

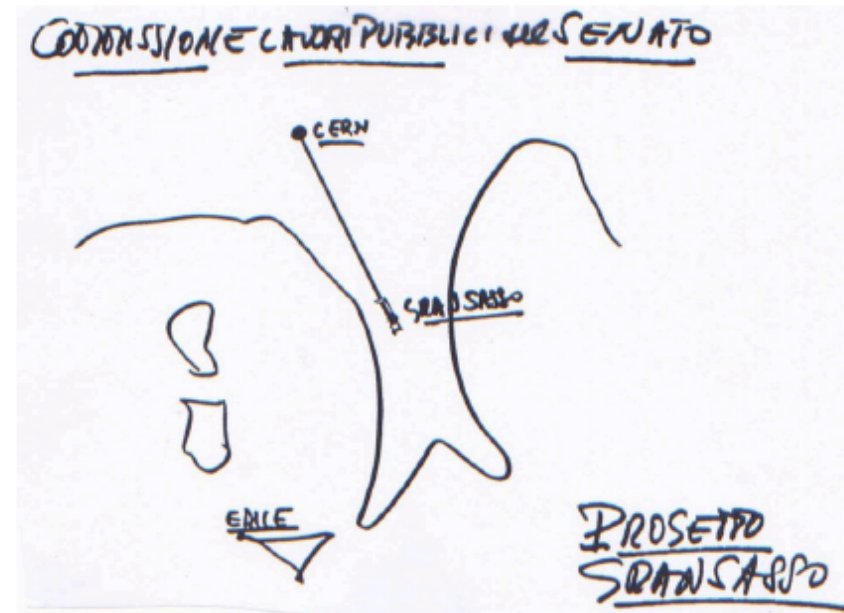
**Laboratori Nazionali del Gran Sasso**  
**WELCOME**  
**INFN – IHEP**  
**Meeting**



S. Ragazzi LNGS Director Sep. 16, 2013

# LNGS

- 1979: proposal by A. Zichichi to Italian Parliament
- 1982: Approval of LNGS construction
- 1987: construction completed
- 1989: Start data taking of first large experiment (MACRO)



Note manoscritte di A. Zichichi presentate nella Seduta della Commissione Lavori Pubblici del Senato convocata con urgenza dal Presidente del Senato per discutere la proposta del Progetto Gran Sasso (1979).

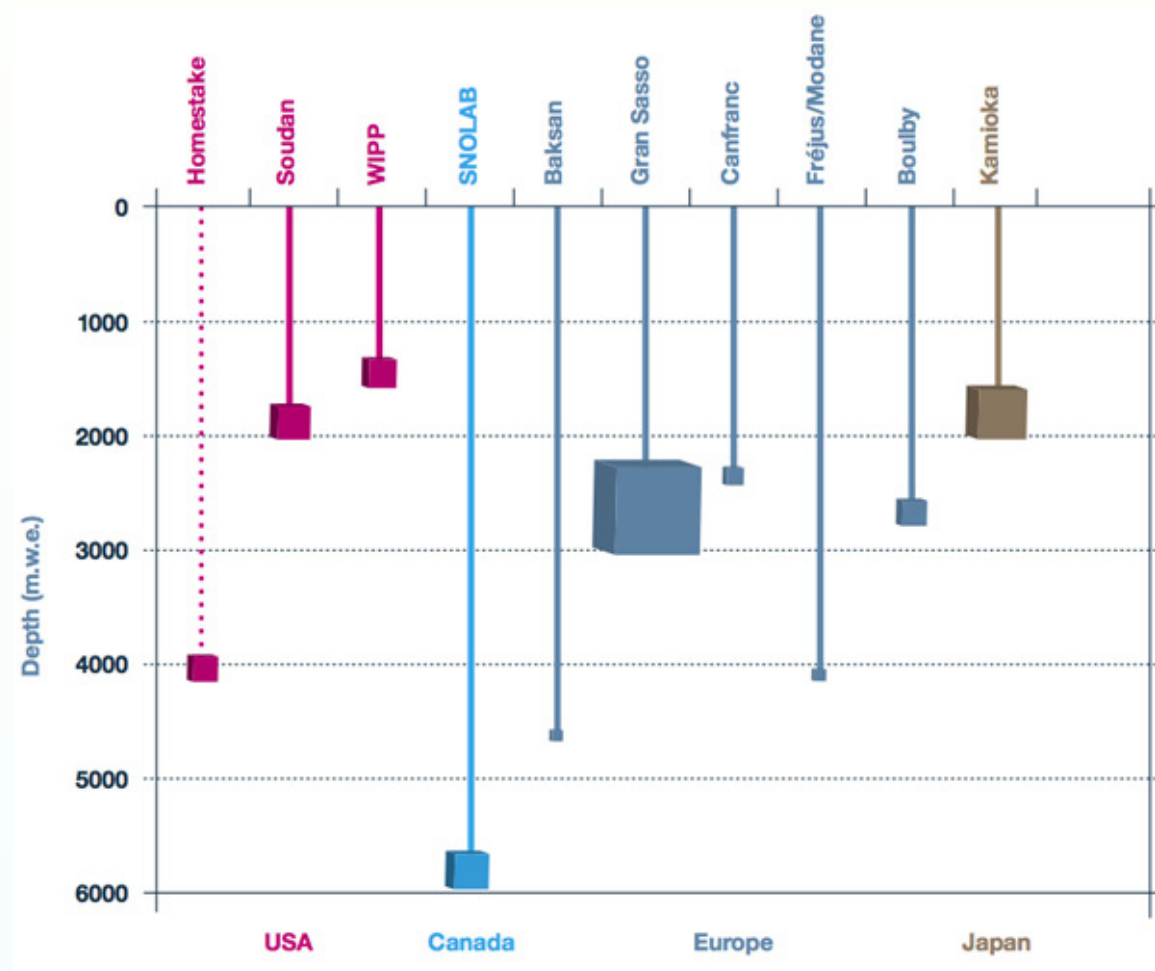
To summarize, the scientific aims of the "Gran Sasso" laboratory are the study of:

- 1) nuclear stability;
- 2) neutrino astrophysics;
- 3) new cosmic phenomenology;
- 4) neutrino oscillations;
- 5) biologically active matter;
- 6) ground stability.

Not only  
 $\tau_p \neq \infty$

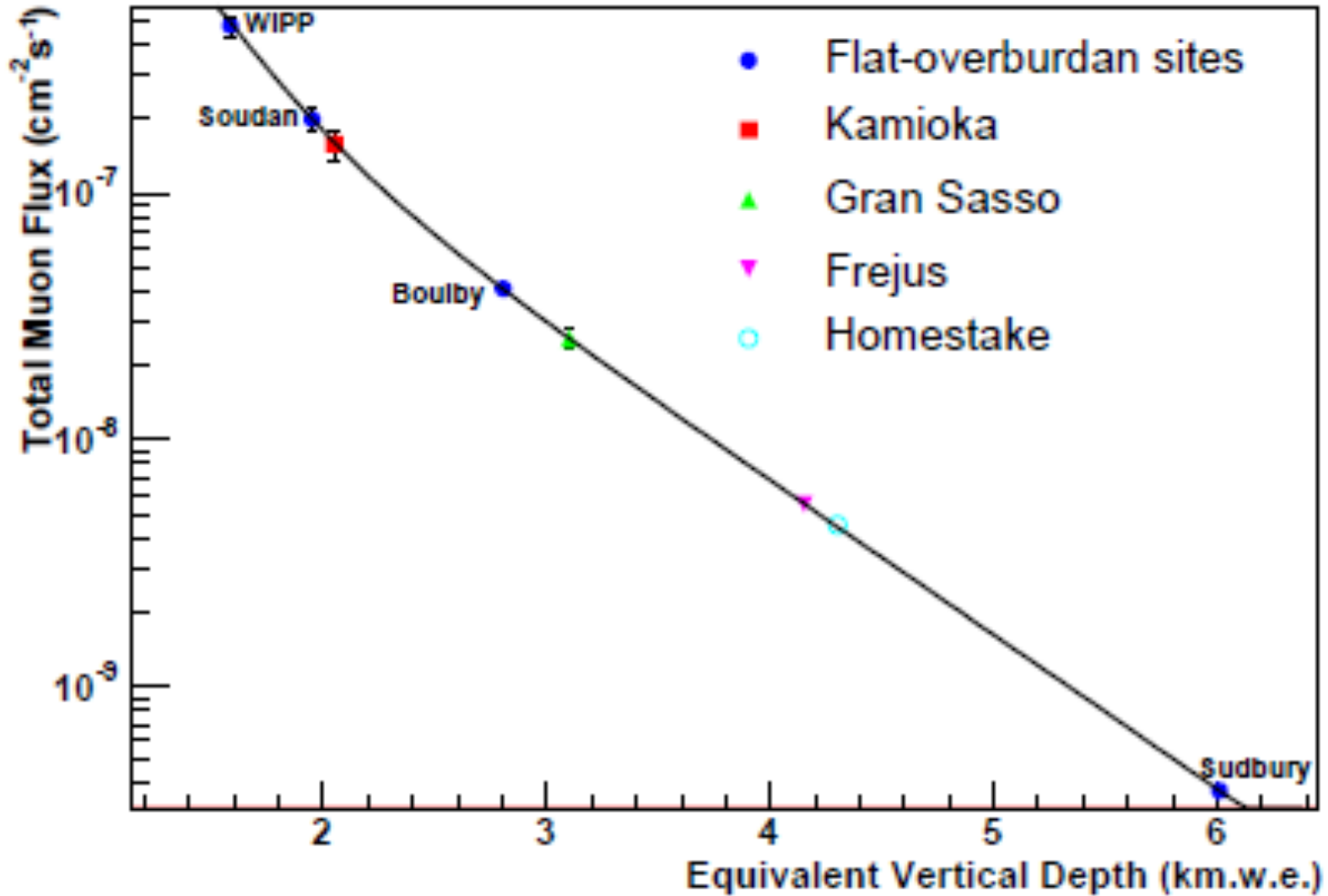
# Underground Science Laboratories

- **LNGS**
  - Largest
  - Easiest to access

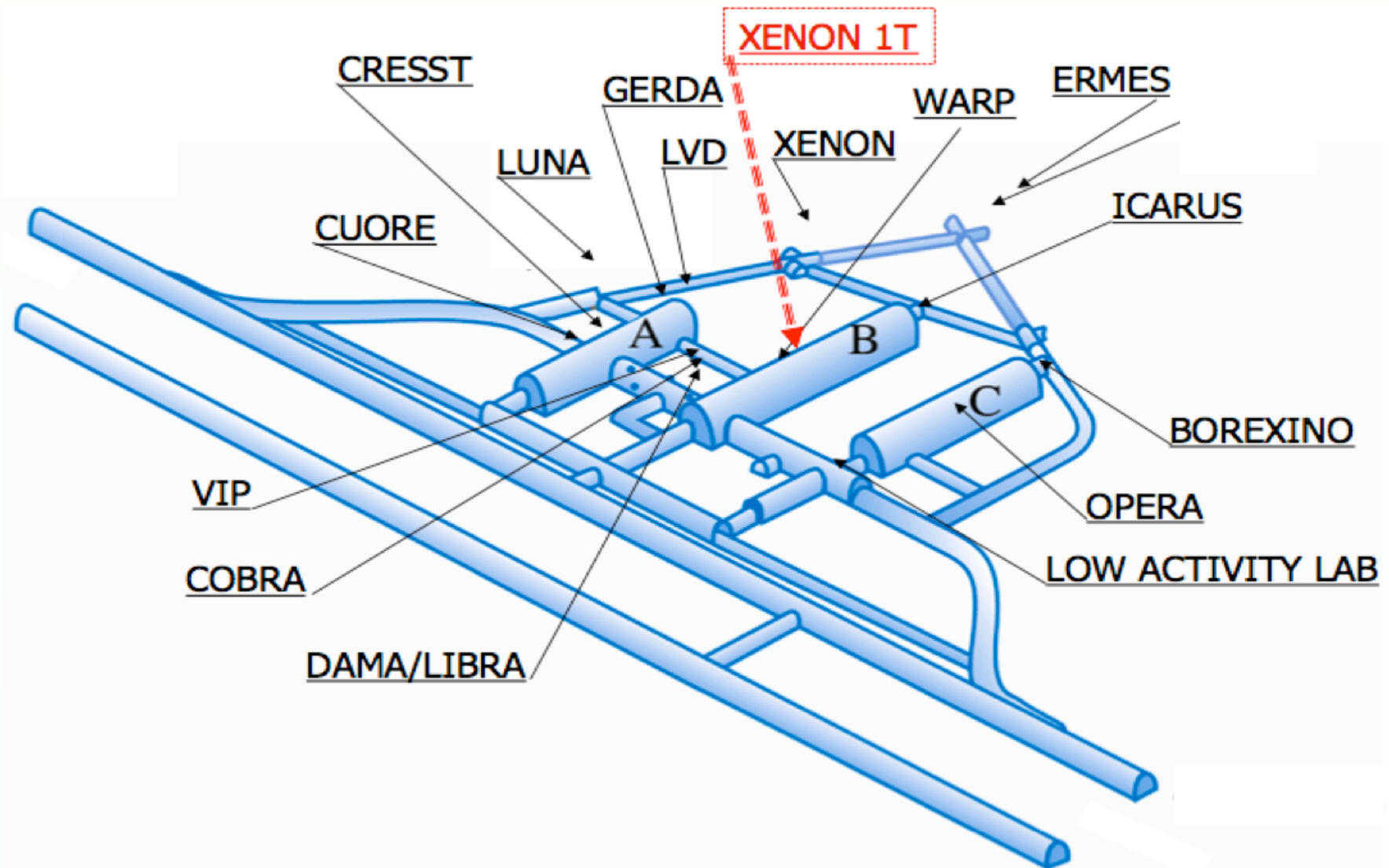


Plot adapted from <http://www.deepscience.org/contents/facilities.shtml>

# Muon Flux versus depth

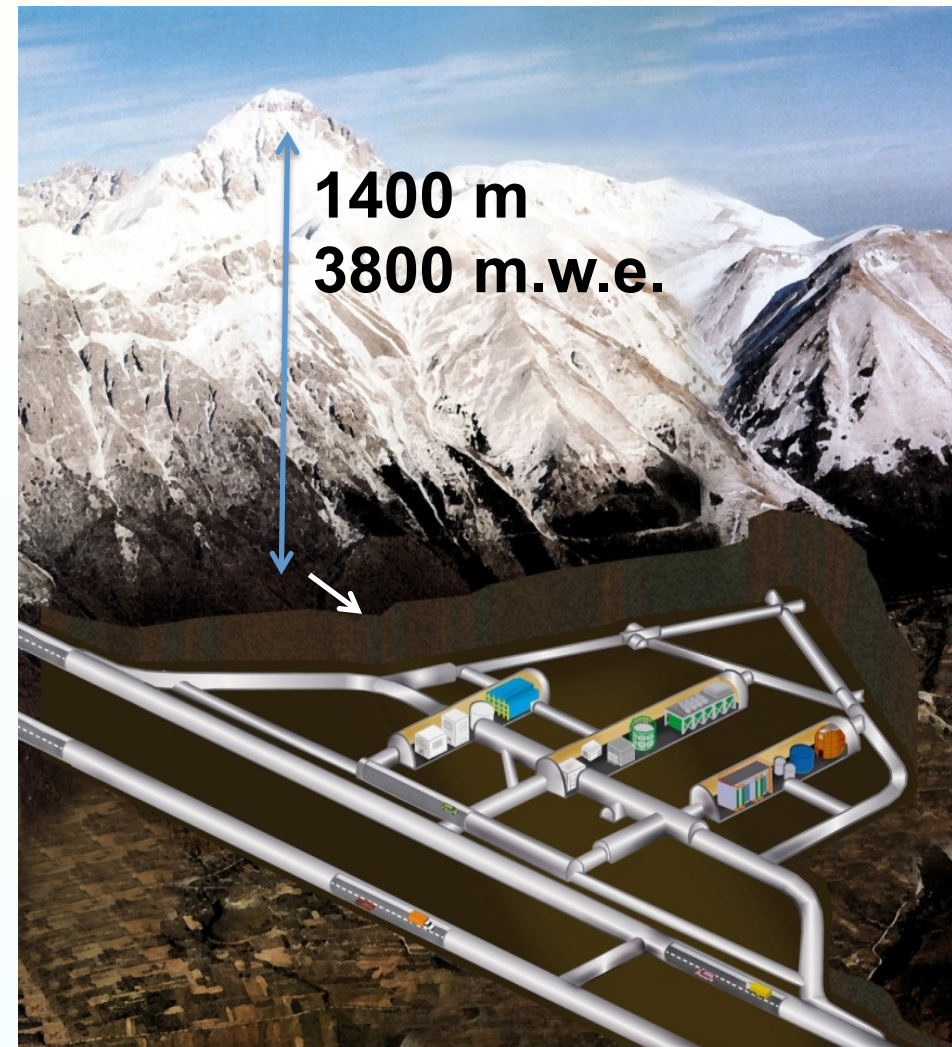


# Lab overview - 2013



# The LNGS Laboratory

- Muon flux:  $3.0 \cdot 10^{-4} \text{ m}^{-2}\text{s}^{-1}$
- Neutron flux:
  - $2.92 \cdot 10^{-6} \text{ cm}^{-2}\text{s}^{-1}$  (0-1 keV)
  - $0.86 \cdot 10^{-6} \text{ cm}^{-2}\text{s}^{-1}$  ( $> 1 \text{ keV}$ )
- Rn in air: 20-80 Bq  $\text{m}^{-3}$
- Surface: 17 800  $\text{m}^2$
- Volume: 180 000  $\text{m}^3$
- Ventilation: 1 vol / 3 hours



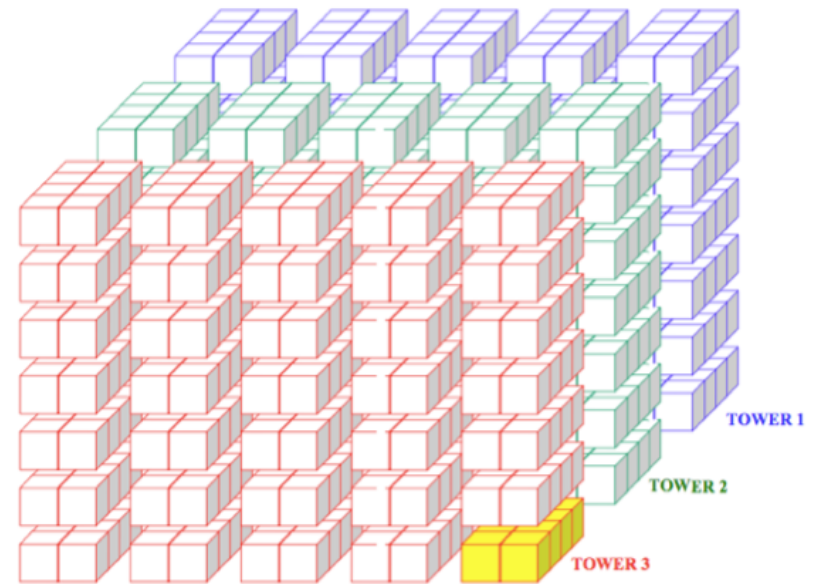
# Science Program - I

- **Neutrino physics**
  - neutrino oscillations
    - CNGS: Opera, Icarus – data taking **COMPLETED**
  - solar physics and neutrino oscillations
    - Borexino
  - cosmogenic and geo neutrinos
    - LVD, Borexino
  - double beta decay
    - GERDA, CUORE, COBRA, LUCIFER

# LVD

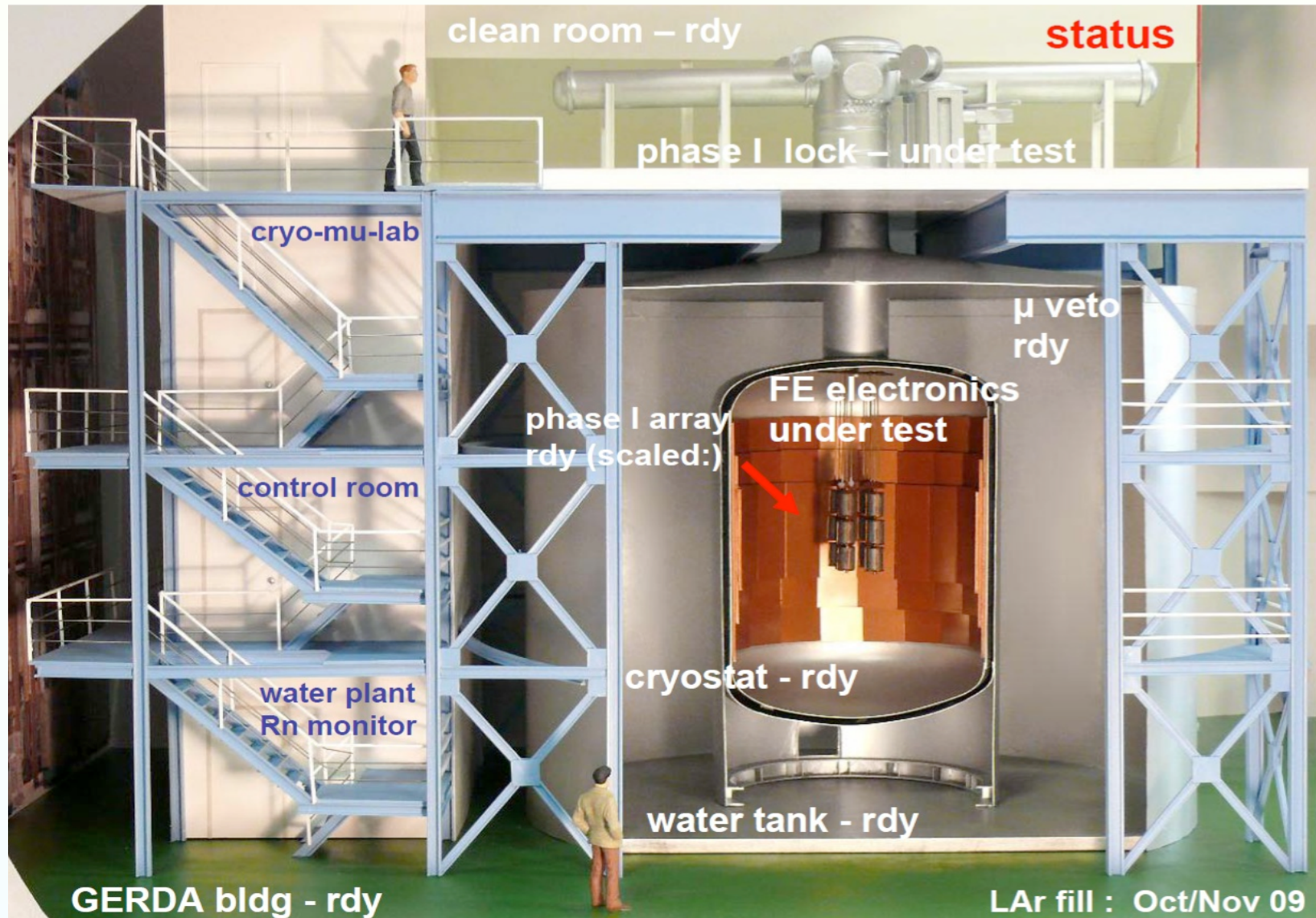


- **Waiting for a Supernova**

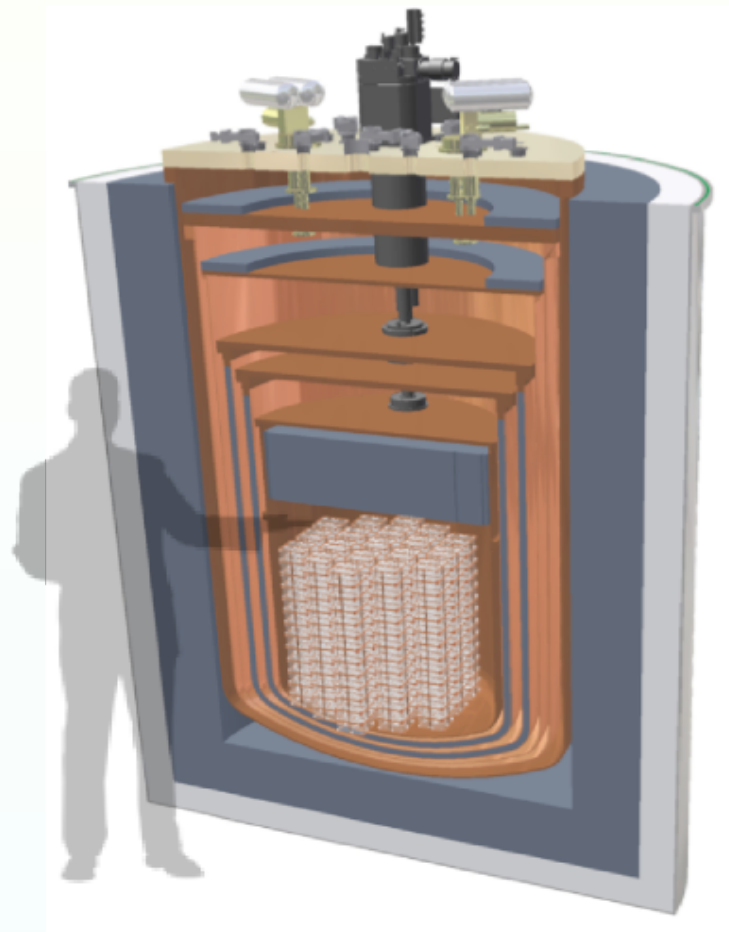




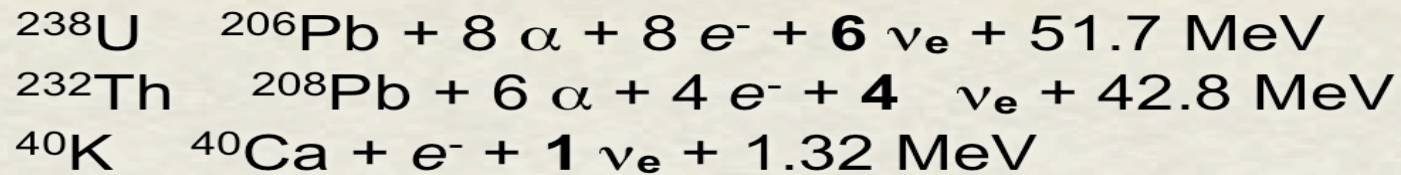
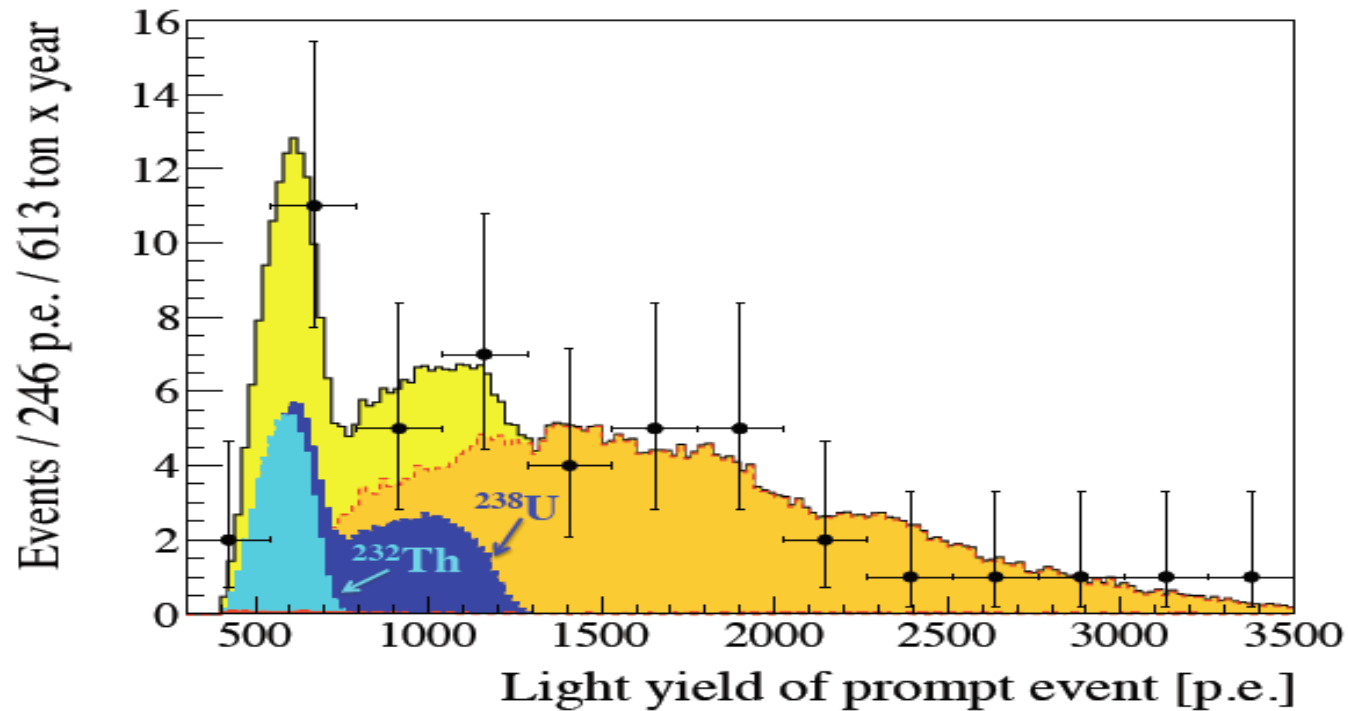
# Gerda



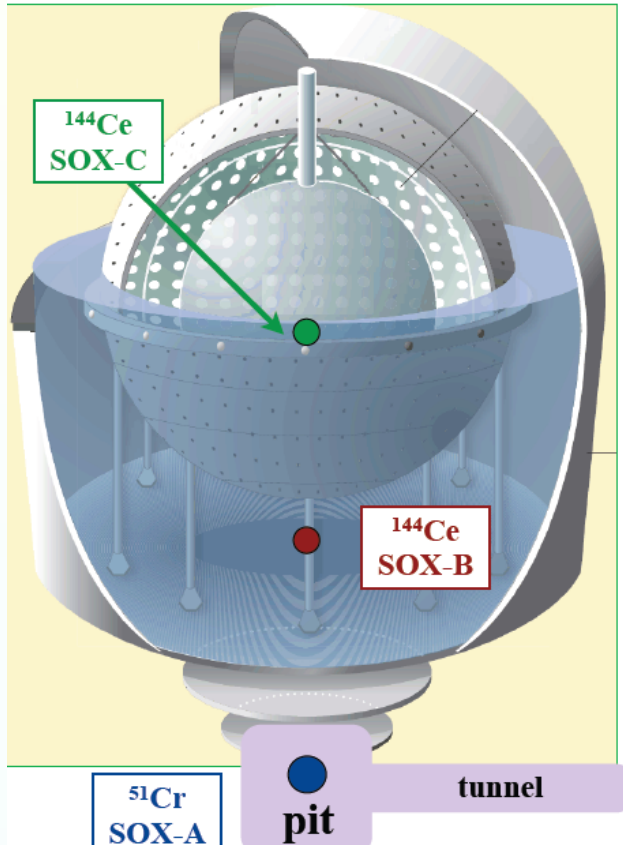
# Cuore



# Geo Neutrinos with Borexino

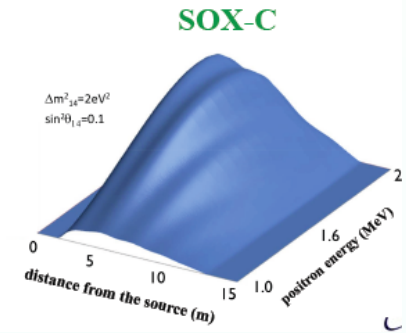
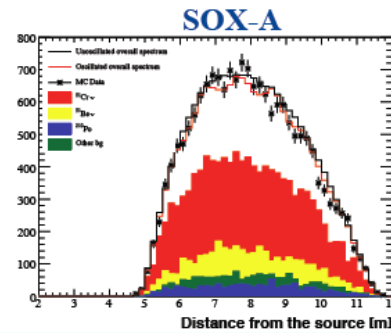
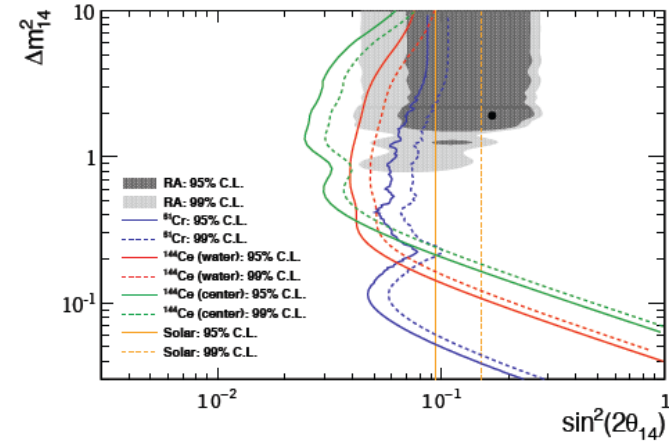


# SOX – 4<sup>th</sup> neutrino



## anti-neutrino sources

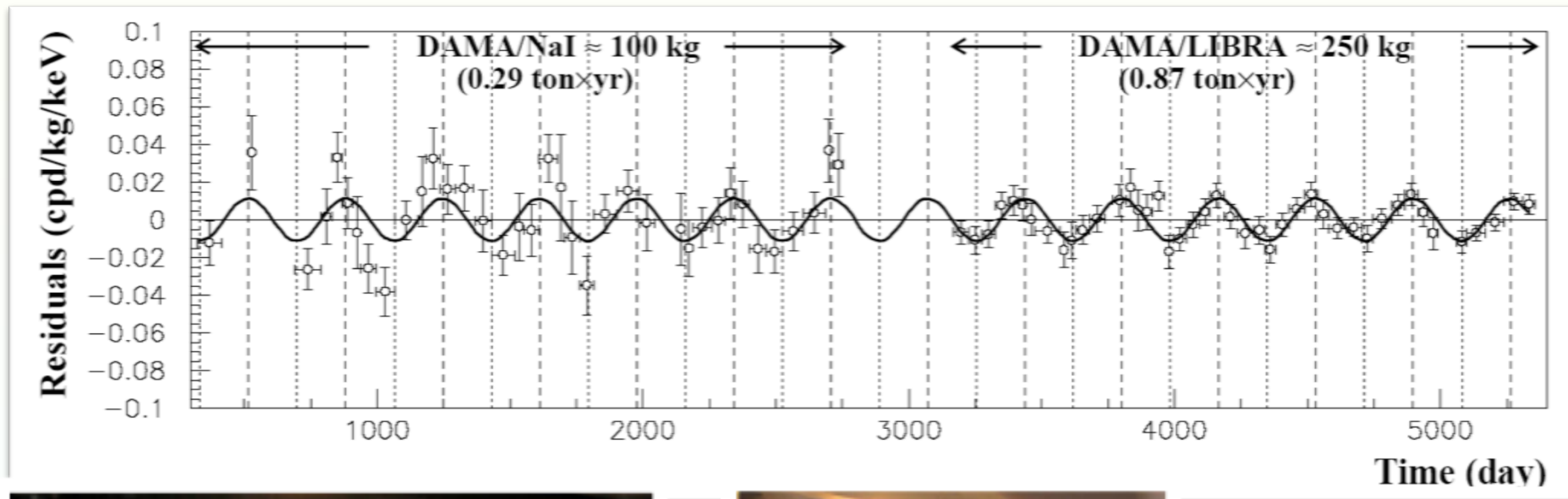
- **SOX-A**
  - $^{51}\text{Cr}$  neutrino source (external)
  - Tentative schedule: 2015/2016
- **SOX-B**
  - $^{144}\text{Ce}$  anti-neutrino source (external)
  - Tentative schedule: 2015-2016 (TBD)
- **SOX-C**
  - $^{144}\text{Ce}$  anti-neutrino source (internal)
  - No schedule (>2016)



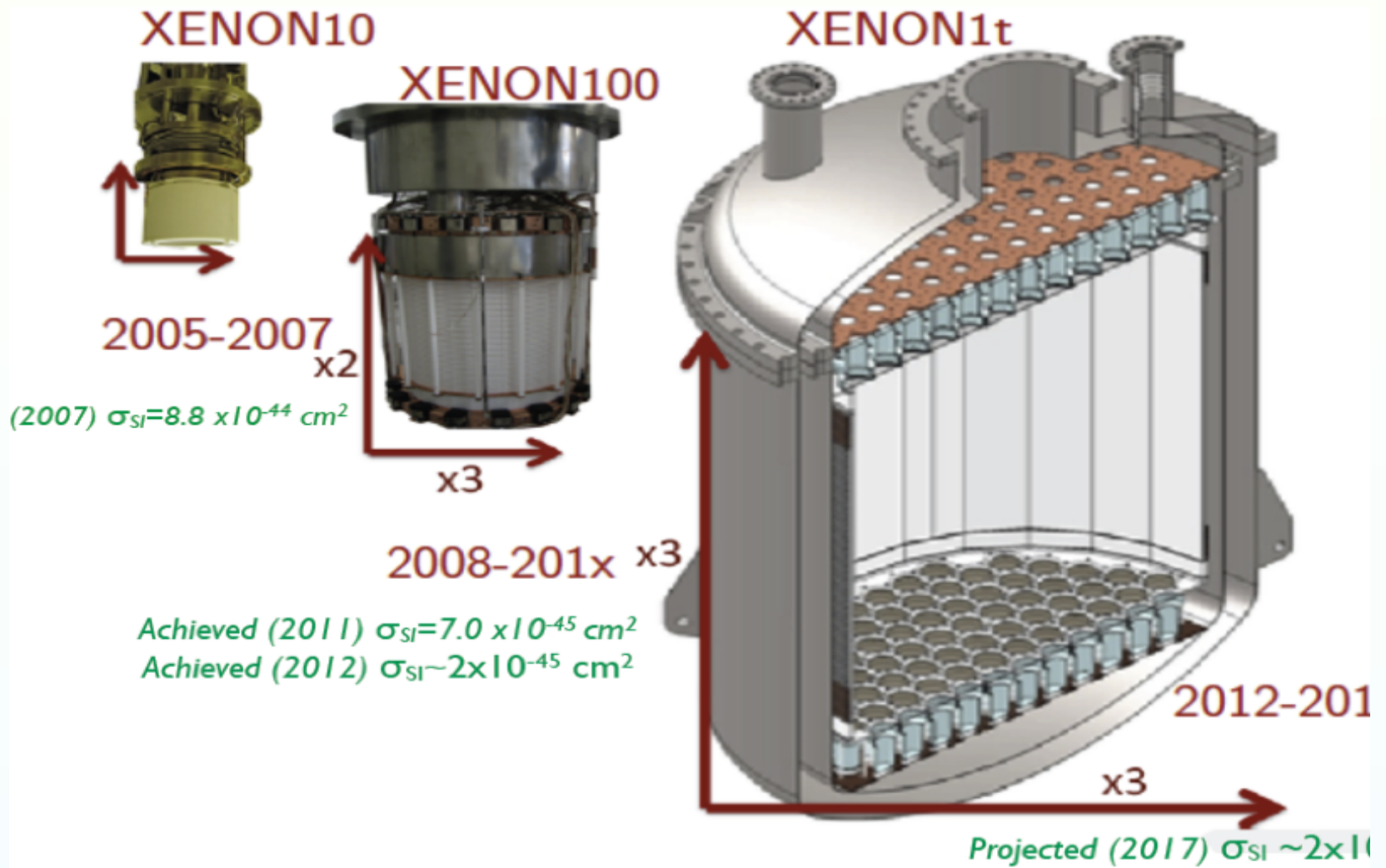
# Science Program - II

- **Dark Matter**
  - DAMA/LIBRA
  - Xenon
  - DarkSide
  - **Cresst**

# DAMA/LIBRA – annual modulation

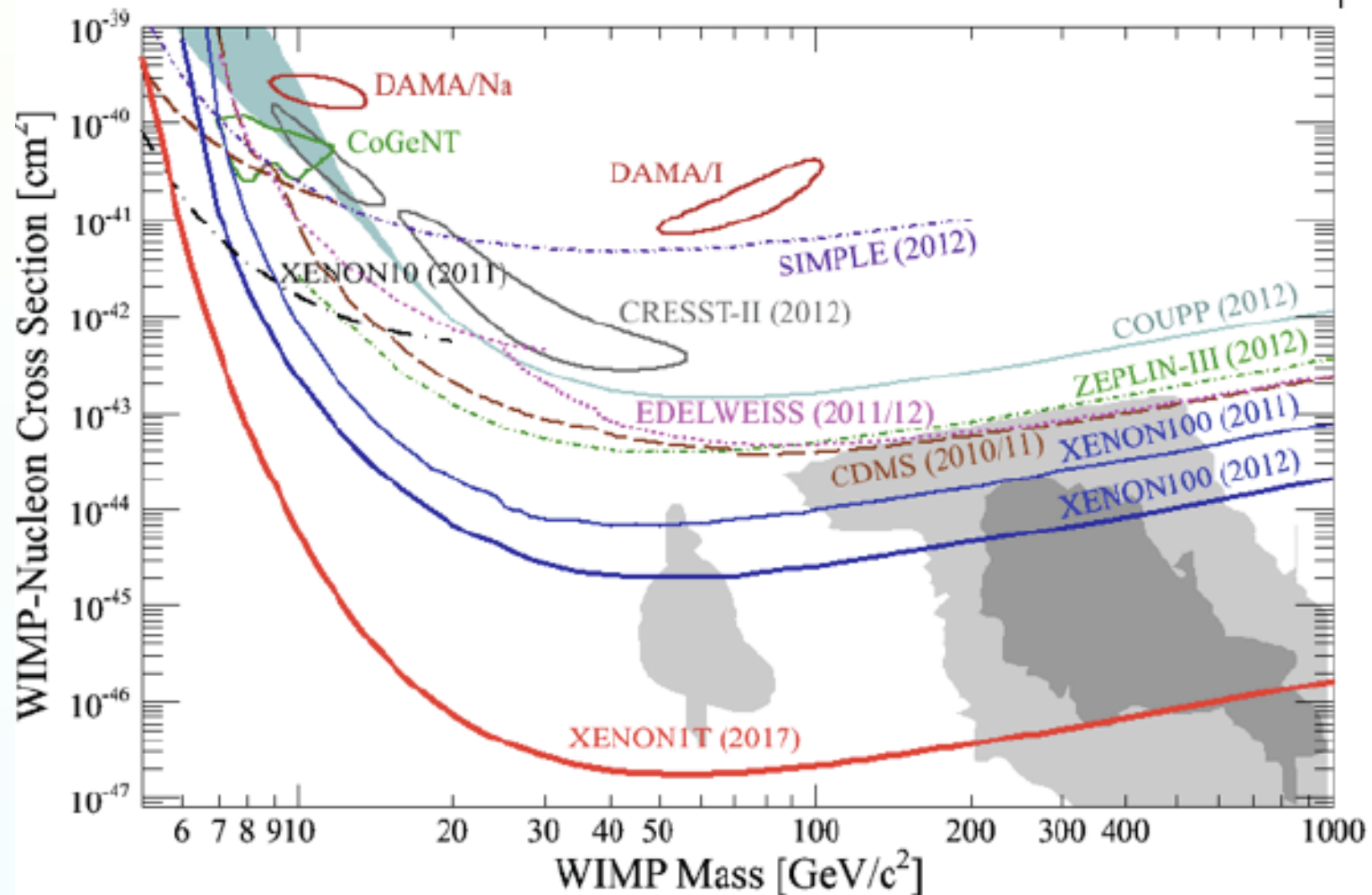


# Xenon family



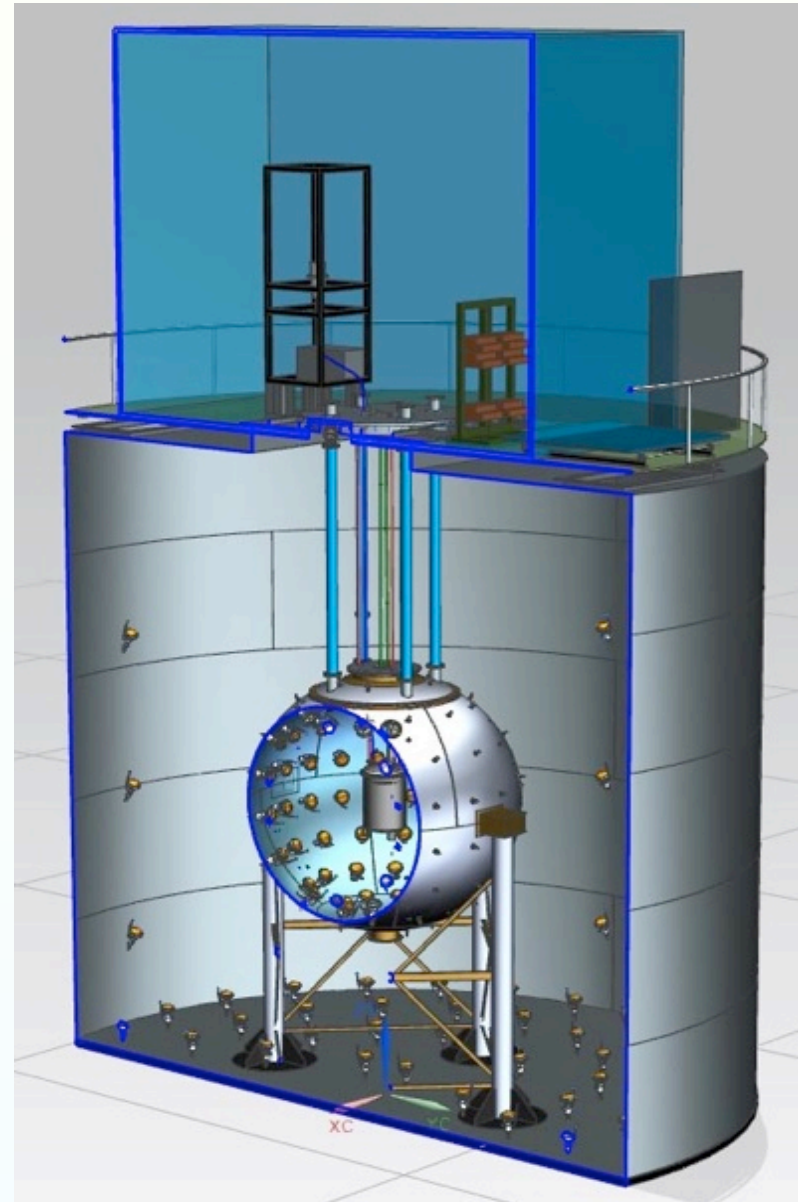
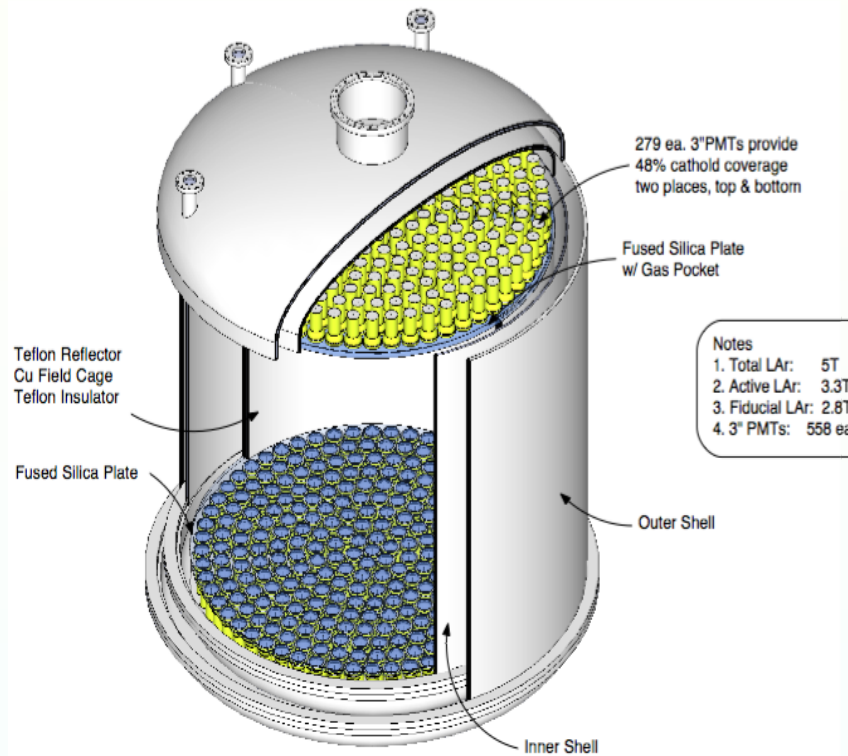
# XENON1T Sensitivity

- Expected limit after 2T-years

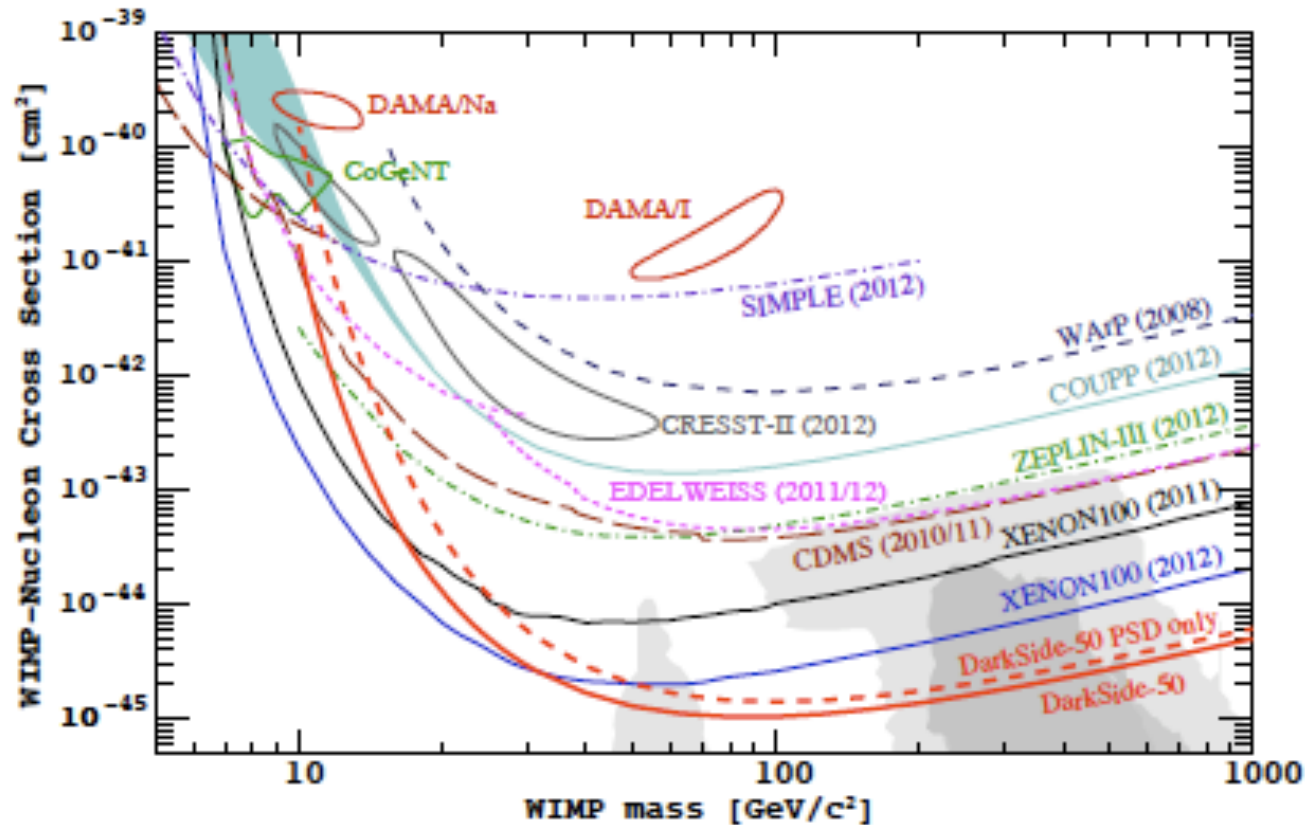




# Dark Side



# DarkSide Program



- **DarkSide-50 ( $2 \times 10^{-45} \text{ cm}^2$ )**
  - **Funded by DOE, INFN, NSF**
- **DarkSide-G2 ( $2 \times 10^{-47} \text{ cm}^2$ )**
  - **R&D funded by NSF (May 1 2012)**

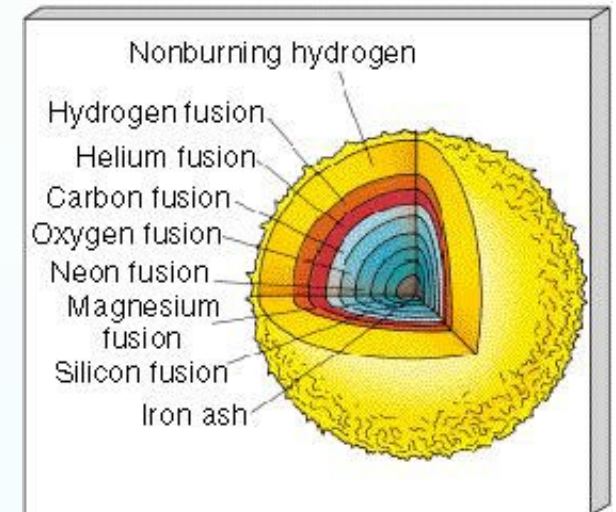
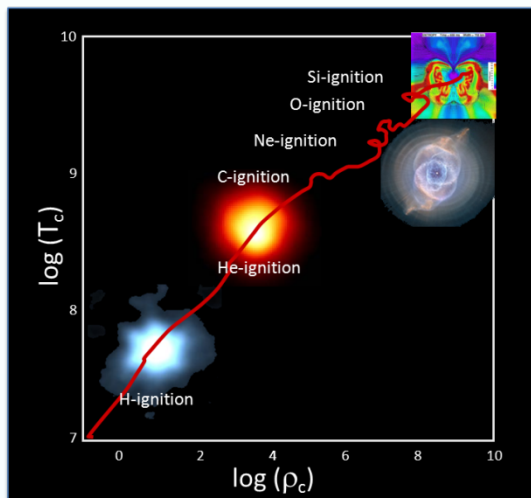
# Science - III

- **Test of fundamental principles**
  - VIP: Pauli exclusion principle
  - Ginger: General Relativity
- **Nuclear Astrophysics**
  - LUNA / LUNA-MV

# The LUNA experiment

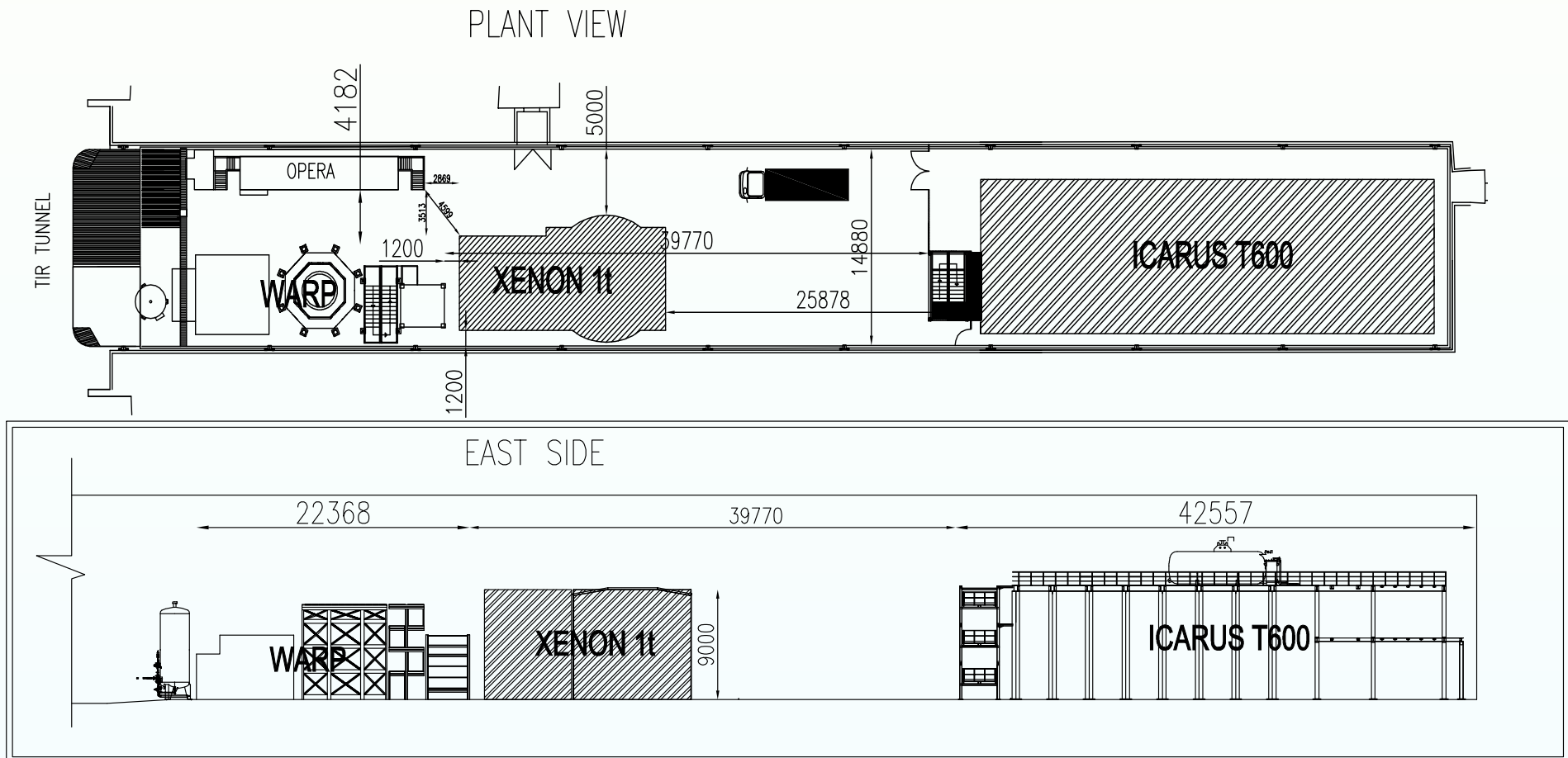
## nuclear fusion reaction cross sections

- Stars powered by nuclear reactions
- Key parameters to model stars
  - chemical composition, opacity...
  - reactions cross sections
    - determine the origin of elements
    - stellar evolution and dynamics
  - Many reactions need high precision data.



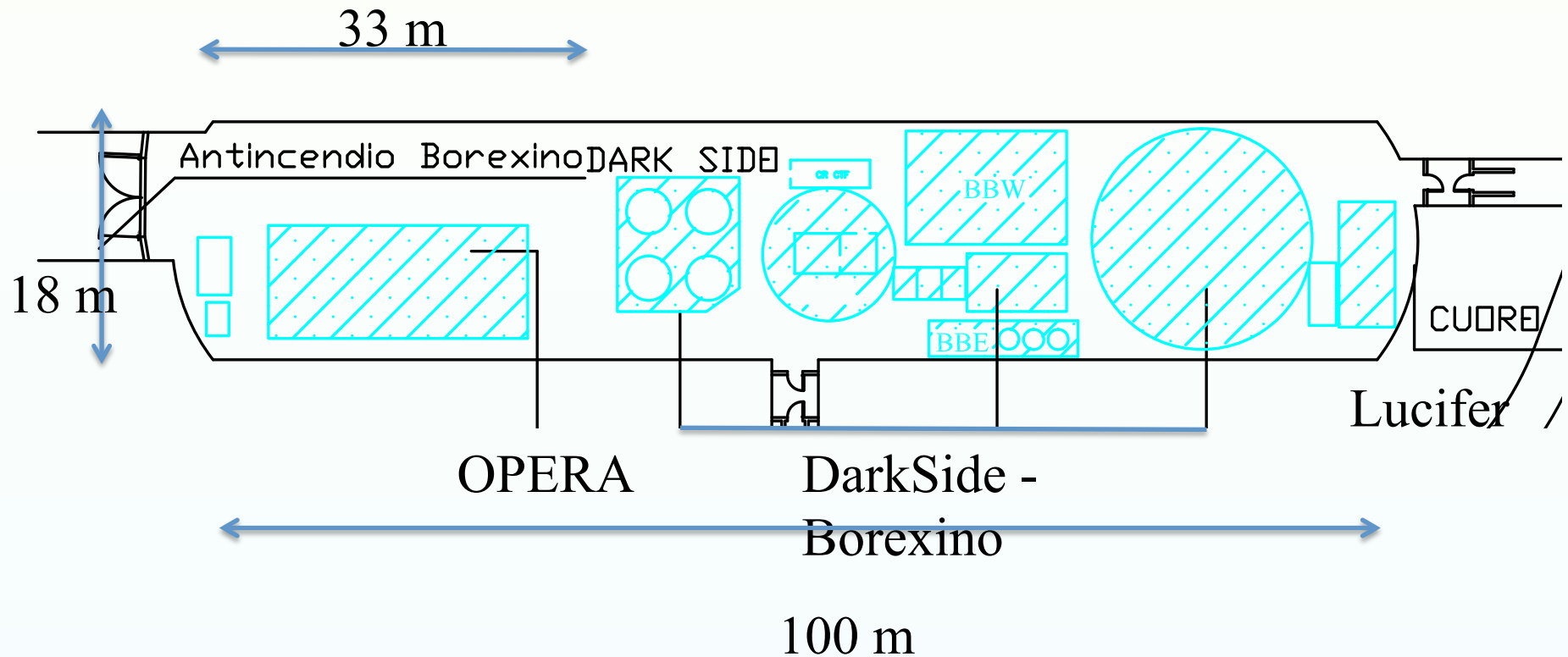
# Hall b

- Icarus decommissioning: June 2013 -> October 2014



# Hall C

Opera dismantled by January 2017



# An International Laboratory welcomes you

