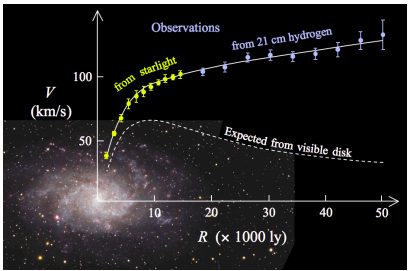
Searching for Dark Matter Using Jets and Jet Substructure at the Large Hadron Collider

Siddharth Narayanan

Ph.D. Thesis Defense - 2019/01/22

Dark matter - in space

Strong astrophysical evidence for DM:



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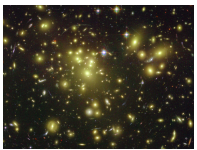

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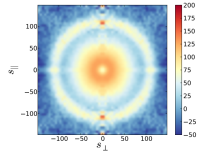

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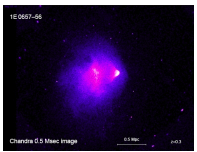
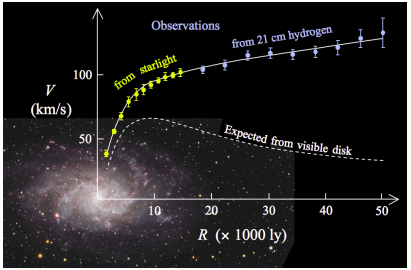


[5]

Dark matter - in space

Strong astrophysical evidence for DM:



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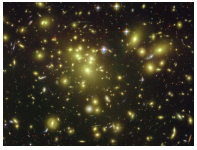

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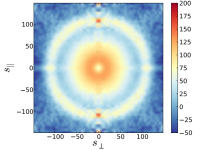

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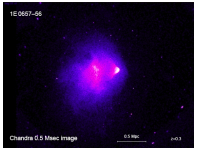


[5]

Weakly Interacting Massive Particles

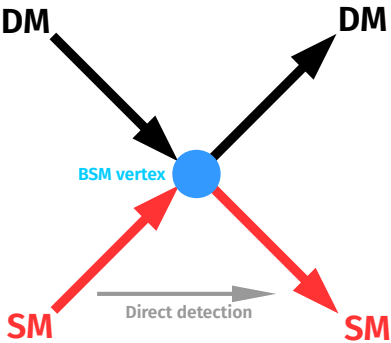
- Weakly: DM-SM coupling $g_\chi \sim g$
- Massive: mass $m_\chi \sim 100$ GeV
- Approximates measured relic density:

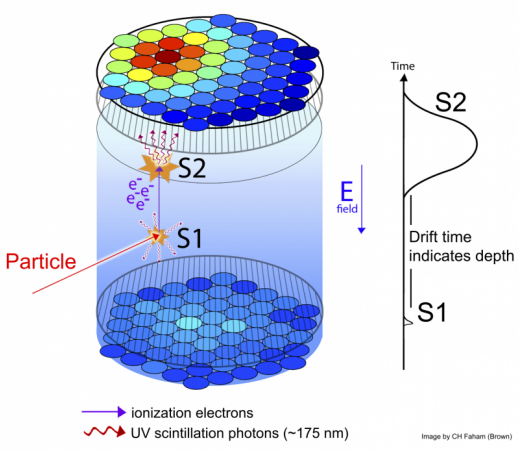
$$\Omega \propto \frac{\rho}{\rho_c}$$

$$\Omega_{\text{meas.}} = 0.12, \quad \Omega_\chi \sim 0.1$$

- Particle colliders can probe WIMPs

Dark matter - in a laboratory

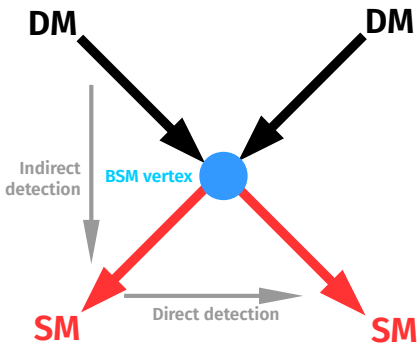


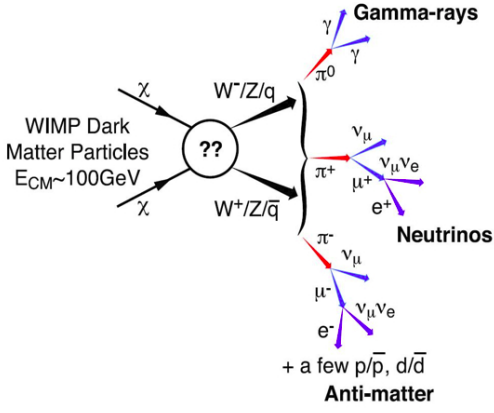


Search for DM-SM interactions as Earth moves through DM halo

[6]

Dark matter - in a laboratory





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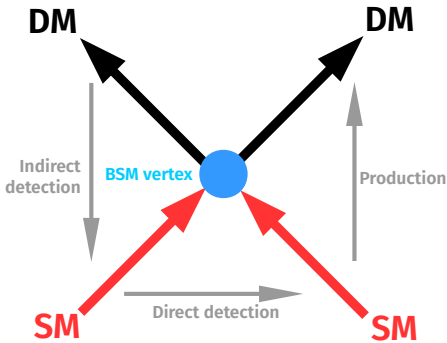
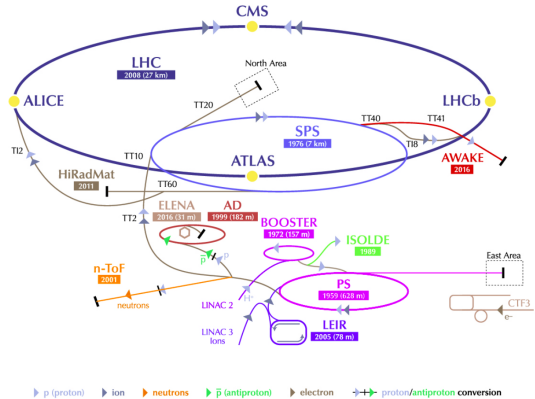
Look for SM remnants of DM-DM annihilation in space

Dark matter - in a laboratory



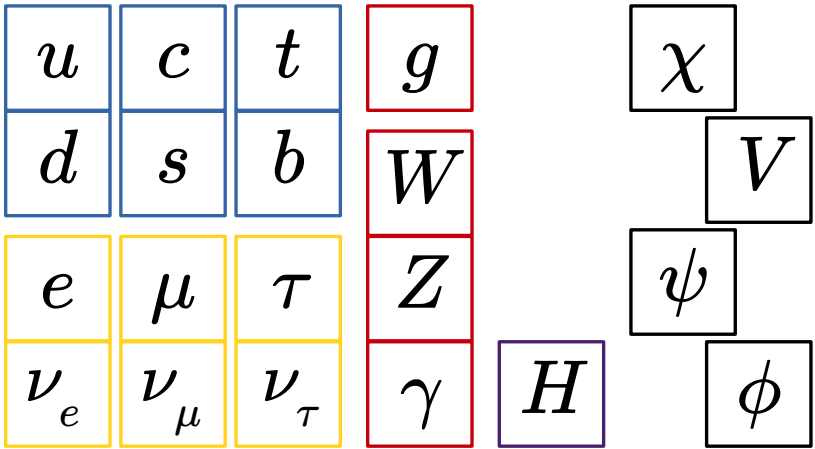


Exploit DM-SM interaction to produce DM in a laboratory

Assumptions for production of WIMPs at LHC

Effective coupling to quarks/gluons $\gtrsim 10^{-4}$

Masses $\lesssim \sqrt{s}$



References

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