

# USING UNDERGROUND NUCLEAR ACCELERATORS

## IN THE QUEST FOR DARK MATTER

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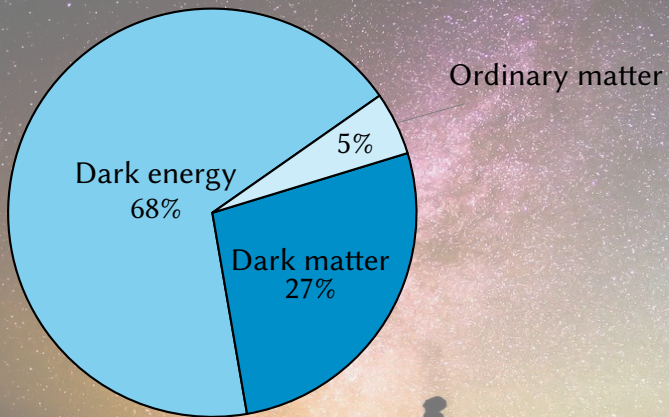
TRIUMF & UBC

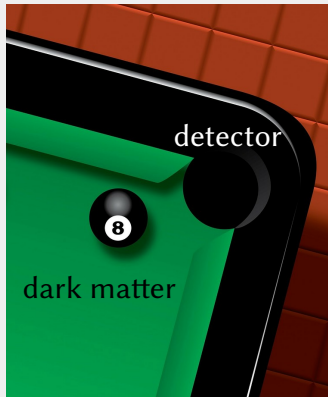
FEBRUARY 11, 2021



- WHAT IS DARK MATTER
- THE MODEL
- DARK MATTER ACCUMULATION
- UP-SCATTERING IN UNDERGROUND LABORATORIES
- CONCLUSIONS AND OUTLOOK

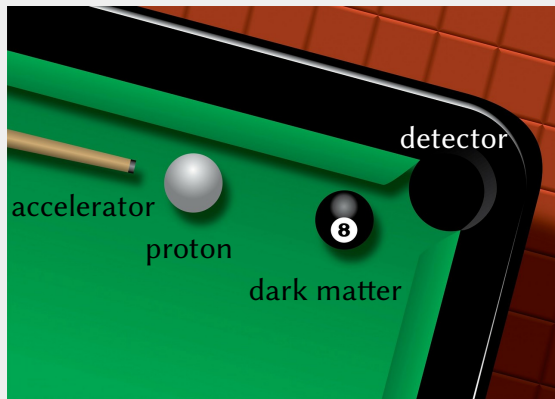
# WHAT IS DARK MATTER





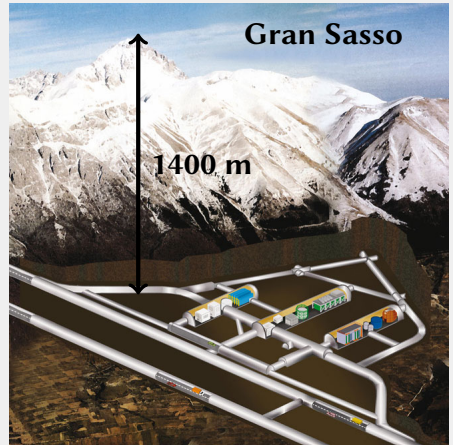
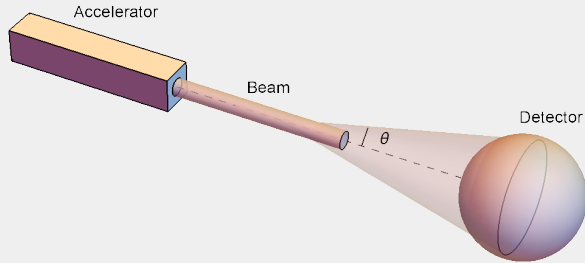
## Two consequences:

- ▶ Not enough energy to give a signal in the detector!
- ▶ Can accumulate in the Earth



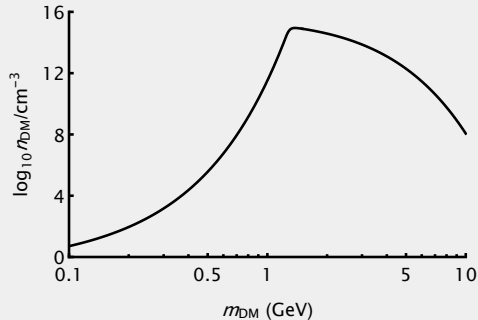
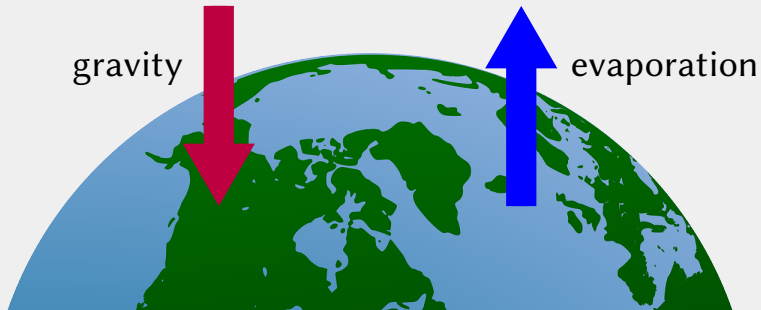
## Two consequences:

- ▶ Not enough energy to give a signal in the detector!
  - ▶ Can accumulate in the Earth
- But we can accelerate it

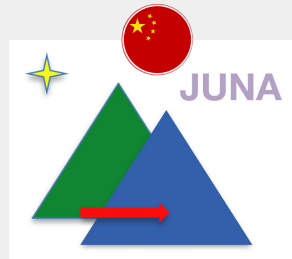


Use underground nuclear accelerators to ***kick*** dark matter toward detectors.

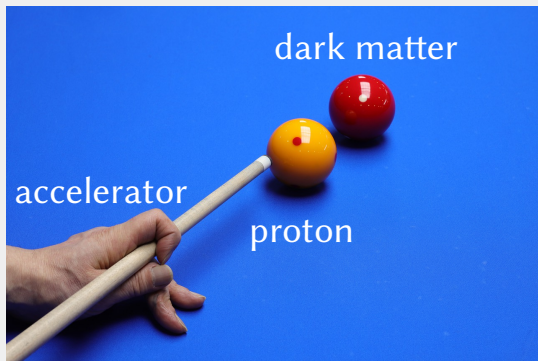
# DARK MATTER ACCUMULATION



Neufeld *et al.*, ApJ (2018)



$$\begin{aligned}
 N_{\text{events}} &\propto \underbrace{N_{\text{DM scattered}}}_{N_{p+} \times l_{\text{beam}} \times \sigma \times n_{\text{DM}}} \times \sigma \times n_{\text{nucleons}} \times l_{\text{detector}} \\
 &\propto \begin{cases} 10^{-7} \text{ events/year} & n_{\text{DM}} = 0.3/\text{cm}^3 \\ 10^7 \text{ events/year} & n_{\text{DM}} = 10^{14}/\text{cm}^3 \end{cases}
 \end{aligned}$$



- Strongly interacting dark matter has less energy than the detector threshold
- But it can accumulate!
- Can we do better than current and proposed experiments?

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