BSM Searches in Opposite-signed Dilepton Final States

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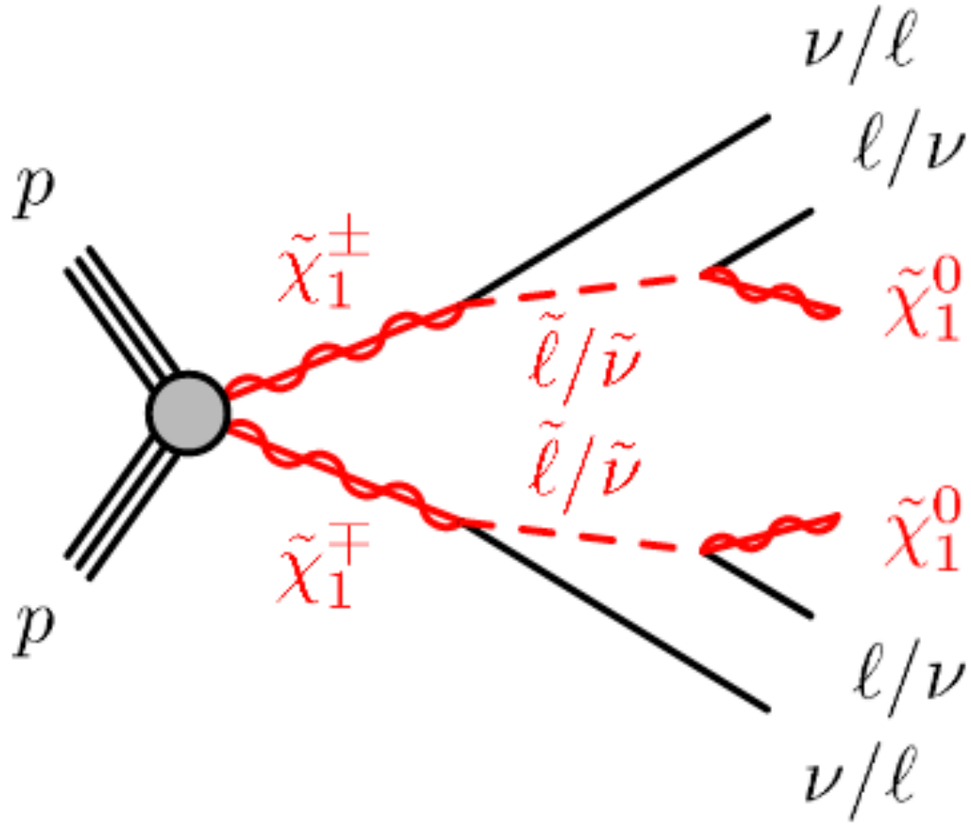
UNIVERSITY of CALIFORNIA
IRVINE

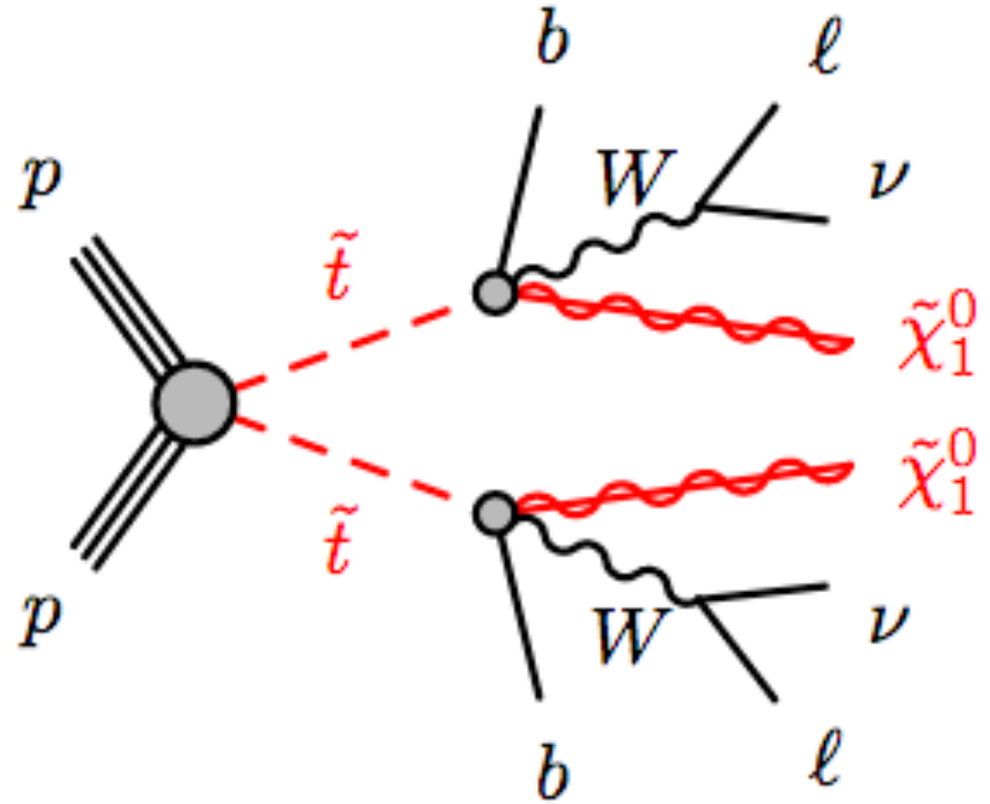
Supersymmetric Searches in 2L Final States

Searches for SUSY via…



…the electroweak interaction

charginos, **neutralinos**, & **sleptons**, oh my!



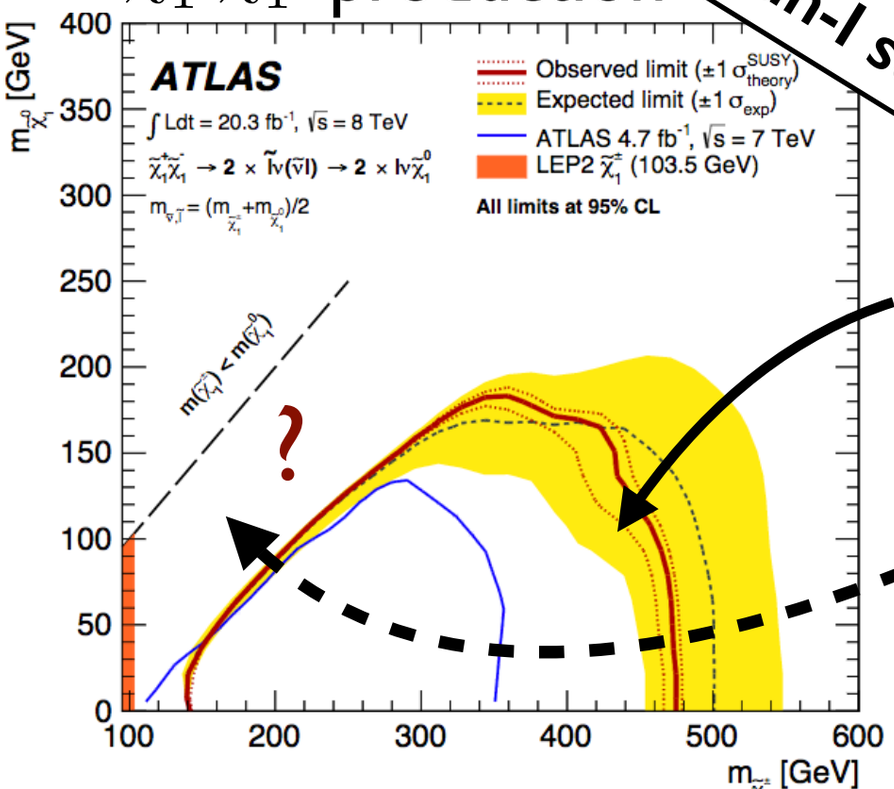
… the strong interaction

in ***compressed*** regions of phase space using ***novel*** techniques

Compressed Scenarios

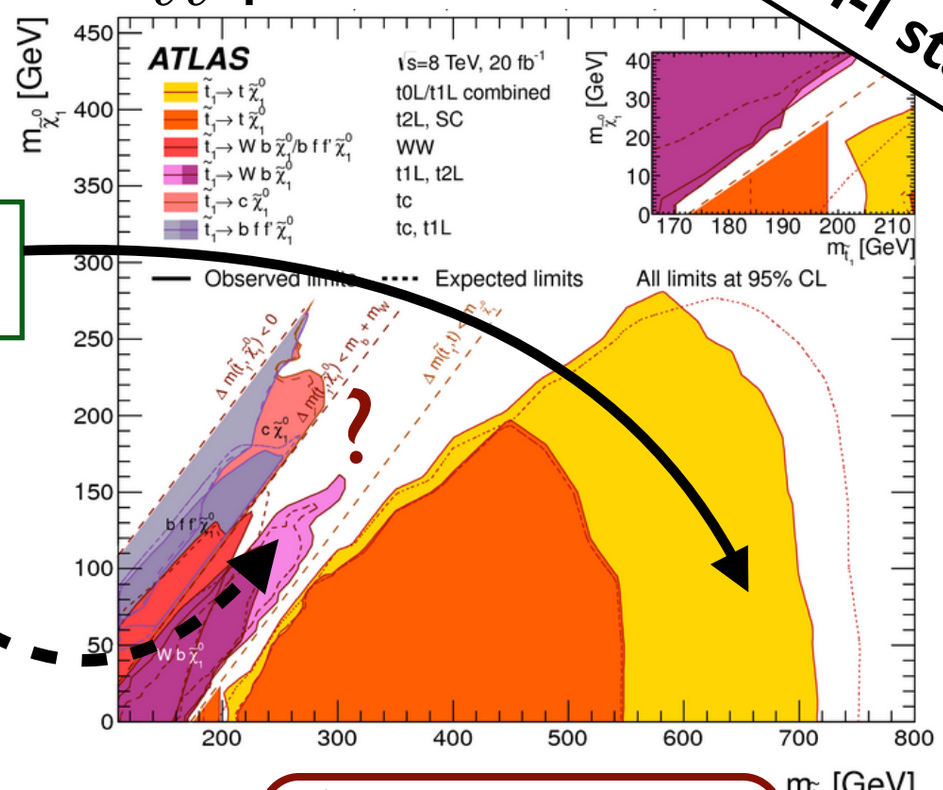
$\tilde{\chi}_1^{\pm}\tilde{\chi}_1^{\mp}$ production

Run-I status



$\tilde{t}\tilde{t}$ production

Run-I status



we got these areas covered

but what about here?

$\Delta m \rightarrow 0$

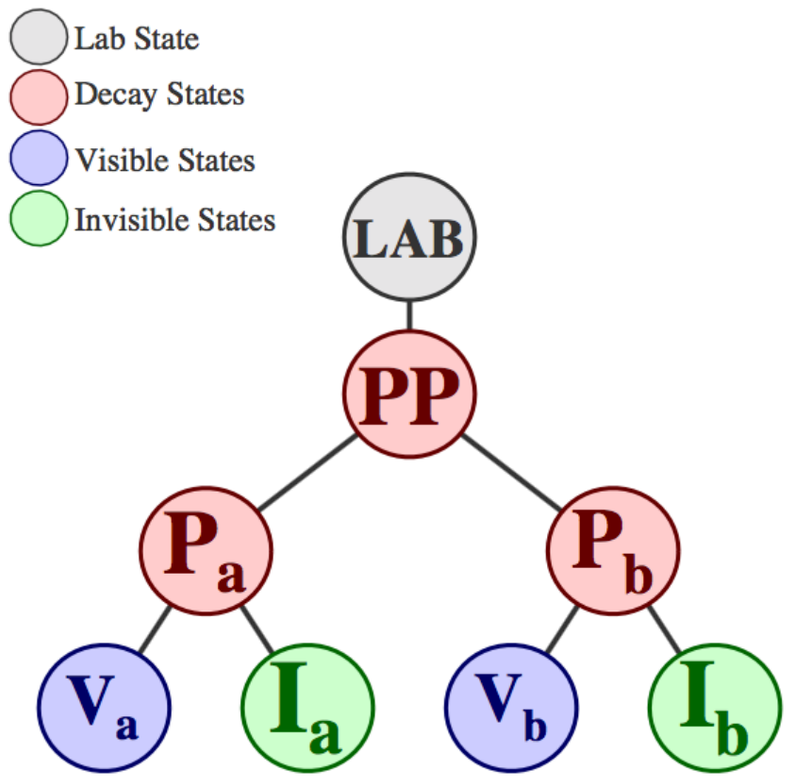
$\Delta m < m_{top}$

few kinematic handles to distinguish signal from background!

For both topologies use the **Recursive Jigsaw (RJ)*** technique to enhance signal sensitivity

*https://arxiv.org/abs/1705.10733

Recursive Jigsaw



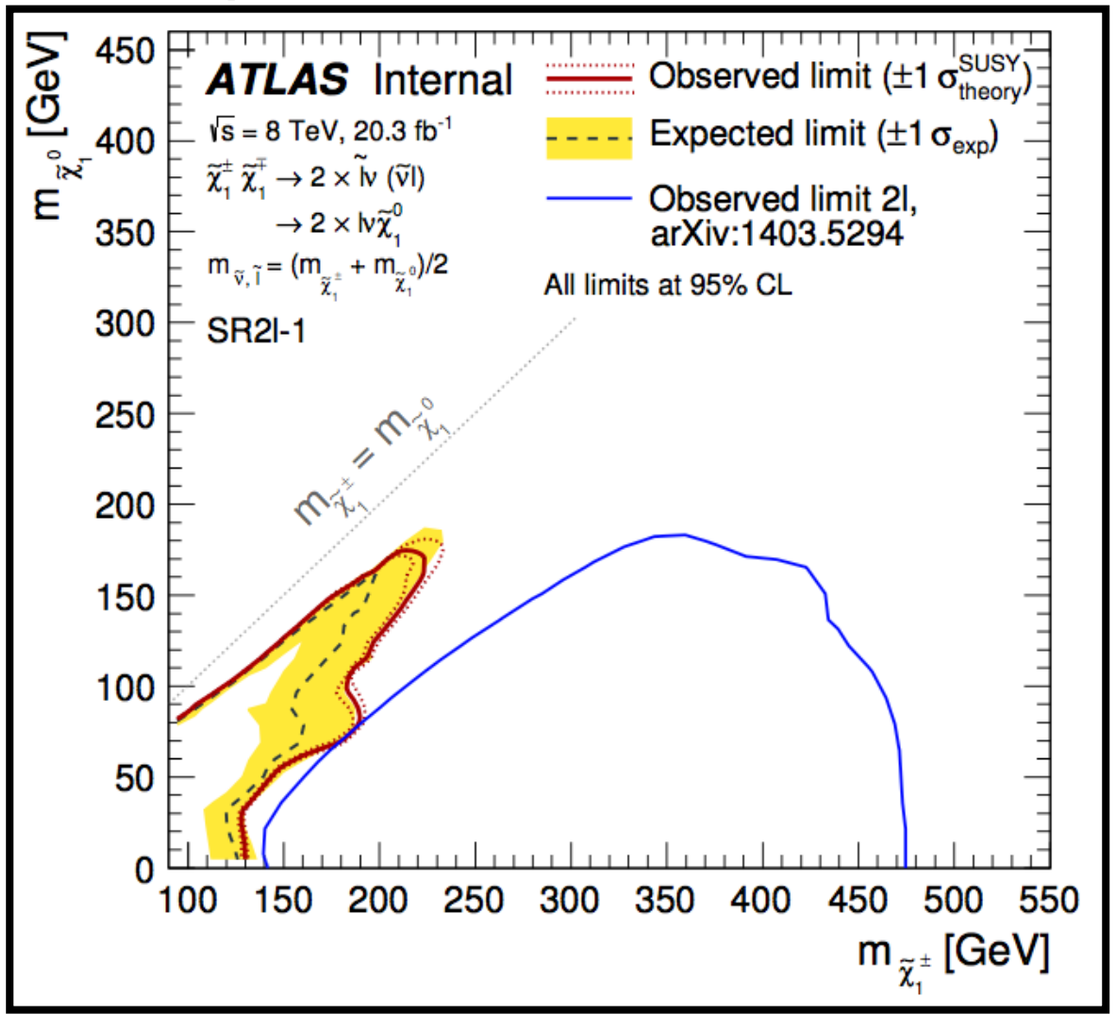
general SUSY decay

RJ pieces together visible and invisible objects using well-defined kinematic rules to fit an *imposed* decay tree, allowing **access to all steps of the decay**

For **both** $\tilde{\chi}_1^{\pm}\tilde{\chi}_1^{\mp}$ and $\tilde{t}\tilde{t}$ searches we use this **general** decay tree

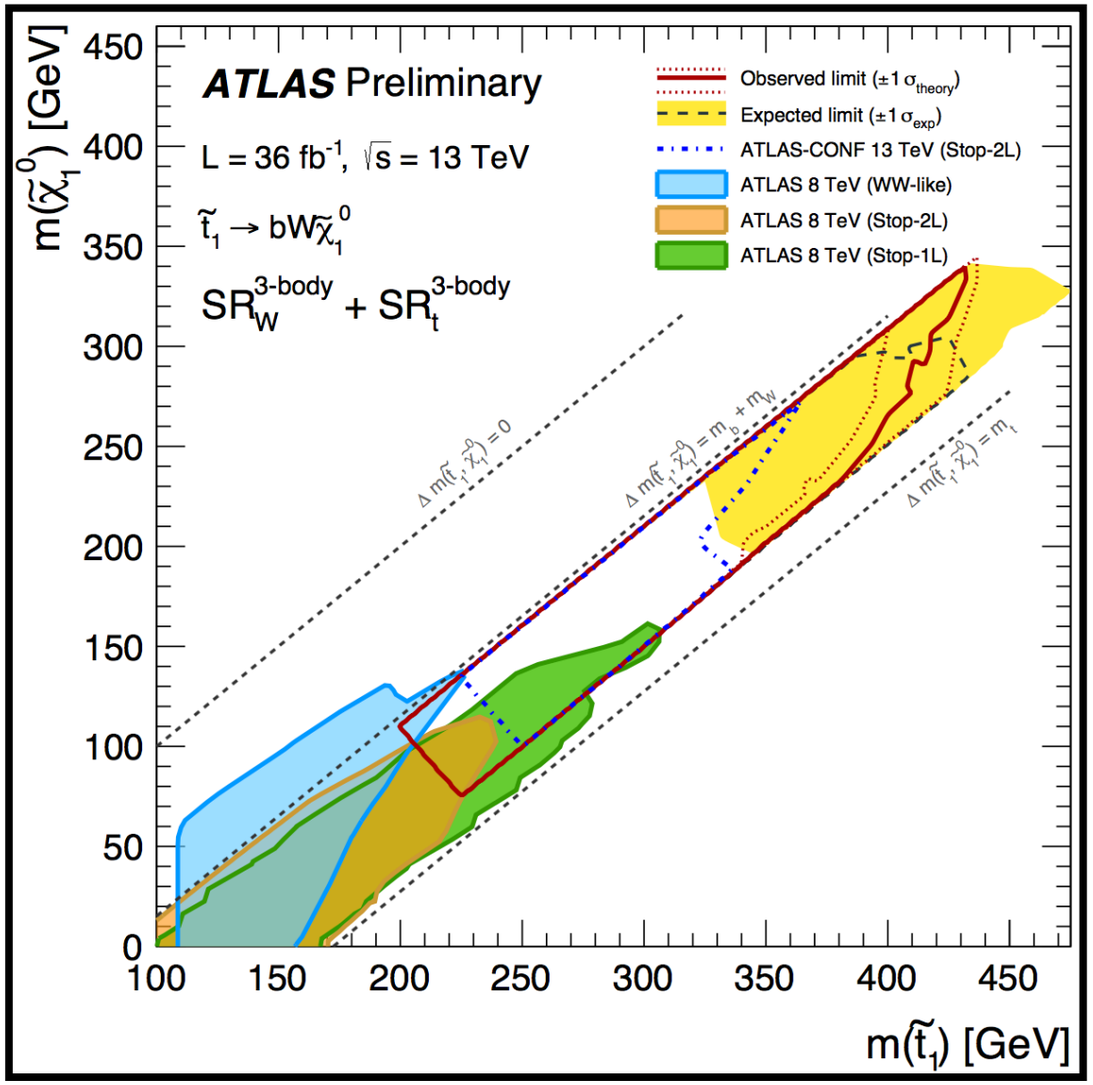
Recursive Jigsaw Results

$\tilde{\chi}_1^{\pm}\tilde{\chi}_1^{\mp}$ production



[arXiv PRD]

$\tilde{t}\tilde{t}$ production



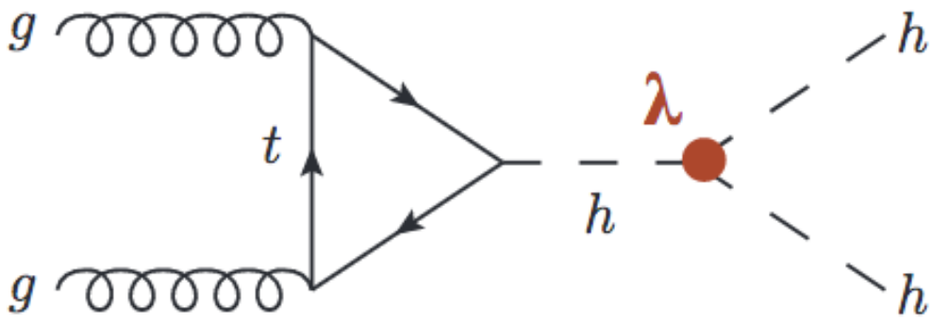
[arXiv EPJC]

Using the ***same*** set of RJ rules and observables we gain access to compressed scenarios of quite different SUSY scenarios — illustrating the **general applicability of these methods**

It takes 2 to lambda

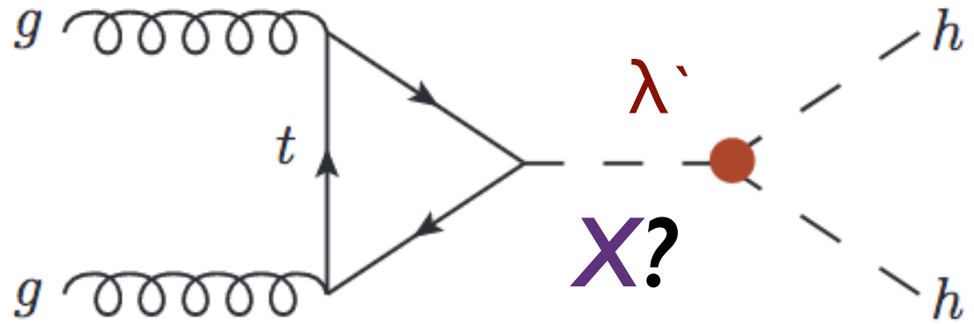
BSM physics likes to modify the Higgs sector

is it…



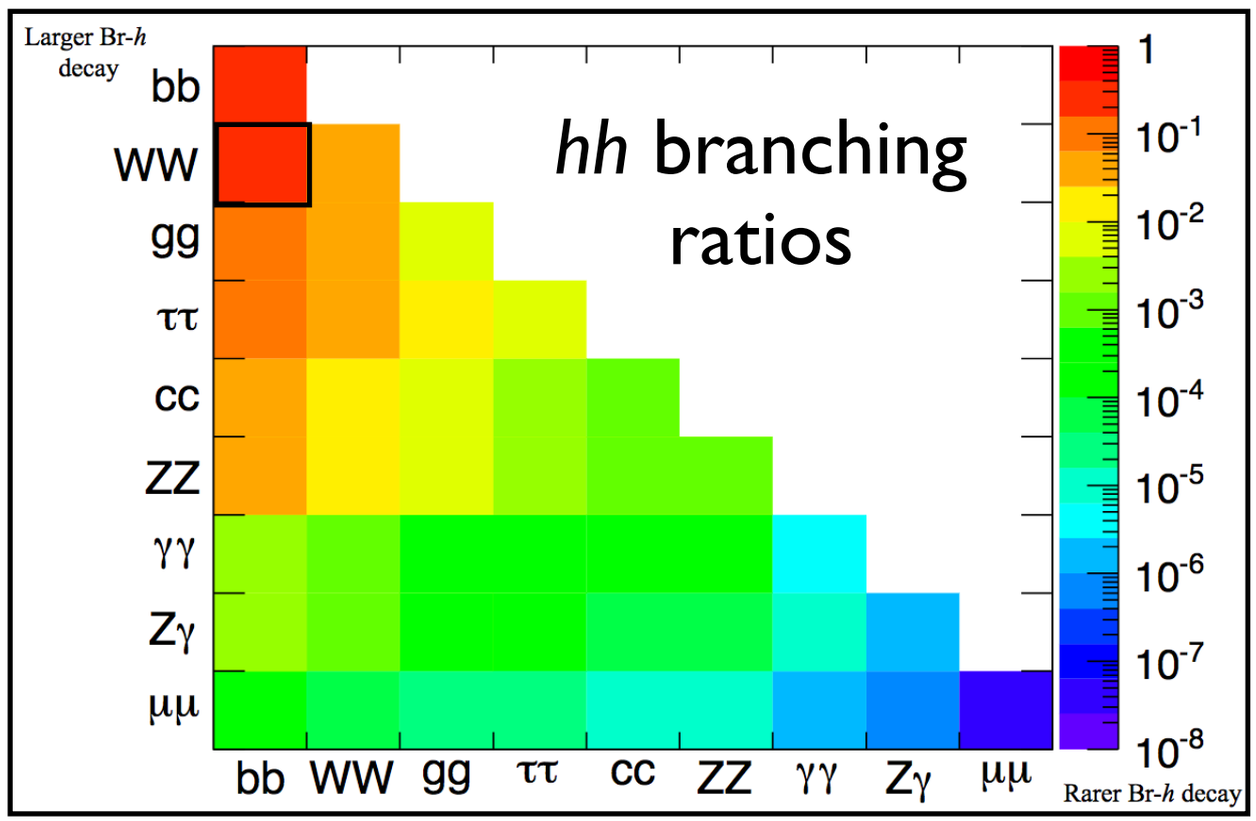
measurement of *hh* coupling provides **robust test of BSM physics**

or is it…



existence of heavy X may lead to **early observation of *hh***

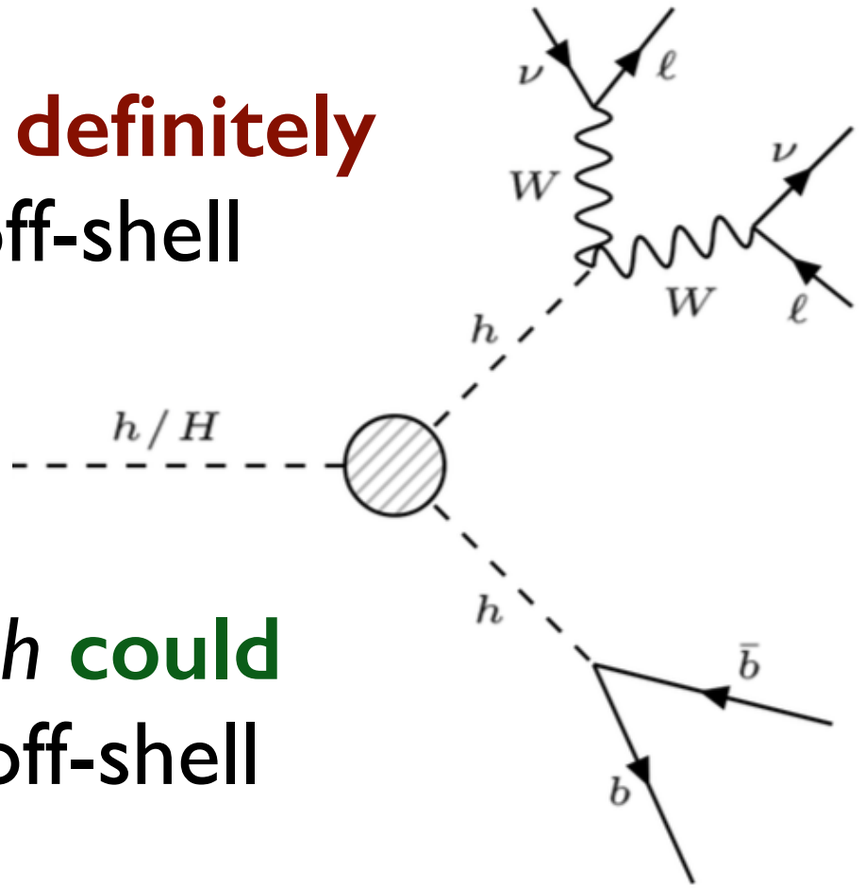
2L final state of *hh*→*WWbb* offers unique access to *hh* production

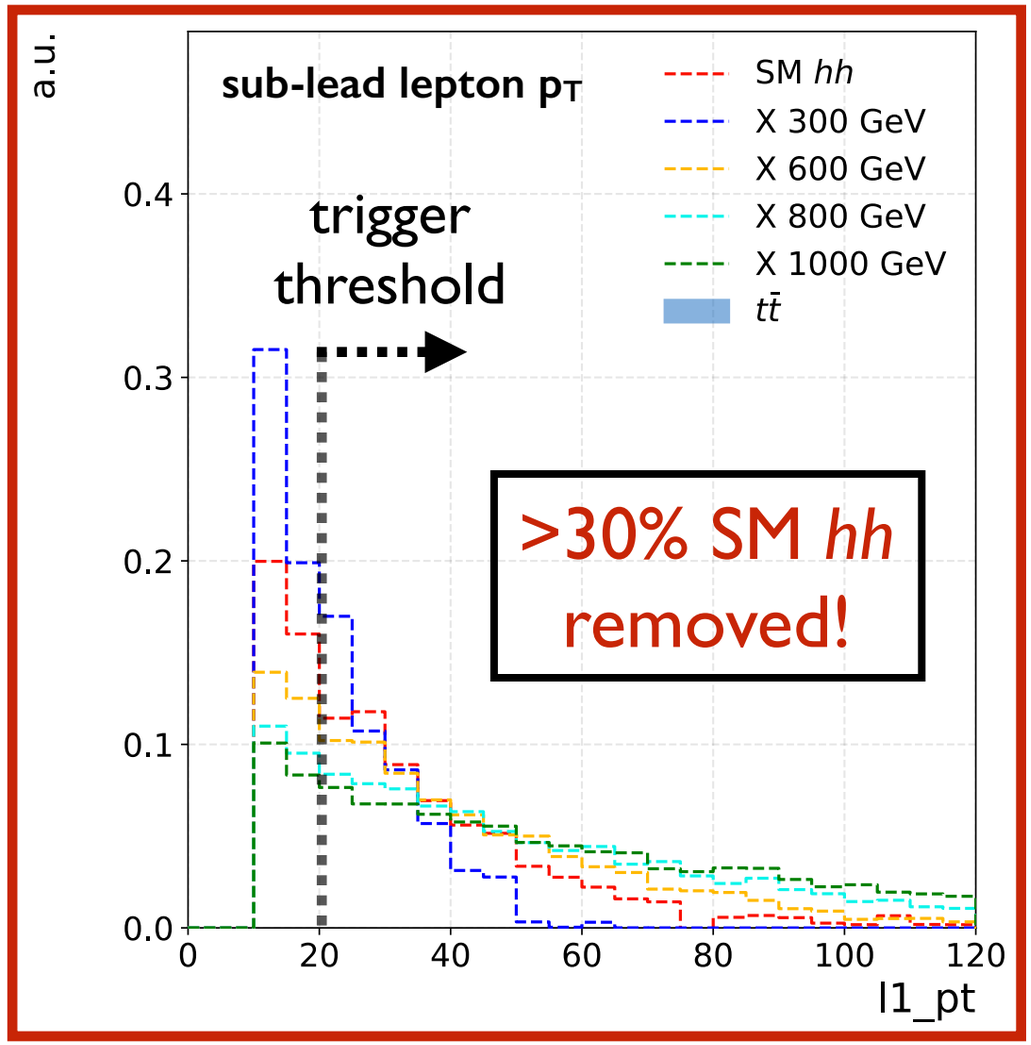


Improving hh to WWbb Trigger Strategy

one W **definitely** is off-shell

one *h* **could** be off-shell





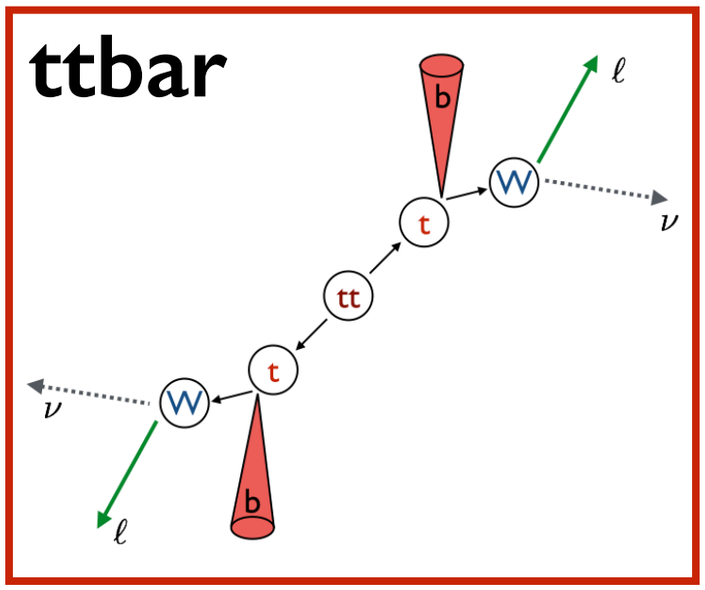
Soft 2nd lepton and standard lepton trigger thresholds diminish our acceptance

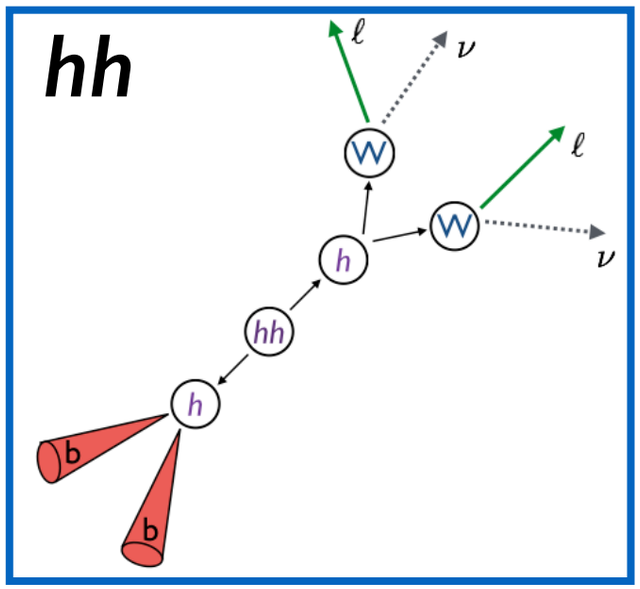
Can this be avoided?

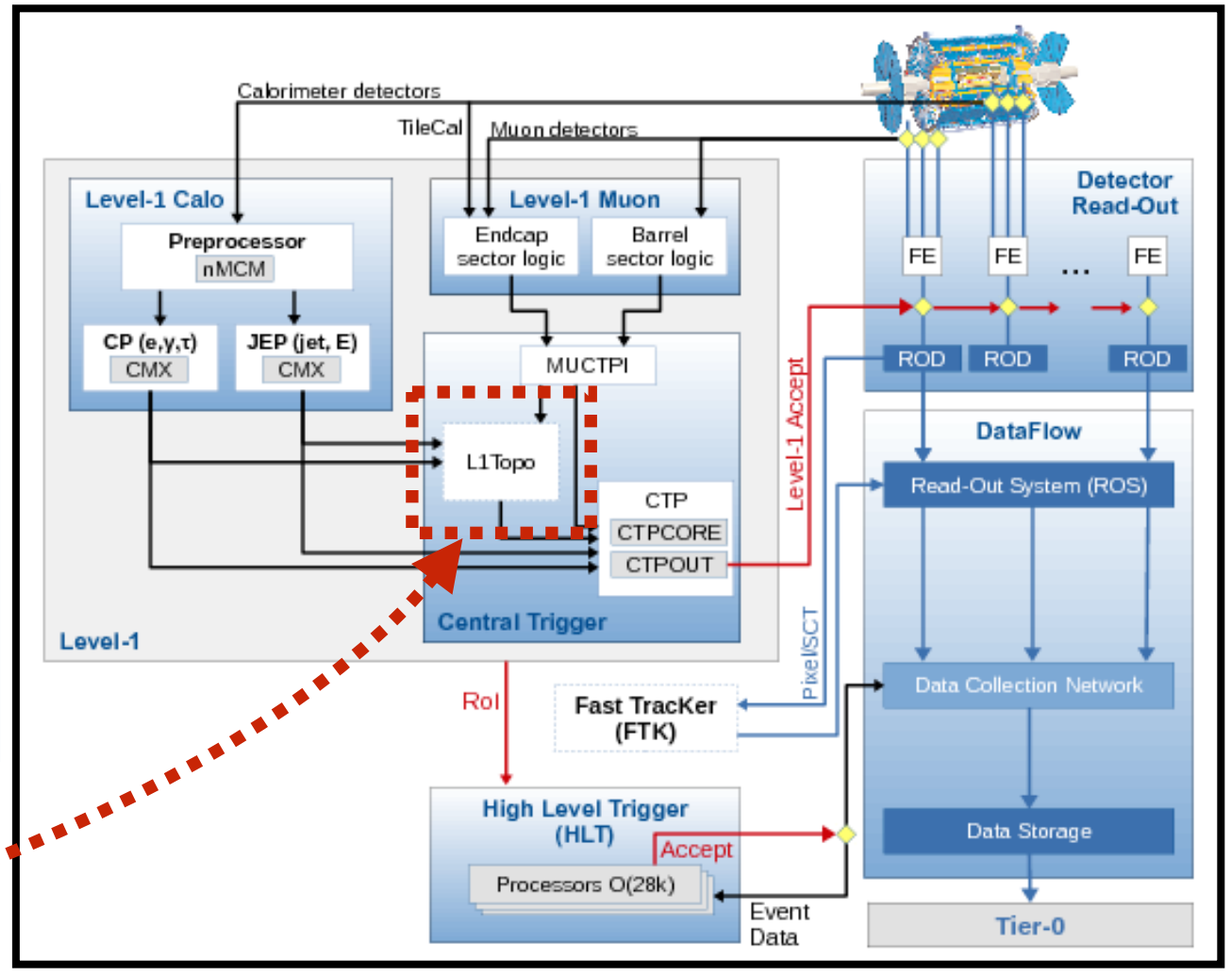
New Analysis, New Trigger

Can this be avoided? **Yes**.

(We hope. It is still early days)







Use unique-to-dilepton *hh WWbb* topology in ATLAS' new **Level 1 Topological Trigger**

- Trigger based on **ΔR between lepton and jet** or **Δφ between lepton and E_T^{miss}** at earliest stage of the trigger
  - Expect **20% gain** in SM *hh* production
  - Upwards of **200% gain** in low-mass X-to-*hh* resonances

New Analysis, New Trigger

Can this be avoided? **Yes**.

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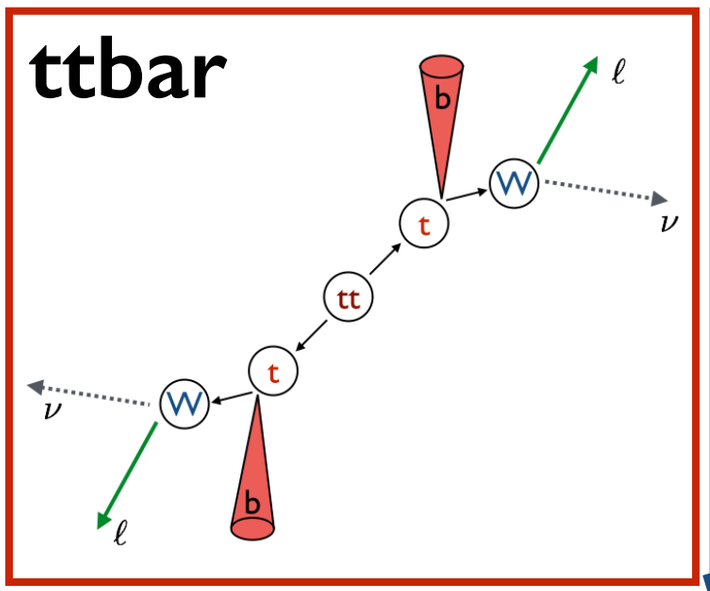

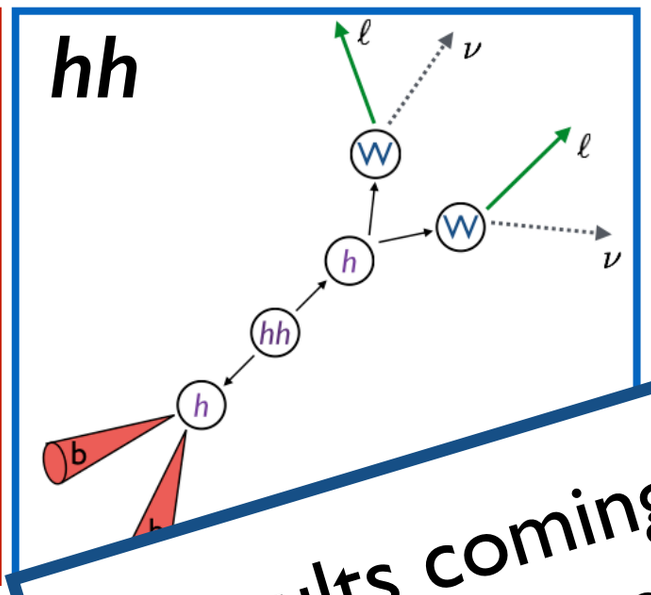

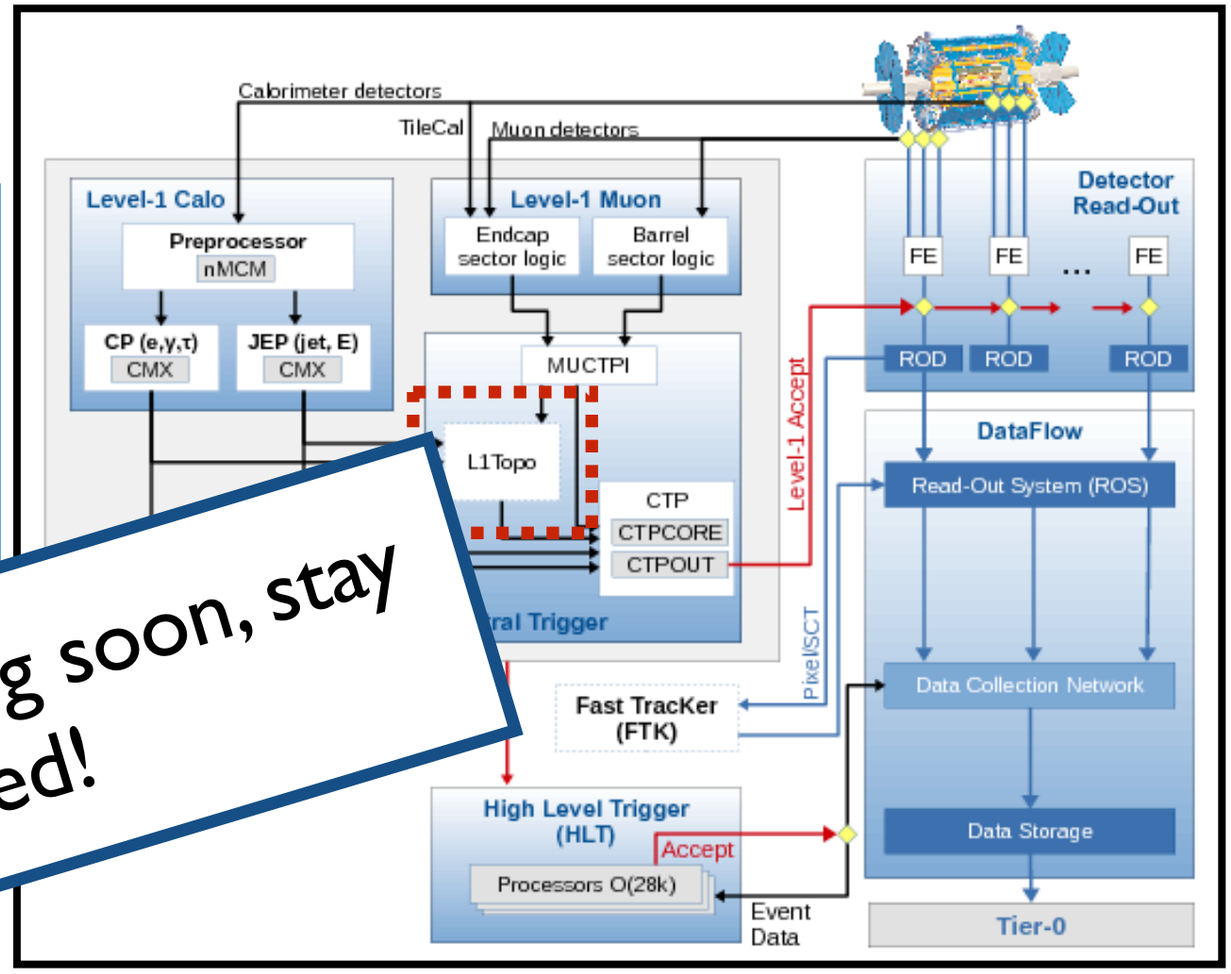

Results coming soon, stay tuned!

Use unique-to-dile topology in ATLAS Level 1

Topological Trigger

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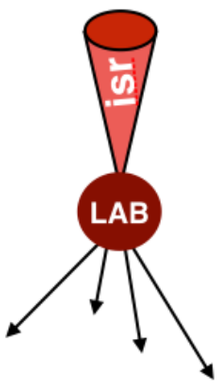
Thanks!

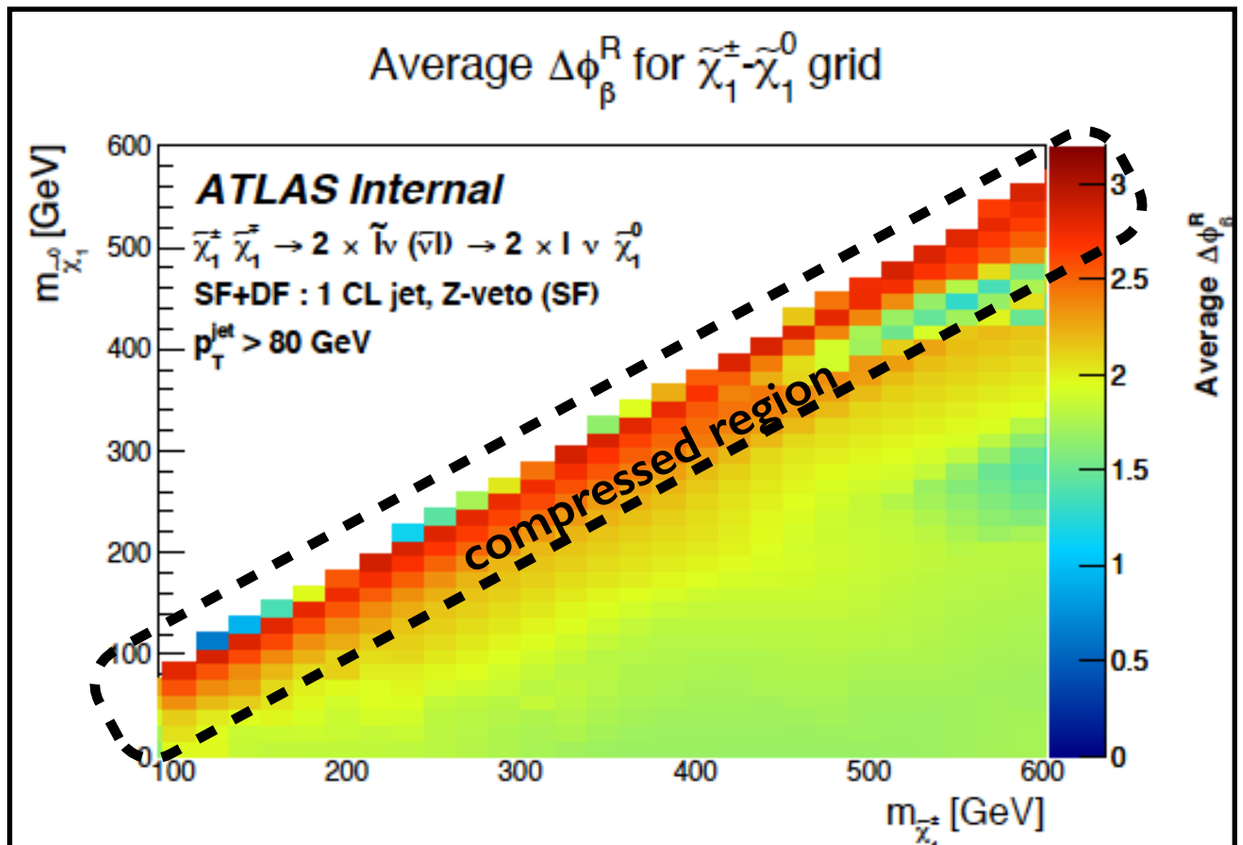
Back-up

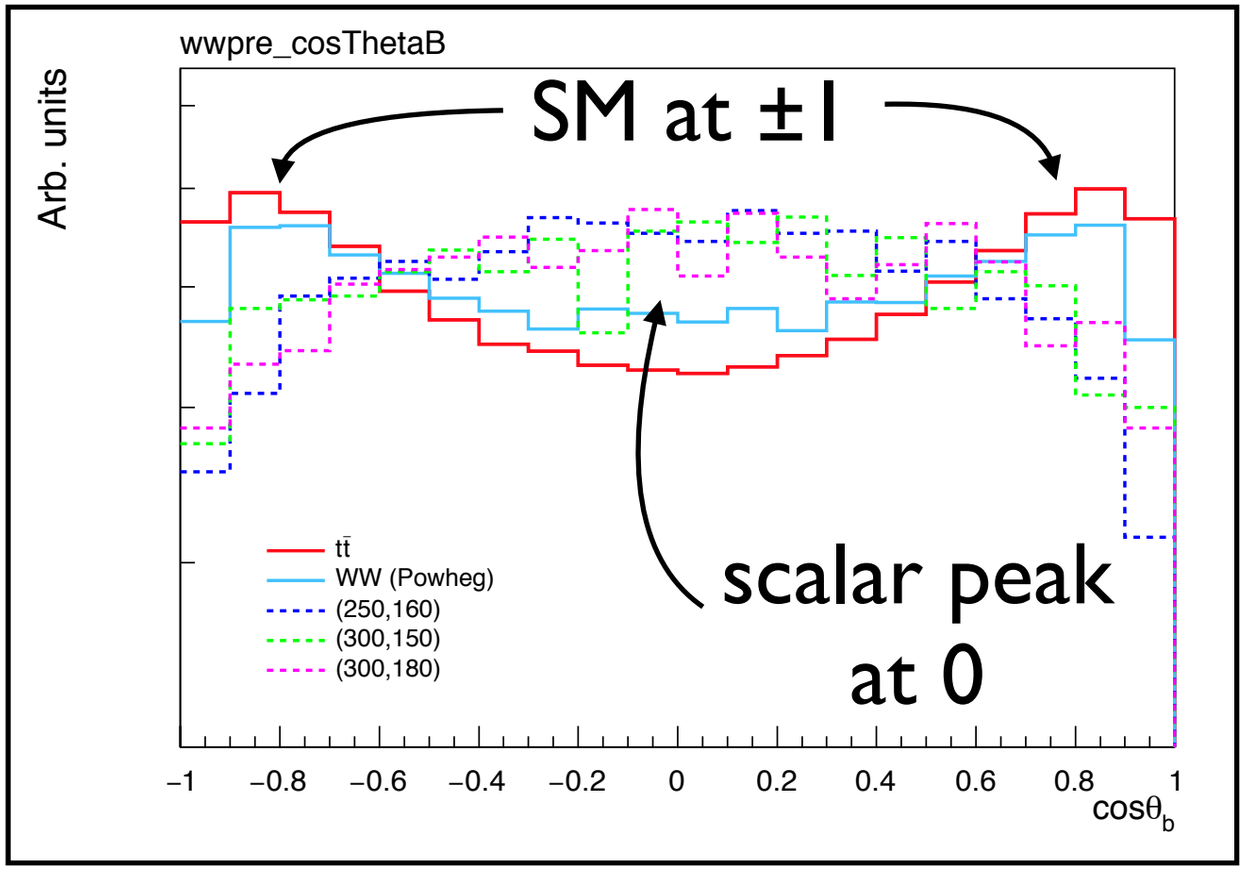
Recursive Jigsaw Strategy



In the $\tilde{\chi}_1^{\pm}\tilde{\chi}_1^{\mp}$ search we boost power of RJ observables by requiring an ISR jet

✓ Enhancement observed **only in signal** due to **massive invisible sparticles**





In the $\tilde{t}\tilde{t}$ search the **scalar** nature of the stop is used alongside angular observables from RJ