

*37 th International Cosmic Ray Conference 12-23 July 2021*

# Simulations and background estimates for the DAMIC-M experiment

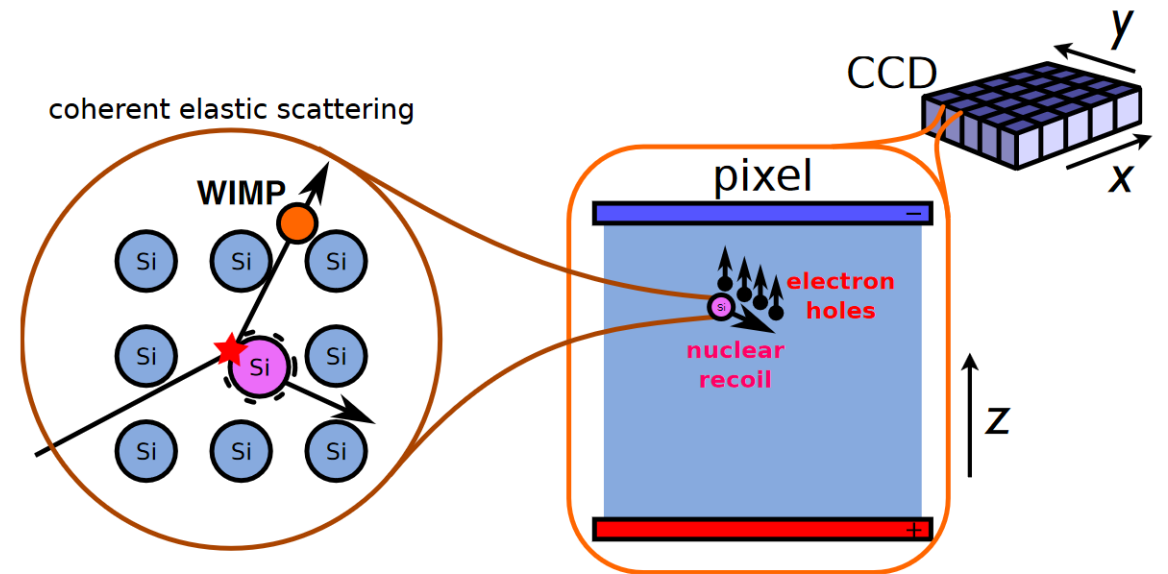
Claudia De Dominicis and Mariangela Settimo on behalf of the DAMIC-M collaboration

*SUBATECH, IMT Atlantique, Université de Nantes, CNRS-IN2P3*

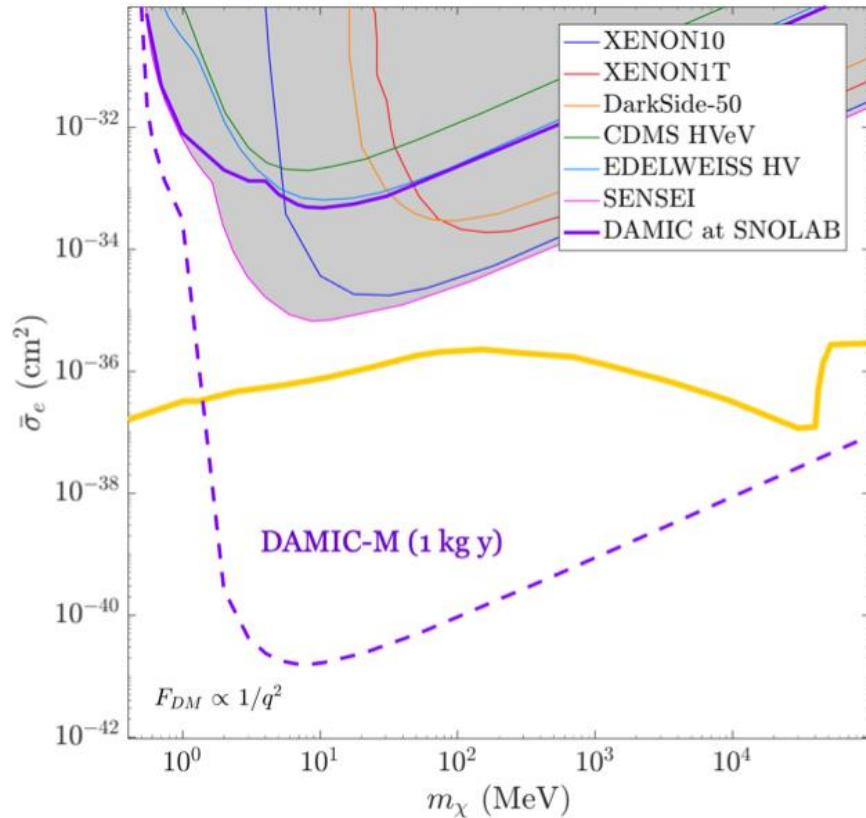


# DAMIC-M: Dark Matter in CCDs at Modane

- Near-future experiment
- Aim: search for low-mass dark matter particles in Charge Coupled Devices (CCDs) via their interaction with Si nucleus or electrons
- Location: Laboratoire Souterrain de Modane (LSM), France, under 1700 m of rock.



# DAMIC-M Novelties



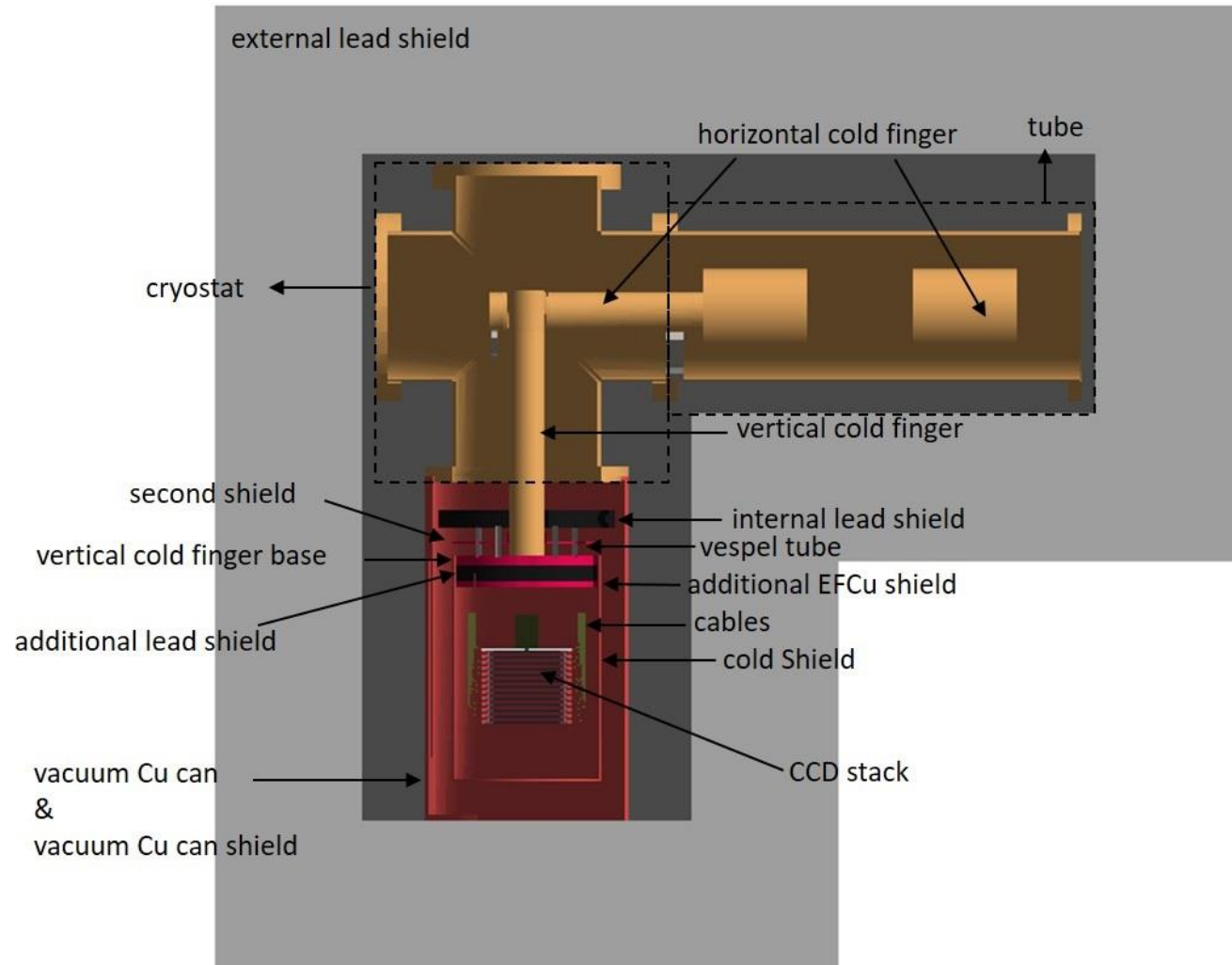
kg-size mass  
200 CCDs, 6000 x 1000  
pixels, 0.675 mm thick

skipper-CCD with  
sub-electron  
resolution

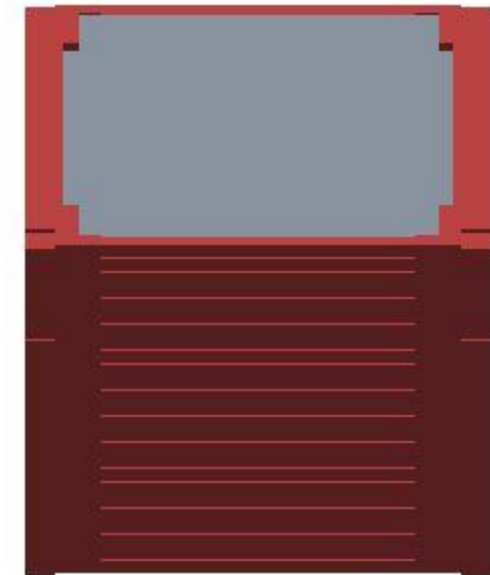
background rate:  
 $\sim 0.1$  d.r.u

**Geant4 simulations to optimize the  
detector design and drive the material  
selection and handling.**

# Detector design in Geant4 (baseline design)



Horizontal  
CCD stack



# Results: energy spectra and background estimate

- Radioactive isotopes uniformly simulated in the bulk of the detector components:

238U & 232Th chains

Cosmogenic isotopes  
in Cu

K40 & Rb87

- For each isotope:

background rate:

$$n_{\text{clusters}} \frac{n_{\text{bins}} \cdot A_{\text{iso}} \cdot m_{\text{vol}}}{\Delta E \cdot N_{\text{decays}} \cdot M_{\text{detector}}}$$

$A_{\text{iso}}$ : isotope activity [decay/kg/day]

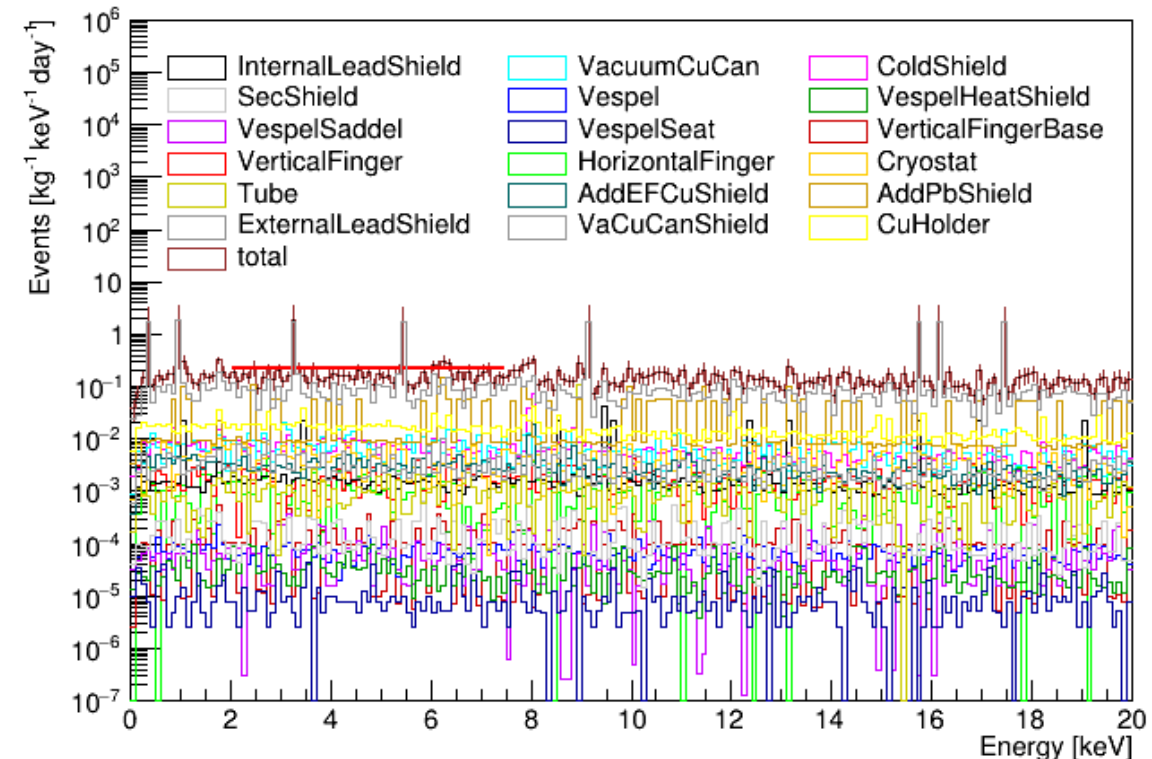
$m_{\text{vol}}$ : mass of simulated volume [kg]

$N_{\text{decays}}$ : number simulated events

$M_{\text{detector}}$ : mass sens. detect. [kg]

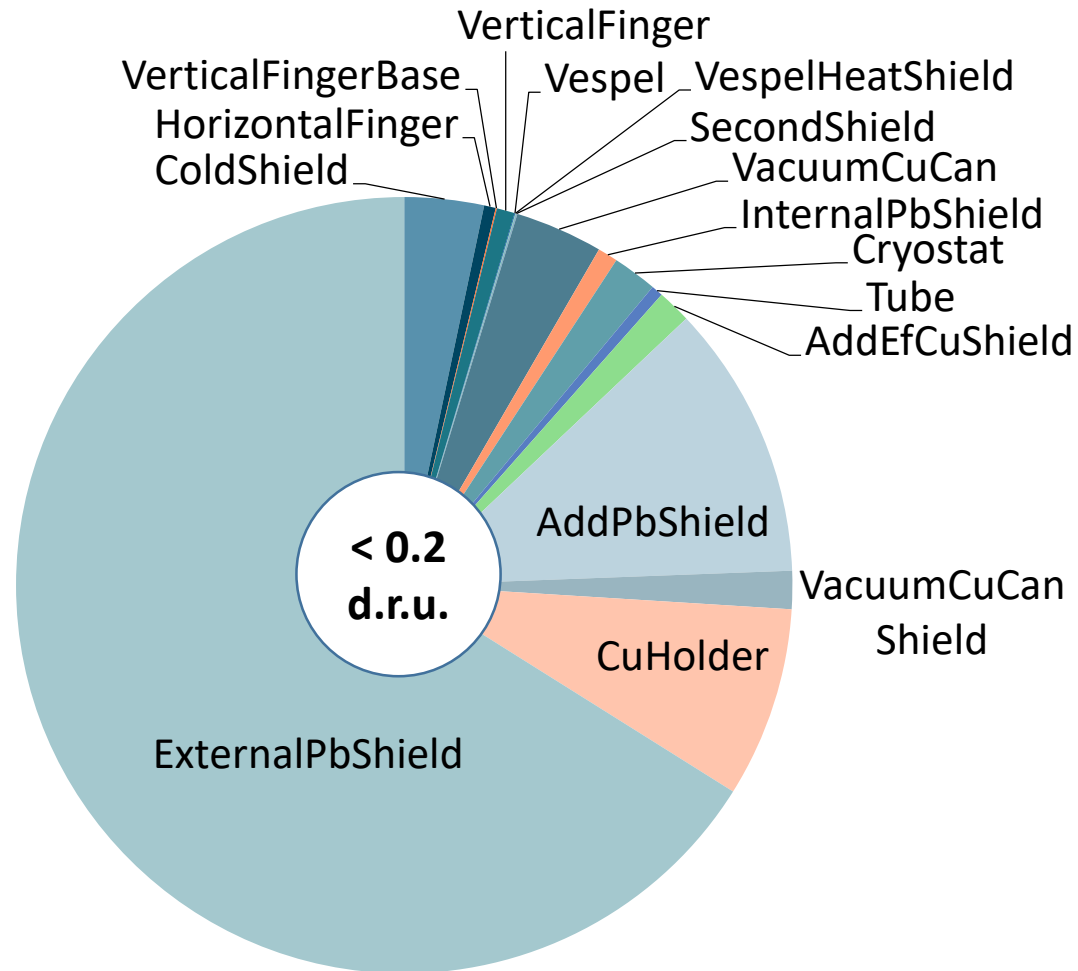
$\Delta E/n_{\text{bins}}$ : bin width [keV]

$n_{\text{clusters}}$ : number of clusters in a given bin



# Results (II): Main background contributors

- Copper holder and cables: major background contributors.
- The external lead shield contribution is an upper limit. Measurements of the isotopes' activities are required.
- Substantial contribution from cosmogenic activation of EF copper. Control and reduction of the exposure time to cosmic rays is crucial.



Cosmogenic in EFCu  
Texp = 10 days,  
Tcool = 6 m,  
Trun = 1y

+

**0.1**  
**d.r.u.**

# Outlook

- Precise measurements of radiogenic isotope activities in all materials. A screening campaign is scheduled.
- Detector storage and handling underground.
- Finalized DAMIC-M detector design and simulations coming soon.
- A prototype (Low Background Chamber, LBC) will be installed at LSM in 2021 for detector study in low background environment and preliminary physics results. Validity of simulations may be tested in an unexplored low energy region

