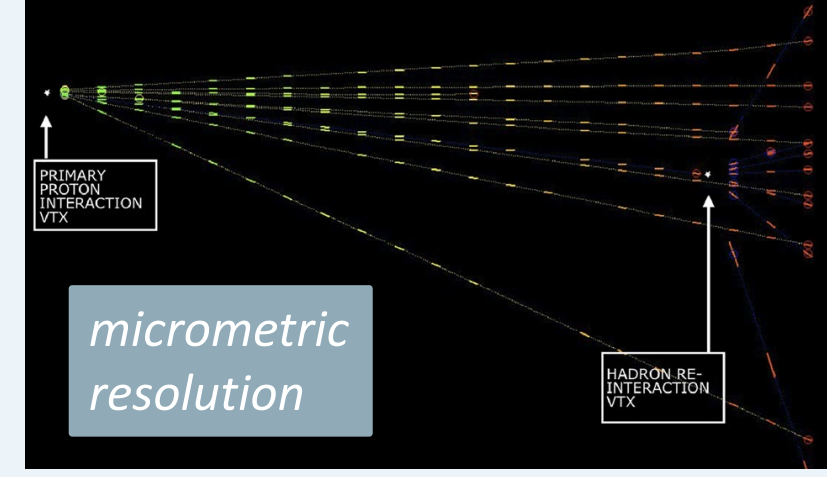


Rich program at Scattering & Neutrino Detector (SND):

- Search for **Light Dark Matter (LDM)** via scattering of nuclear & electron recoils
- ν_τ physics, ν interactions, ν -induced charm production...

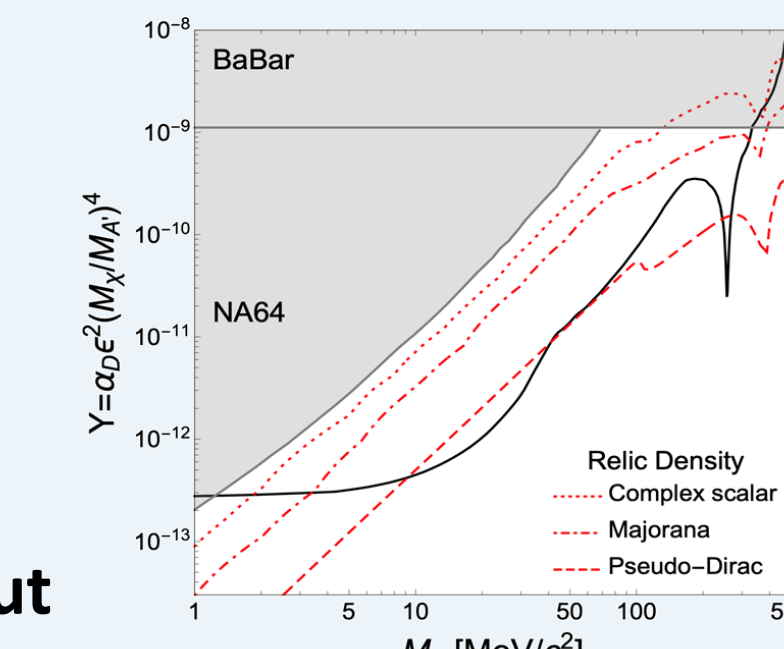


CC DIS interactions

<E> [GeV]	CC DIS interactions	CC DIS charm prod.
N ν_e	2.8×10^6	1.7×10^5
N ν_μ	8.0×10^6	3.5×10^5
N ν_τ	8.8×10^4	
N $\bar{\nu}_e$	5.9×10^5	0.3×10^5
N $\bar{\nu}_\mu$	1.8×10^6	0.7×10^5
N $\bar{\nu}_\tau$	6.1×10^4	

Observed signal $\nu_\tau (\bar{\nu}_\tau)$

Decay channel	ν_τ	$\bar{\nu}_\tau$
$\tau \rightarrow e$	8 000	
$\tau \rightarrow \mu$	4 000	3 000
$\tau \rightarrow 3h$	11 000	
Total	53 000	



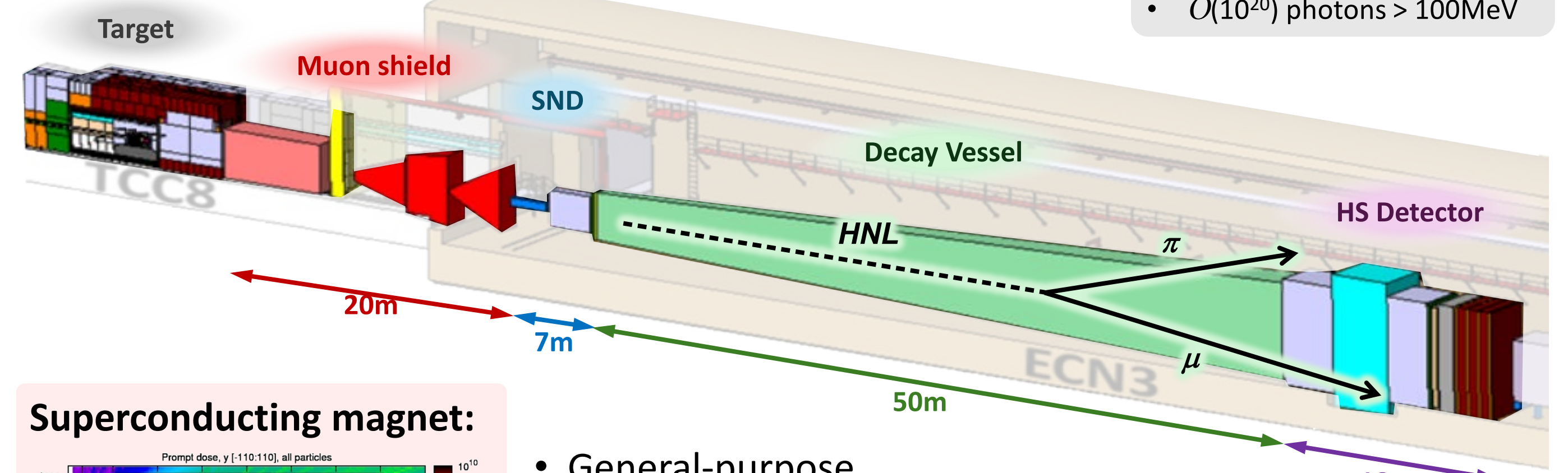
- Original detector design based on **ECC nuclear emulsions**
- Re-optimisation for **realtime readout** with CMS TOB

Search for Hidden Particles (SHIP) at a dedicated SPS Beam Dump Facility (BDF):

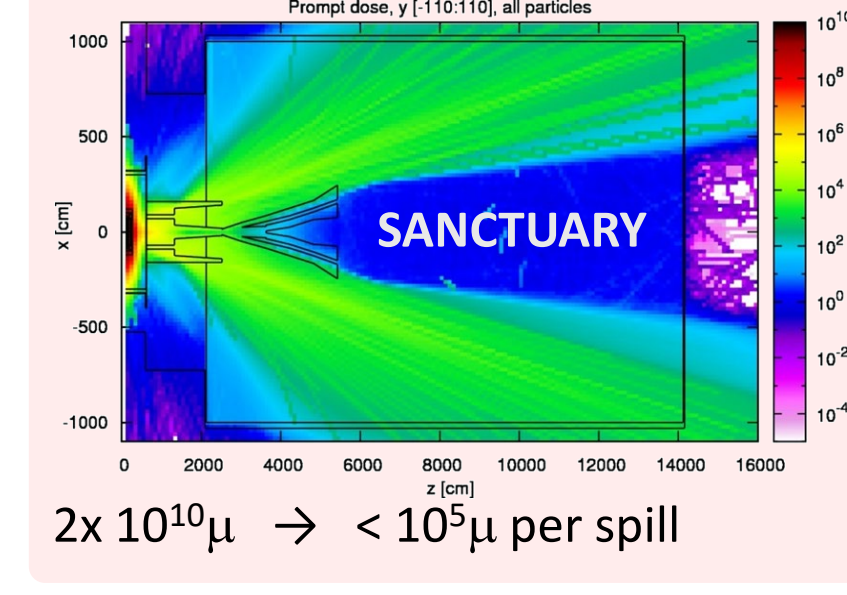
High-Intensity (HI) upgrade of SPS NA 400 GeV proton facility

Particle Production: within detector acceptance, per year, independent of model

- 2×10^{17} D (charm) mesons
- 1.4×10^{13} B (beauty) mesons
- 2×10^{15} τ neutrinos
- $O(10^{20})$ photons > 100 MeV



Superconducting magnet:



- General-purpose beam dump facility

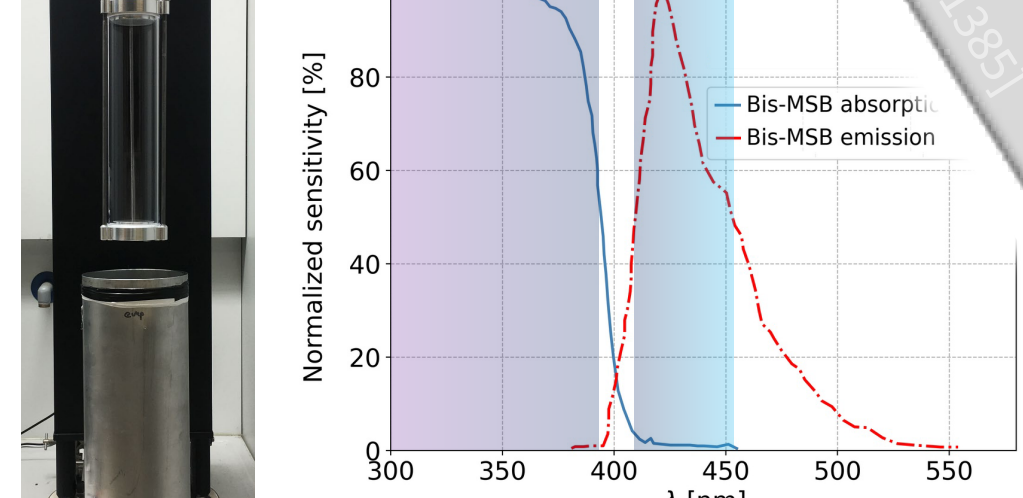
- Dedicated beam to ECN3

- Intensity: 4.0×10^{13} p/spill $\rightarrow 4.0 \times 10^{19}$ p.o.t./yr
- $\rightarrow 6.0 \times 10^{20}$ p.o.t. after 15 years

WOMs in SHIP:

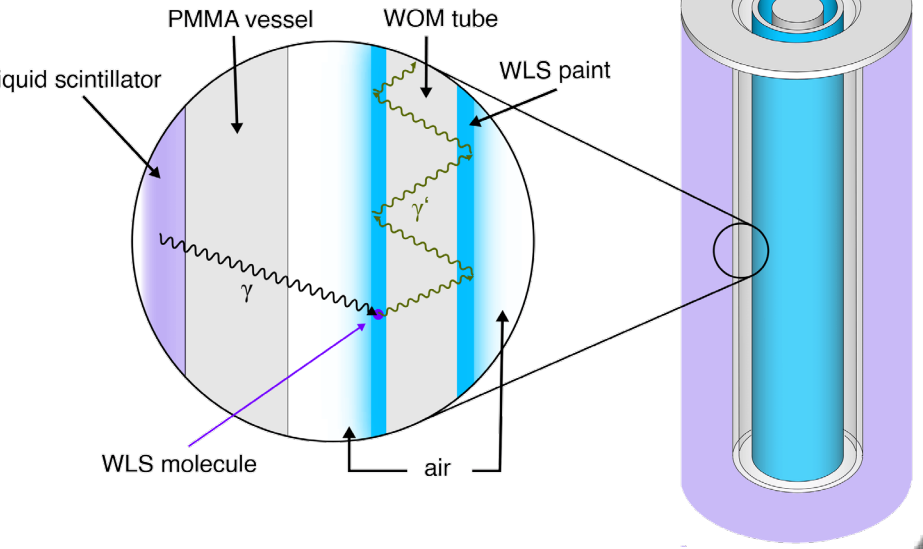
- Tubes of **PMMA**, \varnothing 6 cm x 20 cm, 3 mm thickness

Bis-MSB WLS coating:

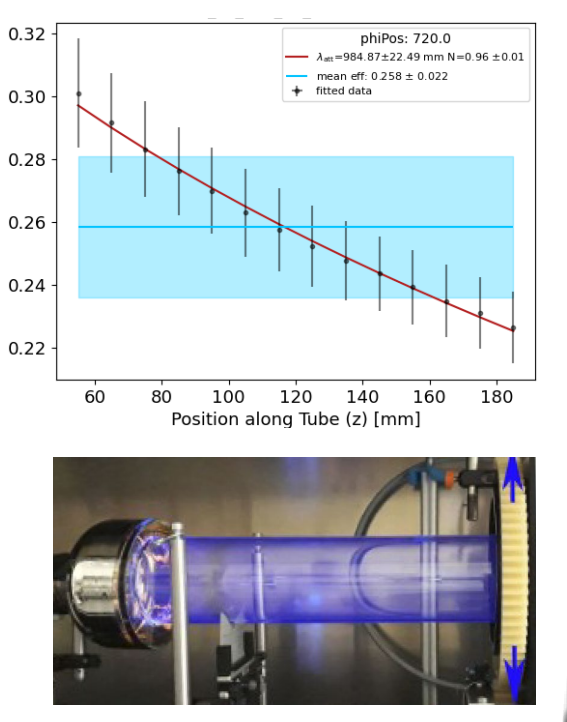


- UV / blue absorption
- Isotropic vis. light emission

- Insulated from LS by transparent **PMMA vessels**

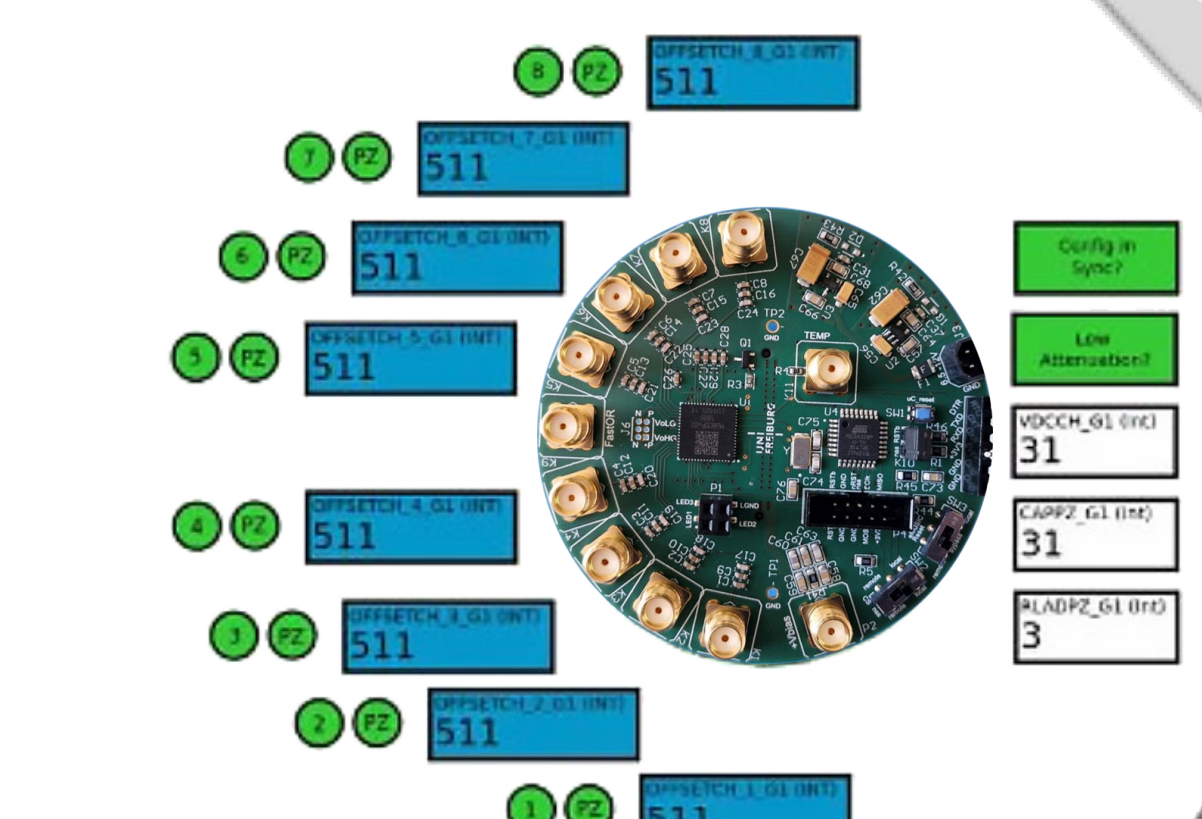


- Internal **total reflection**
- $\triangleright > 73\%$ coll. efficiency



- SiPM PCB:**
- 40x 3x3 mm² **Hamamatsu S14160-3050HS**
- + Temp. sensor

- Readout PCB:**
- eMUSIC ASIC from Scientifica
- 8 analogue channels per WOM, 5 SiPMs each
- Individual **amplification** & signal shaping



- SlowControl:**
- CAEN A7585D programmable voltage converter
- eMUSIC programming via Raspberry Pi PicoW
- SiPM power supply
- Temp. compensation

- DAQ:**
- 64-channel **WaveCatcher** digitiser, 3.2 GS/s, 12 bit

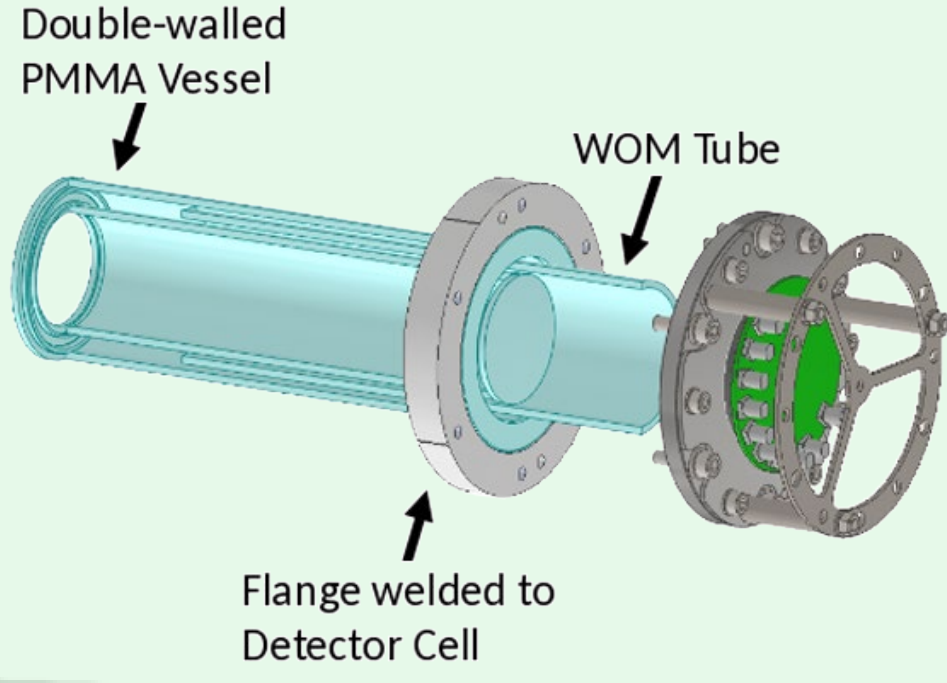


LS-SBT The Liquid Scintillator-Surrounding Background Tagger: Tagging of μ - and ν -induced BG

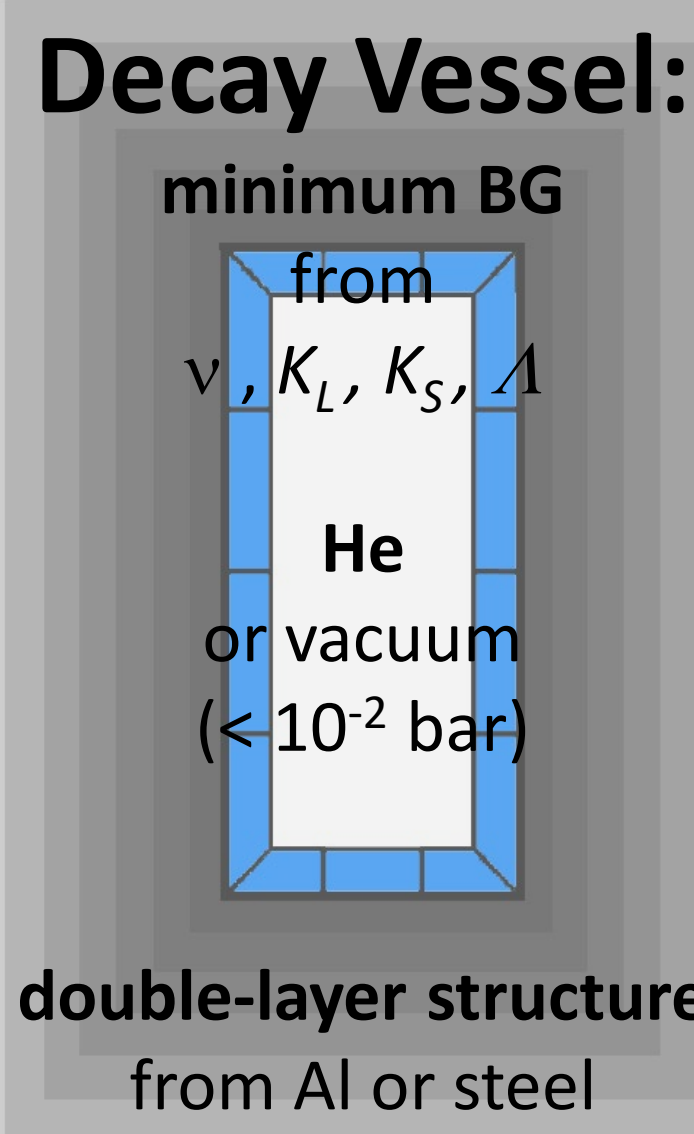
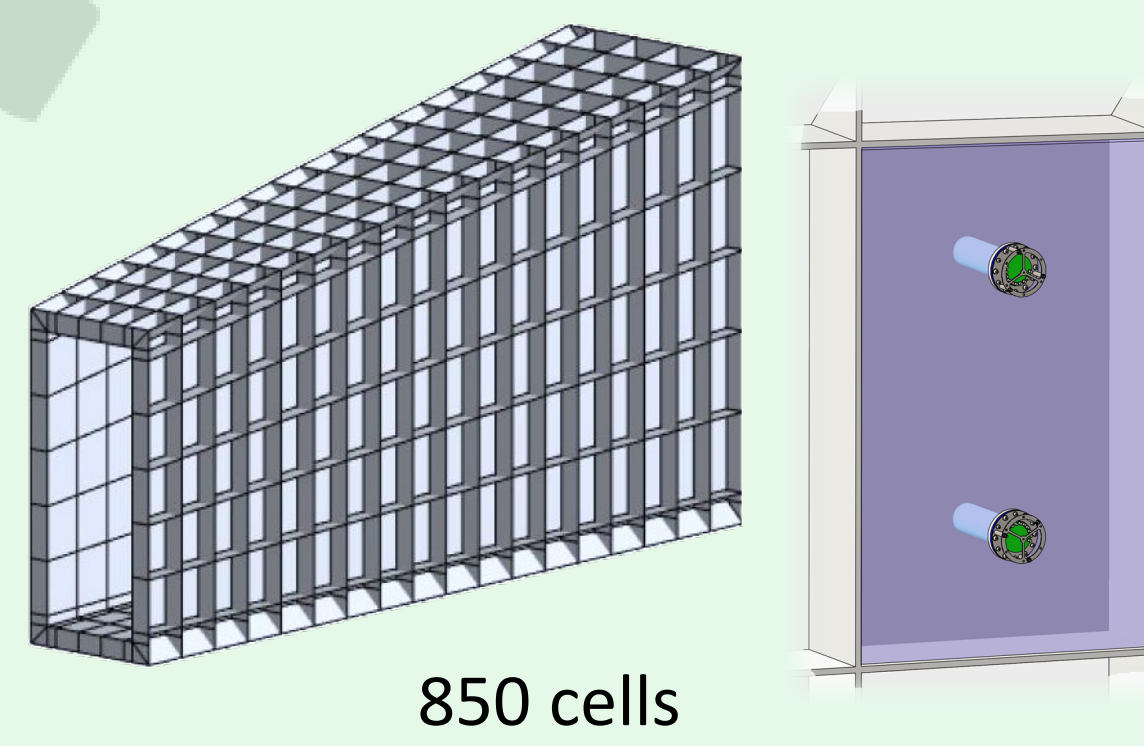
High efficiency: $> 99.0\%$ for m.i.p.

Good time resolution: $O(1 \text{ ns})$

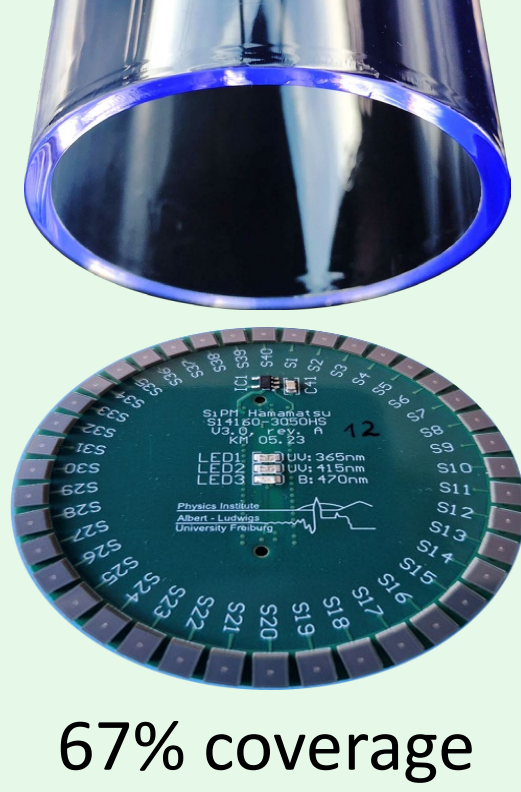
Light Detectors: 1 500 Wavelength-Shifting Optical Modules



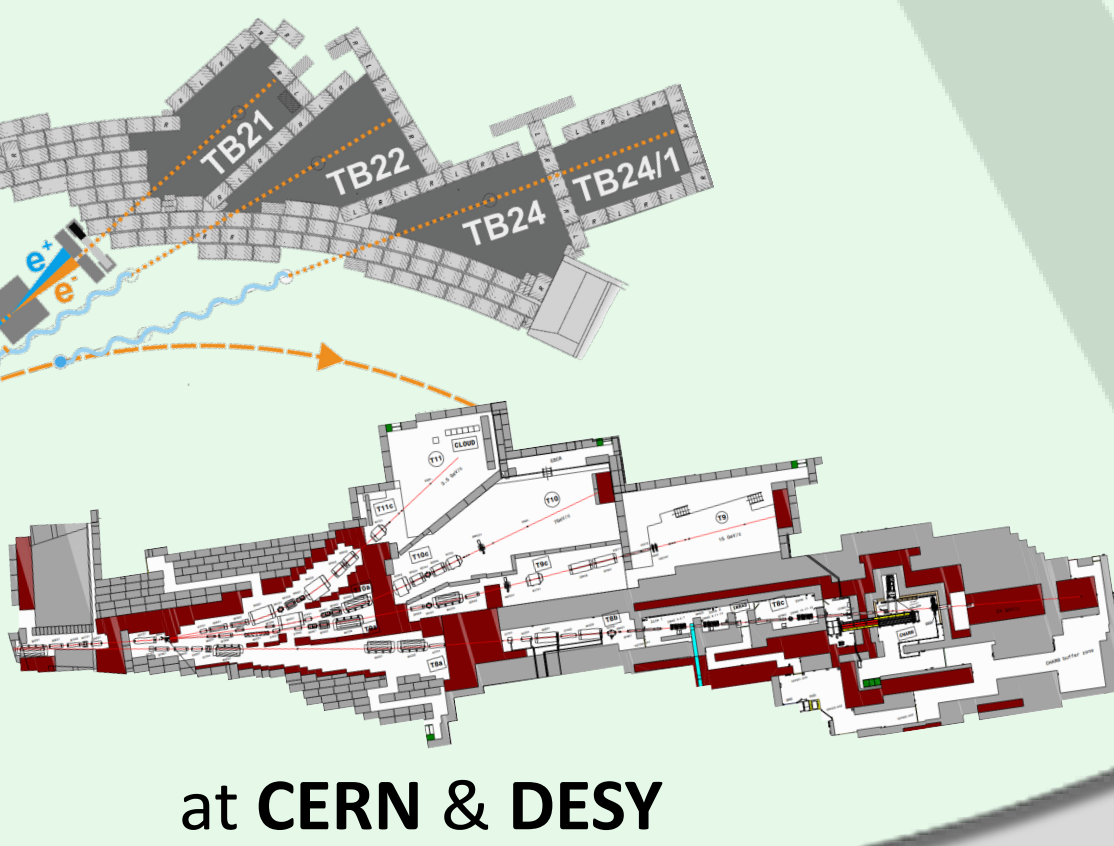
HS Decay Vessel: Segmented structure



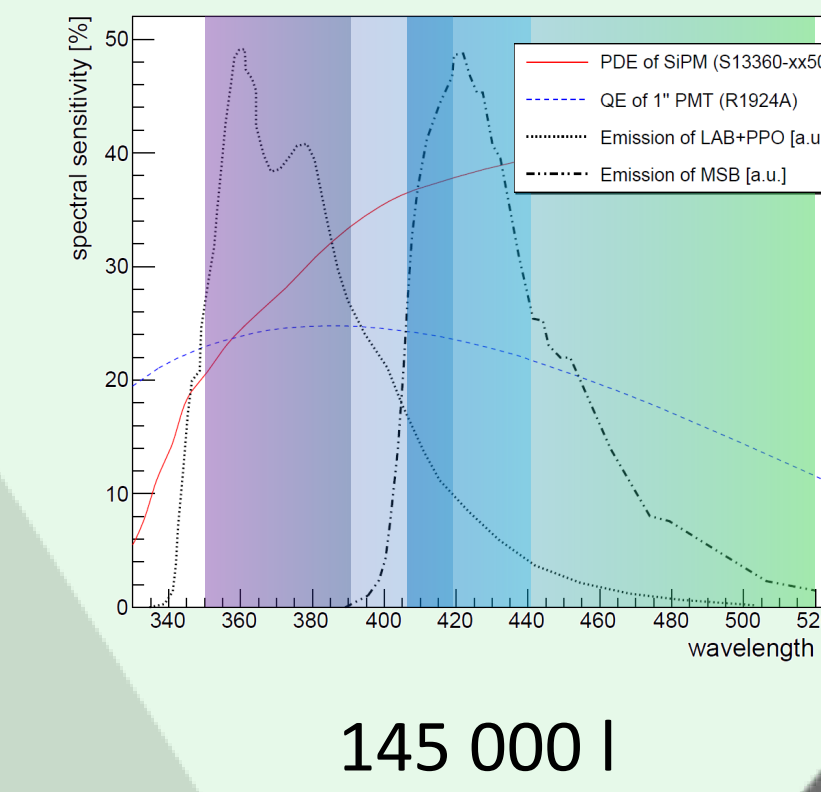
Readout & DAQ: 40 SiPMs on circular PCB directly coupled to WOM



Test Beams & Prototypes:

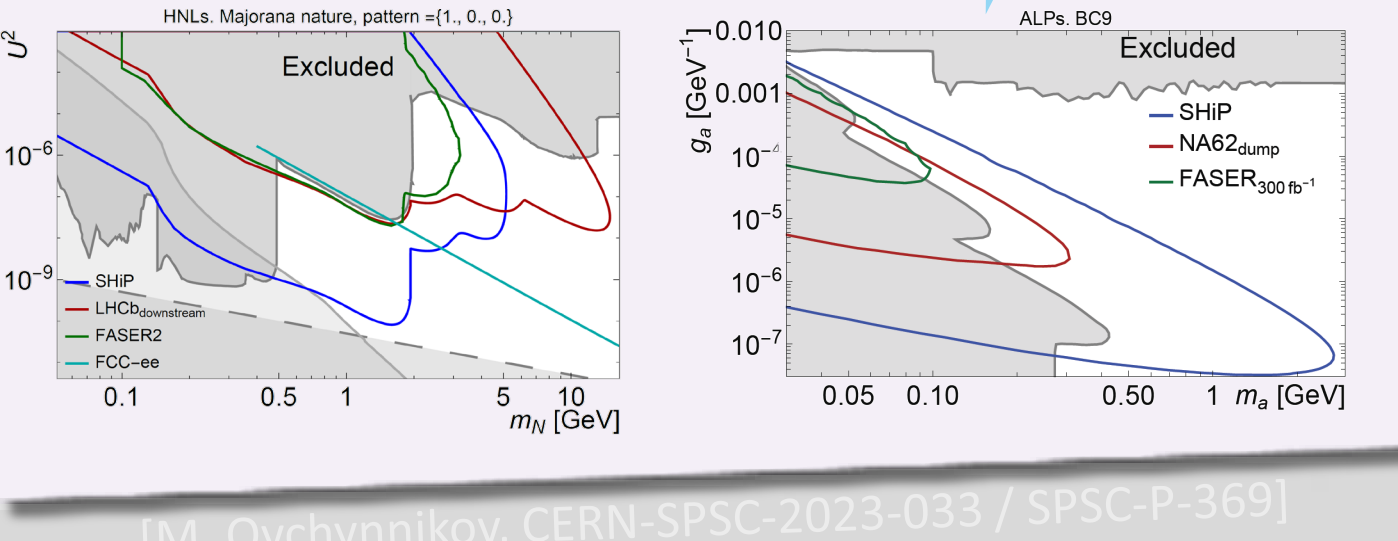


Liquid Scintillator: Linear Alkylbenzene (LAB) + 2.0 g/l 2,5-Diphenyloxazole (PPO)

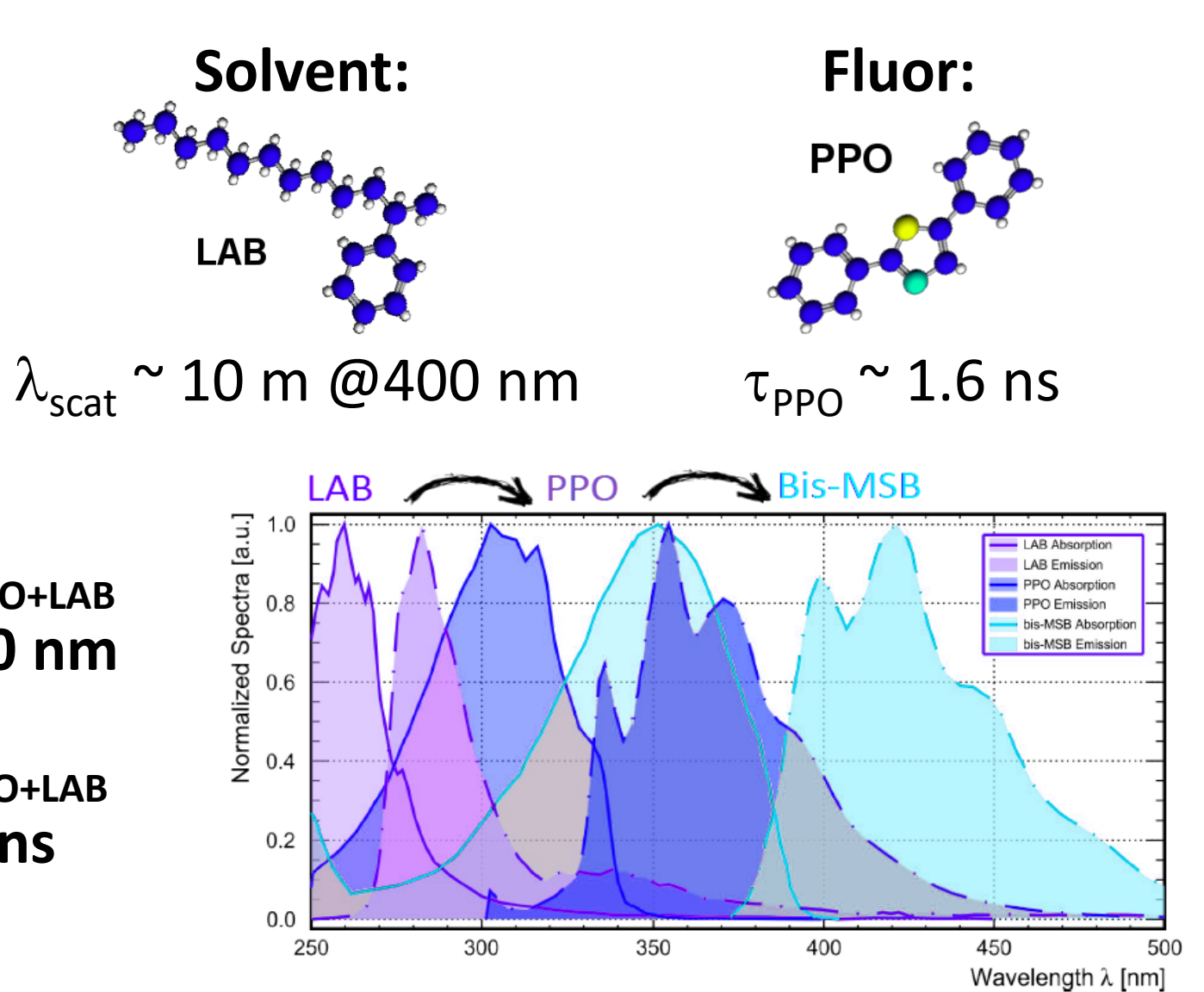


Search for Feebly-Interacting Particles (FIPs) with the Hidden Sector (HS) detector:

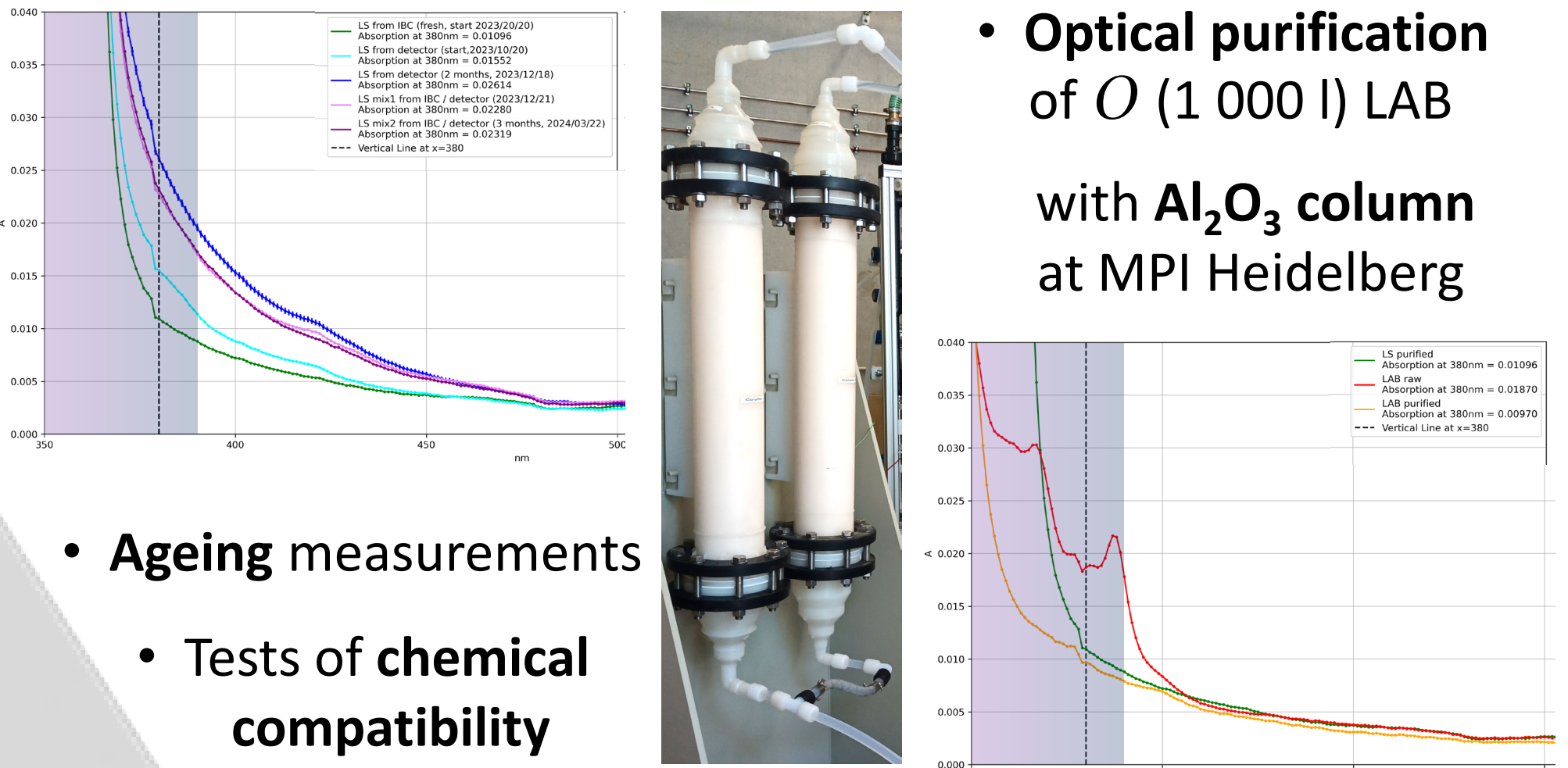
- Decays of **Heavy Neutral Leptons (HNL)**, **Axion-Like Particles (ALPs)**, dark photons, light scalars...
- Comprehensive search at **MeV-GeV scale** over many orders of magnitude in coupling



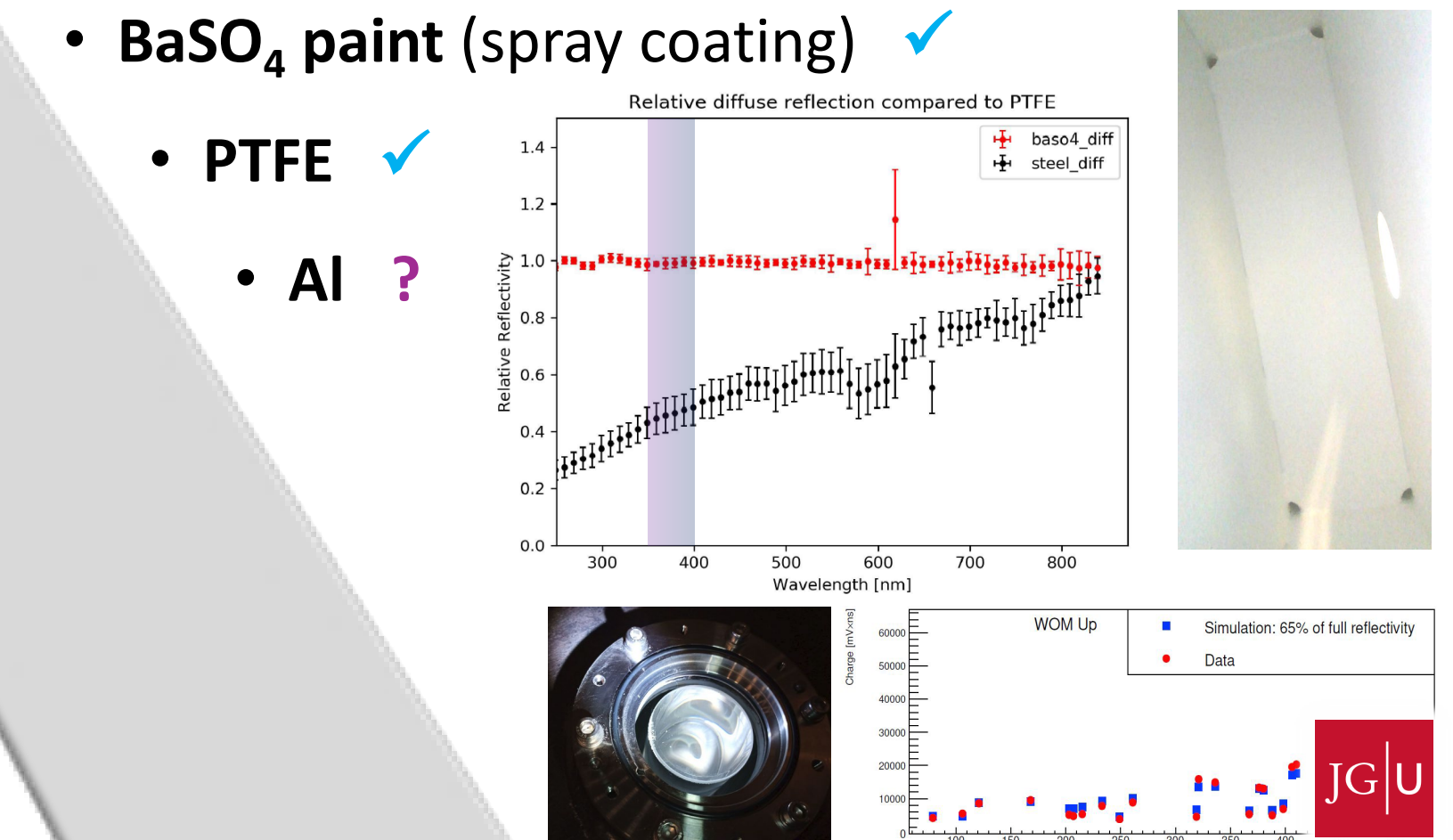
LS Development:



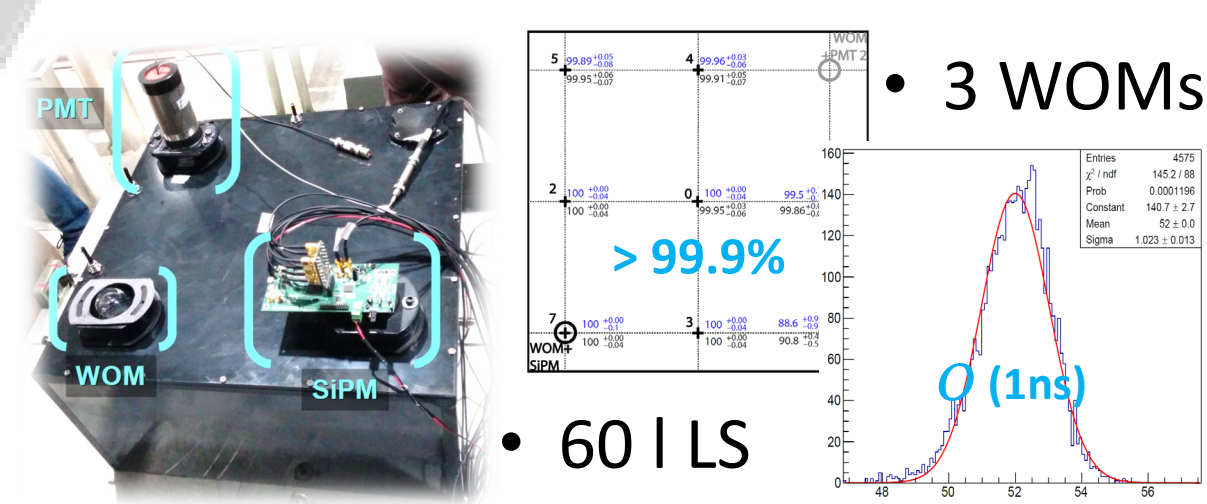
LS Purification & Ageing:



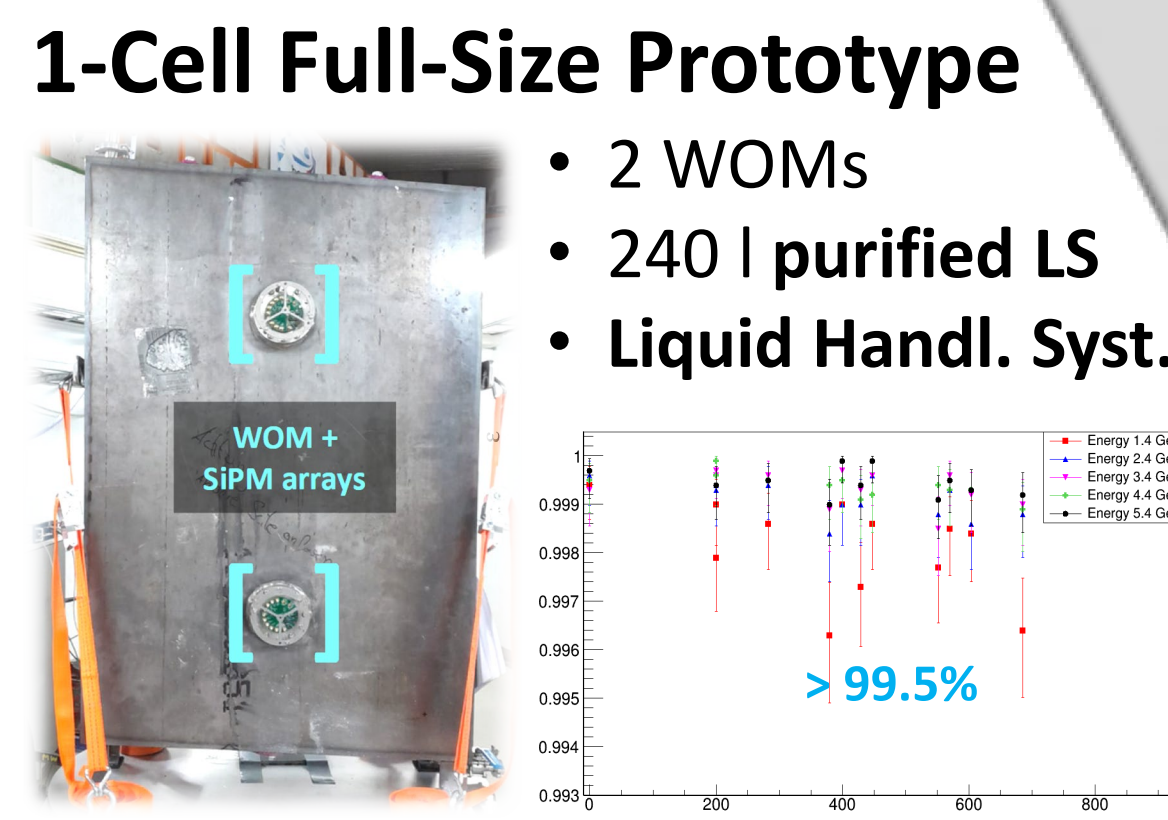
Cell Reflectivity:



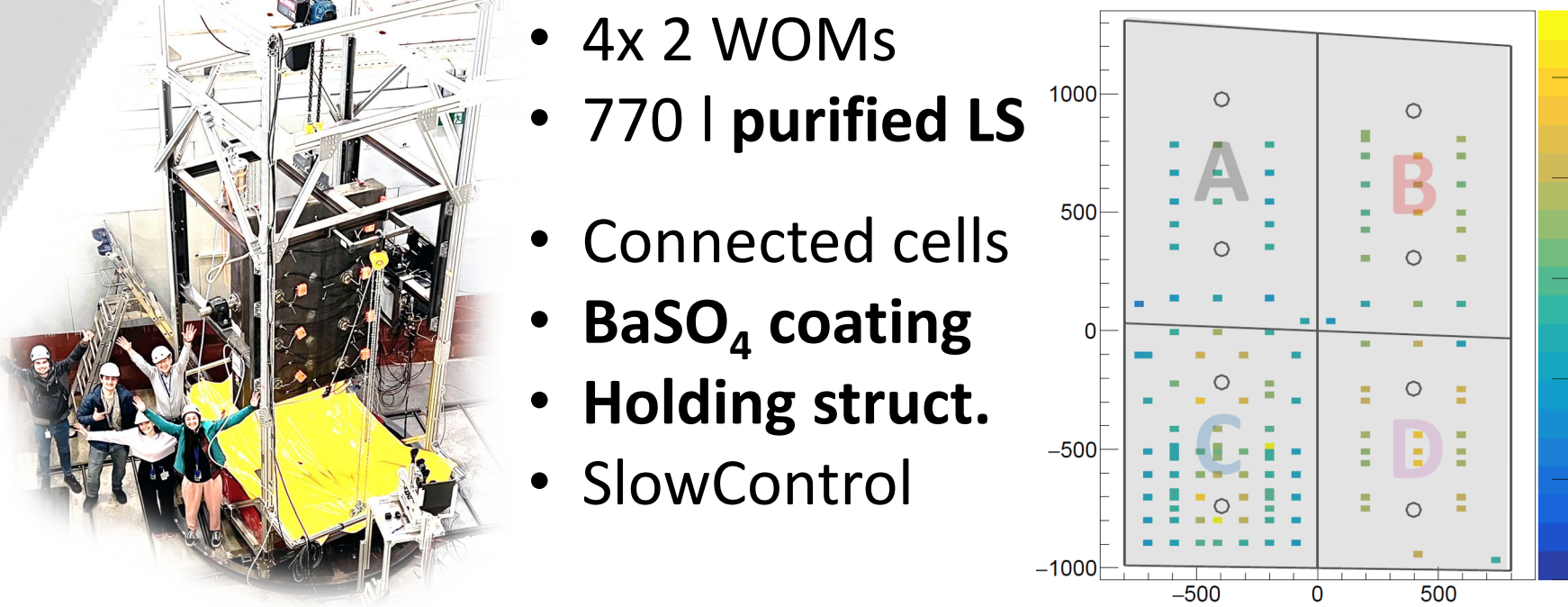
2017, CERN SPS: Proof-of-Principle



2019, DESY:



2023/2024, CERN PS: 4-cell Prototype



2025, CERN SPS: 3-Ring Prototype...

