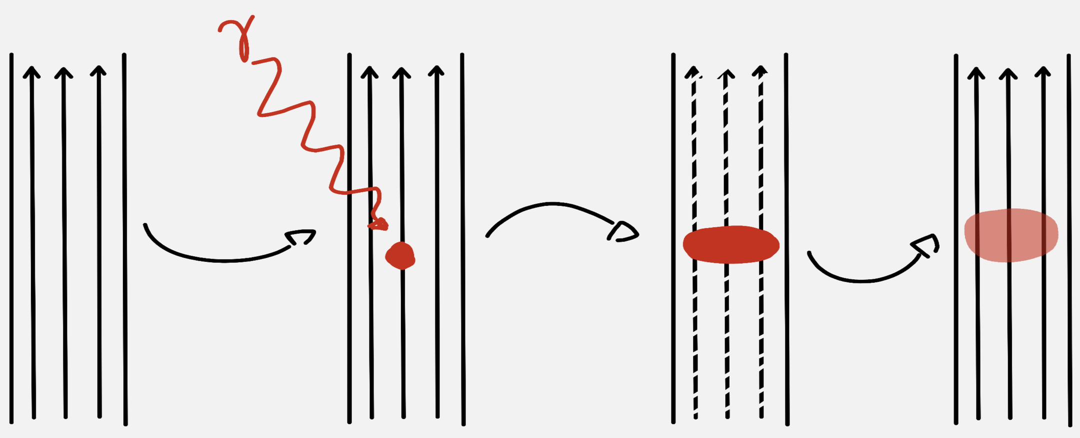
A short trek through the mystical land of detectors

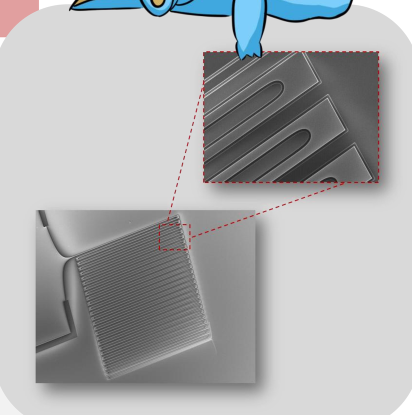
Kilminster group

SNSPD ~20+ years
Timing LGAD ~15years
LGAD ~7 years
DAMIC ~2-5 years
TPEX ~now

FCC-ee
HL-LHC

SNSPD (Superconducting nanowire single photon detector)

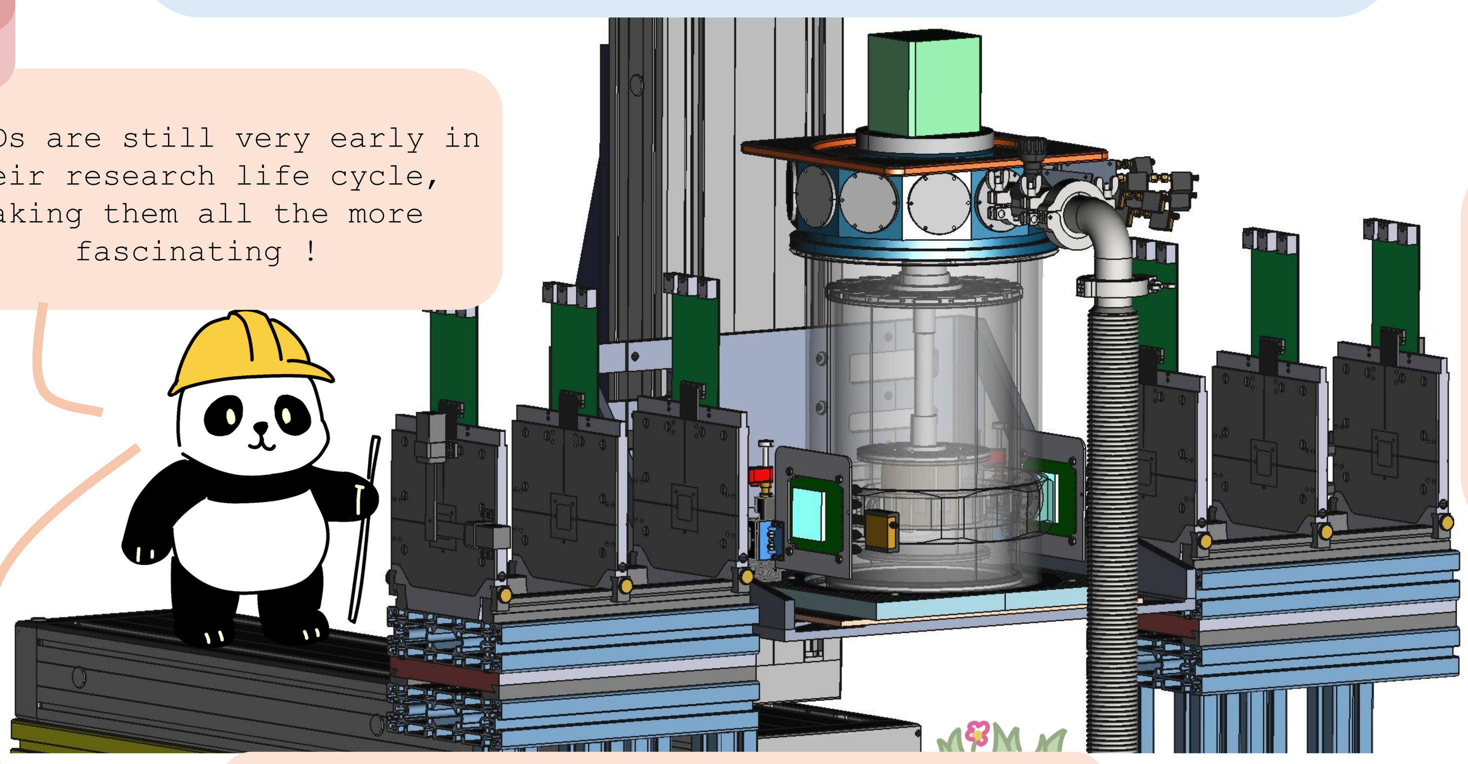




Particle hits the wire → Creates a hotspot → Breaks superconductivity → Creates a measurable voltage signal → Returns to stable state for new detection !

- 98% photon detection efficiency
- Photon, electron and pion detection
- Excellent timing resolution
- Potential luminometer application at FCC

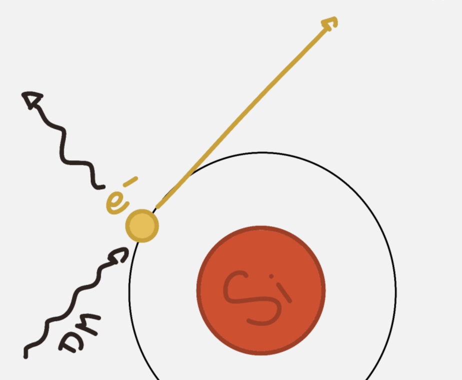
SNSPDs are still very early in their research life cycle, making them all the more fascinating !



This is our test beam setup; it uses 6 telescope planes and 2 timing LGADs for coincidence measurements of our SNSPD

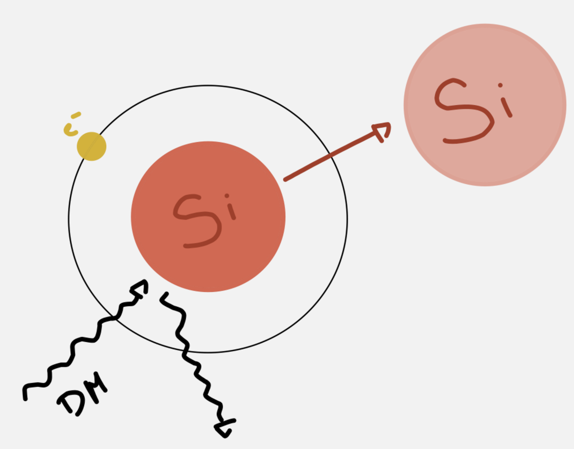
DAMIC (Dark matter in CCDs)

e-scattering



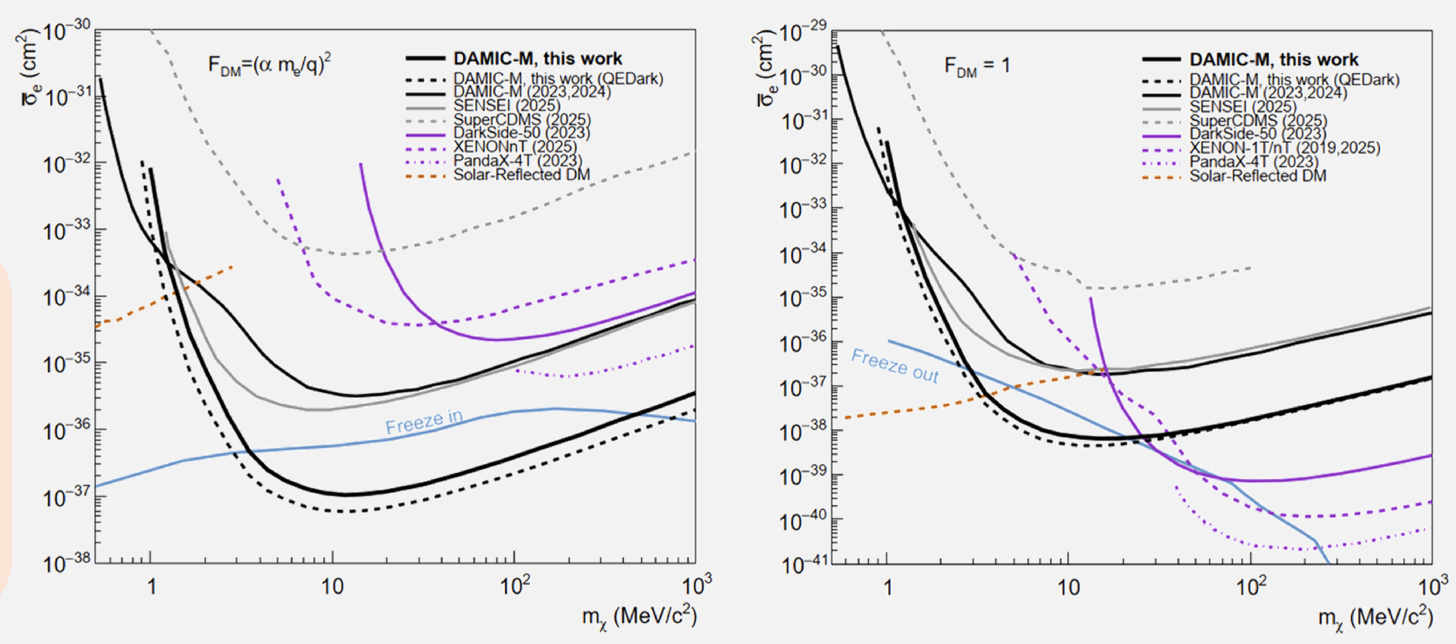
Dark matter comes in, knocks the electron out of the silicon's orbit, which we can then detect

Atom recoil

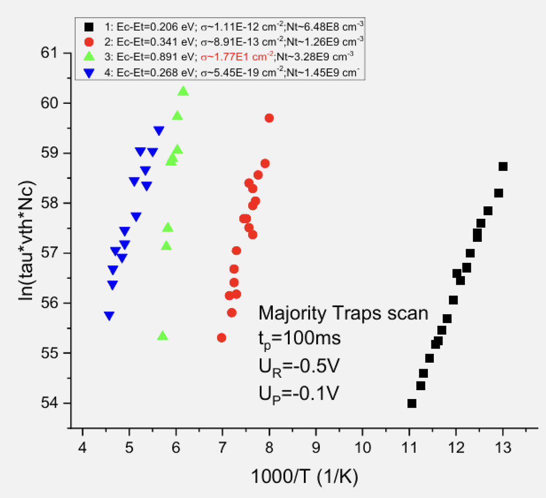


Dark matter hits the silicon atom hard enough to knock it out of the lattice creating e-h pairs, and also defects

In our search for dark matter, we use two detection mechanisms, electron scattering and atom recoil

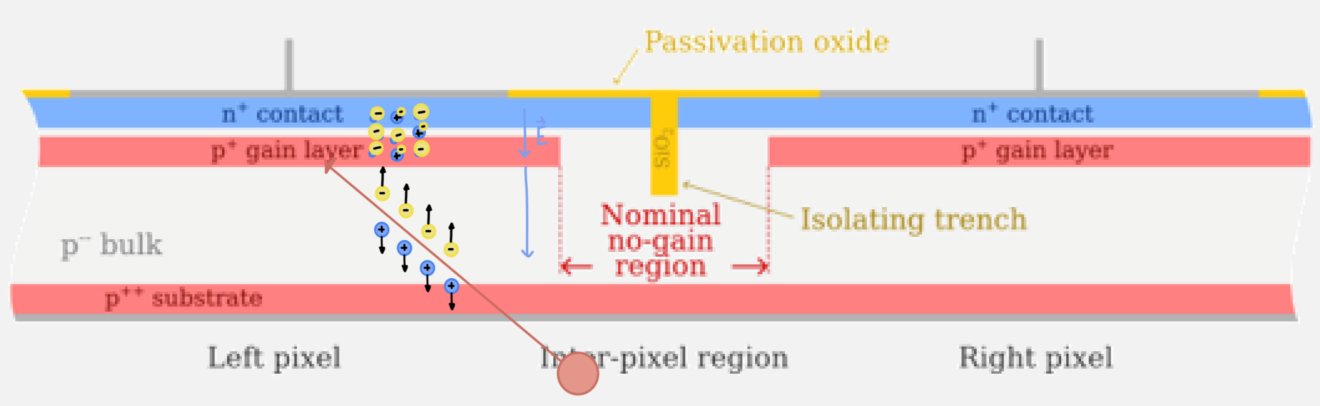


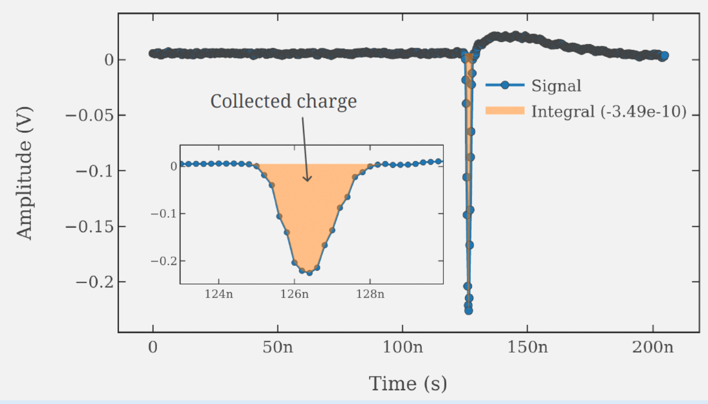
So, which one is it ? Freeze out means the DM interacted only soon after to the Big Bang. Freeze in means it barely interacted but piled up over time…

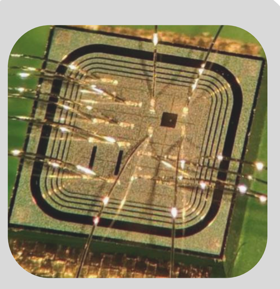


DAMIC-M uses normal silicon CCD detectors. We are developing a new detection mechanism through non-ionizing energy loss by exploiting defect quantum states

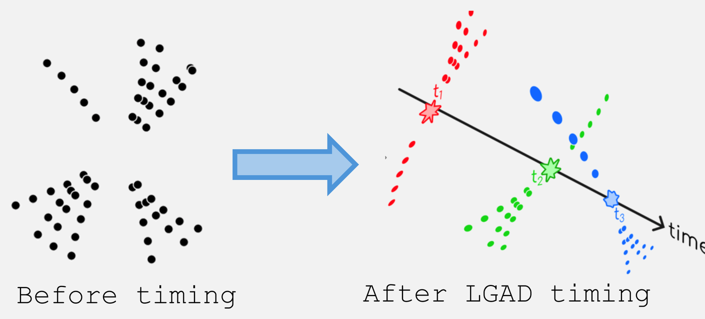
LGAD silicon detector (Low gain avalanche detector)





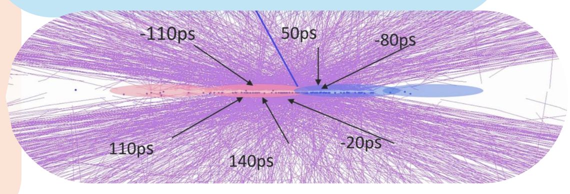


- 4D detector with 30ps and 10μm resolution
- Pileup mitigation in LHC-HL
- Particle identification through TOF in FCC-ee



Timing helps go from a random pile of points to accurate tracks of particles !

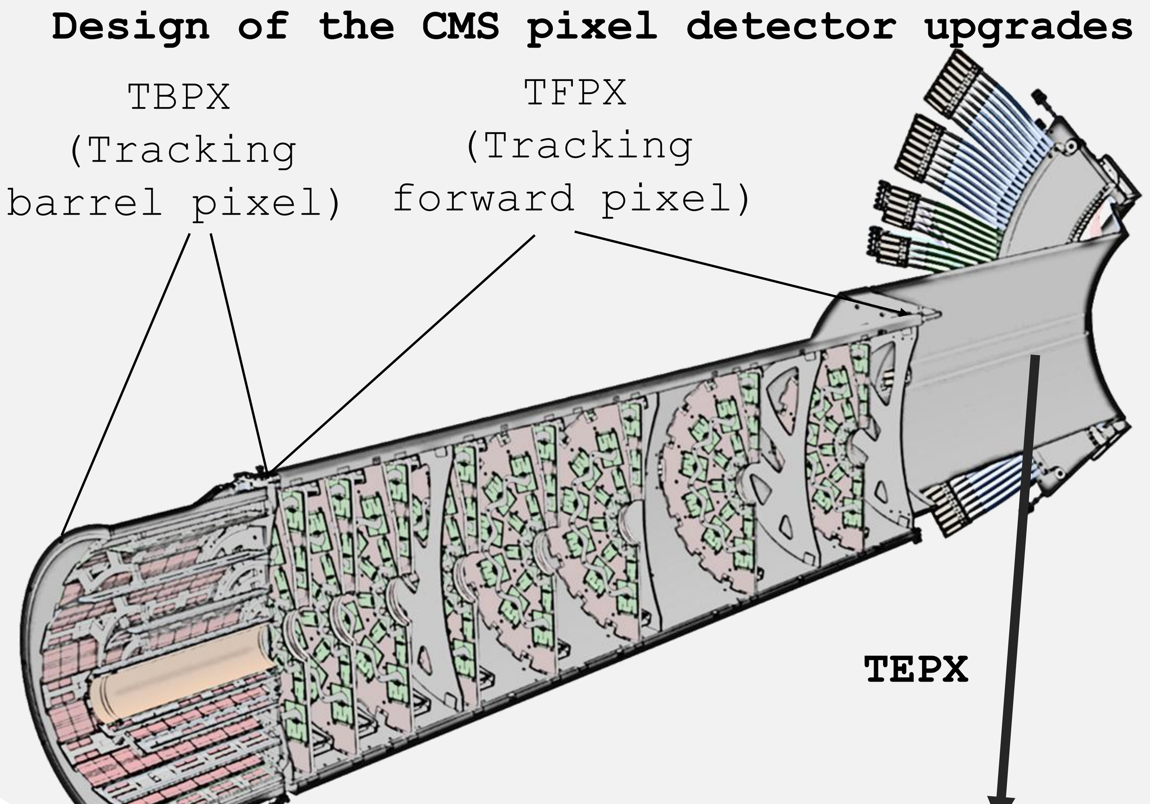
The LGAD detectors are developed for the phase 3 upgrade of the CMS tracker to achieve 4D timing, combining advanced space and timing resolution.



TEPX (Tracking endcap pixel)

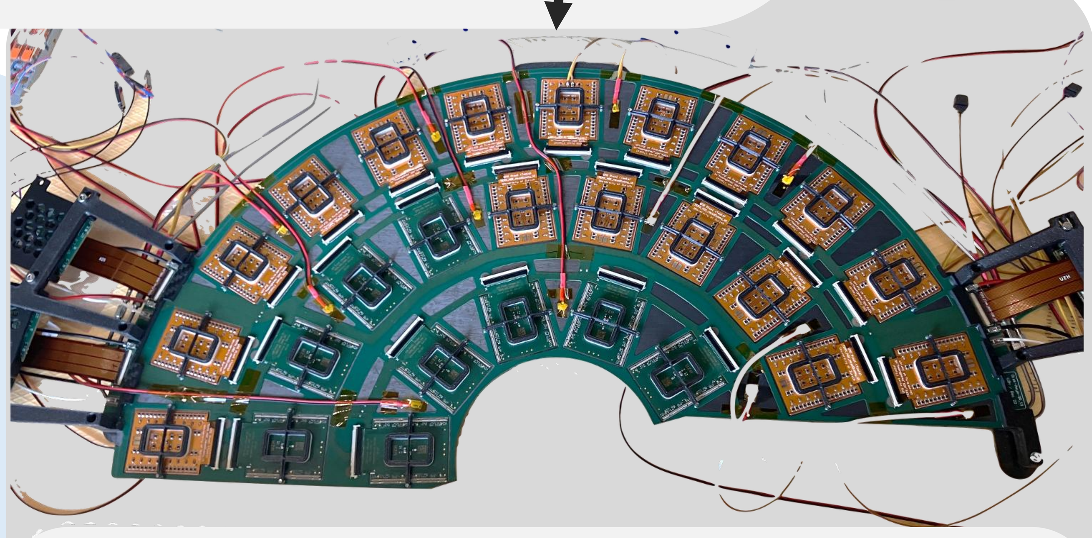
Design of the CMS pixel detector upgrades

TBPX (Tracking barrel pixel)
TFPX (Tracking forward pixel)



The Future HL-LHC will increase luminosity by a factor of 10, so we need detectors capable of handling such a high rate, radiation level… And also over 16Pb of data per second

- Part of the phase 2 update to the CMS detector
- 5m² active Si area with 4 layers and 24 disks
- 800 million pixels in total, with 40MHz readout rate



All of this is being built in the clean room at UZH, come visit !

Would you like to join us ?

- Master and Bachelor projects
- Lots of simulation
- Lab work with future detectors
- Possibility of test beam experiments at CERN SPS

SCAN ME

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