

# Candidacy Report Outline

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## 1 Intro

- Briefly introduce the proposed DM search channel
- Explain what we hope to achieve with the channel: fit to dark higgs candidate mass to search for above-bkg excess
- If no excess found:
  - Set limits in  $m(s)$ ,  $m(Z')$  phase space
  - Stat combination with hadronic analysis
  - RECAST analysis to enable future re-interpretation of final state with other signal models

## 2 Motivation

### 2.1 Theory

- Briefly review evidence for DM from astrophysics
- Discuss simplified vs. UV complete approaches to DM signal models (ref: 2HDMa whitepaper)
- Describe why simplified models are useful for mono-X models in particular
- Introduce the simplified model used for the search (ref: DESY-17-016)

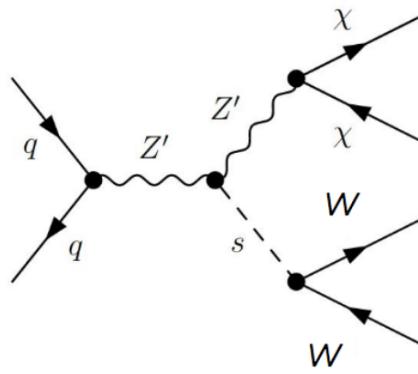


Figure 1: Signal model

## 2.2 Experimental Background

### 2.2.1 Re-interpretation of mono-H(bb) search for dark higgs mediator

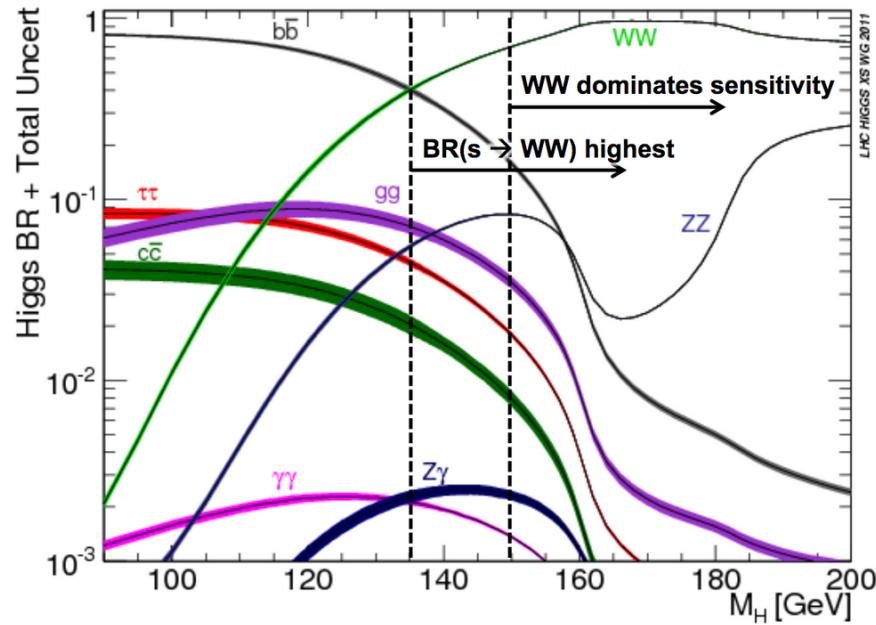


Figure 2: Higgs decay branching ratios as a function of Higgs boson mass

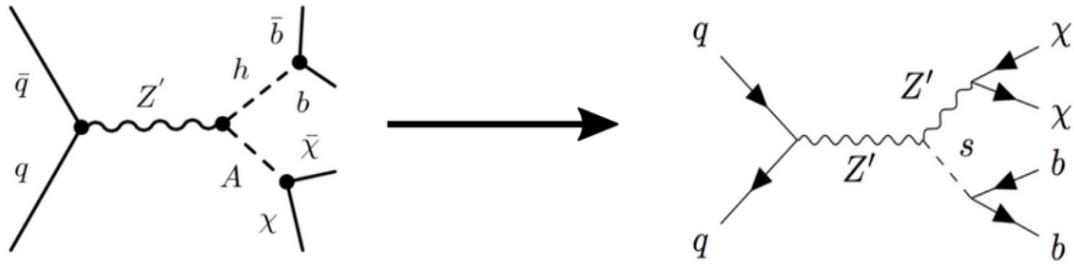


Figure 3: Re-interpretation of mono-H(bb) search using dark higgs boson with floating mass

### 3 Brief intro to LHC and ATLAS detector

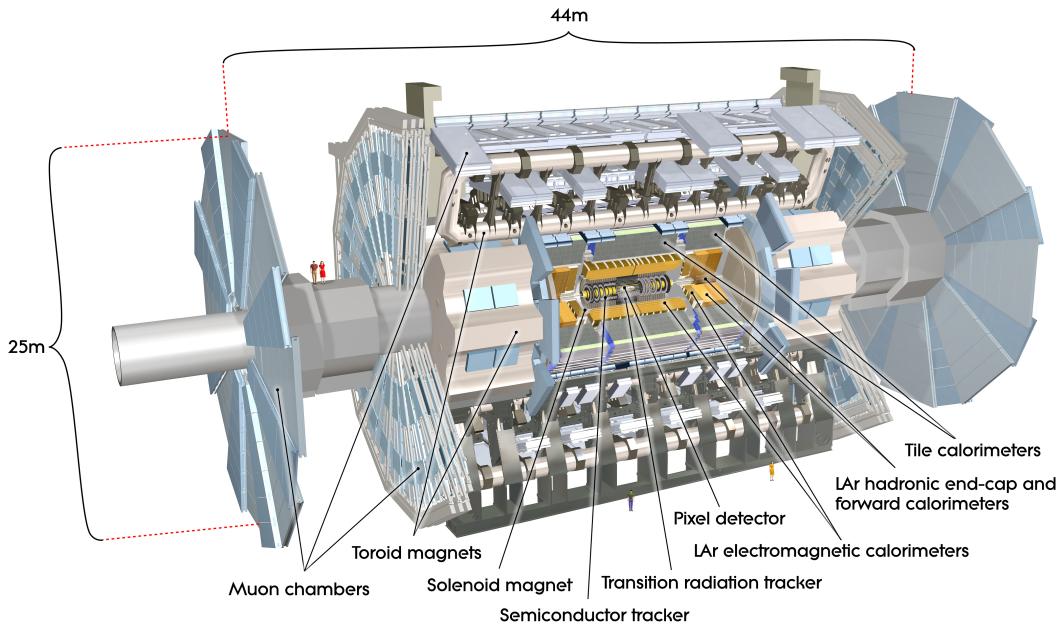


Figure 4: ATLAS detector

- Inner detector
- EM cal
- Had cal
- Muon spectrometer

### 4 Ongoing analysis of mono-s(WW) hadronic channel

- Preselection

- Signal region selection
- Control regions
- Very brief summary of systematics (exp and modeling)
- Sensitivity estimates
- RECAST

## 5 Signal Sample Generation for Semileptonic Channel

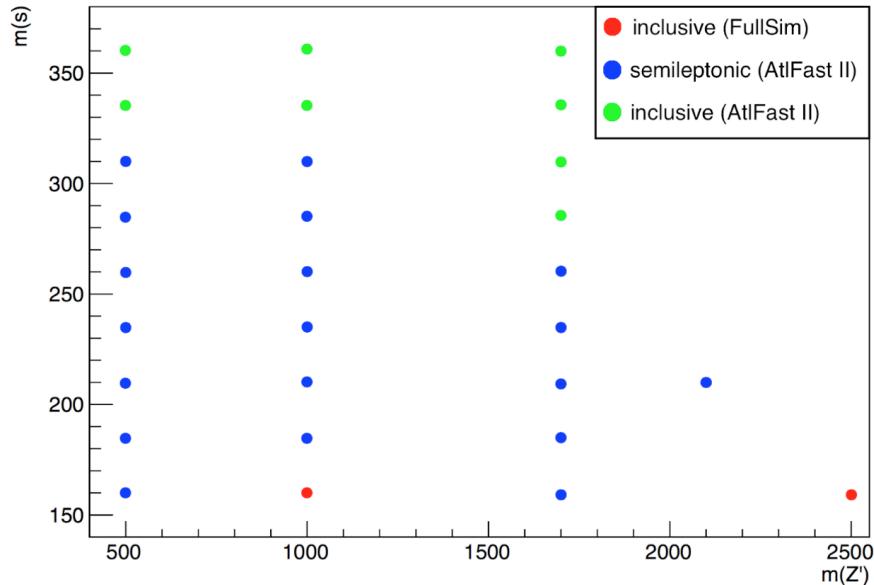


Figure 5: Grid of signal points with respect to dark higgs ( $s$ ) and  $Z'$  boson masses of generated signal sample

- Scan over range of  $m(s)$  and  $m(Z')$
- Need to fix some parameters in the model:
  - $g_q = 0.25$
  - $g_\chi = 1$
  - $\theta = 0.01$
  - $m_\chi = 200 \text{ GeV}$
- Discuss motivation for above choices of fixed model parameters

## 6 Event Selection for Semileptonic Channel

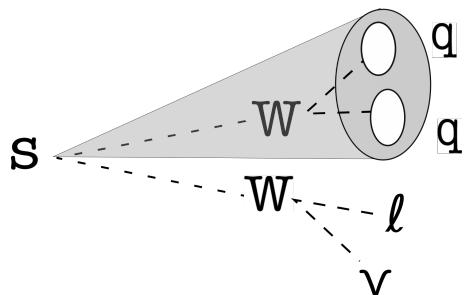
### 6.1 Preselection

- MET trigger passed
- 1 signal lepton
- MET  $\geq 150$  GeV

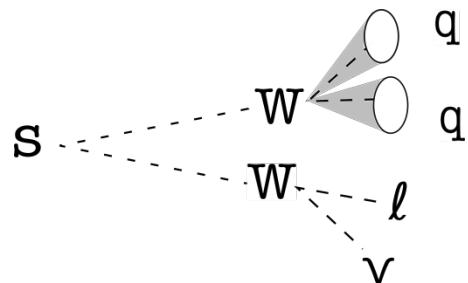
### 6.2 Regions

- Signal region
- W+jets control region
- ttbar control region (if we plan to do one)

### 6.3 Categories



(a) Merged category



(b) Resolved category

Figure 6: Kinematic categories for final state selection

- Resolved category
- Merged category

## 7 Sensitivity Studies

### 7.1 Background on limit setting

### 7.2 HistFitter setup

- Fit variable
- Binning
- Use of temporary systematics proxy

### 7.3 Preliminary sensitivity limits

- Resolved
- Merged
- Combined

## 8 Remaining Work and Outlook

- Study variables to help address  $p_\nu$  vs.  $p_{\chi\bar{\chi}}$  MET ambiguity
- Finalize SR and CR definitions
- Experimental and modeling systematics
- Finalize sensitivity estimates with final systematics
- Statistical combination with hadronic channel for combined limits