Nanowire Detection of Photons from the Dark Side

Crocodile

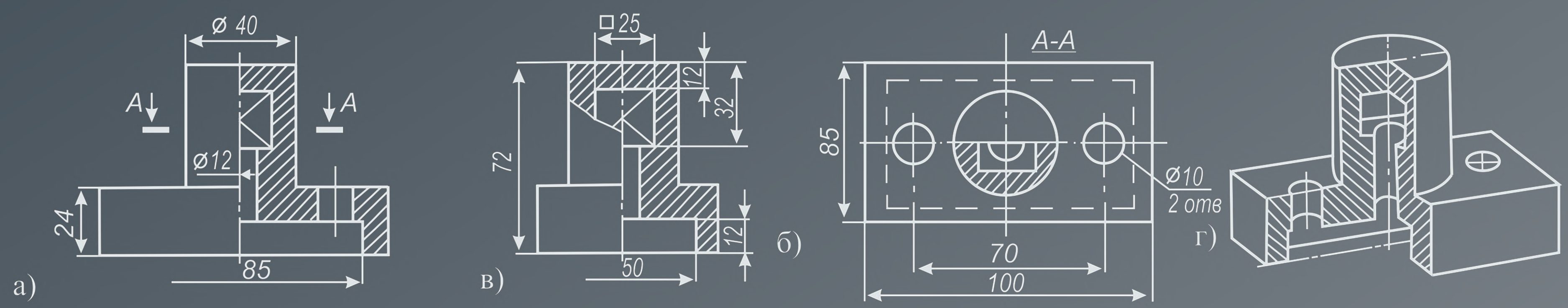
Quantum sensor cryogenic search for dark matter in light mass range

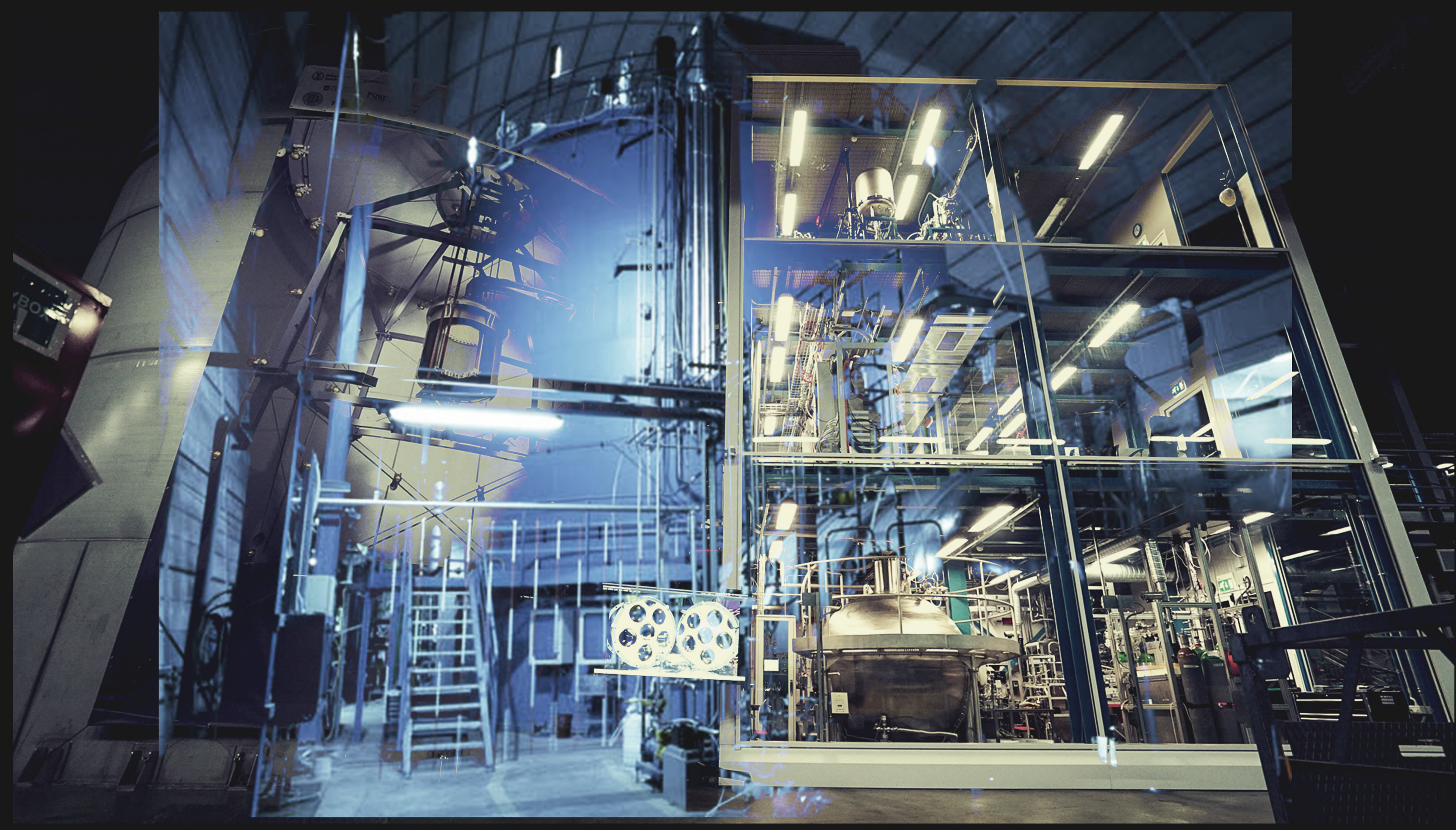
DARK MATTER

University of Zurich
searching for dark matter

We propose the use of superconducting nanowires as both target and sensor for direct detection of sub-GeV dark matter. With excellent sensitivity to small energy deposits on electrons and demonstrated low dark counts, such devices could be used to probe electron recoils from dark matter scattering and absorption processes.

We'll implement the experiment using existing fabricated tungsten silicide and molybdenum silicide nanowire prototypes with 0.1 – 0.8 eV energy threshold and large detector mass. The results from these devices might place meaningful bounds on dark matter-electron interactions, including the strongest terrestrial bounds on sub-eV dark photon absorption to date.

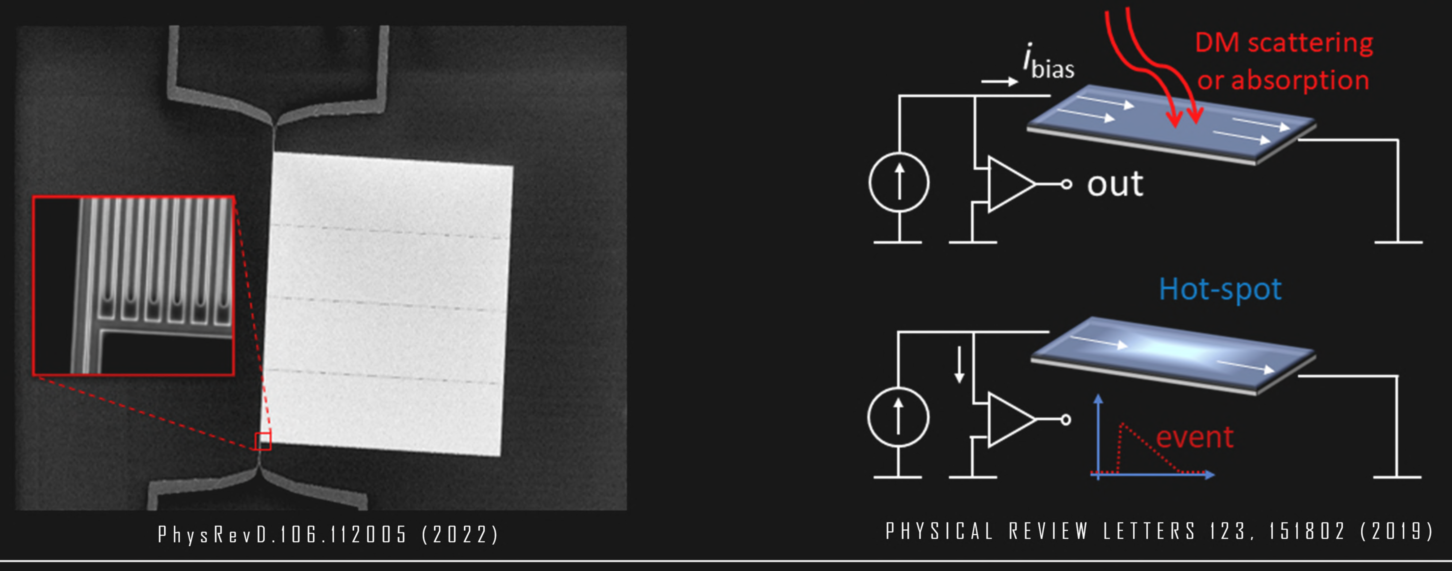




Laboratori Nazionali del Gran Sasso

We can probe a variety of dark matter candidates, including fermions or bosons via absorption, or scalars, pseudoscalar and vectors through scattering.

Large-area Superconducting Nanowire Single-Photon Detector (SNSPD)



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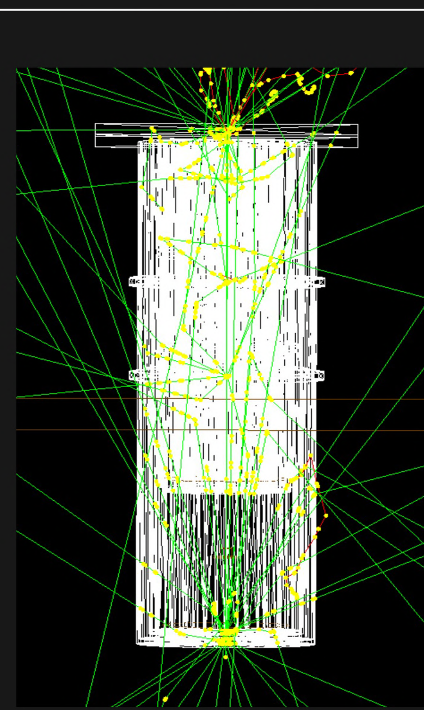
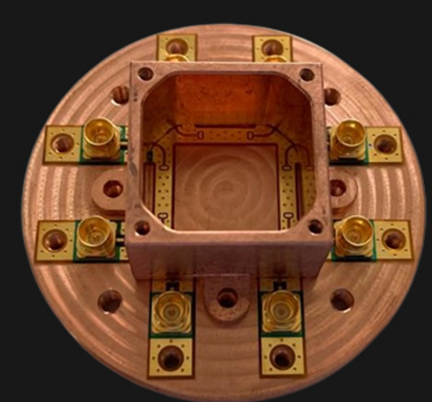
Simulation of radioactive sources

- Multiple amounts of particles simulated to check behavior
- Final simulation conducted with 25 Million gammas
- Hits clearly indicate position of the holder
- Deposited energy on holder: 2.193keV
- For 140M gammas: 12.3 keV

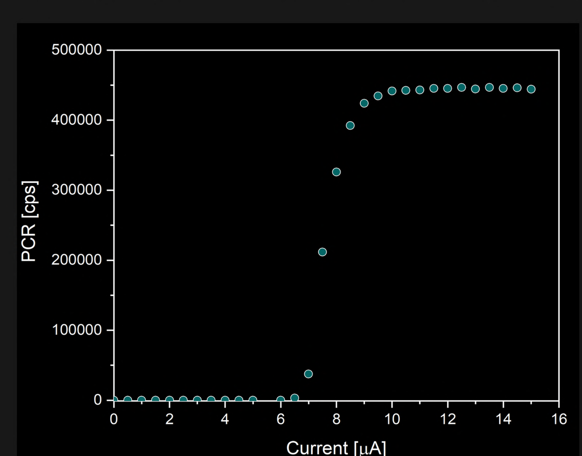


Ongoing experiment

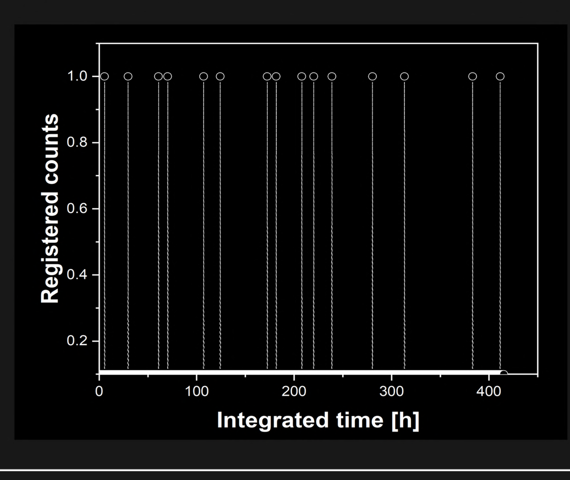
1. Oxygen-free cooper holder



2. Saturation of DE at 1550 nm



3. Long-integration time experiment



Metrics

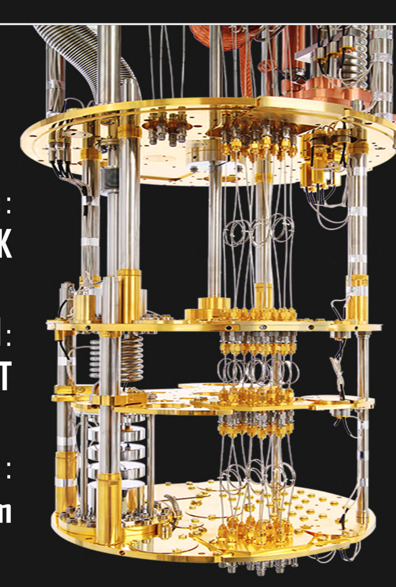
High detection efficiency :
98% @ 1550 nm

Broad response range:
from X-ray to mid-infrared

Ultra short timing jitter:
< 3 ps

Low noise characteristics:
< 10-5 cps

Cryogenics



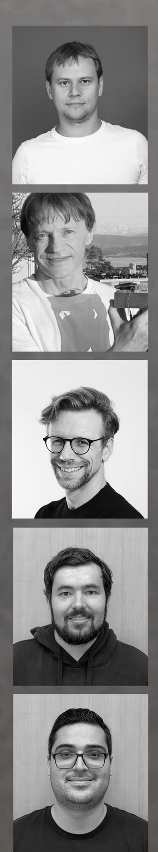
Base temperature:
100 mK

Magnetic field:
up to 8 T

Light sources:
400 nm - 11000 nm

- Excellent Temperature Control
- Low vibration and noise
- External magnetic field
- Single and multimode fibers

Condensed matter physics



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