Mono-H Dark Matter Search

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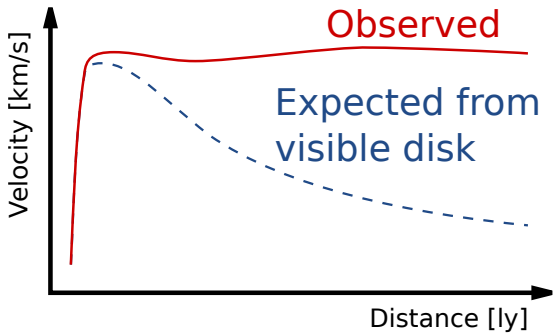
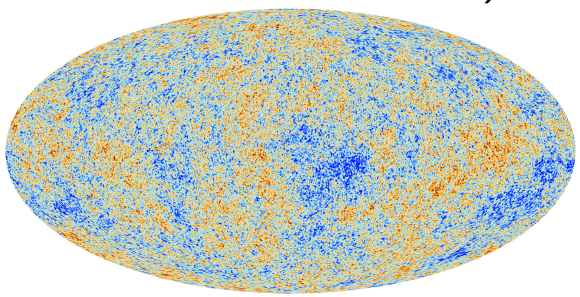
Motivation for Dark Matter (DM)

Presence of dark matter inferred from the observation of its gravitational interactions.

rotation curves of spiral galaxies



structure formation in the early universe ($\approx 25\%$ of the matter in our universe is DM)



gravitational lensing effect of galaxy clusters

Properties of Dark Matter

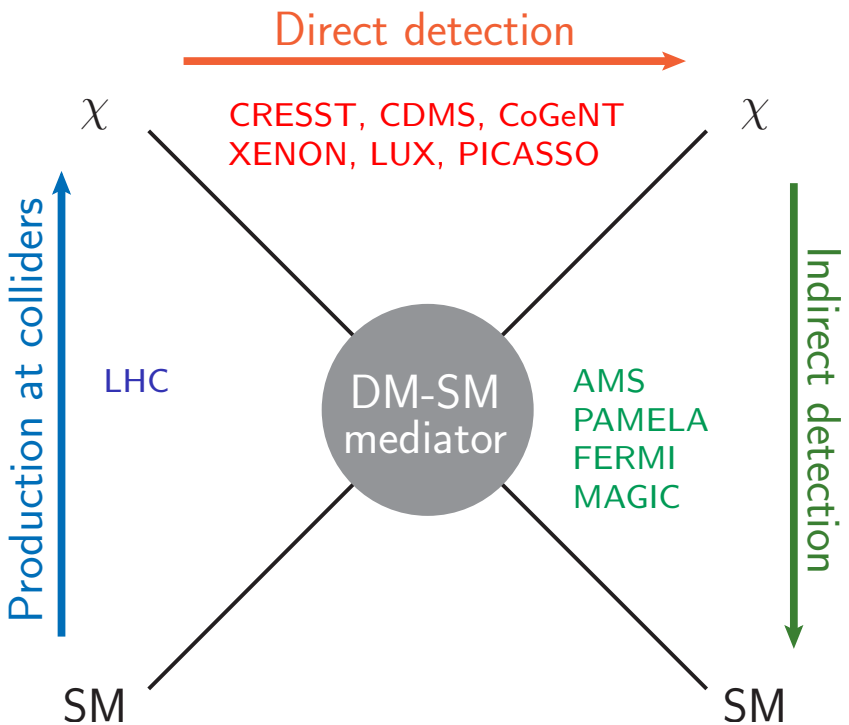
Requirements:

- massive
- stable
- electrical neutral
- weakly interacting

Candidates:

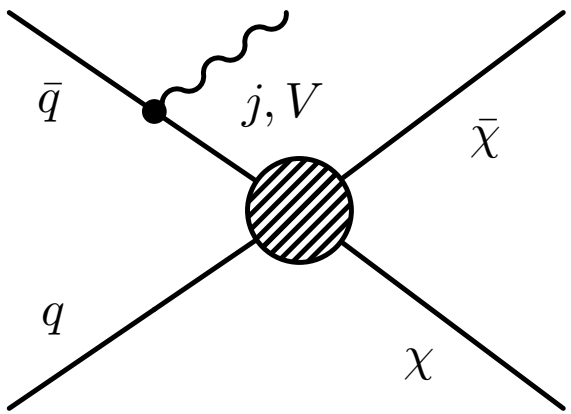
- WIMPs, Axions, sterile Neutrinos

Complementary dark matter experiments:



At colliders like the LHC, WIMPs are produced in pairs.

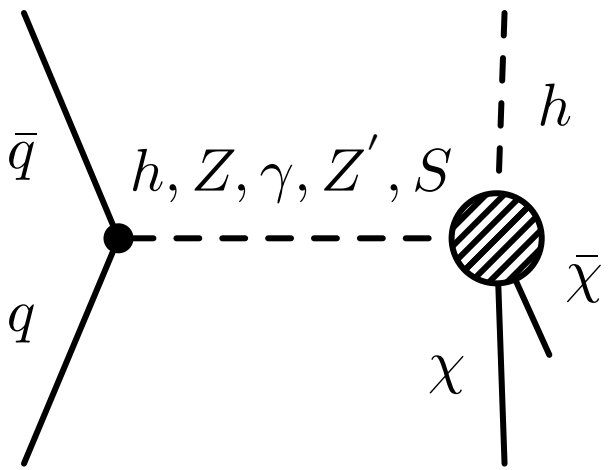
- DM particles ($\chi\bar{\chi}$ pairs) escape undetected
- look for events with a large imbalance of energy in the transverse plane ($E_{\mathrm{T}}^{\mathrm{miss}}$)
- additional (triggerable) particles in the final state are needed:
  energetic jet, $V = \gamma, W, Z$ or a Higgs boson

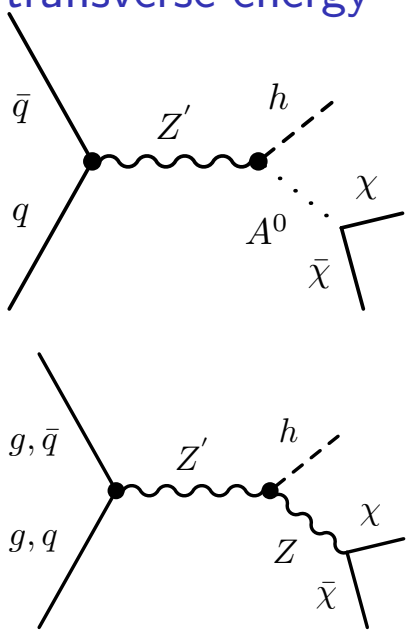


The Mono-H Search

- new signal channel for WIMP searches
- SM Higgs ISR strongly suppressed due to the small couplings to light quarks
- Higgs boson produced in association with WIMP pair according to EFT or simplified models via intermediate particles
- $H \to b\bar{b}$ channel because of highest $BR(H \to b\bar{b}) \approx 0.577$

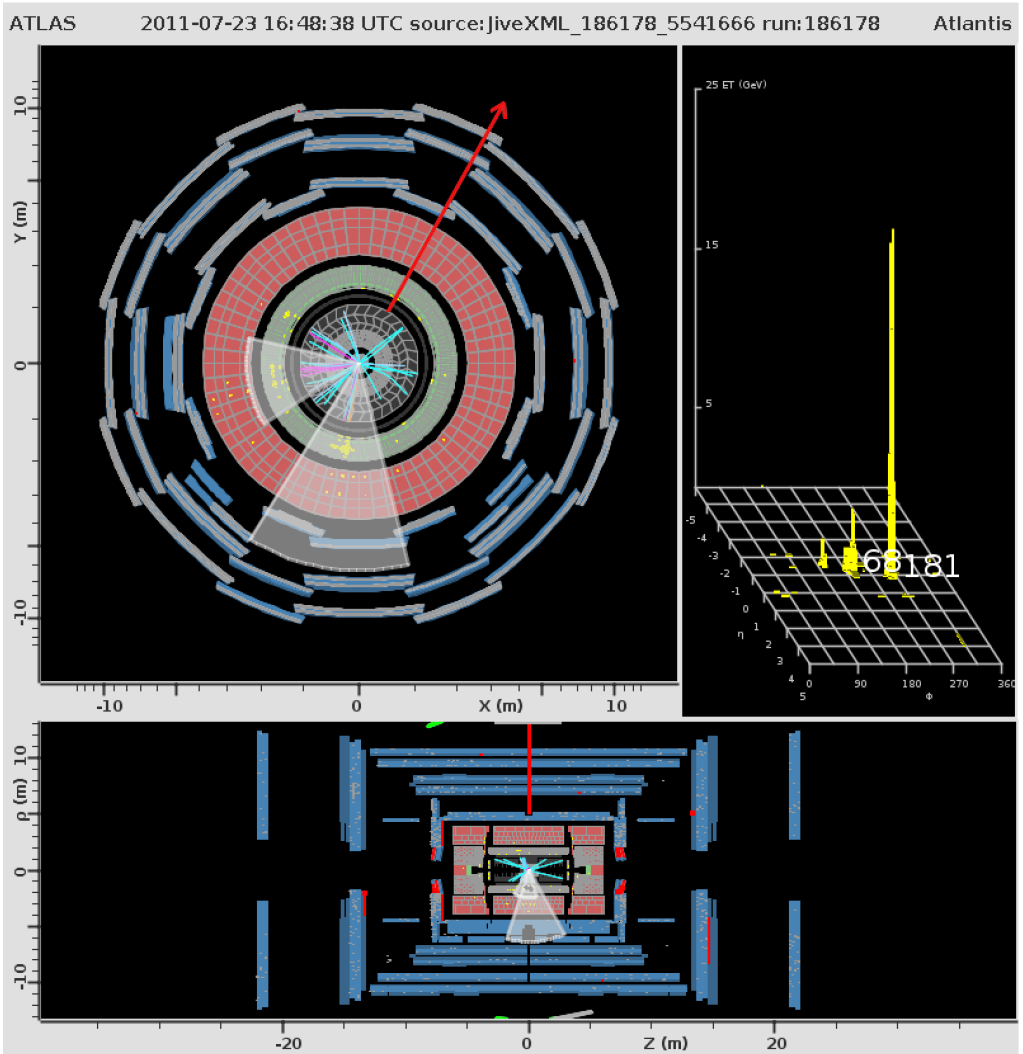
Final state with 2 b-jets and large missing transverse energy





- Z' a heavy Z boson
- S a new scalar particle
- A^0 is a heavy pseudoscalar with a large BR to DM

Event Selection & Backgrounds



Resolved or boosted channel

- massive mediator particles can produce a highly boosted Higgs boson
- either 2 b-tagged jets or 1 fat-jet recoiling against a large E_T^{miss}
- no leptons
- $E_T^{\text{miss}} > 100$ or 300 GeV
- $\Delta\phi_{\text{min}}(E_T^{\text{miss}}, p_T^{\text{jet}}) > 1.0$
- 90 GeV $< m_{b\bar{b}} <$ 150 GeV

Backgrounds processes:

- irreducible background $Z \to \nu\bar{\nu} +$ jets
- reducible backgrounds: $W +$ jets, $Z +$ jets, diboson, single top and $t\bar{t}$ process