

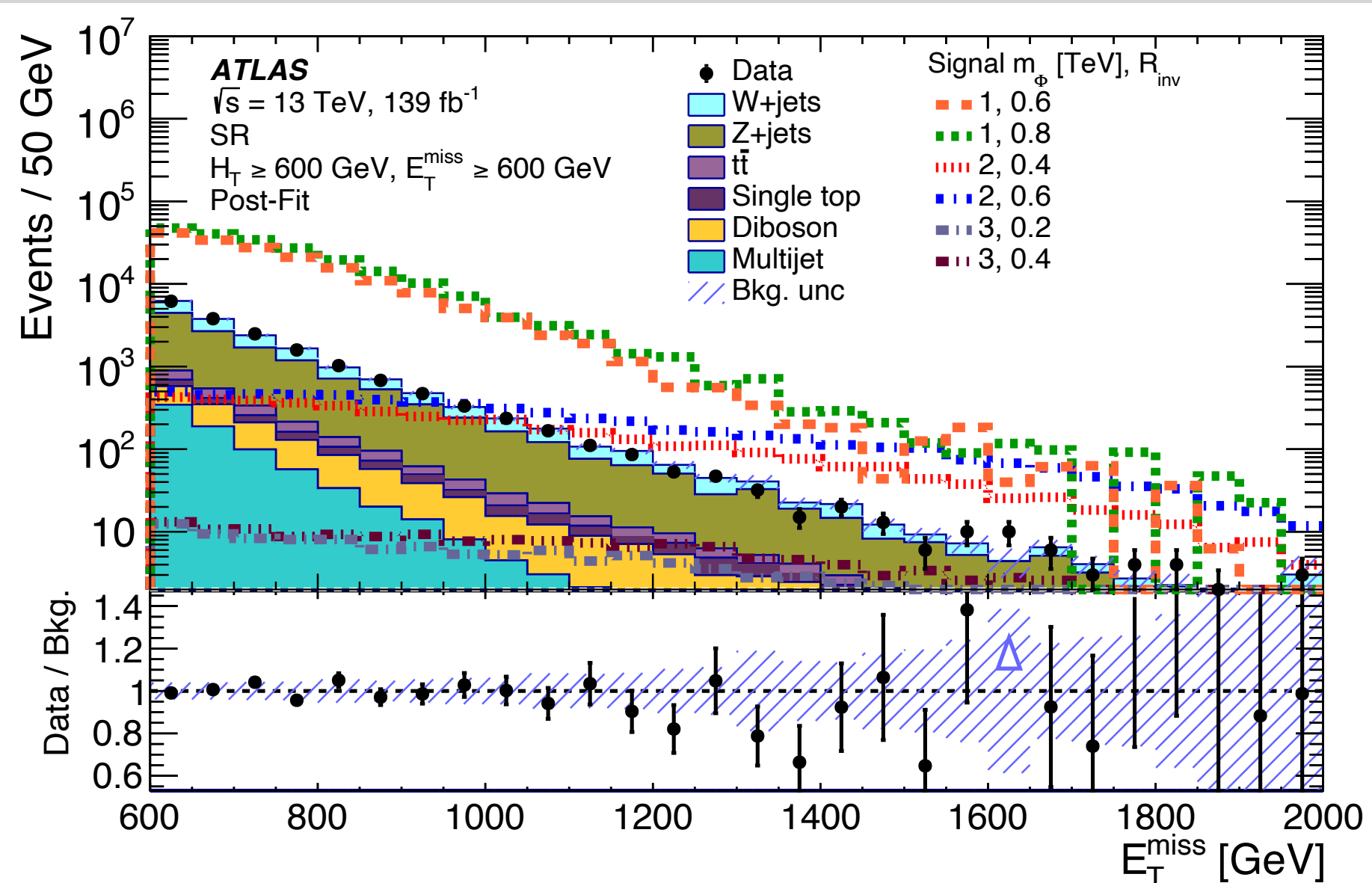
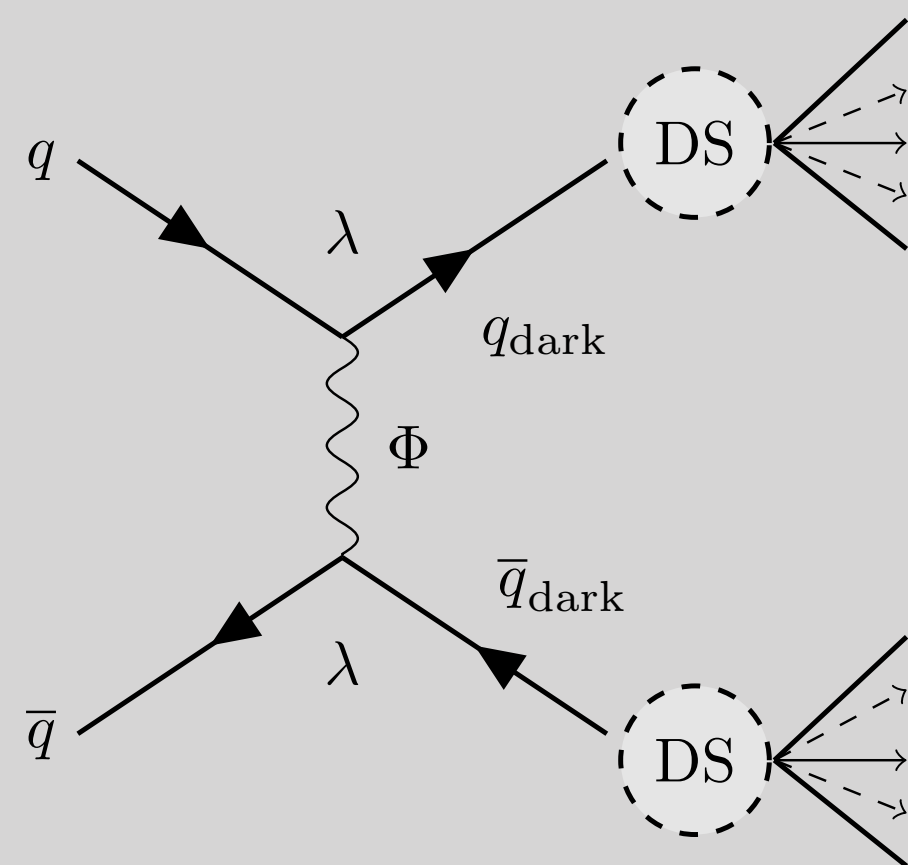
THE EXPLORATION OF BOTTOM-QUARK- PHILIC SEMI-VISIBLE JETS

YOUNGST@RS- COLOURS IN DARKNESS: TOWARDS IMPROVED MODELLING OF STRONGLY INTERACTING DARK-SECTORS SHOWERS

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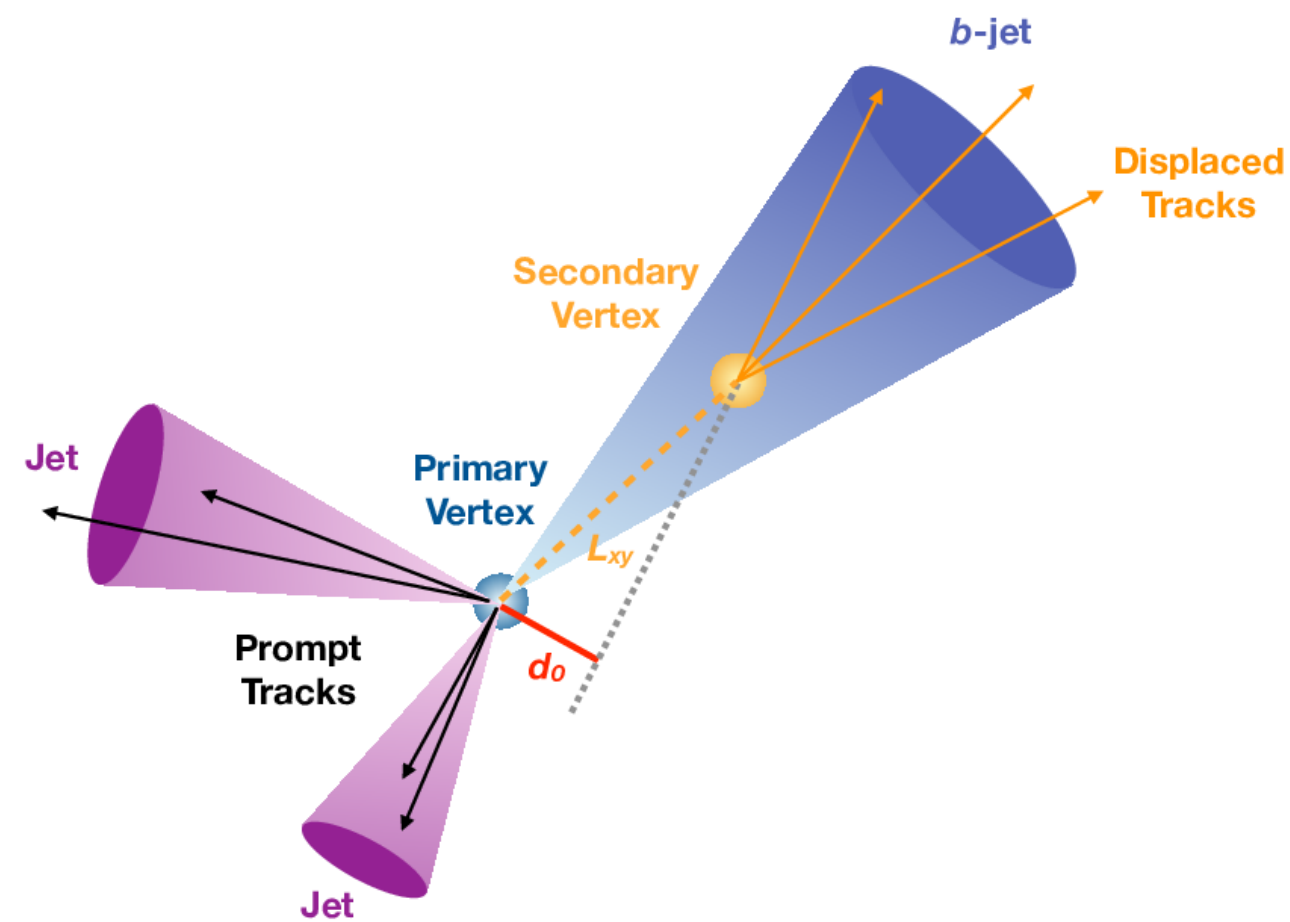


MOTIVATION FOR BOTTOM-QUARK-PHILIC SVJS



- **WITS ATLAS** group presented the first search for **non-resonant** production of SVJs excluding bi-fundamental mediator mass up to **2.7 TeV**.
- There is a significant contribution of **$t\bar{t}$** , which sparked interest in SVJ scenario with **b-jets**.
- The signal generation for our SVJ-b signature makes use of the same setting from the ATLAS paper with different mass values.

MOTIVATION FOR BOTTOM-QUARK-PHILIC SVJS

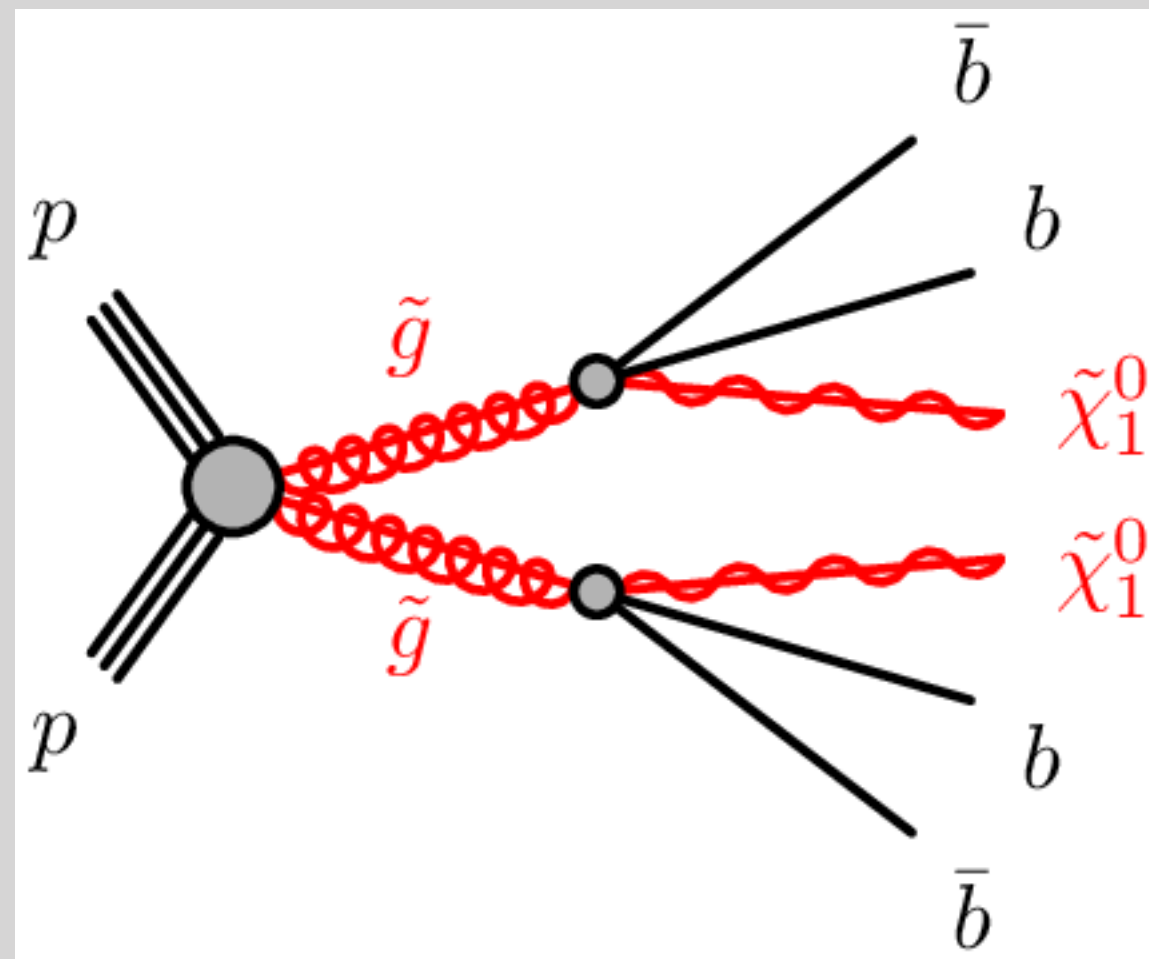


- Searching for SVJ with bottom quarks has never been done before.
- By requiring the jets to be b-tagged, it also gives us more discriminatory.
- It will also assist in reducing the leading multijet background.

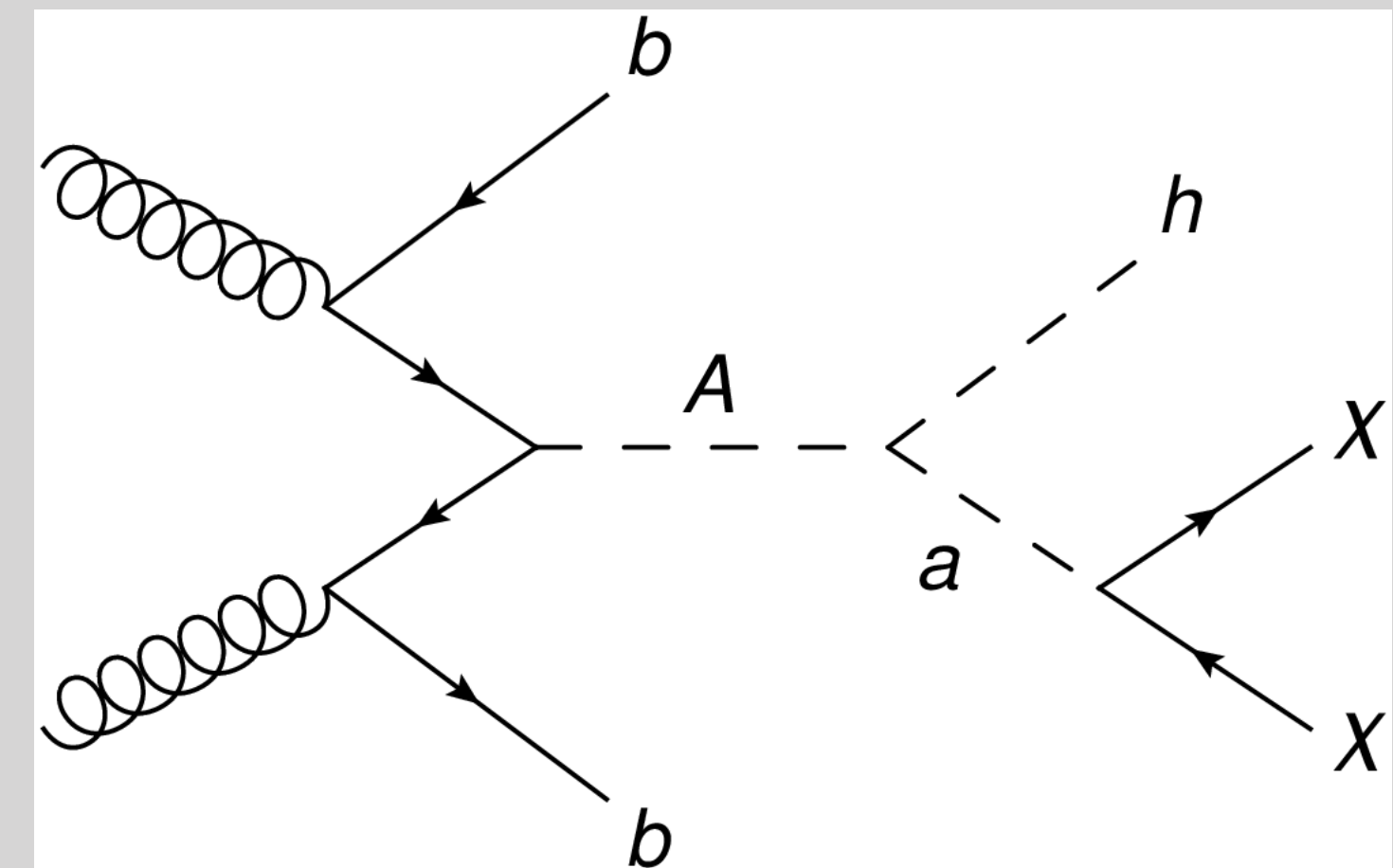
CURRENT CONSTRAINTS ON SIGNATURE

There are two current searches that probe a similar final state

1. Search for supersymmetry in final states with missing transverse momentum and three or more b -jets in 139 fb^{-1} of proton-proton collision at $\sqrt{s} = 13 \text{ TeV}$ with the ATLAS detector



2. Search for dark matter production in association with association with Standard Model Higgs Boson decaying b -quarks using the full Run 2 dataset from the ATLAS detectors



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1. Search for supersymmetry in final states with missing transverse momentum and three or more b -jets in 139 fb^{-1} of proton-proton collision at $\sqrt{s} = 13 \text{ TeV}$ with the ATLAS detector.

- Here the validation of our Rivet analysis was performed both by comparing distributions after 0-lepton preselection and yields in specific signal regions (SRs).
- **No SVJ-b signal events** passed any of the **SR selections**, indicating that this search has **no sensitivity to SVJ-b** signal.

Selection	Benchmark signal		Data yield	SVJ-b signal yield
	ATLAS yield	our yield		
SR-B	10.13	7	7	0
SR-M	28.30	18	18	0
SR-C	34.71	32	32	0

Benchmark signal model = $\tilde{g} \rightarrow b\bar{b}\tilde{\chi}_1^0$



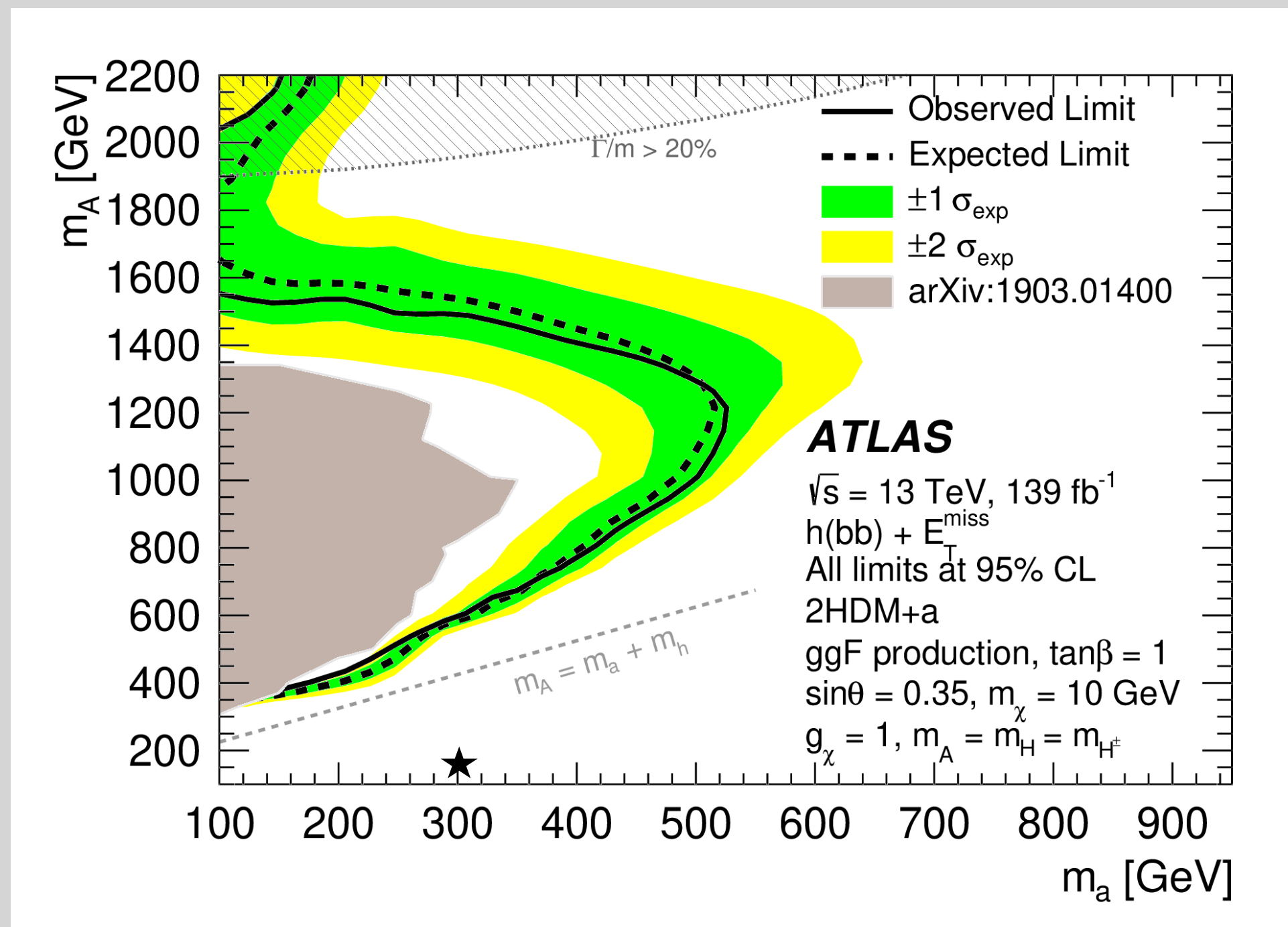
CURRENT CONSTRAINTS ON SIGNATURE

2. Search for dark matter production in association with association with Standard Model Higgs Boson decaying b-quarks using the full Run 2 dataset from the ATLAS detectors

- The yields for this benchmark signal from our Rivet analysis was compared to yields reported by ATLAS for 2-bjet and 3-bjet SRs .
- The **data yields** and the **yields** from **SVJ-b signal**, the latter **being much smaller** than both the data and the benchmark signal, **which is not excluded**.
- So it is safe to say the SVJ-b signal is not excluded based on this search.

3 b-tagged SR				
Selection	Benchmark signal		Data yield	SVJ-b signal yield
	ATLAS yield	our yield		
$150 \leq E_T^{\text{miss}} < 200 \text{ GeV}$	5.3	9	408	0.5
$200 \leq E_T^{\text{miss}} < 350 \text{ GeV}$	18	7	658	1.8
$350 \leq E_T^{\text{miss}} < 500 \text{ GeV}$	2.9	0.5	42	0.2

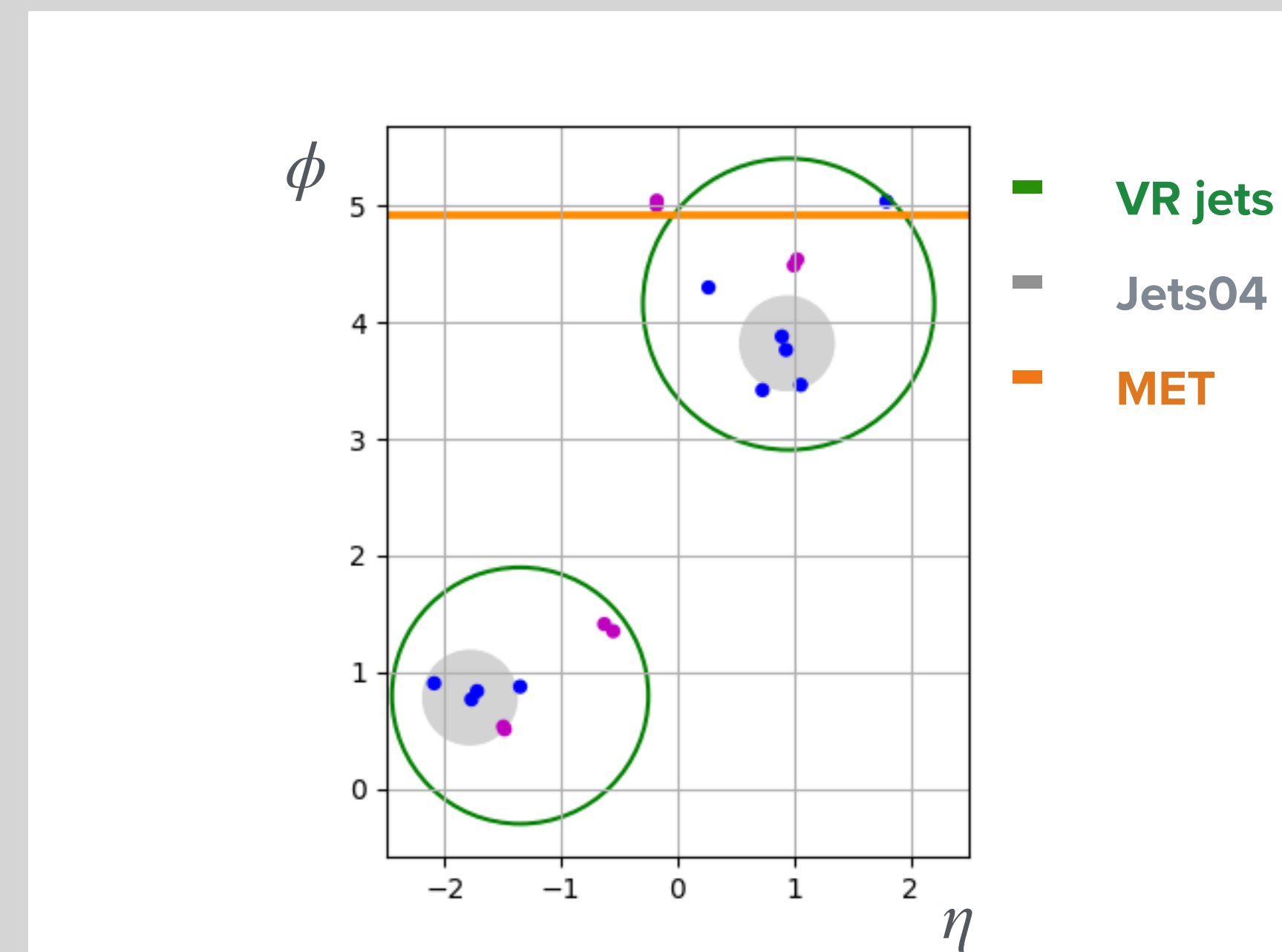
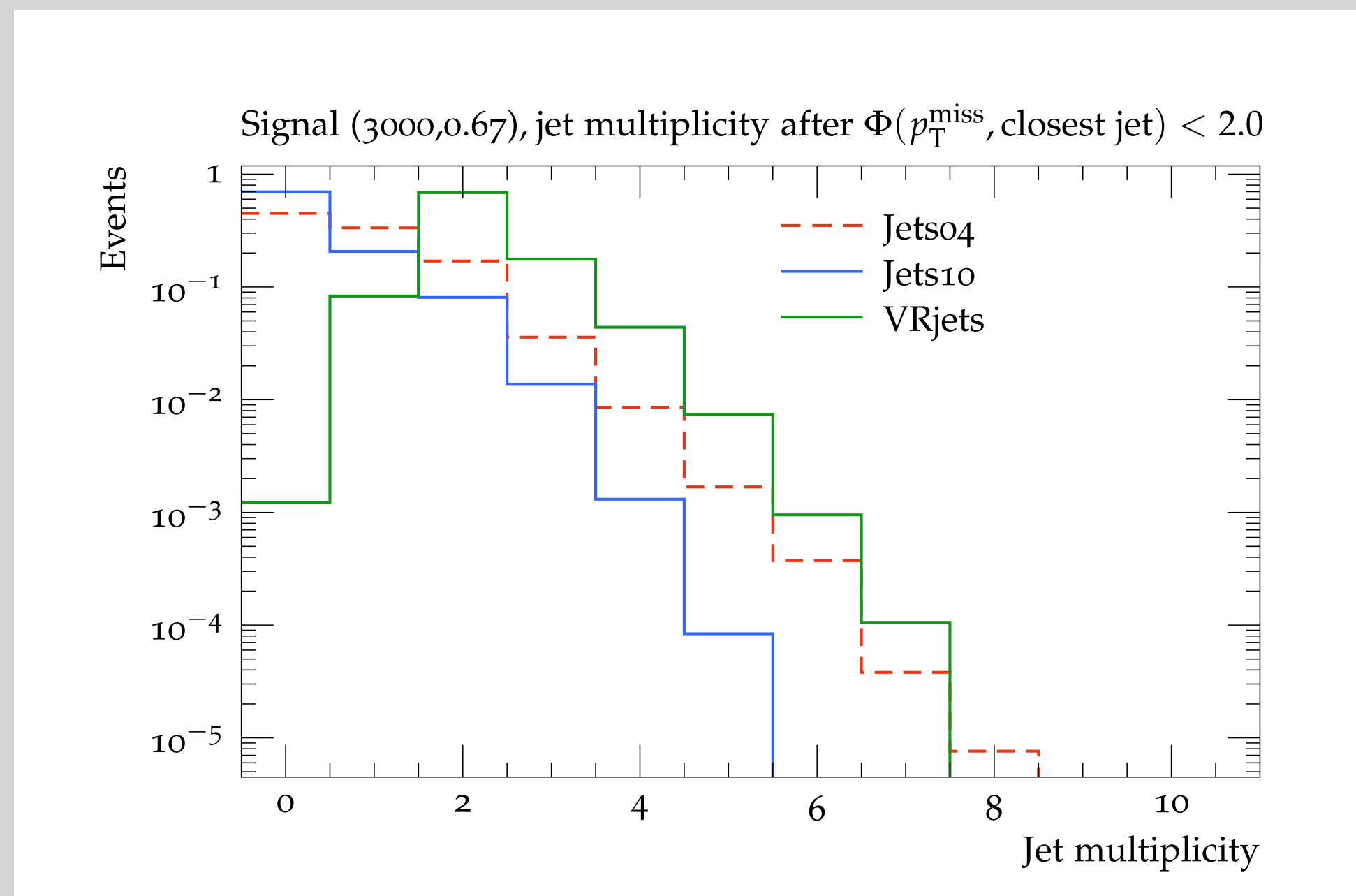
2 b-tagged SR				
Selection	Benchmark signal		Data yield	SVJ-b signal yield
	ATLAS yield	our yield		
$150 \leq E_T^{\text{miss}} < 200 \text{ GeV}$	60	110	14259	39
$200 \leq E_T^{\text{miss}} < 350 \text{ GeV}$	70	100	13724	59
$350 \leq E_T^{\text{miss}} < 500 \text{ GeV}$	3.6	6	799	0.28



★ Benchmark point with $(m_a, m_A) = 300, 150 \text{ GeV}$

JET CLUSTERING ALGORITHM: VARIABLE-R JETS

- Initially, we made use of anti- k_t algorithm with fixed radius of $R = 0.4$
- Investigated which jet clustering algorithm would better reconstruct the signal.
- Implemented variable-R jet algorithm:
 - Makes use of dimensional input parameter (ρ) which can be scanned to optimise the maximum desired sensitivity.

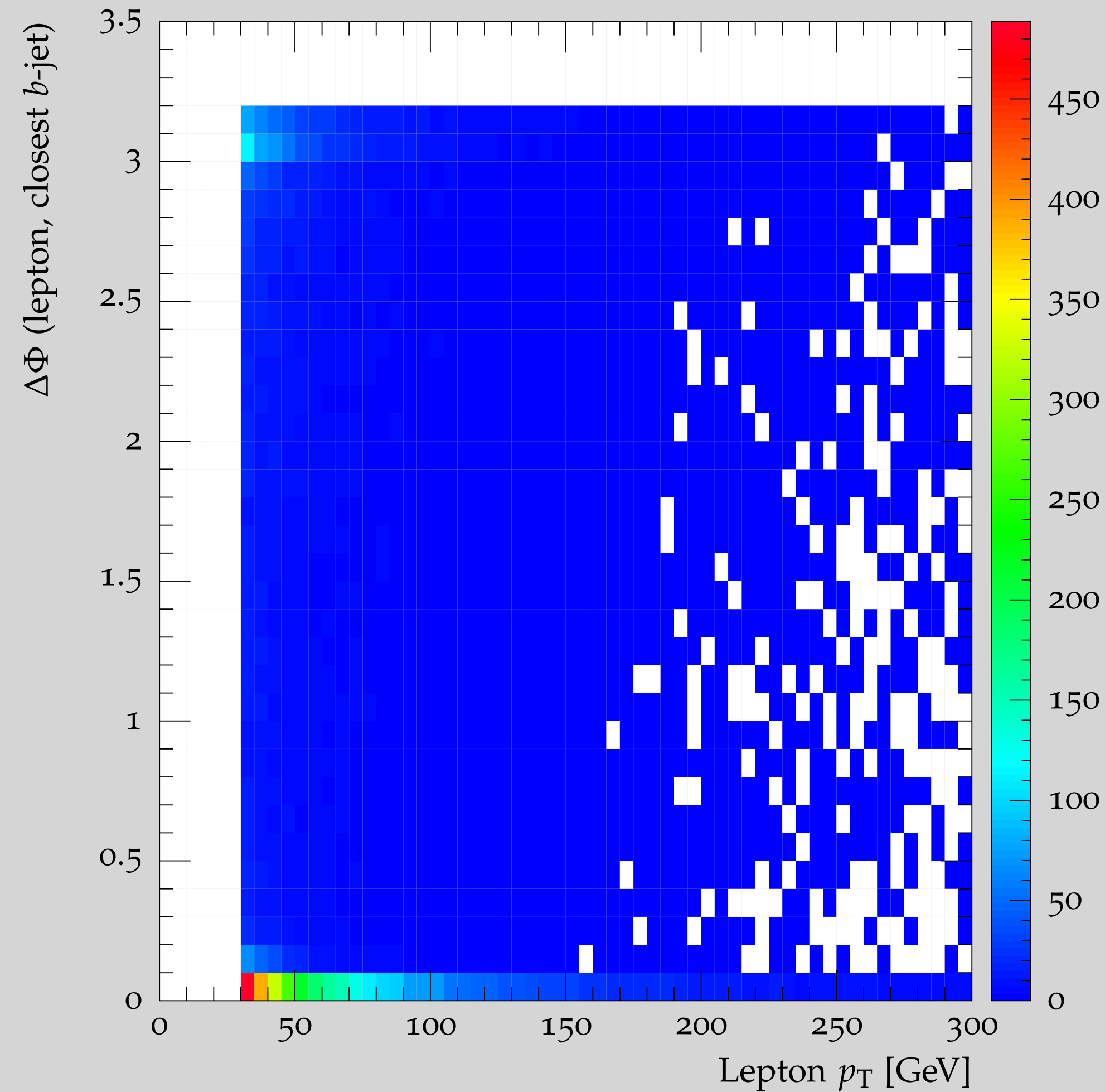


CONCLUSION & FUTURE STEPS

- **The work presented thus far is an initial feasibility study into the SVJ-b signature.**
- **The current bounds on a similar final state don't exclude our signal, making it a promising search channel.**
- **Currently, we're finalising our pheno paper with a search strategy utilising variable-R jets.**



BACK-UP SLIDES



- **Having a lepton veto would seem appropriate for the analysis but this is not the case.**
- **A complete lepton veto results in a lose of events.**
- **Semi-leptonic decays from b-quarks indicate events will have leptons.**