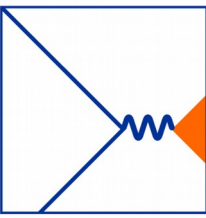


FEEBLY INTERACTING DARK MATTER

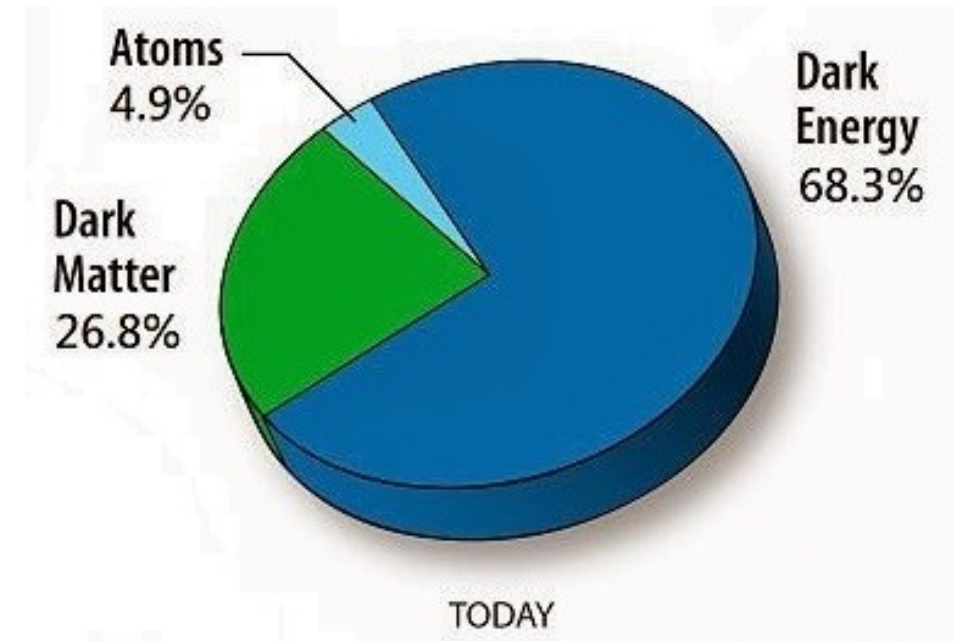
Sam Junius

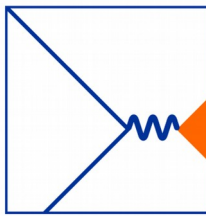
HEP@VUB PhD Event - 19/11/2020



Dark Matter

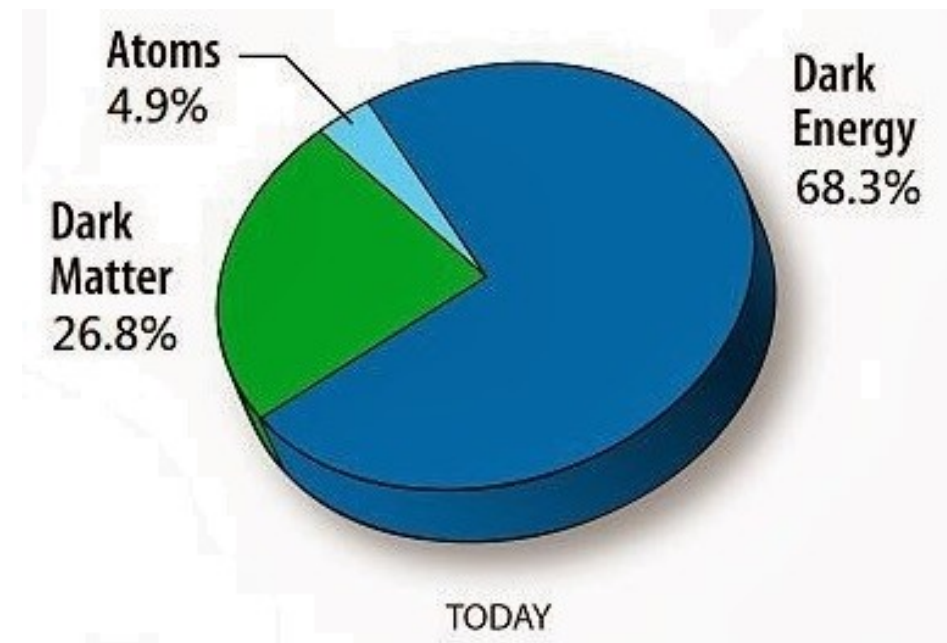
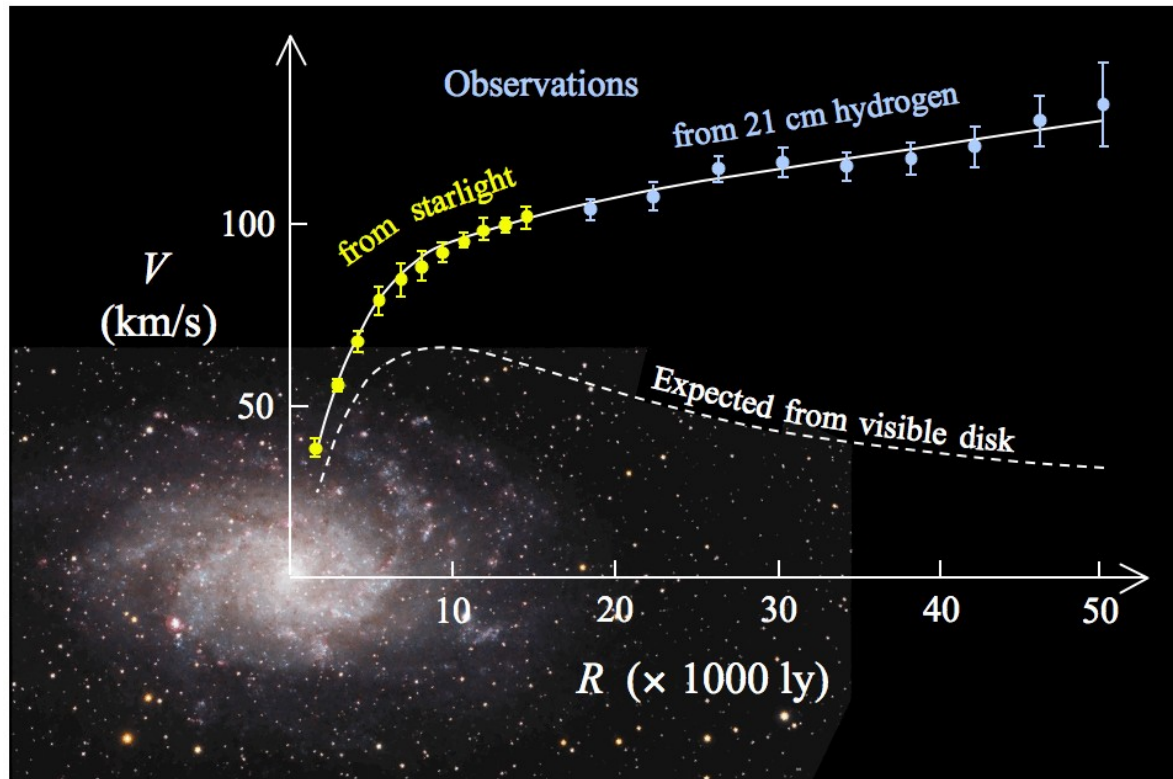
- Five times more dark than visible matter in our universe
- Compelling amount of evidence

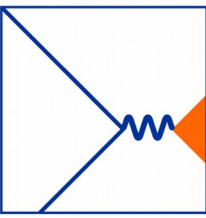




Dark Matter

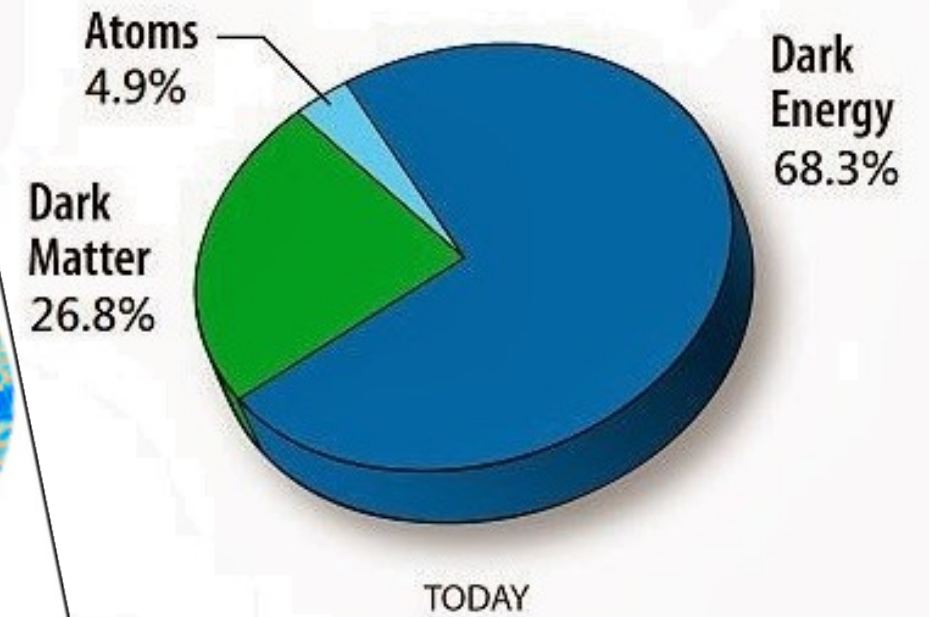
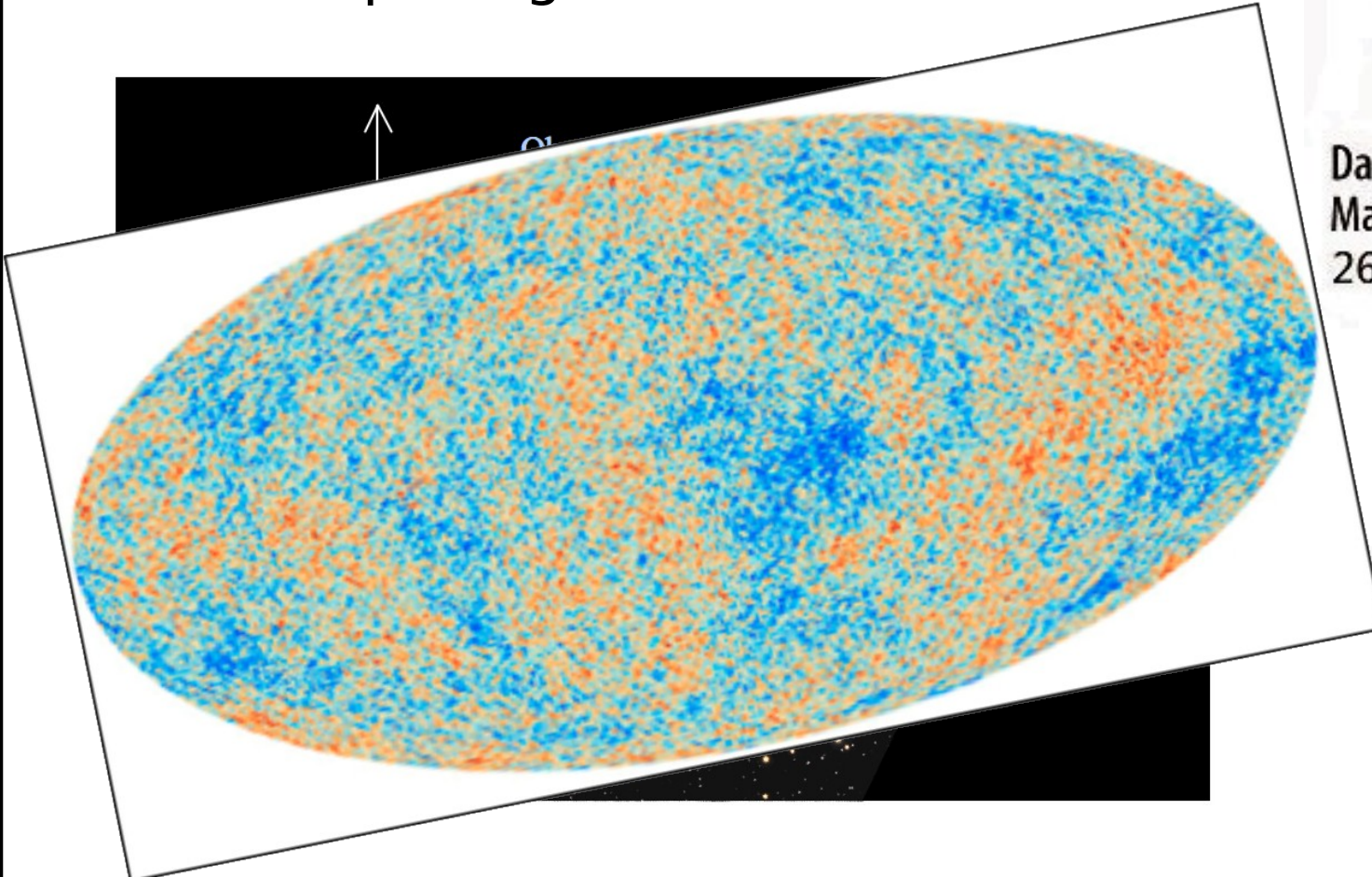
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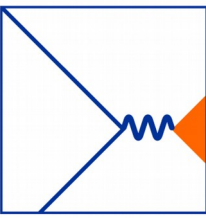




Dark Matter

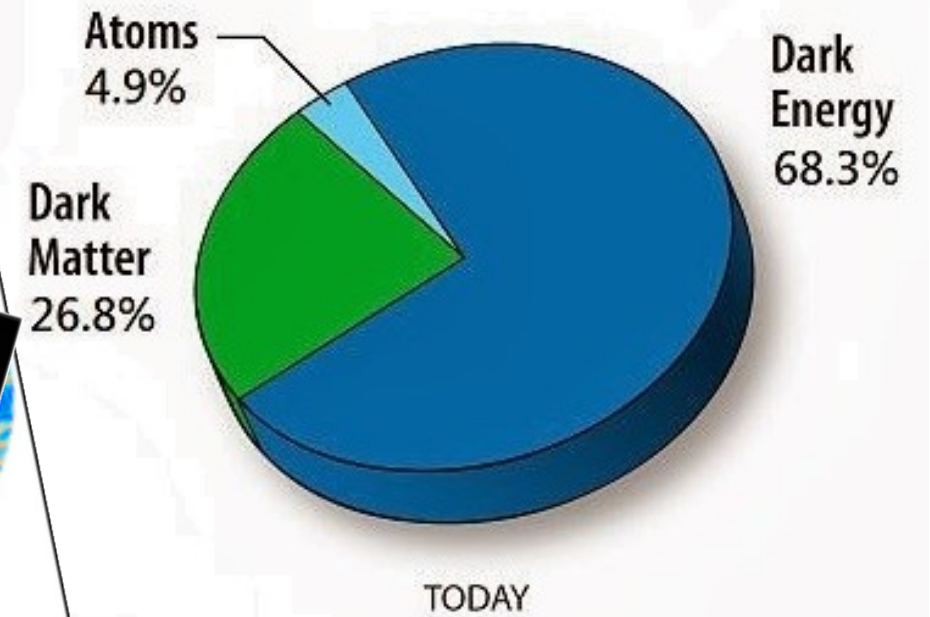
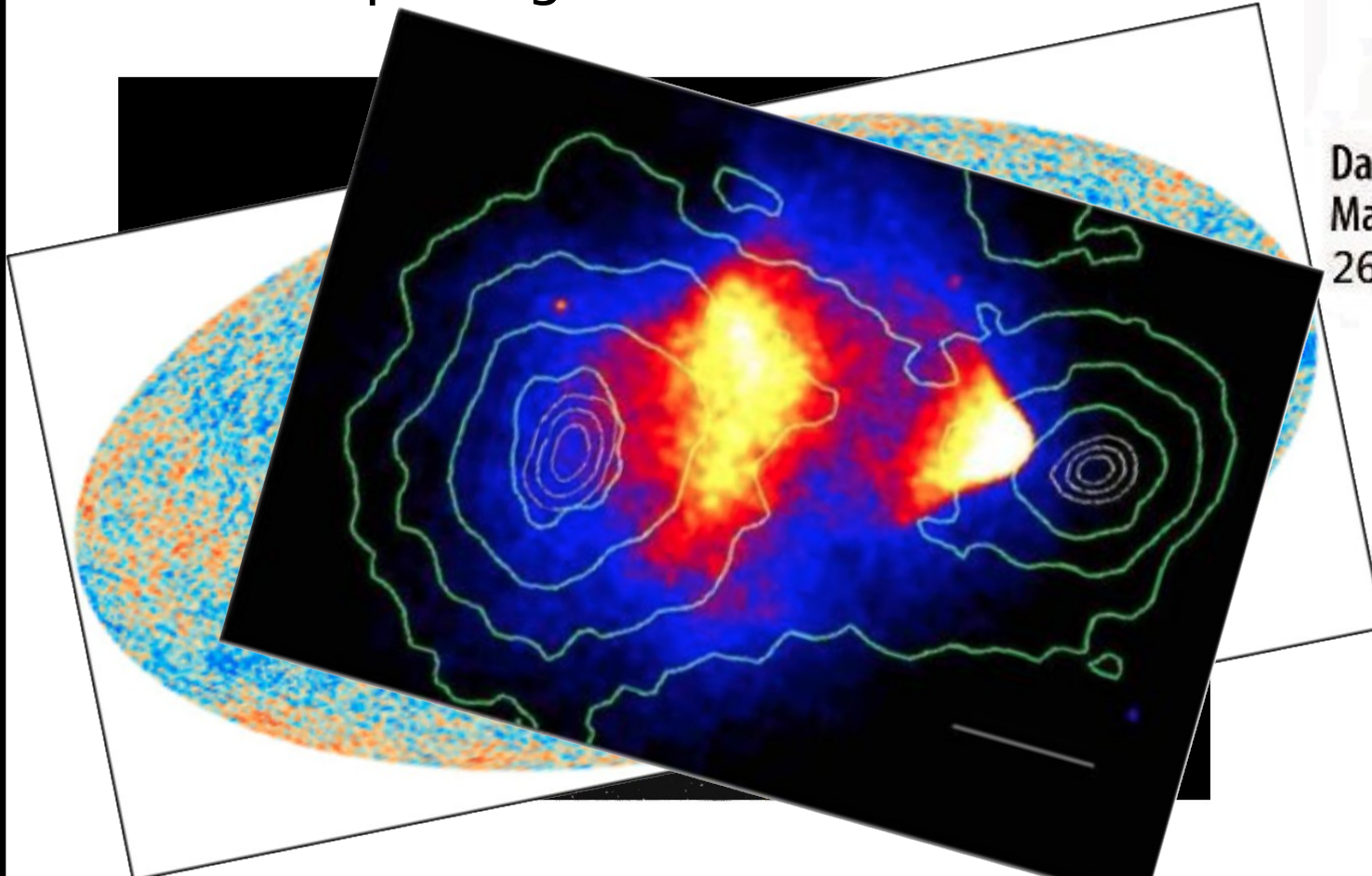
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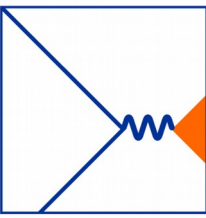




Dark Matter

- Five times more dark than visible matter in our universe
- Compelling amount of evidence





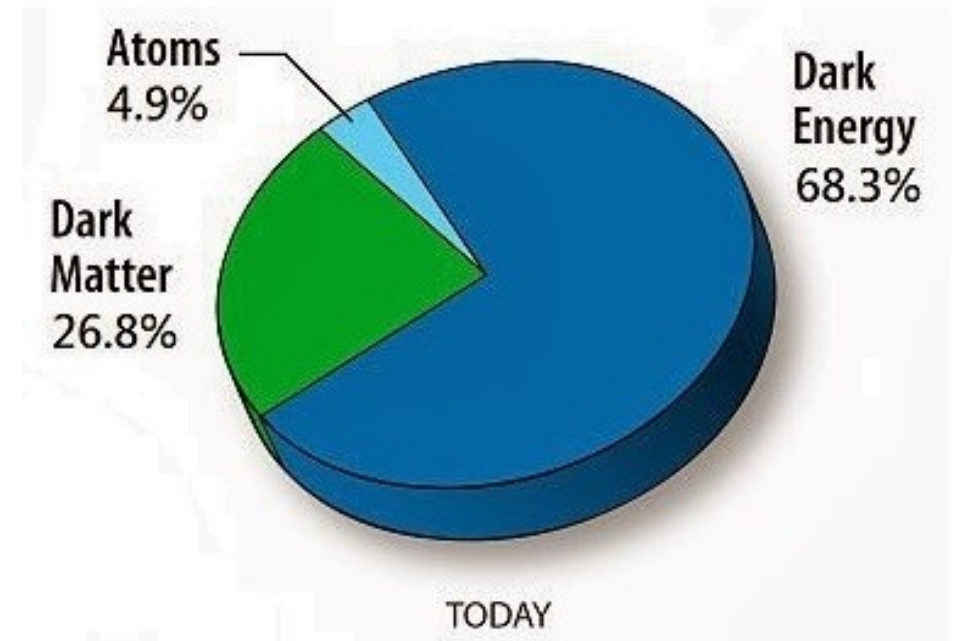
Dark Matter

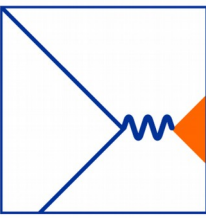
- Five times more dark than visible matter in our universe
- Compelling amount of evidence

Only Gravitational evidence



No info about DM nature

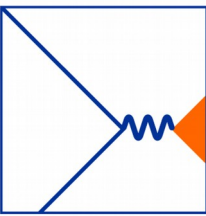




Open questions

- How does dark matter couple to the SM?

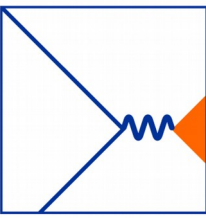




Open questions

- How does dark matter couple to the SM?
- How is it produced in the early universe?



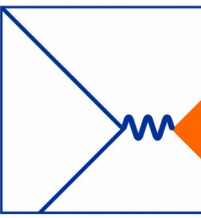


Open questions

- How does dark matter couple to the SM?
- How is it produced in the early universe?
- How can we detect it?

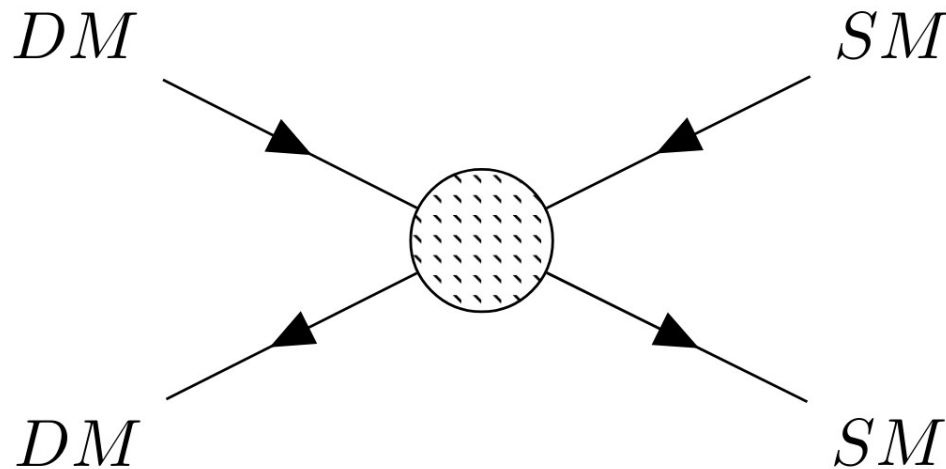


Weakly Interacting Massive Particle

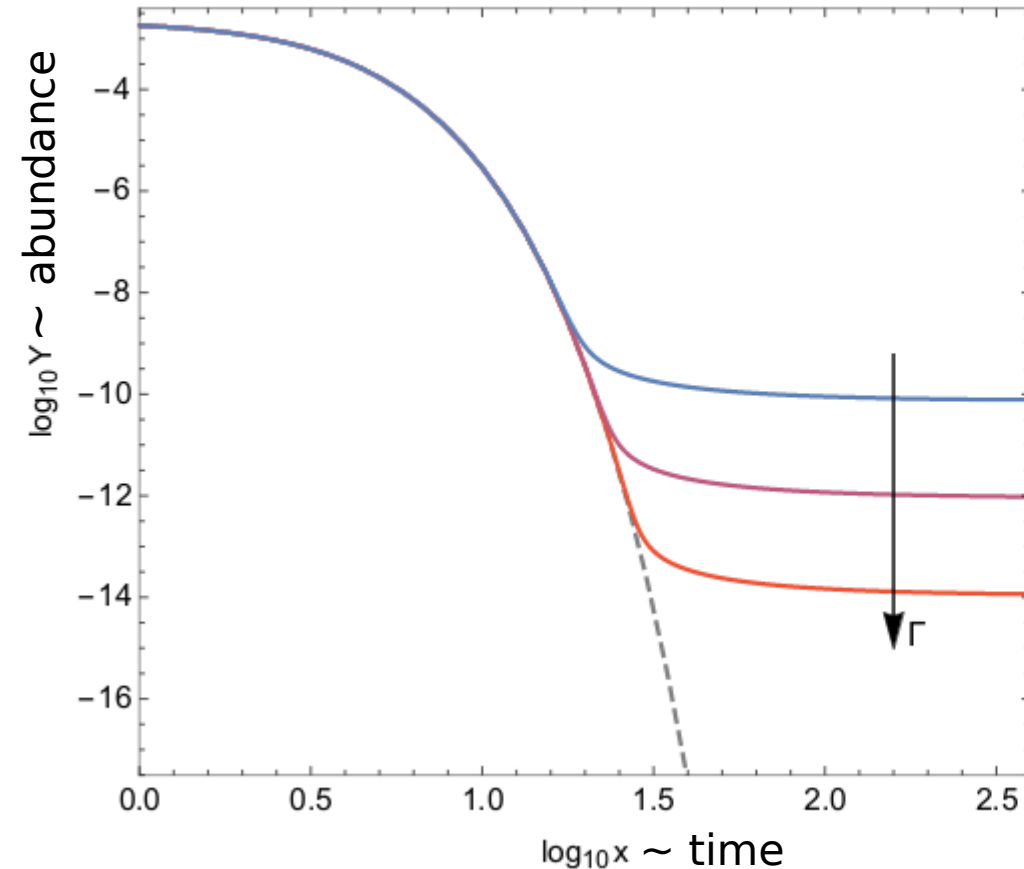


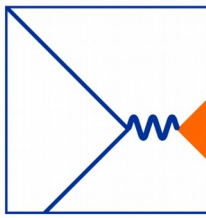
[Lee & Weinberg 1977]

- DM annihilations happening fast
- DM in chemical equilibrium
- Freeze-out when expansion rate of the universe catches up



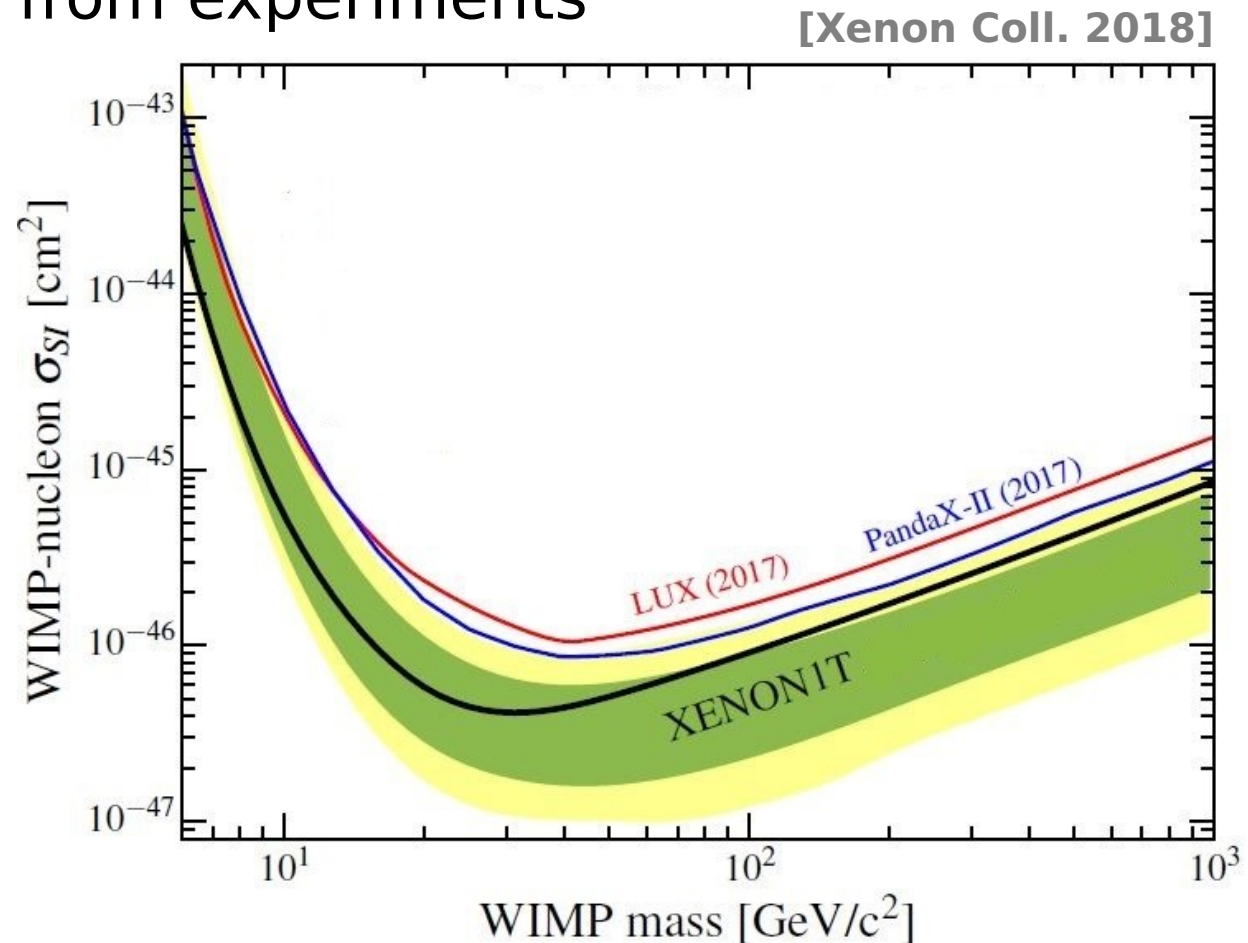
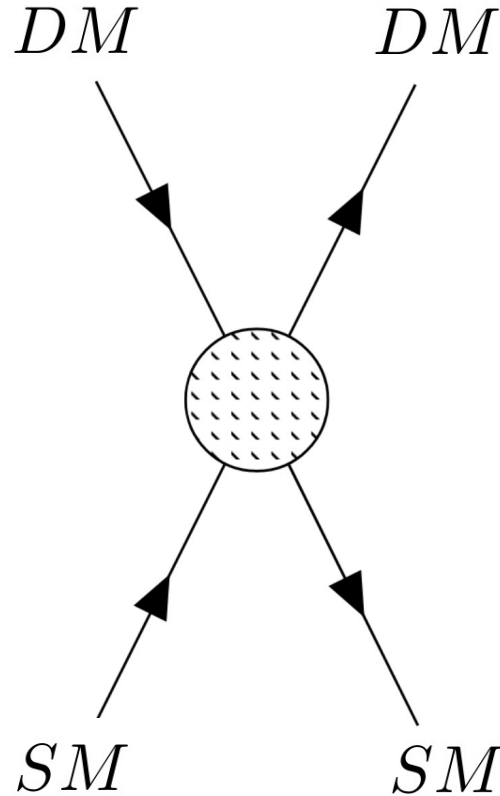
[Bernal 2017]





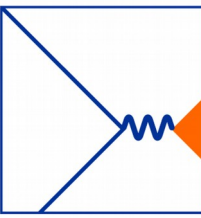
Direct detection constraints

- Same process setting relic abundance responsible for DD signal
- Strong constraints from experiments

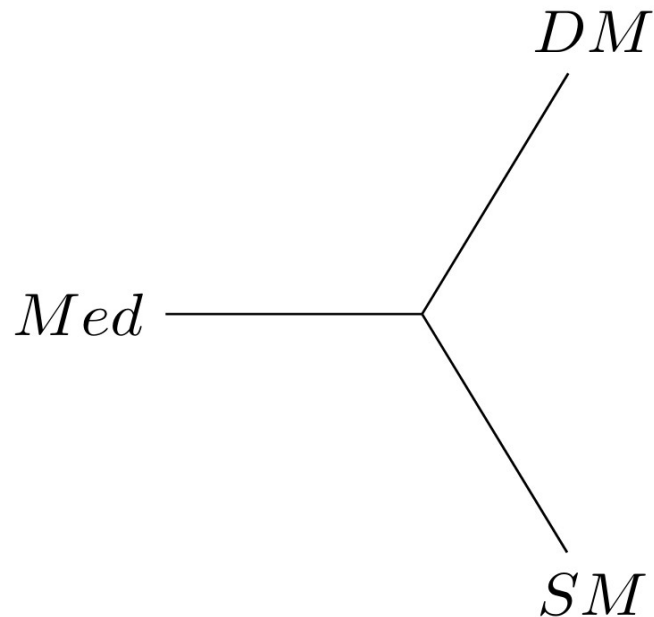


Feeble Interacting Massive Particle

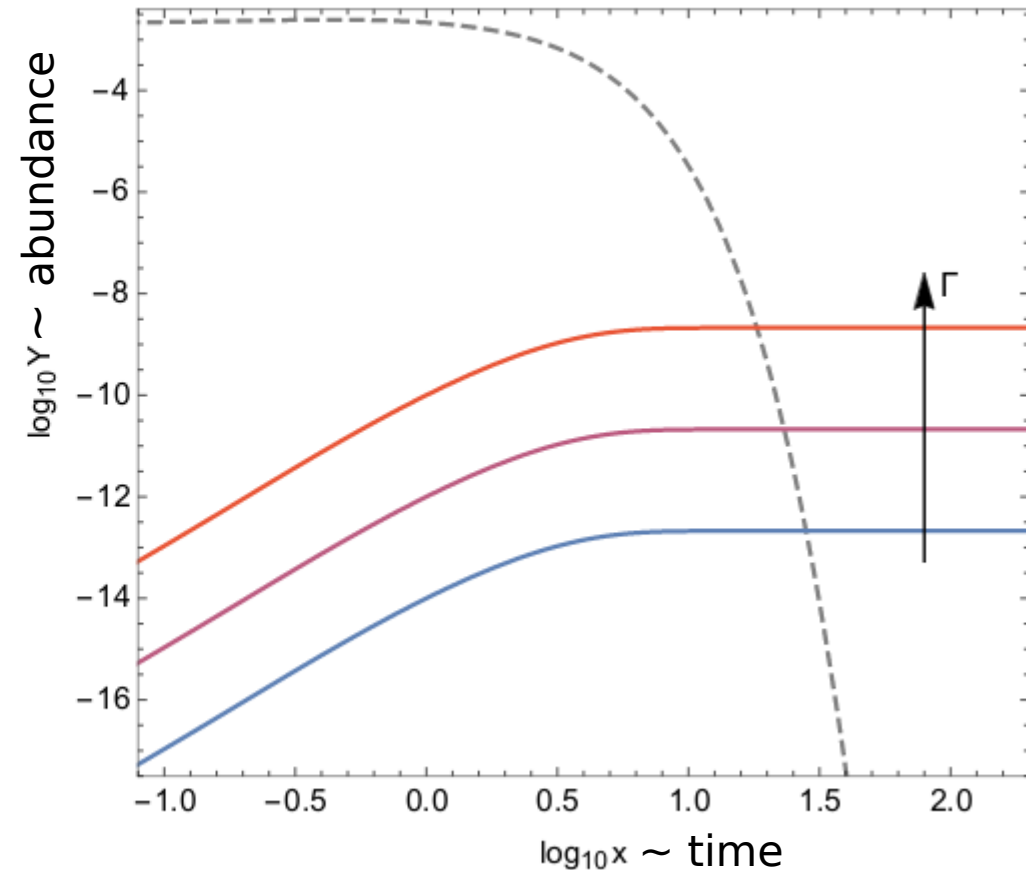
[Hall 2009]

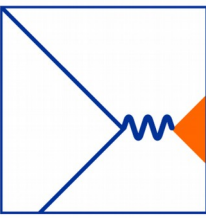


- Dark matter interacting feeble with the SM
- Annihilations are never fast
- Never in equilibrium
- Gradual production \rightarrow freeze-in



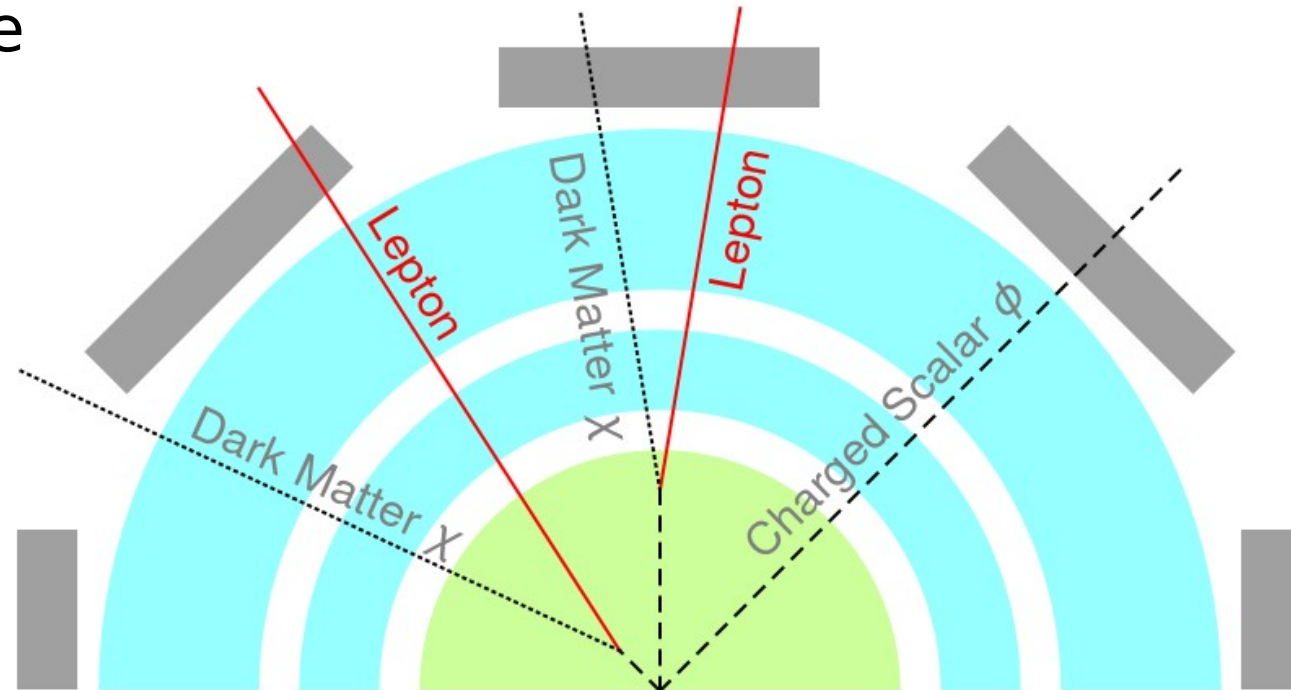
[Bernal 2017]

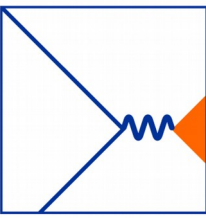




Long Lived Particles

- Mediator is charged under the SM
- Can be produced in pp collision
- Feeble interactions gives rise to LLPs
- Strong link between lifetime and production rate
→ Very predictive





Summary

- Nature of DM still unknown
- WIMP produced through freeze-out mechanism
- Strong constraints from direct detection experiments
- Alternative: FIMP produced through freeze-in
- Gives rise to Long Lived Particles signatures at the LHC