



DELight: a Direct search Experiment for Light dark matter

Lea Burmeister on behalf of the DELight Collaboration

Dark Matter and Neutrinos School 2025, Paris

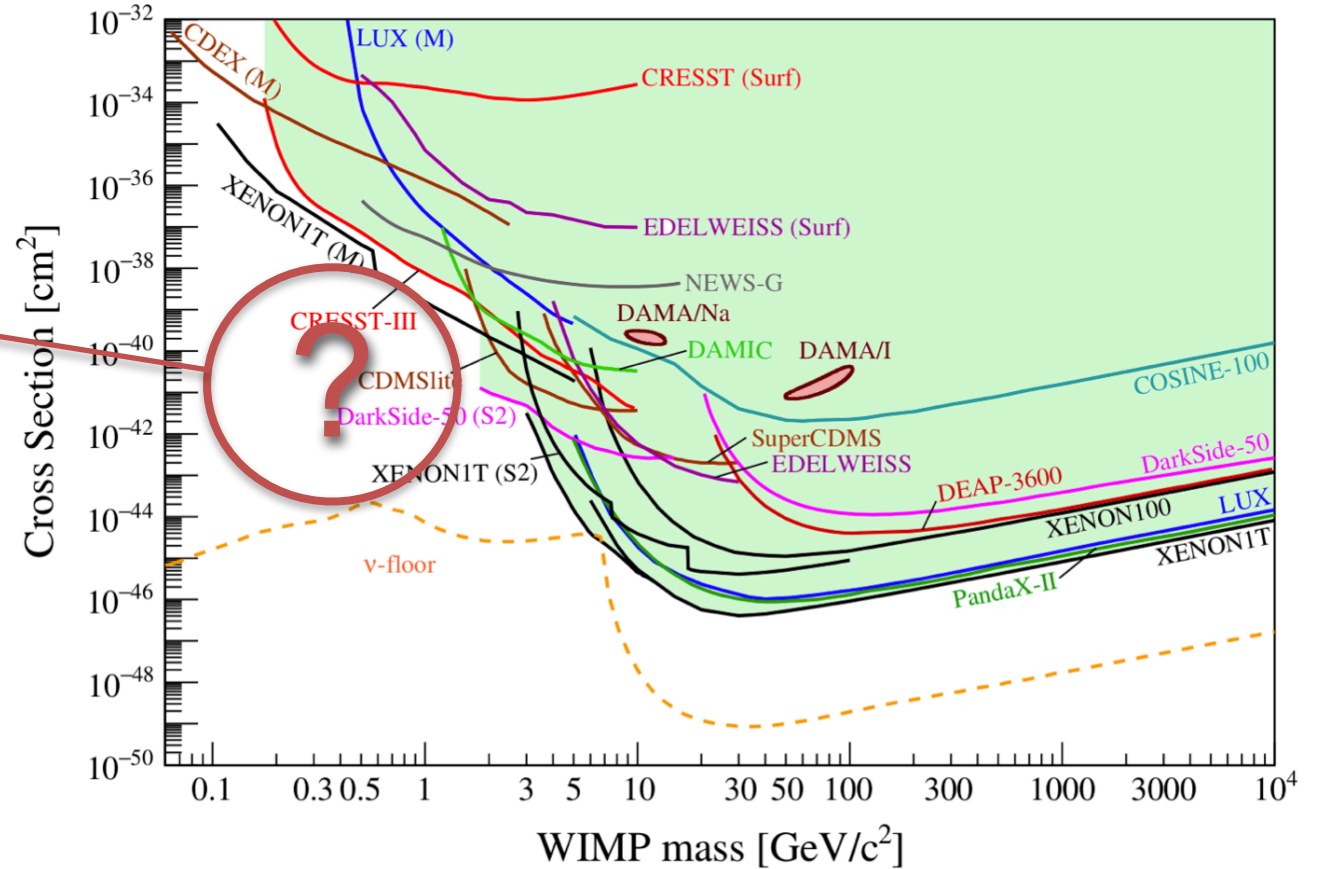
The DELight Collaboration

- 3 institutes from Baden-Württemberg, Germany
- Upcoming experiment for light dark matter searches



Light Dark Matter

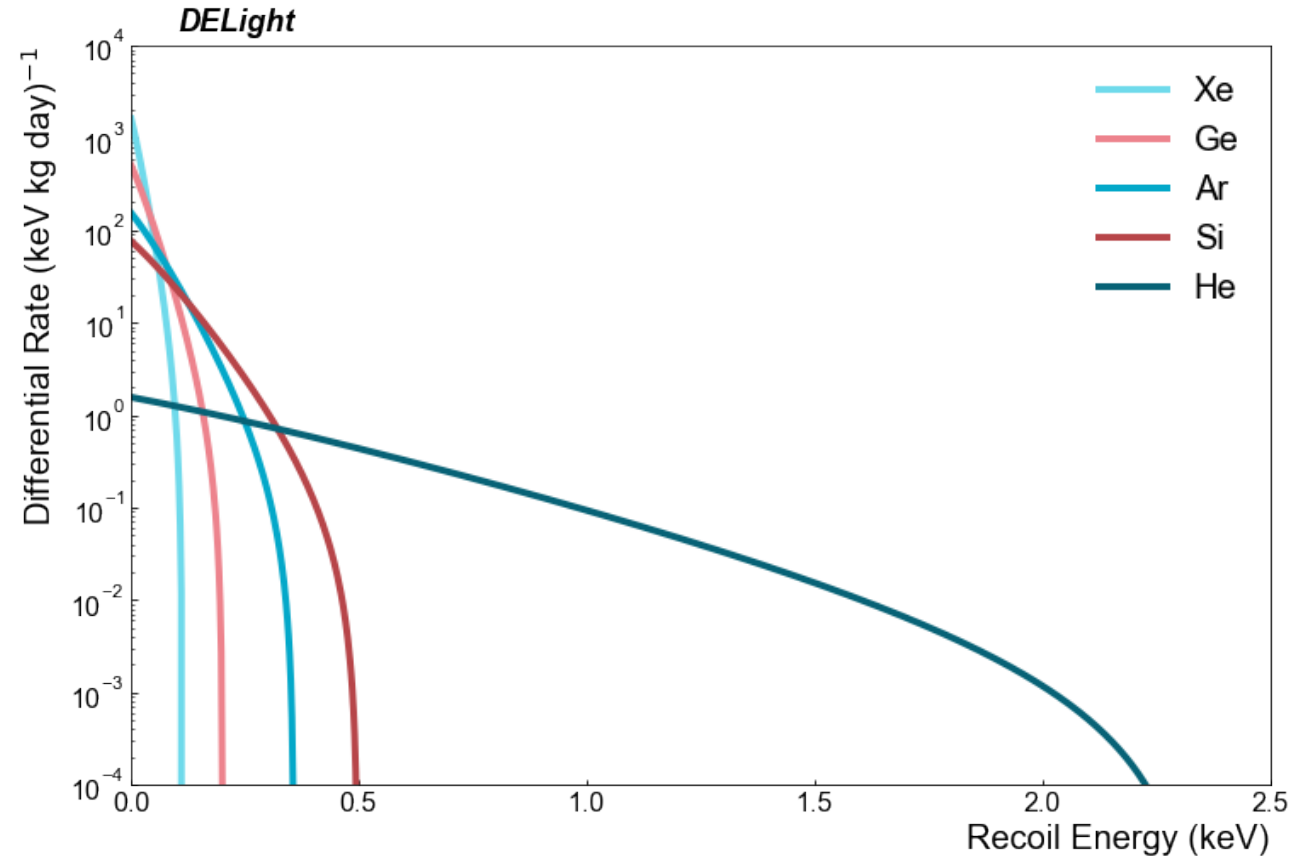
Low mass parameter space is largely unexplored!



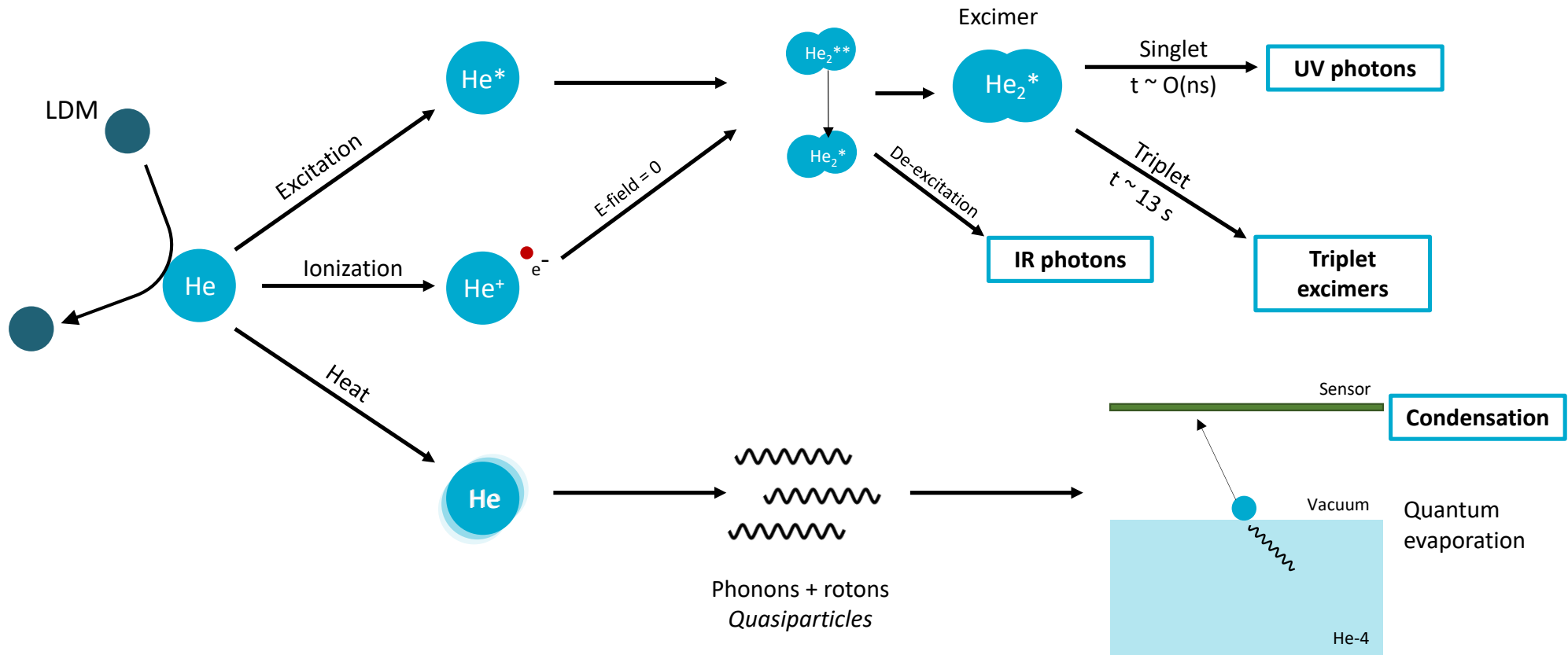
Picture: [J. Billard et al.](#)

Superfluid Helium-4

- Excellent choice as a target
 - Low nuclear mass
 - Inexpensive
 - Scalable
 - ER/NR discrimination
 - Self-cleaning:
 - Other atomic species freeze-out

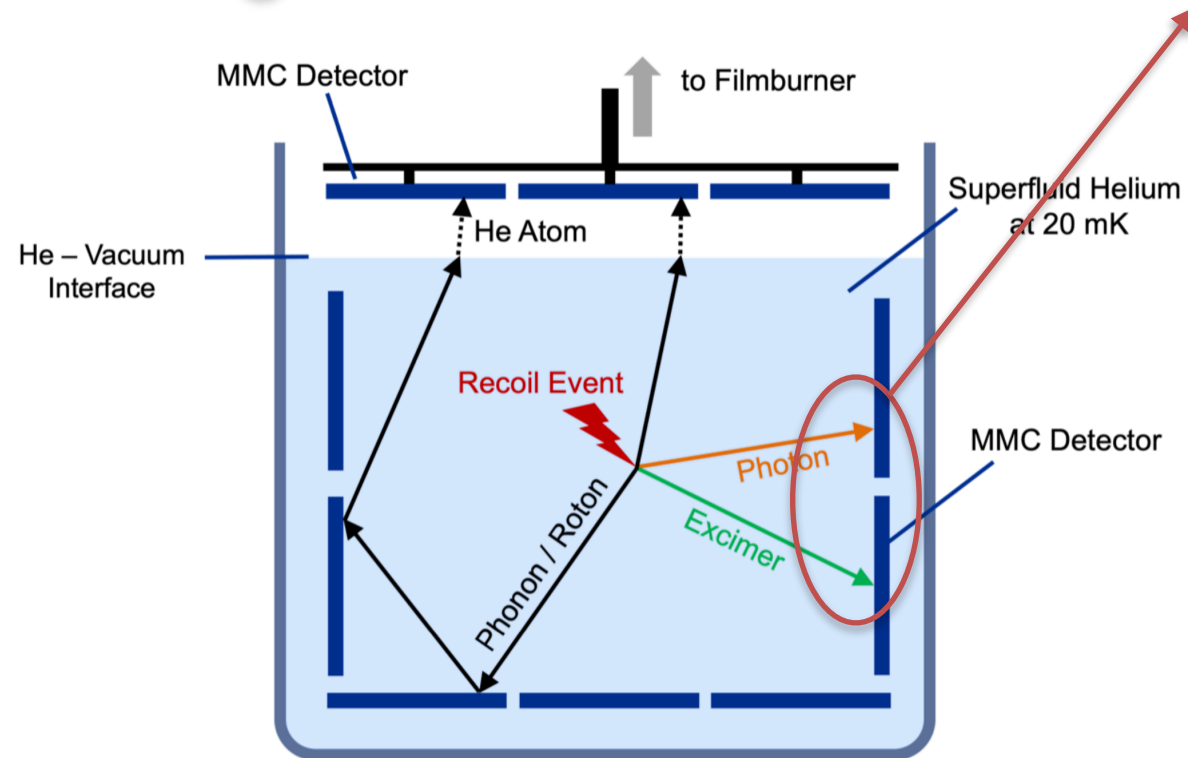


DELIGHT detection principle



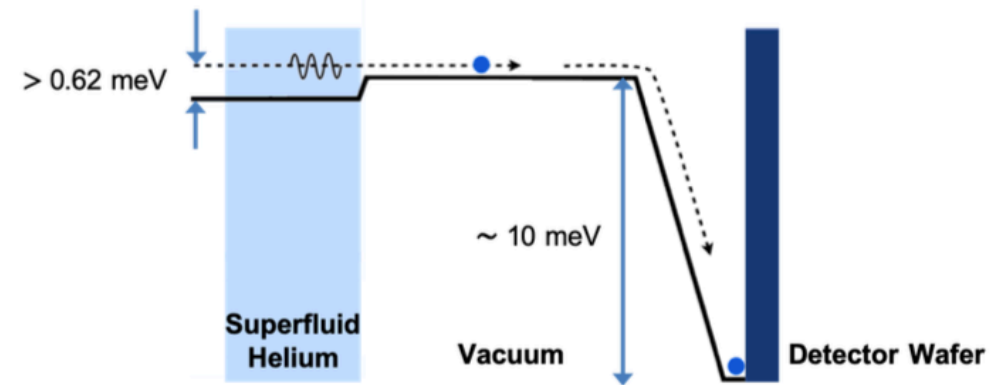
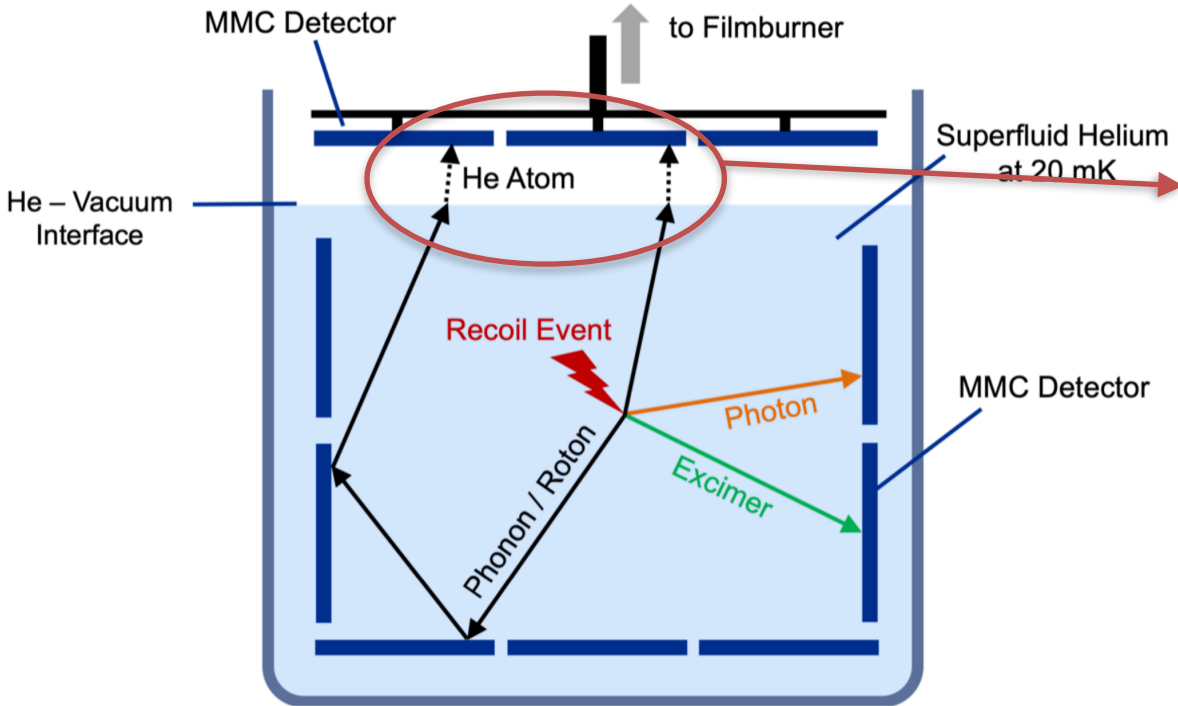
DELIGHT detector

- Prompt signals from photons
- Delayed arrival time for triplet excimers



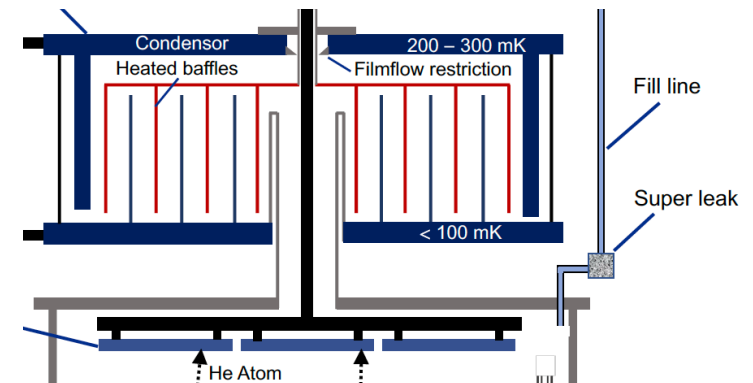
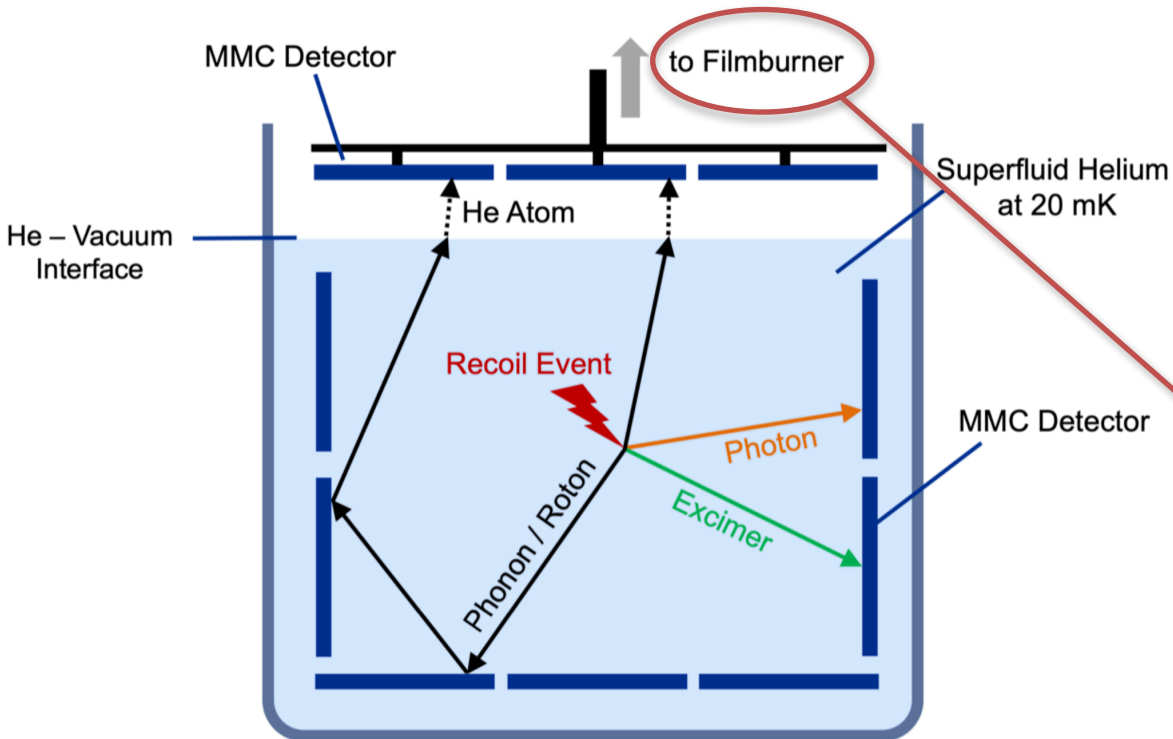
DELIGHT detector

- Prompt signals from photons
- Delayed arrival time for triplet excimers
- Quasiparticles evaporates He atom (quantum evaporation)
 - Adsorbed onto wafer



DELIGHT detector

- Prompt signals from photons
- Delayed arrival time for triplet excimers
- Quasiparticles evaporates He atom (quantum evaporation)
 - Adsorbed onto wafer
- Wafer must be kept free from He



Magnetic MicroCalorimeters (MMCs)

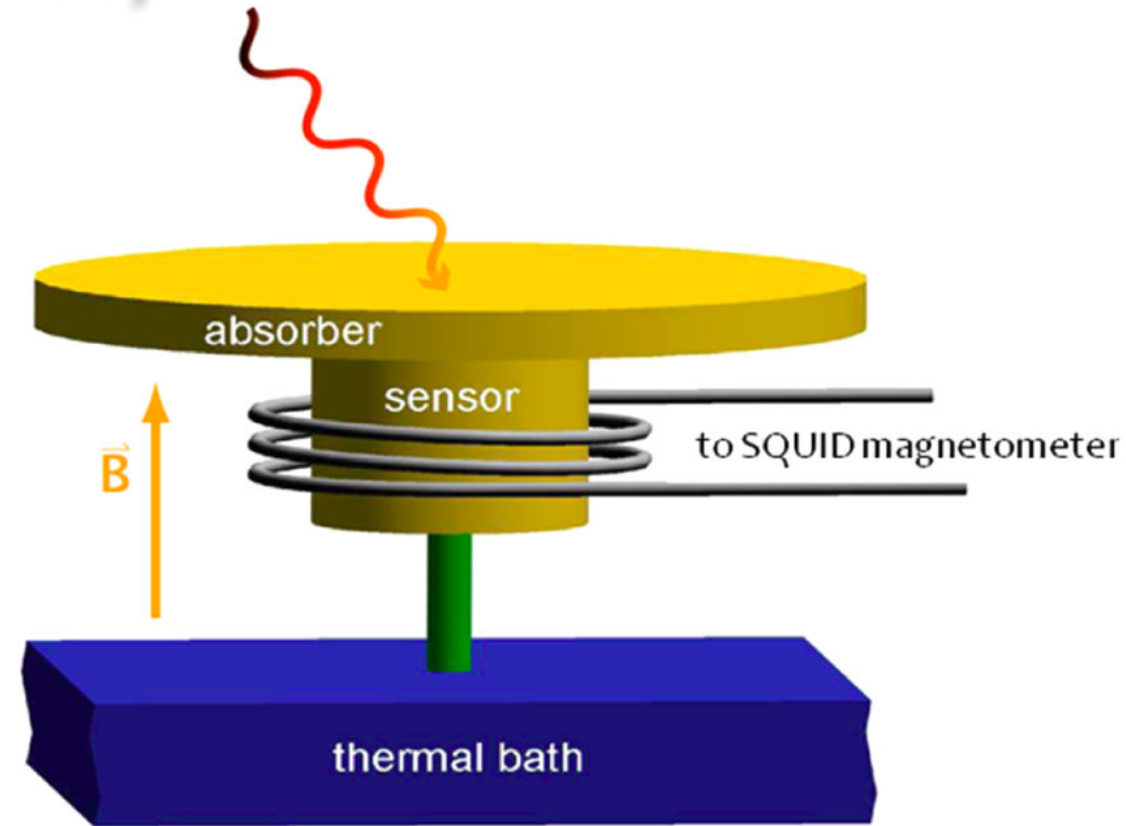
- Operated below 100 mK
- Deposition of energy



Rise in temperature of sensor



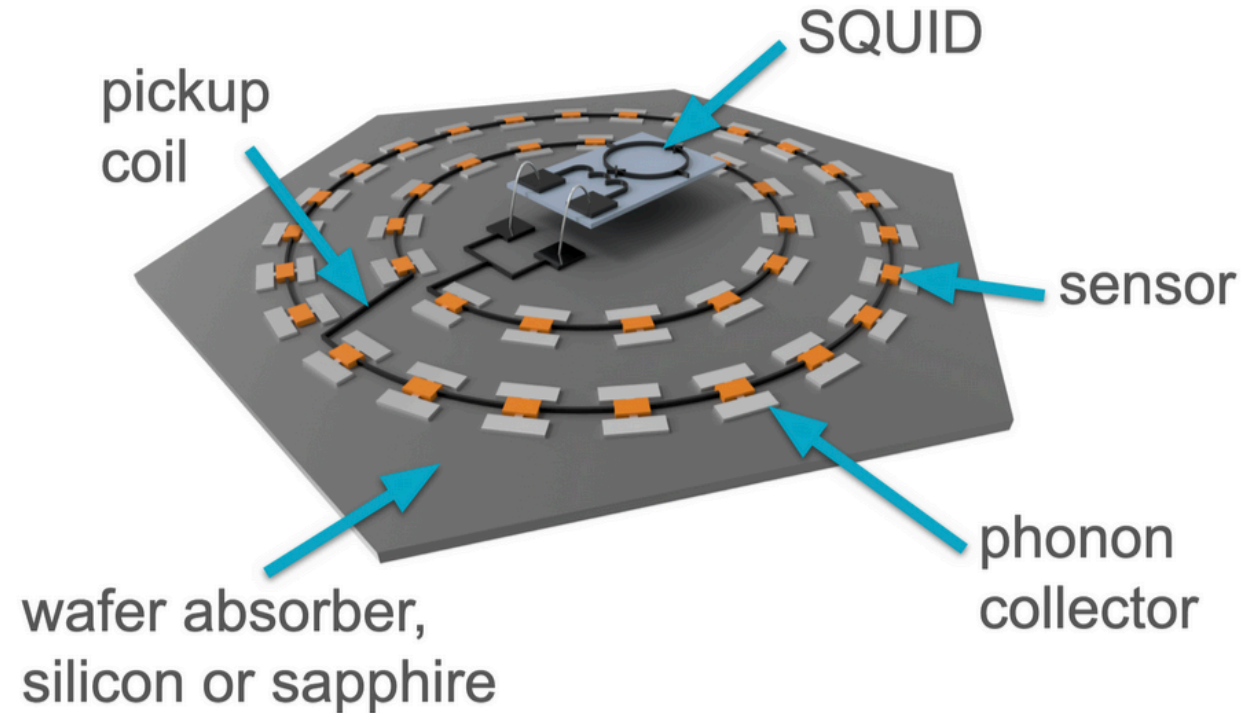
Decrease in magnetization of the
paramagnetic sensor $\delta M \propto \delta T$



Picture: [D. Hengstler et al.](#)

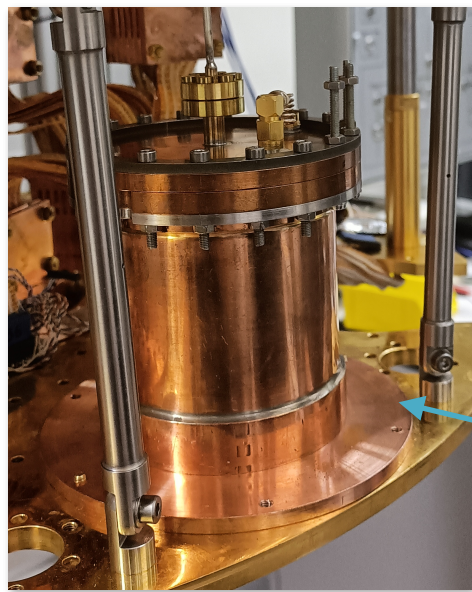
Large-area microcalorimeters (LAMCALS)

- Particle generates athermal phonons in absorber
- ↓
- Reach superconducting phonon collector: Breaks cooper pairs
- ↓
- Diffuse to sensor: Release energy and rise temperature of sensor



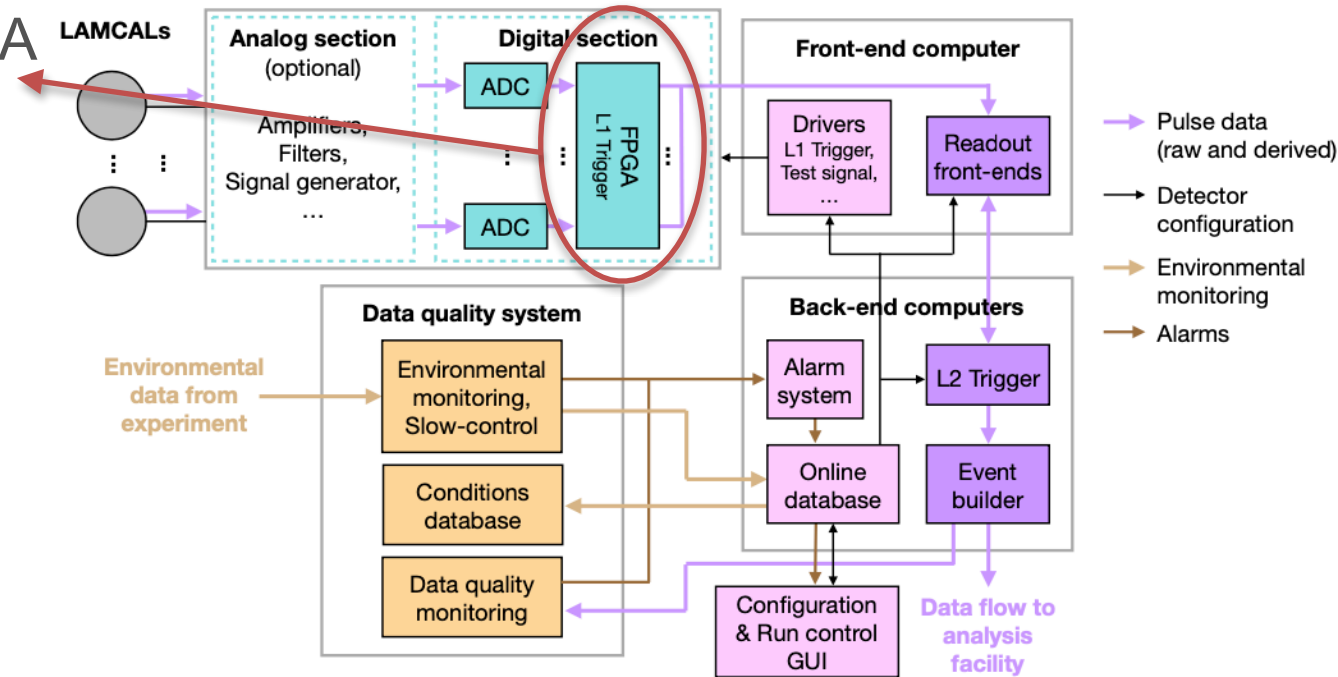
“DELight Demonstrator”

- Helium cell at UHD
 - MMC testing
 - Background modelling
 - DAQ
 - ...and much more



DAQ and trigger system for DELight

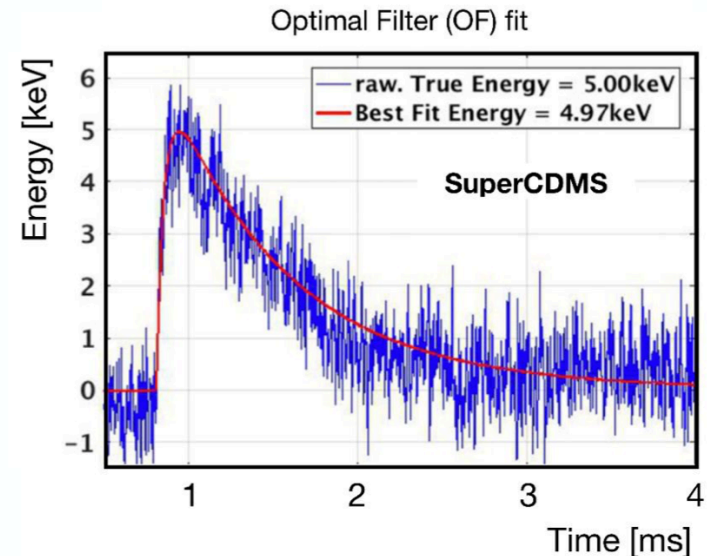
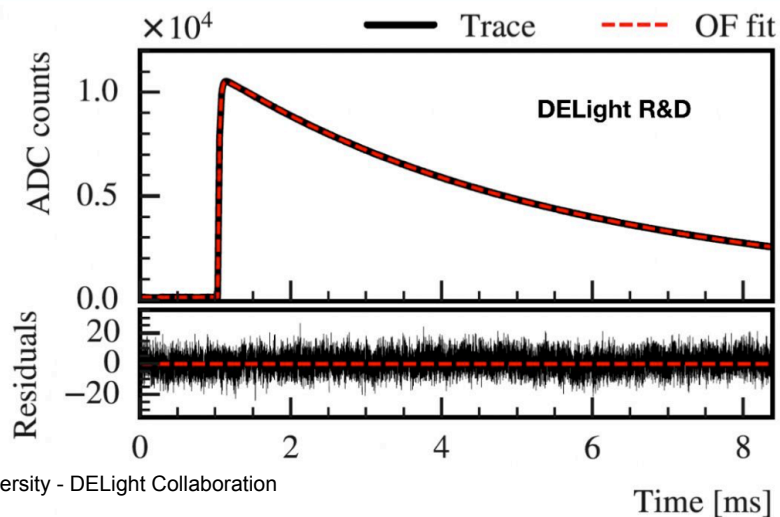
- Level-1 (L1) trigger will run on an FPGA
 - FIR filter



DAQ and trigger system for DELight

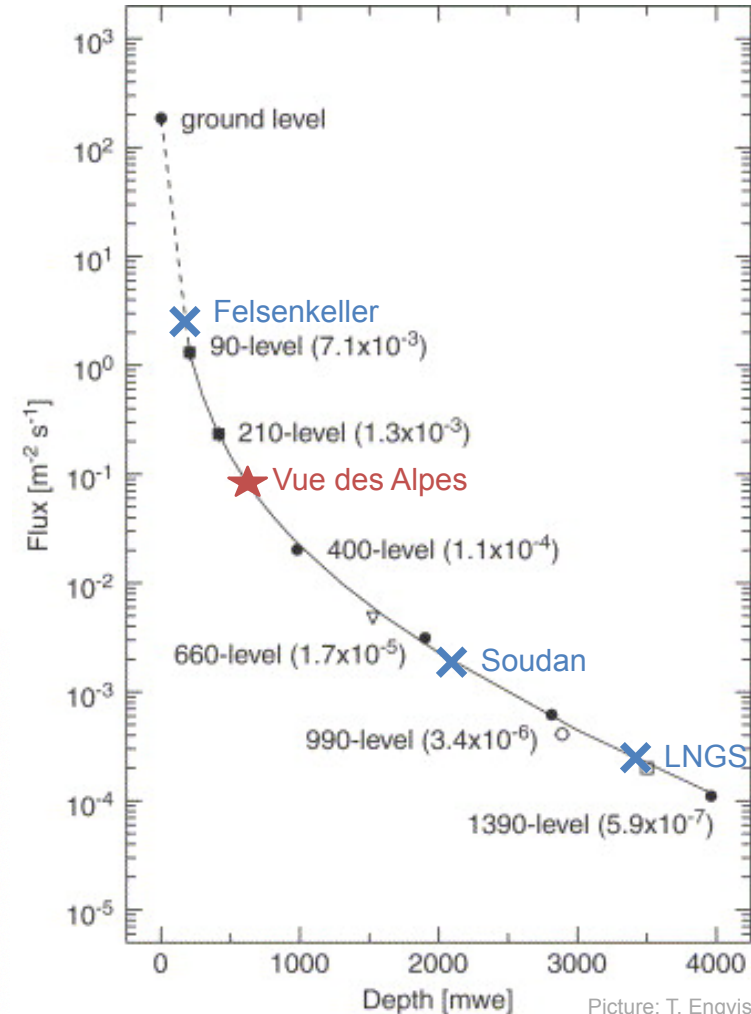
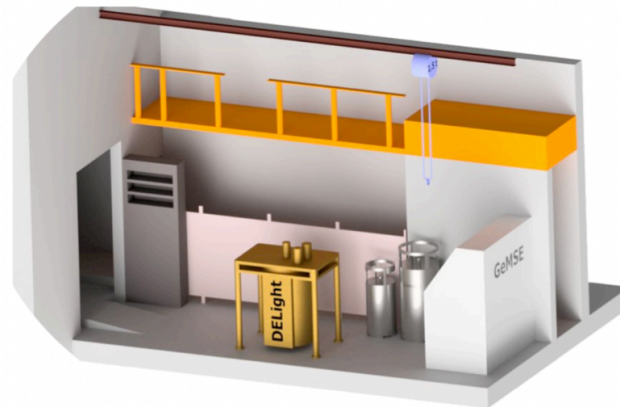
- Level-1 (L1) trigger will run on an FPGA

- FIR filter \longrightarrow Optimal filter: $S(\nu) = a \cdot A(\nu) + n(\nu)$
 - Received signal \longleftarrow $S(\nu)$
 - $A(\nu)$ \longleftarrow Template
 - $n(\nu)$ \longleftarrow Noise



Vue-des-Alpes Underground Lab

- Shallow underground lab in Switzerland
 - 230m rock overburden (620m.w.e.)
- Hosts γ -spectrometer GeMSE
 - Operated by the University of Freiburg



Outlook

- Phase I/II
 - Shallow lab at VdA
 - Up to 10L helium target
- Long range plan
 - Underground lab
 - Larger helium target
 - ...stay tuned!

