Lund University

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UNIVERSITY OF TECHNOLOGY

Universitet Stockholms

Fysikdagarna 2022
Lund University

June 15, 2022

The Light Dark Matter KAW Project

A status update

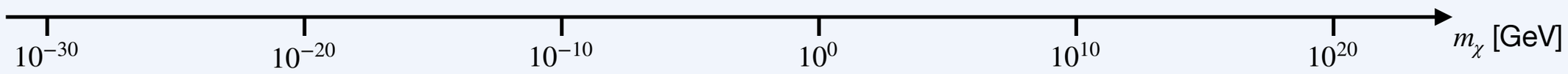
Timon Emken
Stockholm University

timon.emken@fysik.su.se timonemken.com @TimonEmken /temken

Knut and Alice Wallenberg Foundation

The Light Dark Matter KAW project

The case for sub-GeV DM



The Light Dark Matter KAW project

The case for sub-GeV DM

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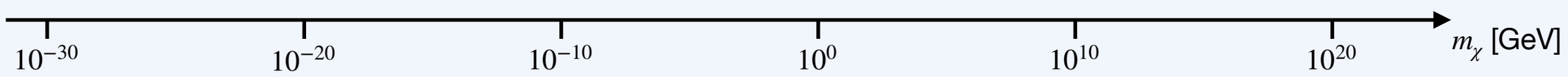
$$\frac{\rho_{\mathrm{DM}}}{\rho_{\mathrm{baryonic}}} = \mathcal{O}(1)$$



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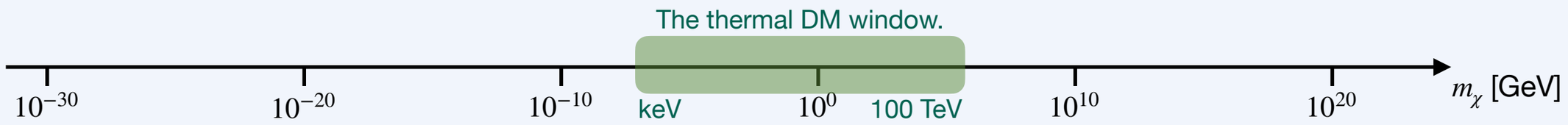

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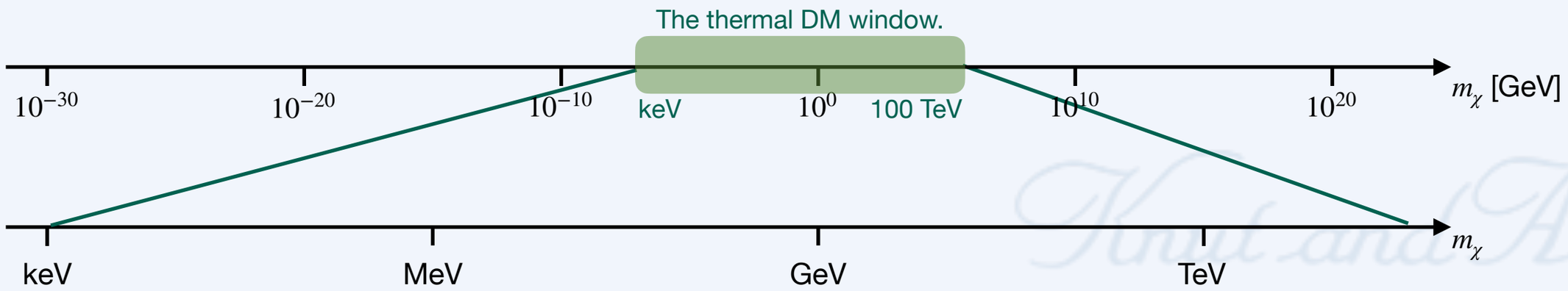

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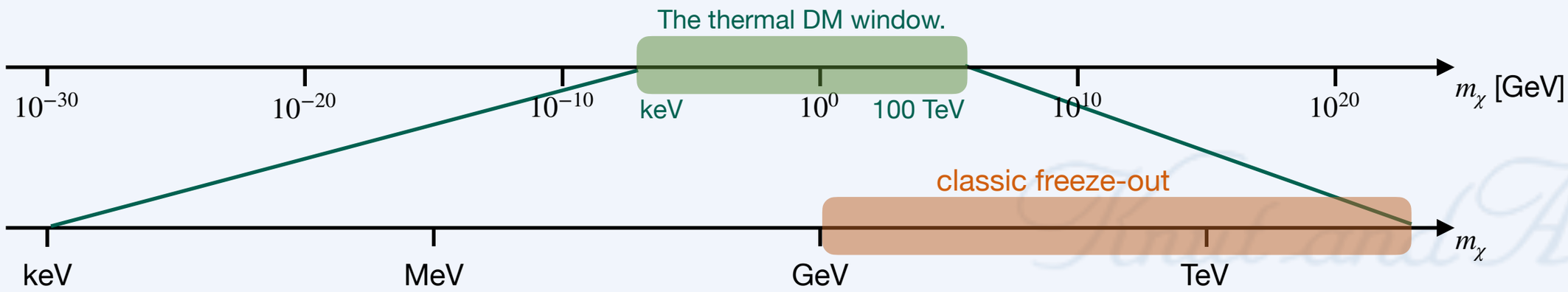

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- Extensive searches for decades.
- Heavily constrained by experiments.

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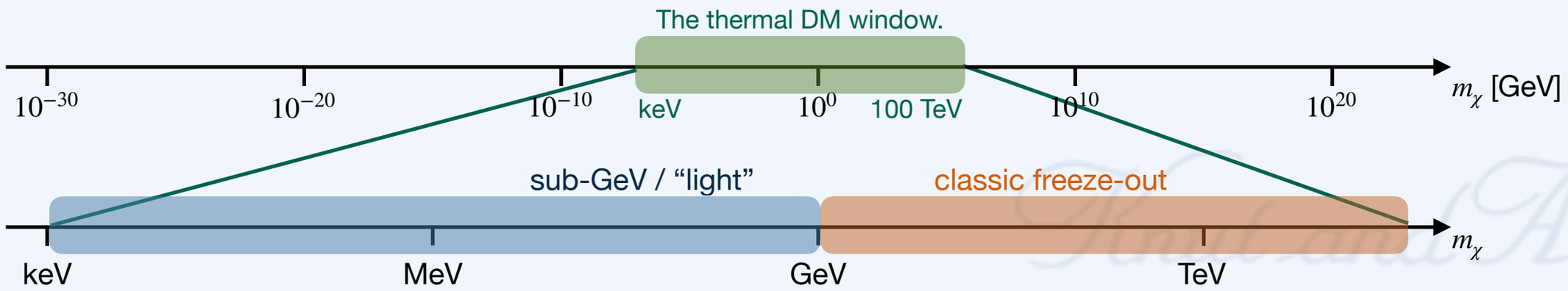

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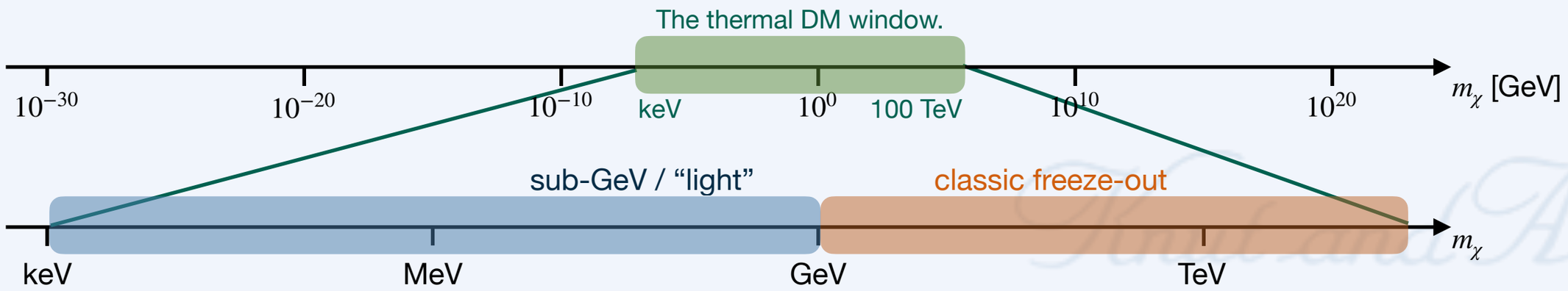

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- **Project organization:** four “work packages”.

Knut and Alice Wallenberg Foundation

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WP1	WP2
WP3	WP4

The Light Dark Matter KAW project

The work packages

WP1
The Light Dark Matter eXperiment, LDMX

- With T. Åkesson and R. Pöttgen, Lund University has leading role in LDMX.
- Hardware: Provide readout electronics for hadron calorimeter.

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- GEANT4 simulations of signal + background.
- Event generation with PYTHIA.
- Explore new DM models.

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WP3
Statistical inference package to LDMX and global data interpretation

- Maximize physics output from LDMX.
- Develop a statistical inference package.
- Interpret LDMX data globally.

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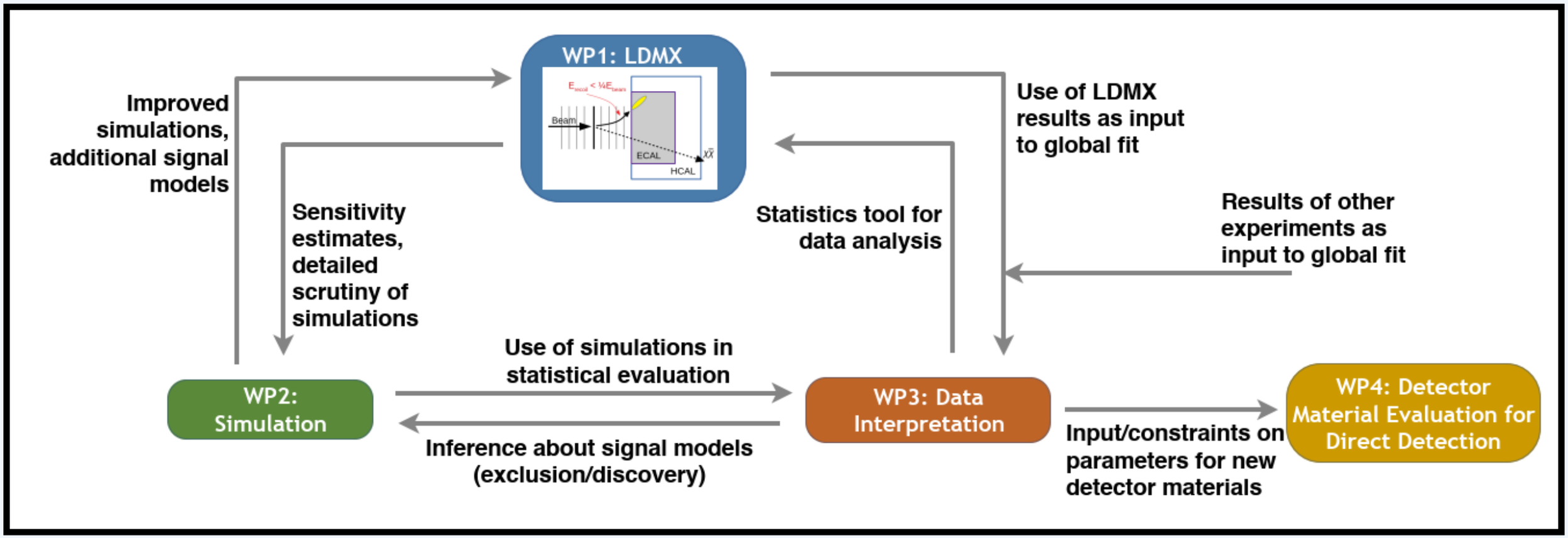
WP4
Detector material evaluation for direct detection

- A discovery would need direct validation.
- Identify novel materials for direct detection.
- Explore signals in new DM models.

The Light Dark Matter KAW project

The interplay of the work packages



The Light Dark Matter KAW project

The time-line

LDMX

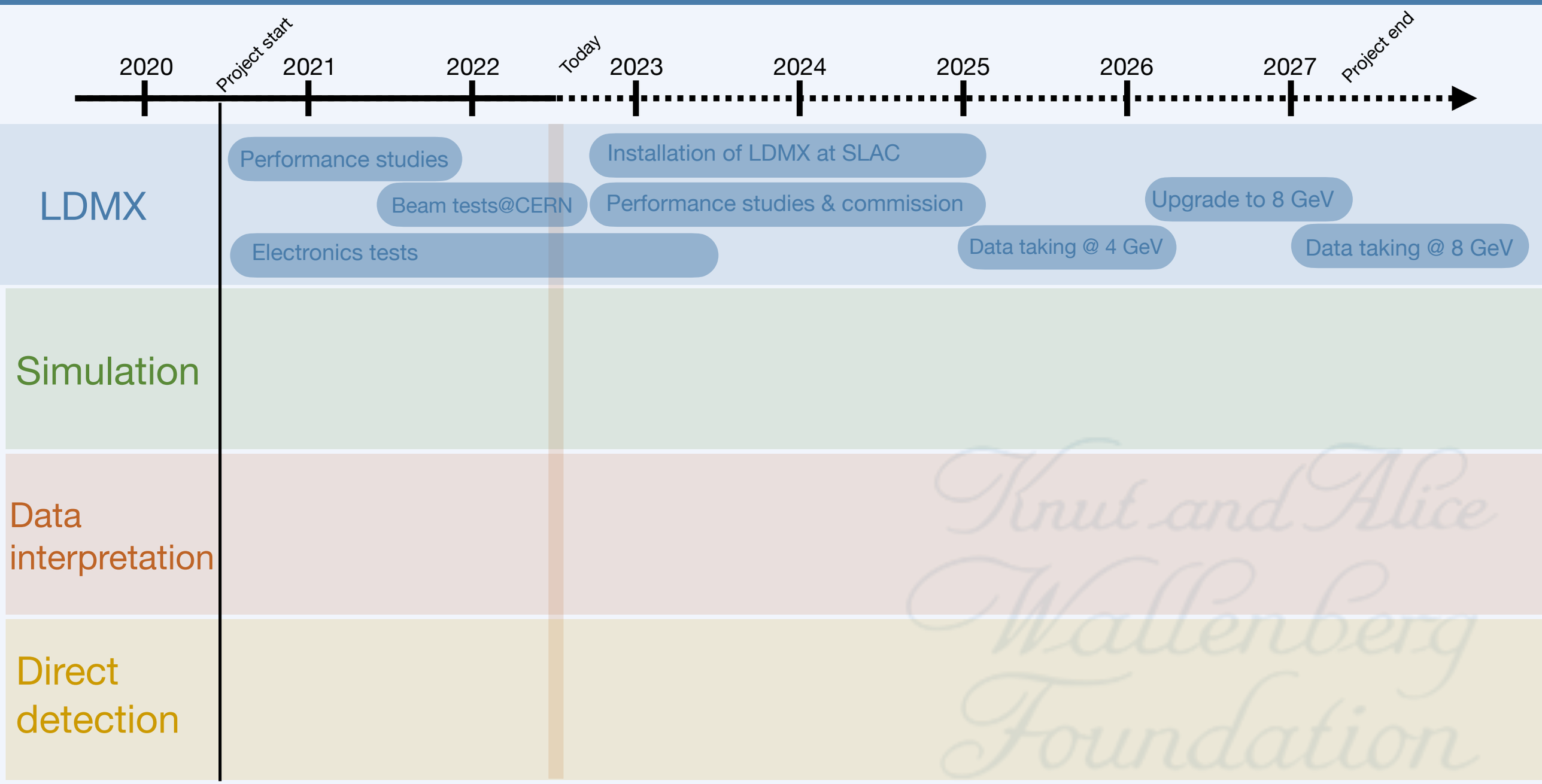
Simulation

Data interpretation

Direct detection

The Light Dark Matter KAW project

The time-line



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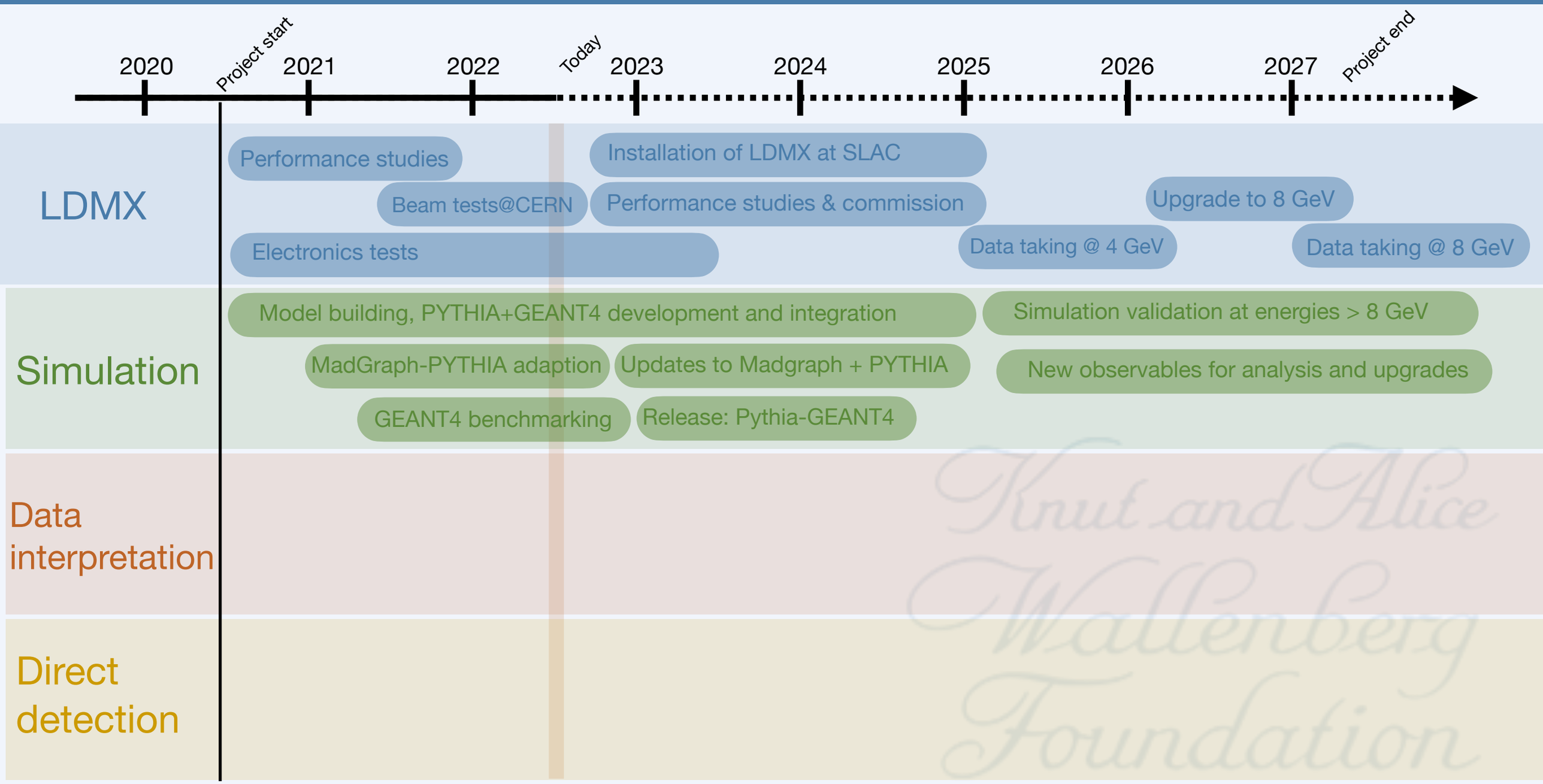

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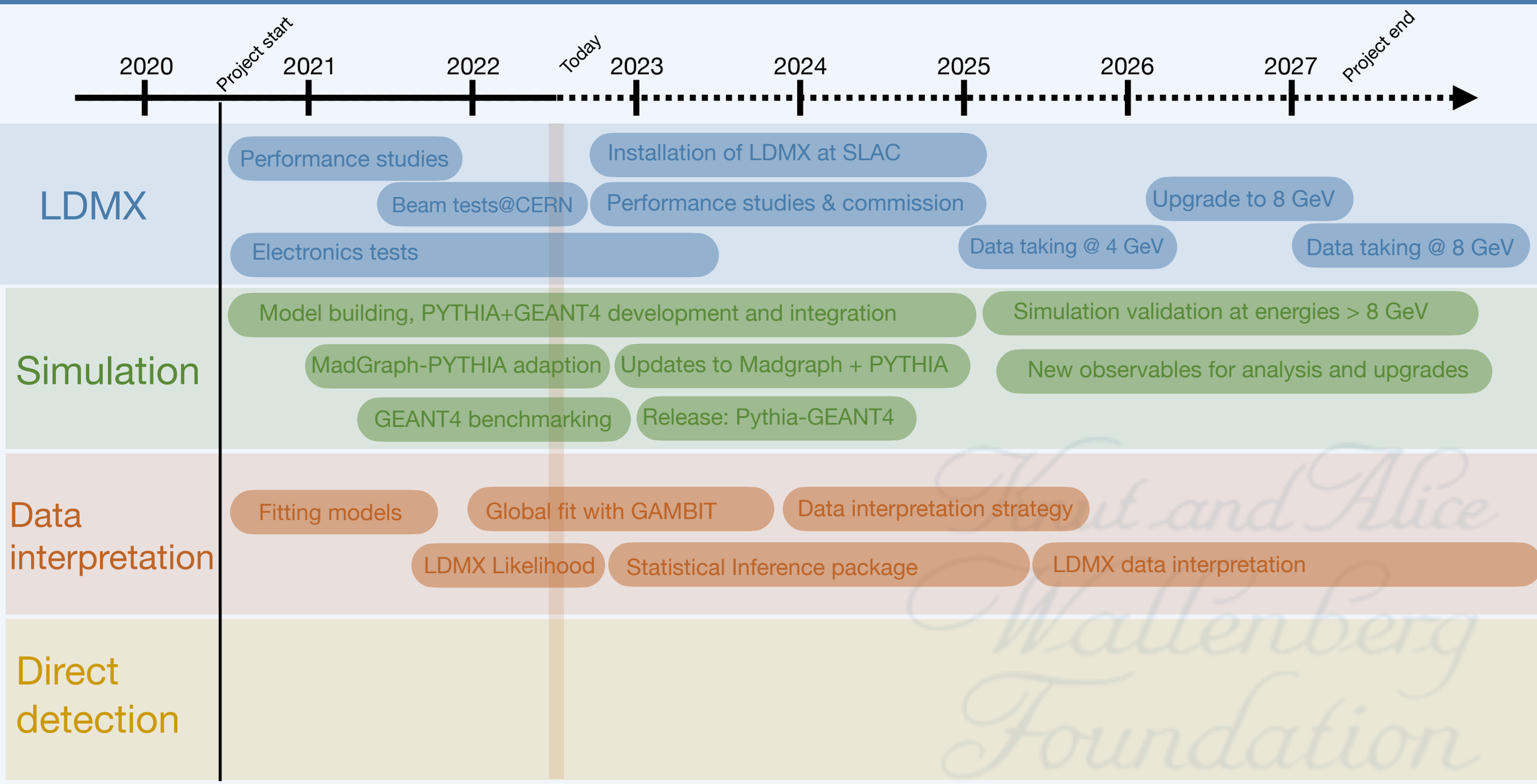

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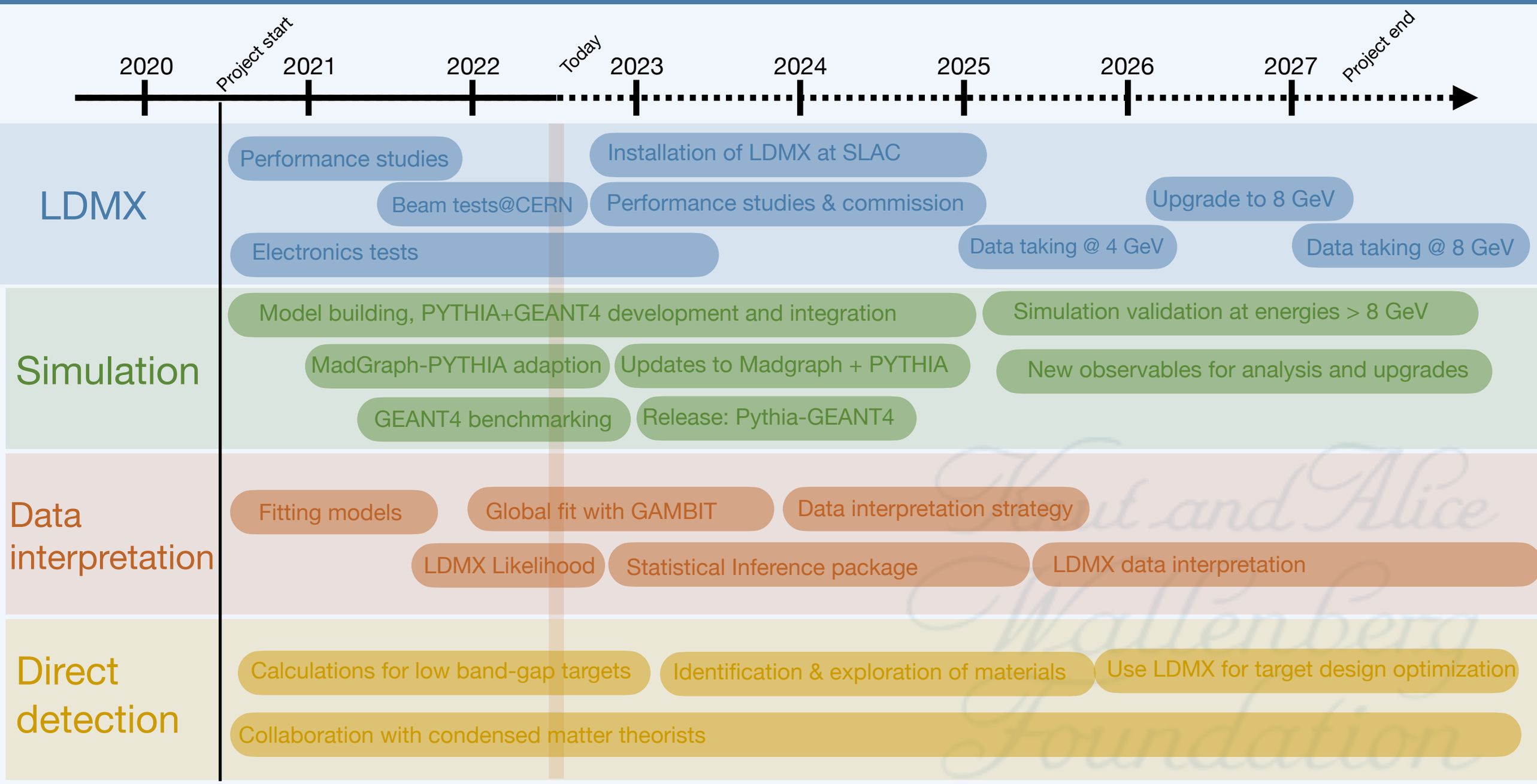


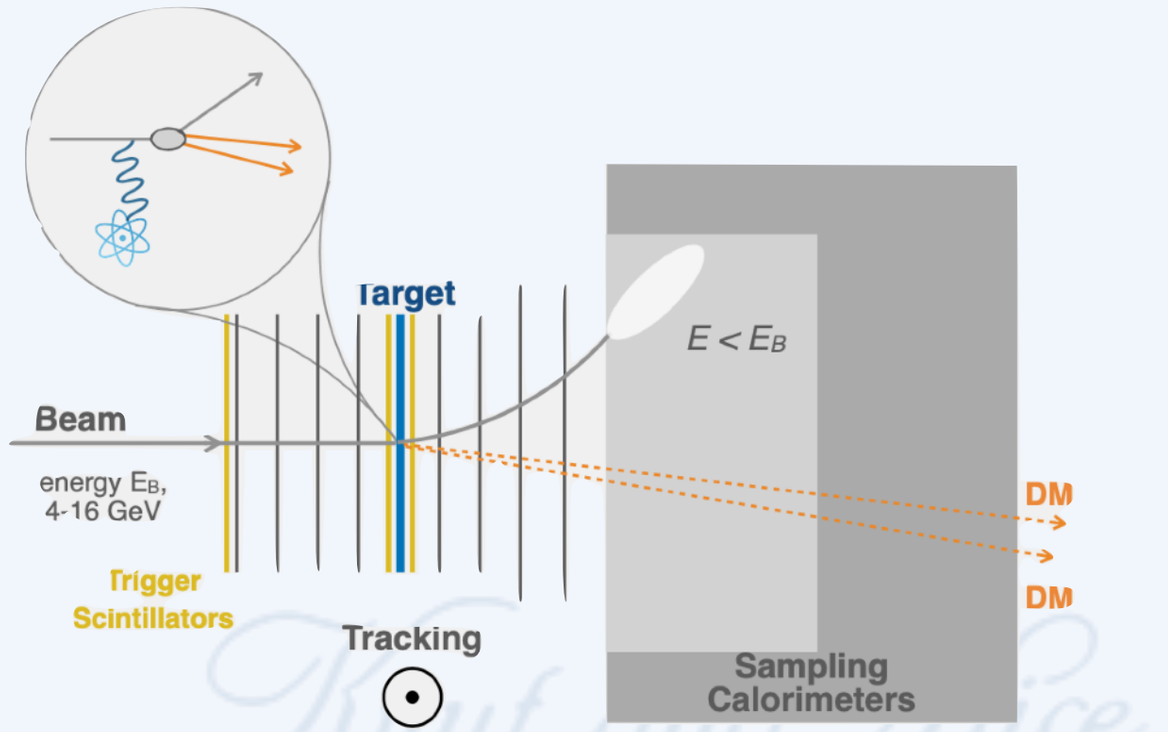
WP1: The Light Dark Matter eXperiment

Status update

(E. Elen, H. Herde, L.S. Pico, R. Pöttgen, E. Wallin, T. Åkesson, L. Österman)

WP1: LDMX

See talk by Ruth Pöttgen.

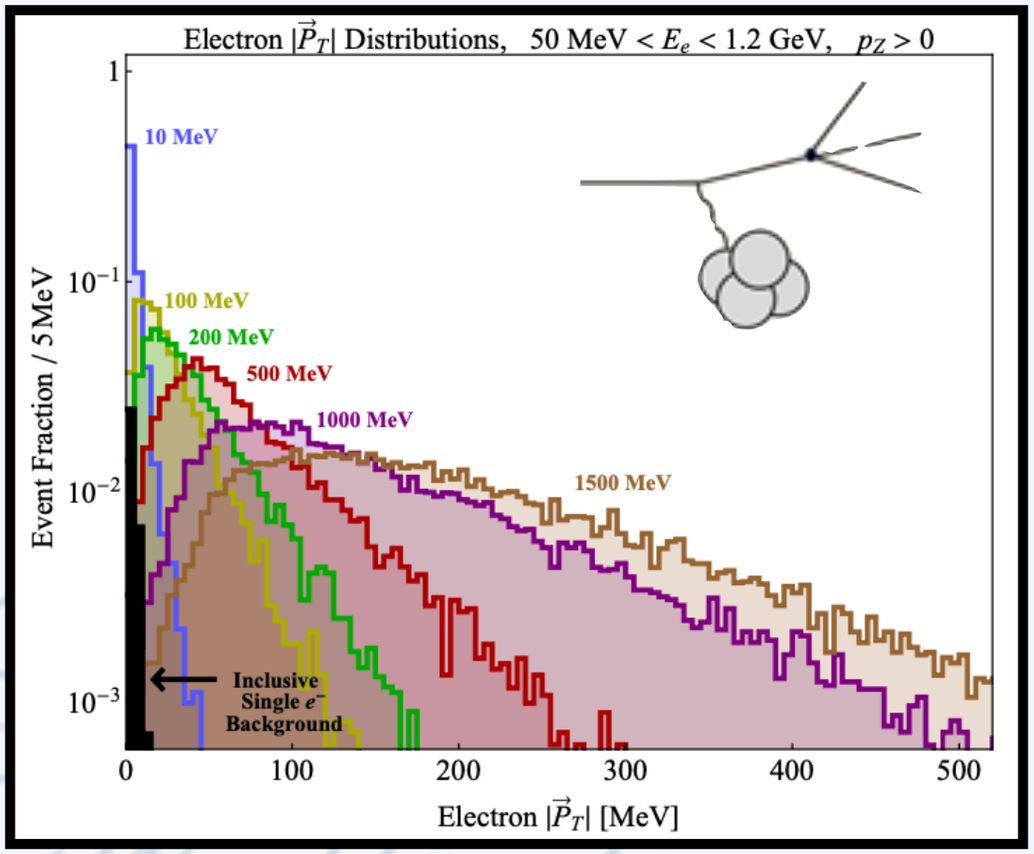


T. Åkesson et al., [arXiv:1808.05219]

WP2: Simulation

Status update

(C. Bierlich, R. Catena, E. Elen, L. Gellersen, T. Gray, R. Pasechnik, L.S. Pico, R. Pöttgen, T. Sjöstrand)



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  - Comparison to other MC codes (FLUKA, MCNP, PHITS) is ongoing.
  - First results show interesting differences.

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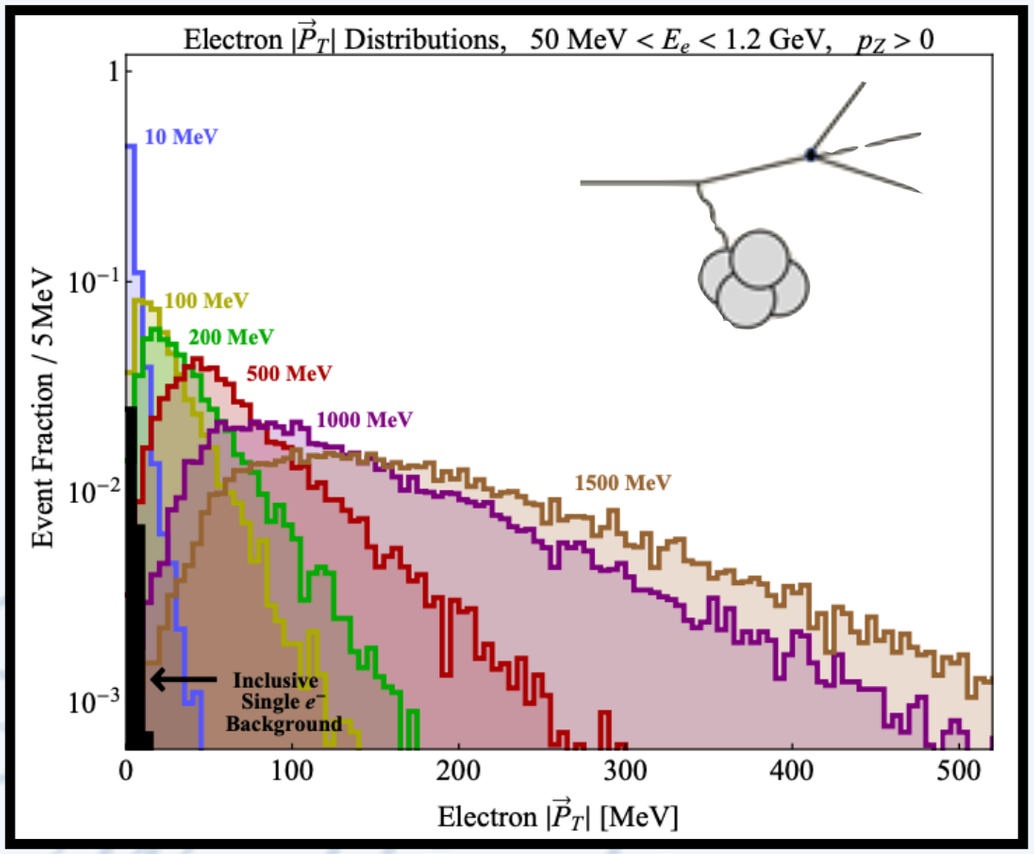

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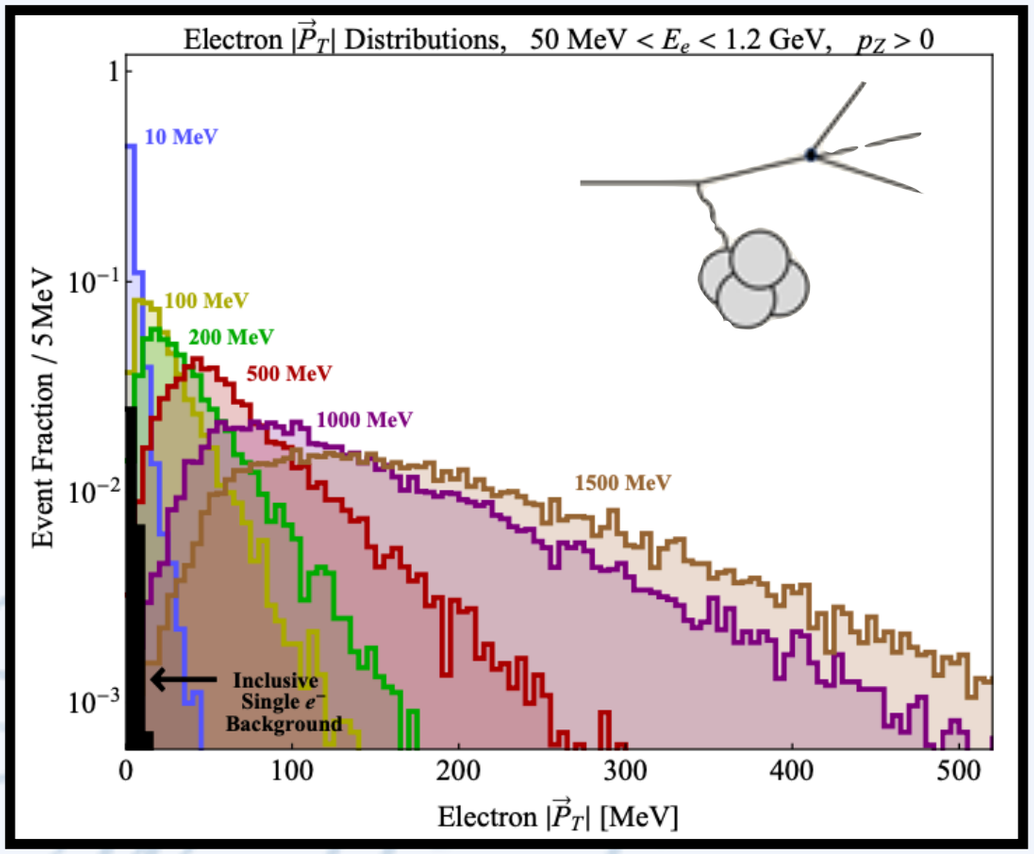

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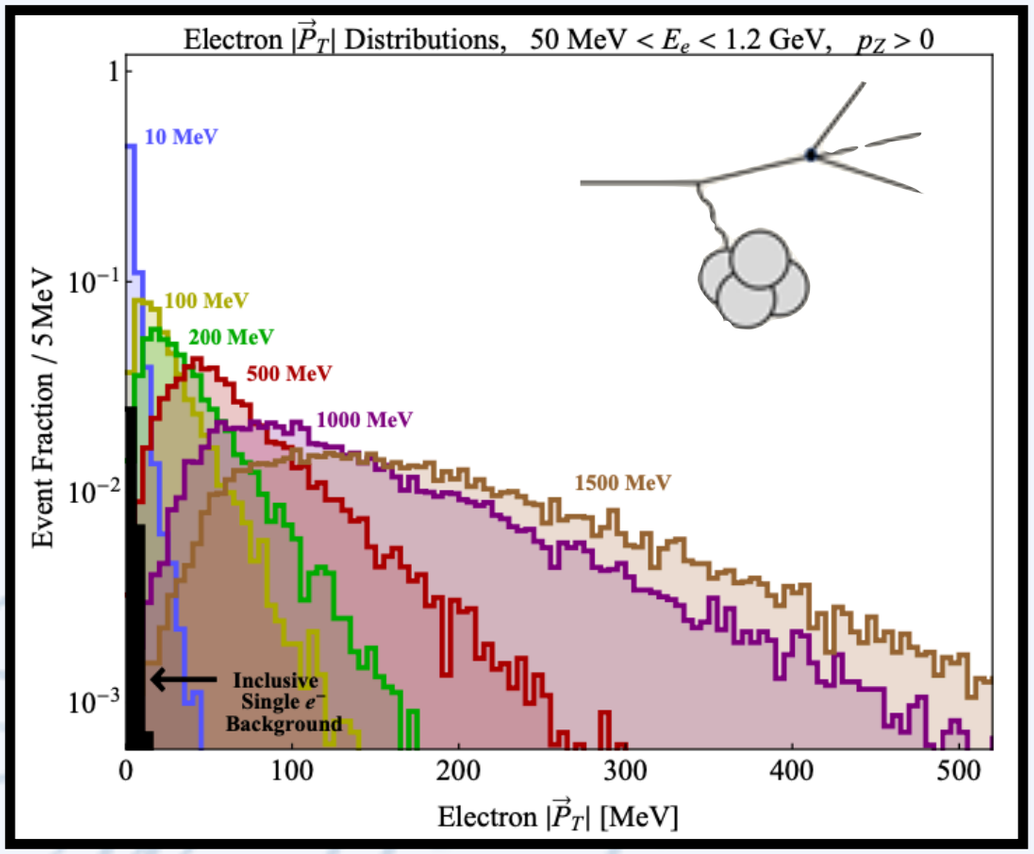

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See Taylor Gray's talk at 16:00.

WP3: Data Interpretation & Statistical Inference

Status update

(R. Catena, J. Conrad, C. Doglioni, E. Elen, T. Emken, T. Gray, R. Pöttgen)

WP3: Statistical Inference

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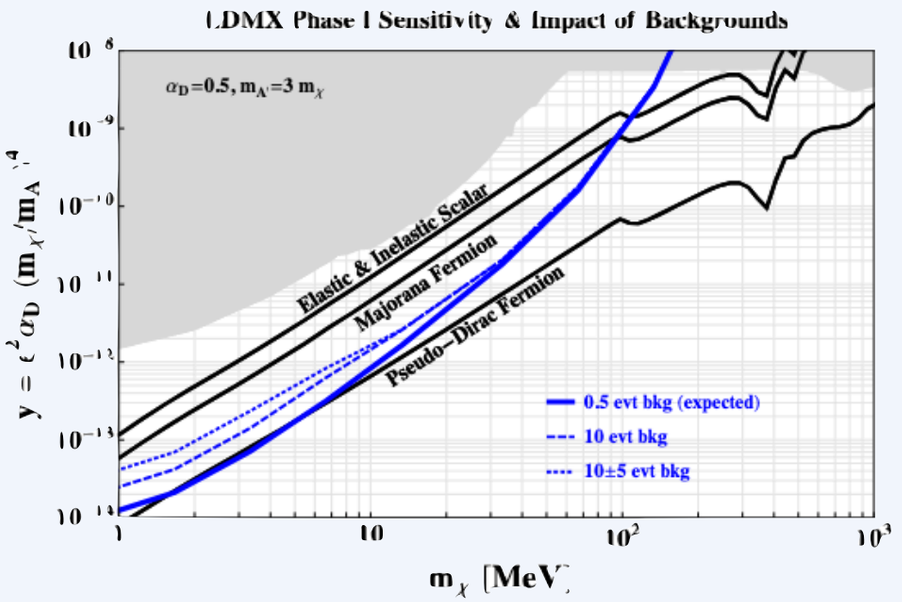
  - Goal: Leading role in LDMX data interpretation by covering wide range of DM models



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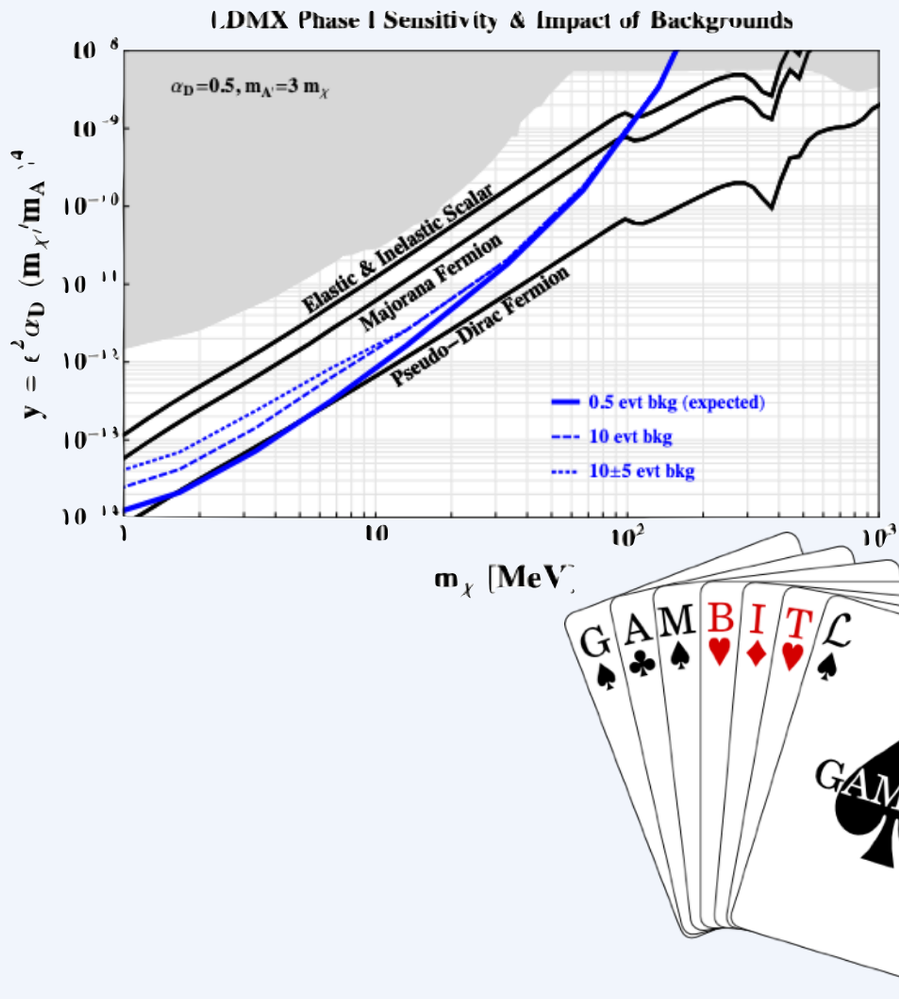
- **Global fits with GAMBIT:**
  - Project in collaboration with the GAMBIT community has started
  - Compute LDMX likelihoods and interface with GAMBIT tool.
  - Combine LDMX with likelihoods of cosmology, direct detection, indirect detection and other colliders.



GAMBIT collaboration, Eur. Phys.J. [arXiv:1705.07908]

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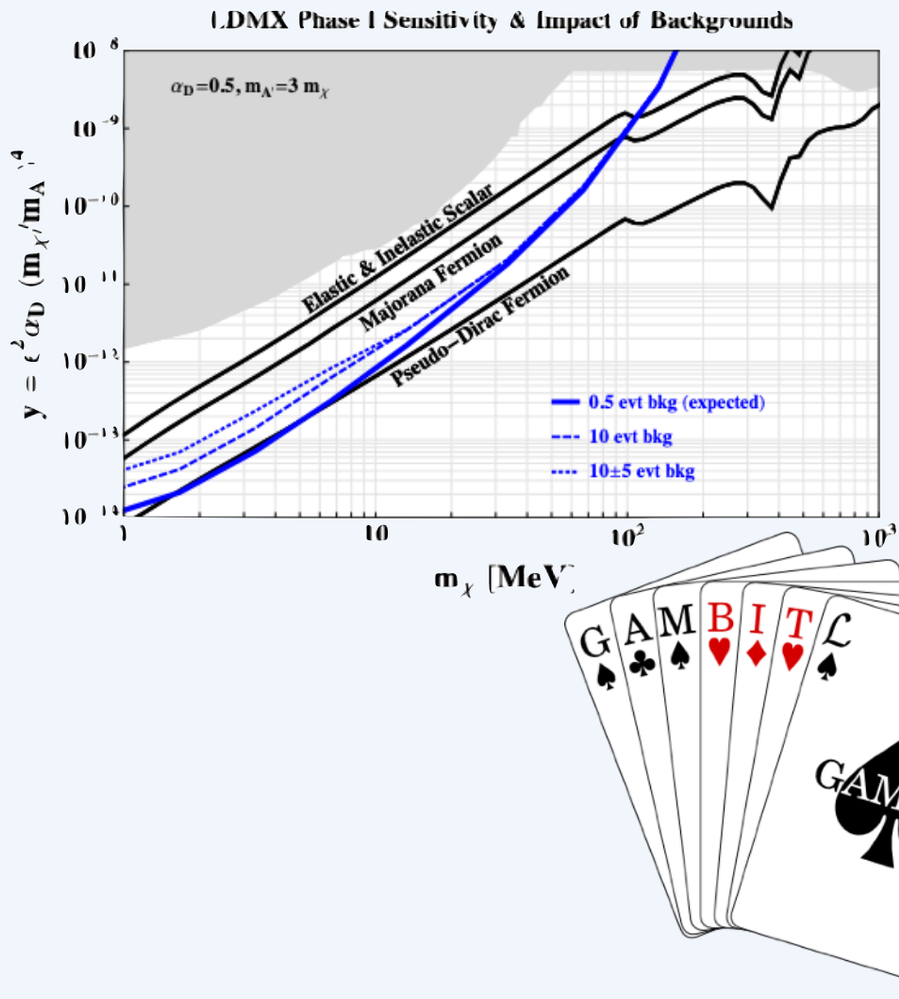

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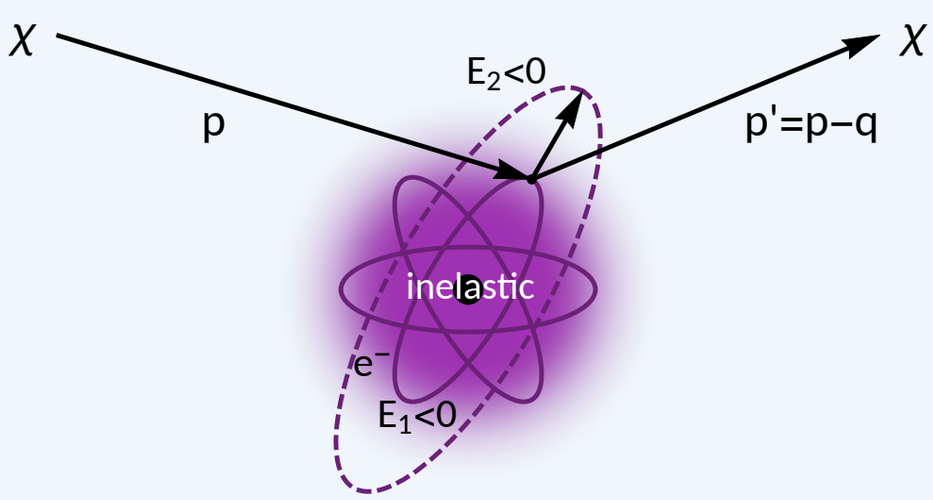
See Joshua Greaves' poster for complementary limits.

WP4: Detector Materials for Direct Detection

Status update

(R. Catena, J. Conrad, T. Emken)



WP4: Direct detection

- A hypothetical LDMX signal still needs validation from direct detection.
- Most relevant strategy for sub-GeV masses: DM-electron recoils.
- Target description requires method from condensed matter theory (DFT). Collaboration with ETH Zurich.

Catena et al., PRR, [arXiv:1912.08204]
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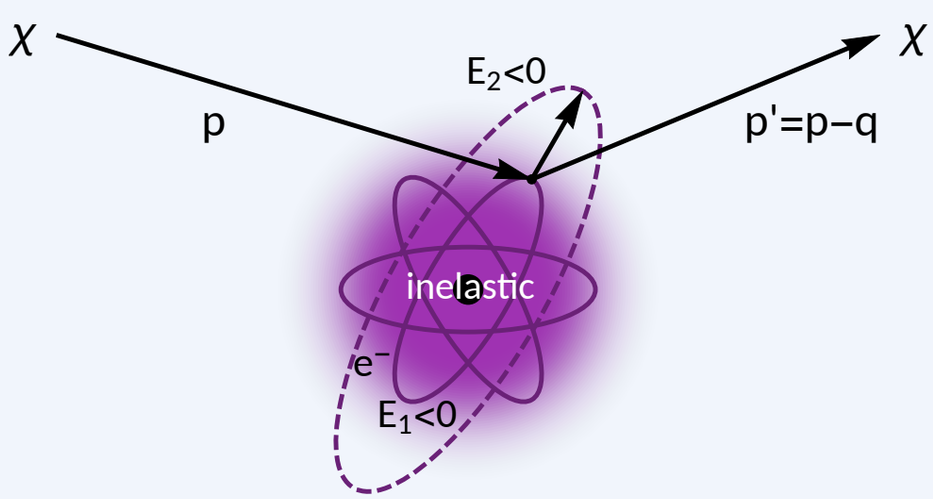

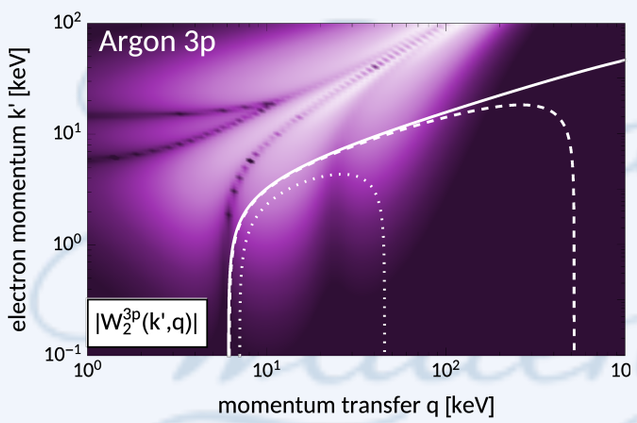

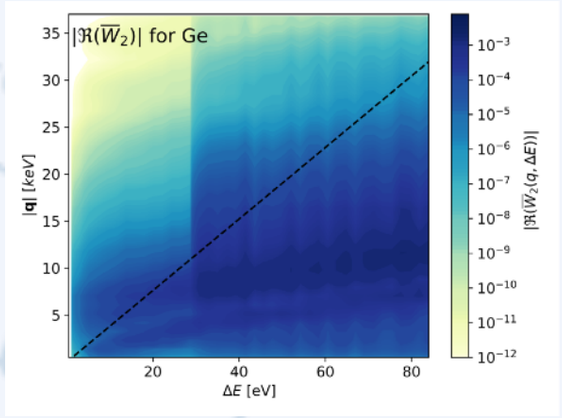

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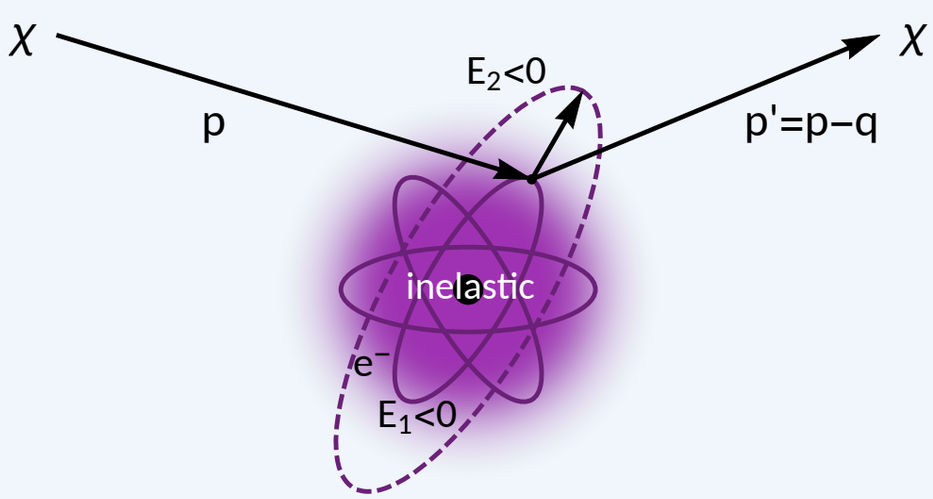

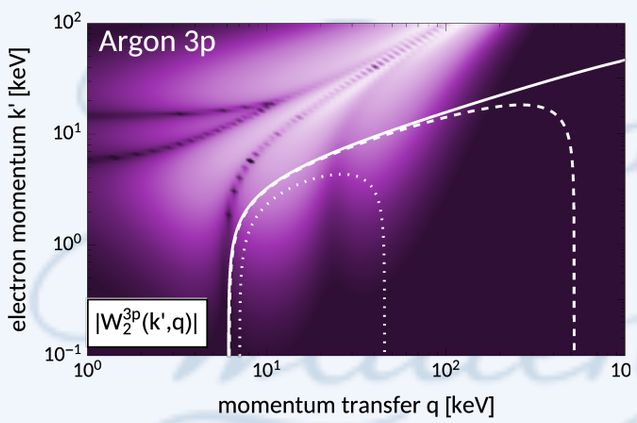

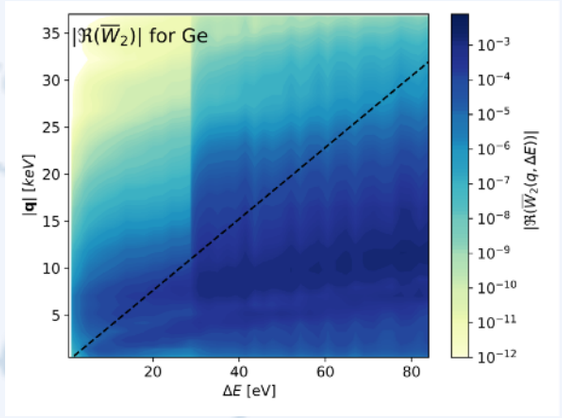

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