



Universidade do Minho  
Escola de Ciências



LABORATÓRIO DE INSTRUMENTAÇÃO  
E FÍSICA EXPERIMENTAL DE PARTÍCULAS  
*partículas e tecnologia*

# Searching for Dark Matter with the ATLAS Detector using Unconventional Signatures

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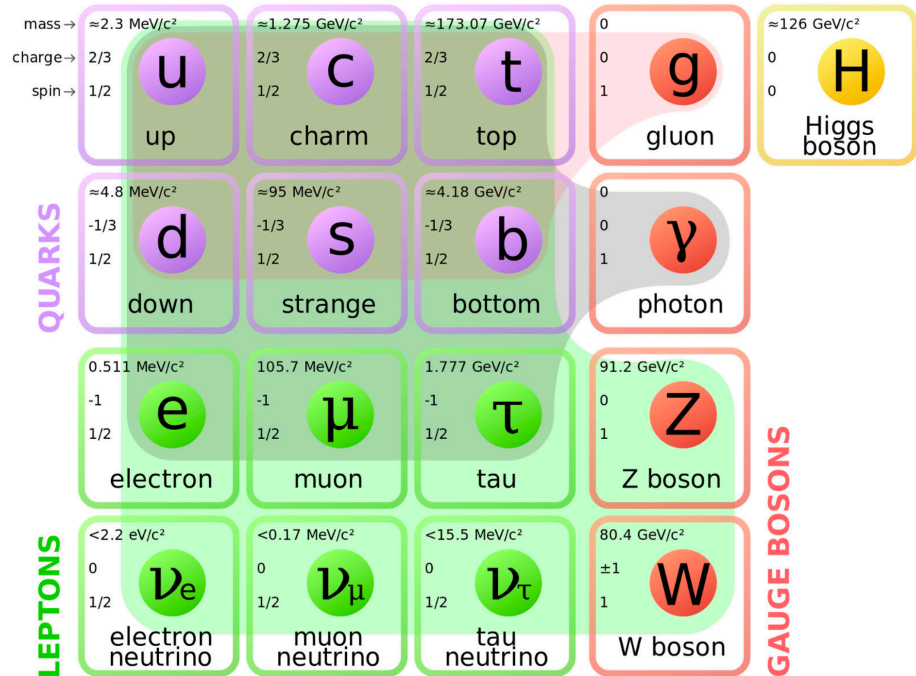
Prof. Marek Taševský

06/09/2021

# Theoretical Framework

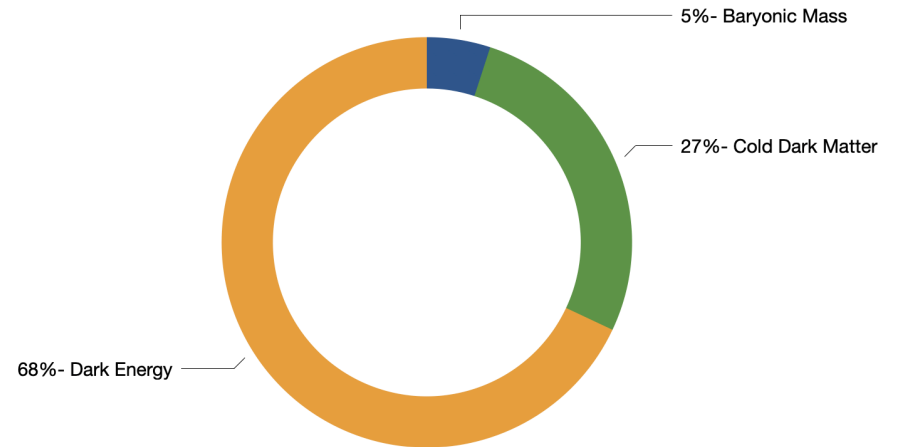
## Standard Model

- Well-tested model that explains successfully most of the present experimental results with high precision.

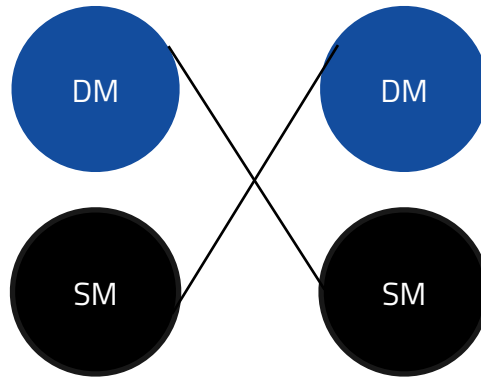


# Dark Matter

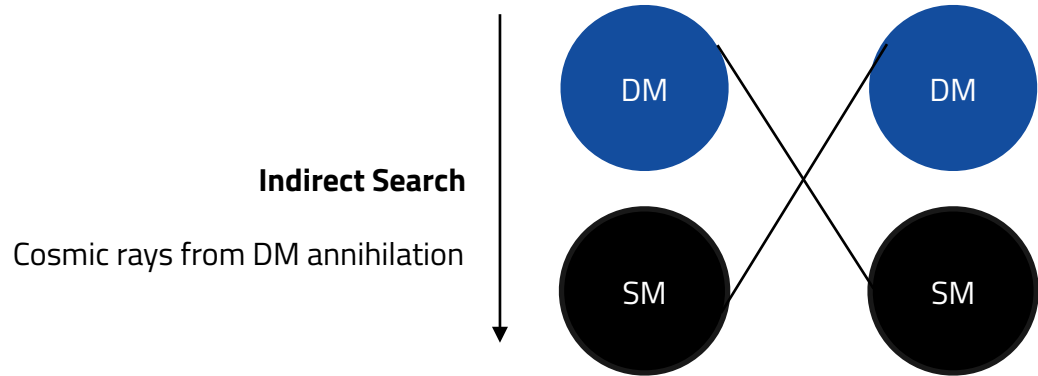
- Major matter component of our Universe;
- Does not interact with the electromagnetic field;
- Interacts very little with baryonic matter.



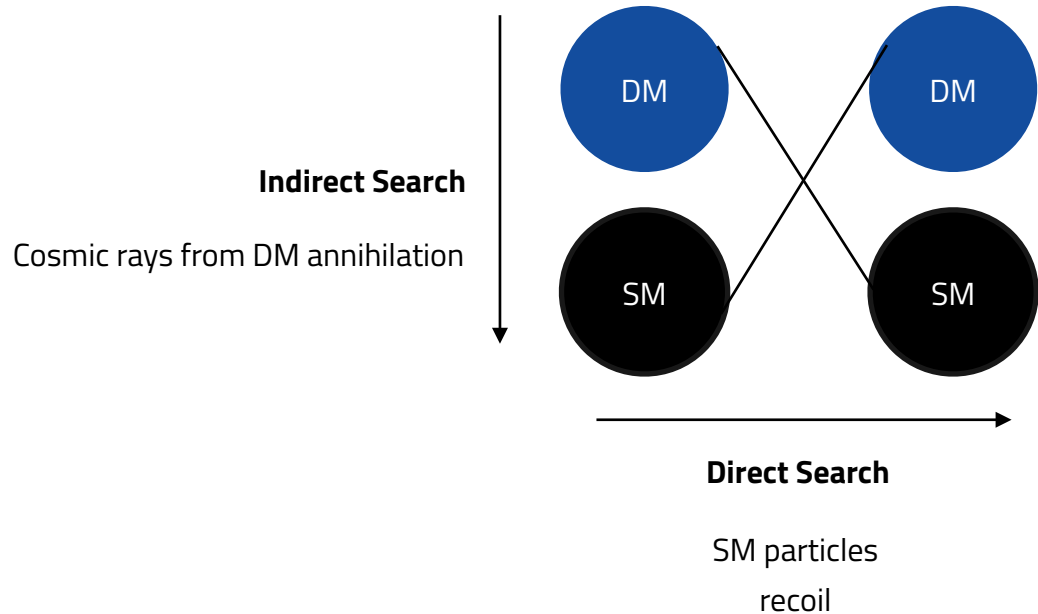
# Dark Matter Searches



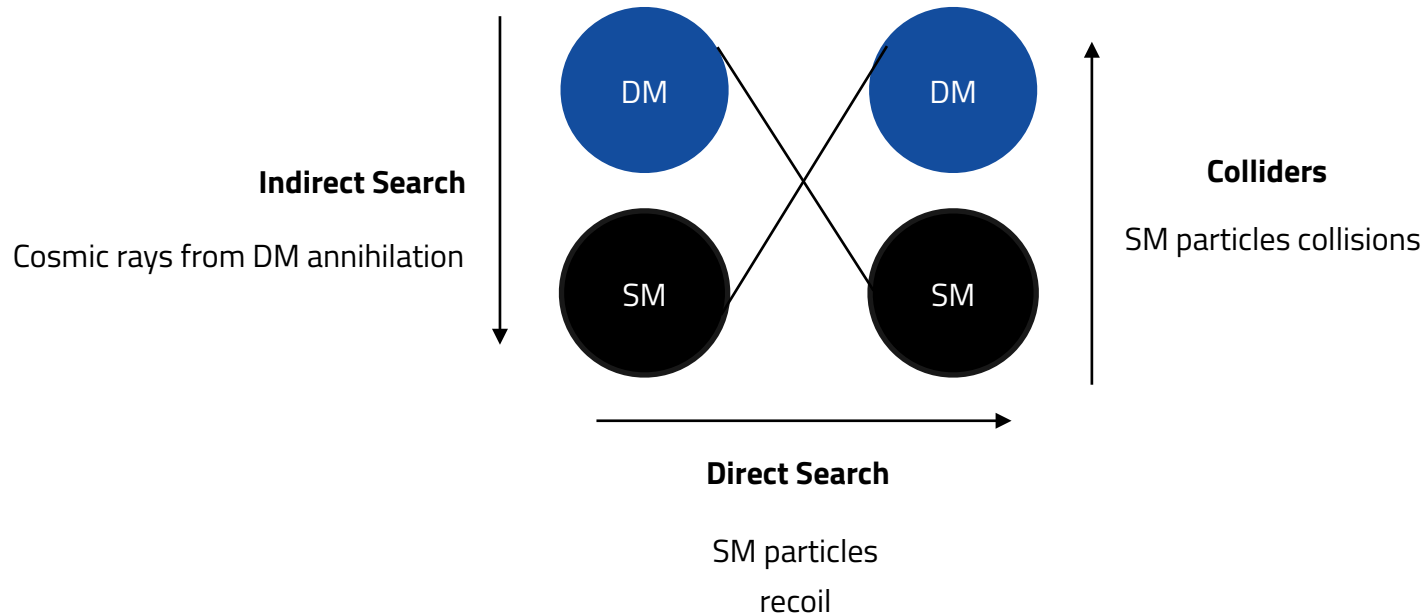
# Dark Matter Searches



# Dark Matter Searches



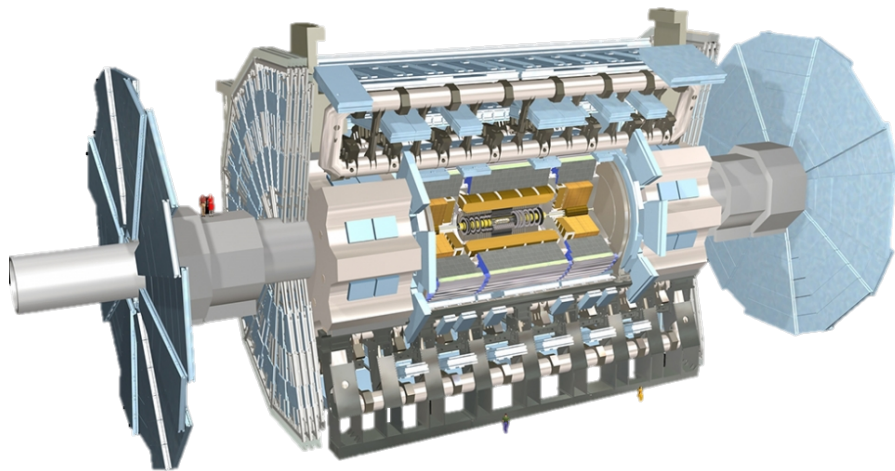
# Dark Matter Searches



# Experimental Setup

## CERN and LHC

- Largest particle accelerator in the world;
- Consists of a 27 km ring;
- Four major detectors:
  - ATLAS;
  - CMS;
  - ALICE;
  - LHCb.



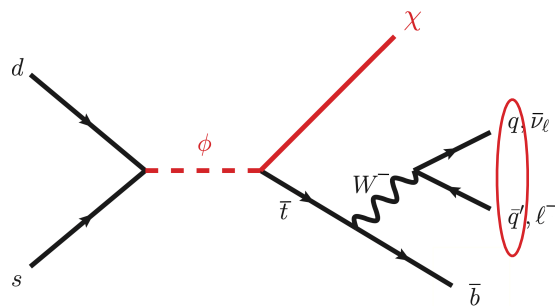
G. Aad et al., "The ATLAS Experiment at the CERN Large Hadron Collider," JINST, vol. 3, p. S08003, 2008.



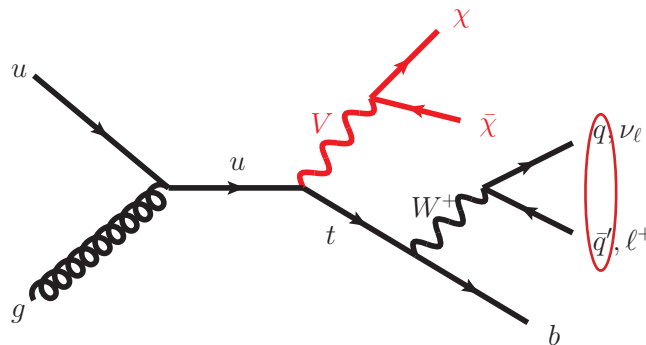
# Dark Matter

## MonoTop Signature

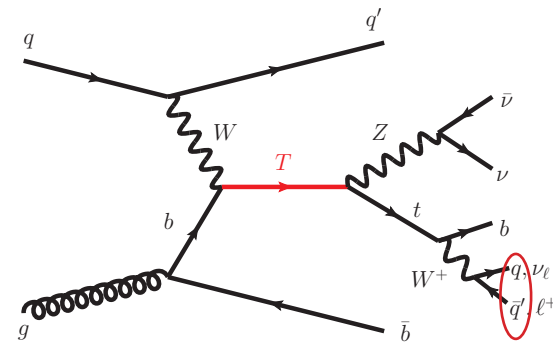
- Looking for **top quark + large missing energy**;
- Different** models:
  - DM Monotop: Resonant and Non-Resonant;
  - VLQ Production
- Only **hadronic channels** considered.



Resonant Model



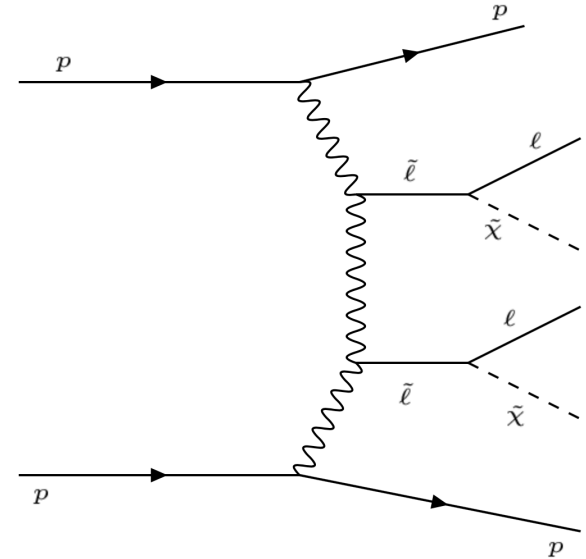
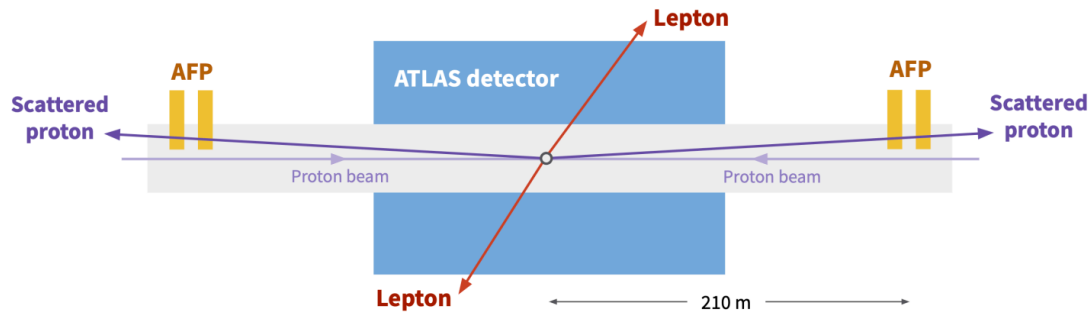
Non-Resonant Model



Single VLQ

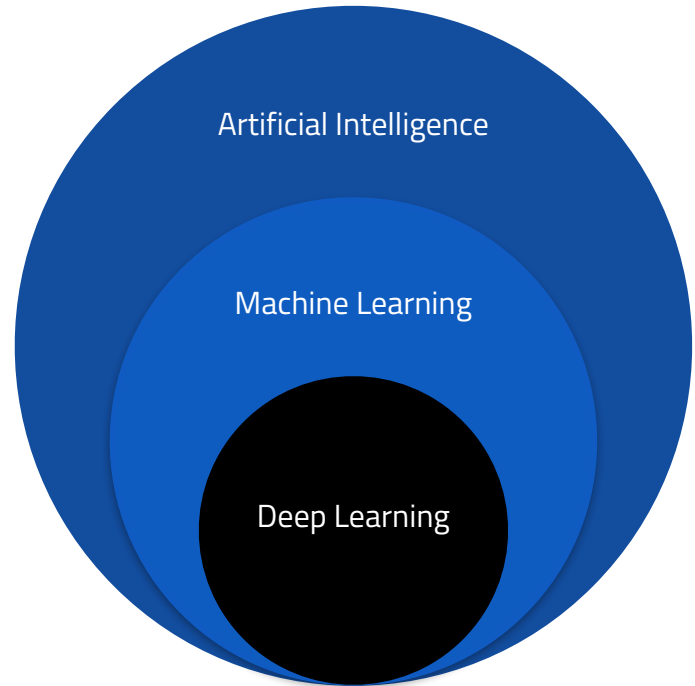
# ATLAS Forward Proton detector

## Search for Dark Matter - Future Work



# Machine Learning Techniques

ML is the science of computer algorithms that improve automatically through experience.



**Thank you!**