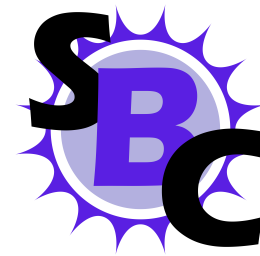
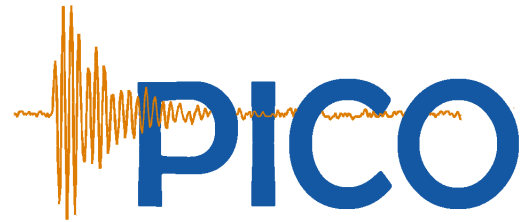


Instituto de Física
Universidad Nacional Autónoma de México



Eric Vázquez Jáuregui
Instituto de Física, UNAM

Research group at UNAM

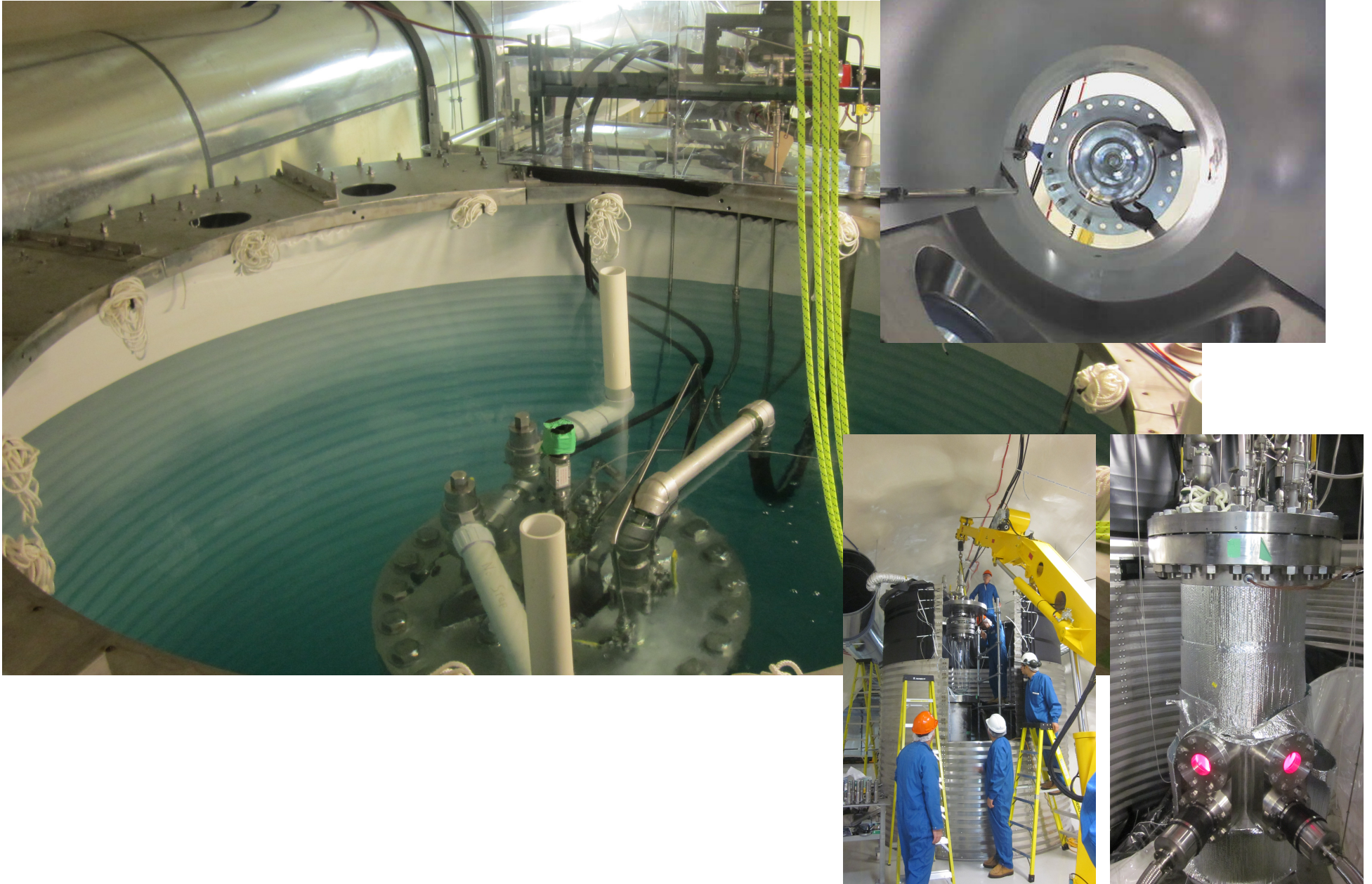
- PICO and SBC: Backgrounds and Simulations
- Analysis: NREFT theory of dark matter in PICO and DEAP
- Analysis: Physics reach of the scintillating bubble chamber in SBC
- Lab DM- ν , instrumentation and spectroscopy at IFUNAM

4 Ph.D., 2 M.Sc., and 3 undergraduate students

COUPP60 and PICO-60

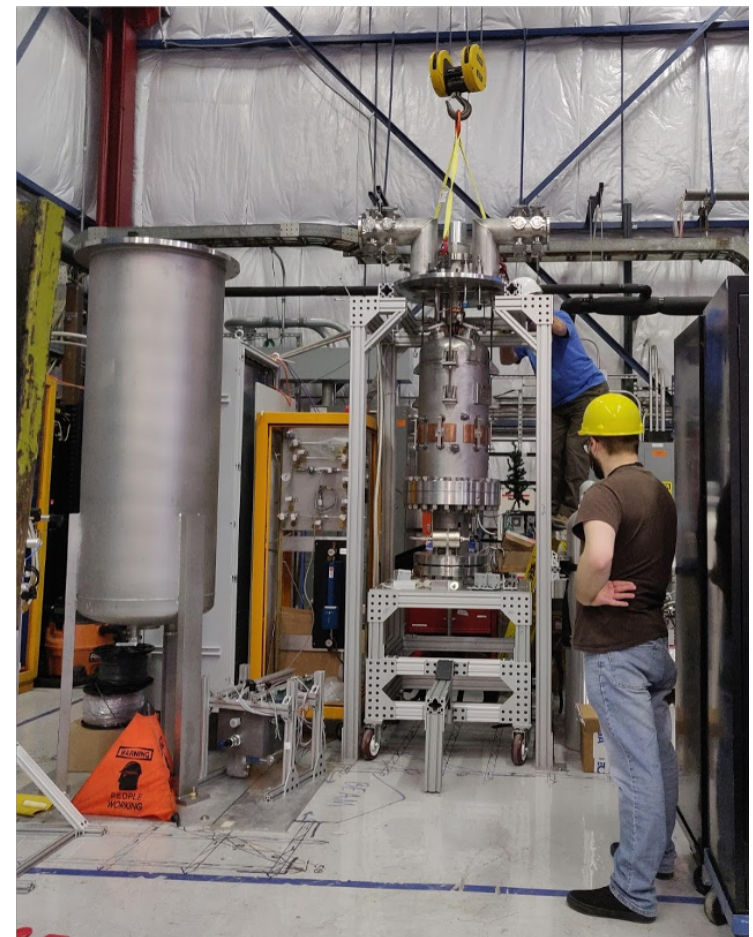
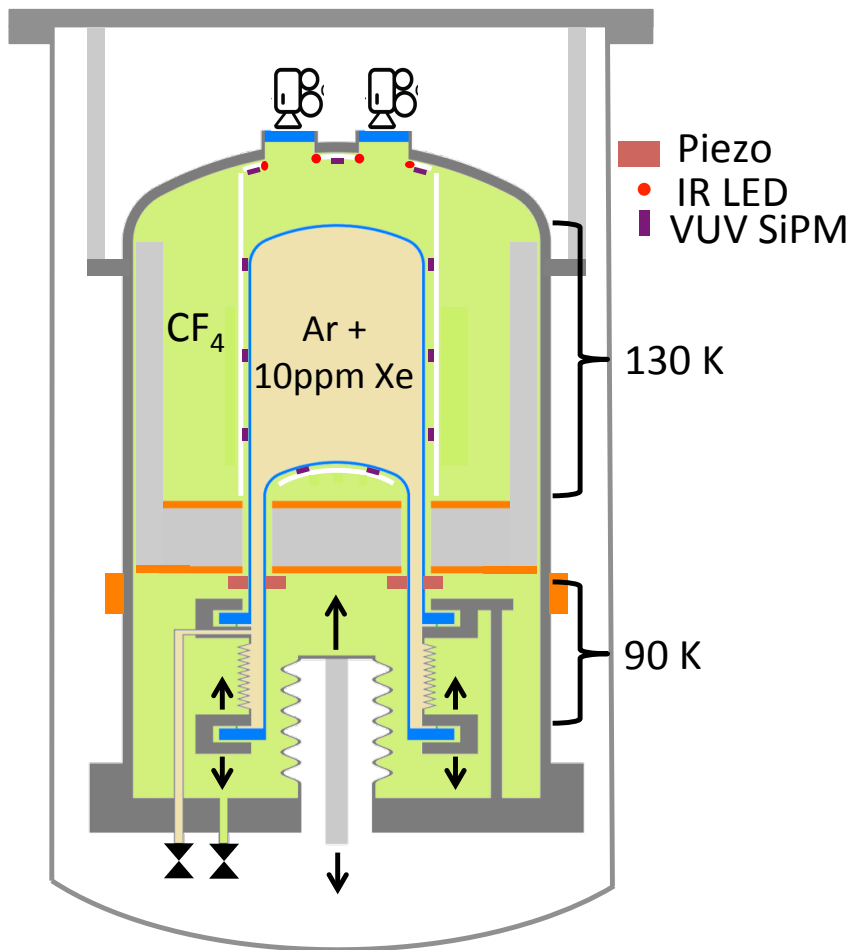


COUPP60 and PICO-60



10 kg liquid Argon bubble chamber: 100 eV threshold

- Ar + 10-100 ppm Xe target, 178 nm scintillation
- SiPMs immersed in hydraulic fluid (CF₄ at 130K)
- 20-360 psia (~1-25 bar) cycles
- Single-fluid, “right-side-up” geometry used by PICO-40L



DEAP-3600: NatGeo



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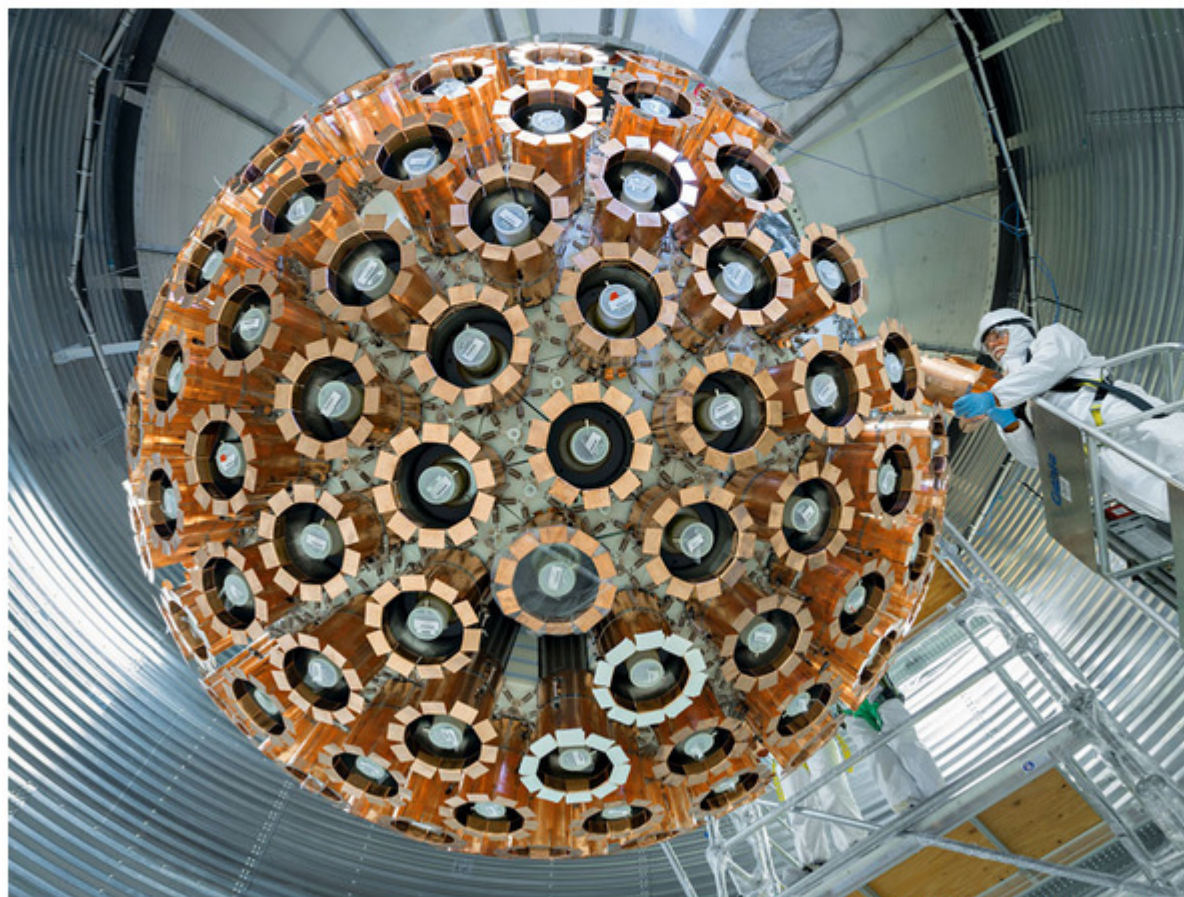
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A First Glimpse of the Hidden Cosmos

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As scientists map the universe, what they can't see—dark energy and dark matter—is key.



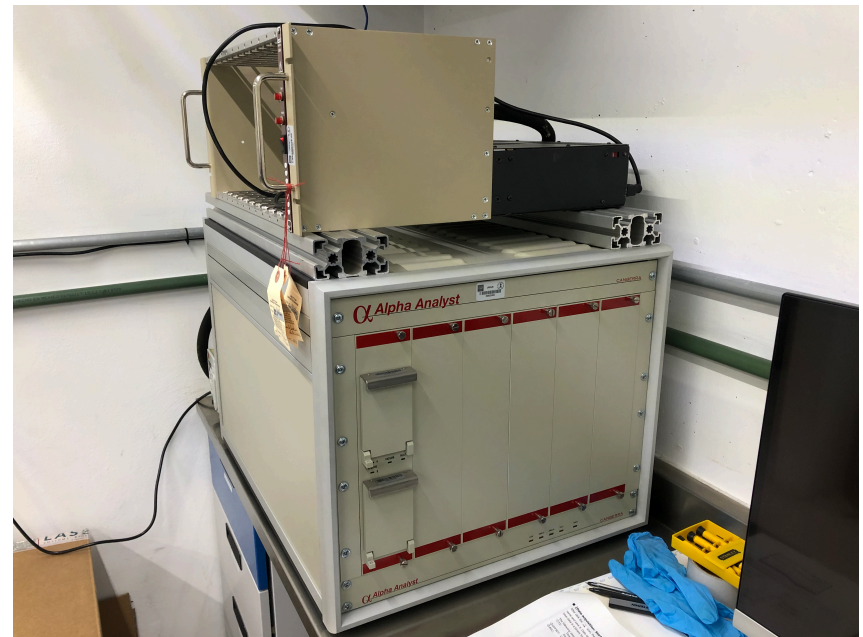
PHOTOGRAPH BY ROBERT CLARK

FIRST TO CAPTURE DARK MATTER ON EARTH? DEAP-3600, maybe the most sensitive dark matter detector yet, was installed last year more than a mile underground in a nickel mine in Ontario. Its spherical array of light sensors points inward, toward a core full of liquid argon. The hope is that dark matter particles striking argon atoms will trigger tiny flashes of light.

Lab DM- ν and spectroscopy at IFUNAM

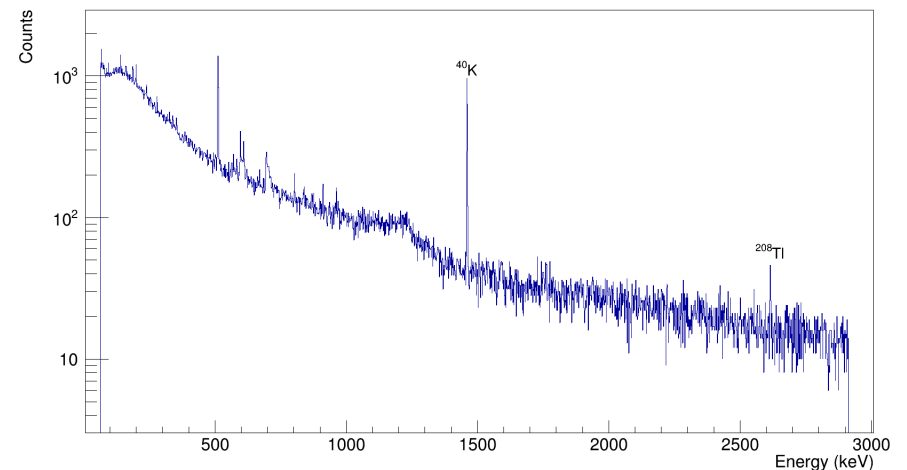
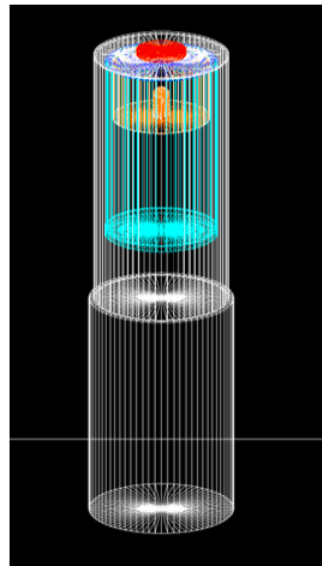
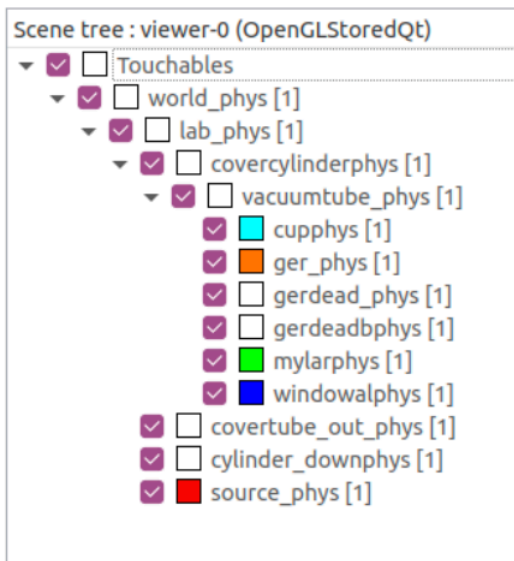
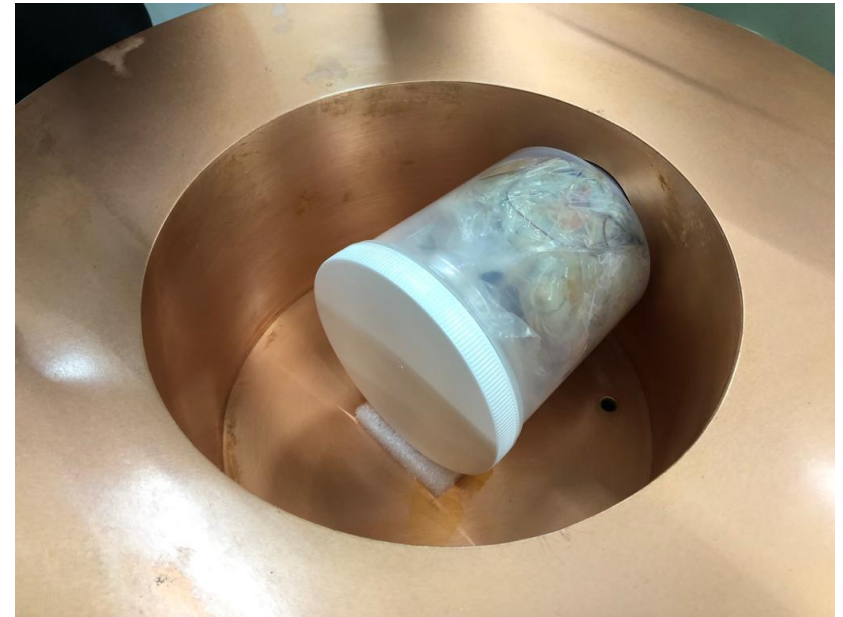
Spectroscopy and low background counting at IFUNAM

- Germanium detectors:
Gamma assay
- Alpha counters:
alpha spectroscopy
- Assay programme at IFUNAM
coupled to shallow UG lab
- Applications to
environmental radioactivity



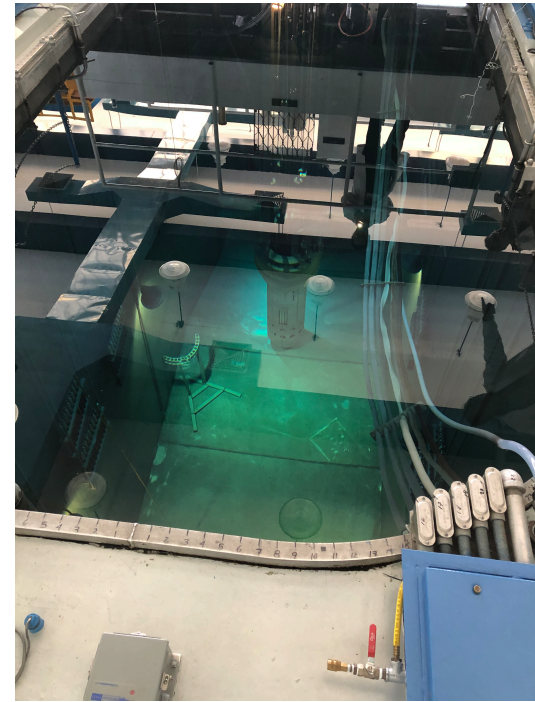
Detector characterization and Monte Carlo simulations

- Four Germanium detectors:
two undergrad thesis
- Laboratory courses:
environmental radioactivity
- Several projects:
prototype bubble chamber
scintillator detector



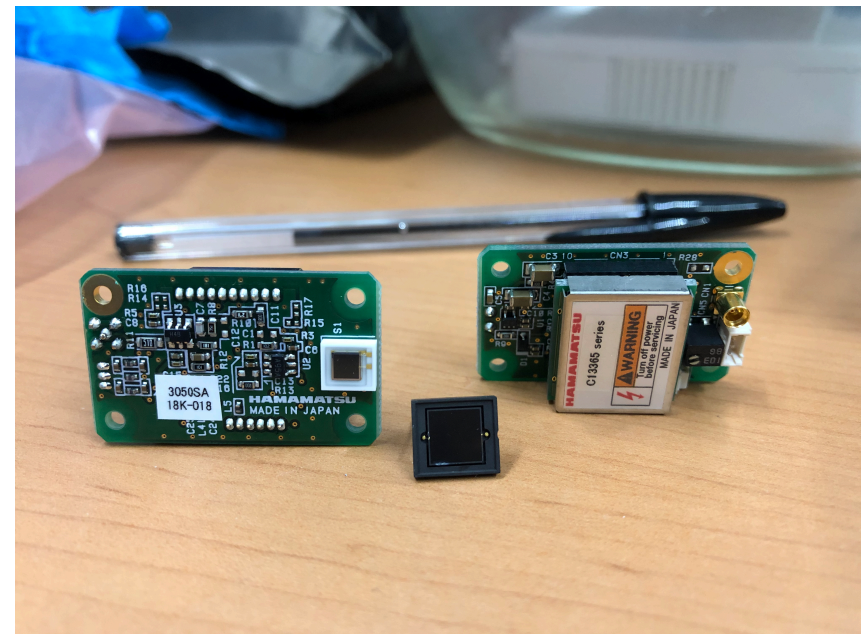
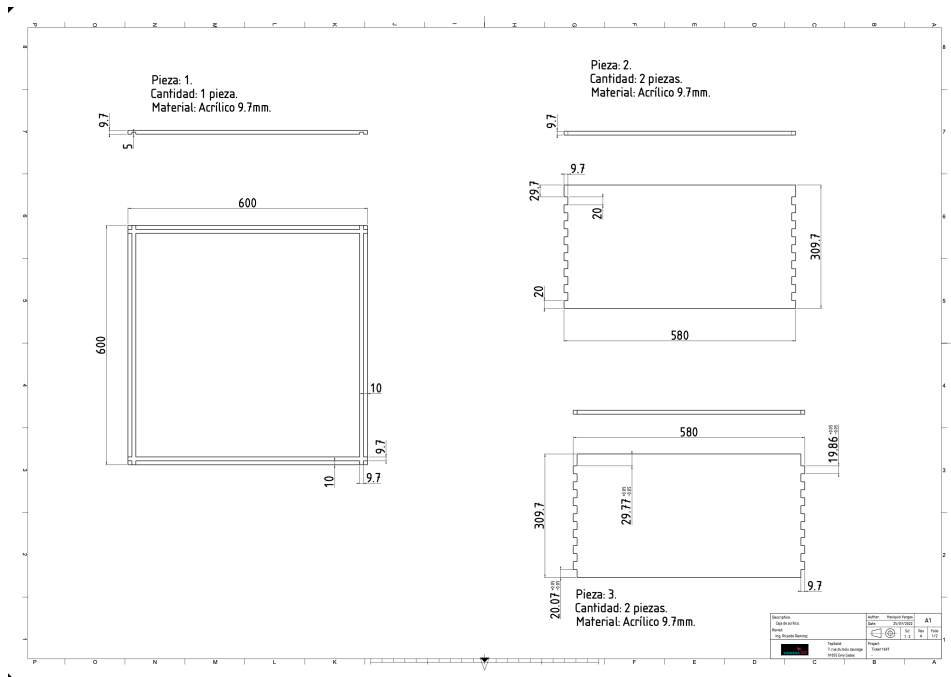
Scintillator detector at ININ: 1 MW movable reactor

- Liquid scintillator detector:
Two modules,
60cm x 60cm x 30cm,
100 lts per module,
0.25% Gd loaded scintillator
- Measure IBD:
Tagging coincidence,
 $\nu + p \rightarrow n + e^+$
- Background characterization:
Cosmic: neutrons, muons, γ 's
Reactor: neutrons and γ 's

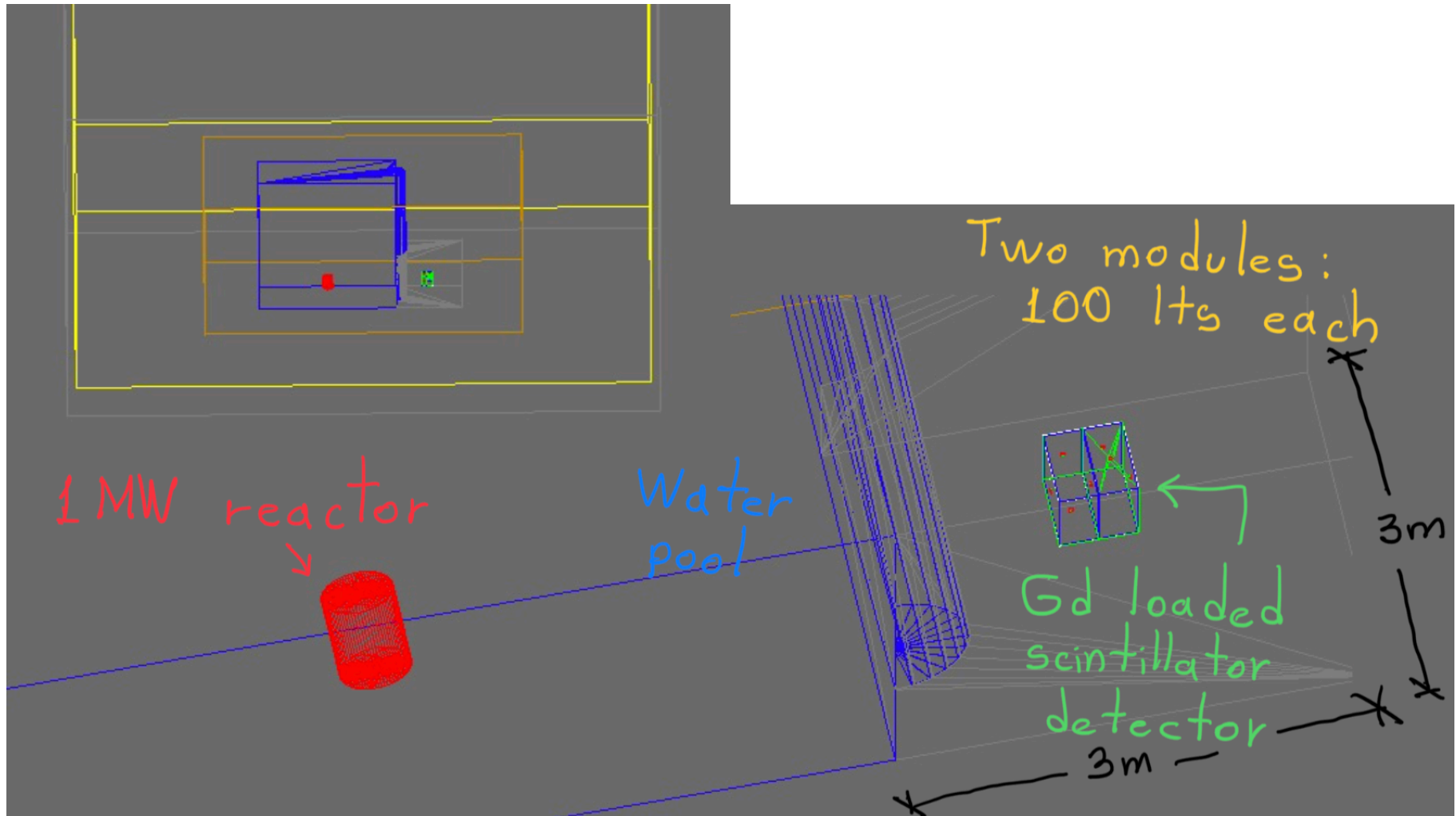


Scintillator detector at ININ

- Cast acrylic:
Gamma and alpha assay
- Light detection:
8 SiPMs, CAEN digitizer, MIDAS
Considering to install 8 extra SiPMs
Gamma and alpha assay

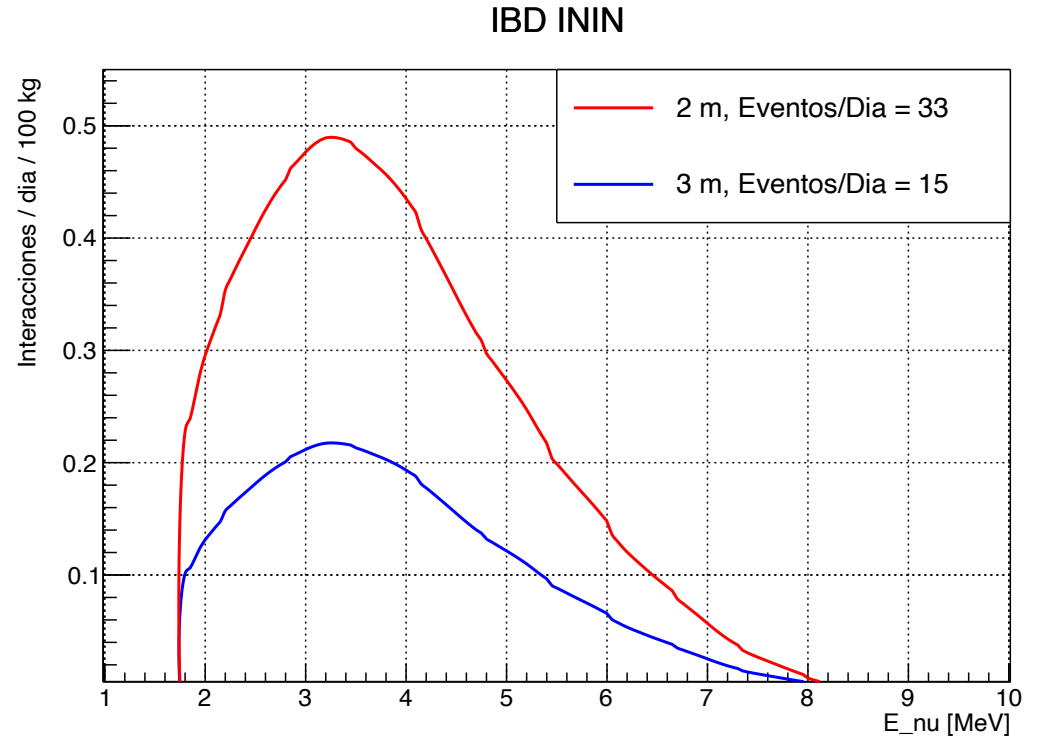
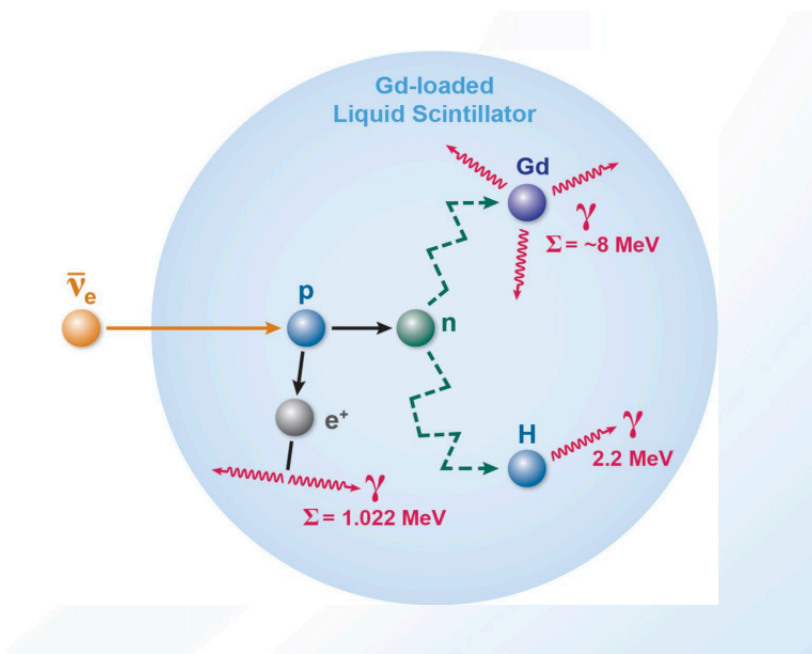


Detector design and modelling



GEANT4 simulations underway to estimate backgrounds from cosmogenics and reactor

Expected signal



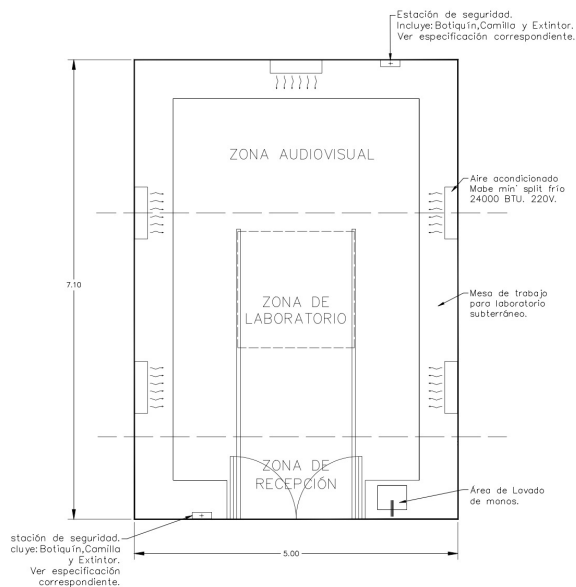
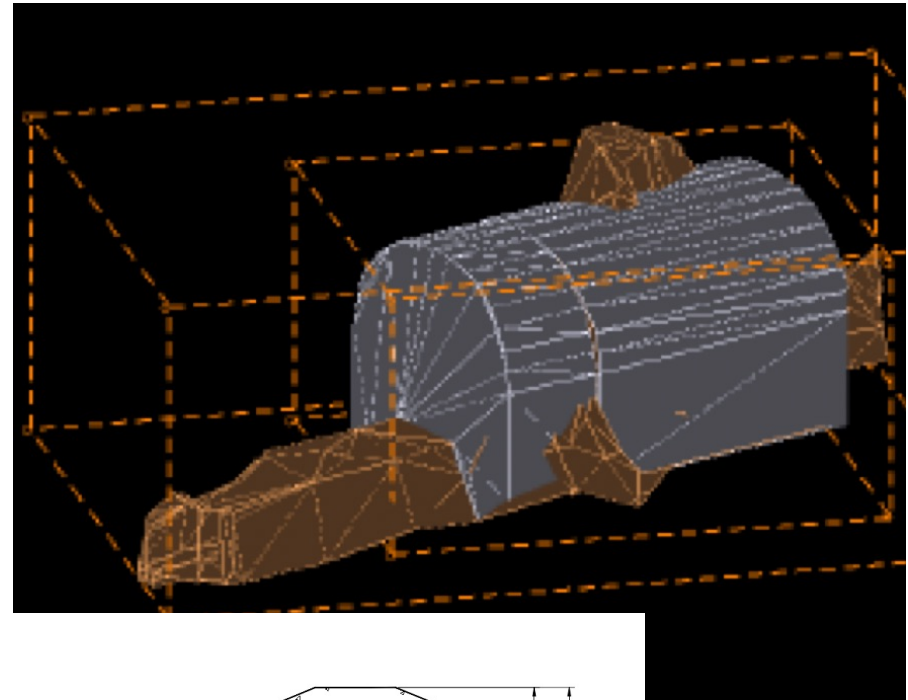
Background assessment in the vicinity of the reactor for SBC

LABChico proposal

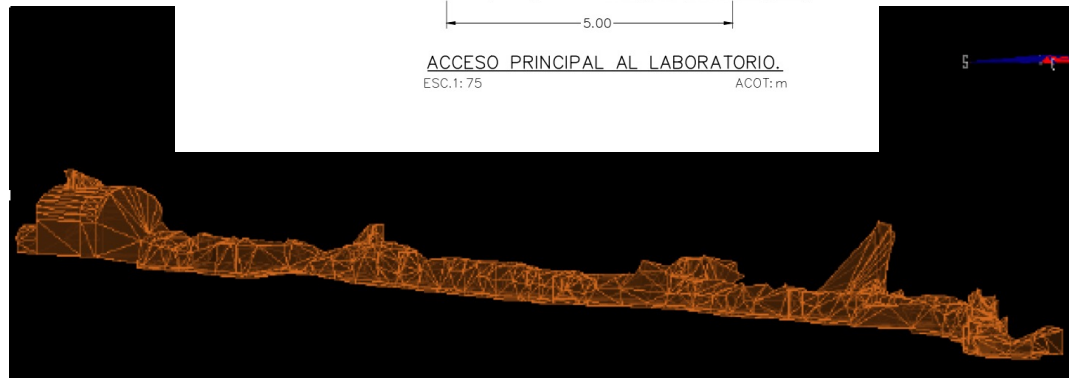
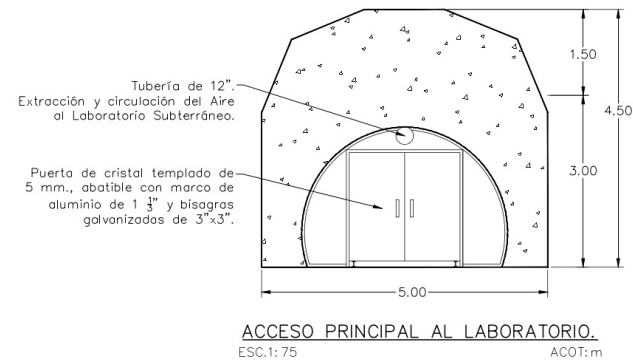
The laboratory

Characteristics

- Experimental area: approximately 25 m²
- Dedicated power line
- Temperature and humidity control (ISO9)
- Minimum overburden: 100 m
- Laboratory and visitor center outside the mine



PLANTA DEL LABORATORIO SUBTERRÁNEO:
UBICACIÓN DE AIRE ACONDICIONADO Y MOBILIARIO
ESC:1:75 ACOT:m

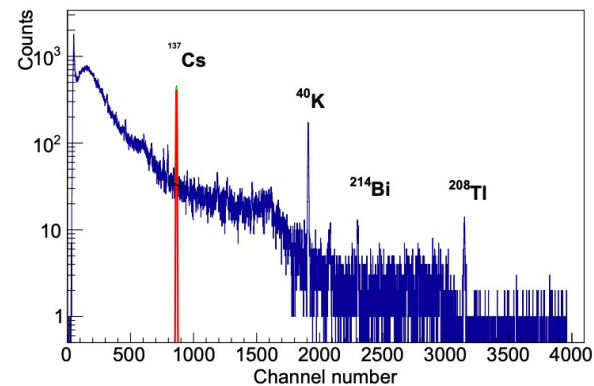
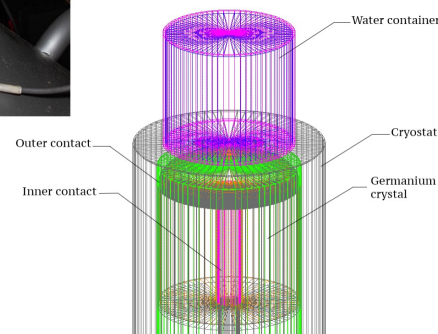
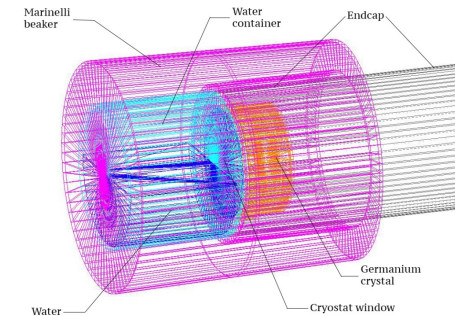
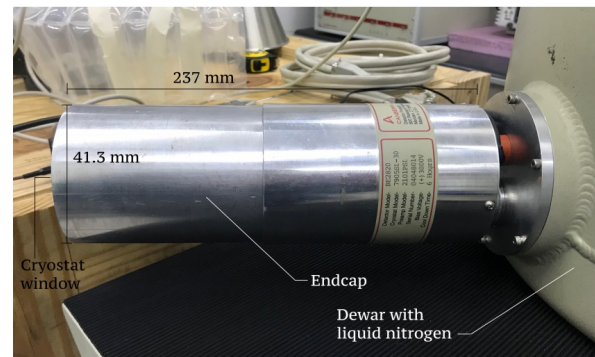
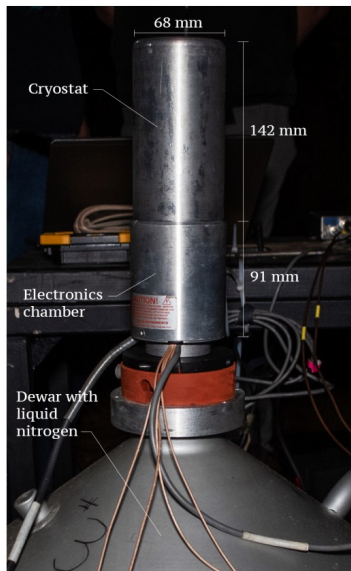


LABChico and DM- ν Lab at IFUNAM

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Gamma-ray assay facility

- One coaxial HPGe and one planar BEGe.
- Low background surface laboratories at ICN-UNAM and IF-UNAM.
- A. Aguilar-Arevalo *et al* 2020 *JINST* **15** P11014: “Characterization of germanium detectors for the first underground laboratory in Mexico”



Characterization of germanium detectors for
the first underground laboratory in Mexico

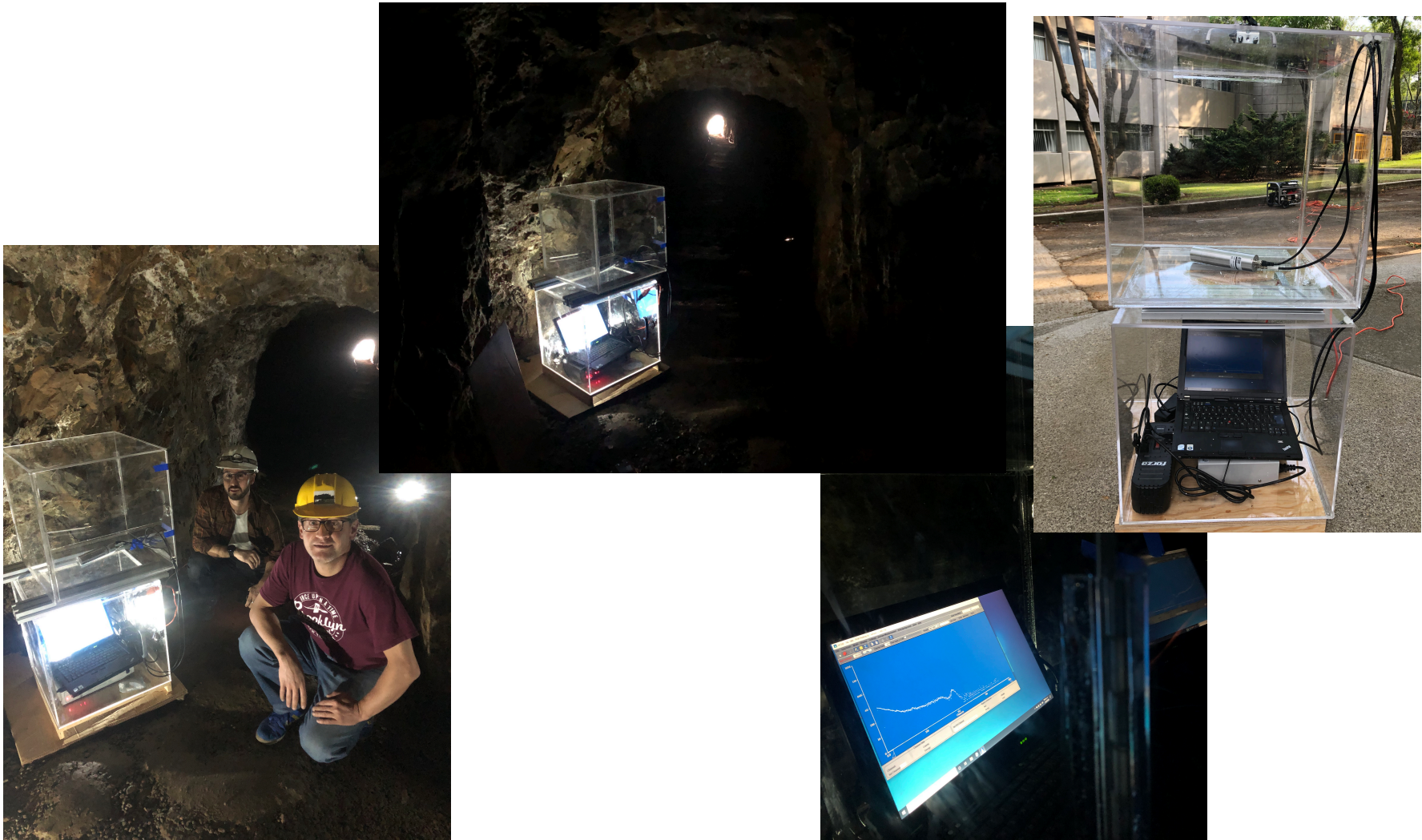
JINST 15(2020), P11014

Gamma backgrounds at LABChico

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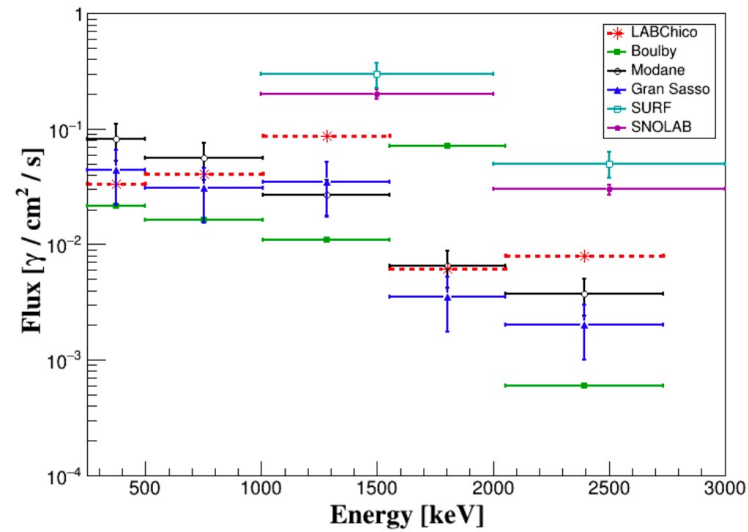
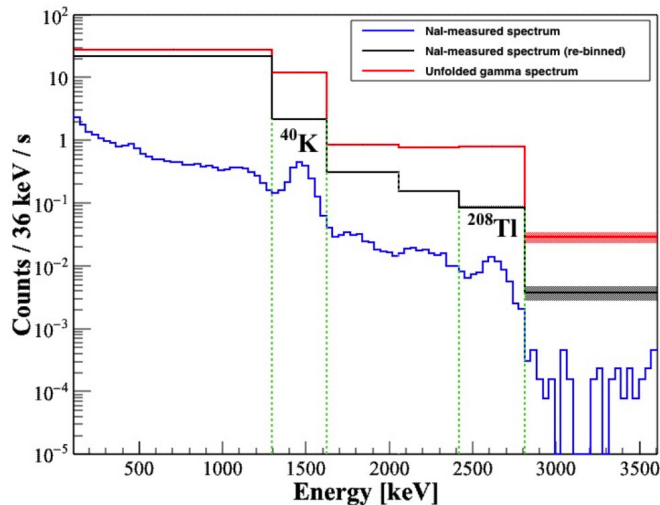
Gamma ray flux measurement, March 2020

- March 12-13, 2020, inside La Guadalupe mine.
- Gamma ray flux below 3 MeV measured with a NaI crystal.



Gamma backgrounds at LABChico

- Gamma ray flux below 3 MeV with a NaI crystal.
- Submitted to EPJP: “Gamma-ray flux measurement and geotechnical studies at the selected site for the LABChico underground laboratory”



Laboratory	Flux ($\gamma/\text{cm}^2/\text{s}$)	
	^{40}K	^{208}Tl (^{232}Th)
LABChico	0.0363	0.0016
SURF (Davis cavern)	<0.3600	<0.0560
SNOLAB	0.0590	0.0160
Boulby	0.0027	0.0001
Modane	0.0030	0.0007
Gran Sasso	0.0020	0.0004

Gamma-ray flux measurement and geotechnical studies at the selected site for the LABChico underground laboratory

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