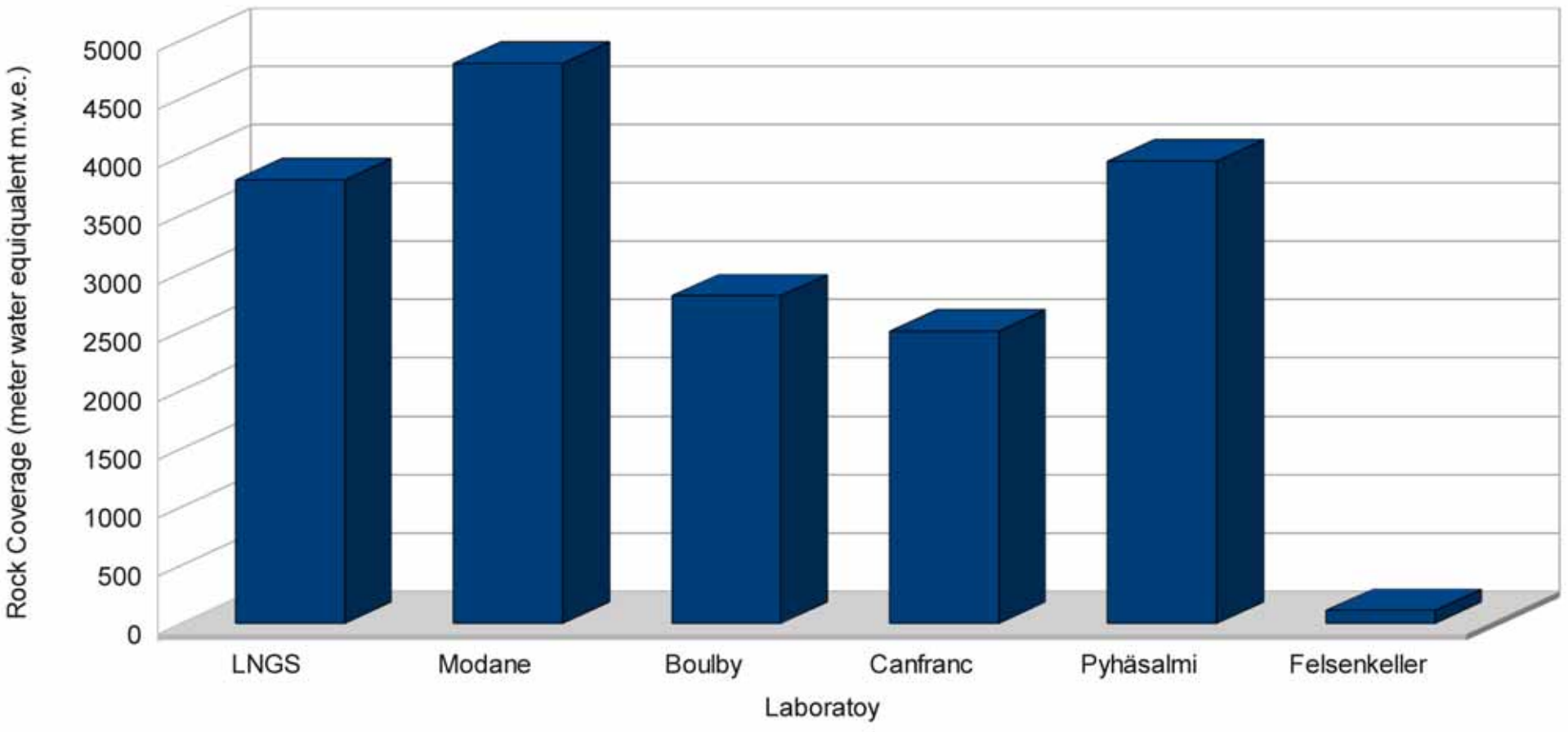
The LUNA – MV Machine at LNGS

Matthias Junker
INFN Laboratori Nazionali del Gran Sasso

The LNGS Underground Laboratory

- Rock coverage of 3800m.



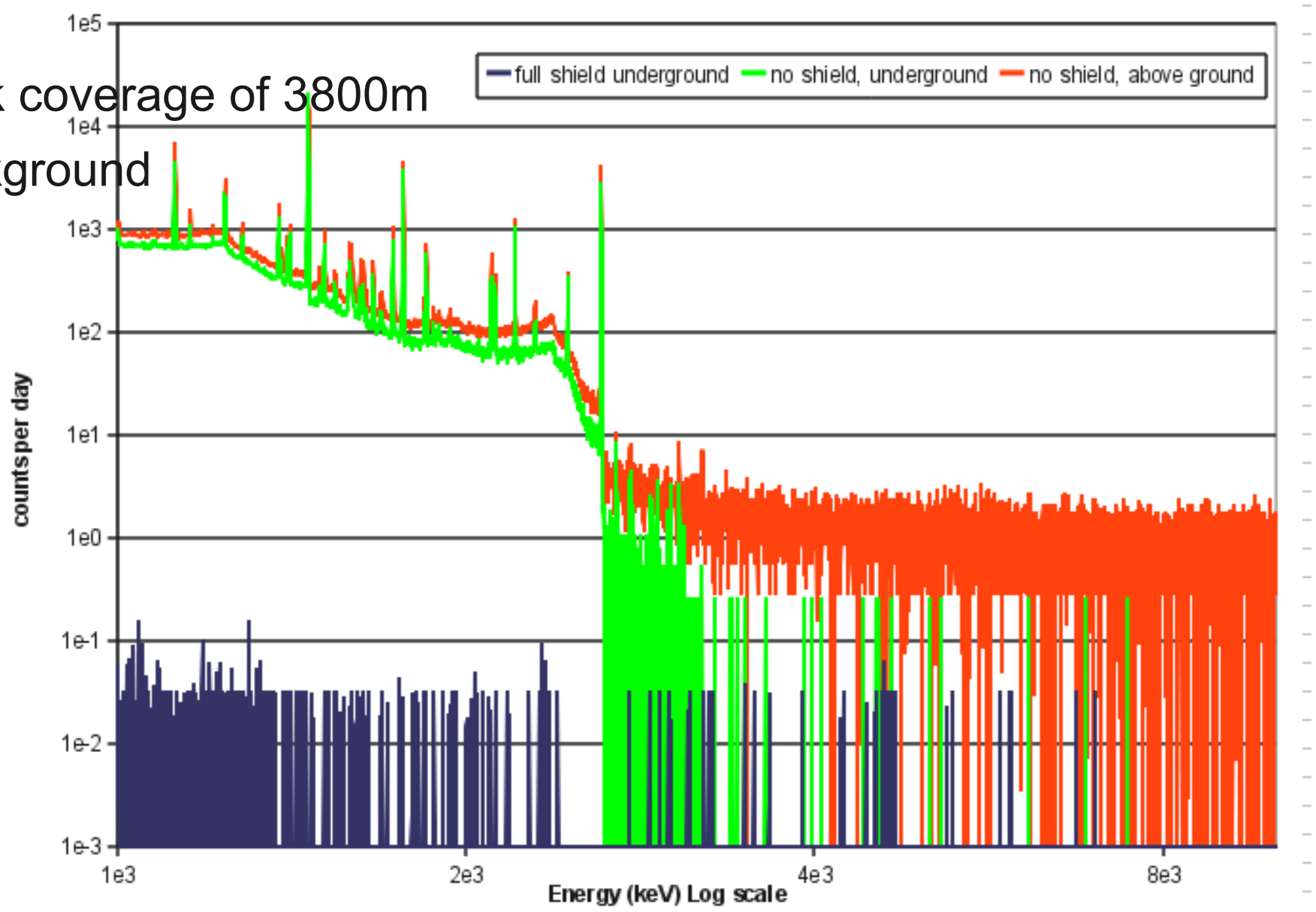
The LNGS Underground Laboratory

- Rock coverage of 3800m

Underground laboratory		Depth	Cosmic Rays	Mean specific gamma activity			Neutrons		Radon
		m.w.e.	Muon flux [cm^{-2} s^{-1}]	^{40}K [Bq/kg]	^{238}U [Bq/kg]	^{232}Th [Bq/kg]	Neutron energy	Neutron flux 10^{-6}[cm^{-2} s^{-1}]	[Bq/m3]
LNGS	Hall A Rock	3800	2.87E-008	224.0	84.7	8.8	(0 ÷ $1*10^{-7}$) eV	1.08	26
							($50*10^{-3}$ ÷ $1*10^{3}$) eV	1.98	
							1 keV< E_{neut} < 2.5 MeV	0.54	
							E_{neut} > 2.5 MeV	0.23	
	Hall B Rock			5.1	5.2	0.25			21
	Hall C Rock			2.9	8.2	0.27	1 < Eneut< 10 MeV	0.42	87
Modane		4800	4.86E-009	210.0	10.4	9.95			
Boulby		2805	3.79E-008	34.9	0.83	0.52	Eneut> 0.5 MeV	1.72	
Canfranc		2500	3.94E-007	169.0	41.4	34.4			66.2
Pyhäsalmi		3960	1.10E-008						
Felsenkeller		112							

The LNGS Underground Laboratory

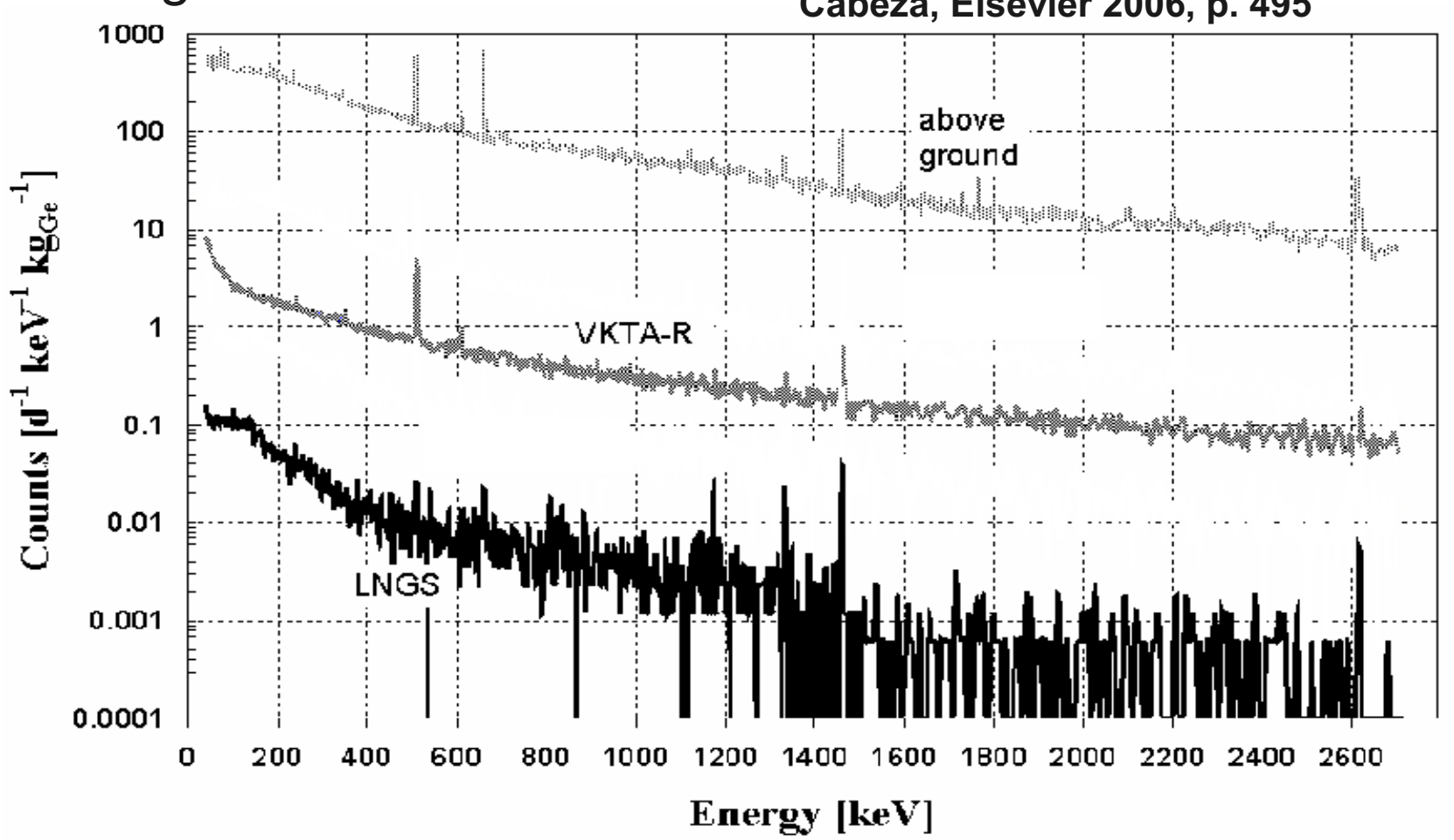
- Rock coverage of 3800m
- Background



The LNGS Underground Laboratory

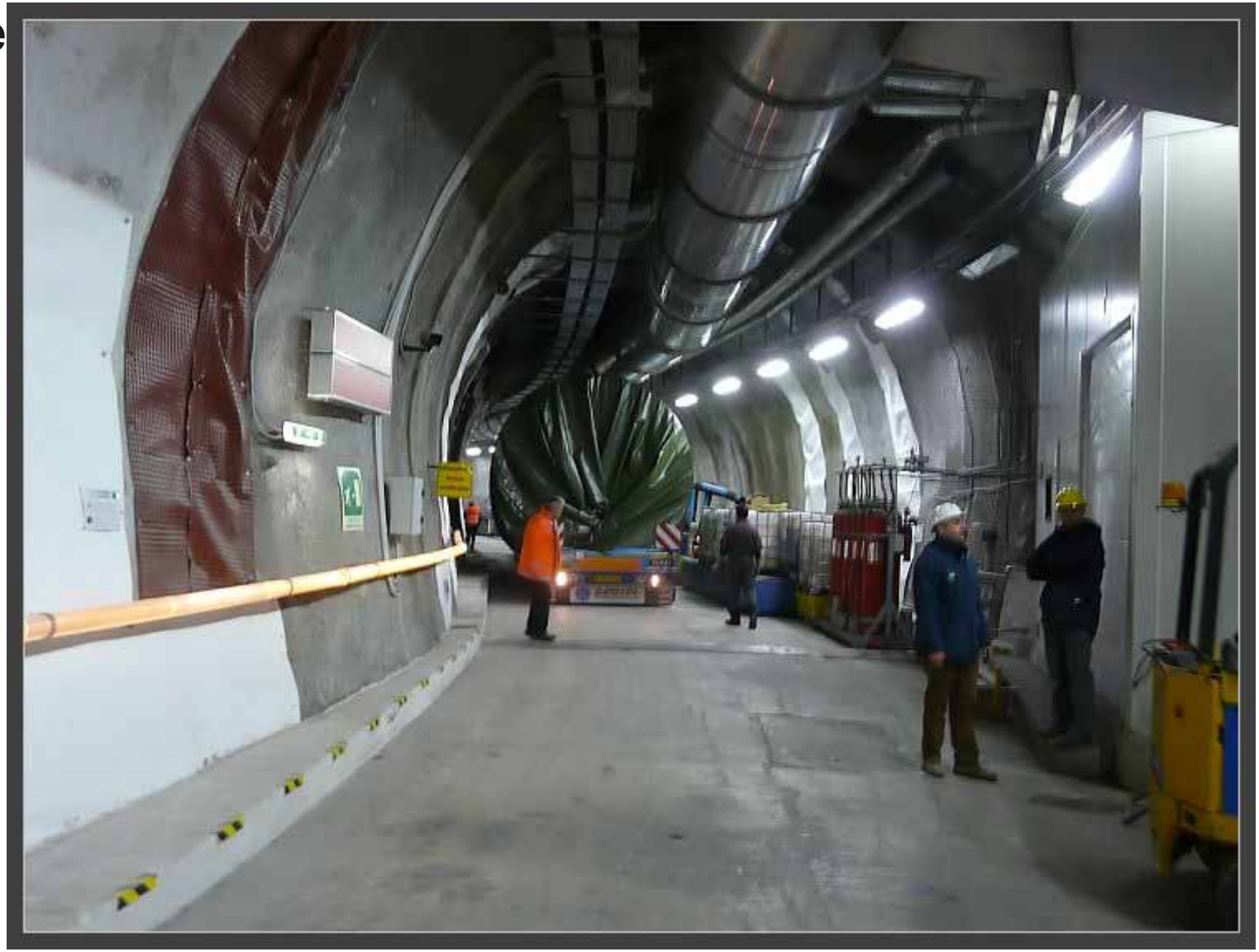
- Rock coverage of 3800m
- Background

Heusser, Laubenstein, Neder
In: Radionuclides in the Environment,
P.P. Povinec and J.A. Sanchez-Cabeza, Elsevier 2006, p. 495



The LNGS Underground Laboratory

- Rock coverage
- Background
- Accessibility



The LNGS Underground Laboratory

- Rock coverage
- Background
- Accessibility

The LNGS Underground Laboratory

- Rock coverage
- Background
- Accessibility

The LNGS Underground Laboratory

- Rock coverage
- Background
- Accessibility

The LNGS Underground Laboratory

- Rock coverage
- Background
- Accessibility

The LNGS Underground Laboratory

- Rock coverage
- Background
- Accessibility

The LNGS Underground Laboratory

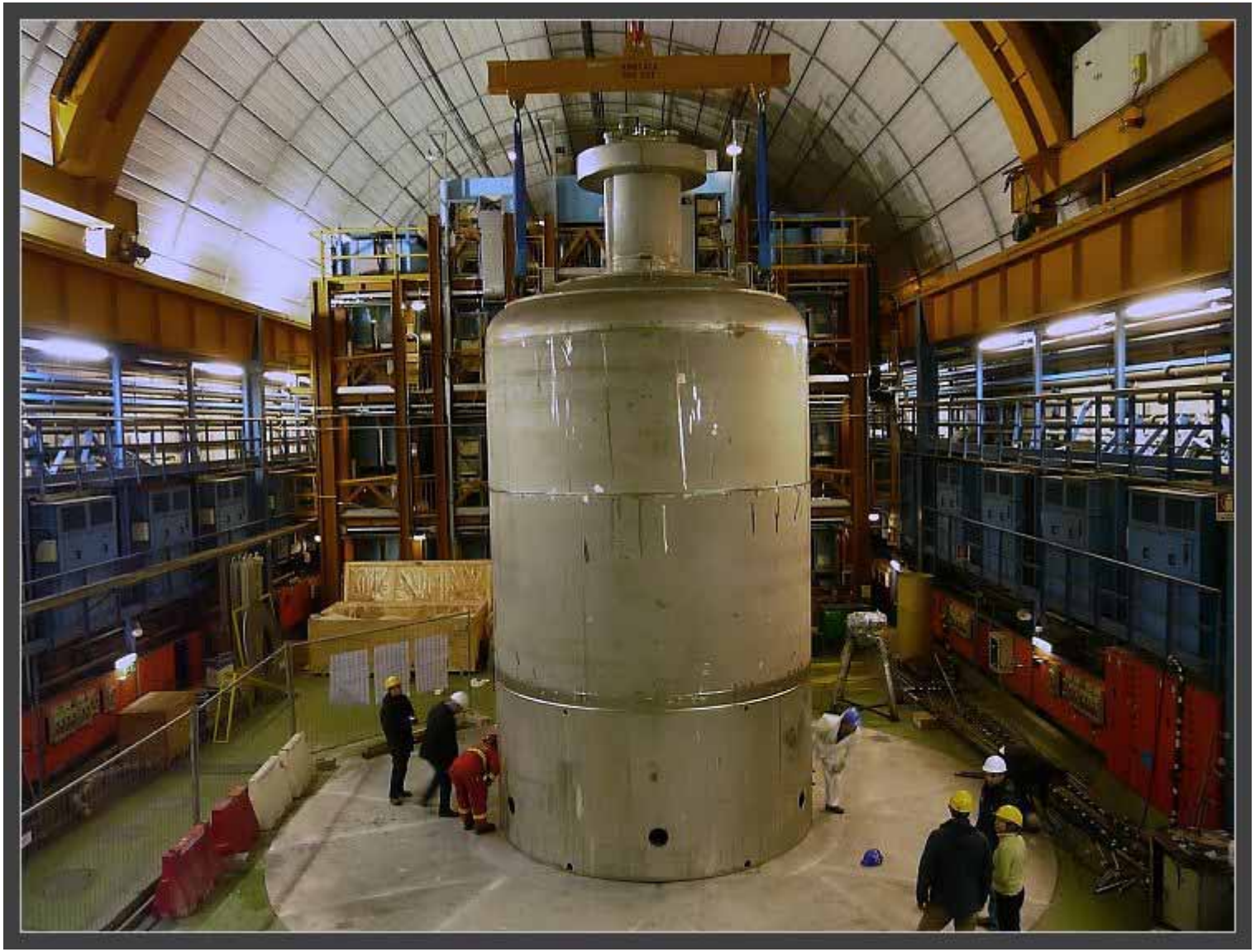
- Rock coverage
- Background
- Accessibility

The LNGS Underground Laboratory

- Rock coverage
- Background
- Accessibility

The LNGS Underground Laboratory

- Rock coverage
- Background
- Accessibility

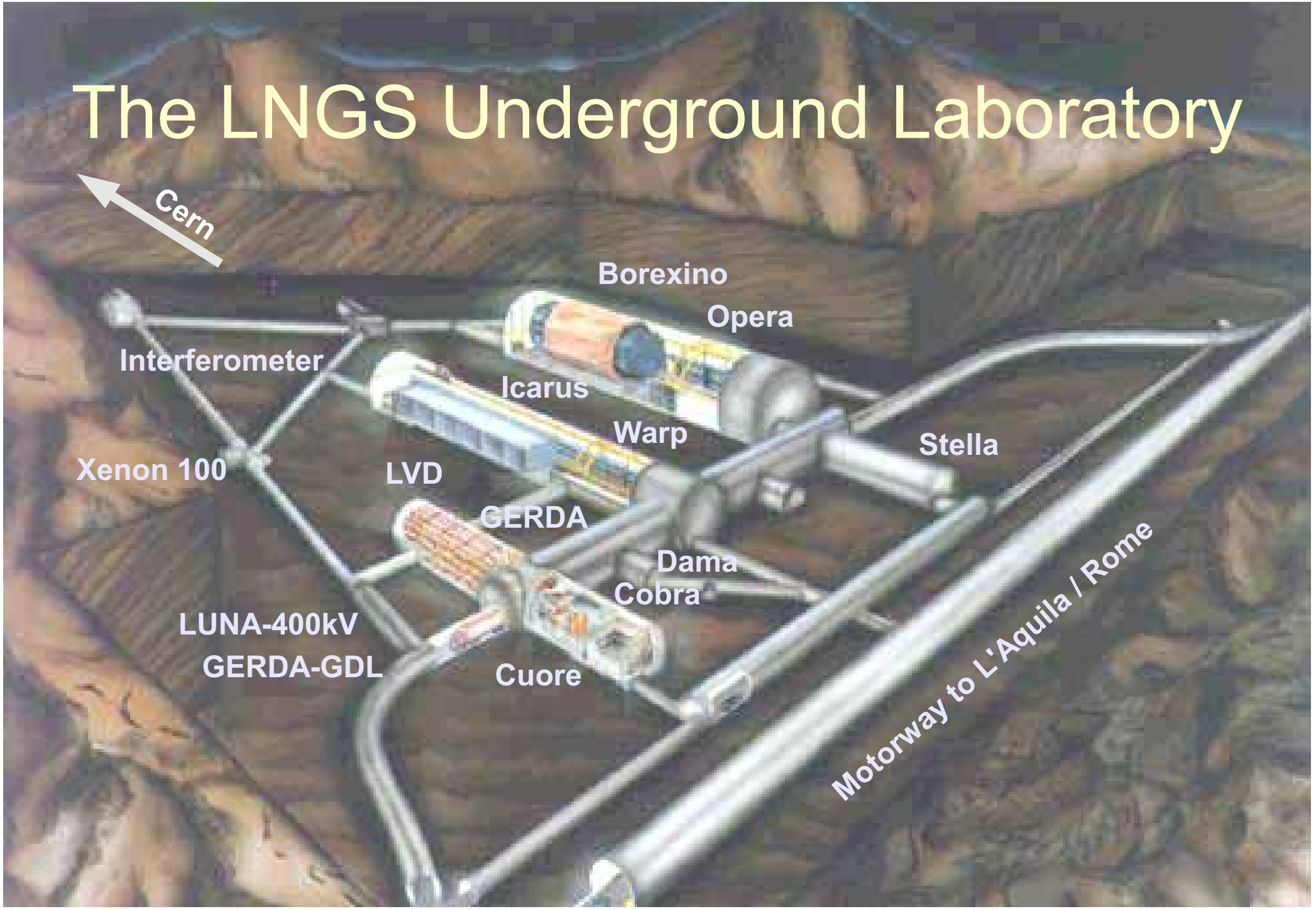


The LNGS Underground Laboratory

- Rock coverage of 3800m
- Background
- Accessibility
- Scientific Infrastructure e.g.:
  - Stella (SubTErranean Low Level Assay)
  - ICPMS applied to Low Level Counting Science
  - Clean room environments for material cleaning and decontamination
  - Chem lab for development of new approaches e.g. in target production
- Scientific Community: sharing of experience with low background experiments
- Mechanical and electronic workshops, experienced engineering
- Almost 20 years experience with accelerators underground

The LNGS Underground Laboratory

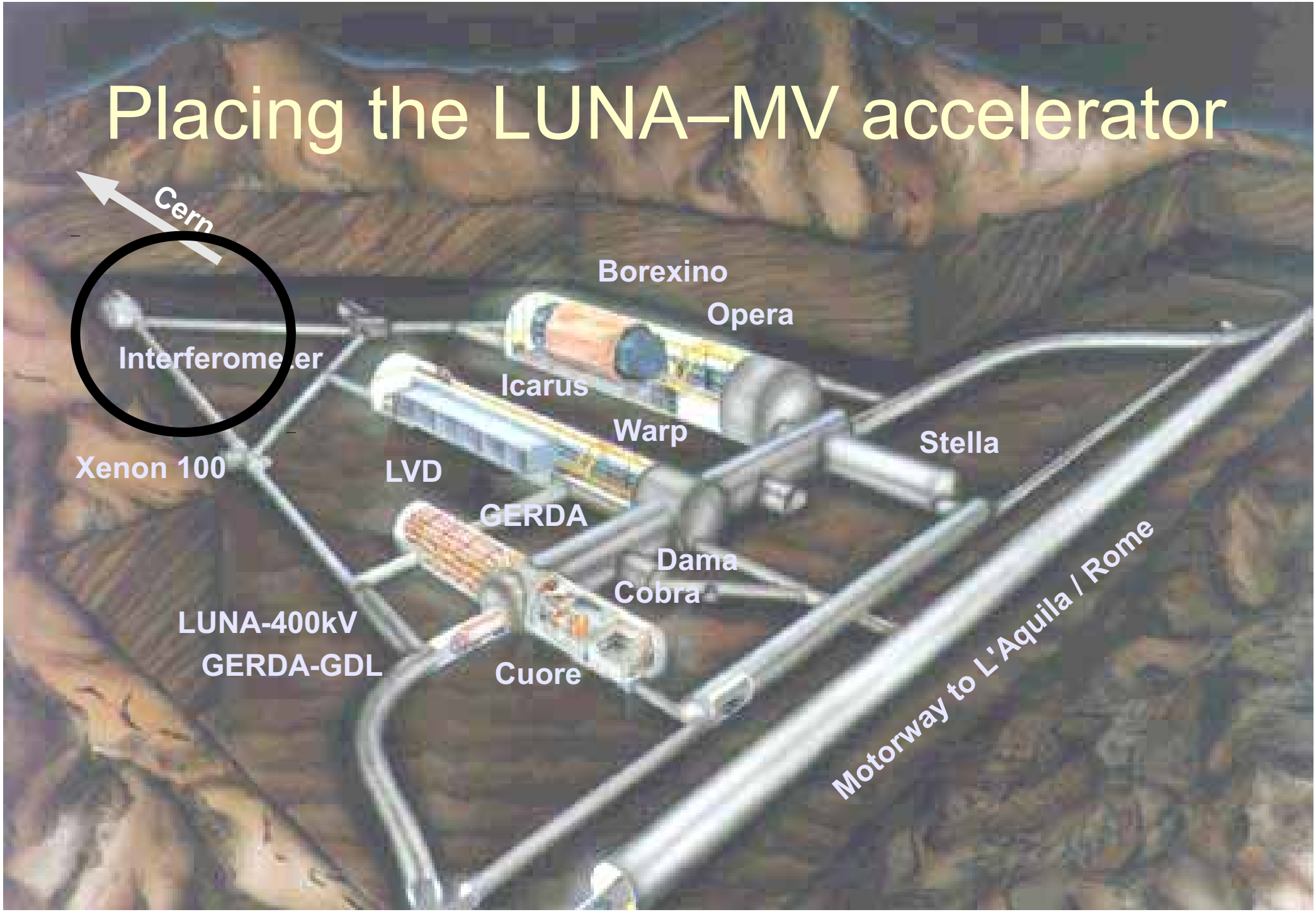
- 3 Experimental Halls of app. 100m x 16m x 16m
  - Equipped with
    - Ventilation
    - Crane
    - Electricity
    - Cooling water
    - Compressed air
    - Networking
    - Safety plants
- Kilometers of connection tunnels partially used for
  - Experiments
  - Technical infrastructure
    - transformer stations,
    - water cooling system
    - Safety Plants
    - Safe Rooms
    - LN_2/LAr Storage


The LNGS Underground Laboratory
Cern
Borexino
Opera
Interferometer
Icarus
Warp
Stella
Xenon 100
LVD
GERDA
Dama
Cobra
LUNA-400kV
GERDA-GDL
Cuore
Motorway to L'Aquila / Rome

The LNGS Underground Laboratory

- Place and Infrastructure considerations
  - Choose system which fits in...
  - Consider the available infrastructures of the Lab to speed..
- Competition among scientific initiative
  - Present full scientific program proposing the technical approach (accelerator, target, detector) to carry it out
  - Technological approach which is functional to the proposed program
- Presence of Low Level Counting experiments
  - Cuore/Gerda – Neutrinoless double beta decay
  - DAMA/CREEST/XENON – Dark Matter
  - Requirement to maintain background conditions stable and unchanged.
    - Proper choice of site
    - Proper neutron shielding
- Underground location has proven not to be a favorable place for R&D
  - use of conservative technology which is commercially available

Placing the LUNA–MV accelerator



The proposed accelerator

- Electrostatic, single ended with RF source for H and He^+ beam
  - robust, commercially available, certain time line, certain cost!
- 2 beam lines accessible independently
  - One for solid state target station (which can be biased);
  - One for gas target station;
- Side wide slow control system for full remote control of the experiment and automatic shifter alert in case of anomaly.

LUNA–MV hypothesis