

The DarkSide-20k experiment at GSSI

12th Astroparticle Science Fair: Underground Physics

12th February 2026

Oscar Taborda on behalf of the GSSI DarkSide group



(3D model of the detector)

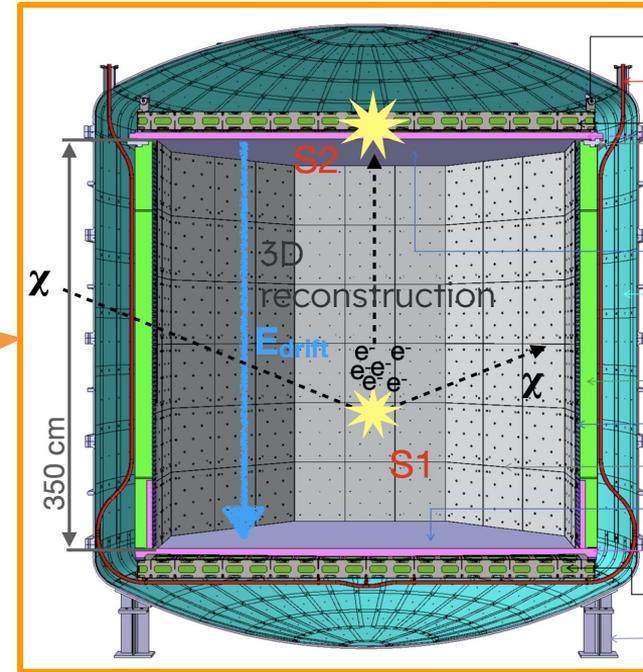
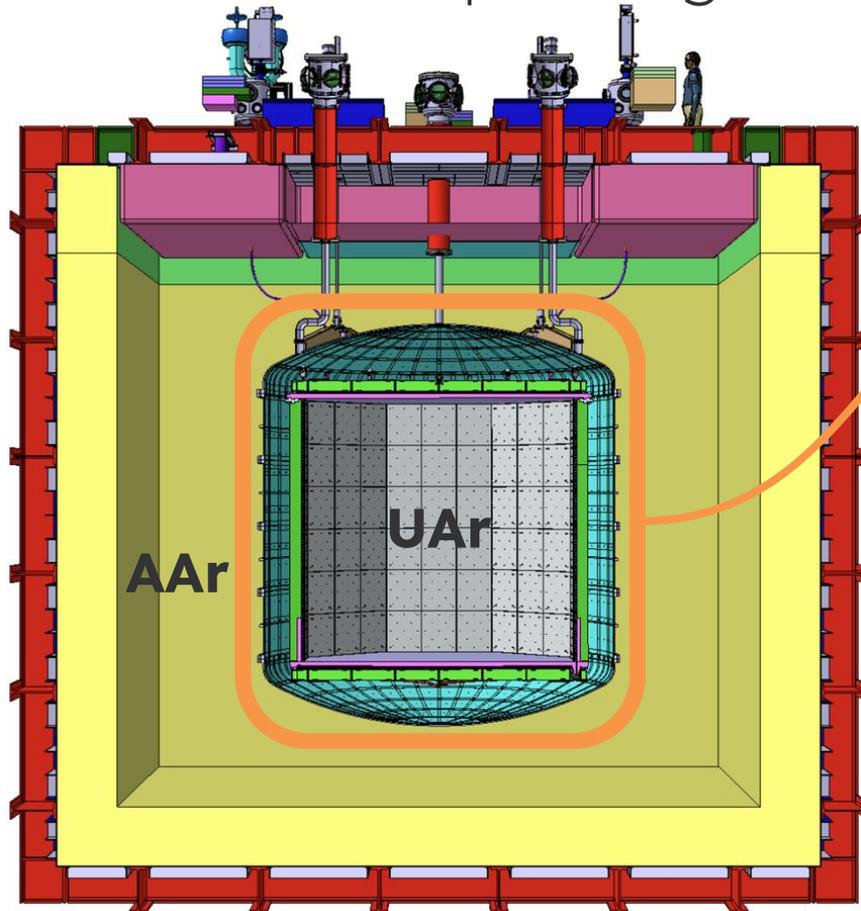
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Dark matter direct detection with DarkSide-20k: Dual Phase Liquid Argon TPC



Signal from WIMP

Nuclear recoil in liquid Argon

- **S1**: Liquid Argon scintillation (128nm) - **prompt signal**
- **S2**: Ionization electrons drifting to the top reaching gas phase -> **second light signal**

Need background free condition for discovery program

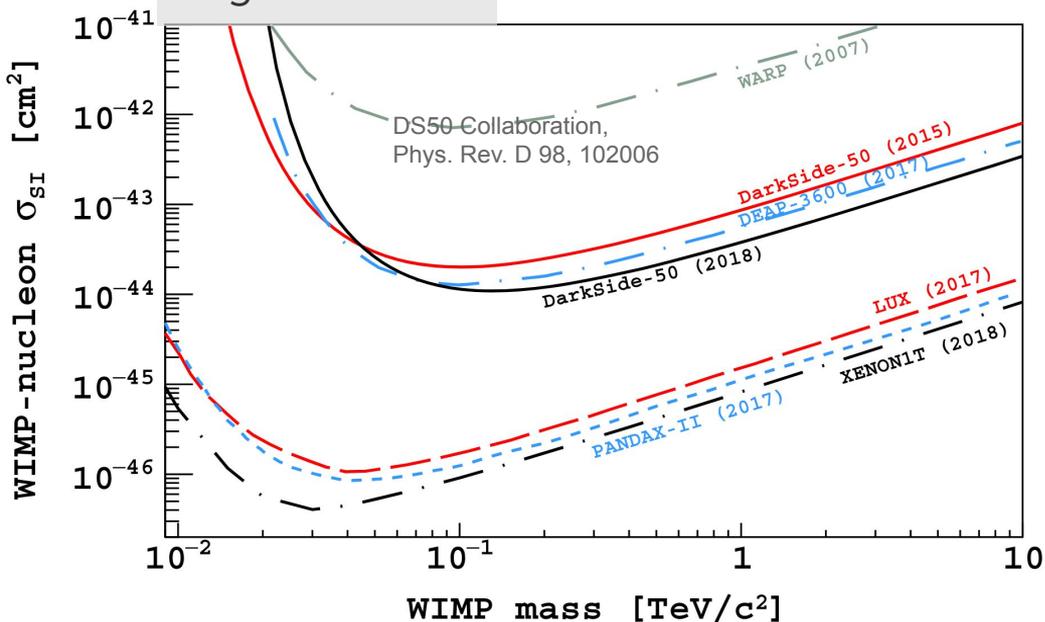
WIMPs Sensitivity with the DarkSide program

DarkSide-50
(final results)

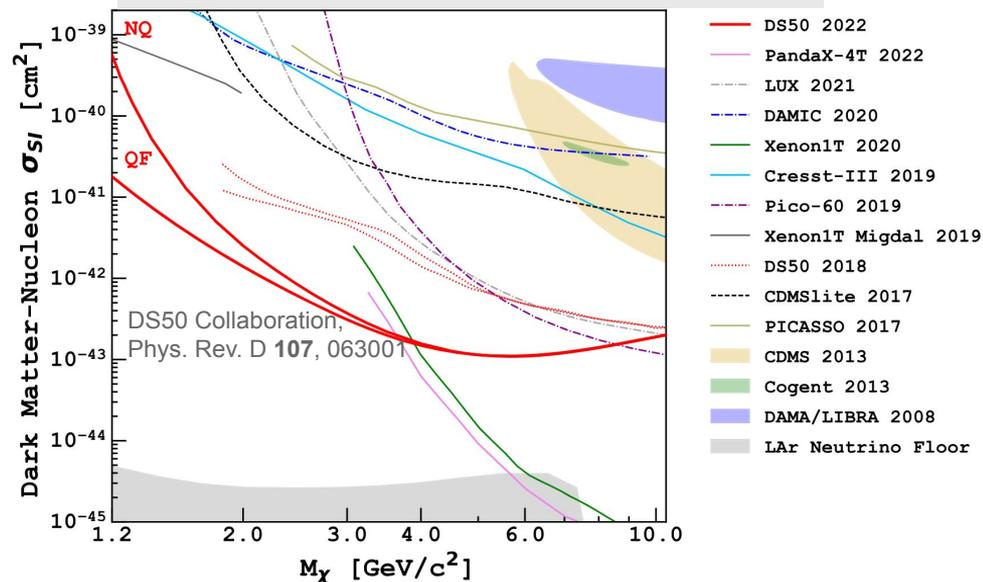
46 kg Ar
target mass



Bkg-free result



Ionization signal only study:
**World leading low mass
WIMPs limit**

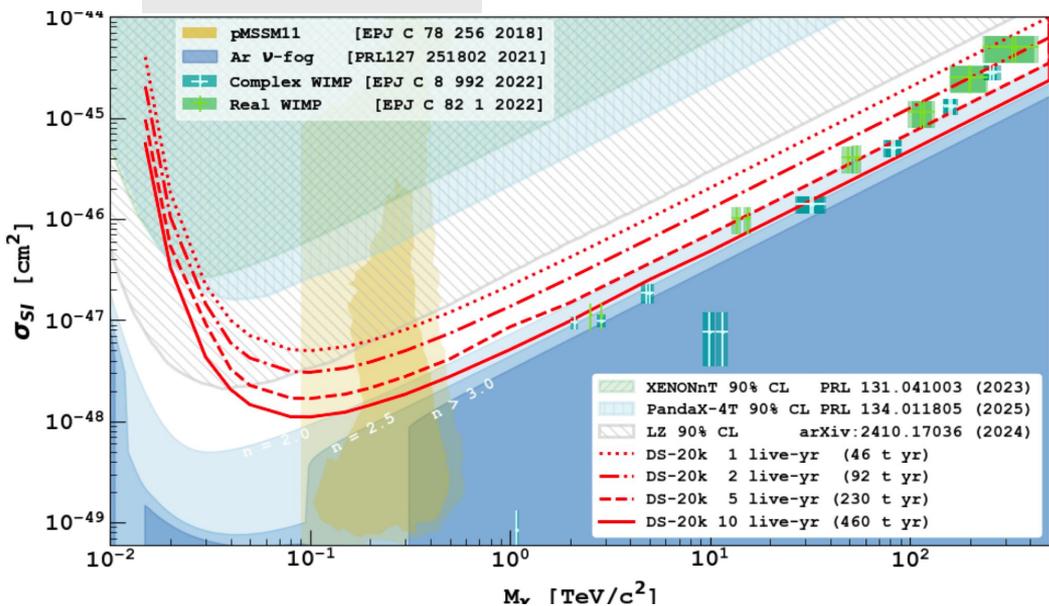


WIMPs Sensitivity with the DarkSide program

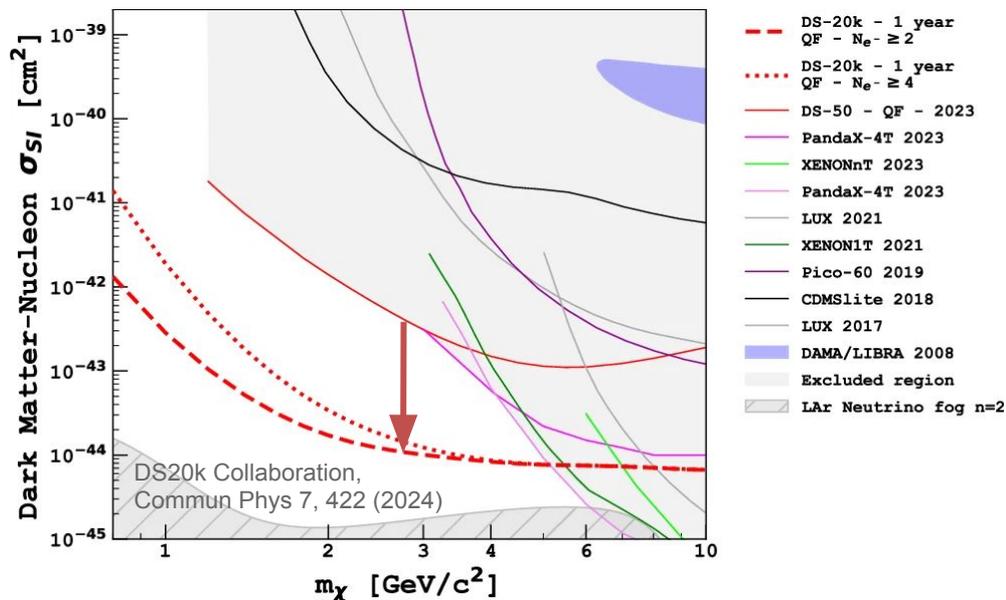
DarkSide-20k
(expected sensitivity)

20 tonne Ar
fiducial

Bkg-free result



Ionization signal only study:
~x100 improved sensitivity



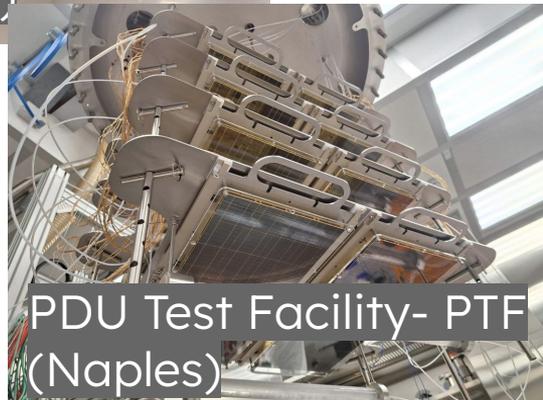
DarkSide-20k construction



LNGS Hall C



Nuova Officina Assergi
Clean room (LNGS)



Activities at GSSI

- QA/QC methods for the PDU production
- Photo detectors database and SW infrastructure
- Testing PDUs at PTF

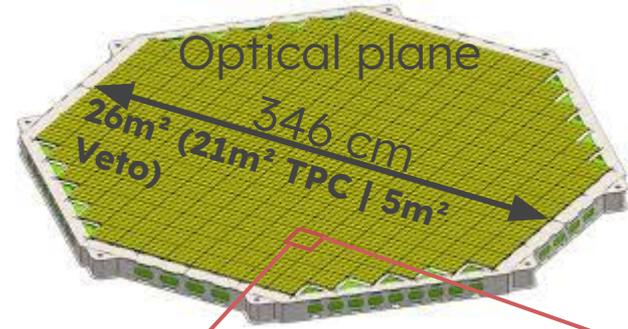
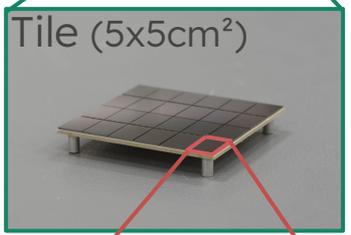
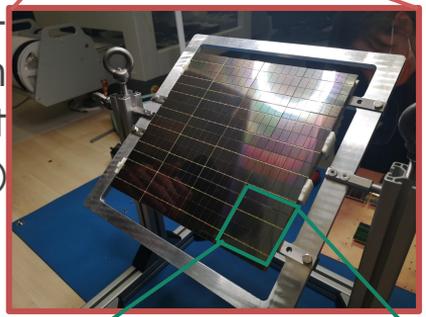
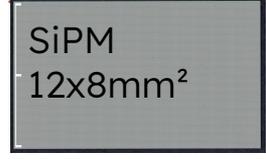


Photo-Detection Unit
(20x20cm²)

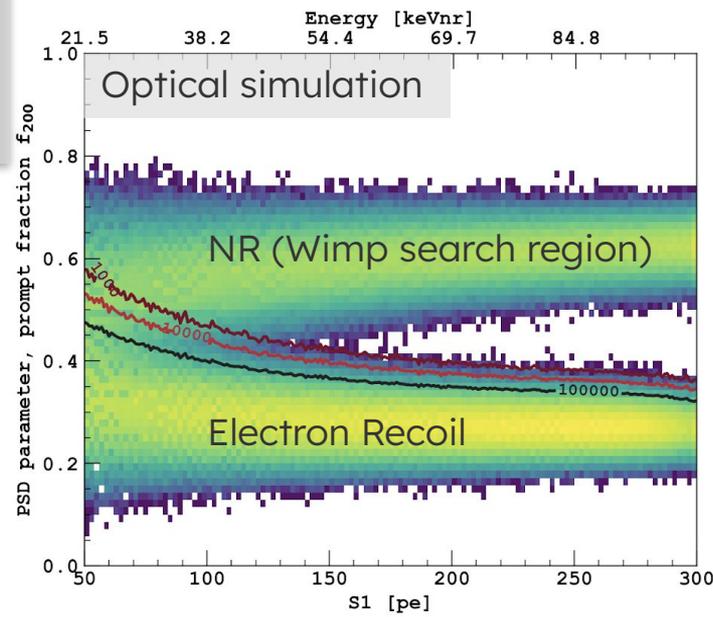
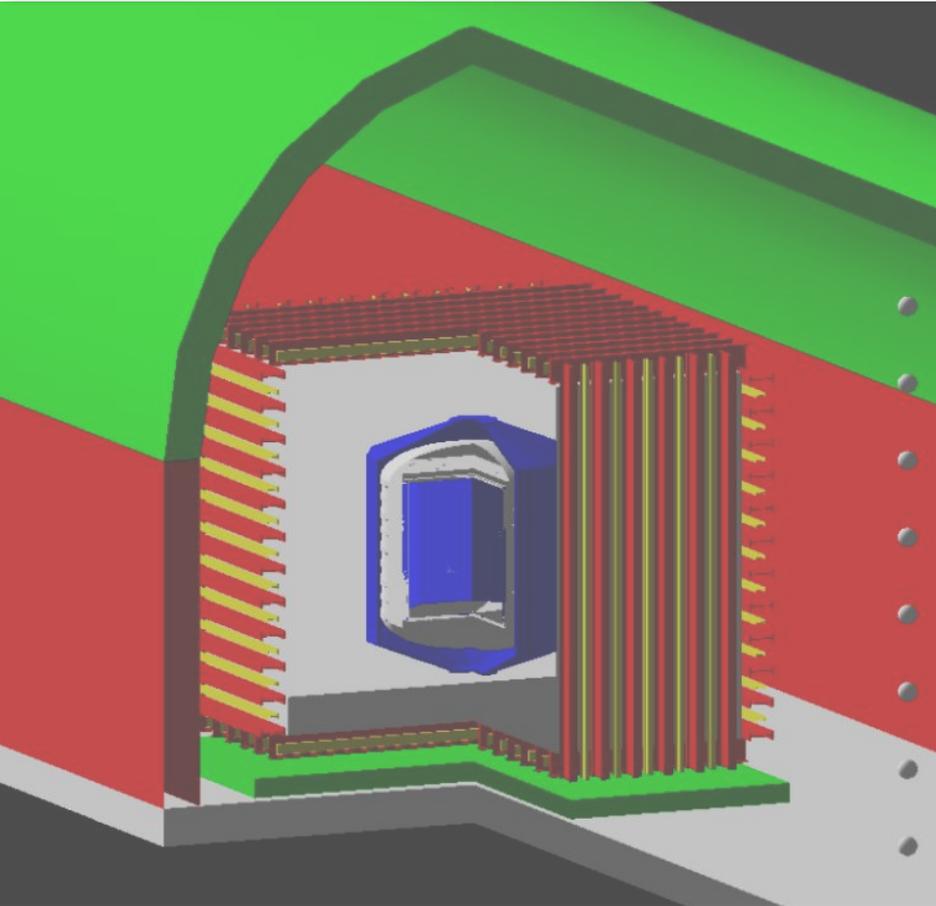


Tile (5x5cm²)



SiPM
12x8mm²

Activities at GSSI: Geant4 Simulation



Pulse Shape Discrimination

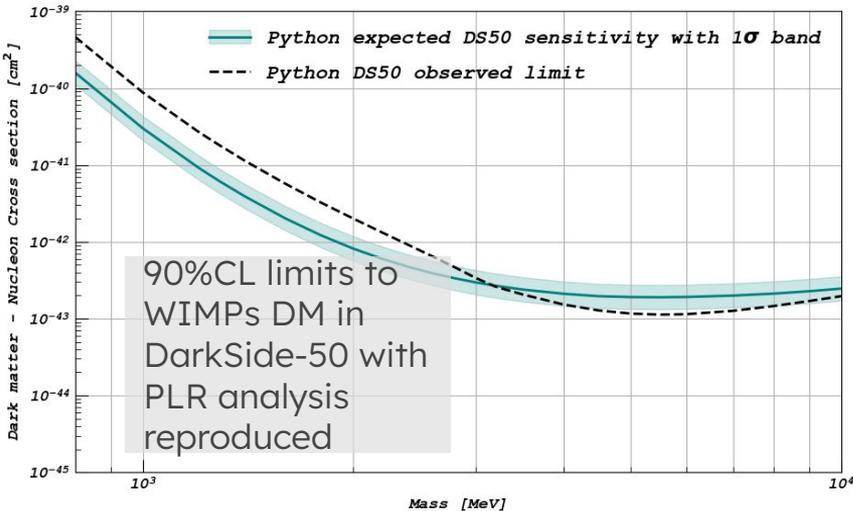
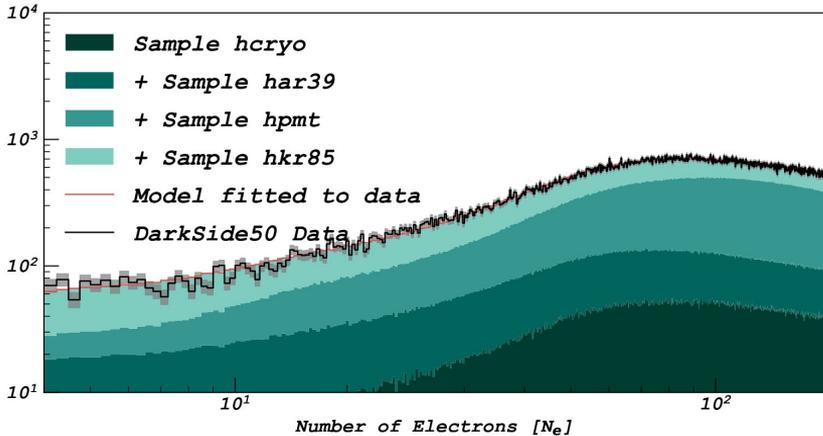
- Liquid Argon response allows discrimination between ER and NR
- Evaluate impact of SiPM parameters on PSD

Full detector simulation

- Background levels (NR and ER) from the detector materials, the Hall C, cosmic rays
- Use for detector design
- Base for sensitivity analysis

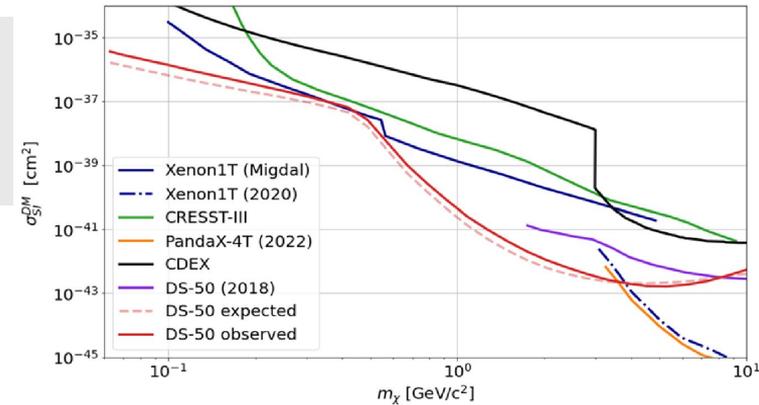
New python framework to compute sensitivity
(no dependence on ROOT and RooFit)

Background only fit

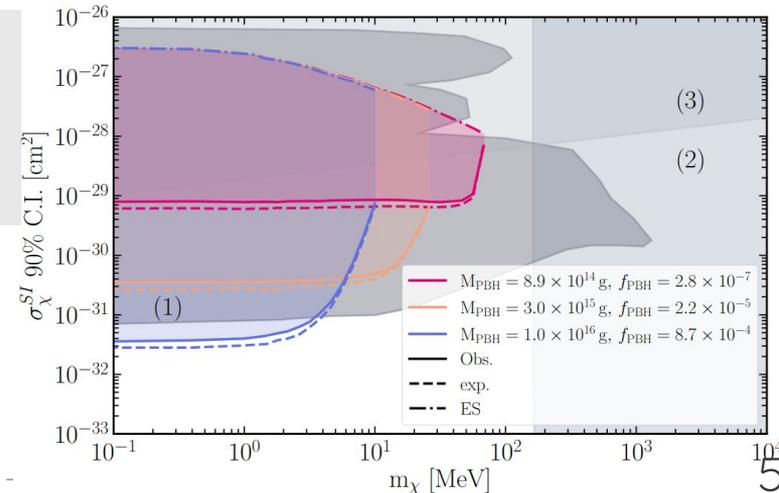


Activities at GSSI: Sensitivity studies

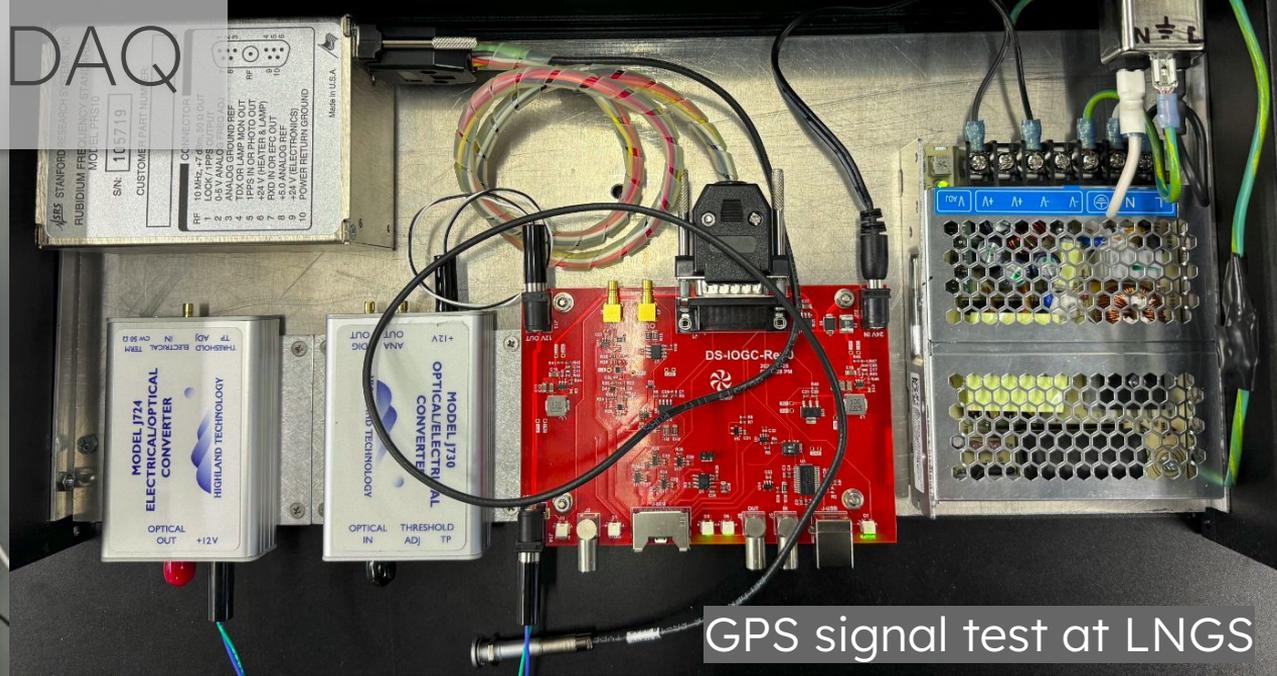
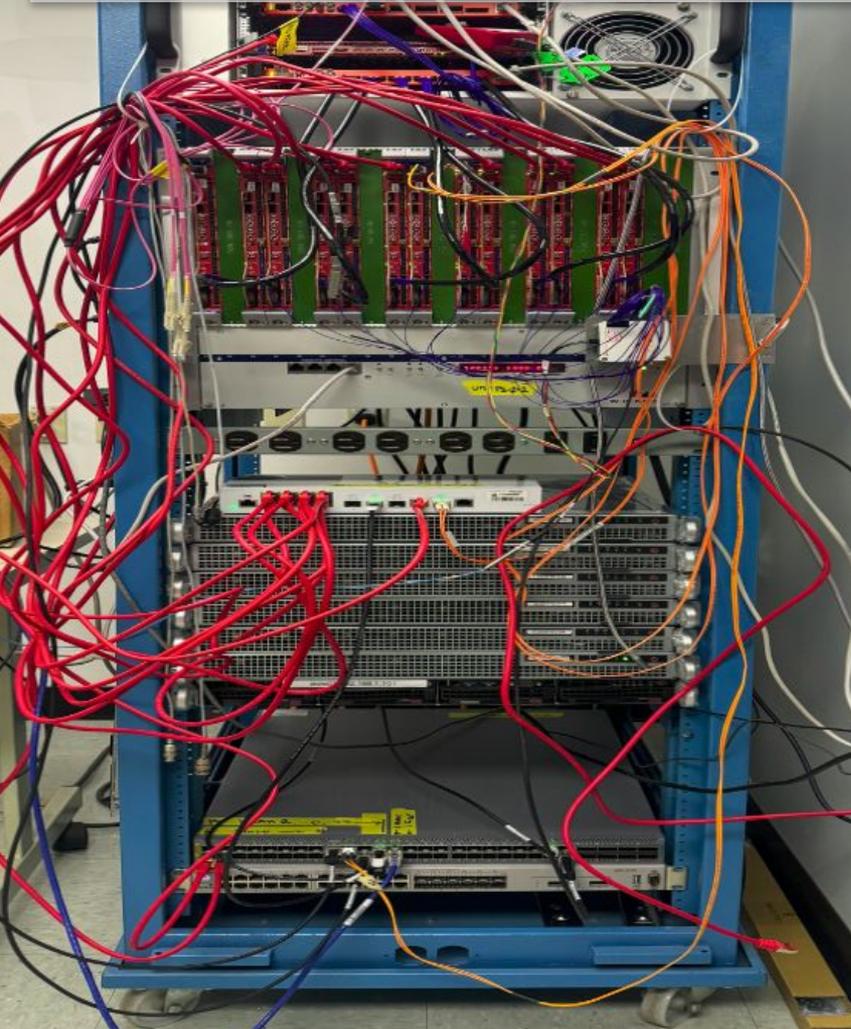
90%CL limits to WIMPs DM with Bayesian approach in DarkSide-50 ->



90%CL limits to DM from Primordial black holes with DS50->



Activities at GSSI: DAQ



GPS signal test at LNGS

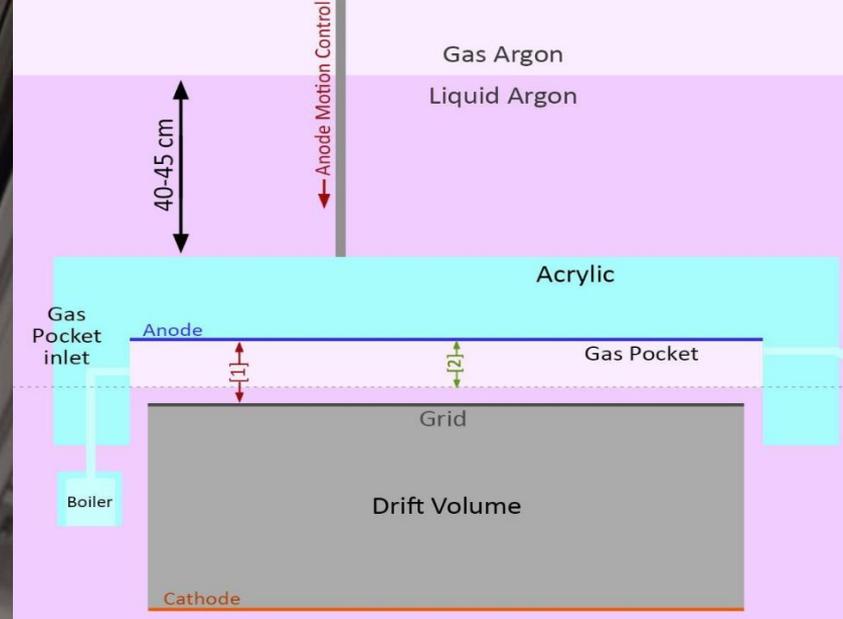
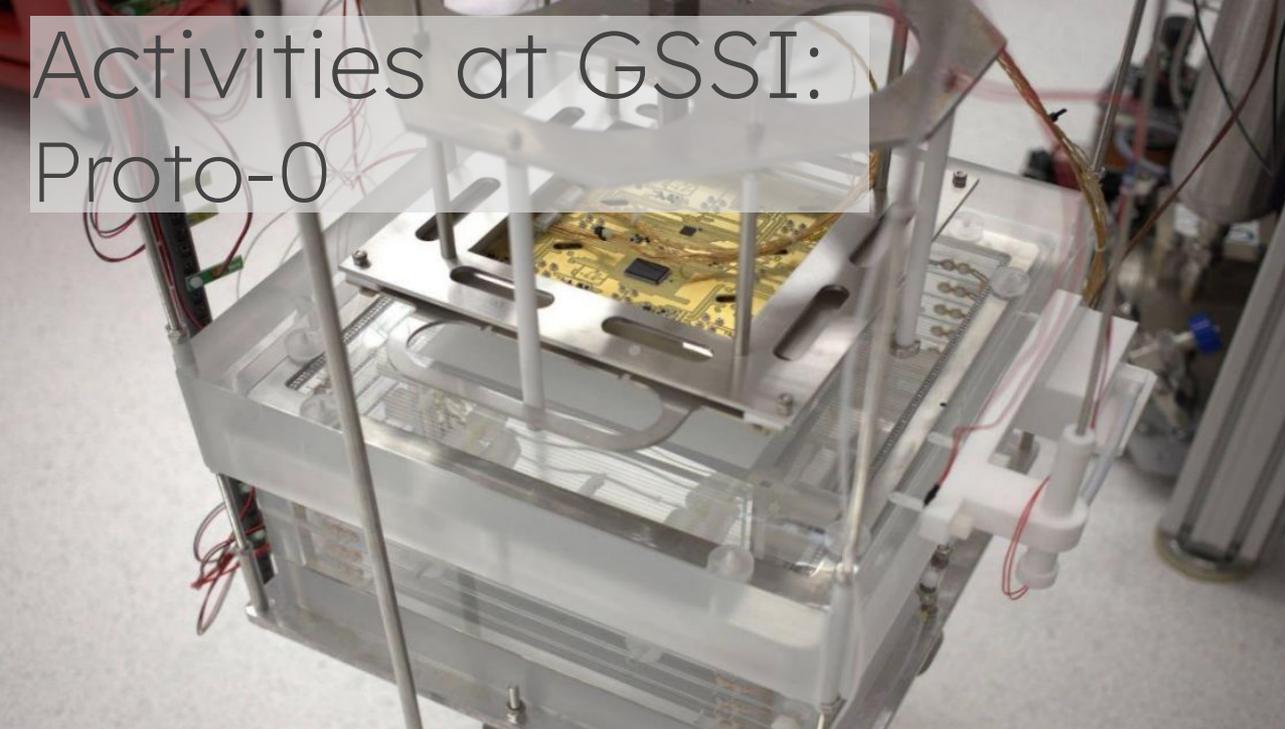
DAQ challenges

More than 2700 channels
Gbits of data per second
Precise timing

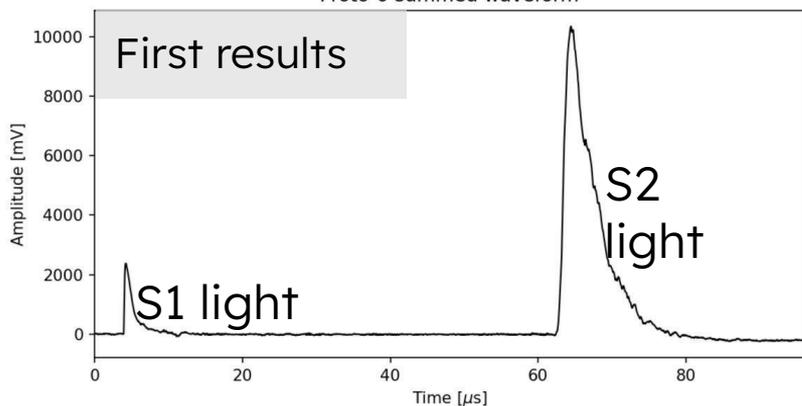
Responsible of DarkSide-20k

DAQ implementation in
collaboration with Triumf in
Canada

Activities at GSSI: Proto-0



Proto-0 summed waveform



Detector

Small Dual Phase LAr TPC (12cm drift)
Operated in Napoli
Results and analysis on going
First working TPC with DarkSide PDUs !

DarkSide people at GSSI



Mauro Caravati



Michele Angiolilli



Stefano Piacentini



Celín Hidalgo



Paolo Agnes



Camilla Salerno



Pablo Kunzé



Marek Walczak



Oscar Taborda

Thanks for your attention !