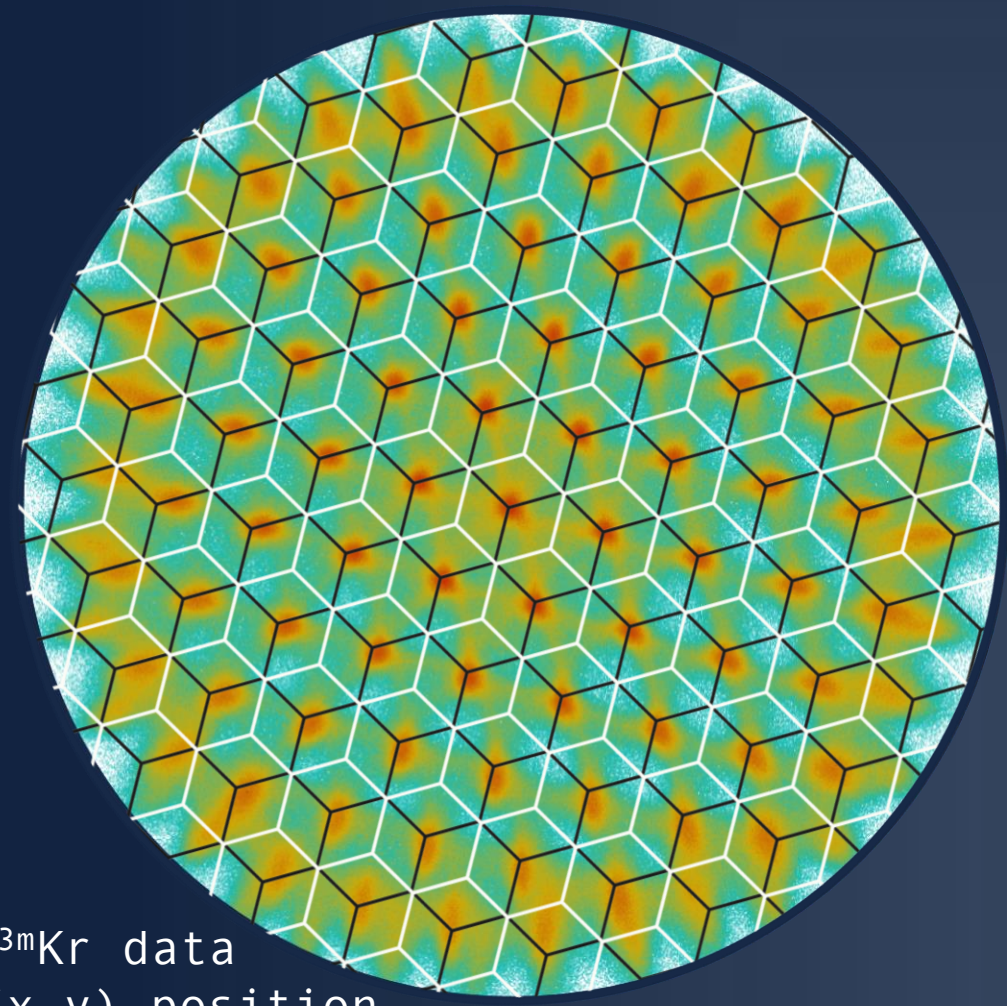


POSITION RECONSTRUCTION

- (x,y) position from S2 in top array => Resolution ~ 1.5 mm
- Center-of-gravity algorithm:

$$(x,y) = \frac{1}{Q_{S2}^{tot}} \sum_{i=1}^{16} (X_i, Y_i) \frac{Q_{S2}^i}{G_i}, \quad Q_{S2}^{tot} := \sum_{i=1}^{16} \frac{Q_{S2}^i}{G_i}$$
- Map onto circle and scale by comparing to CAD of gate mesh (electron focusing to the knots during drift)

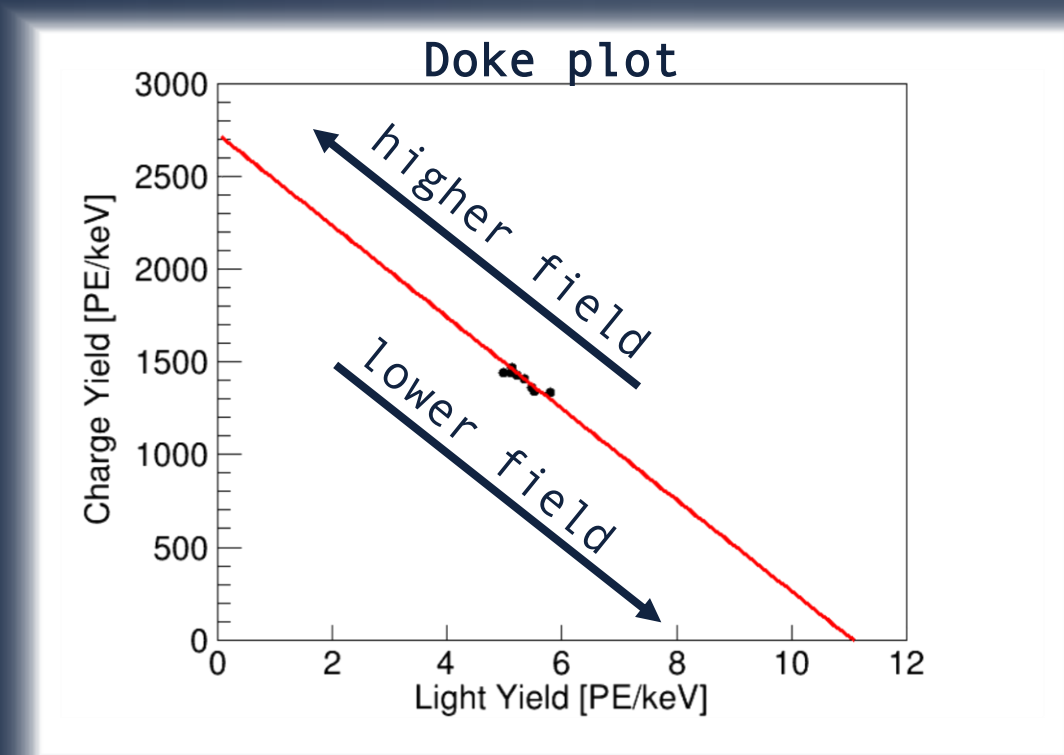


^{83m}Kr data (x,y) position reconstruction with gate and anode meshes

DETECTOR RESPONSE PARAMETERS

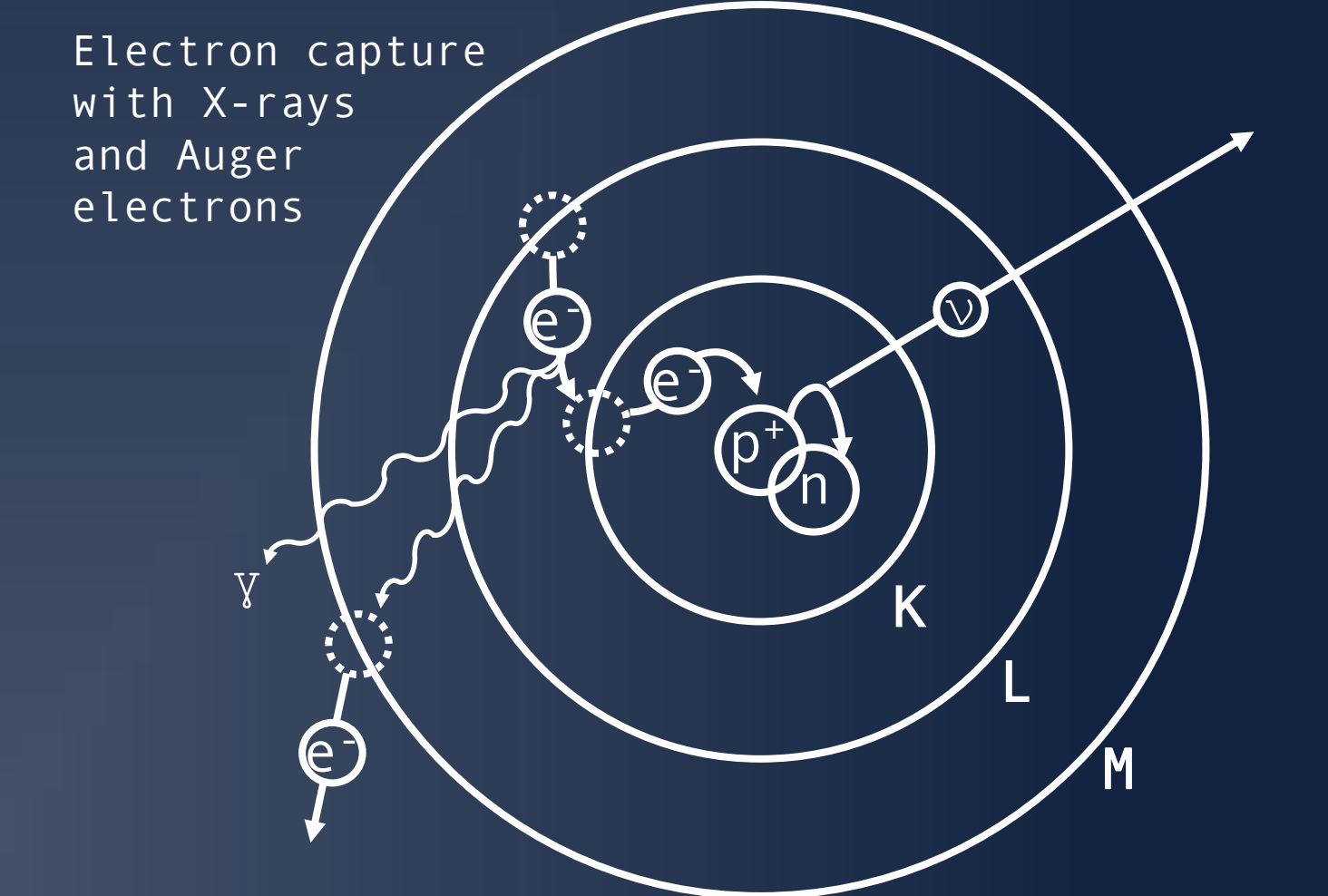
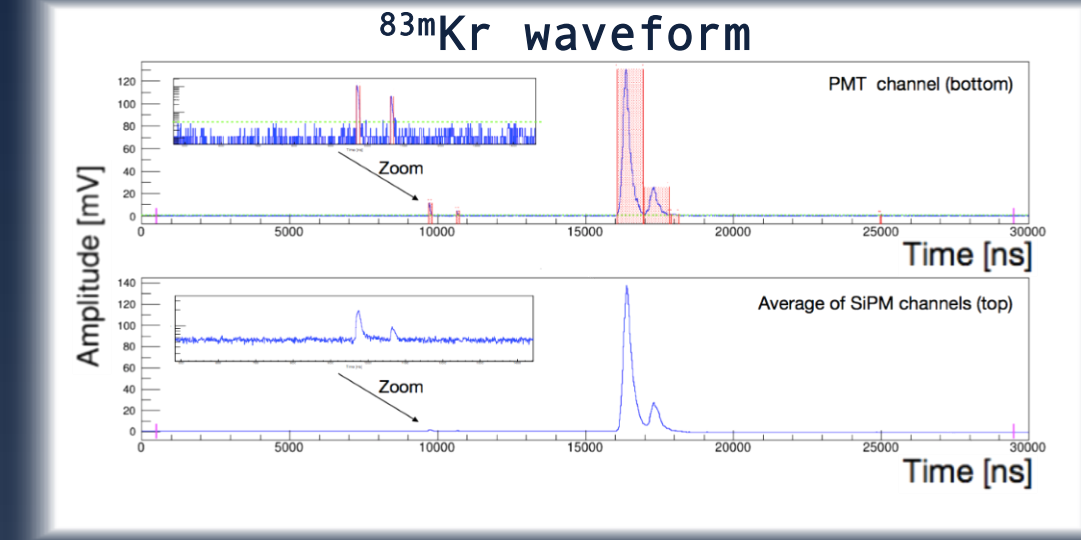
- Combined energy scale:

$$E = (N_\gamma + N_{e^-})W = \left(\frac{S1}{g1} + \frac{S2}{g2}\right)W$$
- $W = 13.7$ eV
- At 2.82 keV:
 - $g1 = (0.152 \pm 0.003) \text{ PE}/\gamma$
 - $g2 = (37.3 \pm 0.6) \text{ PE}/e^-$

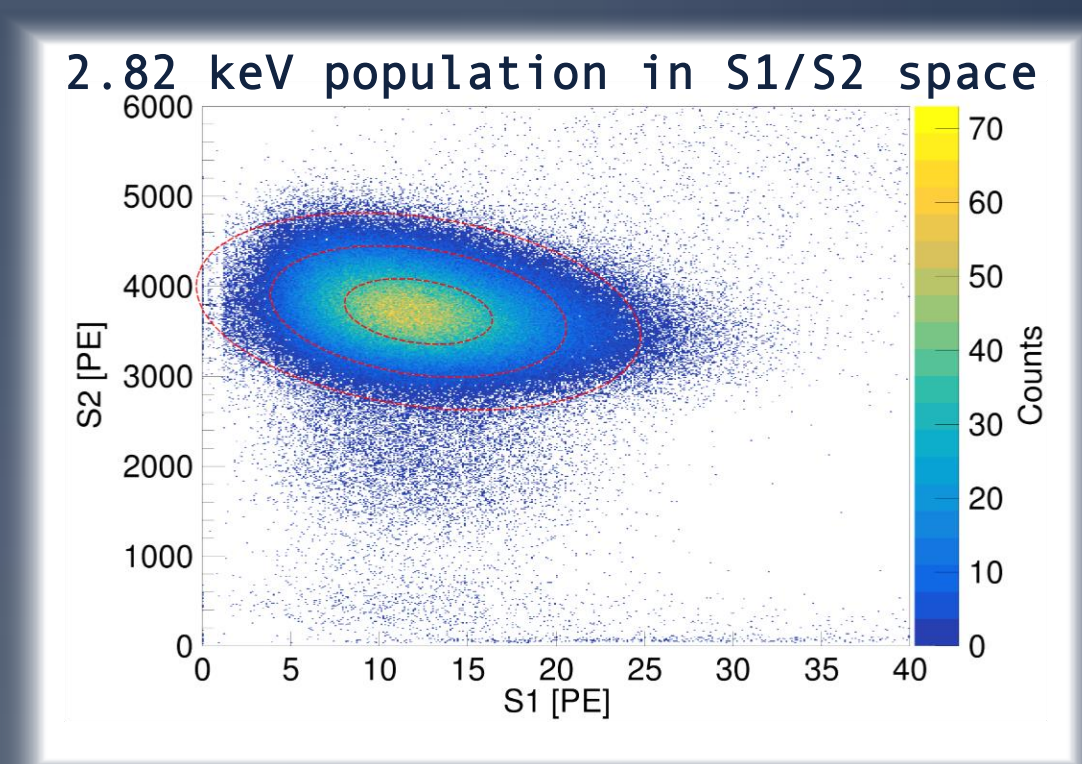
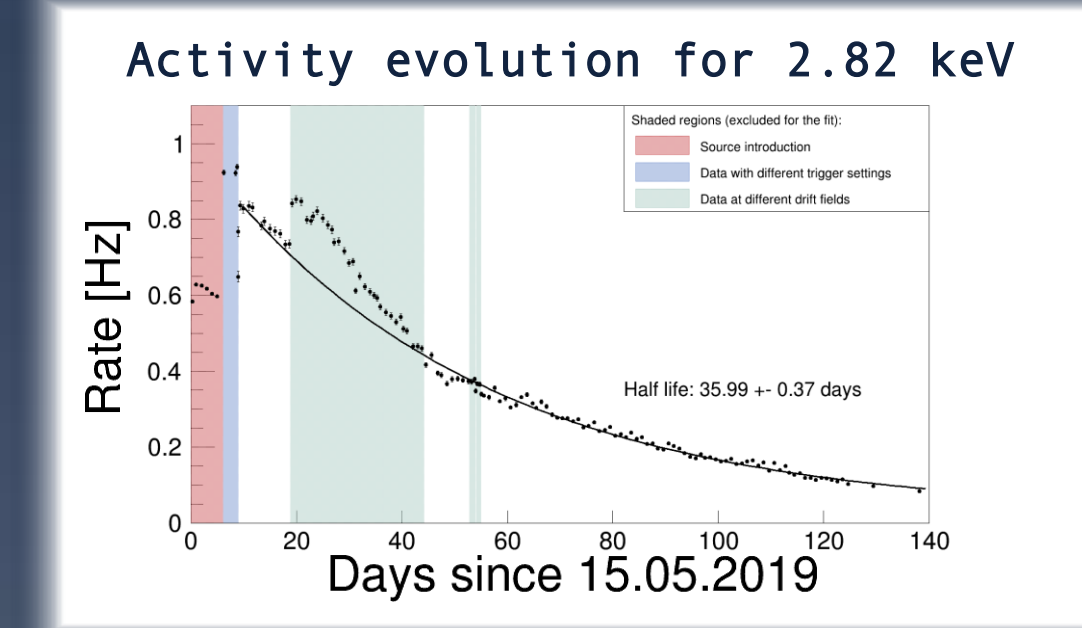


KRYPTON CALIBRATION

- Low-energy ER-calibrations 571.1 keV 62 %
- Homogenously distributed in detector volume 562.0 keV 30 %
- ^{83m}Kr 41.6 keV $T_{1/2} = 1.83$ h
- 9.4 keV $T_{1/2} = 156.8$ ns
- ^{83}Kr stable 0 keV



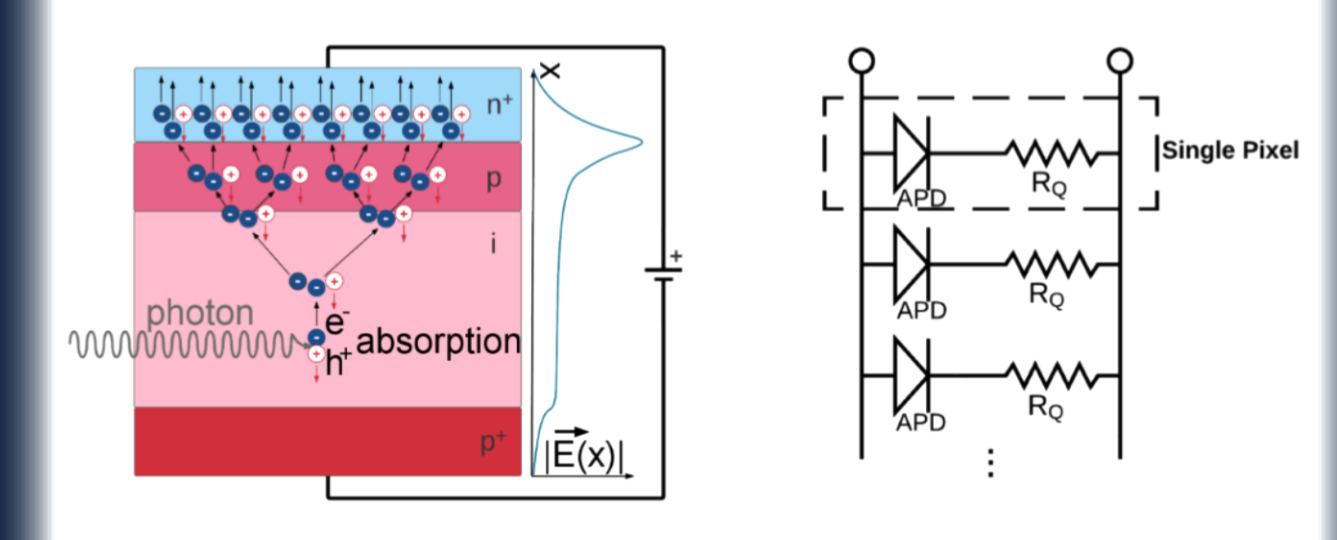
ARGON CALIBRATION



Decay mode	Energy release [keV]	Branching ratio
K capture	2.8224	90.2 %
L capture	0.2702	8.9 %
M capture	0.0175	0.9 %

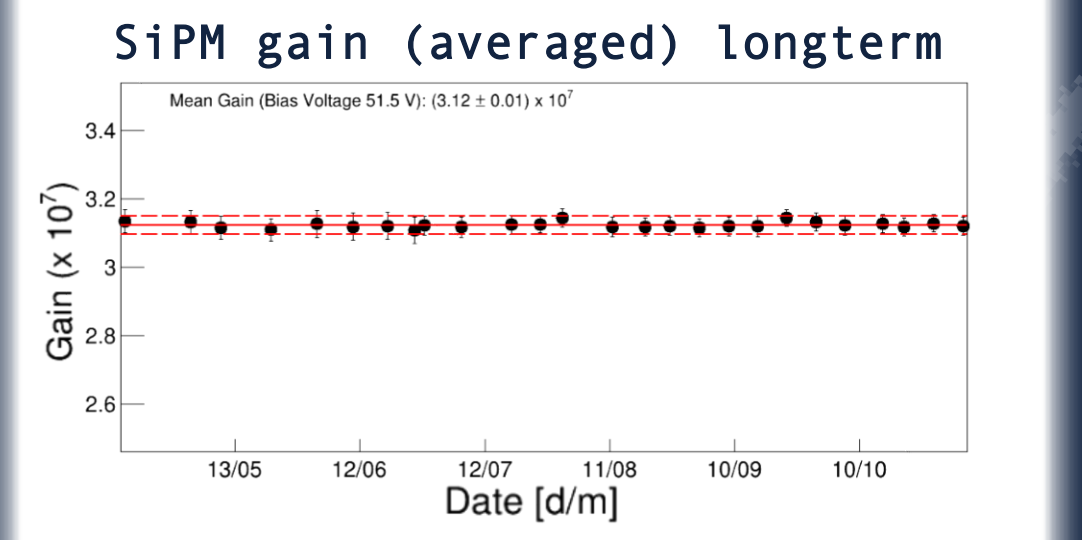
SILICON PHOTOMULTIPLIERS

- Parallel Single-Photon Avalanche diodes with quenching resistors
- Reversely biased in Geiger mode



SiPM PERFORMANCE

- + Radiopurity
- + Longterm stability
- + Position resolution
- + Slim form factor
- + Low operation voltage
- + Good SPE resolution
- Dark Count Rate (0.8 Hz/mm²) at LXe temperature



THE PROJECT

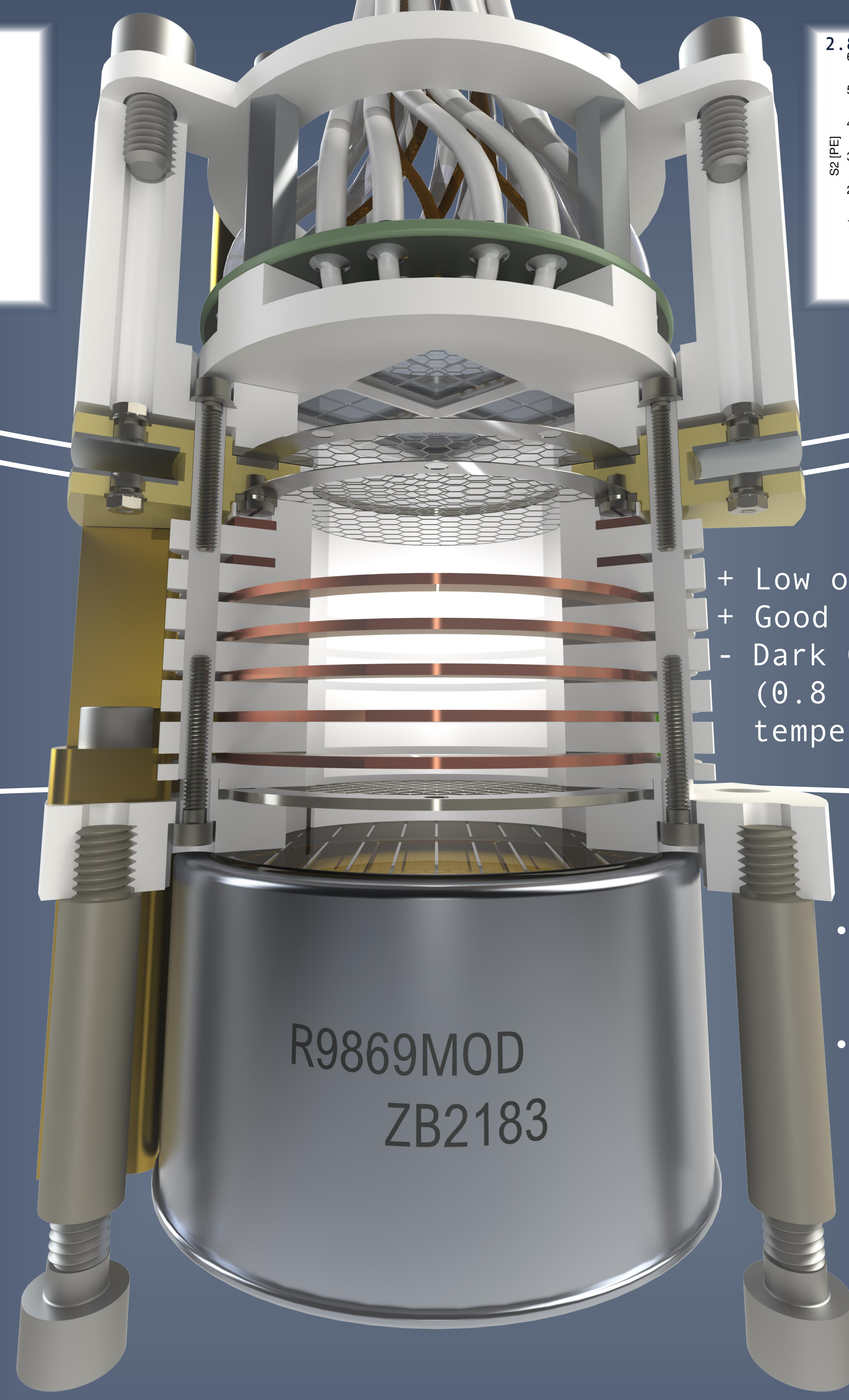
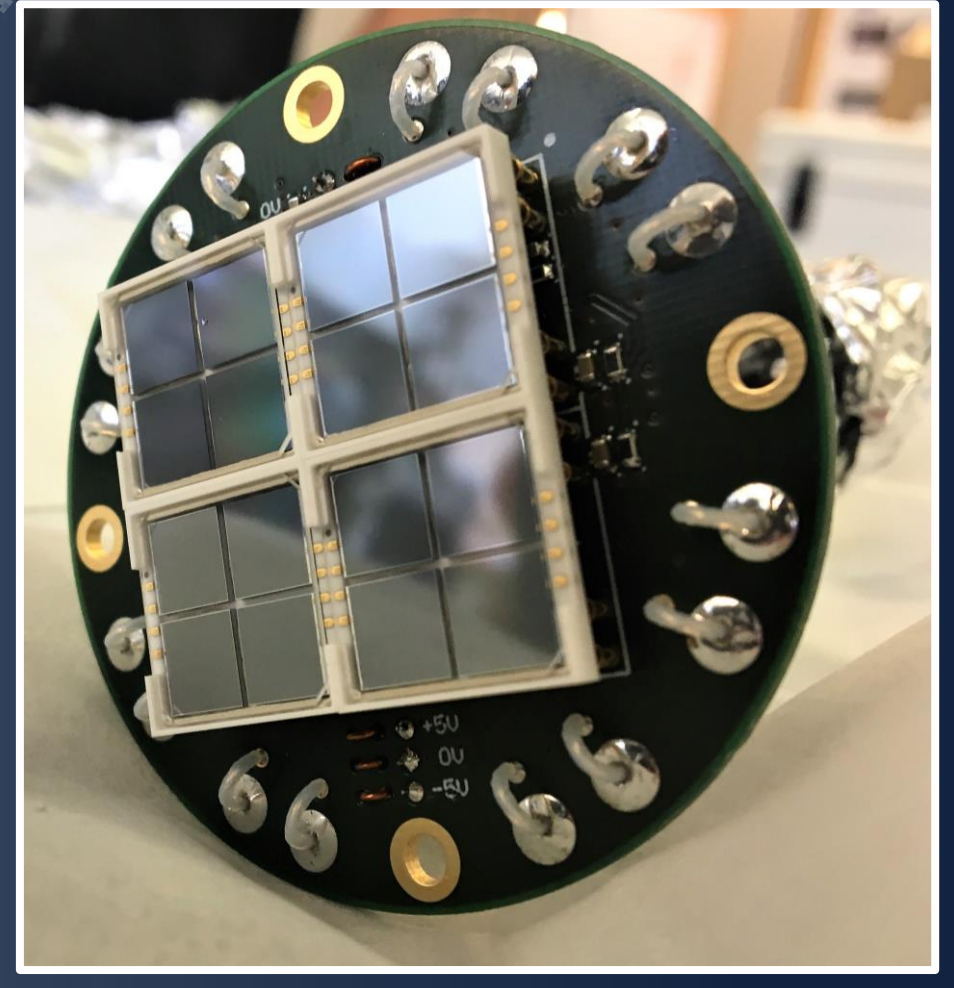
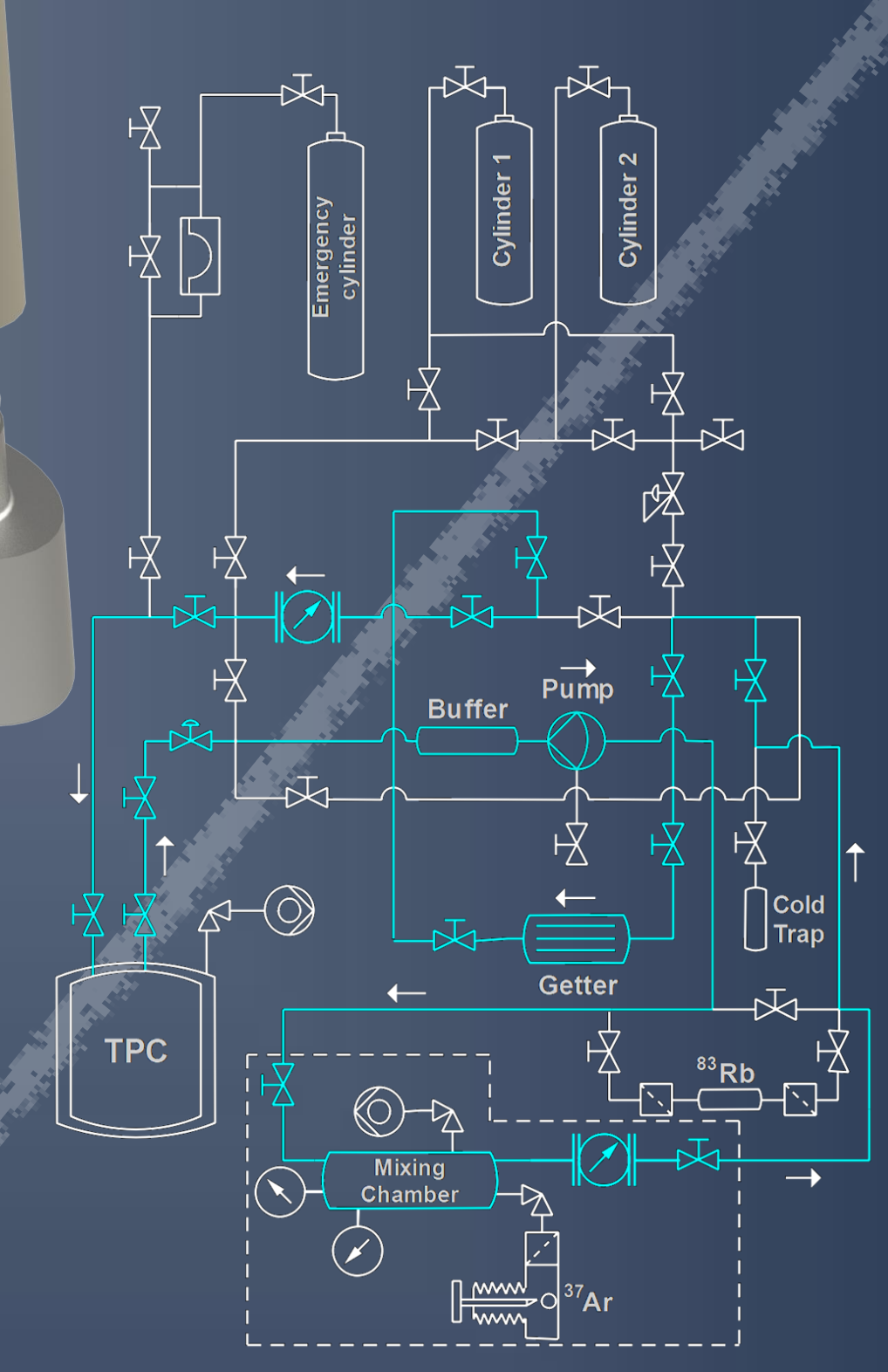
- Xenoscope, ERC advanced grant, started in 2017
- Cutting edge R&D towards the ultimate dark matter observatory DARWIN

THE SETUP

- LOCATION: UZH, Campus Irchel
- DETECTOR: Dual-phase xenon Time Projection Chamber (TPC)
- SIZE (h x d): (3.1 x 3.1) cm²
- DRIFT FIELD: up to over 1 kV/cm (10 kV/cm extraction field)
- ENERGY THRESHOLD: < 0.27 keV (S2 only)
- BOTTOM PHOTODIODE: 2-inch R9869 PMT, Hamamatsu Photonics (1 channel)

THE UPGRADE

- TOP PHOTODIODES: 2x2 S13371 VUV-4 MPPCs (12 x 12) cm², (50 x 50) μm², Hamamatsu Photonics (16 channels)
- GAS SYSTEM: ^{37}Ar calibration setup



XURICH II: FIRST DUAL-PHASE XENON TPC WITH SiPM READOUT

K. Thieme for the Astroparticle Physics Group of L. Baudis
University of Zurich



Universität Zürich UZH