# From Edelweiss/ CRESST to EURECA

G Gerbier IRFU-Saclay
For Edelweiss+CRESST
Andes 1st workshop
Buenos Aires 11-14 april 20011


European Underground Rare Event Calorimeter Array

# EURECA short status

- Foundation date : 2005 : 1st meeting in Oxford Edelweiss and CRESST decided to put efforts together for next generation experiment : **1 ton cryogenic multitarget exp**
- 2006 : CERN, ROSEBUD joined, collaboration agreement written, WP structure set up
- 2007-2010 : Bordeaux. Kiev. Sheffield ioined

**United Kingdom**
Oxford (H Kraus, coordinator)
Sheffield

**Germany**
MPI für Physik, Munich
Technische Universität München
Universität Tübingen
Karlsruhe Institute of Technology

**International**
JINR Dubna
CERN

**France**
CEA/IRFU Saclay
CEA/IRAMIS Saclay
CNRS/Neel Grenoble
CNRS/CSNSM Orsay
CNRS/IPNL Lyon
CNRS/IAS Orsay
CNRS/ICMCB Bordeaux

**Spain**
Zaragoza

**Ukraine**
Kiev

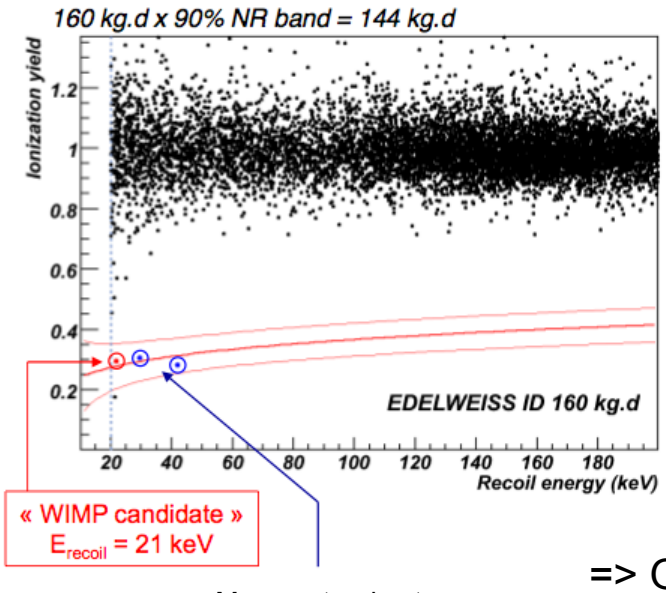
Around 115 members (65 FTE) currently on **Edelweiss**, **Cresst**, **Rosebud** and others

# Phased approach

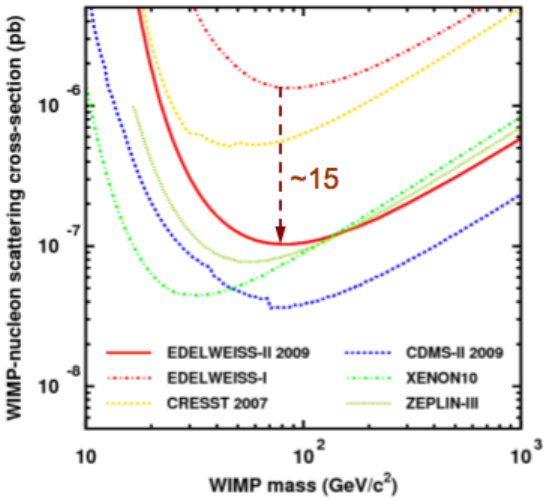
1. **EURECA 0 = Edelweiss + CRESST**
2. EURECA 1 = set up for 1 t , 150 kg
3. EURECA 2 = set up for 1 t , 1000 kg

# Data from 1 year running

with 10 ID400 detectors




Muon vetoed evts



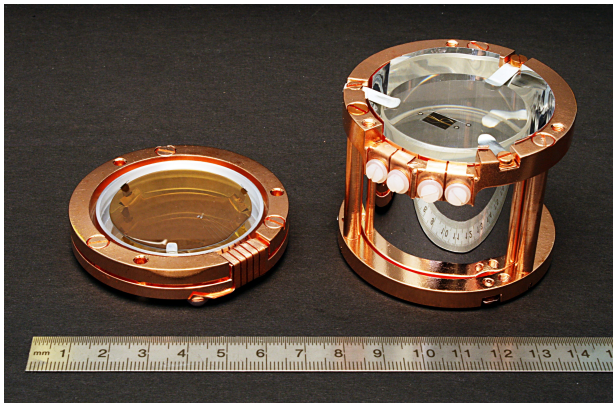

=> Going to FID800, 40 kg phase
=> 1200 g ?

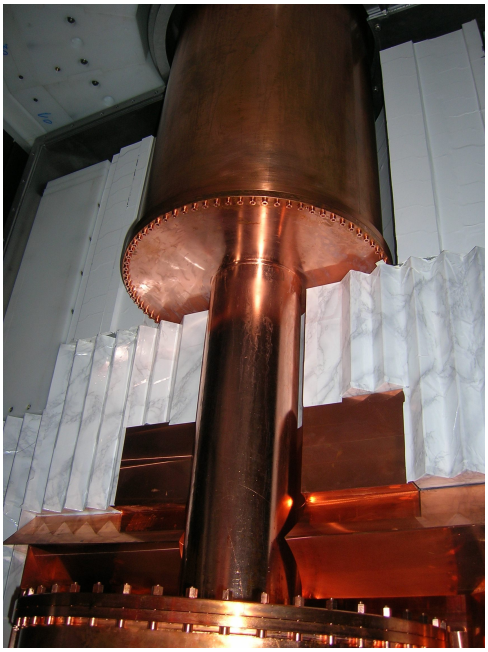
# CDMS and Edelweiss

- Use same nucleus as target
- Similar detectors
- Similar sensitivities
- => combine data to improve limits
- Work and agreement ongoing

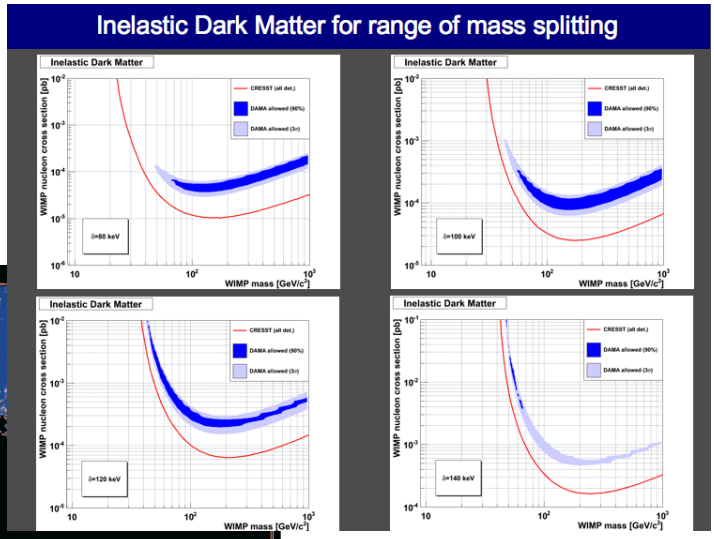
# CRESST

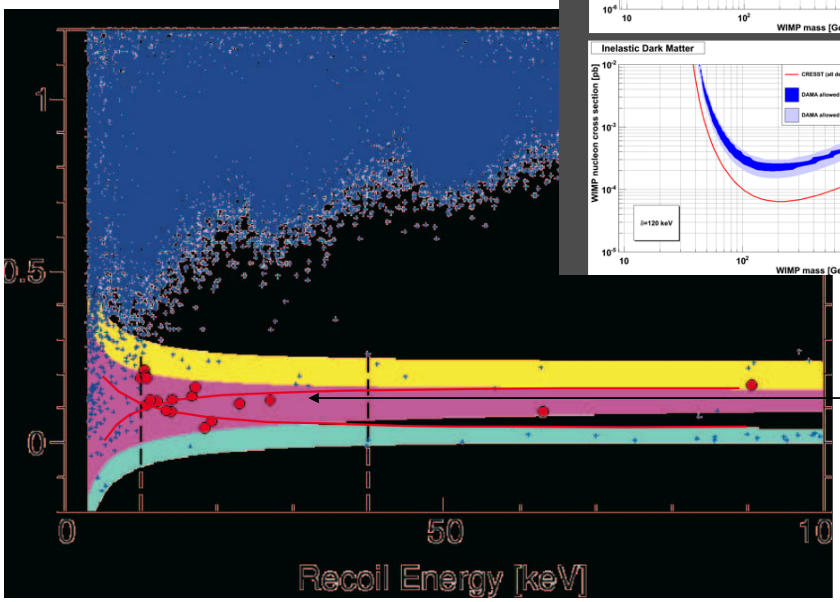
- CaWO4 crystals with heat and light sensors
- 10 modules operated since summer 2009





# CRESST data
# Few 560 kg.d




-More events than expected in « Oxygen » band
-New run with less alpha bck expected

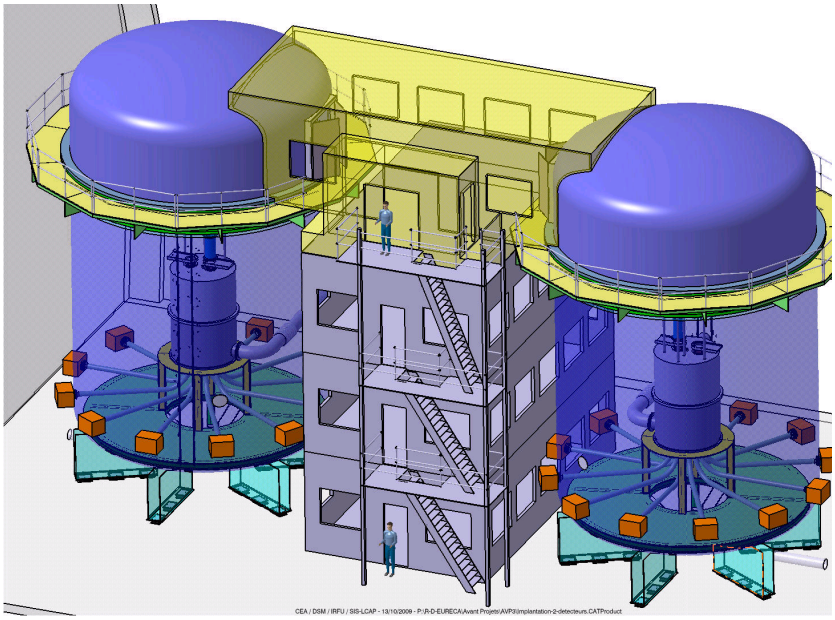
# Phased multi target approach

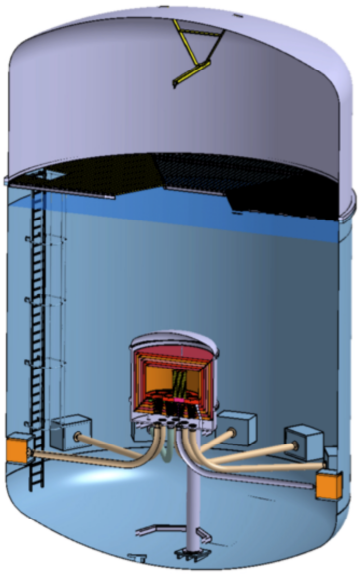
1. EURECA 0 = Edelweiss + CRESST
2. **EURECA 1 = set up for 1 t , 150 kg**
3. EURECA 2 = set up for 1 t , 1000 kg

# Progress on key elements

- Simulations => Shieldings
- Cryogenics line defined
- Studies on going for wiring / electronics
- Implantation @ LSM extension sketched
  - => submission of LOI to LSM in sept 09
- Going to CDR and TDR by 2012

# Infrastructure 1: shields, implantation



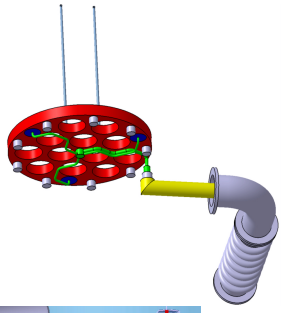


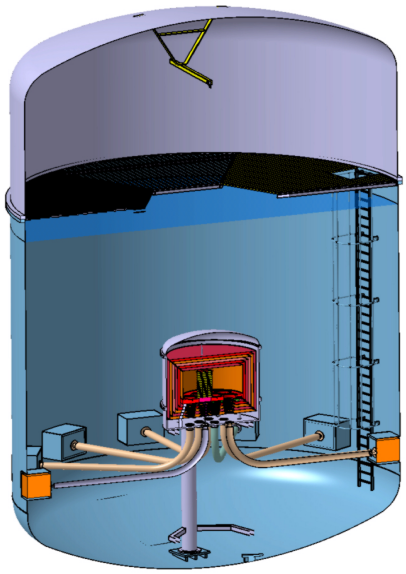
Two cryostats: 1 taking data , 1 installation/development
Water shield= muon veto : pure water equipped with PMT's

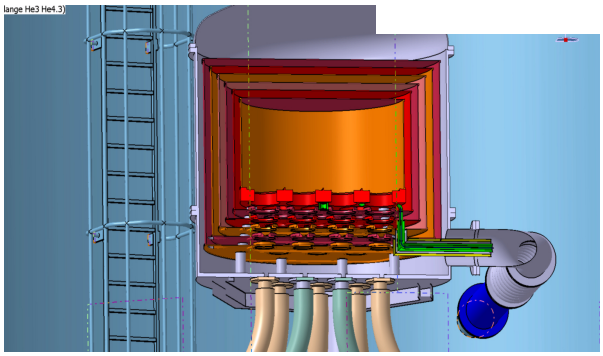
8 m

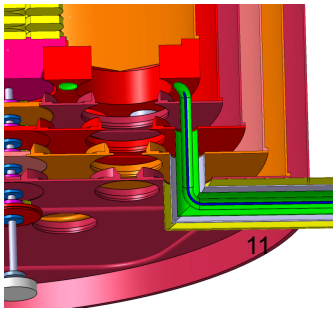
# Cooling system

- Cryostat inside large water tank
- Cooling by pipes with cold gaz or liquid flow
- No cryogenic devices inside the shield
- No vibrations / no radioactivity

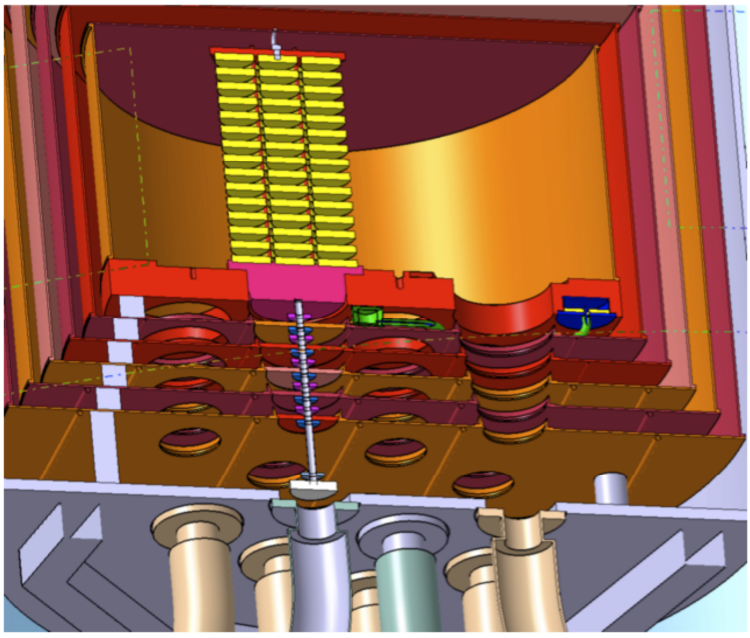




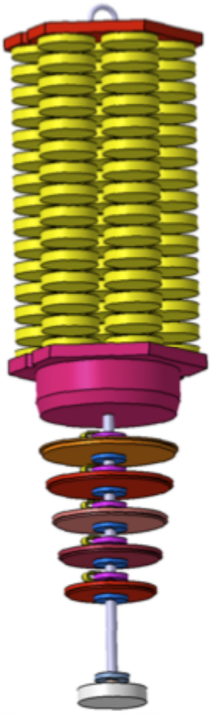





# Infrastructure 2 : detector arrangments



« Building block » : 0.8 to 1.2 kg being validated



# *Changing part of detectors*

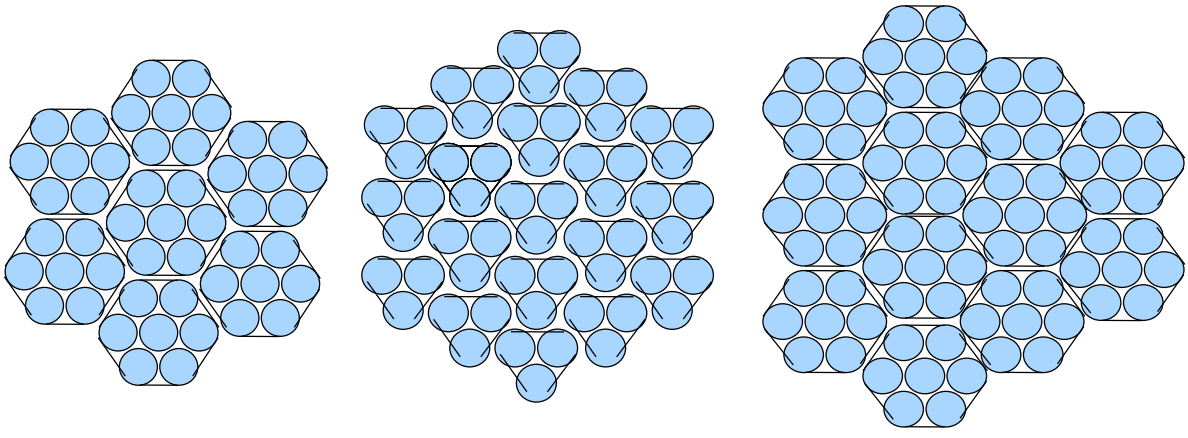
- **Changing detectors and electronics**
  - Built with separate towers
  - Each tower includes detectors, cabling and electronics
  - Electronics connections at 300K with connector
  - Thermalisation at each stage
  - Very convenient for the user
  - Allows to prepare and test each tower before mounting in Eureca
- Choice for 19 towers of 30 kg each
  - **Automatic connect/disconnect at 300K (no acces)**
  - **Part of the room temperature electronics in the tower**

**Electronics signals Between tower and out of the cryostat :**

- Typical 6 * 62 = 372 wires
- Analog out signal at high level
- Digital input to drive the Dac for detector polarisation
- (no digital command during measurement)



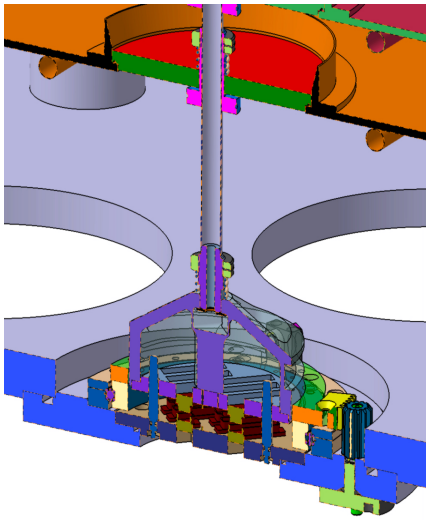
## detector assembly 650 detectors = 0.8*650 =520kg

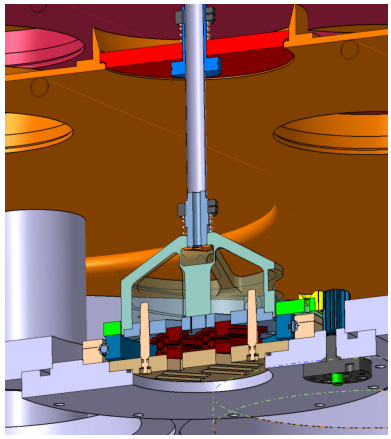


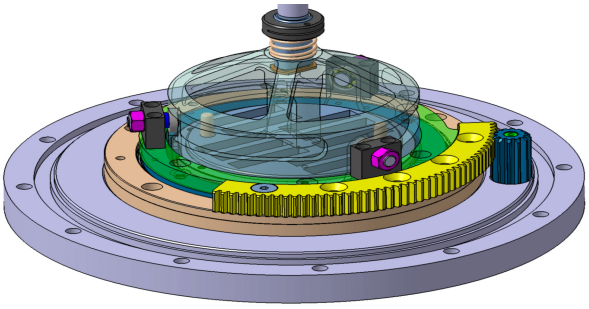
| 7 tower of 7 detectors<br>height 13 detectors<br>diameter 8 detectors<br><br>1 tower =91 d = 73 kg | 19 tower of 3 detectors<br>height 12 detectors<br>diameter 9 detectors<br><br>1 tower = 36 d = 29 kg | 12 tower of 7 detectors<br>height 8 detectors<br>diameter 11 detector<br><br>1 tower = 56 d = 45 kg |
|---|---|---|

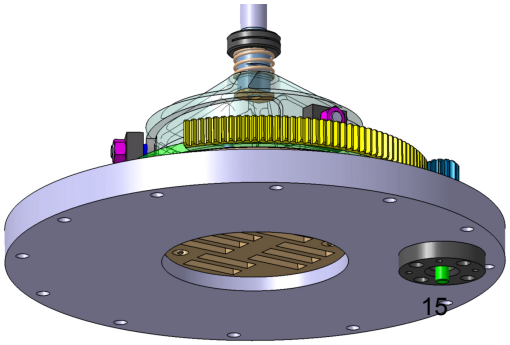
NB : current hypothesis here is 90 diameter by 50 height

# The clamping mechanism at 300K



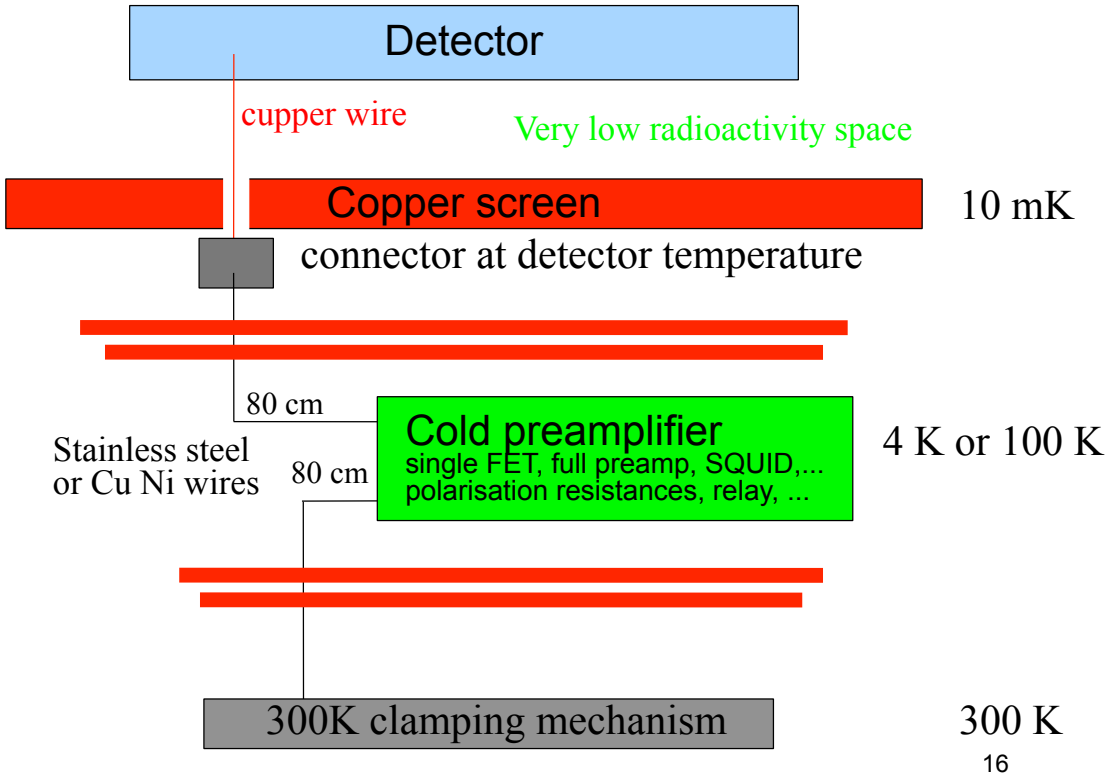




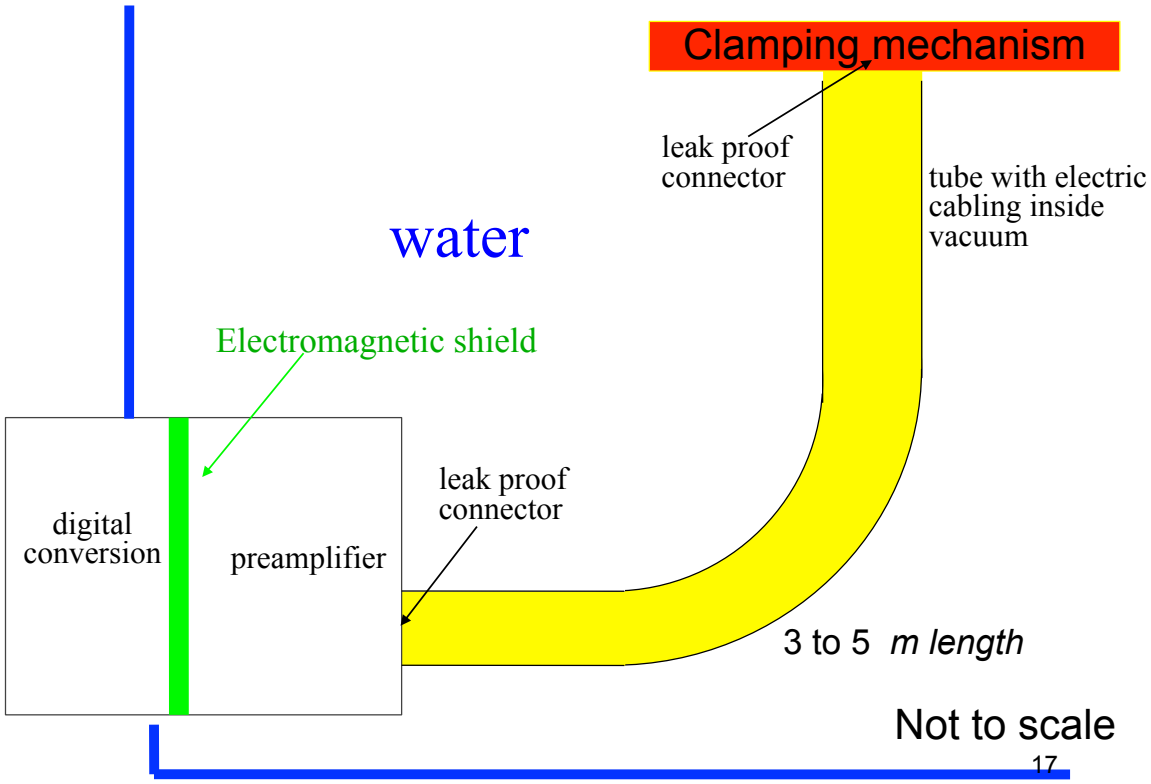




# One Tower electronic and cabling

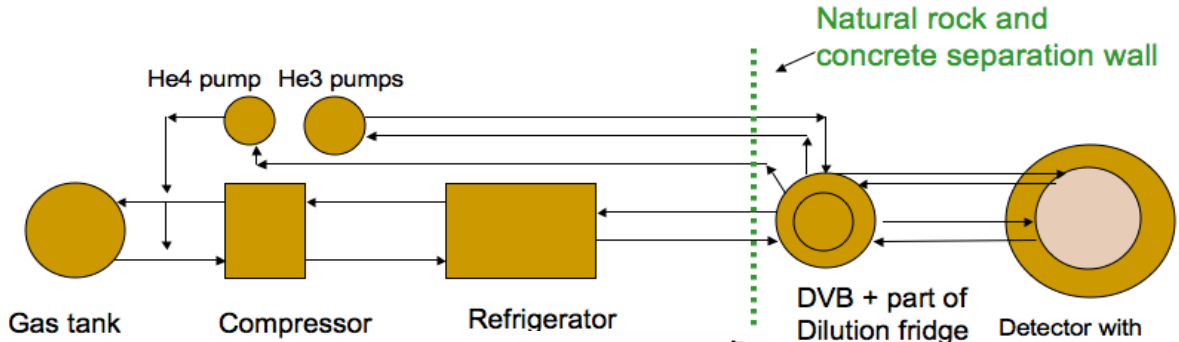


# Cryostat warm electronics and cabling






# Infrastructure 3 : cryogenics






Inventory

**Technical side cavern**

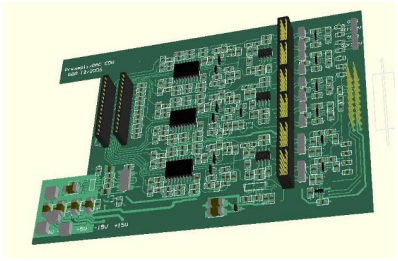
1) 2 x 4He Gas Tank 20 bar
each capacity 500 liter LHe equivalent = 350 Nm2
nominal Volume 18 m3
size: diameter 2 m, length 6 m
2) 2 x 3He tanks
3) 2 x Compressors
size 2,5 x 2 x 2 m
4) 2 x 4He Pumps
size 1 x 1 x 1 m
5) 2 x 3He Pump units
size 2 x 2 x 2 m

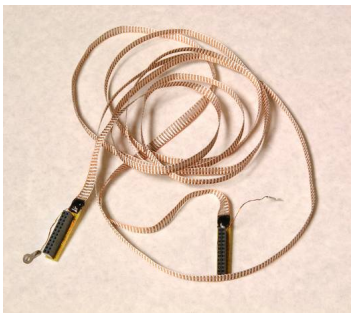
Cooling time : 2 to 3 days

.....

Total power : 300 to 500 kW

# Electronics, cabling, etc

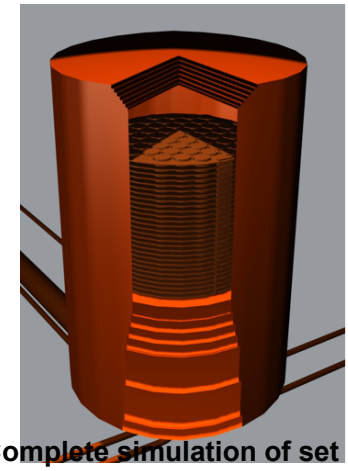




- Electronics :
  - Reduce cost per channel
  - Optimise number of needed channels
- Wiring :
  - High impedance option preferred (NTD sensors)
  - Simplify
  - Design, prototyping on track
  - Test foreseen in EDW III set up
- Significant savings identified

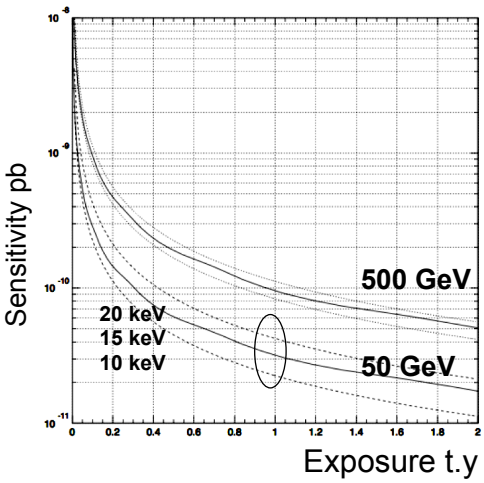
# Backgrounds for EURECA

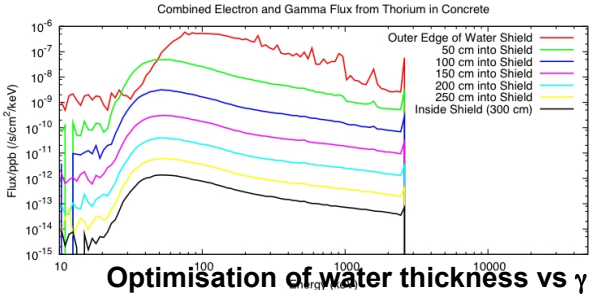
- Ge : reach backg level ~<1 evt/t.y
  - **Gamma** : w present level @ 0.16 evt/kg.d.keV, **ok**
  - **Beta** : need factor 10 less on $^{210}$Pb surface contamination : **at hand**
  - **Neutrons** : use of water shield : **ok**



**Complete simulation of set up**

**Limits from gamma backgnd w present level & rejection factor**




**Optimisation of water thickness vs γ**

# Costs and timeline

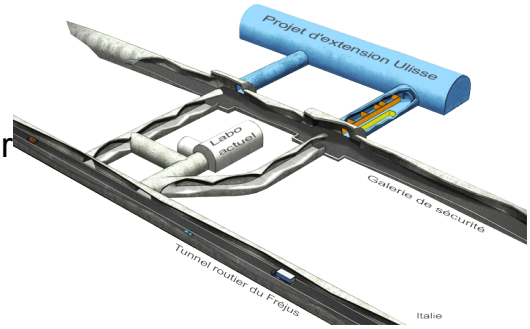
- Equipment / investments
  - ~M€15 for detectors (1000 kg Germanium with NTD-sensors or scintillators bolometers)
  - ~M€12 for cryostats (2 cryo lines + dilution refrigerators)
  - ~M€3 for electronics / readout / computing / data processing
  - ~M€3 for 2 water tanks, equipped with PMT muon veto
  - ~M€1 for cleanrooms, services, etc
- Equipment cost: ~34 M€ for phase 2 ,15 M€ phase1
- Running costs : 300-500 k€

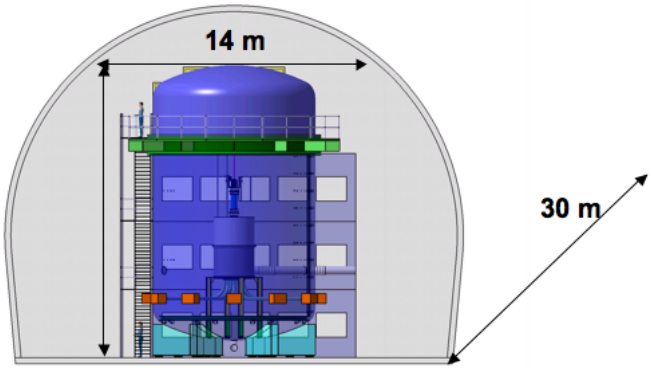
| Project | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CDR/ASPERA D. Study | | | | | | | | | | | |
| TDR | | | | | | | | | | | |
| Decision | | | | | | | | | | | |
| Construction I (150 kg) | | | | | | | | | | | |
| Exploitation I | | | | | | | | | | | |
| Construction II (1 ton) | | | | | | | | | | | |
| Exploitation II | | | | | | | | | | | |

# ULISSE = LSM extension

- Civil works started for safety gallery (600m done)
- Decision for ULISSE to be taken in summer 2011 to profit of dig machines

  Recommendation by SAC in 2010
- EURECA fate linked to ULISSE




# EURECA and GEODM

- 150 kg stage SuperCDMS <=> EURECA 1
- 1.5 T GEODM <=> EURECA 2
- DUSEL vs ULISSE, see before
- =>signed MoU in 2009

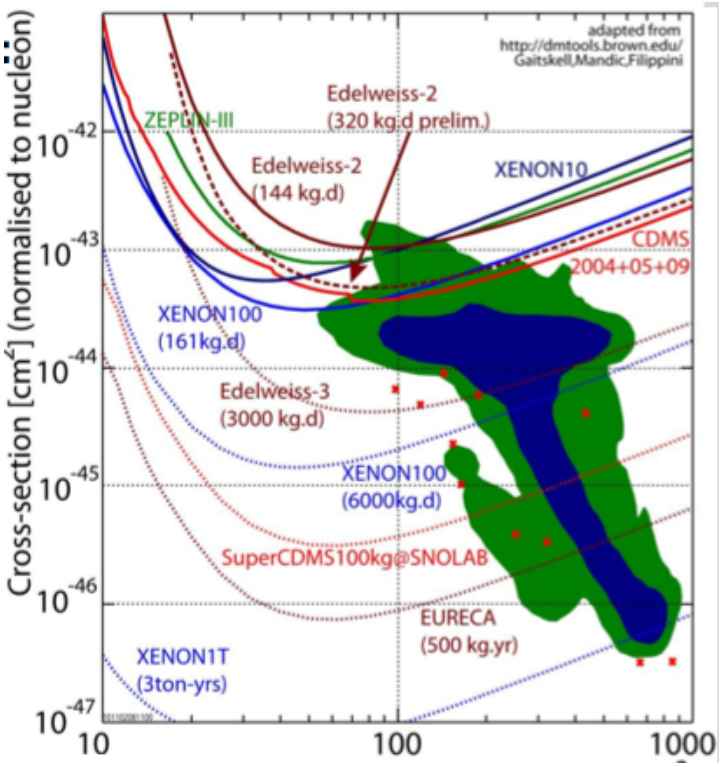
**Memorandum of Understanding between the EURECA, SuperCDMS, and GEODM collaborations**

On behalf of the EURECA collaboration — Hans Kraus, EURECA Spokesperson
On behalf of the SuperCDMS collaboration — Blas Cabrera, SuperCDMS Spokesperson
On behalf of the GEODM collaboration — Sunil Golwala, GEODM Spokesperson

- Maintain scientific independence, but collaborate where this is beneficial

| Work package | EURECA | Super-CDMS | GEODM |
|---|---|---|---|
| Management | H Kraus | D Bauer | S Golwala |
| Infrastructure | G Gerbier | D Bauer | S Golwala |
| Cryogenics | A Benoit | D Bauer | S Golwala |
| Electronics | J Gascon | J Hall | B Sadoulet |
| Detectors | A Broniatowski / F v Feilitzsch | P Brink / N Mirabolfathi | P Brink / N Mirabolfathi |
| Low background | V Kudryavtsev / P Loaiza | P Cushman | P Cushman |
| Data Analysis | K Eitel | R Schnee | R Schnee |

# Predictions of performances




True if background =0

# Summary-outlook

- Detectors
  - Validation of Ge building block within 1 year
  - Scintillator detector improvment
  - Exploration of lower cost options
- Infrastructure : towards TDR
- Collaboration with US teams
  - Common studies on cryogenics, shields, LR issues,…
  - Exchange of detectors
- Goal $10^{-10}$ pb by 2017-2018
- Open to new collaborators