

Light dark matter constraints with DAMIC-M prototype

Speaker: Nicolás Avalos



Brief description of DAMIC-M

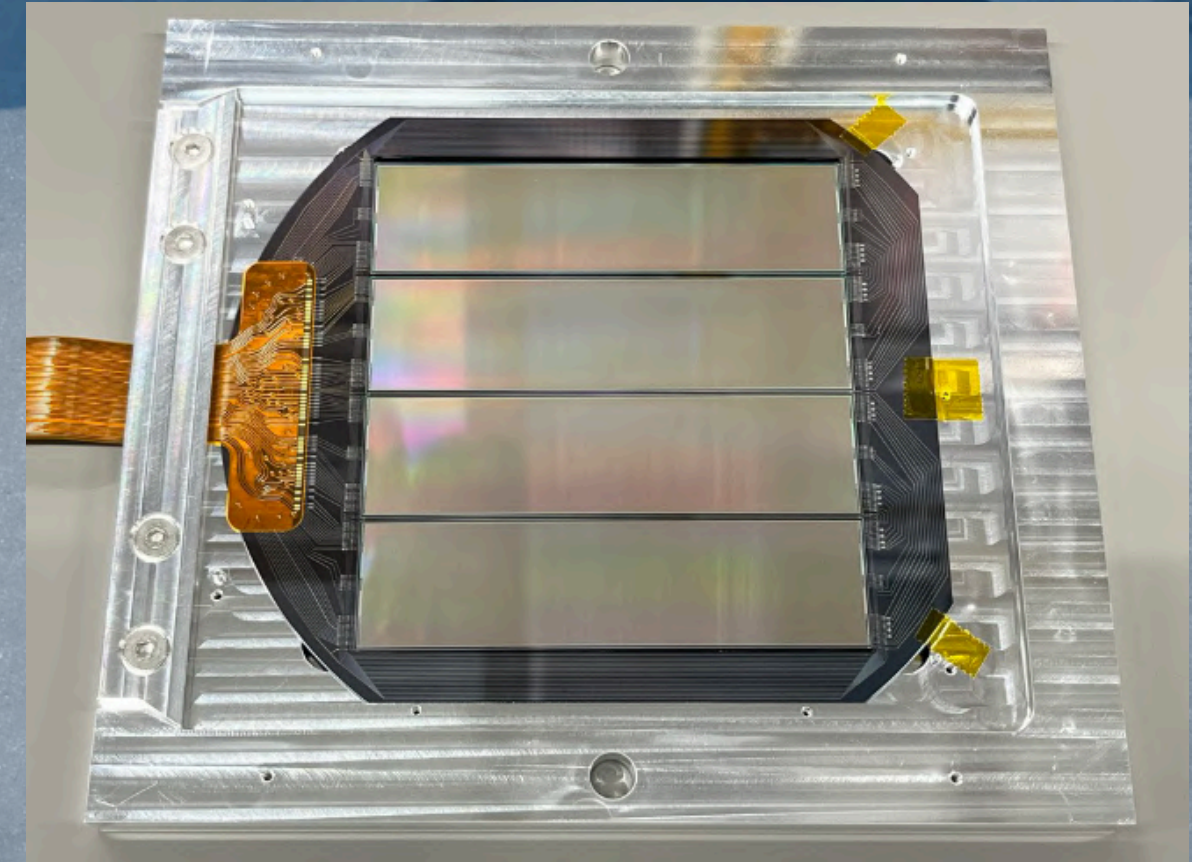
- The goal: detect dark matter
- The detectors: Skipper CCDs
- The place: Modane Underground Laboratory (LSM)
- The people: international collaboration of ~45 scientists*

*: number of authors of last paper. More people are actually involved.

Brief description of DAMIC-M

- The goal: detect dark matter
- The detectors: Skipper CCDs
- The place: Modane Underground Laboratory (LSM)
- The people: international collaboration of ~45 scientists*

*Topic of
Monday's talk*



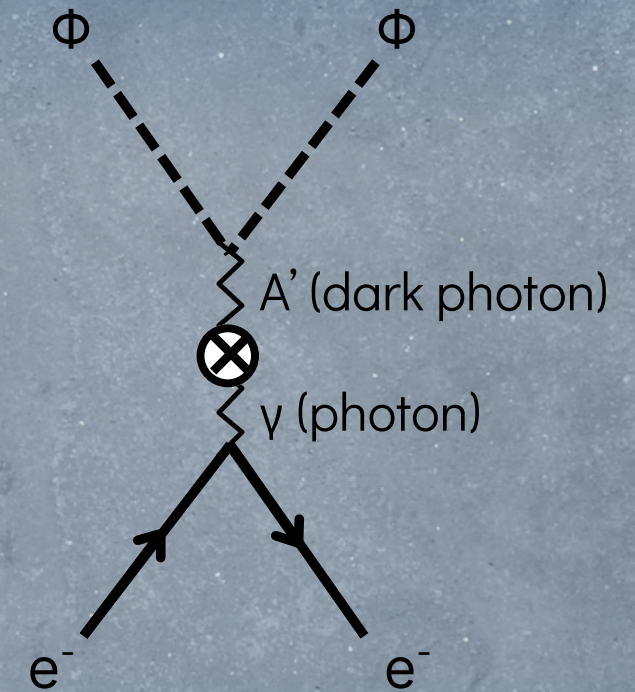
*: number of authors of last paper. More people are actually involved.

Brief description of DAMIC-M

- The goal: detect dark matter

Topic of this talk

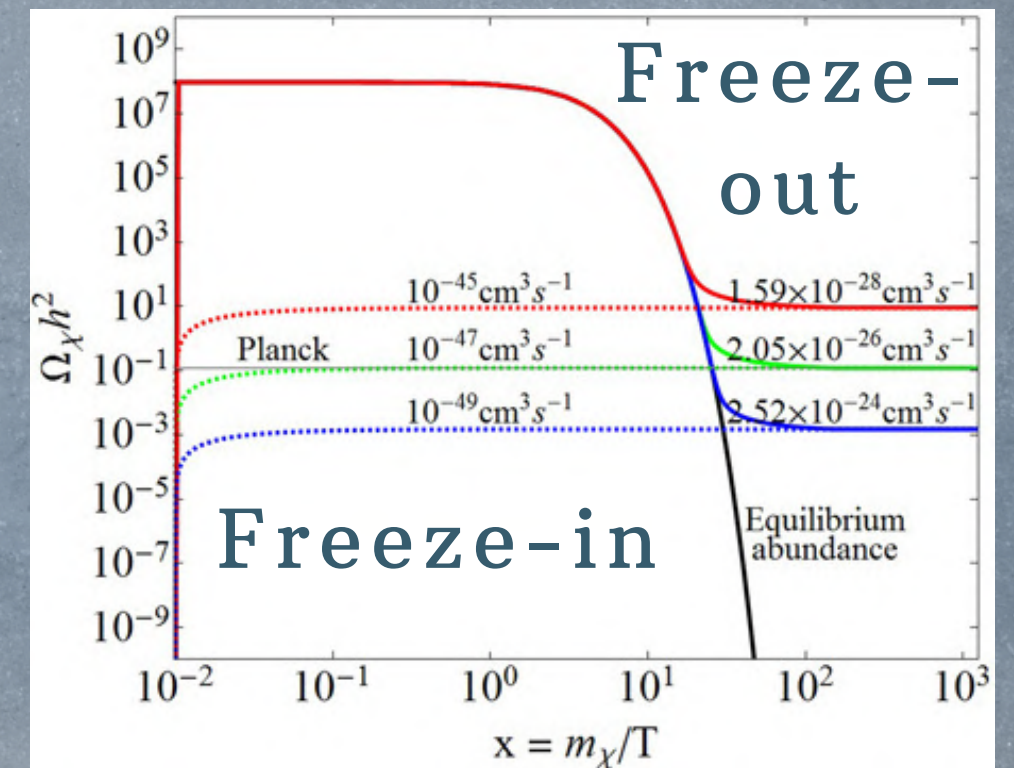
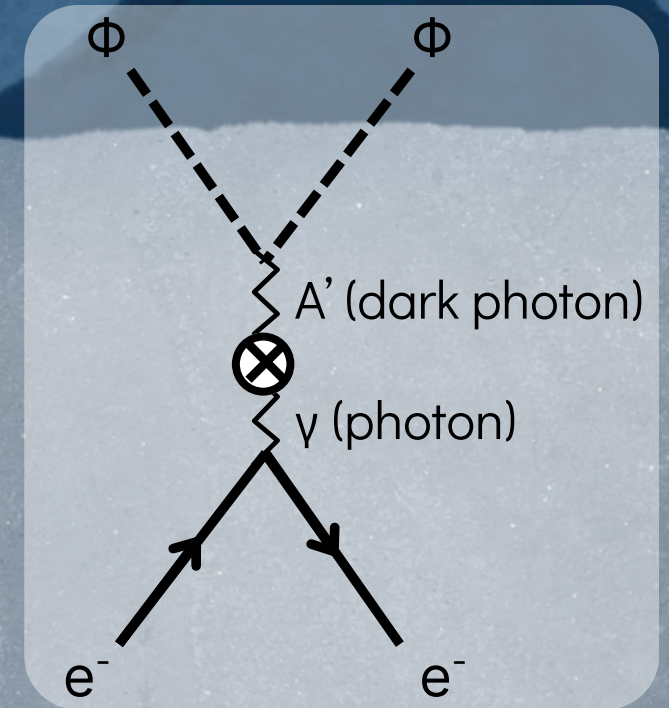
- The detectors: Skipper CCDs
- The place: Modane Underground Laboratory (LSM)
- The people: international collaboration of ~45 scientists*



*: number of authors of last paper. More people are actually involved.

MeV-scale, hidden sector Dark Matter

- These are our DM candidates: particles (either bosons or fermions) with masses in the MeV range that interact with electrons via massive “kinematically-mixed vector mediators”.
- Depending on the mass of the mediator, the DM abundance can be explained either by freeze-out or freeze-in.

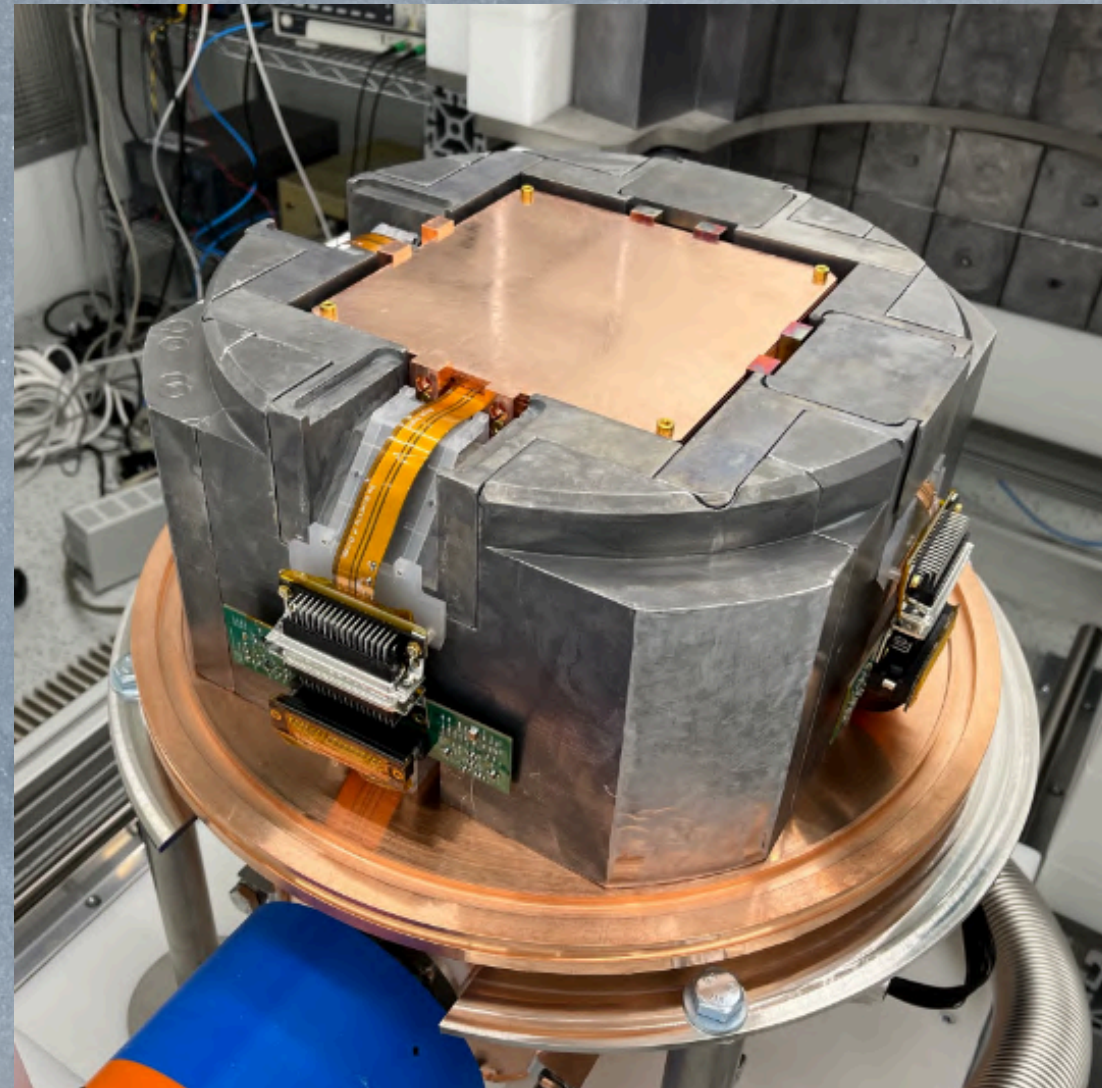
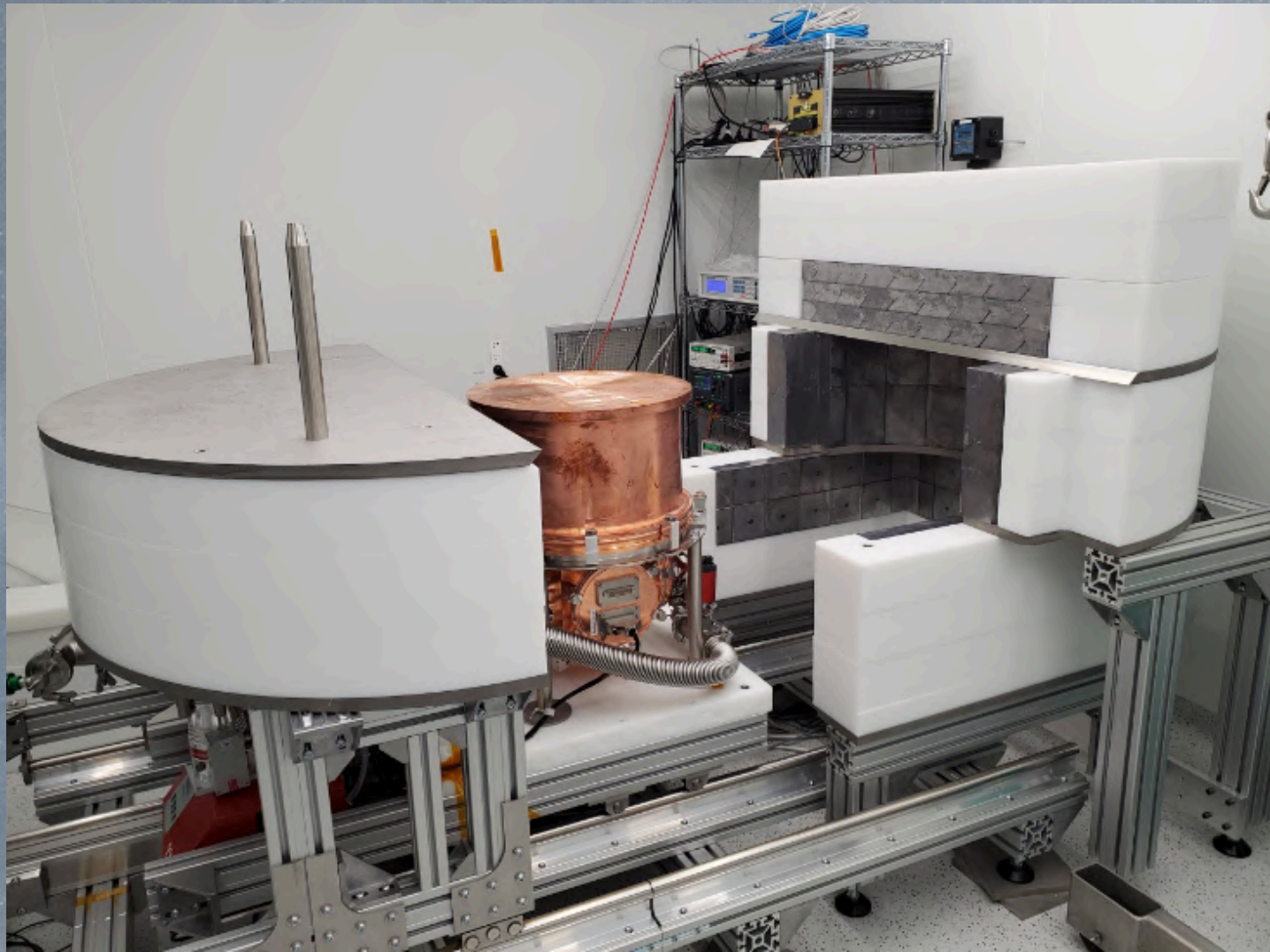


[Dev, Mazumdar, Qutub 2013.](#)

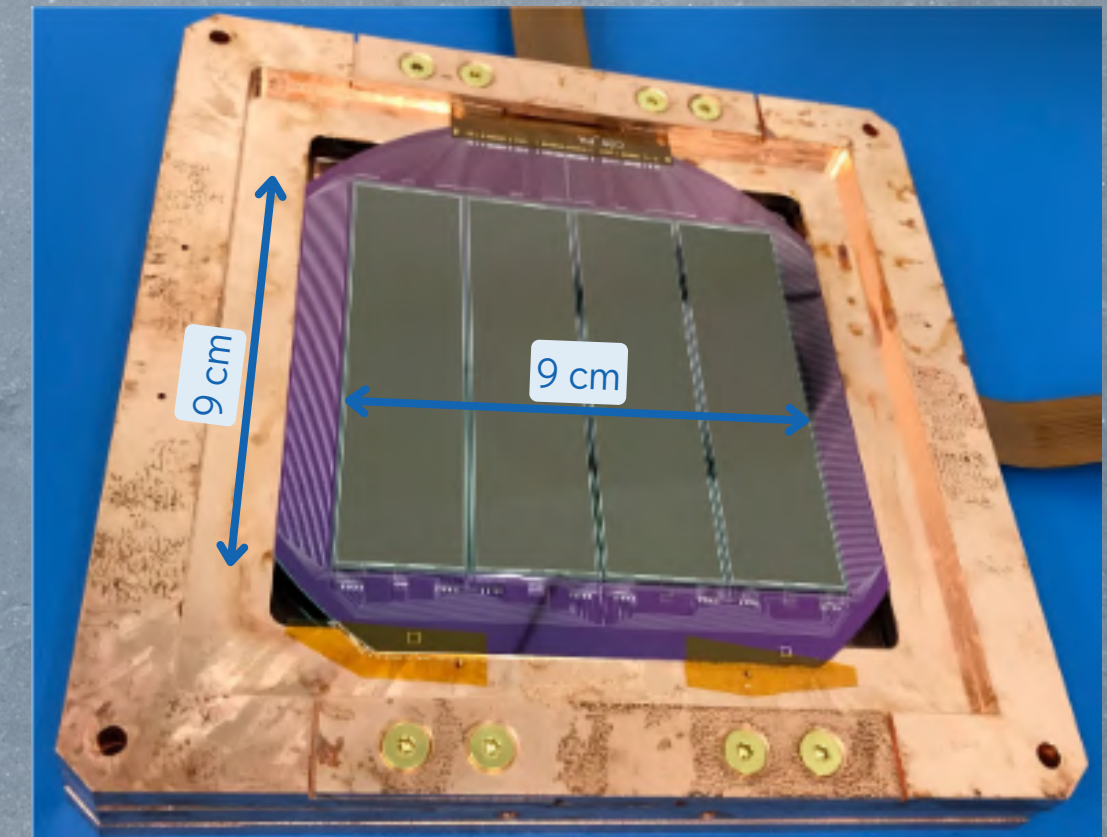
The Low Background Chamber (LBC)

[I. Arnquist et al 2024 JINST 19 T11010](#)

Conceived as the DAMIC-M prototype, it already yielded science world-leading results

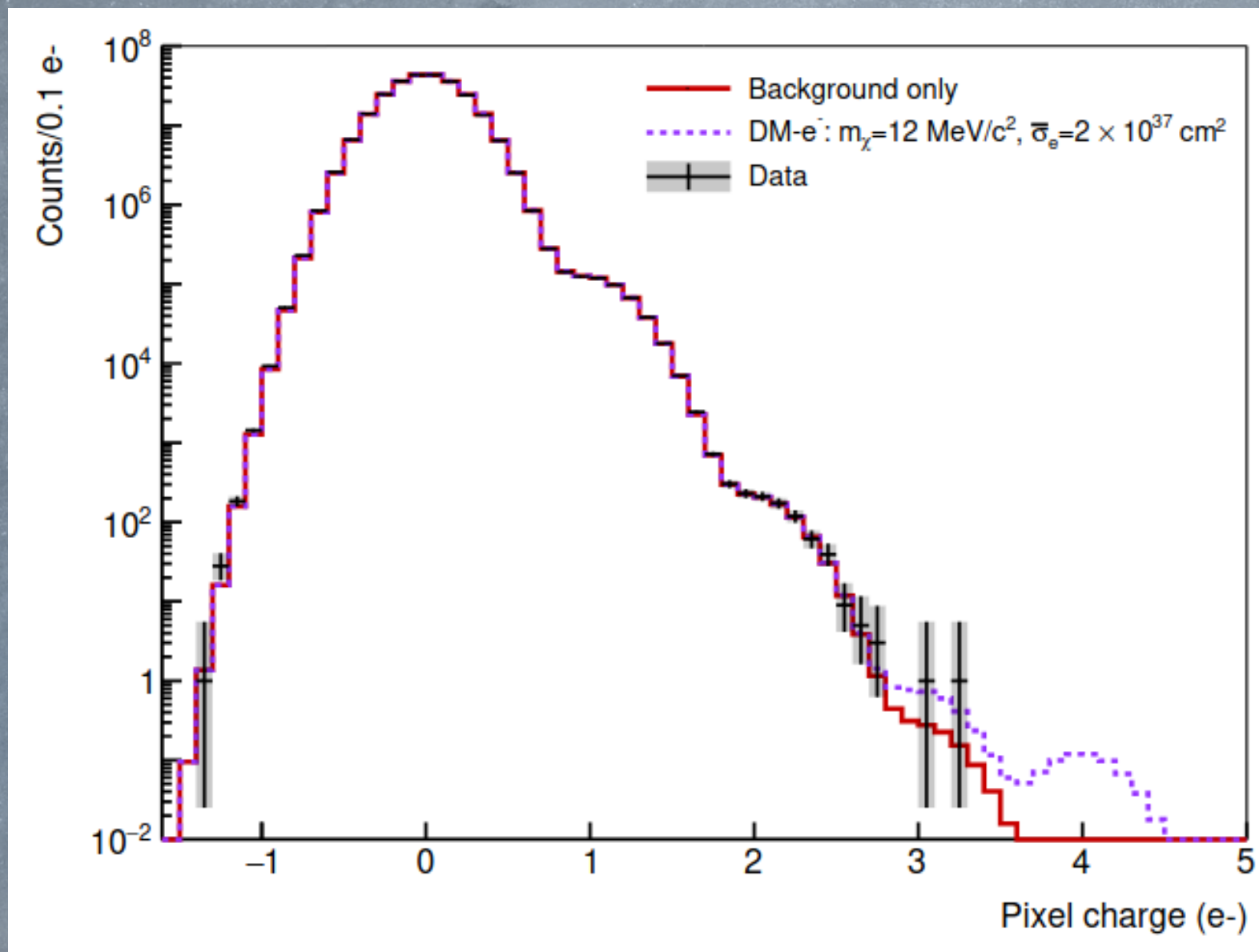


Two DAMIC-M prototype skipper CCD modules (~ 27 g of detection mass)



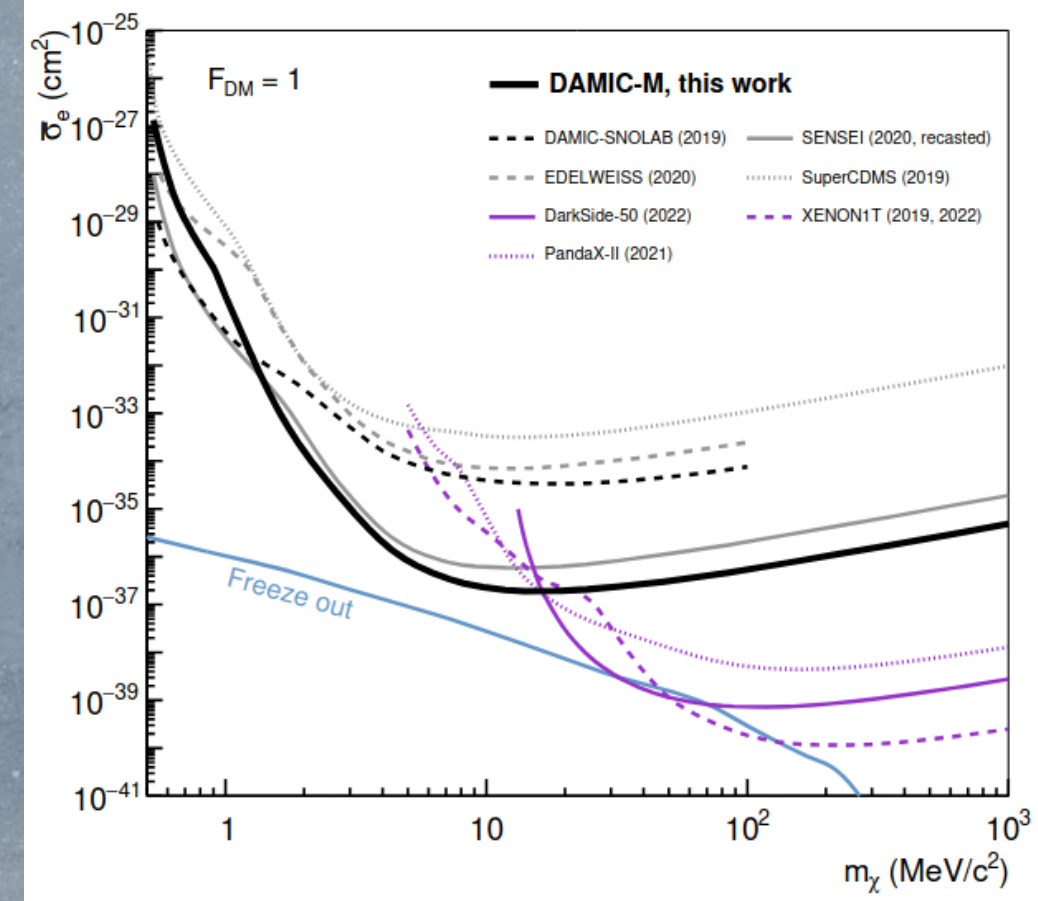
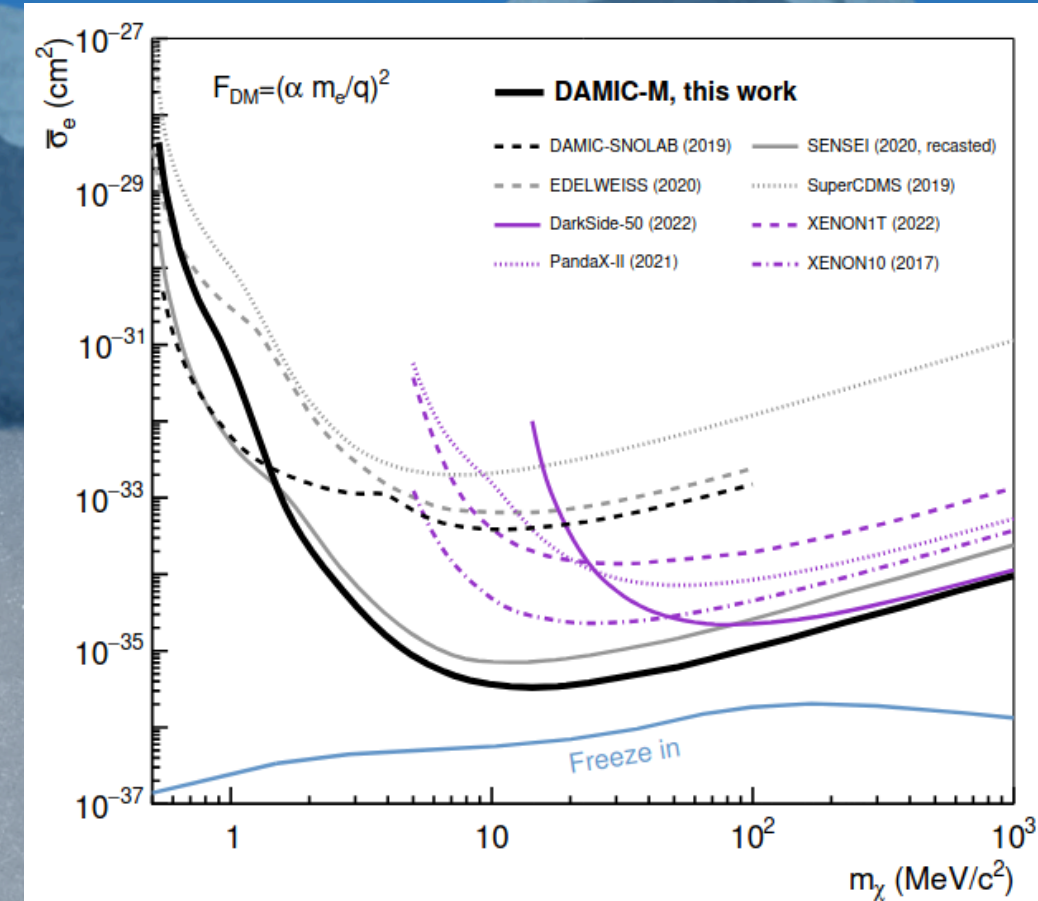
The “traditional approach”

Model background $\rightarrow$ model signal $\rightarrow$ compare



Exposure: 85.23 g-days
(during 2022–2023)

[Phys. Rev. Lett. 130, 171003](#)
Published 28 April, 2023

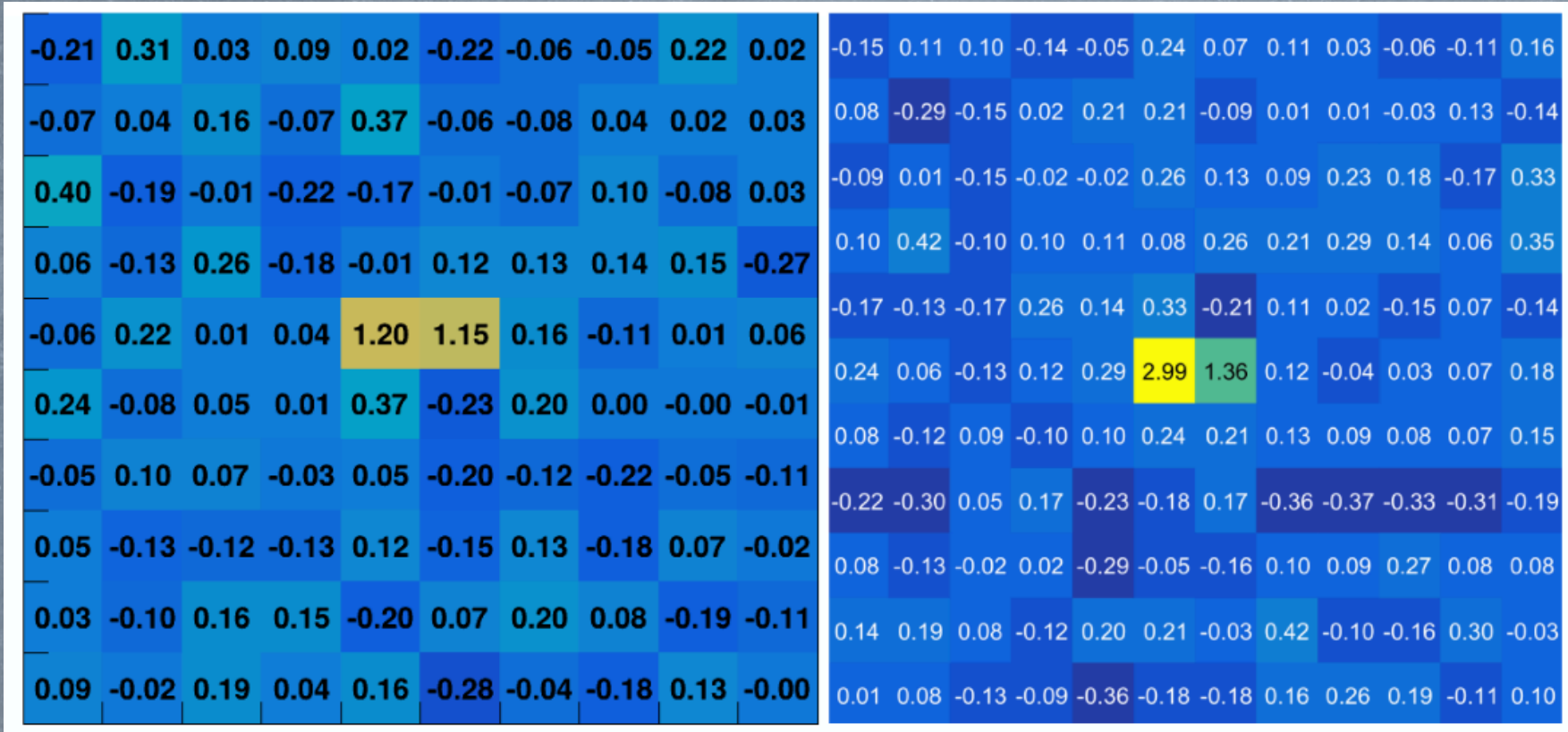


The “pattern analysis”

Events were classified into “patterns” to exclude some detector intrinsic backgrounds.

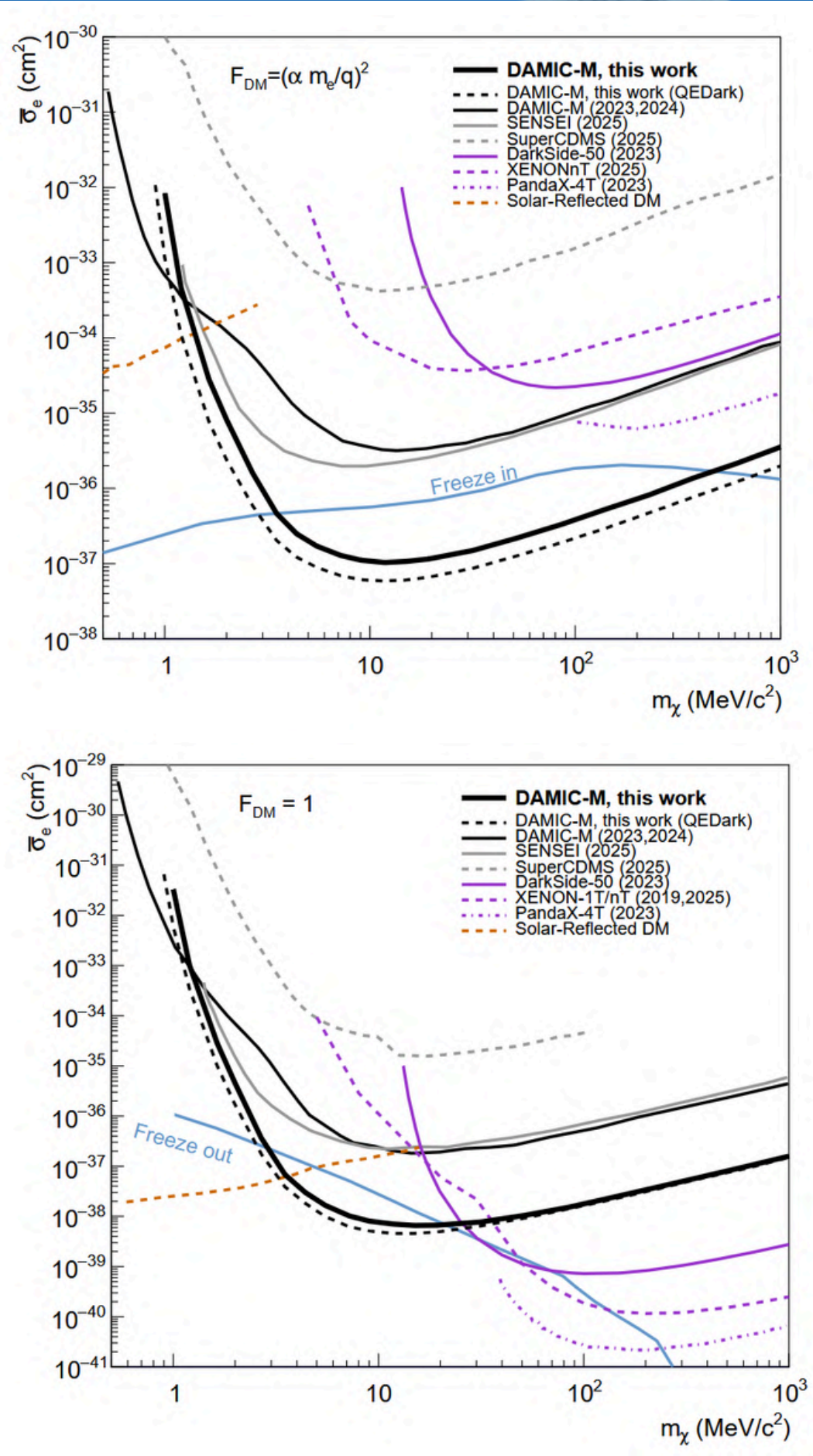
{ 1 1 } candidate

{ 3 1 } candidate



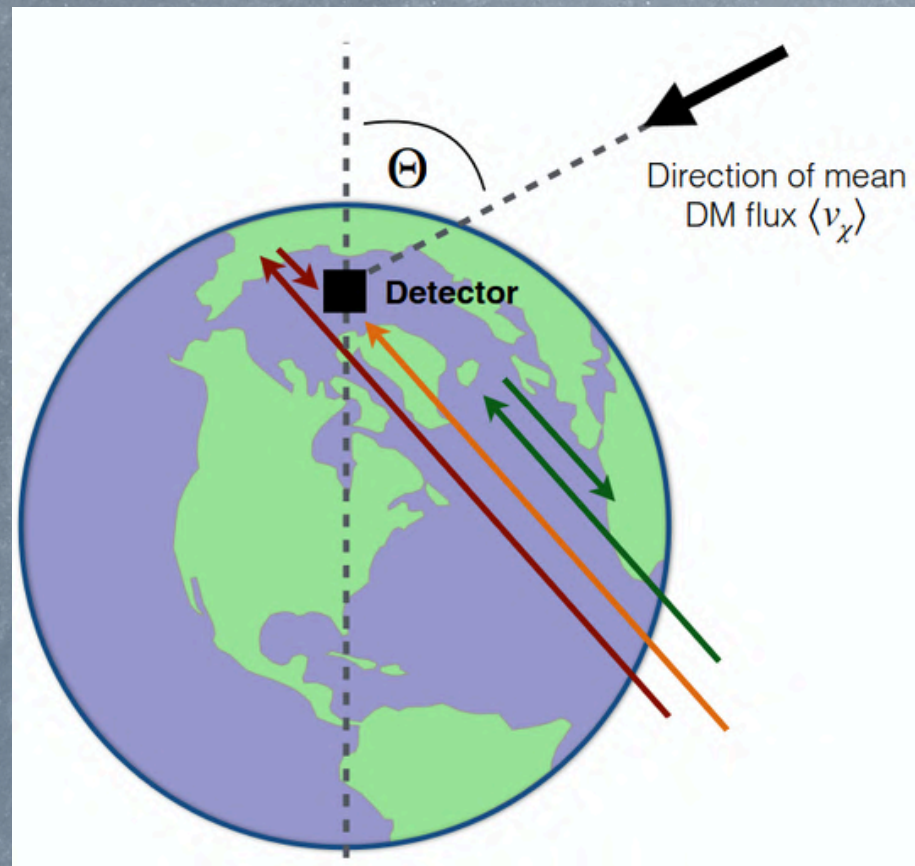
[Phys. Rev. Lett. 135, 071002](#)
Published 13 August, 2025

Exposure: 1.257 kg-days
(during 2024-2025)

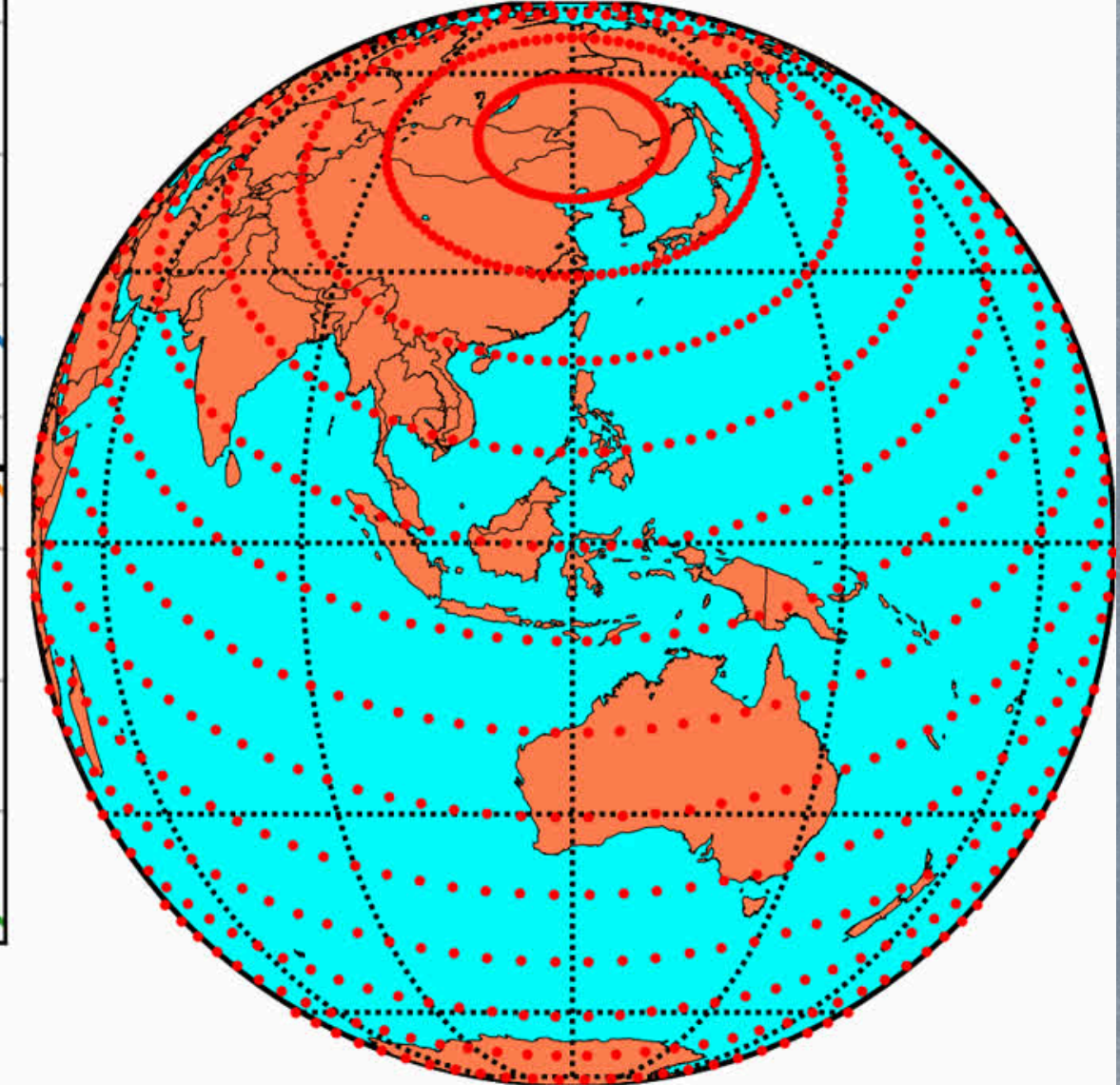
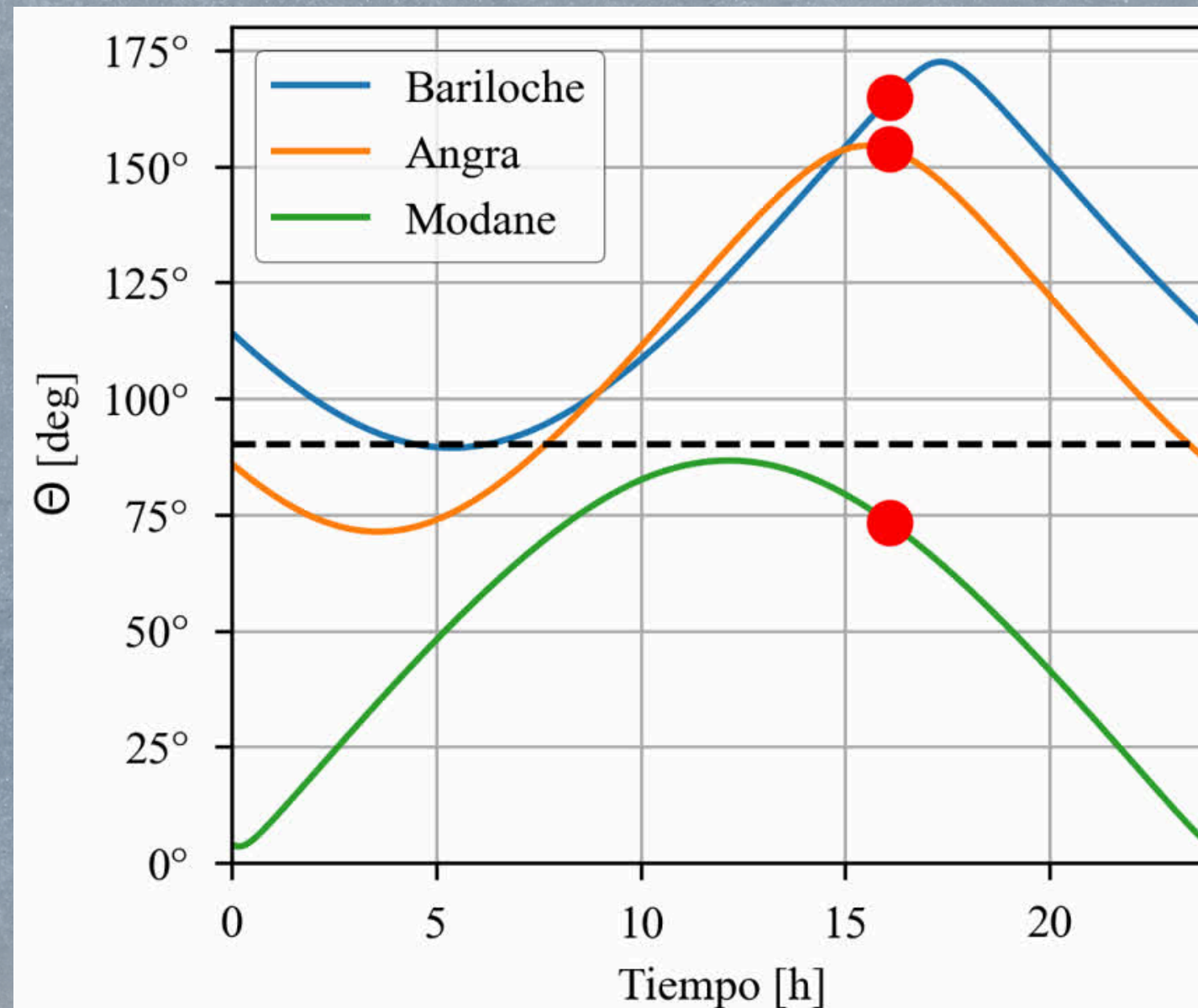


The “diurnal modulation analysis”

Profit of the dark matter scattering inside the Earth to search for a diurnal modulation of events



Drawing from [B. Kavanagh's talk](#)

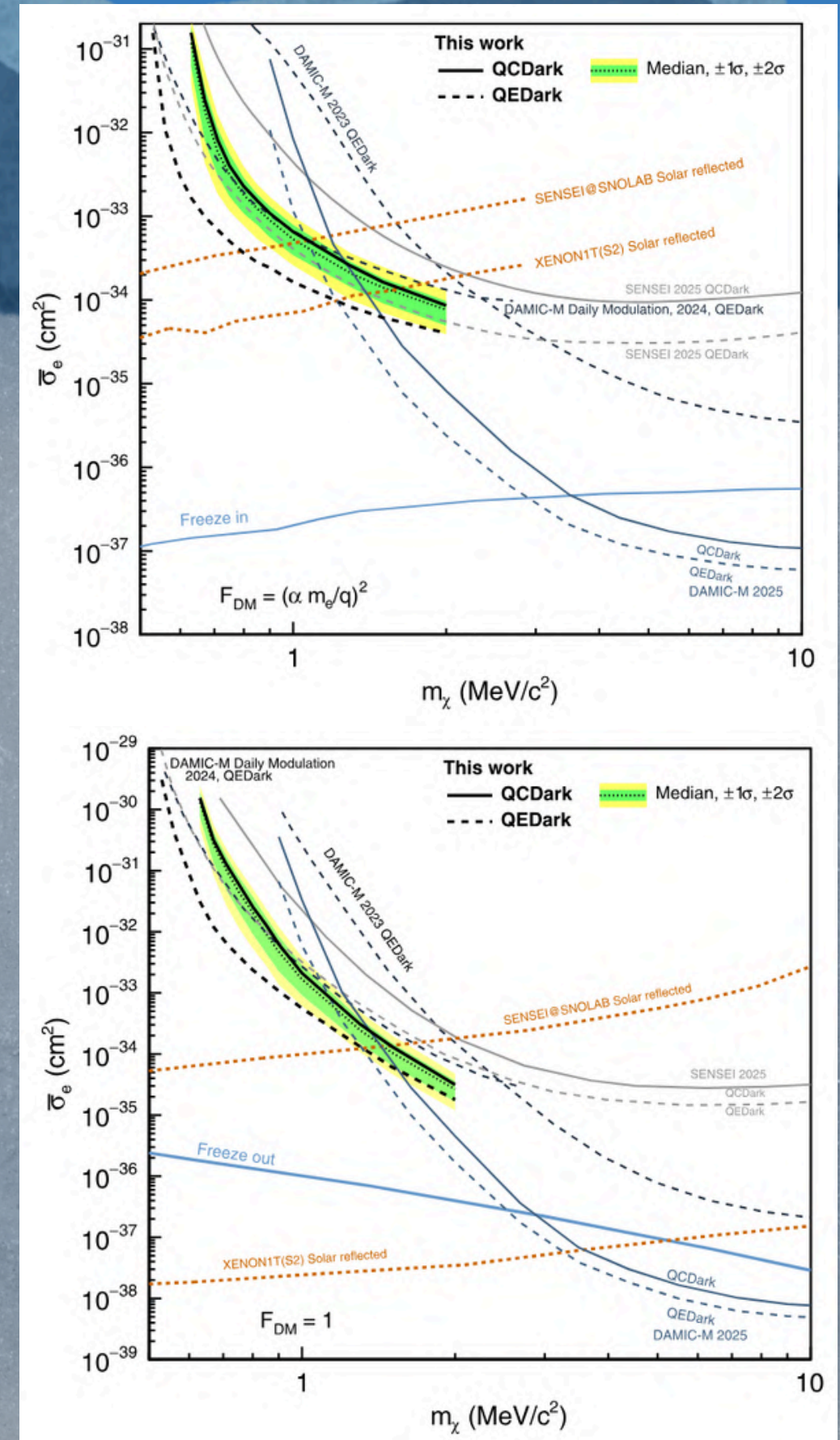
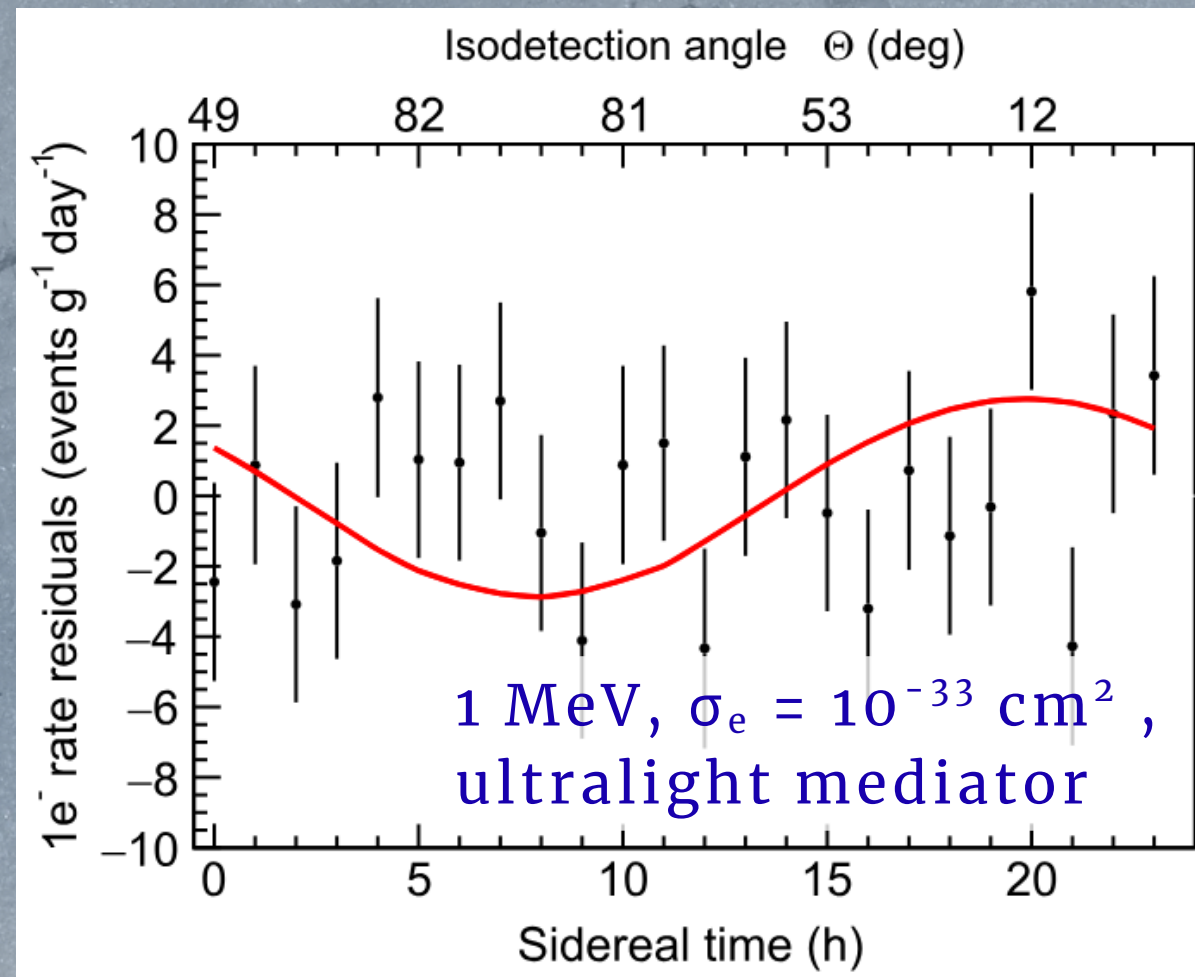


The “diurnal modulation analysis”

Profit of the dark matter scattering inside the Earth to search for a diurnal modulation of events
 → search for a signal on top of an irreducible background

Exposure: 1.257 kg-days
 (during 2024-2025)

[Phys. Rev. D 114, 032010](#)
 Published 19 August, 2026



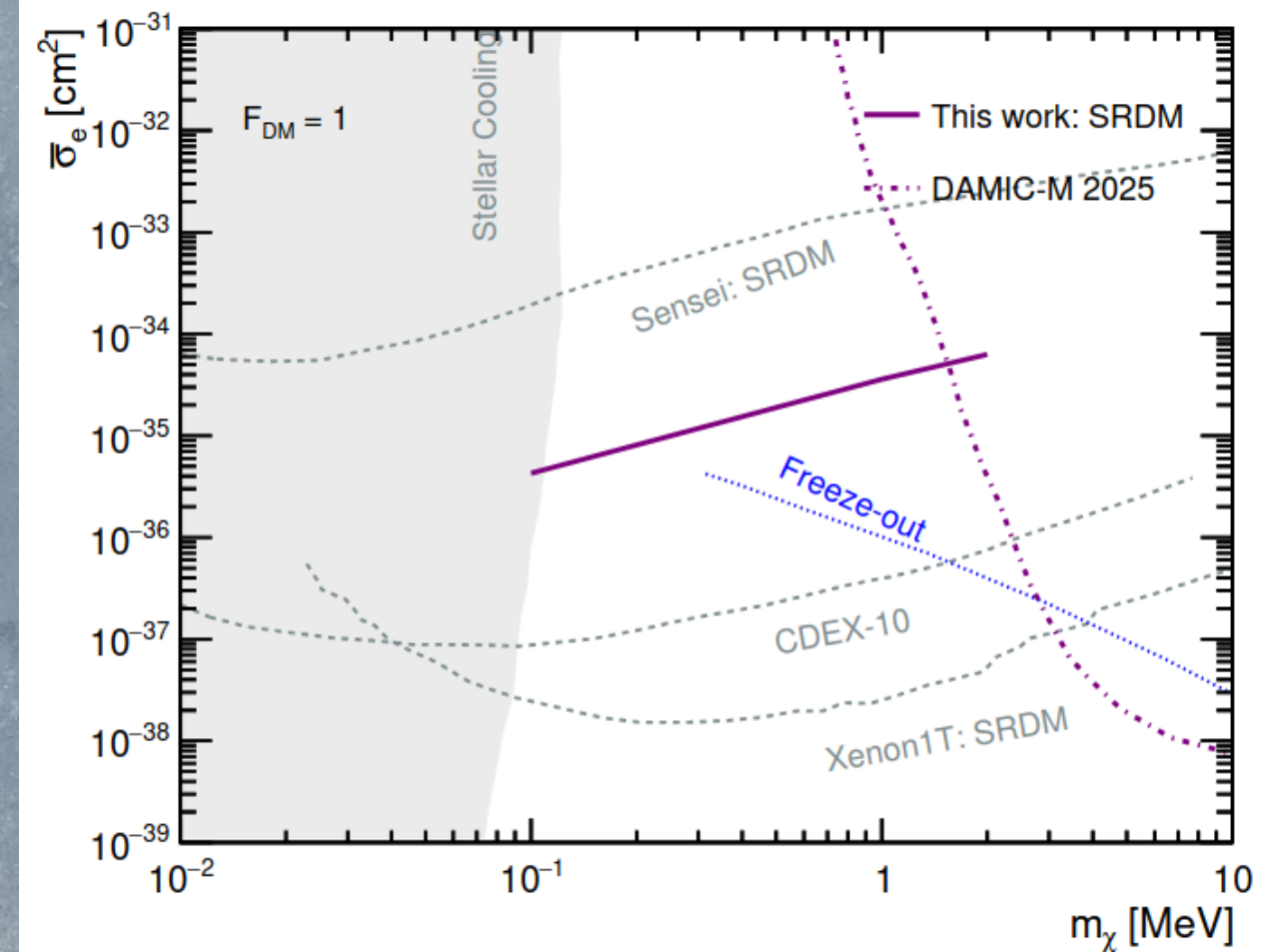
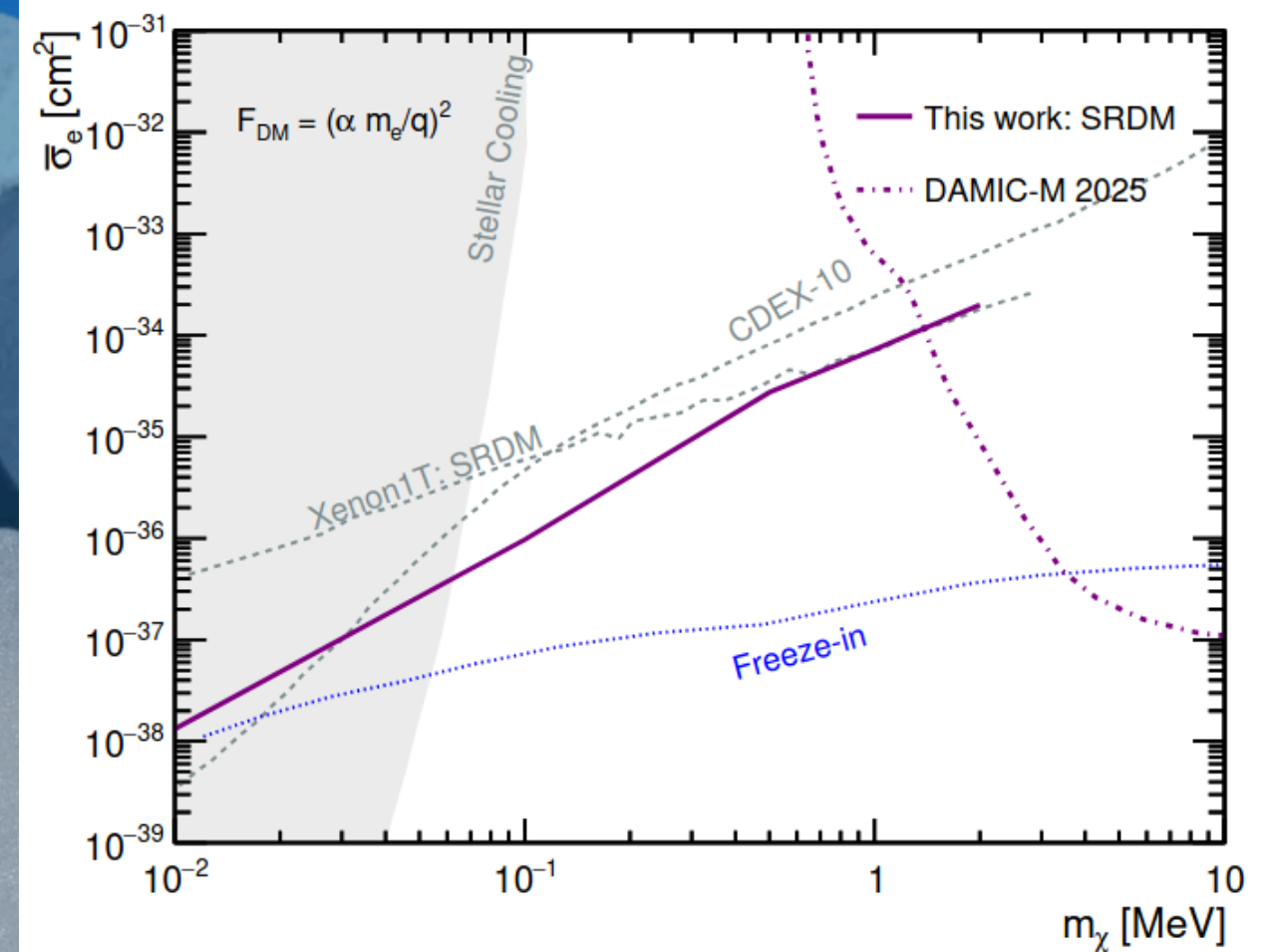
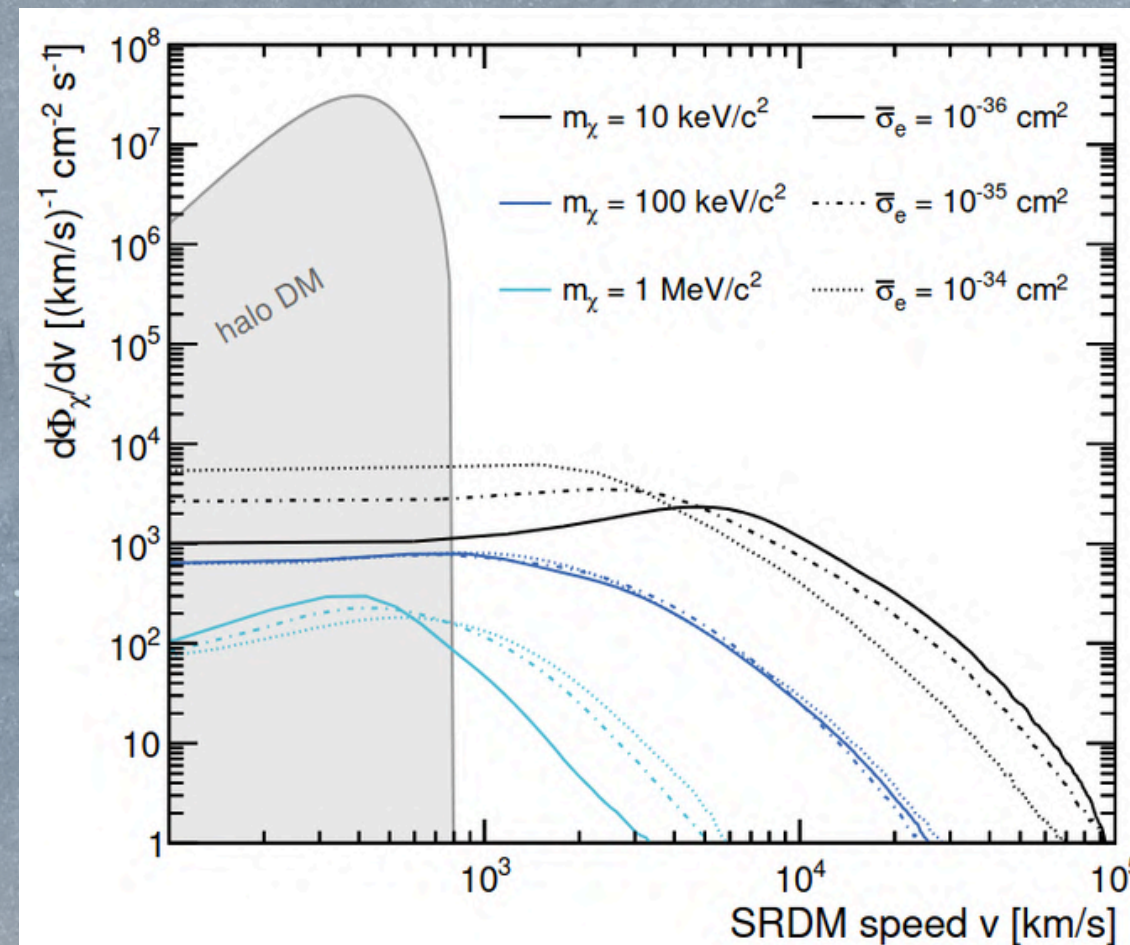
The “solar reflected analysis”

Light(er) dark matter can scatter inside the solar plasma, thus gaining a much higher speed than the galaxy escape speed



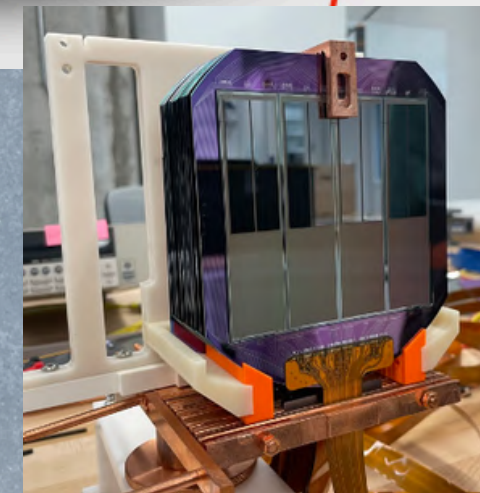
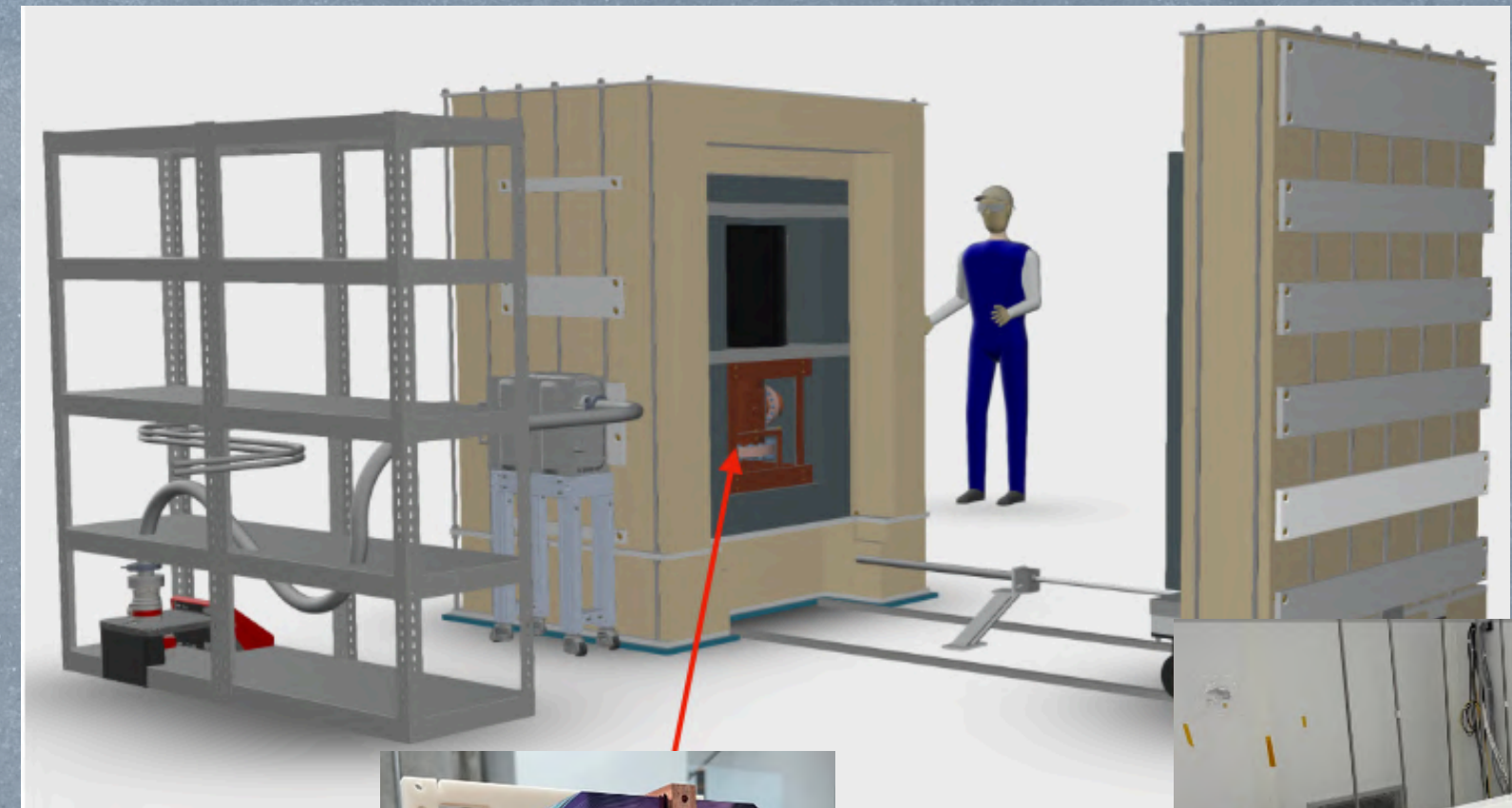
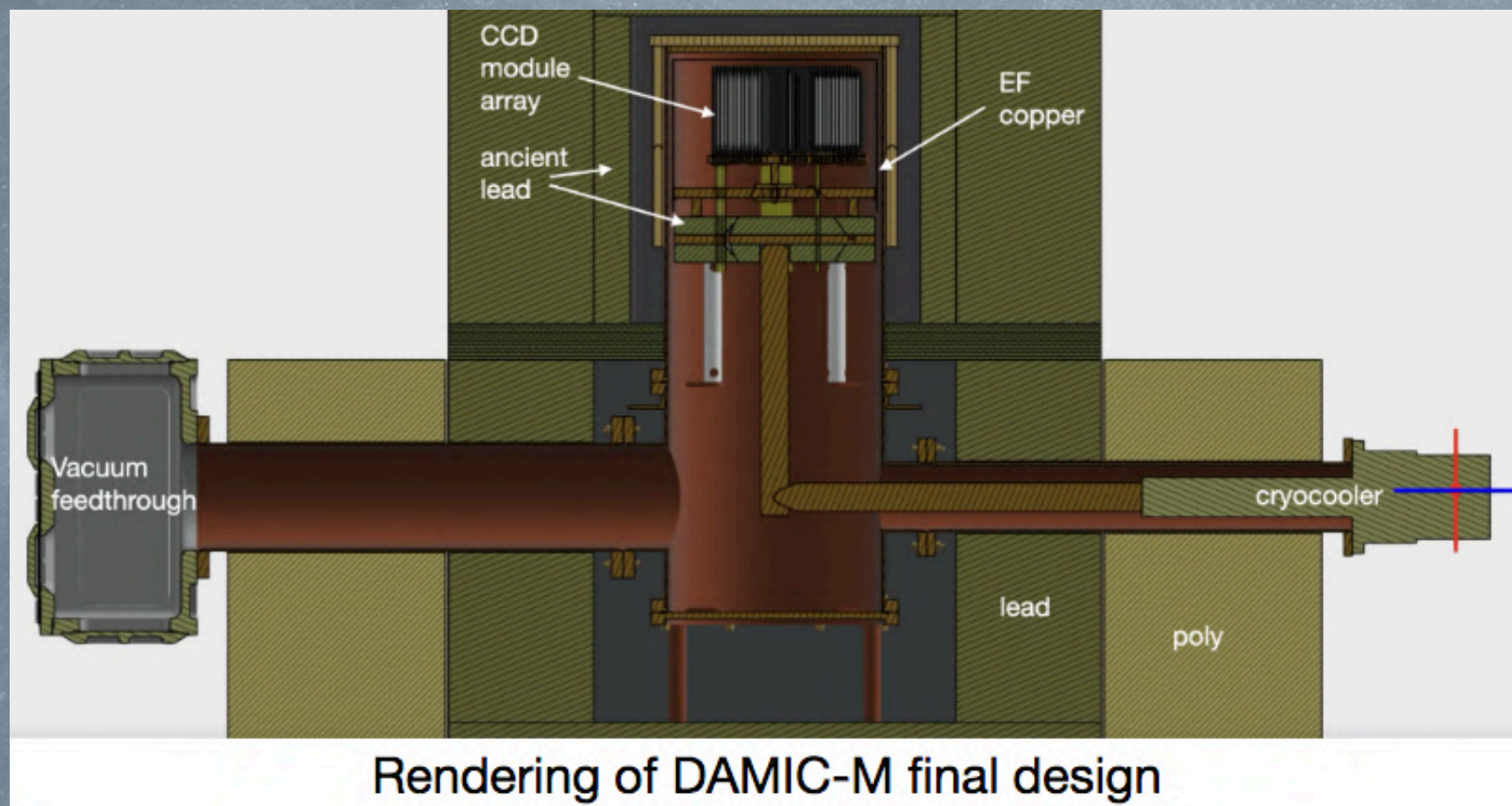
[arXiv:2607.09352](https://arxiv.org/abs/2607.09352)

Exposure: 1.257 kg-days
(during 2024-2025)



Now, to the actual DAMIC-M

With 26 modules (104 detectors), adding up to ~350 g of total detection mass, we will be able to probe even deeper!



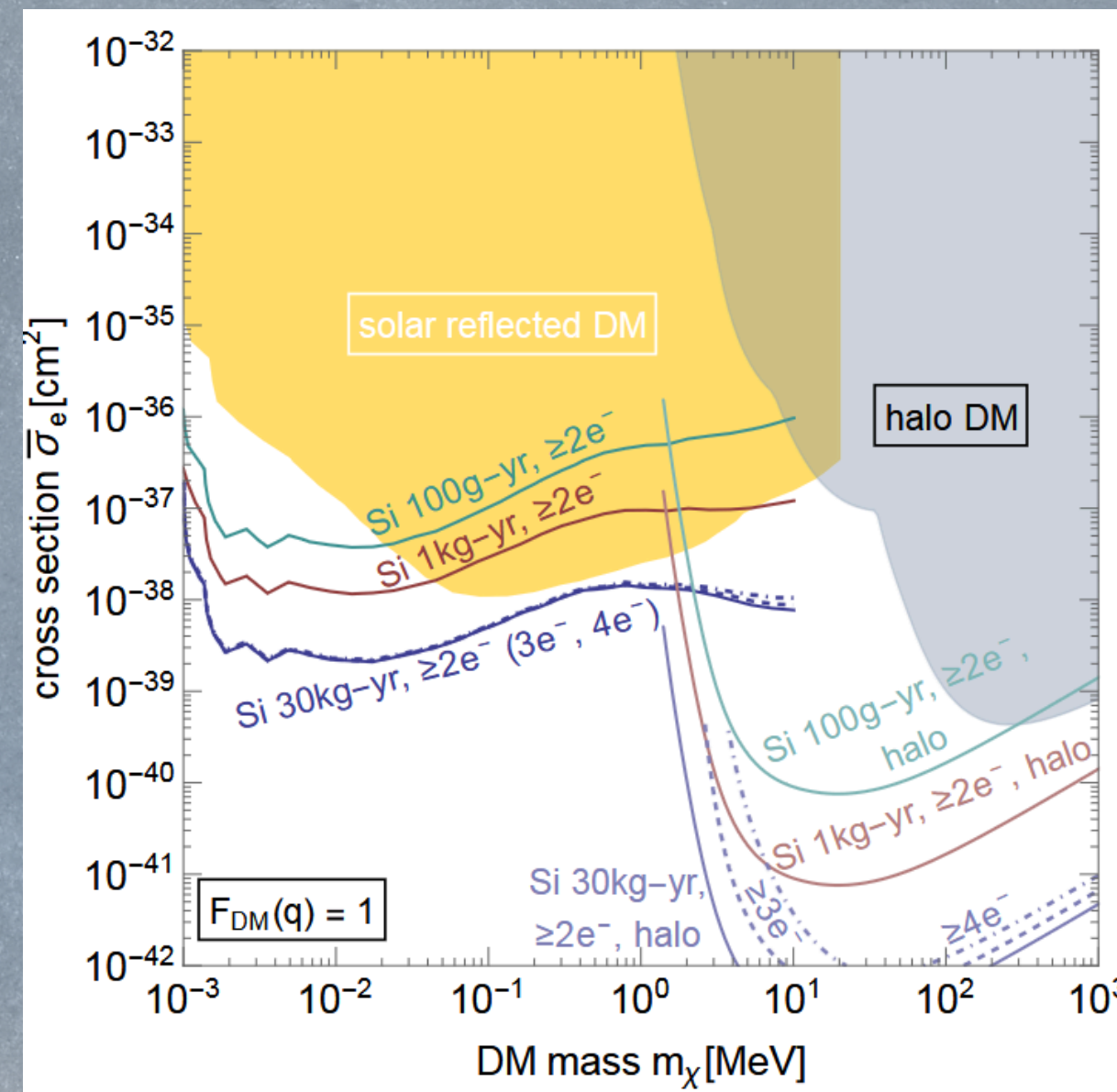
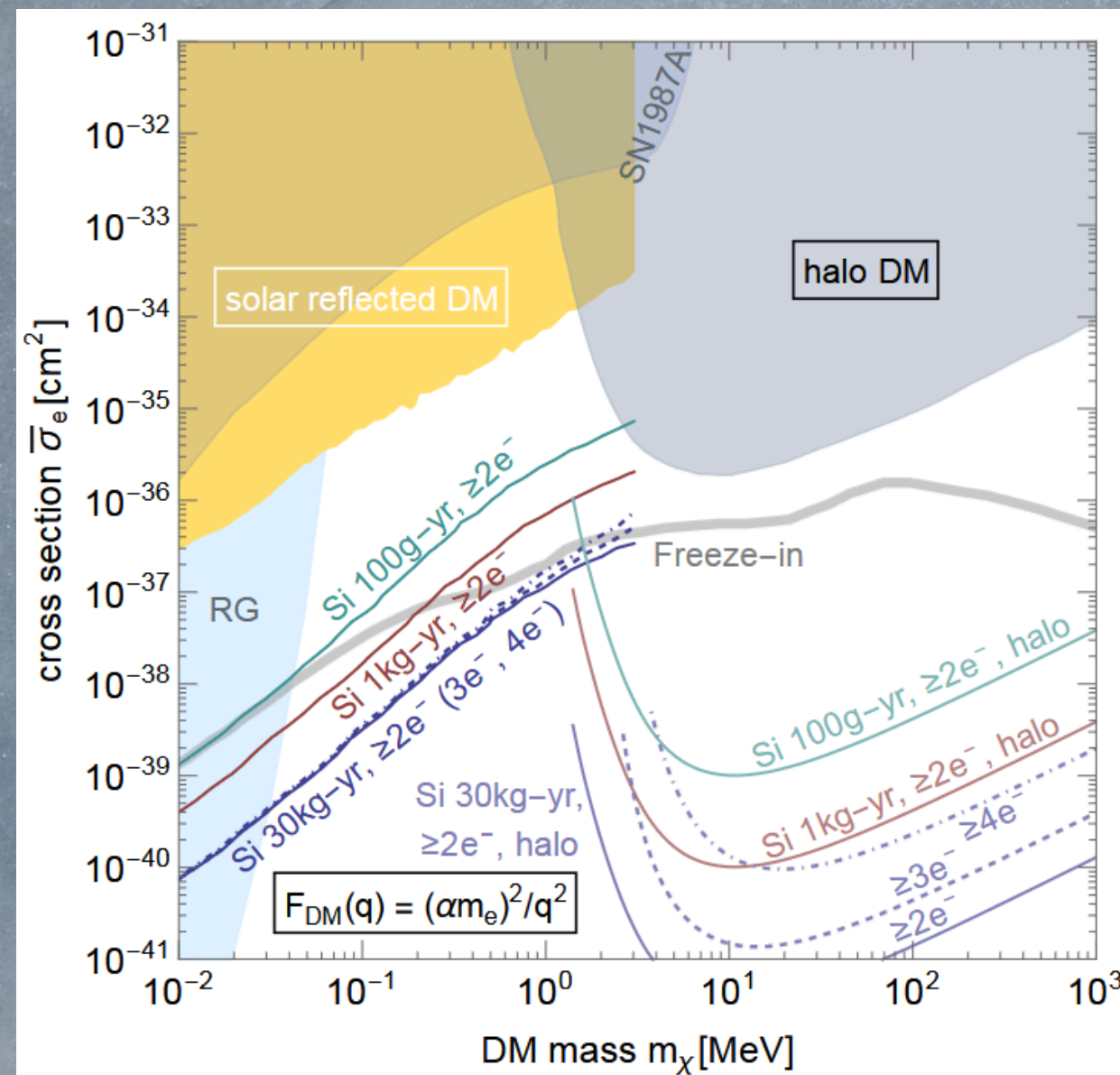
CCD Array assembly
Nov. 2026



Phase1 Installation finished
Aug. 2026

Now, to the actual DAMIC-M

With 26 modules (104 detectors), adding up to ~ 350 g of total detection mass, we will be able to probe even deeper!



Emken, Essig, Xu
[arXiv:2404.10066](https://arxiv.org/abs/2404.10066)

To sum up

- DAMIC-M will search for hidden sector MeV-scale dark matter in currently unexplored portions of the parameter space.
- The prototype detector, the Low Background Chamber, has set world-leading upper bounds to cross sections in both heavy and ultralight mediator scenarios.
- We expect very low backgrounds in the region of interest, and even in the case of irreducible, detector-intrinsic backgrounds, we can exploit features such as solar reflection or diurnal modulation to continue the searches.

Thank you!