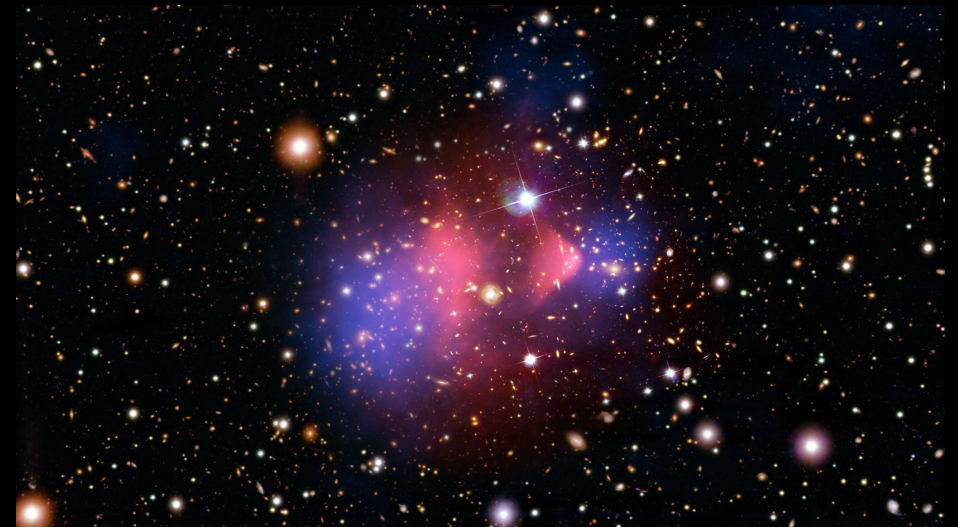
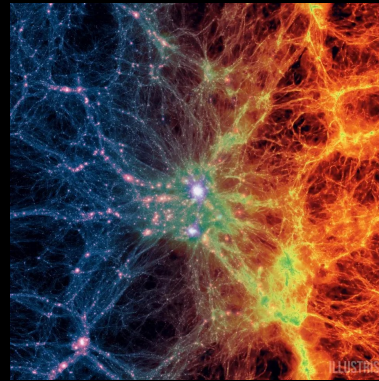
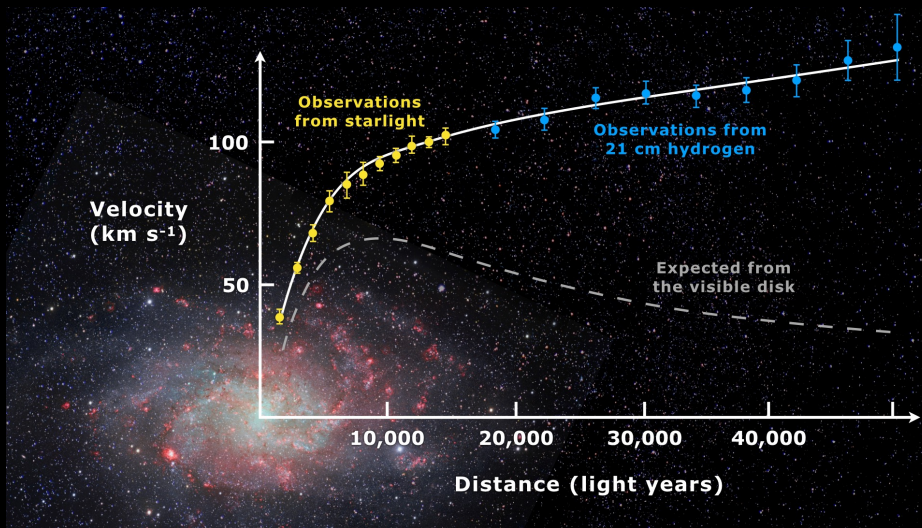


The background features a black field with dynamic, flowing waves of color. On the left, there are vibrant green waves that curve upwards and then downwards. On the right, there are bright yellow and orange waves that curve downwards and then upwards, creating a sense of movement and energy.

BDX @ JLAB

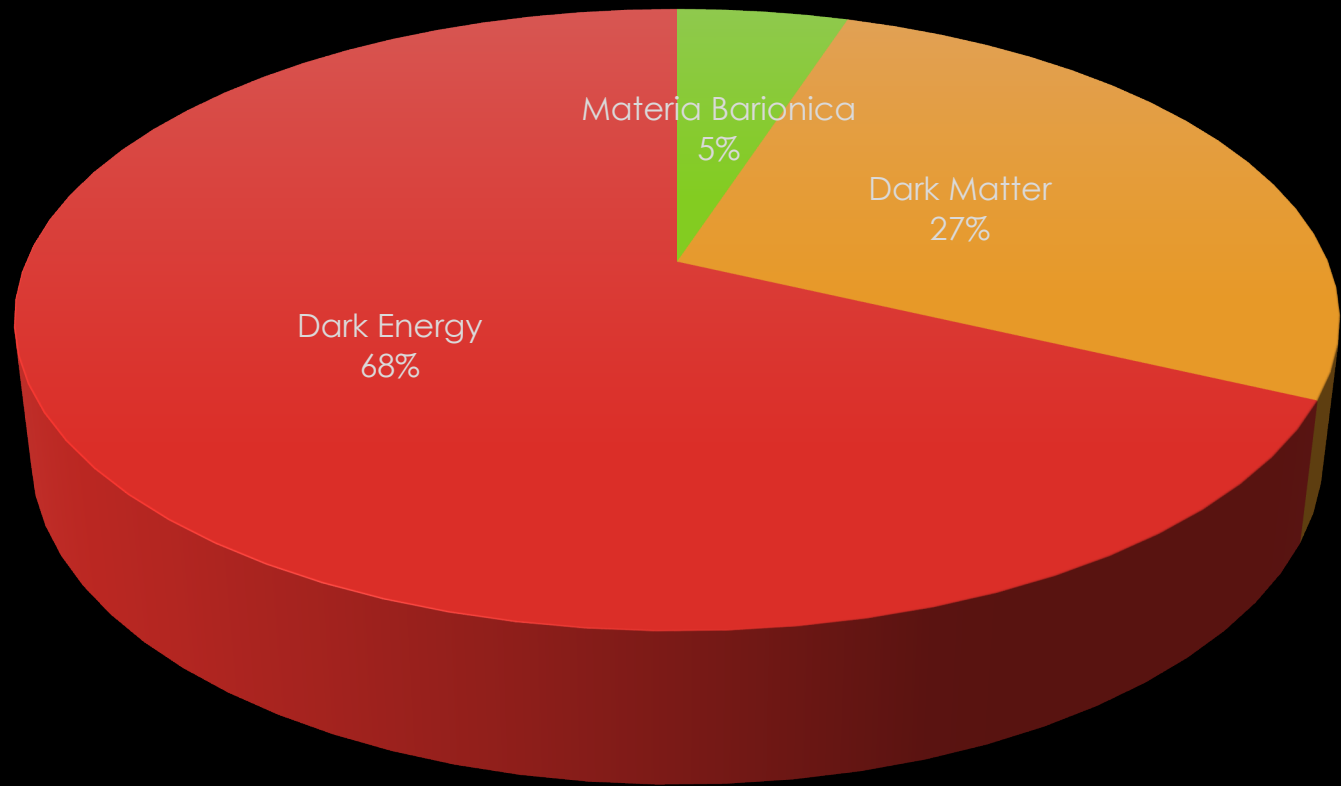
# DARK MATTER



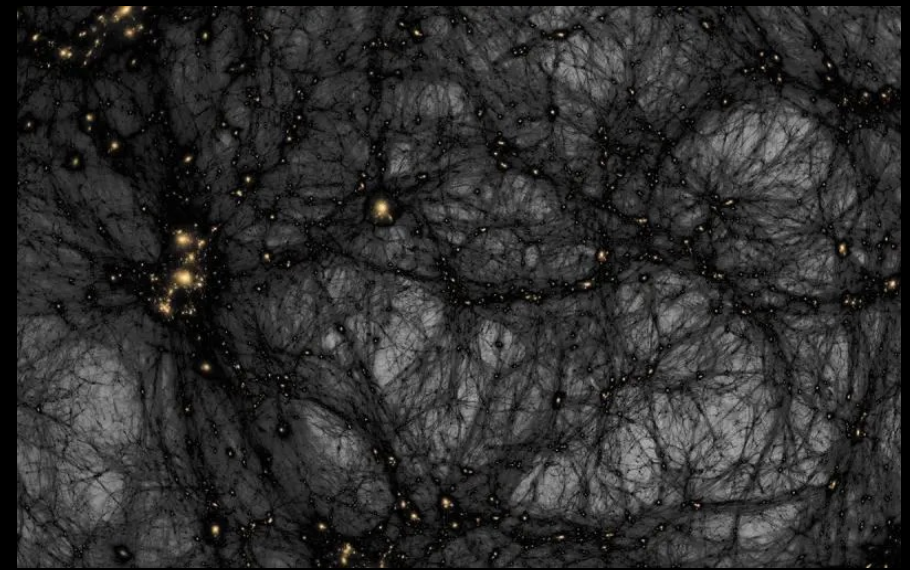
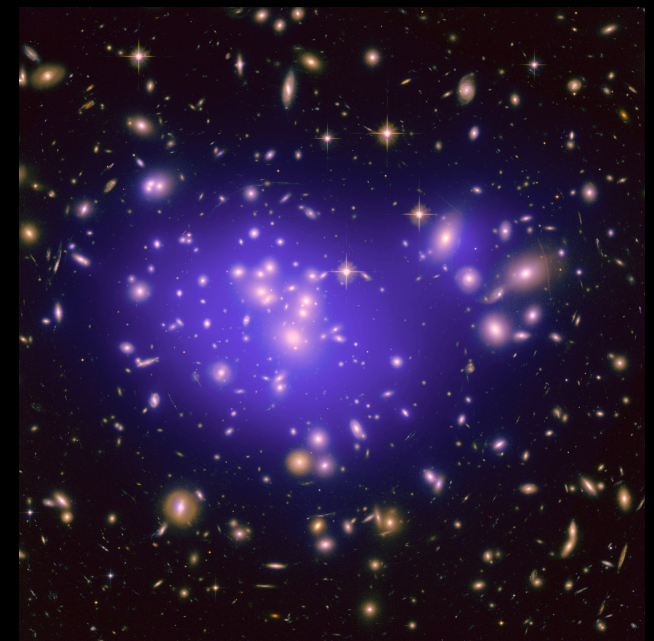
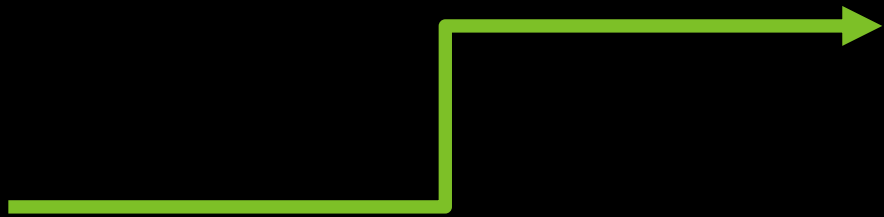
Velocità di rotazione delle galassie

Bullet cluster





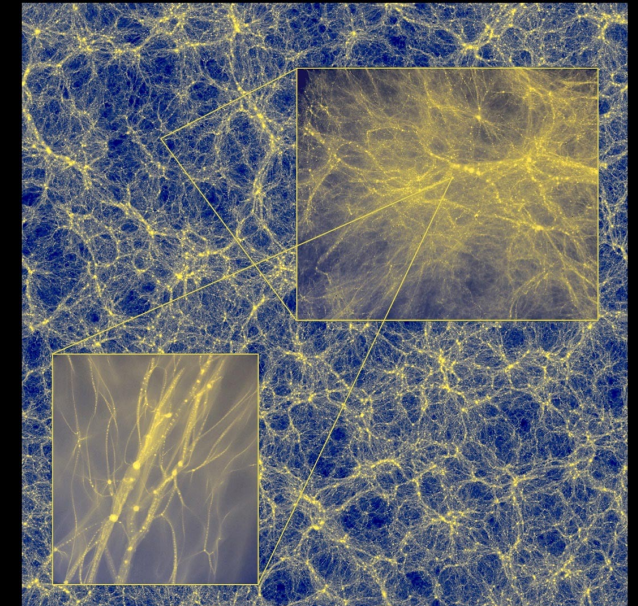
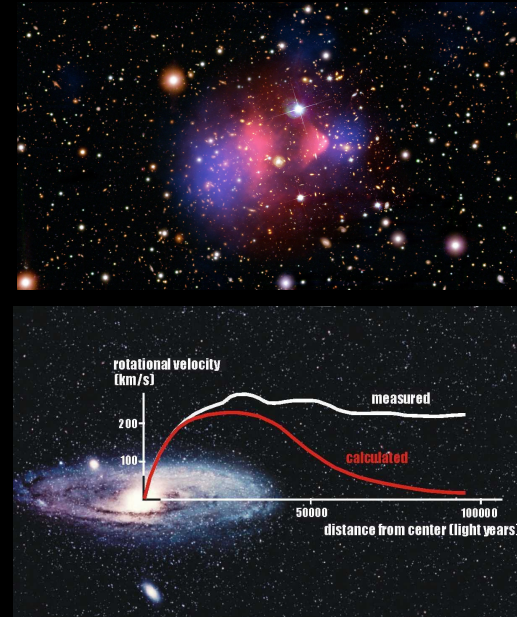
■ Materia Barionica   ■ Dark Matter   ■ Dark Energy



# DARK MATTER

Cosa sappiamo sulla DM:

- Interagisce gravitazionalmente
- Stabile
- Neutra sotto interazioni SM



# DARK MATTER

zeV aeV feV peV neV ueV meV eV

keV

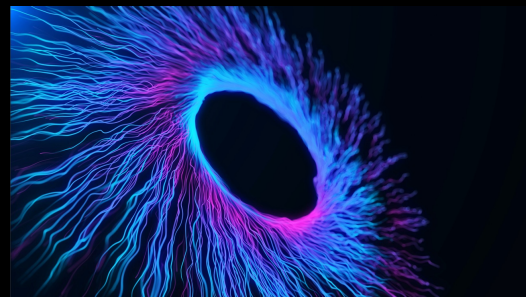
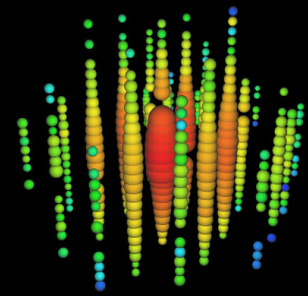
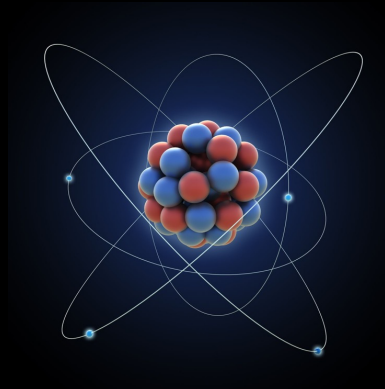
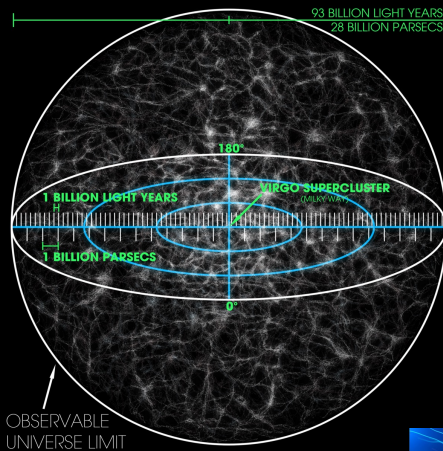
MeV

GeV

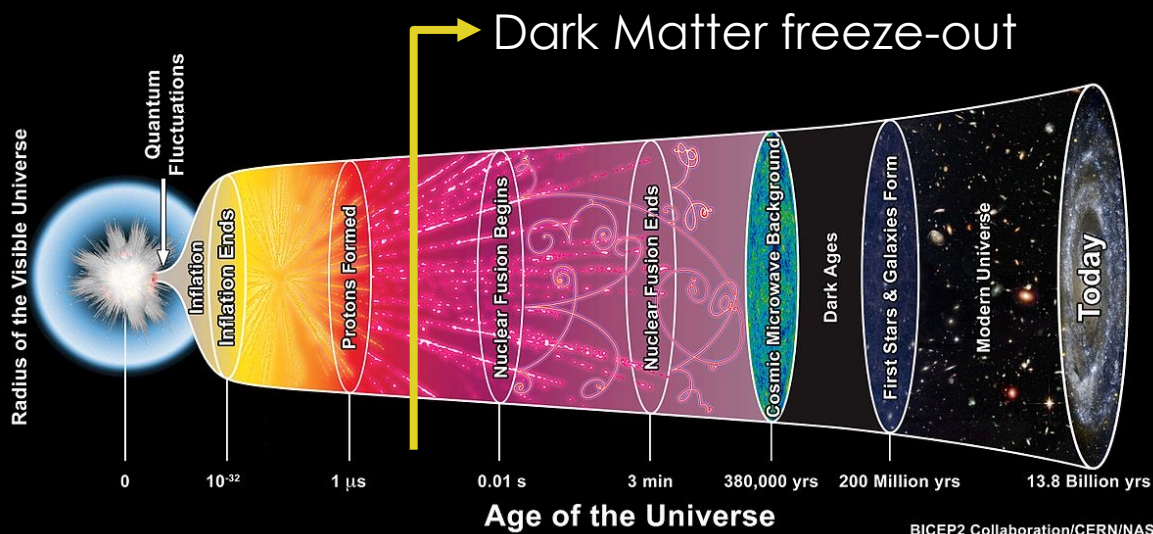
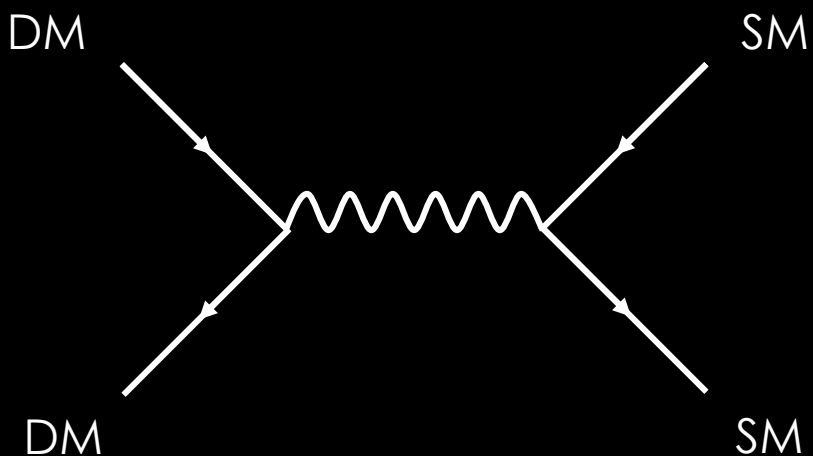
TeV

PeV

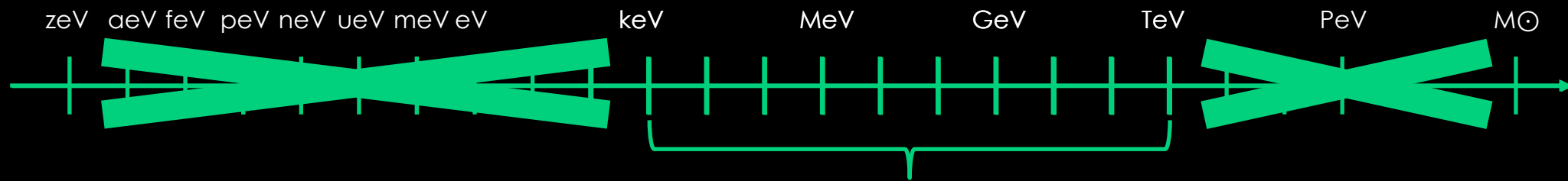
$M_{\odot}$



# DARK MATTER TERMICA

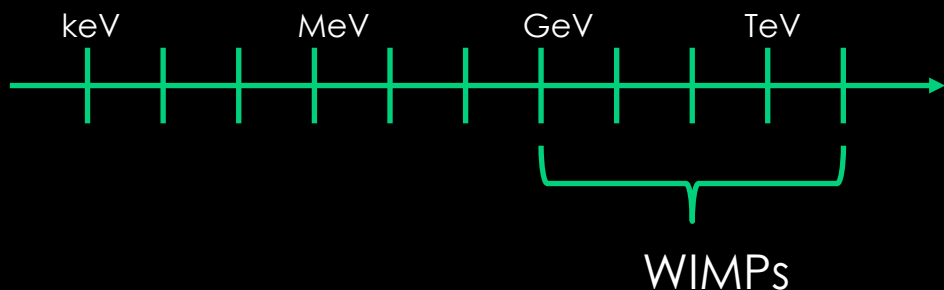


BICEP2 Collaboration/CERN/NASA



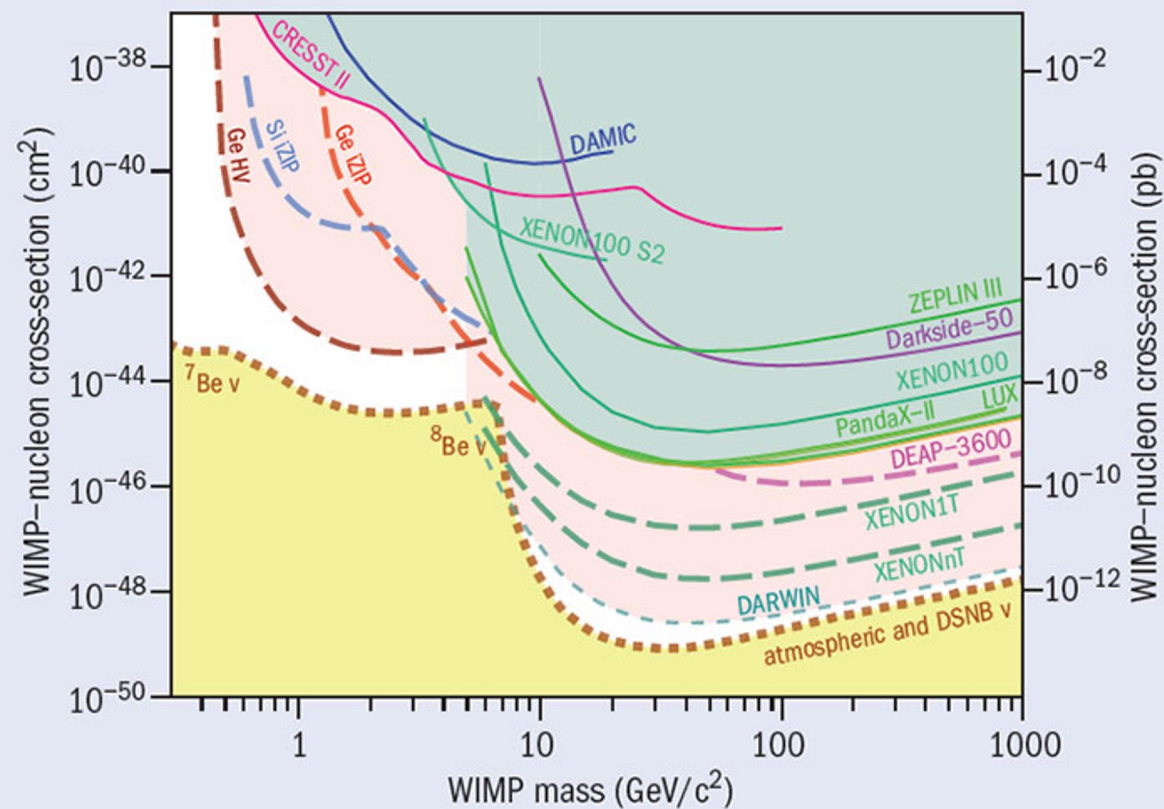
Dark Matter Termica

# WIMP

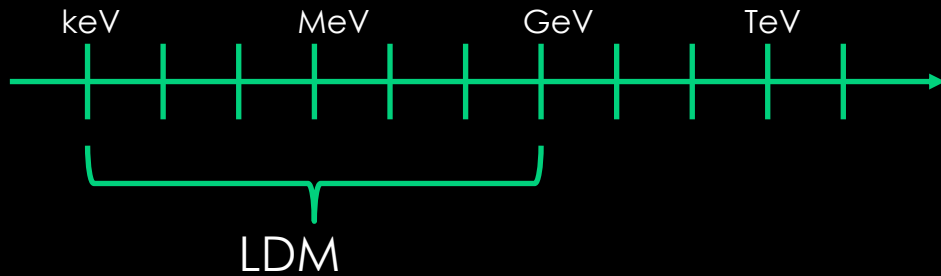


Dark Matter termica

- Massa: GeV-TeV
- Interazione: debole
- Ricerca: diretta
- Problema: non è stata trovata

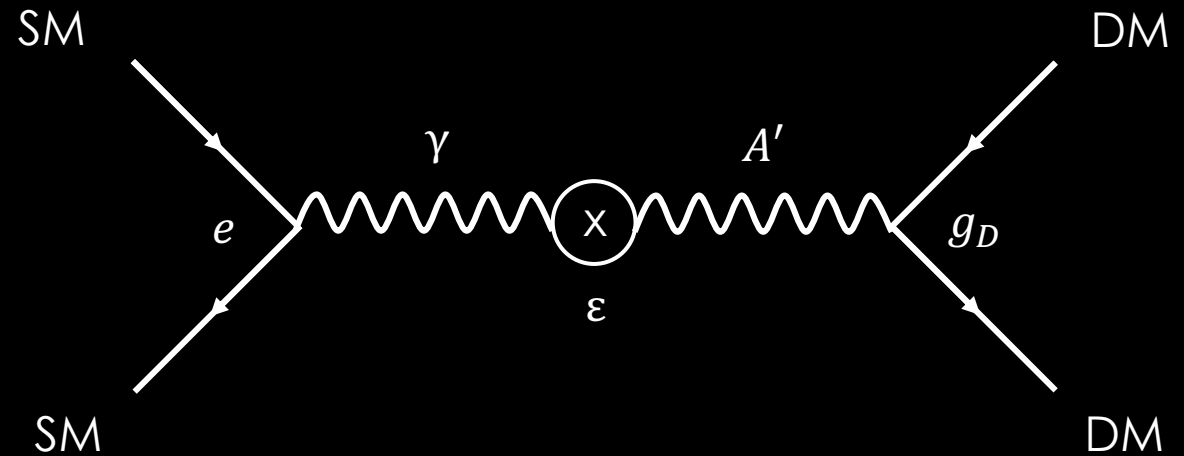


# LIGHT DARK MATTER



Dark Matter termica

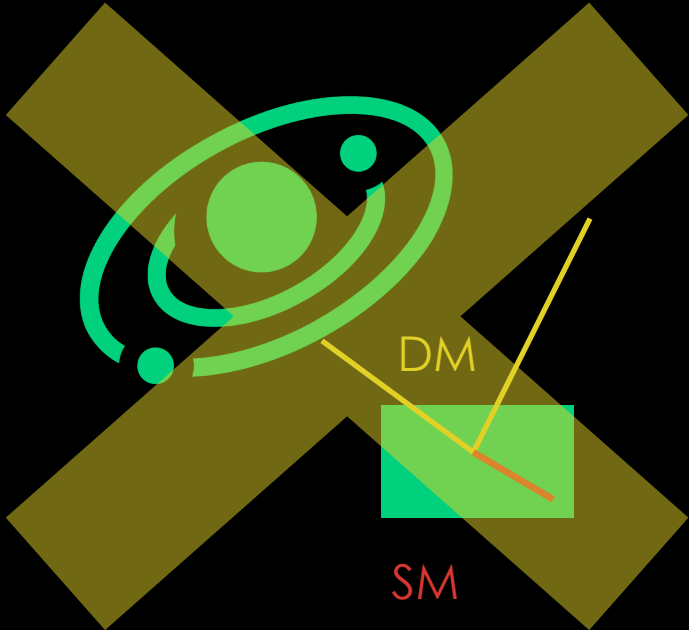
- Massa: MeV-GeV
- Interazione: nuova



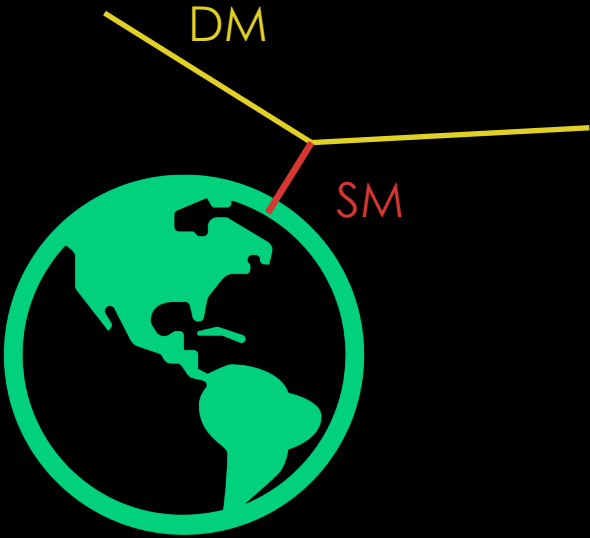
$$y = \frac{g_D^2 \epsilon^2 e^2}{4\pi} \left( \frac{m_{DM}}{m_{A'}} \right)^4 \sim \langle \sigma v \rangle_{relic} m_{DM}^2$$



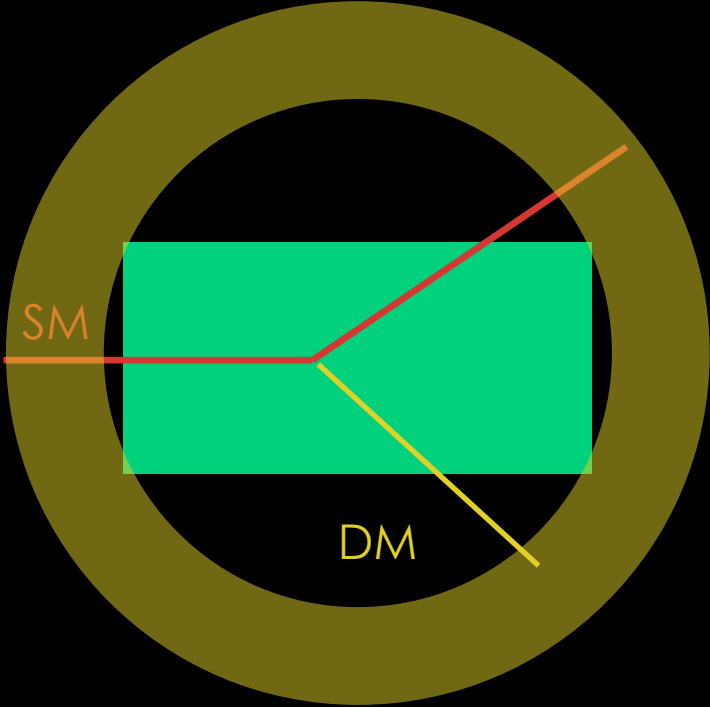
# RICERCA LDM



Ricerca diretta

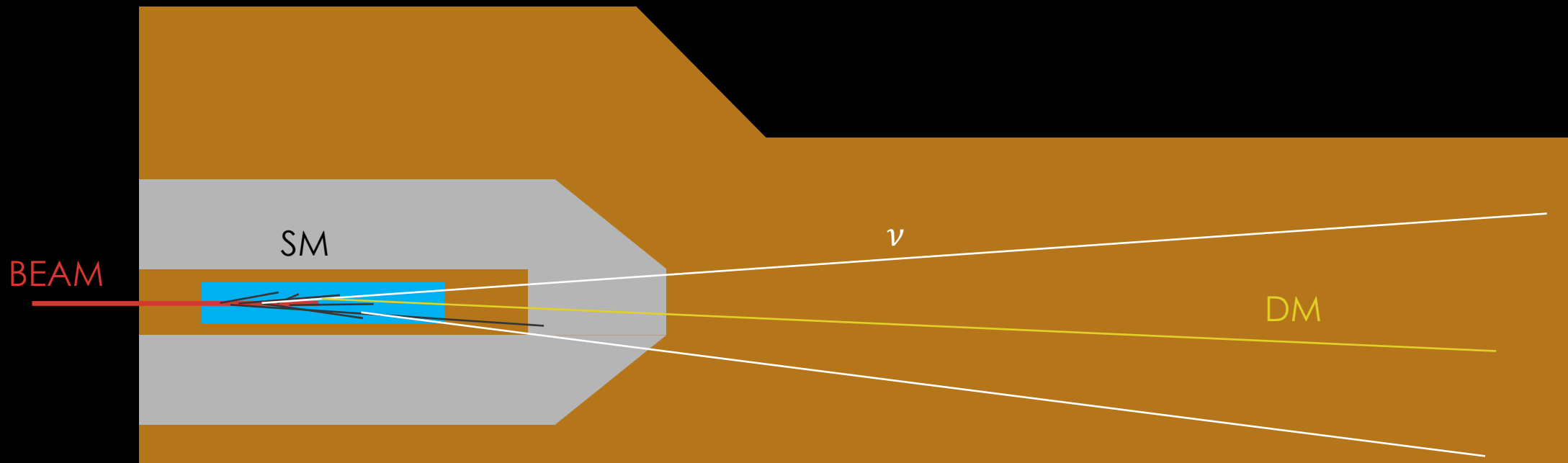


Ricerca indiretta

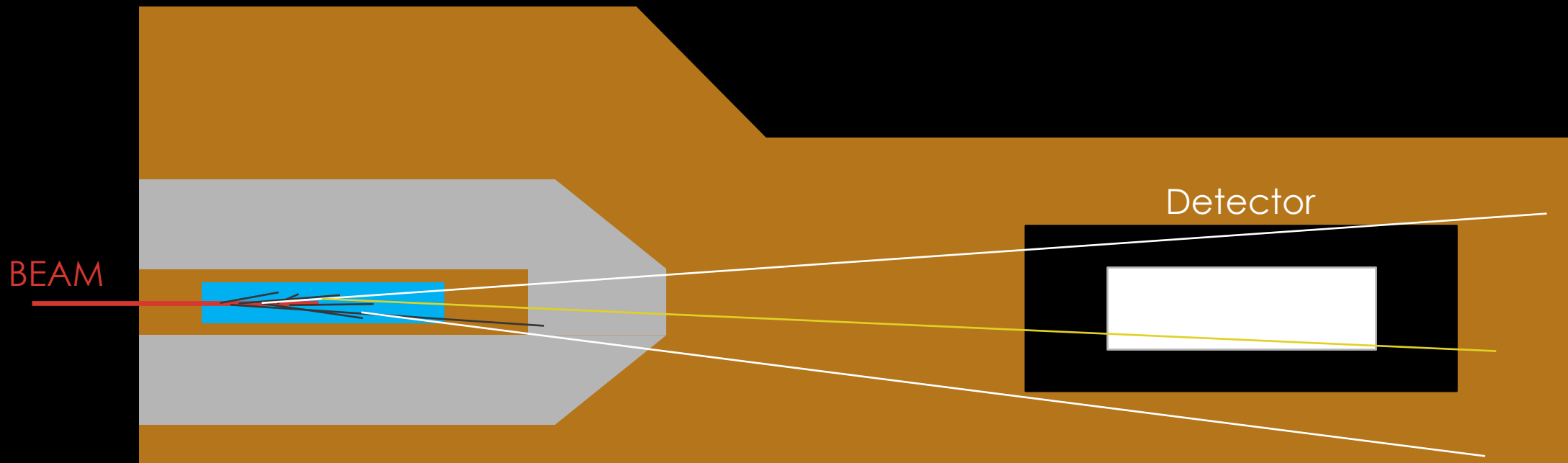


Ricerca agli acceleratori

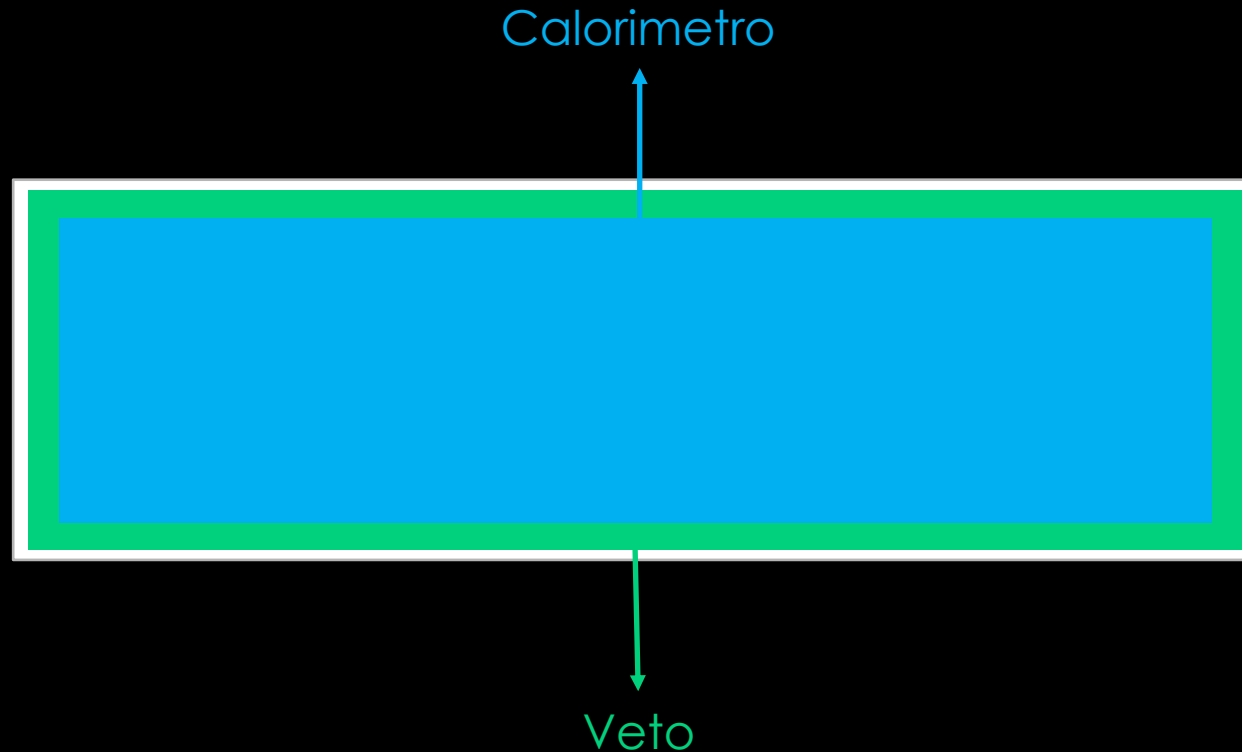
# BEAM DUMP EXPERIMENT



# BEAM DUMP EXPERIMENT



# BEAM DUMP EXPERIMENT



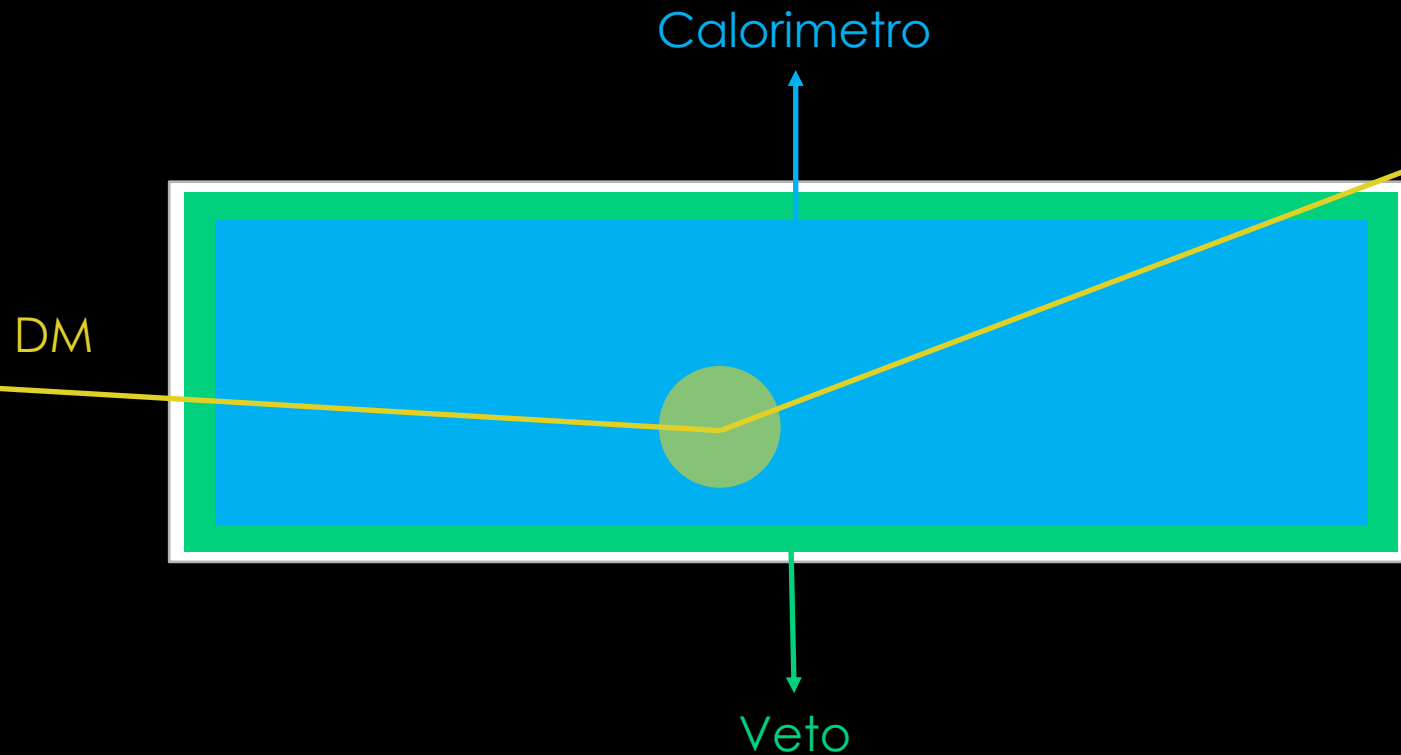
## Calorimetro :

- Materiale ad alta densità
- Rivelazione segnale (sciame EM)

## Veto :

- Materiale con alta resa di luce
- Identificazione particelle cariche

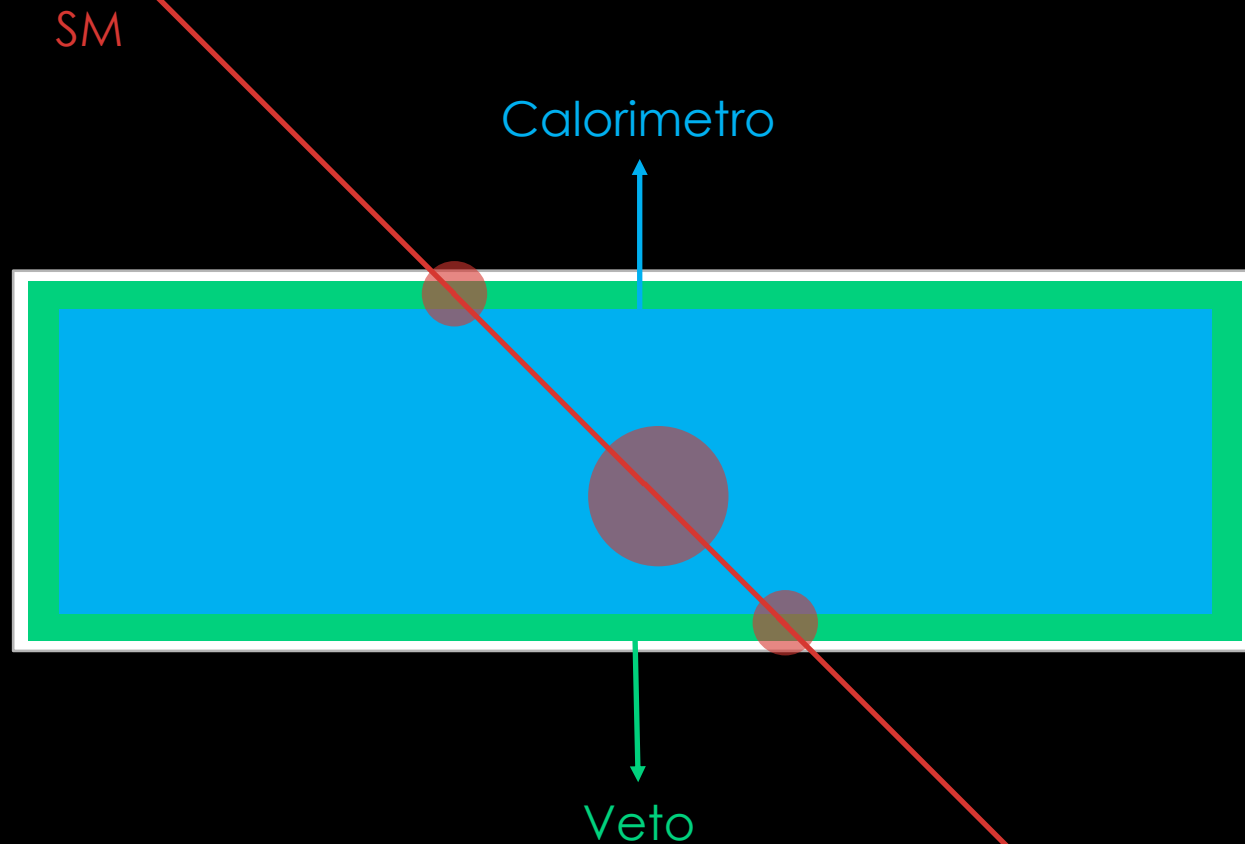
# BEAM DUMP EXPERIMENT



Segnale DM:

- Deposito di energia nel calorimetro
- Nessun segnale nel veto

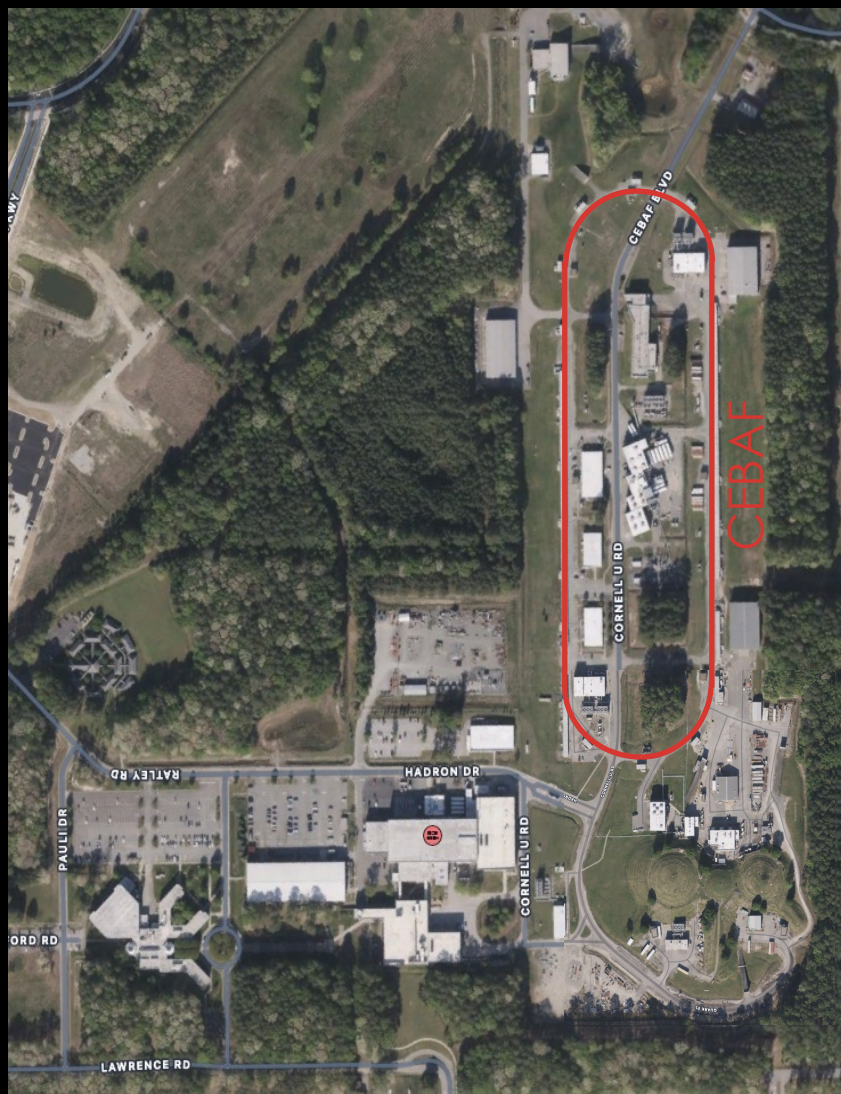
# BEAM DUMP EXPERIMENT



Segnale SM:

- Deposito di energia nel calorimetro
- Segnale nel veto

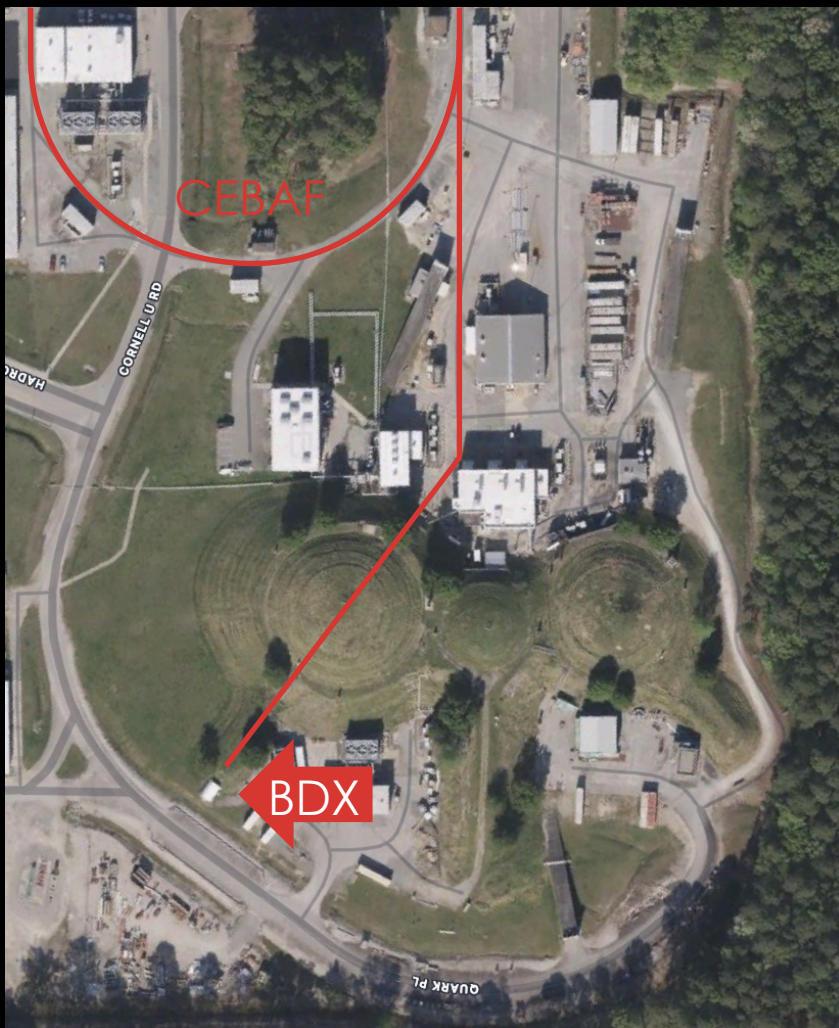
→ Facile reiezione di eventi dello SM



## Beam Dump eXperiment

- Futuro Beam Dump experiment al JLab
- Fascio: elettroni fino a 11 GeV
- Altissima intensità ( $65 \mu\text{A}$ )
- Statistica attesa:  $10^{22}$  EOT
- Inizio presa dati: 2026

# BDX



## Beam Dump eXperiment

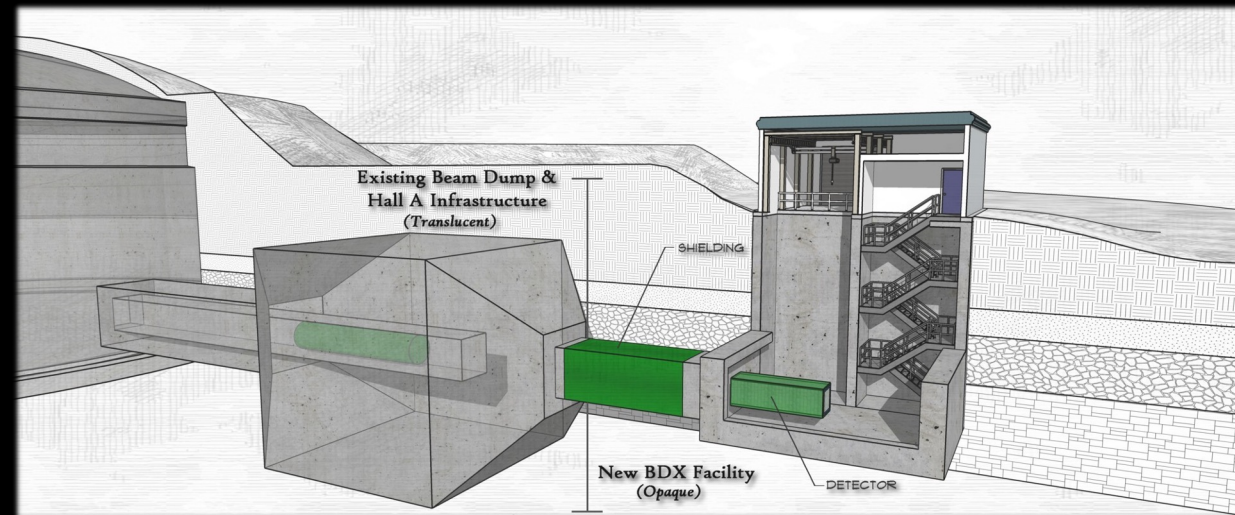
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# BDX

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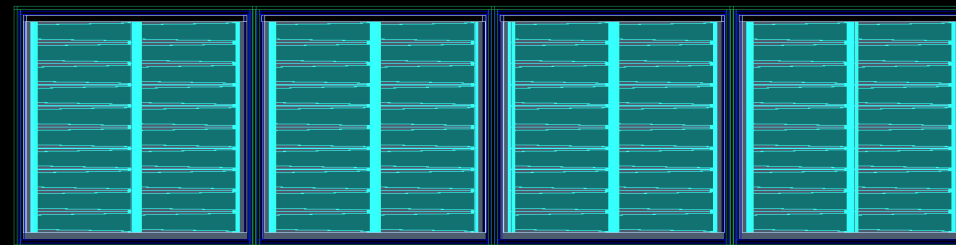
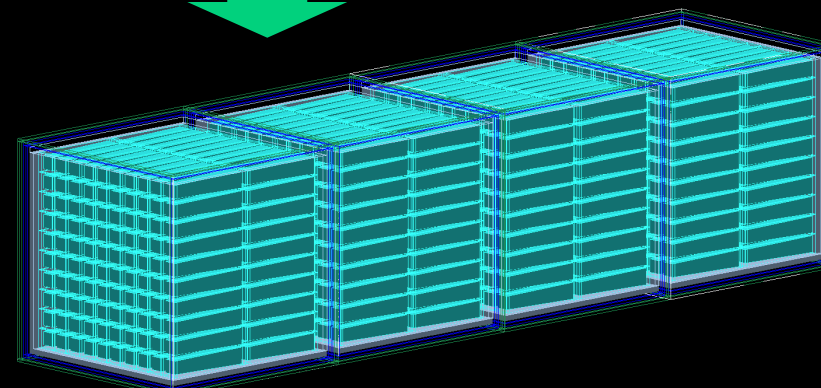
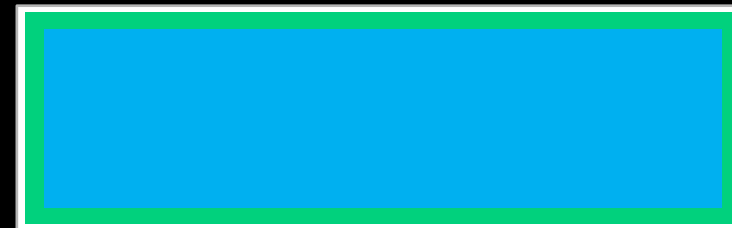
BDX

## Calorimetro elettromagnetico

- 800 cristalli di CsI letti da SiPM
- Design modulare, 4 moduli da 2 matrici di 10x10 cristalli

## Veto

- Strato interno passivo di Pb
- Due strati attivi di scintillatore plastico
- Ogni modulo è circondato dal veto



# BDX-MINI



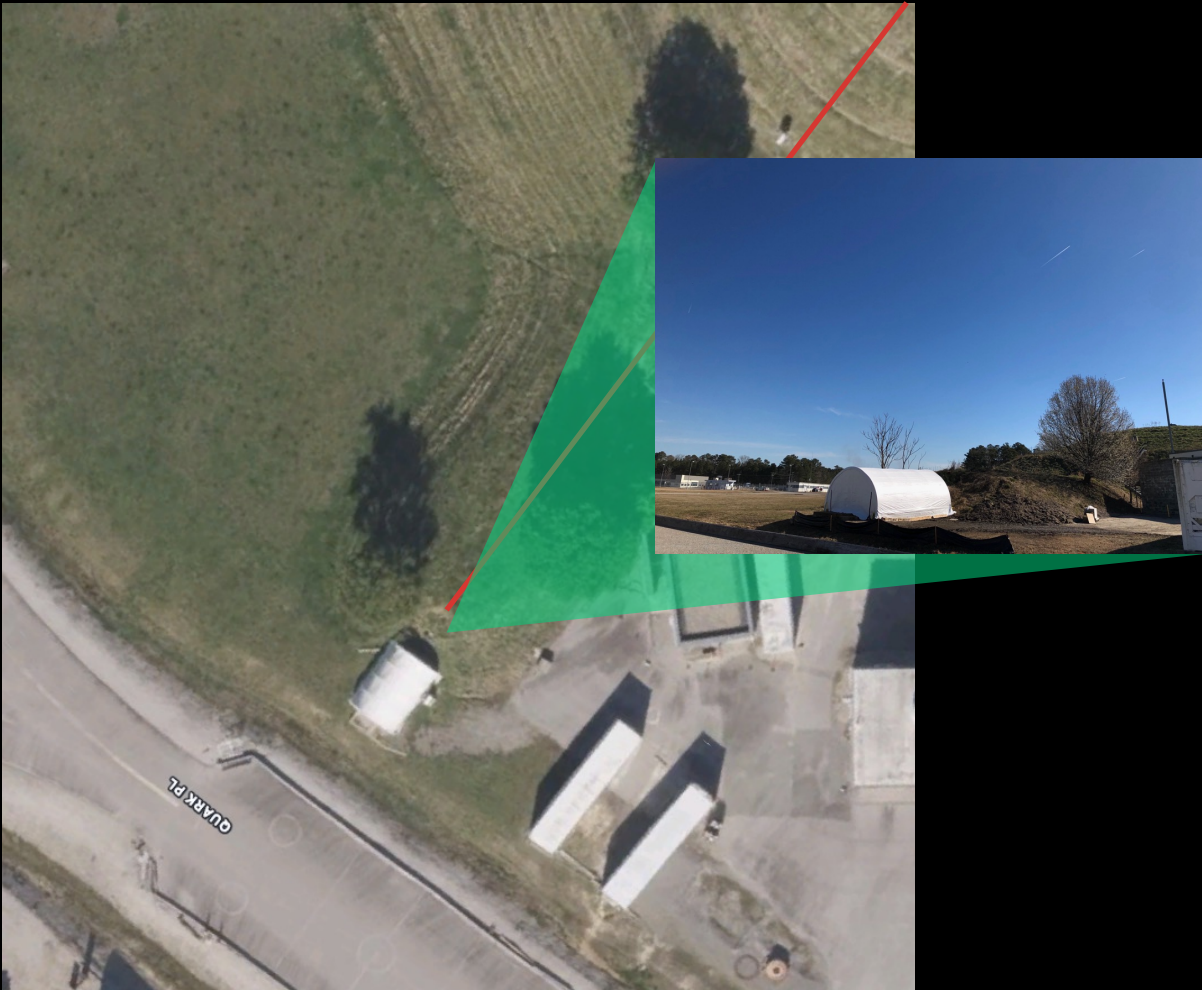
Versione pilota di BDX

- Fascio di elettroni a 2.56 GeV
- Corrente fino a 150  $\mu\text{A}$
- Misura alternando fascio acceso e spento
- Accumulati  $2.54 \times 10^{21}$  EOT
- Misura fondo cosmico con dati a fascio spento

# BDX-MINI

Versione pilota di BDX

- Presa dati: primavera-estate 2020
- Fascio di elettroni a 2.56 GeV
- Corrente fino a 150  $\mu\text{A}$
- Accumulati  $2.54 \times 10^{21}$  EOT
- Misura fondo cosmico con dati a fascio spento



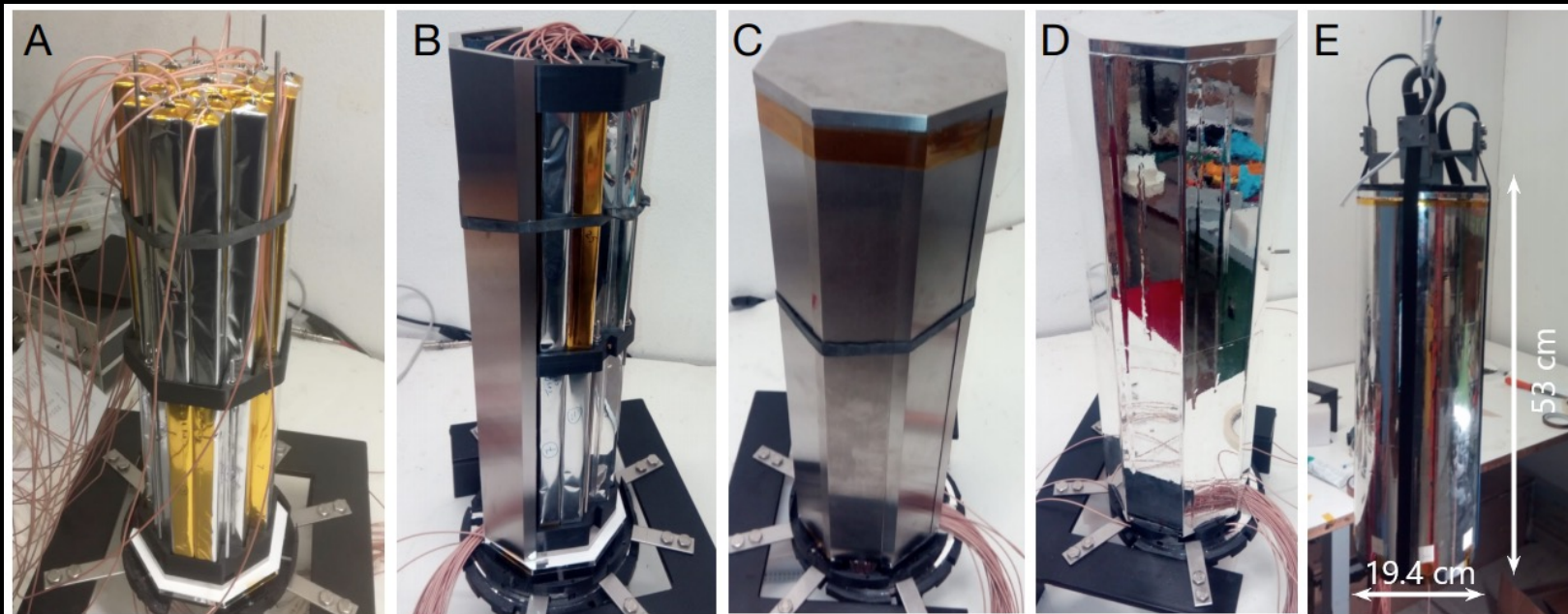
# BDX-MINI

Calorimetro:

- 44 cristalli  $\text{PbWO}_4$

Veto:

- Shielding interno di tungsteno
- Scintillatori plastici cilindrico e ottagonale



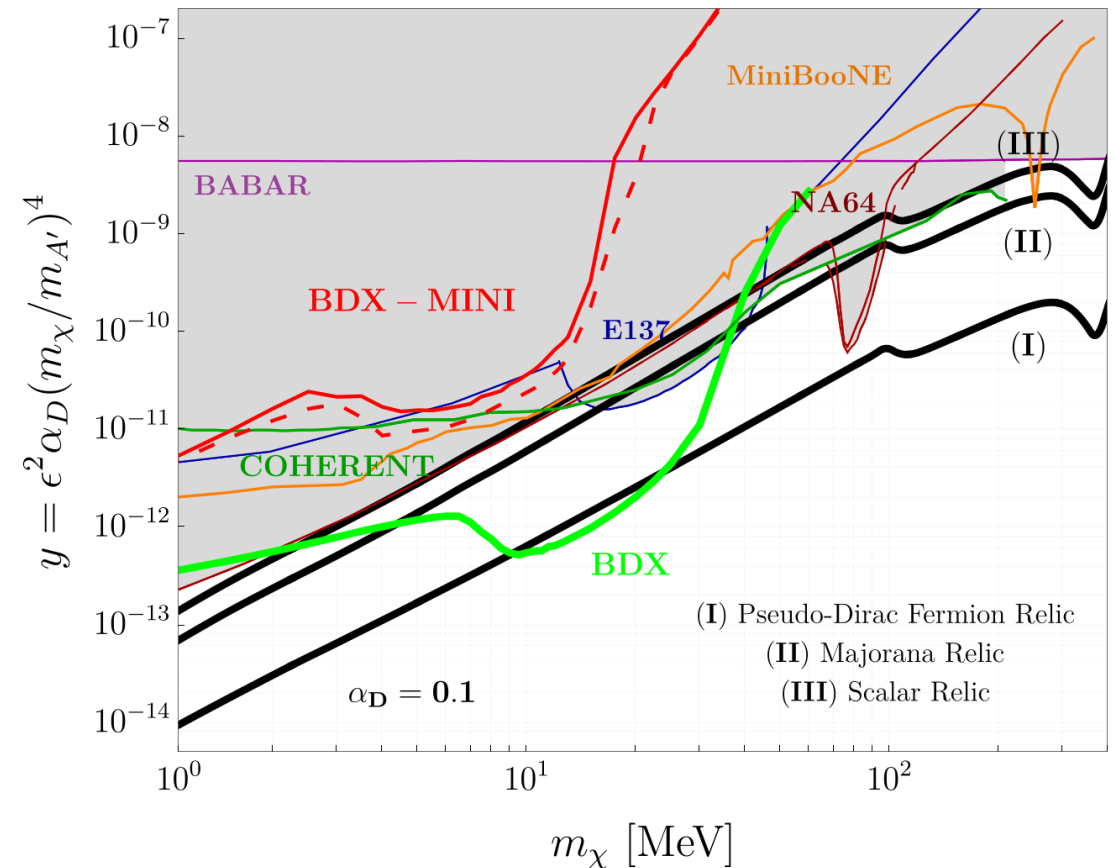
# BDX-MINI

Nessun eccesso di eventi nei dati a fascio acceso:

- $N_{on} = 3623$
- $N_{off} = 3822$

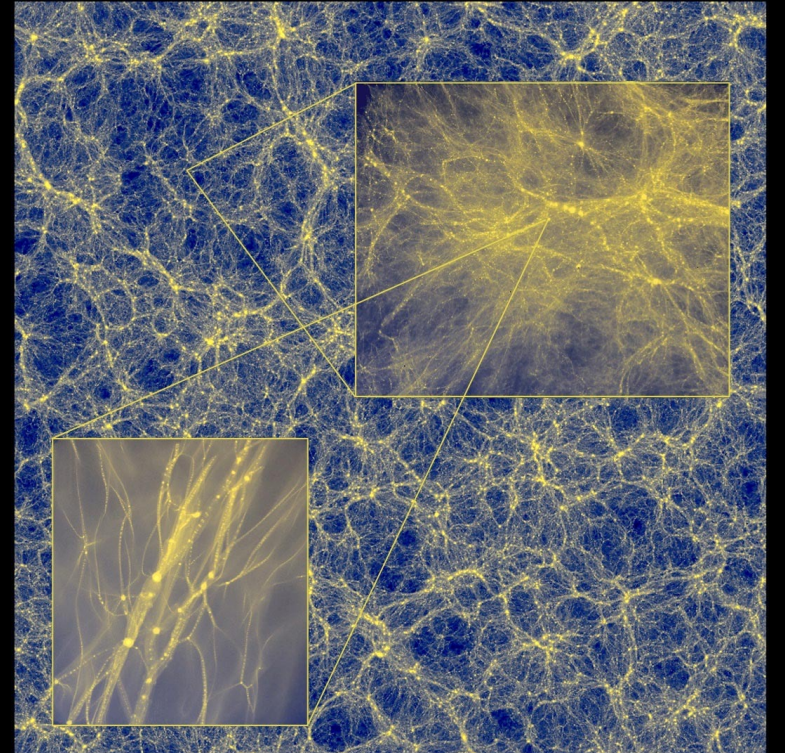
Valutazione limite esclusione DM

BDX sarà in grado di sondare nuove regioni



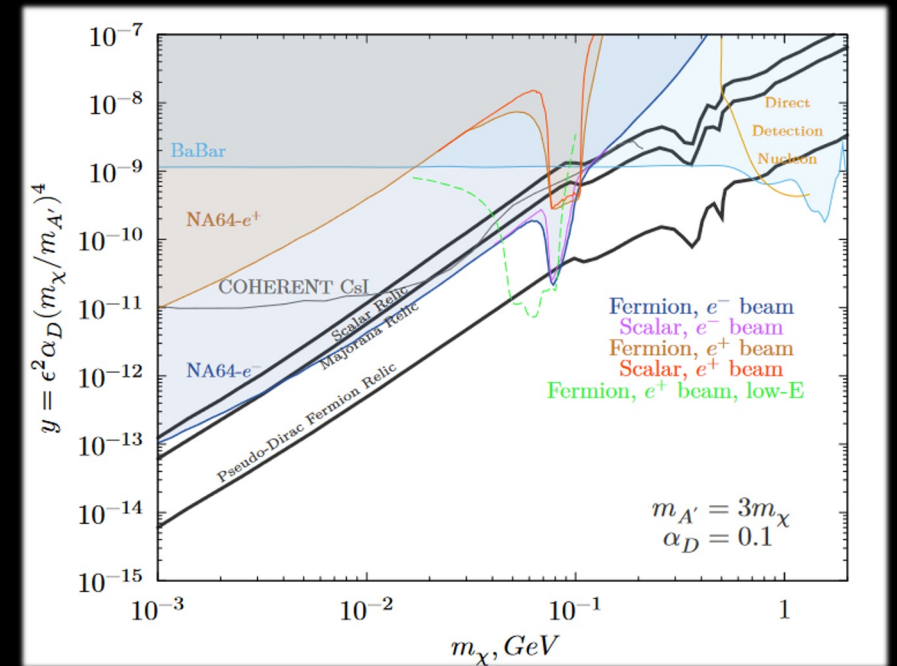
# CONCLUSIONI

- Misure cosmologiche suggeriscono l'esistenza di Dark Matter



# CONCLUSIONI

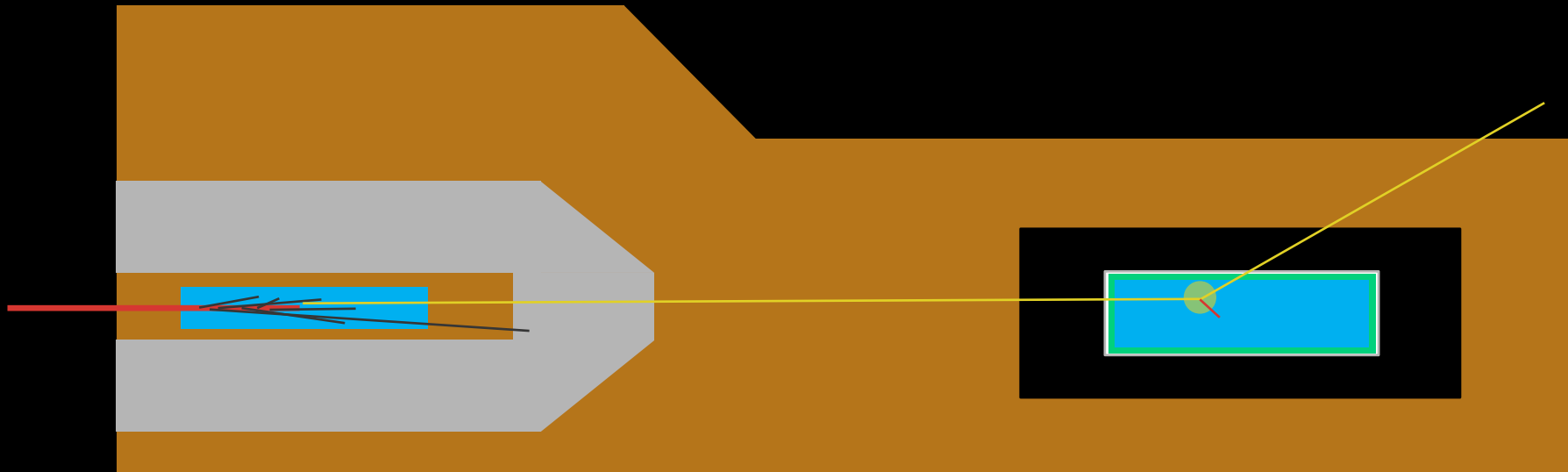
- Misure cosmologiche suggeriscono l'esistenza di Dark Matter
- DM nel range MeV-GeV è ancora relativamente inesplorata





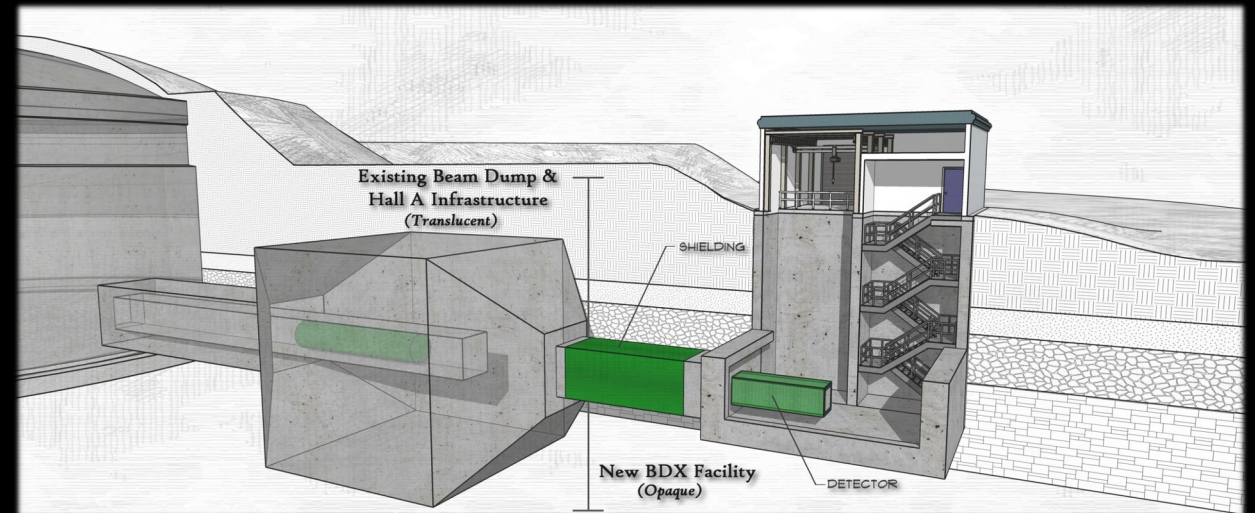
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- LDM studiabile con esperimenti agli acceleratori



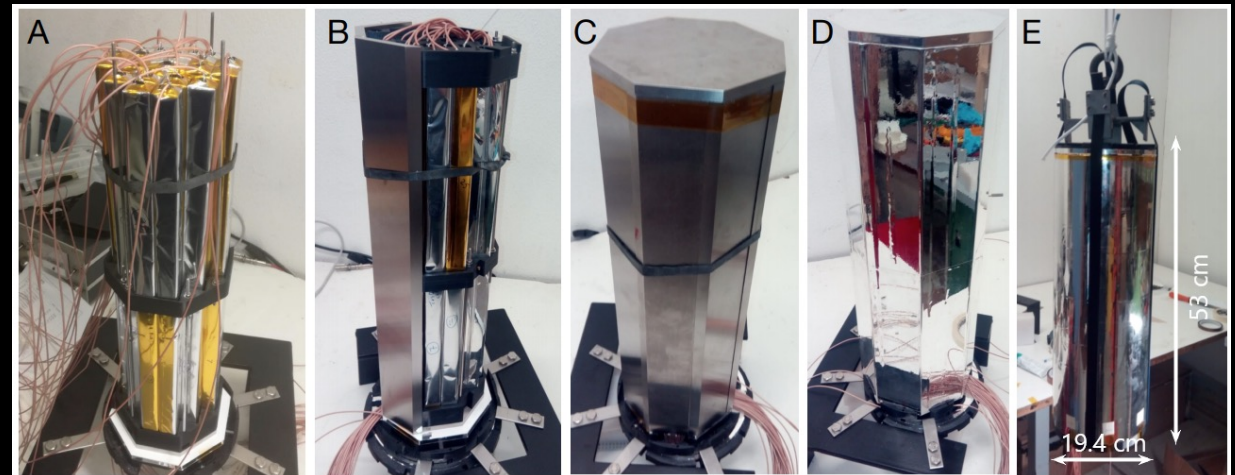
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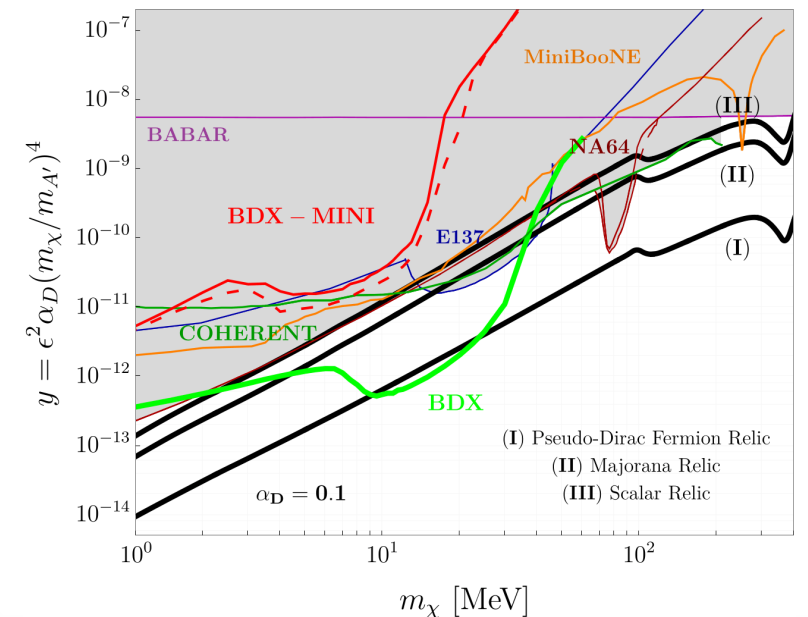
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# CONCLUSIONI

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- LDM studiabile con esperimenti agli acceleratori
- BDX esperimento al JLab per ricerca di LDM
- BDX-MINI esperimento pilota
- *Beam dump experiment* permetteranno di studiare zone ancora inesplorate dello spazio dei parametri della LDM





FINE

(?)