Search for new phenomena in mono-X final states using pp collision data collected in Run-2 by the ATLAS experiment at the LHC

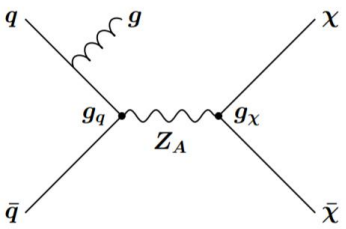
Sergio González Fernández
IFAE, Barcelona

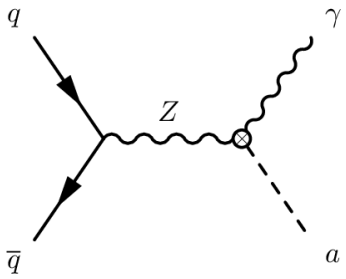
on behalf of the ATLAS Collaboration

Introduction

- Cosmological and astrophysical observations point to the existence of a form of matter known as **Dark Matter** (DM) that accounts for about 27% of the total mass-energy of the Universe.
- If DM interacts with the Standard Model, it can be produced at the LHC and **detected indirectly** via initial state radiation (ISR) of the incoming particles or by identifying some Standard Model (SM) particles produced in association with DM.
- Searches focused in these type of signatures are commonly known as **mono-X** searches. For the rest of this presentation mono-X will refer to **monojet** and **monophoton** searches.

Diagram for the pair-production of weakly interacting massive particles (WIMPs) χ, with an exchanged mediator Z_A in the s-channel. In this process, the DM particles escape the detector as invisible but can be detected indirectly with an ISR gluon that will hadronize yielding an event with a jet and large momentum imbalance. These type of signatures are searched in the **monojet** analysis.



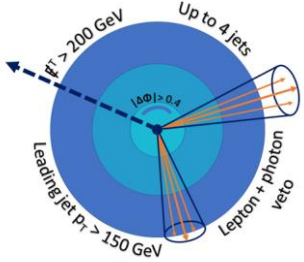


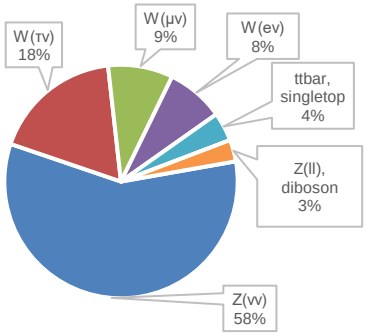
This diagram shows the production of an Axion Like Particle (ALP) in association of a photon through the mediation of a Z boson in the s-channel. If the ALP is considered invisible, the event can be identified with a single photon event with large momentum imbalance. These type of signatures are searched in the **monophoton** analysis.

- Many theoretical models for new physics propose candidates for Dark Matter. These include simplified WIMP models, SUSY interpretations, Large Extra Dimensions and Axion Like Particles.

Analyses overview

Monojet



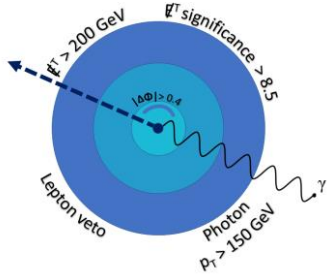


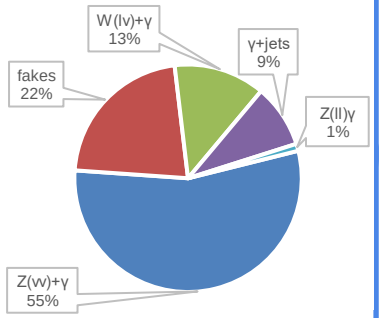
- **Monojet** and **monophoton** searches focus on signatures with large missing transverse momentum associated to jets or photons, respectively.
- The signal region in both analyses focuses on cutting the E_T^{miss} and the p_T of the associated particle (**jets**/**photon**). Both apply a lepton veto.
- In both analyses the jet/photon is expected to be **recoiling** of the dark matter particles so a $\Delta\phi$ cut to the E_T^{miss} is also applied.
- The **dominant background** arises from events with a **Z boson decaying into neutrinos**. If jets or photons are produced in ISR the event becomes indistinguishable from a monojet/photon signal event.
- The **background contamination** in the signal region is computed using **Control Regions**, which are defined in an orthogonal but similar way as the Signal Region.

- Theoretical prescriptions for reweighting **V+jets** processes yield **NNLO (QCD) and NLO+Sudakov logs (EWK) precision.**

- A cut on E_T^{miss} **significance** is introduced to help **reduce** the contamination from the γ**+jets** background.

Monophoton

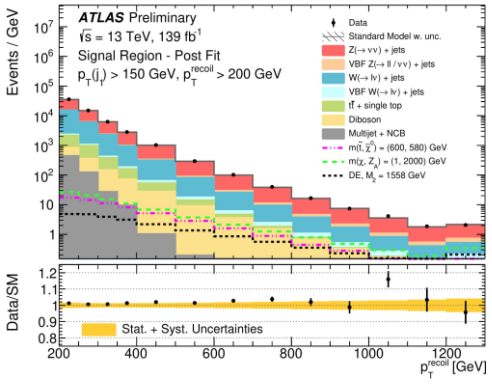


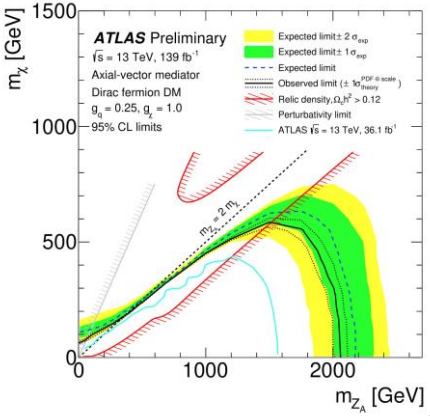


Results and Interpretations

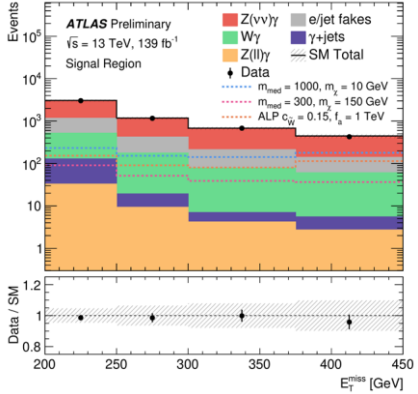
- No significant deviations to the Standard Model predictions is observed and the results are translated into **exclusion limits** for a variety of models with a DM candidate, such as simplified models.

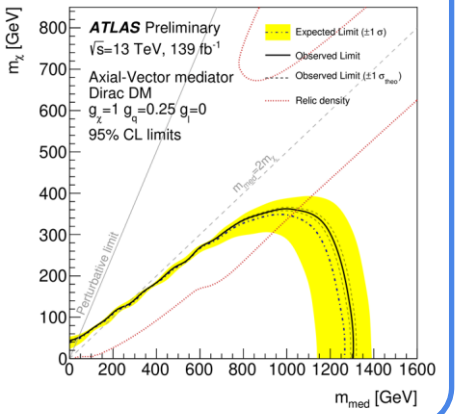
Monojet





Monophoton





- Both analyses consider for the first time setting exclusion limits on a model that describes Axion Lile Particles interactions with the Standard Model.
- The monojet analysis also provides exclusion limits in models related to SUSY, Dark Energy, Large Extra Dimensions and Higgs boson decays to WIMPs.