# Search for gluinos and squarks in final states with jets, missing transverse momentum and same-sign leptons at $\sqrt{s} = 13\,TeV$ with the ATLAS detector

Introduction

Guinos and squarks are one of the primary targets as their pair production may have large cross section. The poster presents recent ATLAS result from searches for gluinos and squarks with same-sign leptons and jets with 139 fb[-1] data.

SUSY signal scenario

$\tilde{g} \to qqWZ\tilde{\chi}_1^0$ $\qquad$ $\tilde{b} \to t\tilde{\chi}^{\pm}$ $\qquad$ $\tilde{t} \to tWW\tilde{\chi}_0^1$ $\qquad$ $\tilde{g} \to tbd$
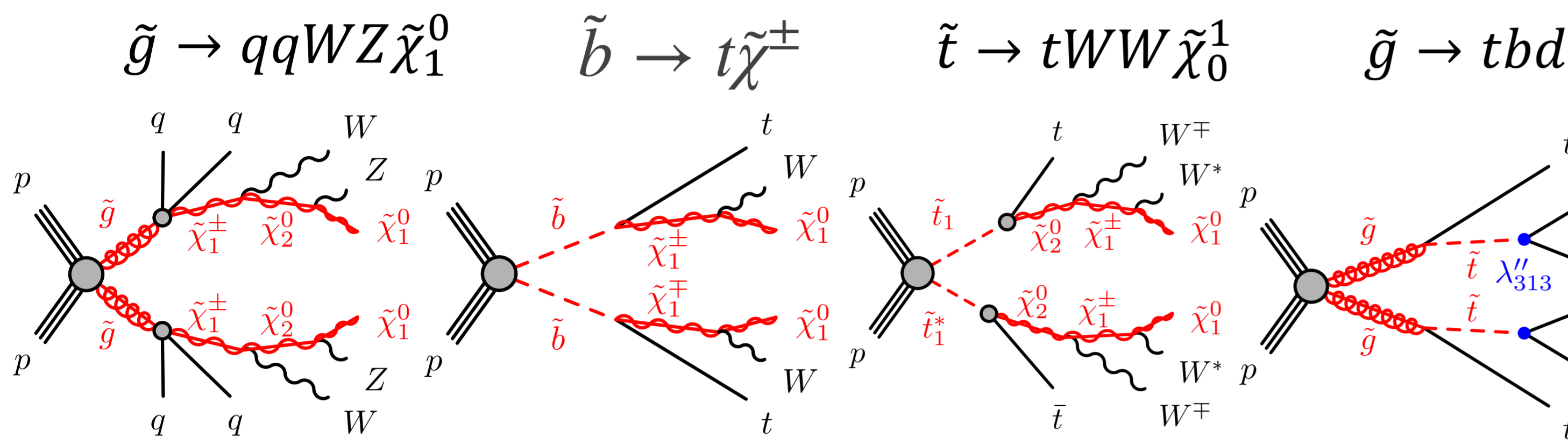
Background

1. Real/Prompt lepton contribution

- Diboson production (WZ / ZZ)
- $t\bar{t}$ production with a vector boson
→ Estimated from Monte-Carlo simulation

2. Reducible background

- Charge flip and Fake/non-prompt lepton
→ Estimated using data-driven method

Event selection

5 different signal regions (SR) are defined

- n_ℓ, n_b, n_j: Number of lepton, b-jet and jets
- E_T^{miss} : Missing transverse momentum
- m_{eff} : scalar P_T sum of all jets, lepton and E_T^{miss}

| SR	n_ℓ	n_b	n_j	E_T^{miss} [GeV]	m_{eff} [GeV]	E_T^{miss}/m_{eff}	SUSY
Rpv2L	$\geq 2\ (\ell^{\pm}\ell^{\pm})$	≥ 0	$\geq 6\ (p_T > 40\ \text{GeV})$	–	> 2600	–	$\tilde{g} \to t\tilde{t}_1^*,\ \tilde{t}_1^* \to qq'\ (\lambda'' \neq 0)$ $\tilde{g} \to t\bar{t}\tilde{\chi}_1^0,\ \tilde{\chi}_1^0 \to 3q\ (\lambda'' \neq 0)$ $\tilde{g} \to q\bar{q}\tilde{\chi}_1^0,\ \tilde{\chi}_1^0 \to qq'\ell\ (\lambda' \neq 0)$
Rpc2L1b	$\geq 2\ (\ell^{\pm}\ell^{\pm})$	≥ 1	$\geq 6\ (p_T > 40\ \text{GeV})$	–	–	> 0.25	$\tilde{b}_1 \to tW\tilde{\chi}_1^0$
Rpc2L2b	$\geq 2\ (\ell^{\pm}\ell^{\pm})$	≥ 2	$\geq 6\ (p_T > 25\ \text{GeV})$	> 300	> 1400	> 0.14	$\tilde{b}_1 \to tW\tilde{\chi}_1^0$ $\tilde{g} \to t\bar{t}\tilde{\chi}_1^0$
Rpc2L0b	$\geq 2\ (\ell^{\pm}\ell^{\pm})$	$= 0$	$\geq 6\ (p_T > 40\ \text{GeV})$	> 200	> 1000	> 0.2	$\tilde{g} \to q\bar{q}'WZ\tilde{\chi}_1^0$
Rpc3LSS1b	$\geq 3\ (\ell^{\pm}\ell^{\pm}\ell^{\pm})$	≥ 1	no cut but veto $81 < m_{e^{\pm}e^{\pm}} < 101$ GeV			> 0.14	$\tilde{t}_1 \to tW^{\pm}(W^*)\tilde{\chi}_1^0$

- Large m_{eff} and E_T^{miss} except RPV scenarios ($\tilde{g} \to tbd$)
  - Low E_T^{miss} for RPV sce
- At least 2 leptons and multiple jets

Rare process in SM → Very low background!

Background estimation

Charge flip: Bremsstrahlung or low track curve

- Transform opposite-sign in same sign events
- Muon charge flip is negligible in this analysis
- The rate for electron is measured in data and simulation for $Z \to ee$
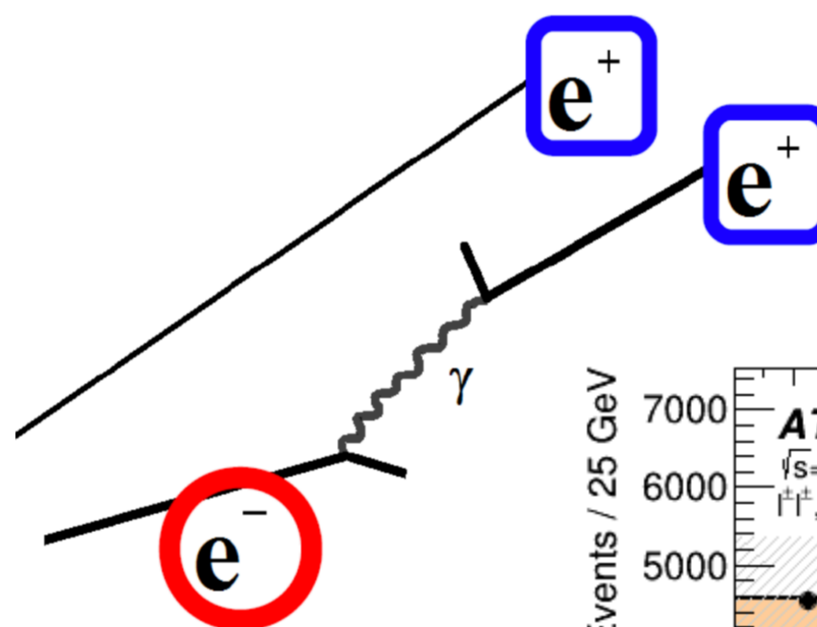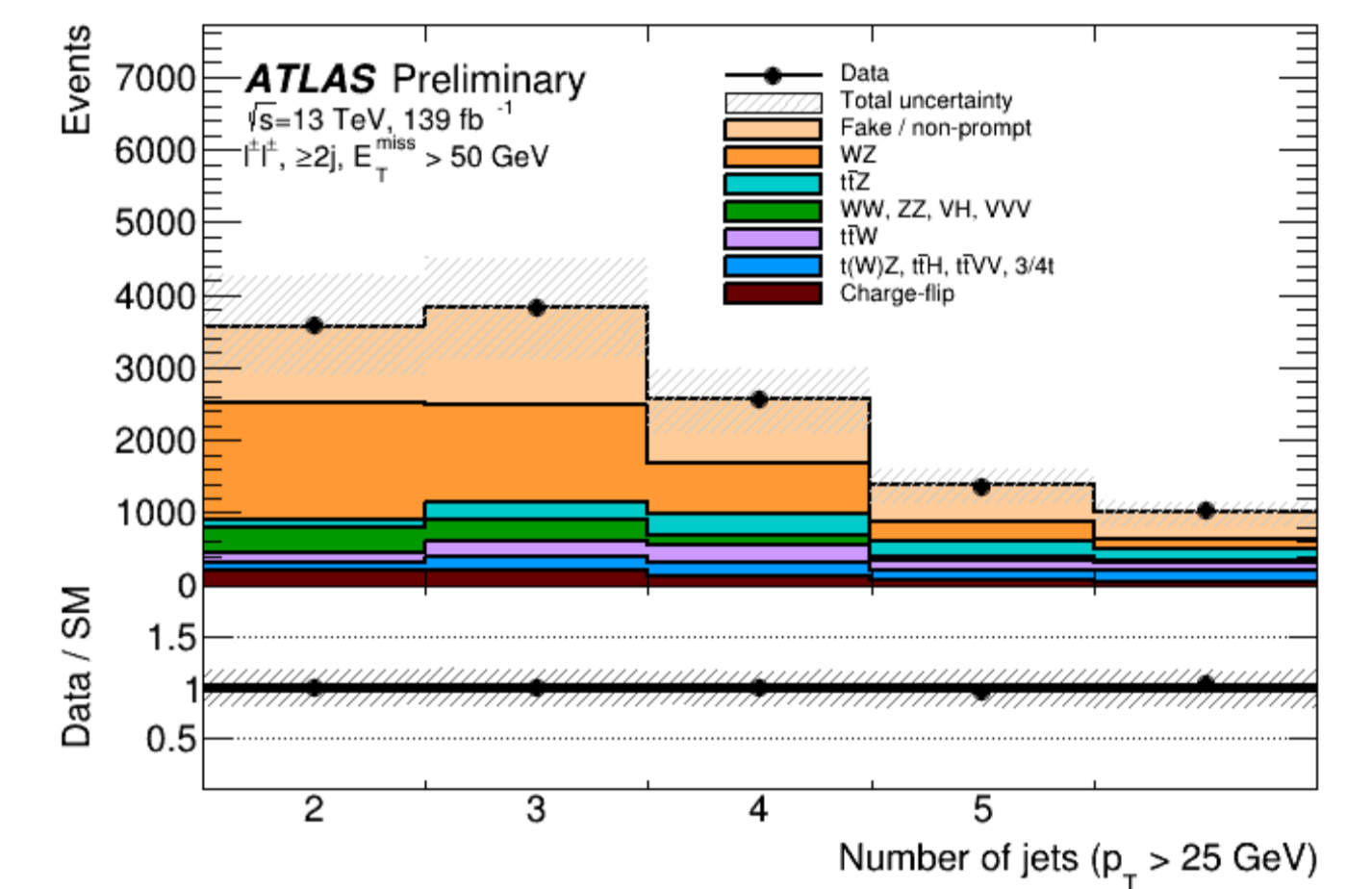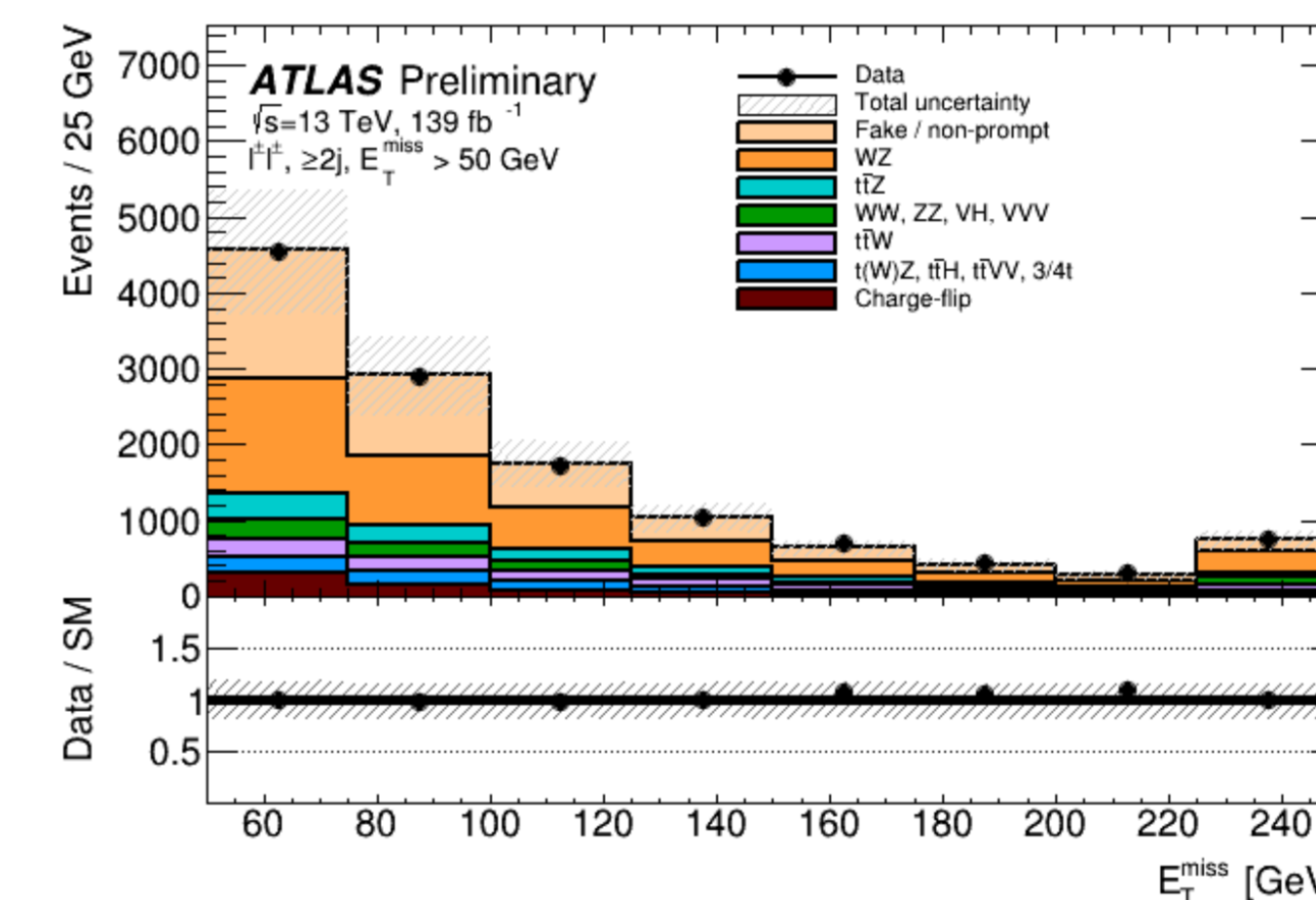
Fake/non-prompt lepton: from heavy/light flavor decays

- Dynamic matrix method with 2 input parameters
  - Real and Fake efficiencies are estimated from data.

Validation regions (VR) are designed to verify the irreducible background.

- Good agreement between data and prediction

	n_ℓ	n_b	n_j	m_{eff} [GeV]	Other requirements
VRWZ4j	= 3,	= 0	$\geq 4\ (p_T > 25\ \text{GeV})$	> 600	$81 < m_{SFOS} < 101$ GeV, $E_T^{miss} > 50$ GeV, no fourth baseline lepton
VRWZ5j	= 1 SFOS pair	= 0	$\geq 5\ (p_T > 25\ \text{GeV})$	> 400	
VRttV	≥ 2, ≥ 1 SS pair	≥ 1	$\geq 3\ (p_T > 40\ \text{GeV})$	> 600	$p_T > 30$ GeV for SS leptons, $\sum |p_T^b| > 0.4 \sum |p_T^j|,\ E_T^{miss} > 0.1 m_{eff}$, $\min \Delta R_\eta(\ell_1, j) > 1.1$
All VRs	$m_{eff} < 1.5$ TeV, $E_T^{miss} < 250$ GeV; veto Rpc2L1b, Rpc2L2b, Rpc2L0b and Rpv2L signal regions.				

Result

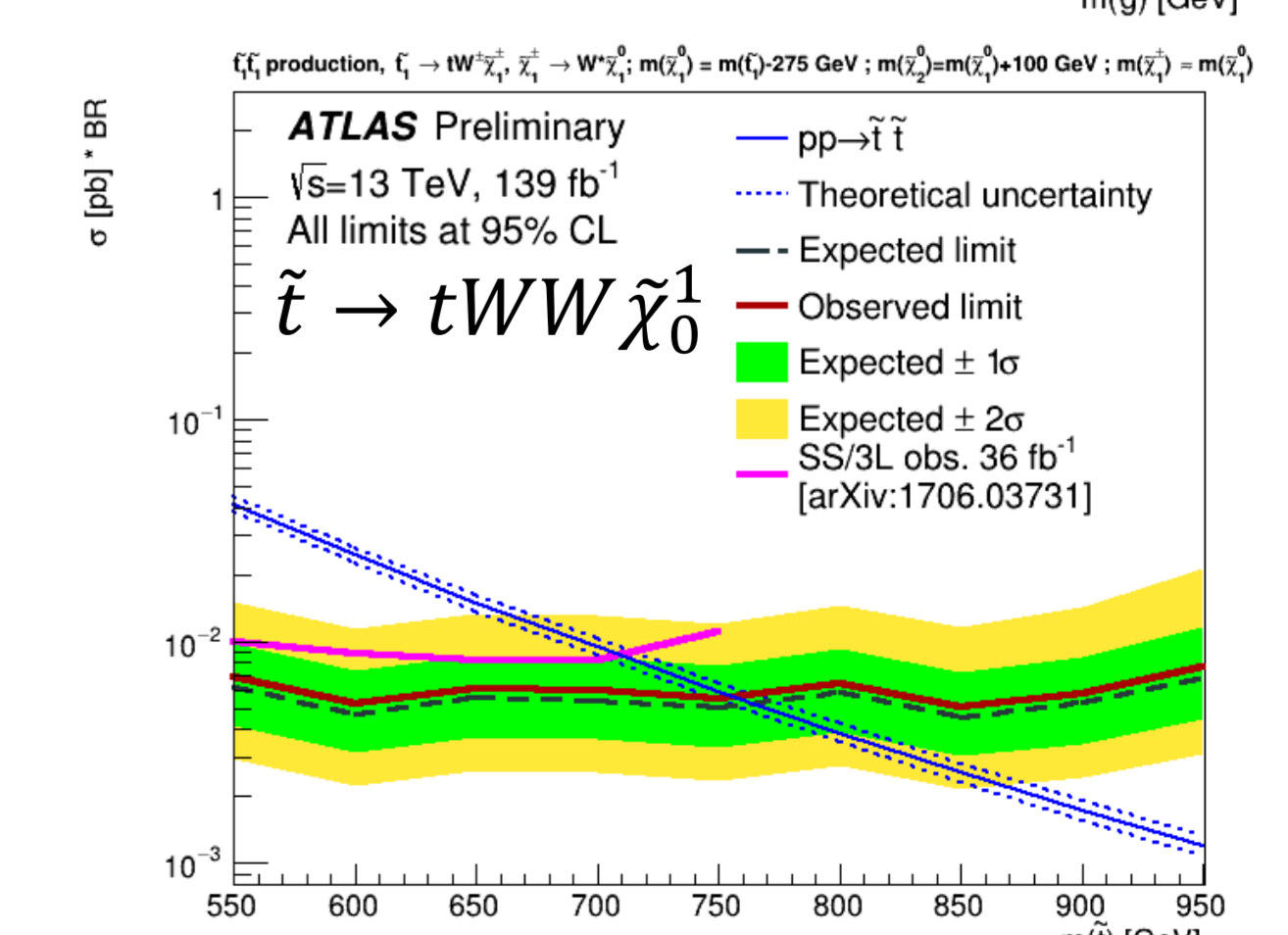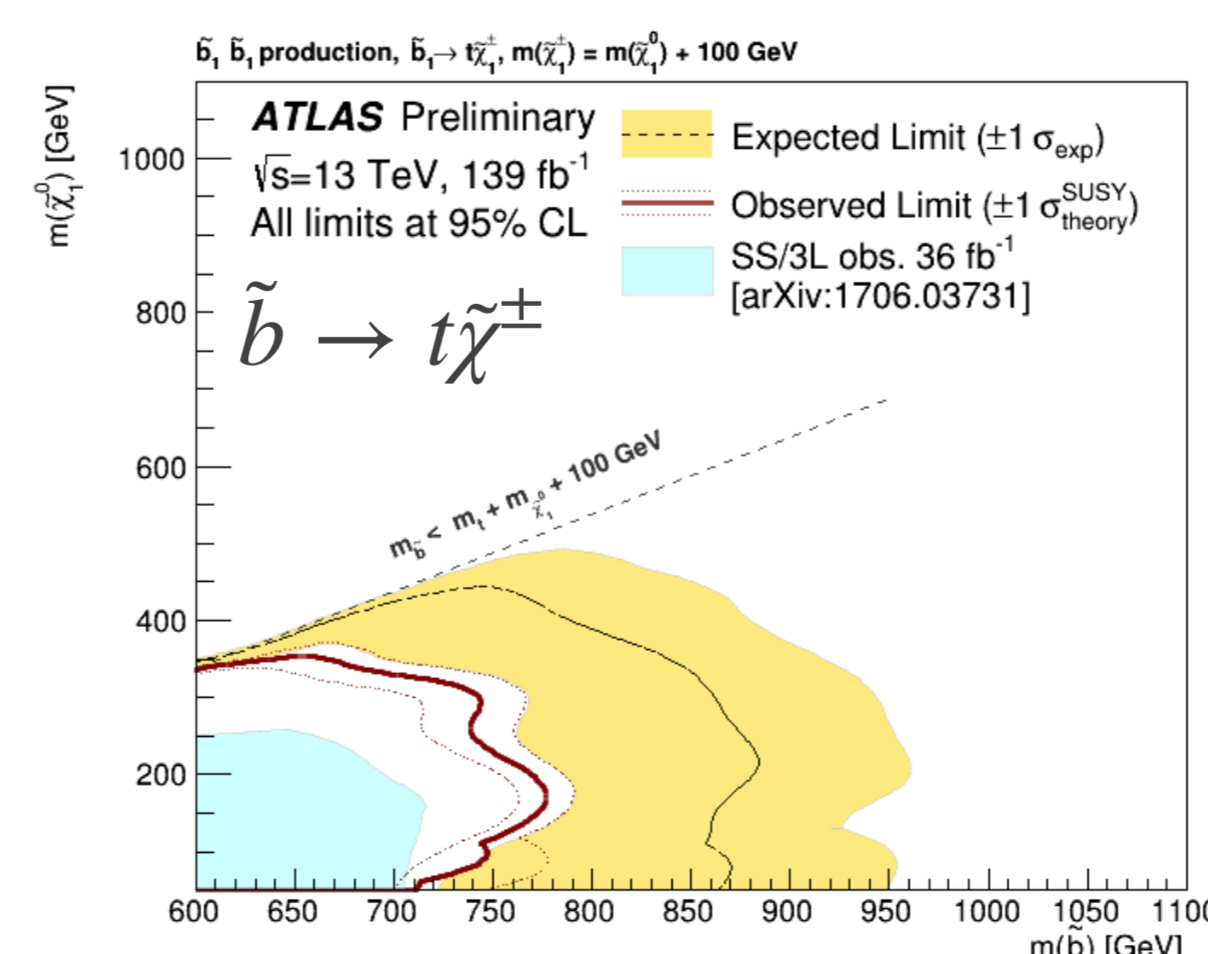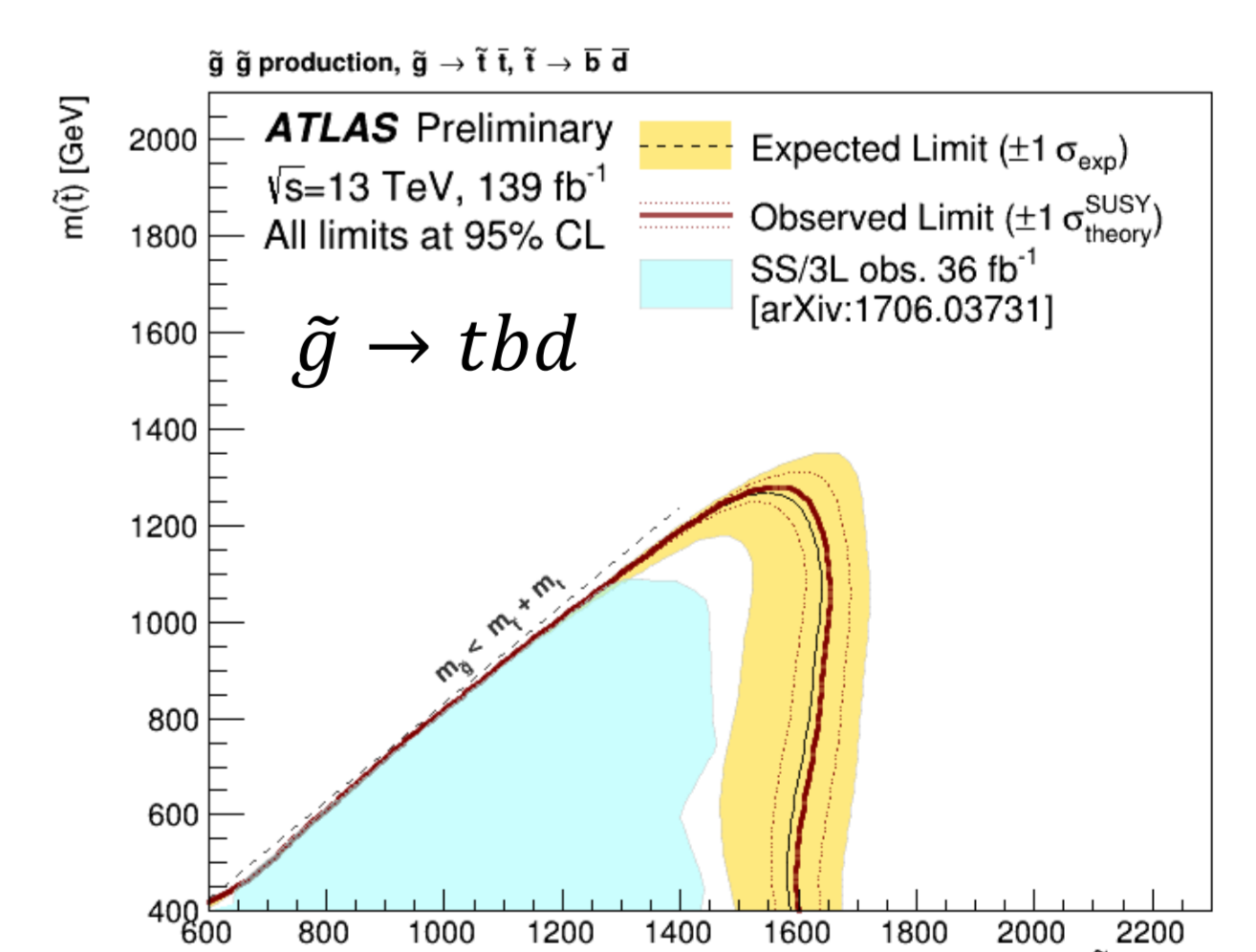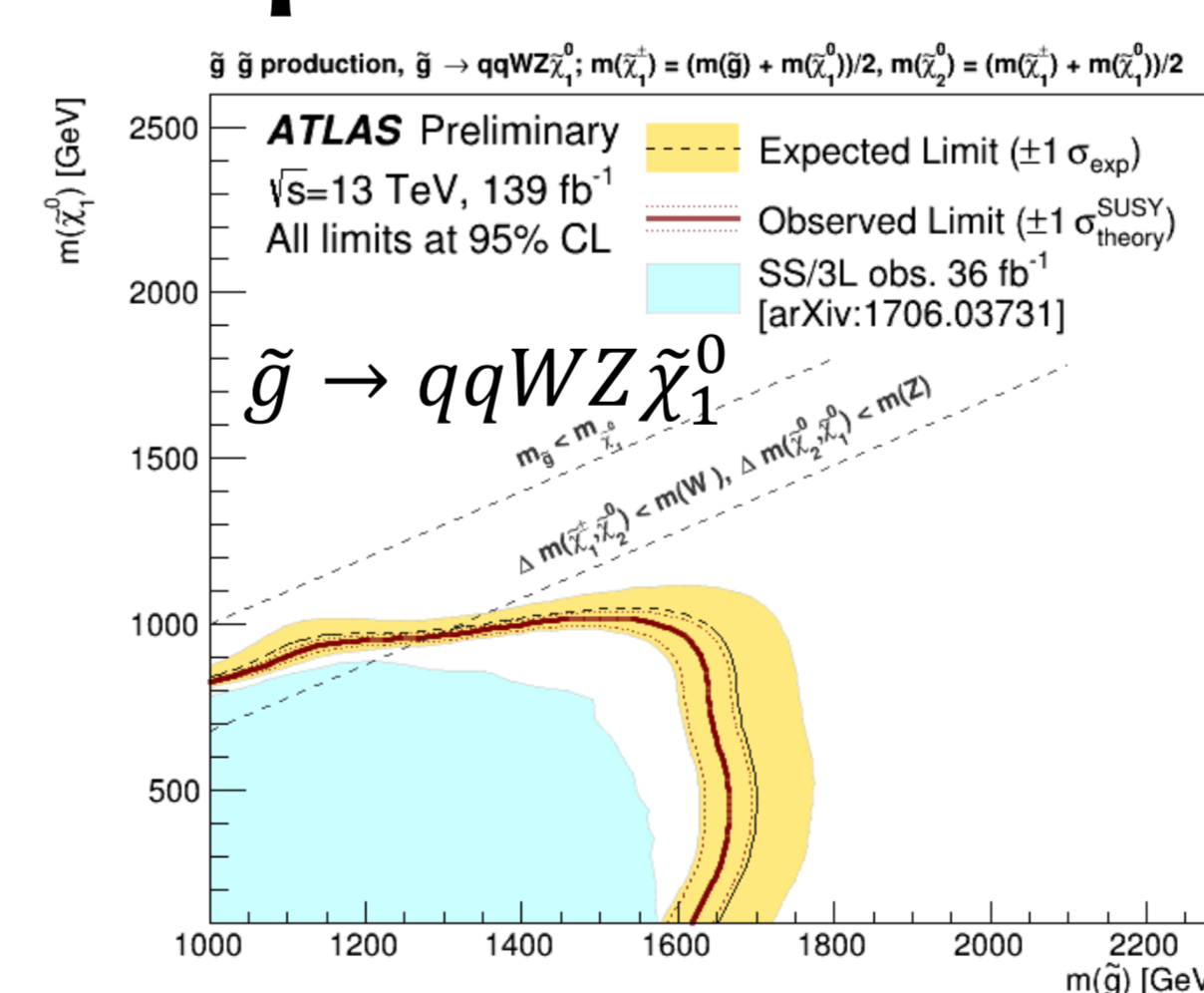The yield of 139 fb[-1] data and the predicted SM background is shown.

- No excess over the expected yields

	Rpc2L0b	Rpc2L1b	Rpc2L2b	Rpc3LSS1b	Rpv2L
Observed	6	11	12	4	5
Total SM background	4.8 ± 1.4	6.5 ± 1.5	7.8 ± 2.2	3.5 ± 1.4	5.6 ± 1.8
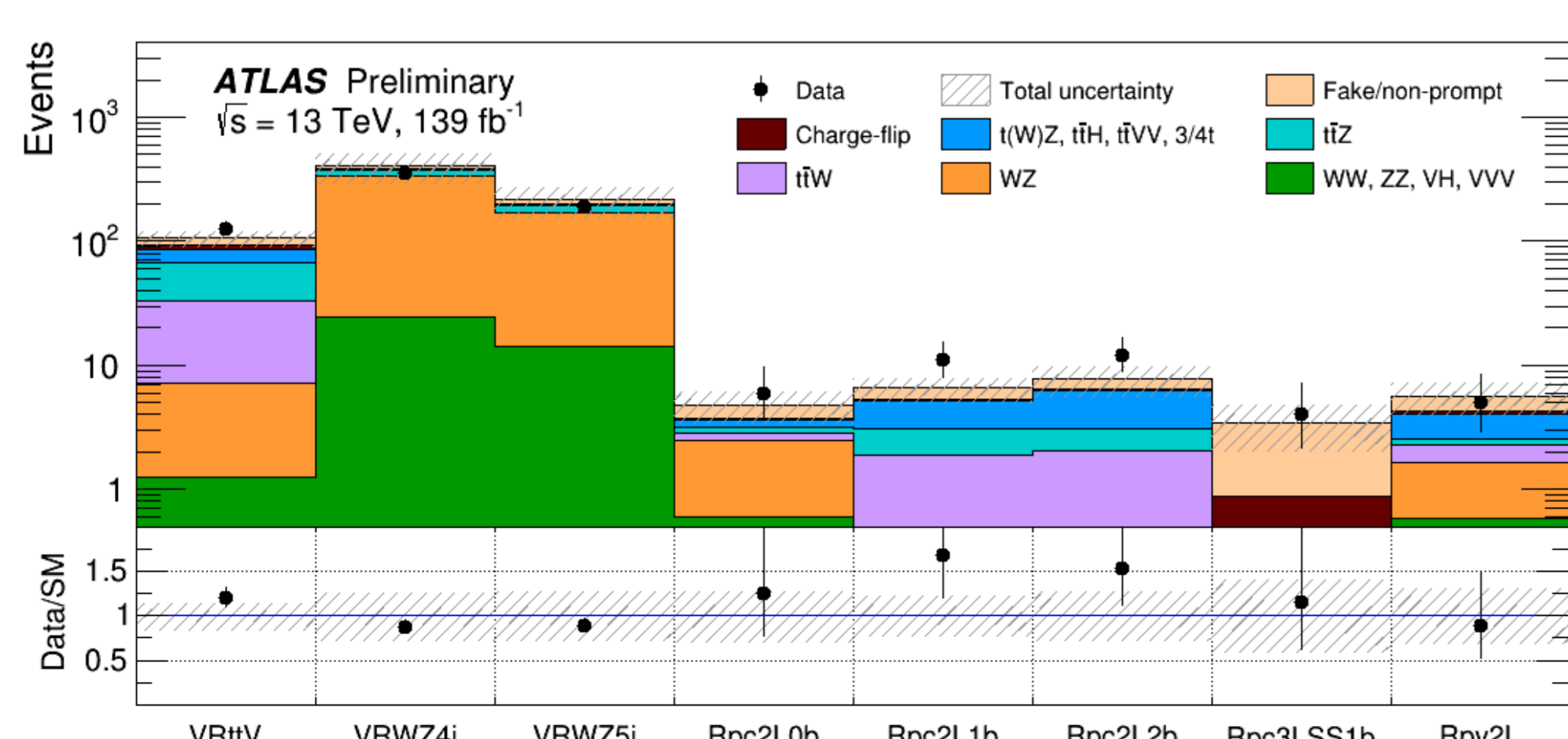
Interpretation

95 % CLs exclusion limits are computed.

$\tilde{g} \to qqWZ\tilde{\chi}_1^0$ $\qquad$ $\tilde{g} \to tbd$ $\qquad$ $\tilde{b} \to t\tilde{\chi}^{\pm}$ $\qquad$ $\tilde{t} \to tWW\tilde{\chi}_0^1$

m($\tilde{g}$) < 1.6 TeV , m($\tilde{\chi}_1^0$) < 1.0 – 1.2 TeV m($\tilde{t}$), m($\tilde{b}$) < 750 GeV can be excluded in the model considered.

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Reference: ATLAS-CONF-015