ASPERA
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R&D and computing challenges for Underground science

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Outline

- Fundamental problems and Underground science
- Crucial R&D areas in Underground science
- ILIAS-next
- Conclusions


Underground
Research
Infrastructure:
Underground Laboratory

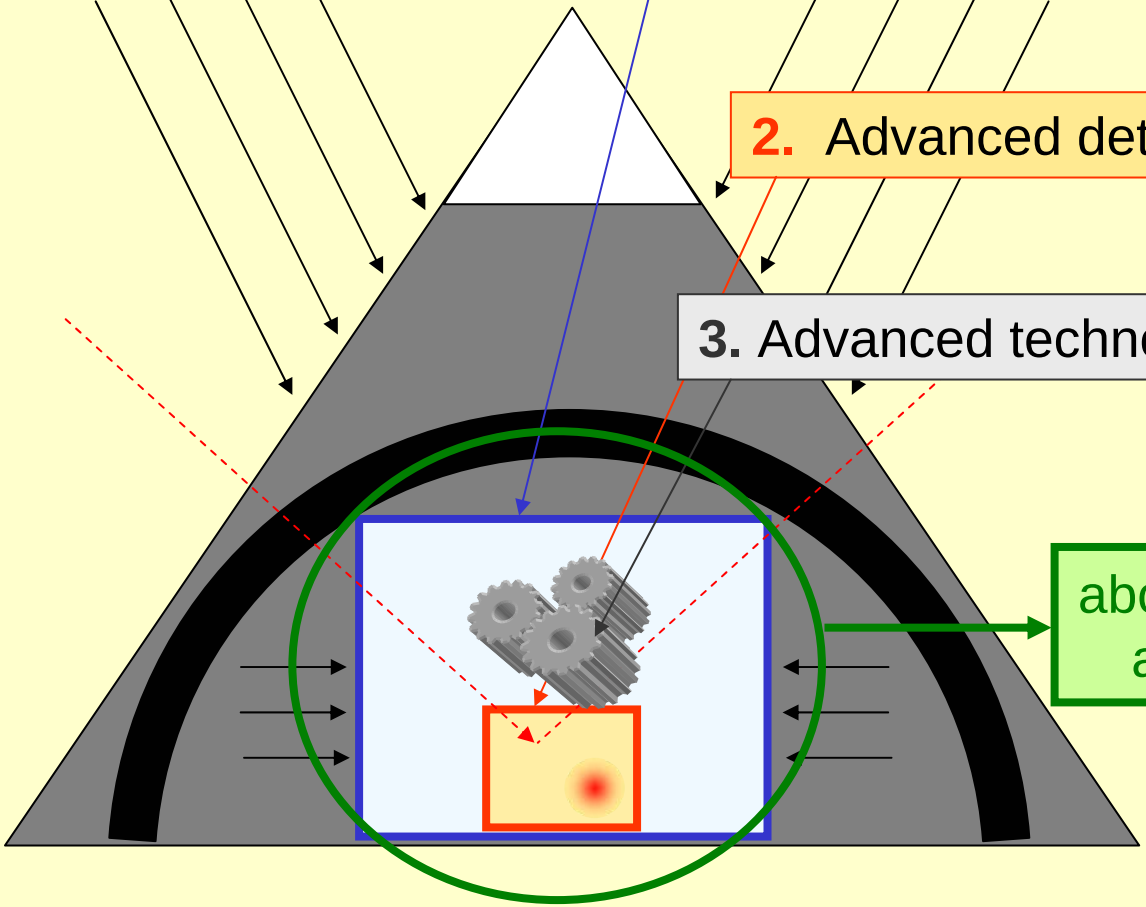

+ other interesting emerging sites (Poland, Romania,...)
and several semi-deep sites
Pyhalsami
Boulby
Modane (Fréjus)
Gran Sasso
Canfranc

Main R&D areas for Underground Science

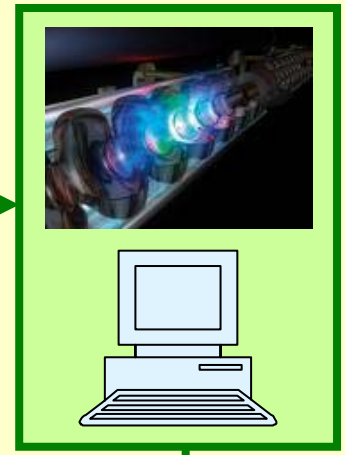
1. Low background environment realized underground

2. Advanced detectors operated underground

3. Advanced technologies for detector operation



aboveground activities

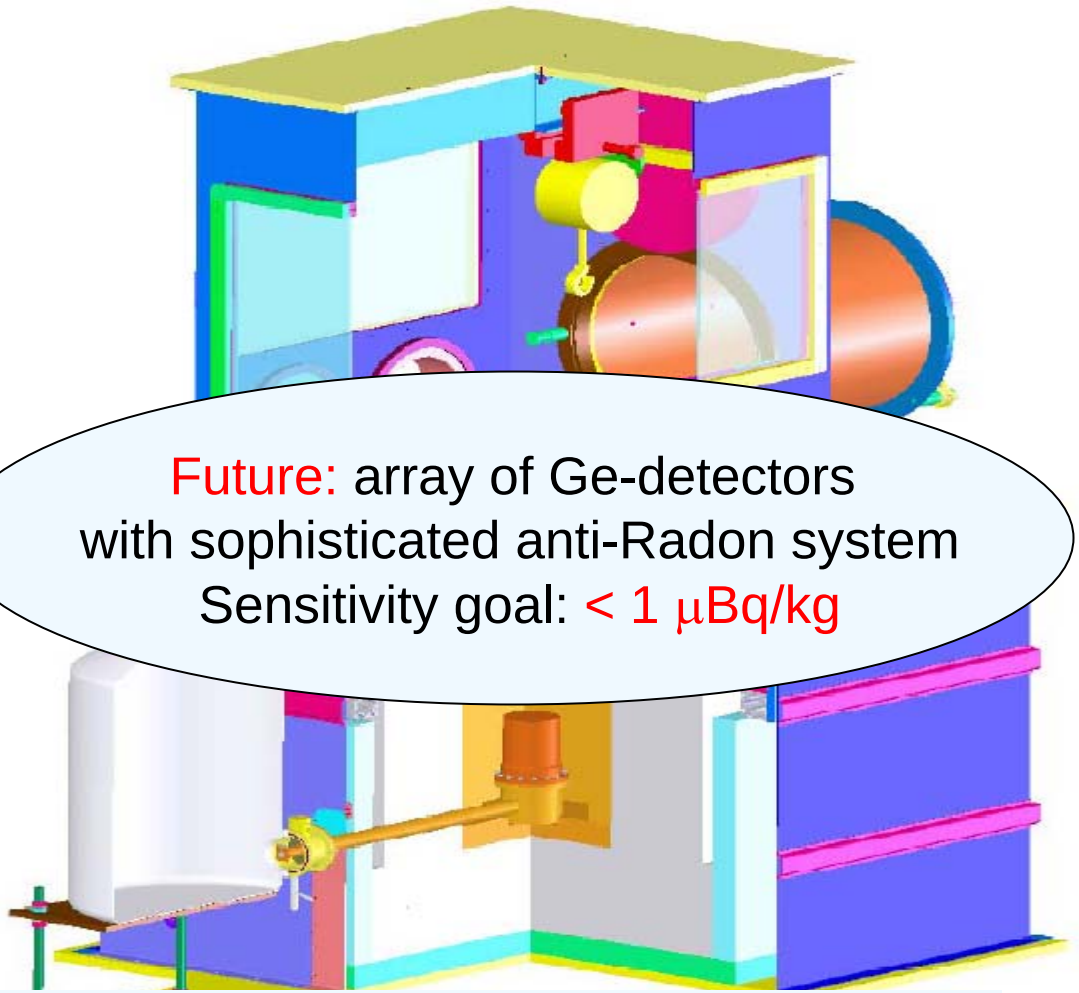


4. Special experiments supporting Underground research

5. Computer simulation for background and detector response

Low background environment in an Underground context

Challenges:



Future: array of Ge-detectors
with sophisticated anti-Radon system
Sensitivity goal: < 1 μBq/kg

Novel anti-Radon insertion system (GeMPI)

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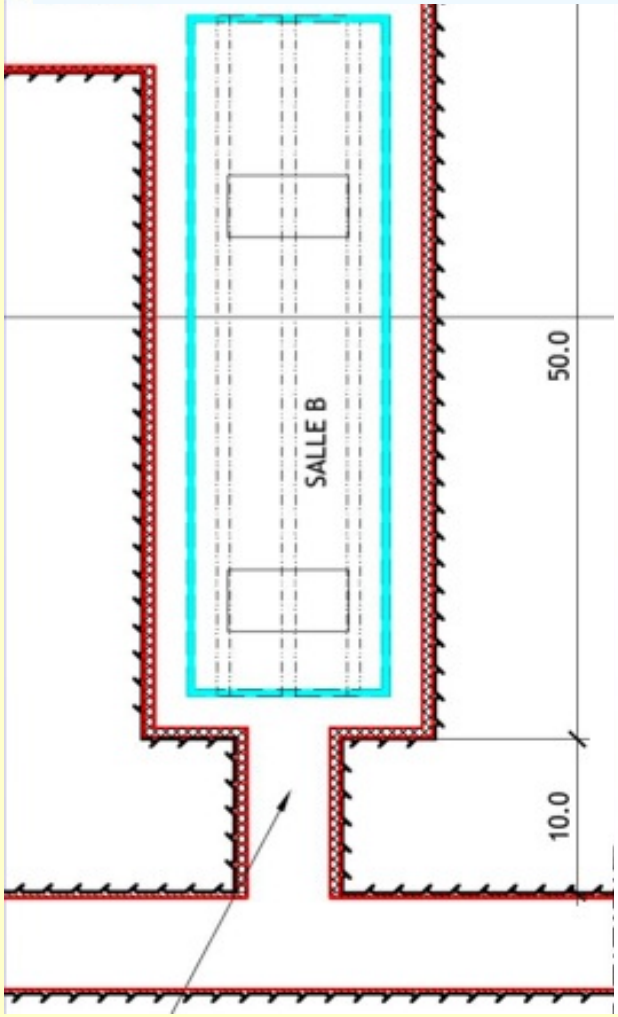
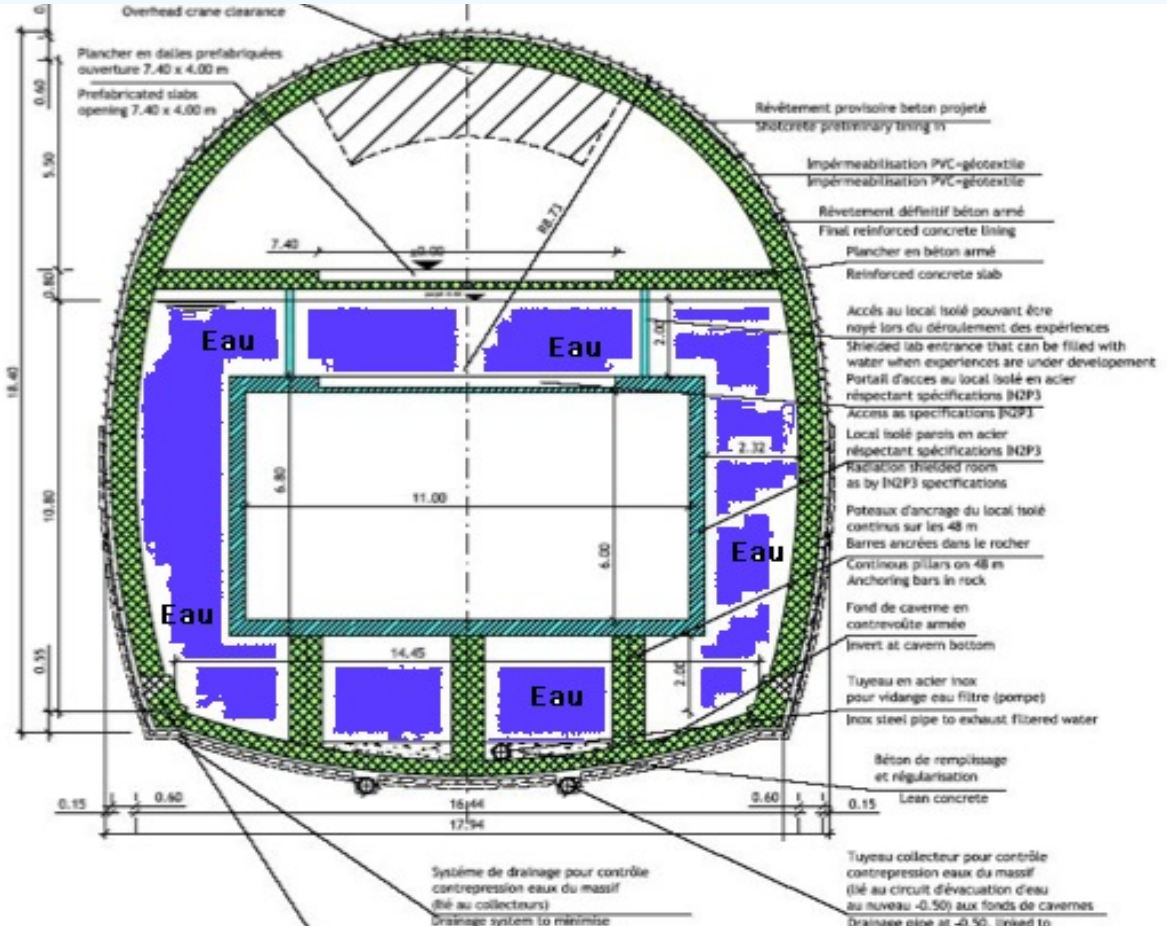
Low background environment in an Underground context

Final goal:
Design of the ultimate underground laboratory





Example: integrated water shield in hall B LSM

Advance

Challenges:

Very low temperature s

- Double read-out bolo
- Surface sensitive bol
- Fast microbolometer

Noble liquid and gas de

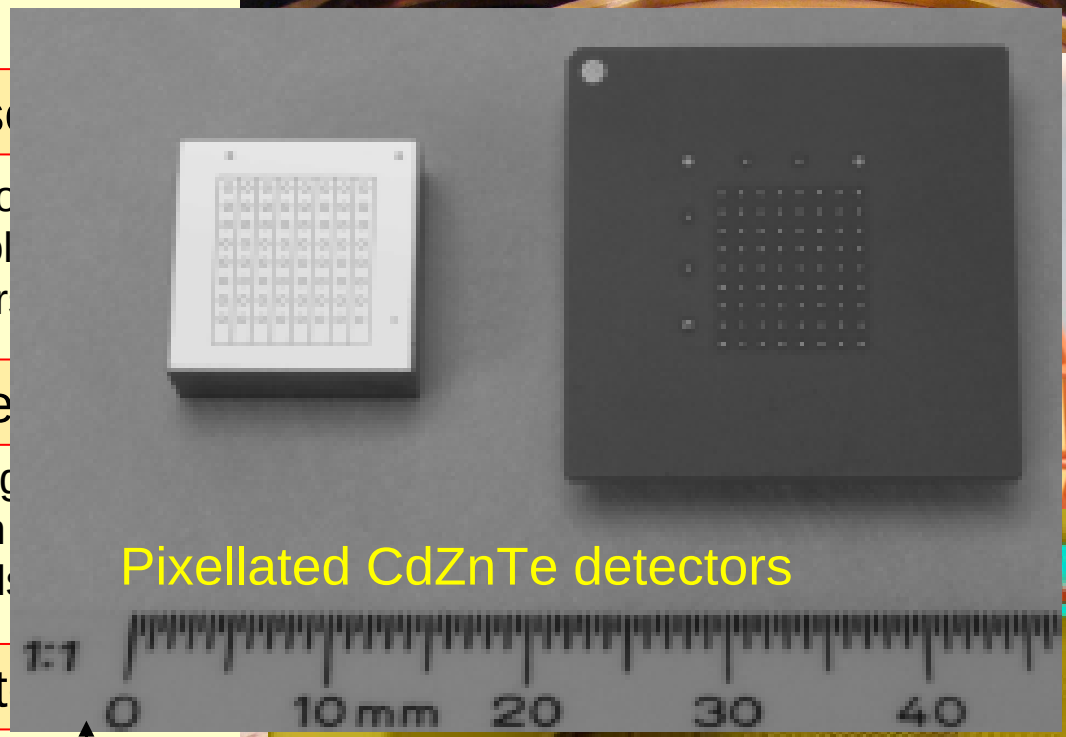
- Optimization of charg
- Physics of ionization
- Pulse shape and puls

Advanced semiconduct

- Pulse shape analysis
- Segmentation and pixellization
- Veto systems

Scintillation detectors optimized fo

- Liquid scintillators
- Low Z organic scintillators
- High efficiency, low activity photom



Specific Underground technologies

Challenges:

Large cryogenic infrastructures

- Isolation of vibration in novel cryogeni
- Vacuum and surface treatment
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Readc

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Shield

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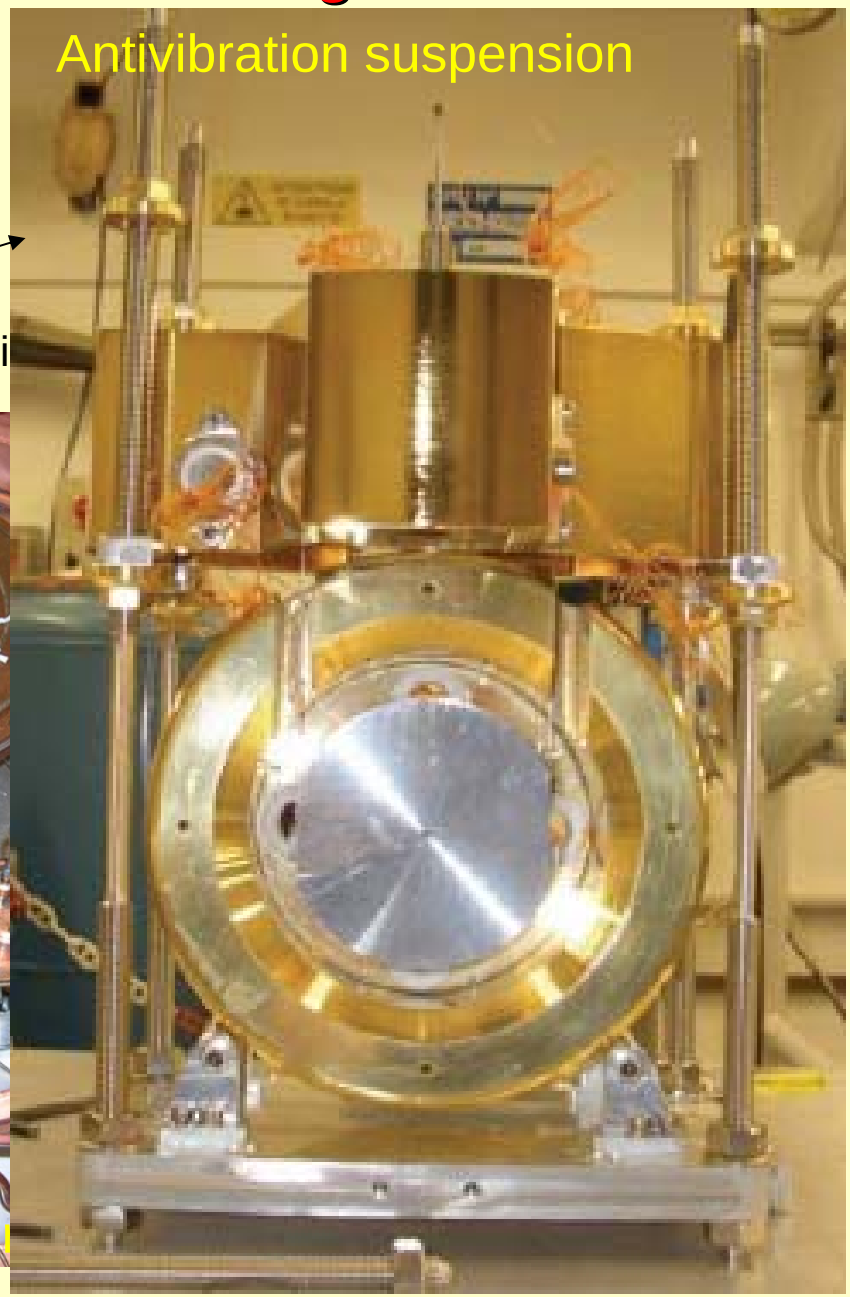
Dilution fridge for Dark Matte



Antivibration suspension

Special experiments supporting Underground science

Challenges:

Study of muon induced background at existing experiments

- Addition of muon detectors to neutron sensitive (semi)deep experiments
- Surface study of muon-induced background

Dedicated (beam) experiments to study BKG activation and detector response

- Study of background induced by neutrons directly in the detectors
- Recoil calibration of Dark Matter detectors
- Production of radioactive nuclides due to high energy muons

Experiments to check double beta decay matrix elements

- Charge exchange reactions measurements
- Measurements of the electron capture parameters for the intermediate nuclei
- Muon capture on nuclei

Computer challenges in Underground topics

Challenges:

Simulation and study of background from radioactivity

- Calculation of efficiency in low-level radioactivity measurements
- Background from radioactivity in running and future experiments
- Background induced by Radon and its daughters

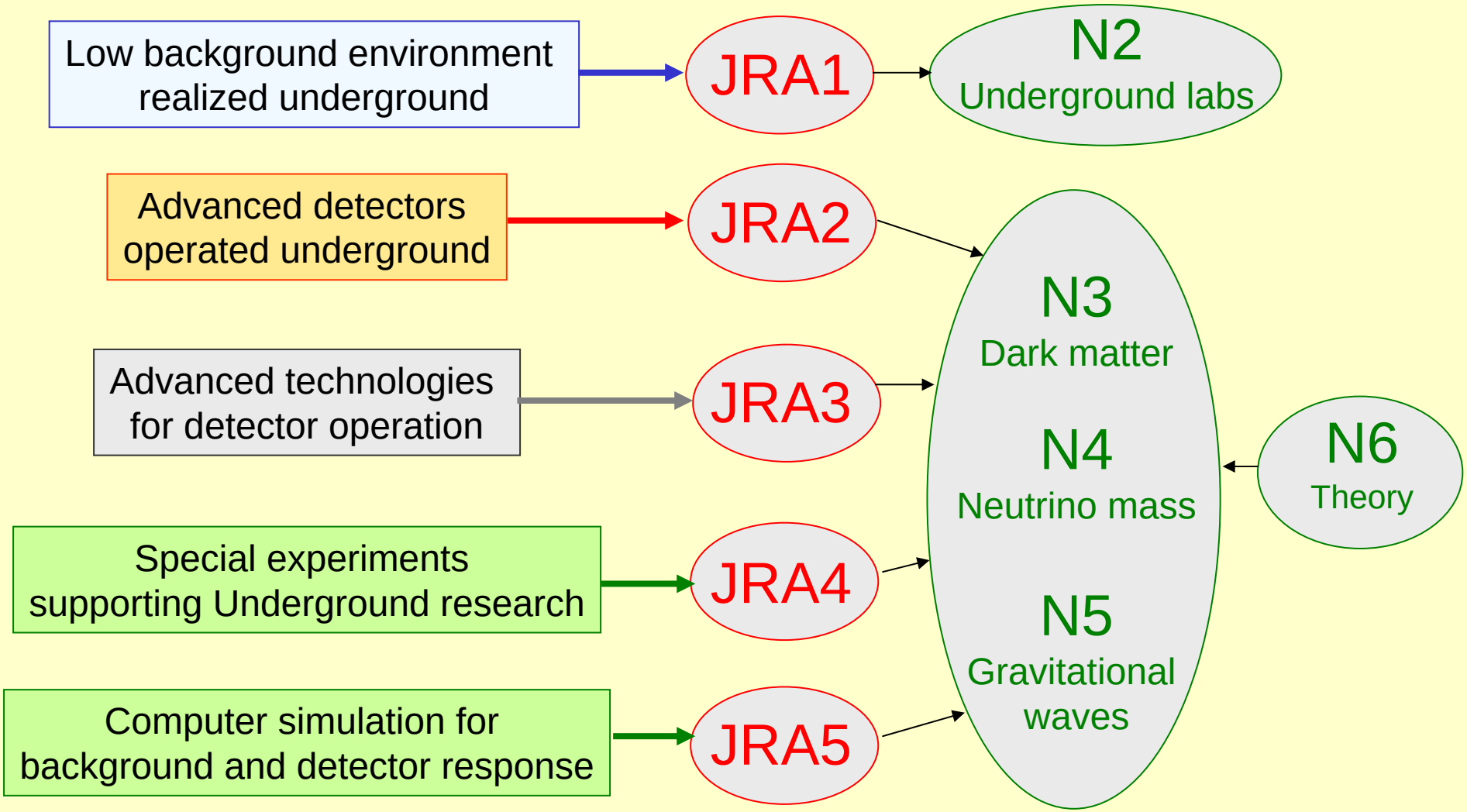
Simulation of the background induced by cosmic rays

- Background from cosmic rays at surface
- Background from muon-induced neutrons underground

Modelling detector operation and physics processes

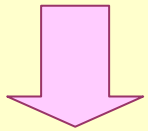
- Support for developing new detector technologies
- Study of detector response to various radiations

The role of ILIAS-next in R&D for Underground Science

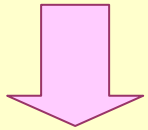


Beyond astroparticle physics

Technology for background control + Underground environment in general



Impact on research outside (astroparticle) physics



Planned dedicated network (N7) for underground science in general

- Underground science and engineering coordination and user panel
- **Deep geo** - geophysics, geology, geo-engineering and mining engineering
- **Deep life** - geo-microbiology, life and environmental science
- **Deep com** - commercial, industrial and security applications

Technological developments in JRA1

- Radiodating, Earth science and environmental applications

Conclusions

- There are strict connections between Underground science and ultimate questions on the nature and structure of the Universe and of the fundamental interactions
- Underground labs are crucial infrastructures for the advancement of fundamental research in physics
- Full and efficient use of Underground lab potential requires the advancement of specific technologies
- In the framework of ILIAS-next, these technological developments will be pursued in a coordinate fashion and under the control and guidance of the involved physics communities
- ILIAS-next will address topics beyond the traditional field of astroparticle physics and will propose itself as a coordination center for Underground science in general