Dark matter at future colliders, astrophysics and non-collider experiments

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Full talk (in collaboration with S. Kulkarni) can be found here

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Answering big physics questions *in synergy*

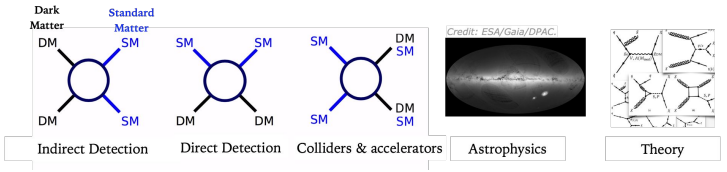
- Astrophysics, non-collider and collider experiment
  - All trying to find answers to **the same question**

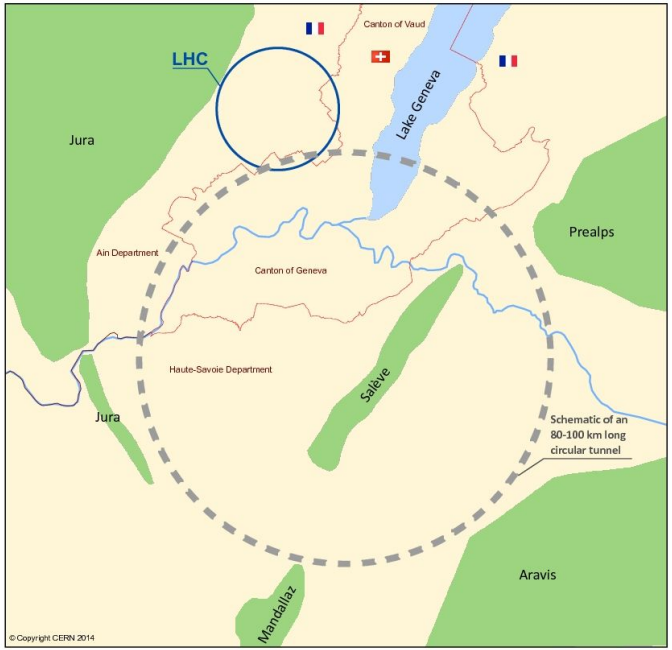
  → It makes sense to **work together & combine efforts**

- Observation of Dark Matter (DM) by one experiment → effec on the others, e.g.
  - Cosmological observations of DM motivate Beyond the Standar Model theories tested at colliders
  - DM observation will need confirmation from multiple experiments

- Survey of scenarios within reach → essential input to present and future experimental strategies:
  - Exploiting synergies maximizes use of existing facilities
  - ...and **helps designing futures ones (e.g. FCC)**

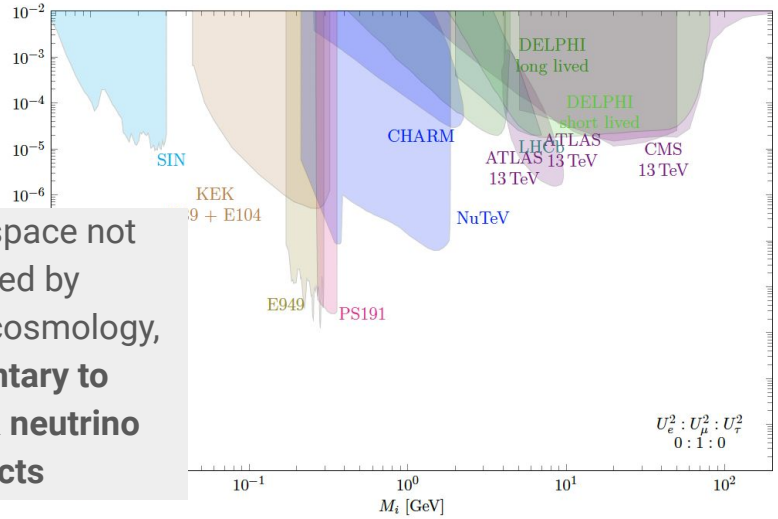
Example of synergies for thermal dark matter

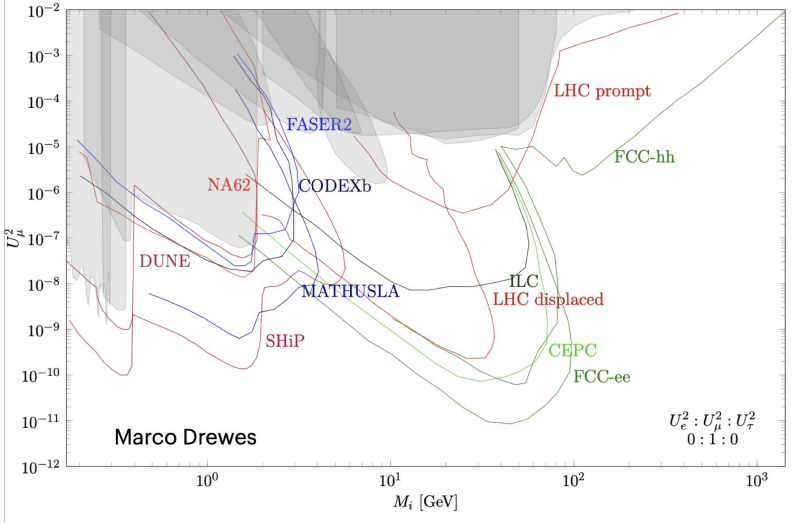




Example: Right Handed Neutrinos

- **Right-Handed Neutrinos** are among the most interesting new physics searches to perform at future colliders and additional experiments. For example, at the FCC:
  - **FCC-ee**: unbeatable at at the Z-Pole (see talk)
    - low mixing → long-lived
      - (arXiv:1411.5230, arXiv:1810.12463, arXiv:2008.13771)
  - **FCC-he**: sensitivity for LFV (arXiv:1908.02852)
  - **FCC-hh**: non-minimal neutrino mass models, see talks by S. Kulkarni, A. Das, M. Mitra





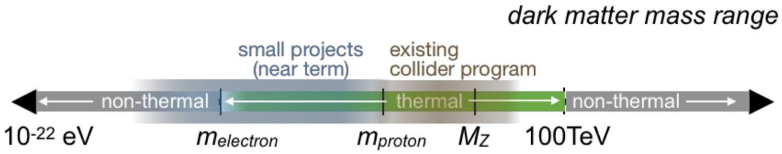
FCC probes space not constrained by astrophysics/cosmology, **complementary to accelerator & neutrino prospects**

Example: light Dark Matter

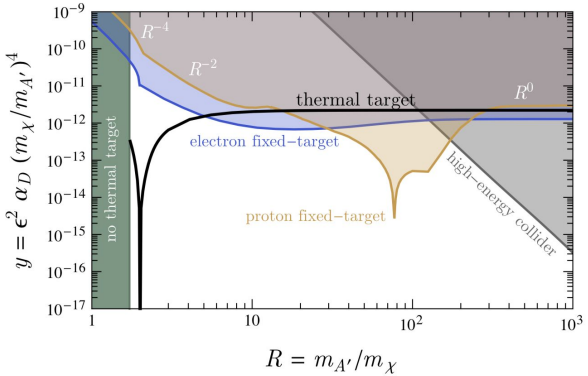
Big leaps in sensitivity to light dark matter:

- Vibrant program of existing/proposed accelerator experiments (e.g. LDMX/SHIP, just restricting to those w/Swedish involvement)

- Exploration of new materials and detectors: collaboration of astro/particle physics & solid state



BRN "New initiatives in DM" report



Ideas and text from https://arxiv.org/pdf/2003.03379.pdf
and Natalia Toro's talk @ Snowmass 18/06/2020

The same new physics scale can come from either:

light, weakly coupled mediator (accelerator experiments)
or
heavy, strongly coupled mediator (collider experiments)

Colliders (including the FCC complex) are an integral part of the discussion for dark matter discovery → let's work together!