Simplified Models for BSM Higgs searches.

Henning Bahl, Víctor Martín Lozano, Tim Stefaniak and Georg Weiglein

Motivations.

We, as phenomenologists, think that it would be nice to have a reinterpretation of the experimental data into simplified models that can be easily translated into the different phenomenological models. For that reason we have developed a framework focused on simplified models for BSM Higgs searches.

It is important to clarify that when we refer to BSM Higgs searches are not the "normal" Higgs channels, i.e. H,A$\rightarrow$tau tau, but the channels with a non-SM final state involving at least one DM/invisible particle.

Framework.

Every simplified model has:

ϕ^0 : Heavy scalar resonance.

$\mathcal{M}_{S,V,F}$: Mediator (scalar, vector, fermion)

$\mathcal{I}_{S,V,F}$: Invisible particle (scalar, vector, fermion)

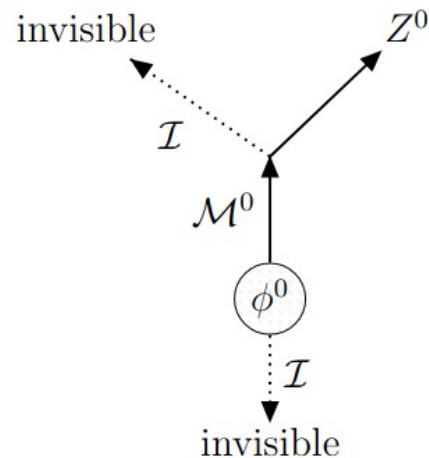We want to see if the differences of the nature of the particles could play a role in the searches.
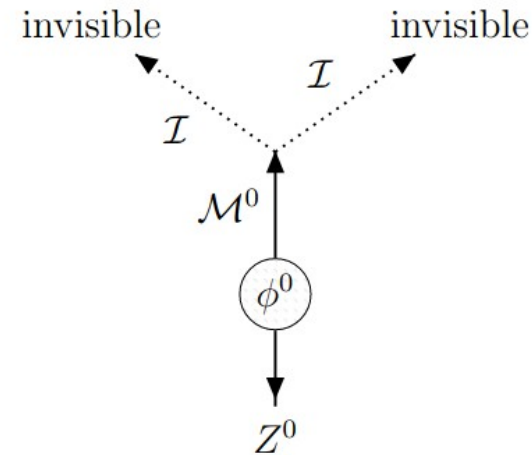These simplified models are already in Feynrules/MadGraph.

Signatures.

We study the following signatures:
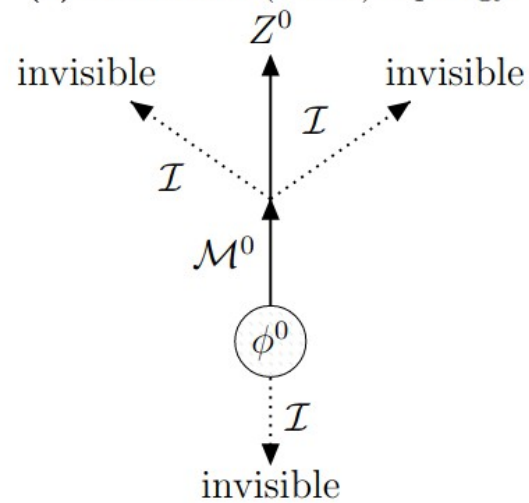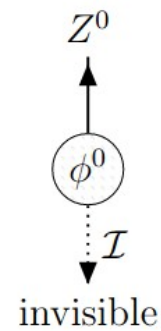
- Dilepton + MET
- Z + MET
- ZZ + MET
- WW + MET
- H + MET
- HH + MET

Z + MET.

(a) Z-balanced (2-vs-1) topology.
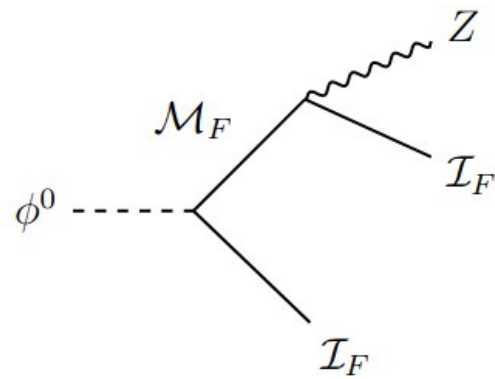
(b) Z-unbalanced (2-vs-1) topology.
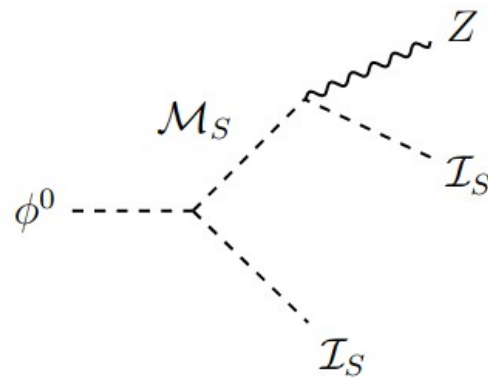
(c) Z-balanced (3-vs-1) topology.
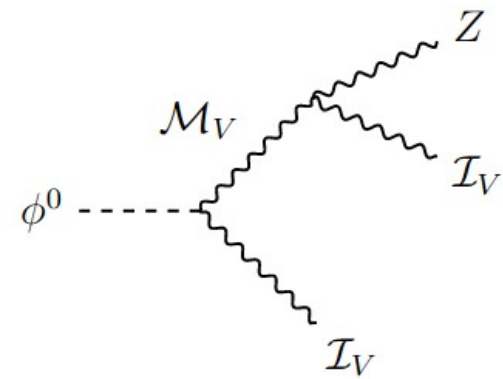
(d) Z-unbalanced (1-vs-1) topology.

Z + MET.
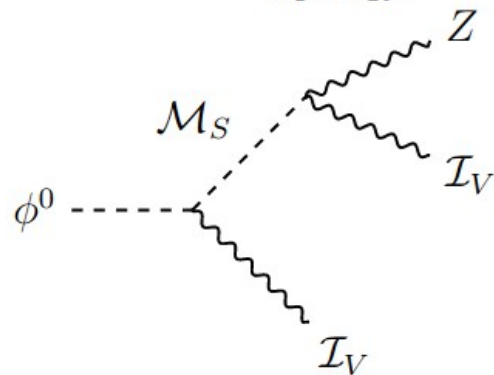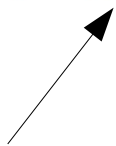

(a) $\mathcal{M}_F\mathcal{I}_F$-$Z$-balanced 2-vs-1 **(b)** $\mathcal{M}_S\mathcal{I}_S$-$Z$-balanced 2-vs-1 **(c)** $\mathcal{M}_V\mathcal{I}_V$-$Z$-balanced 2-vs-1 topology. topology. topology.

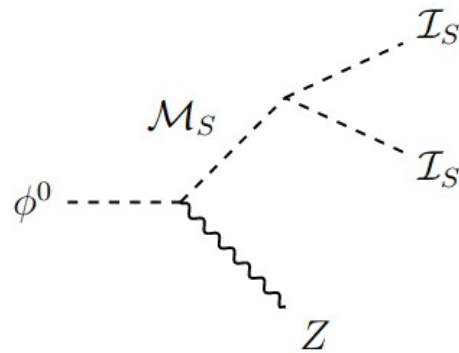EWinos

(d) $\mathcal{M}_S\mathcal{I}_V$-$Z$-balanced 2-vs-1 **(e)** $\mathcal{M}_V\mathcal{I}_S$-$Z$-balanced 2-vs-1 topology. topology.
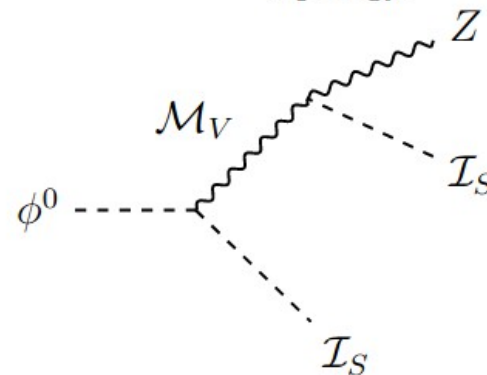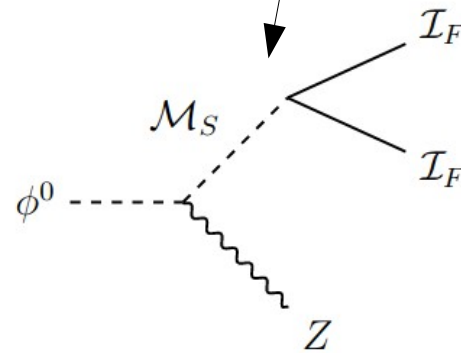
Z + MET.

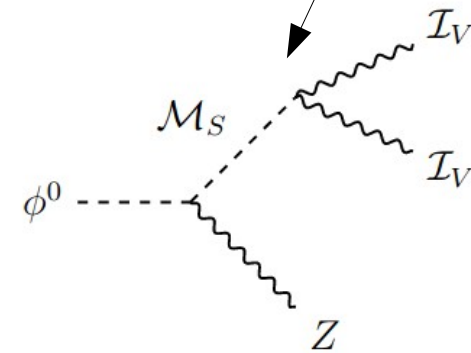MSSM: $H \to ZA, A \to \tilde{\chi}\tilde{\chi}$

THDMa (fermion DM)

THDMa (vector DM)

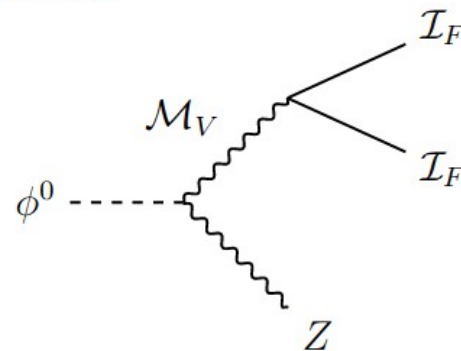(a) $\mathcal{M}_S\mathcal{I}_S$-Z-unbalanced 2-vs-1 topology.

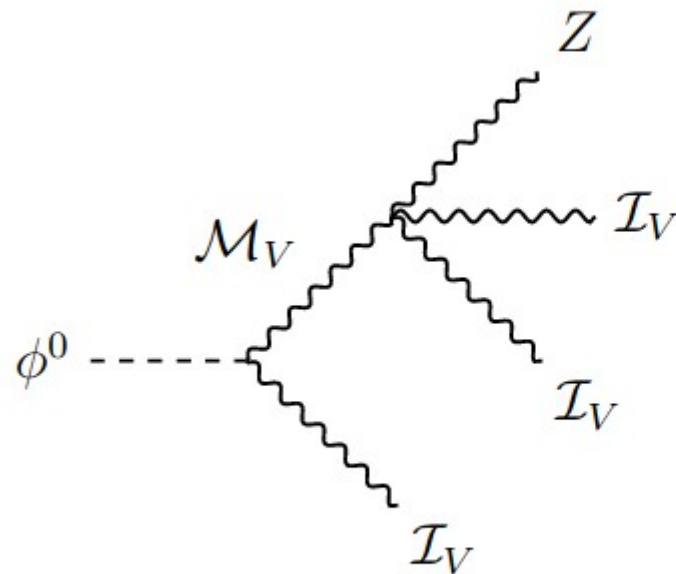(b) $\mathcal{M}_S\mathcal{I}_F$-Z-unbalanced 2-vs-1 topology.

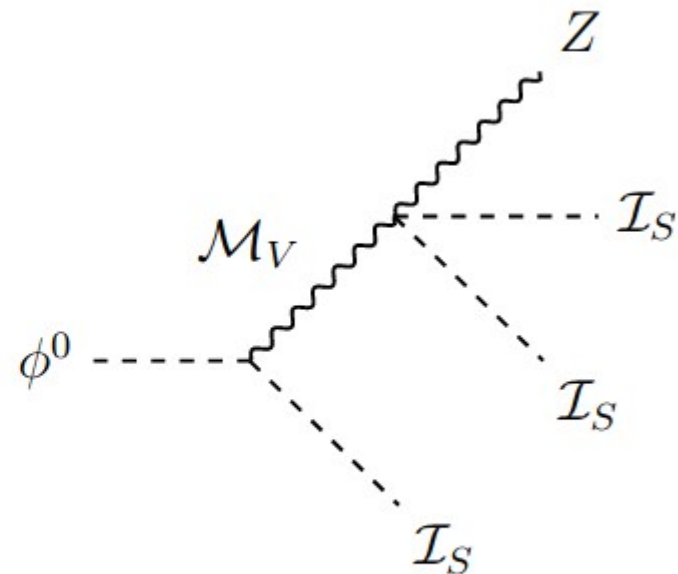(c) $\mathcal{M}_S\mathcal{I}_V$-Z-unbalanced 2-vs-1 topology.

THDMa (scalar DM)

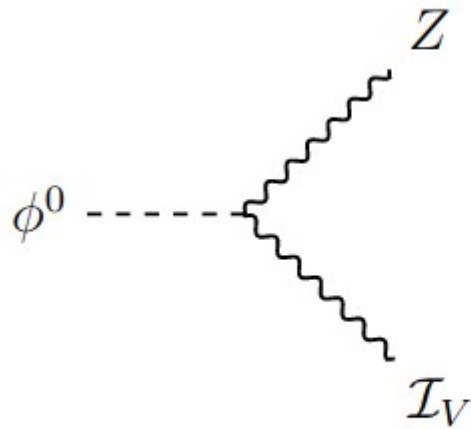(d) $\mathcal{M}_V\mathcal{I}_F$-Z-unbalanced 2-vs-1 topology.

Z + MET.

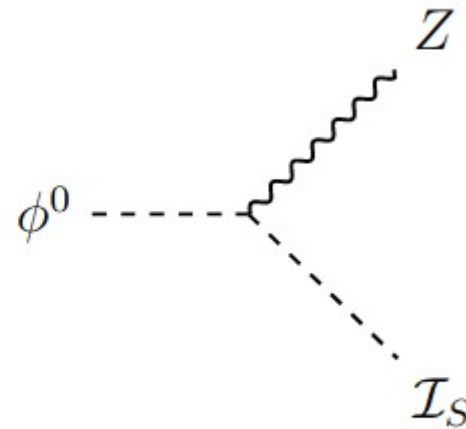(a) $\mathcal{M}_V \mathcal{I}_V$-$Z$ balanced 3-vs-1 topology.

(b) $\mathcal{M}_V \mathcal{I}_S$-$Z$ balanced 3-vs-1 topology.

Z + MET.

(a) $\mathcal{I}_V$-Z-unbalanced 1-vs-1 topology.
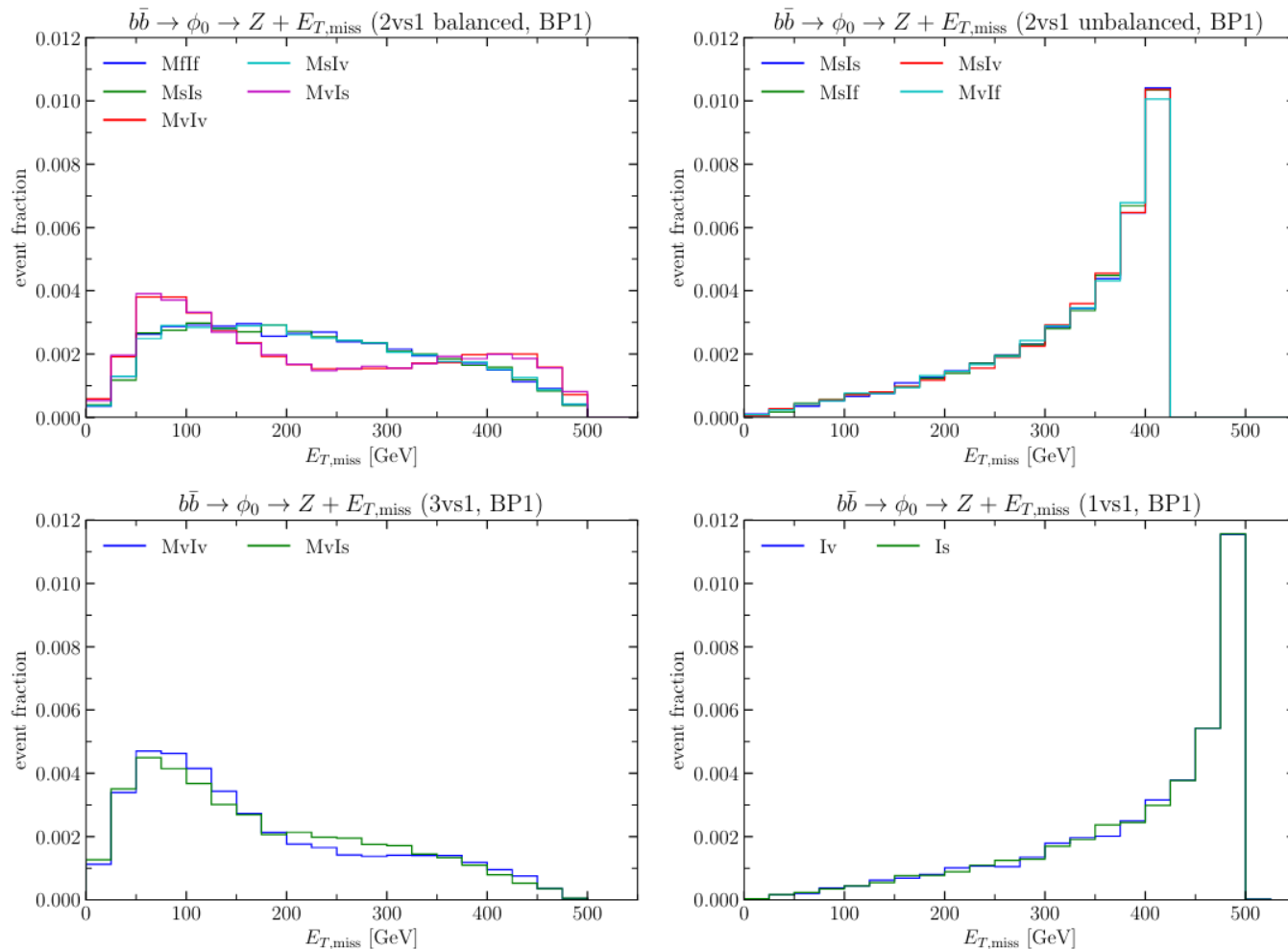
(b) $\mathcal{I}_S$-Z-unbalanced 1-vs-1 topology.

Z + MET.

Benchmark Points:

- BP1: $m_\phi = 1$ TeV, $m_M = 400$ GeV, $m_I = 10$ GeV

- BP2: $m_\phi = 1$ TeV, $m_M = 400$ GeV, $m_I = 100$ GeV

- BP3: $m_\phi = 1$ TeV, $m_M = 260$ GeV, $m_I = 10$ GeV

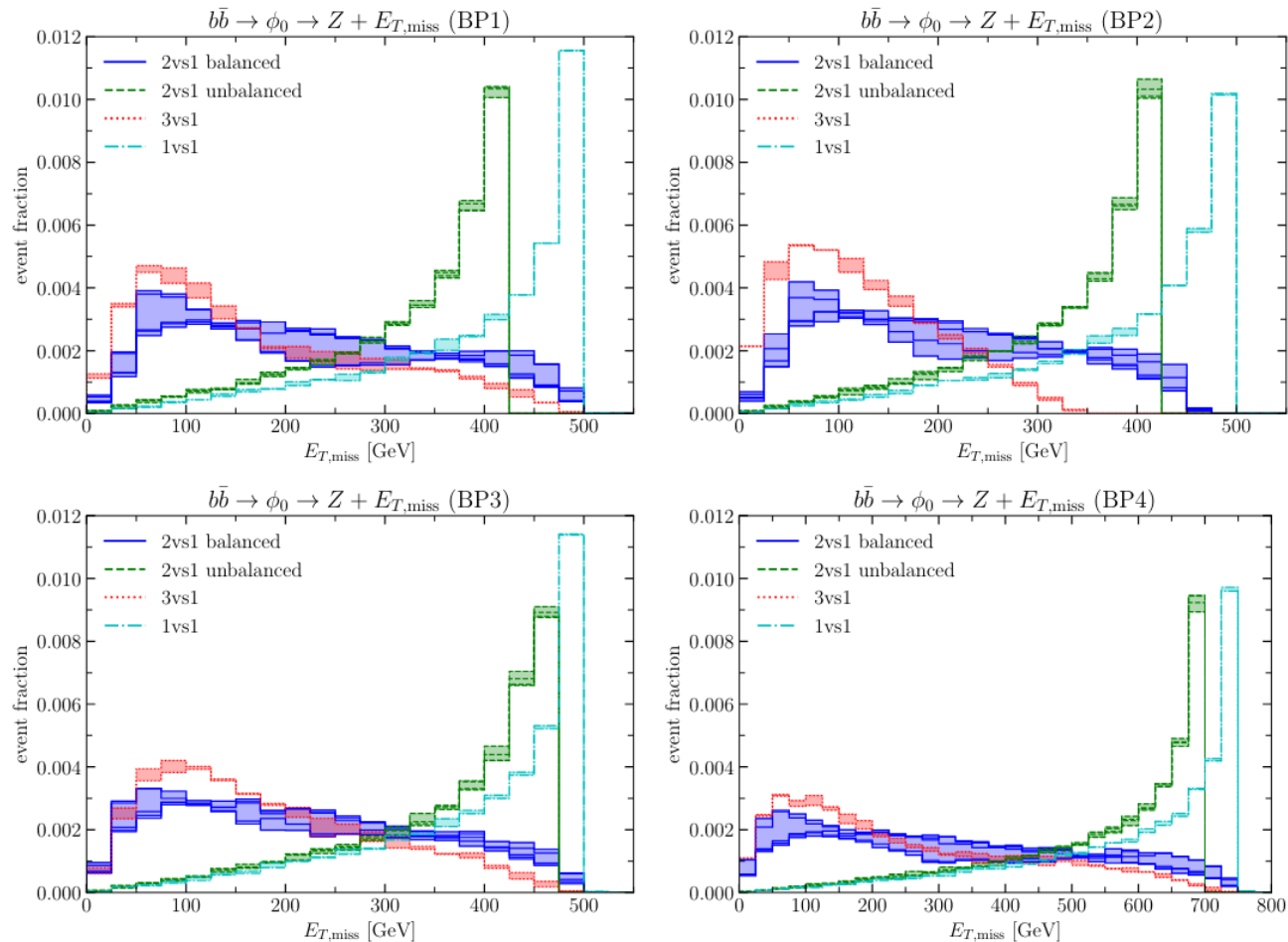- BP4: $m_\phi = 1.5$ TeV, $m_M = 400$ GeV, $m_I = 10$ GeV
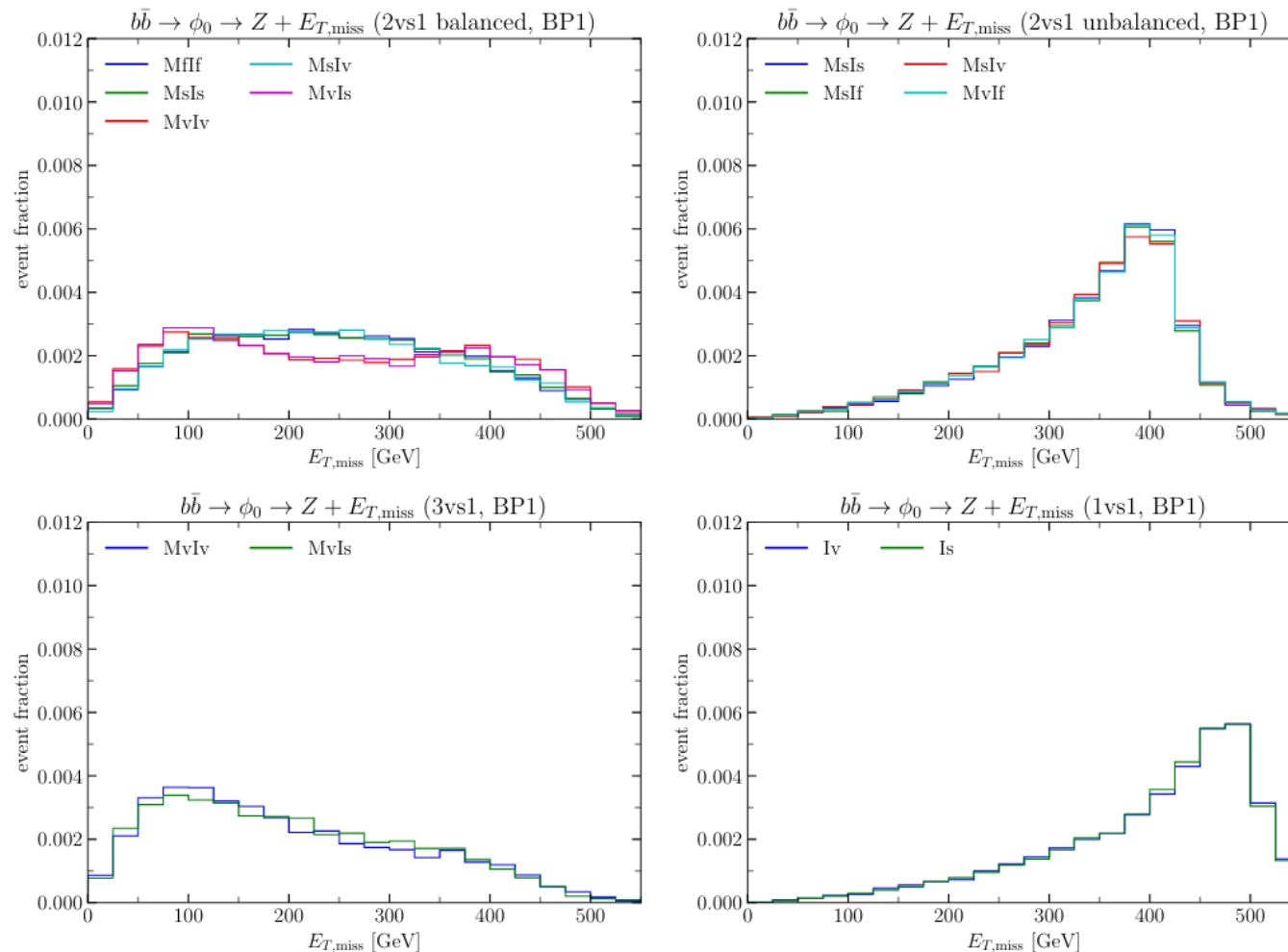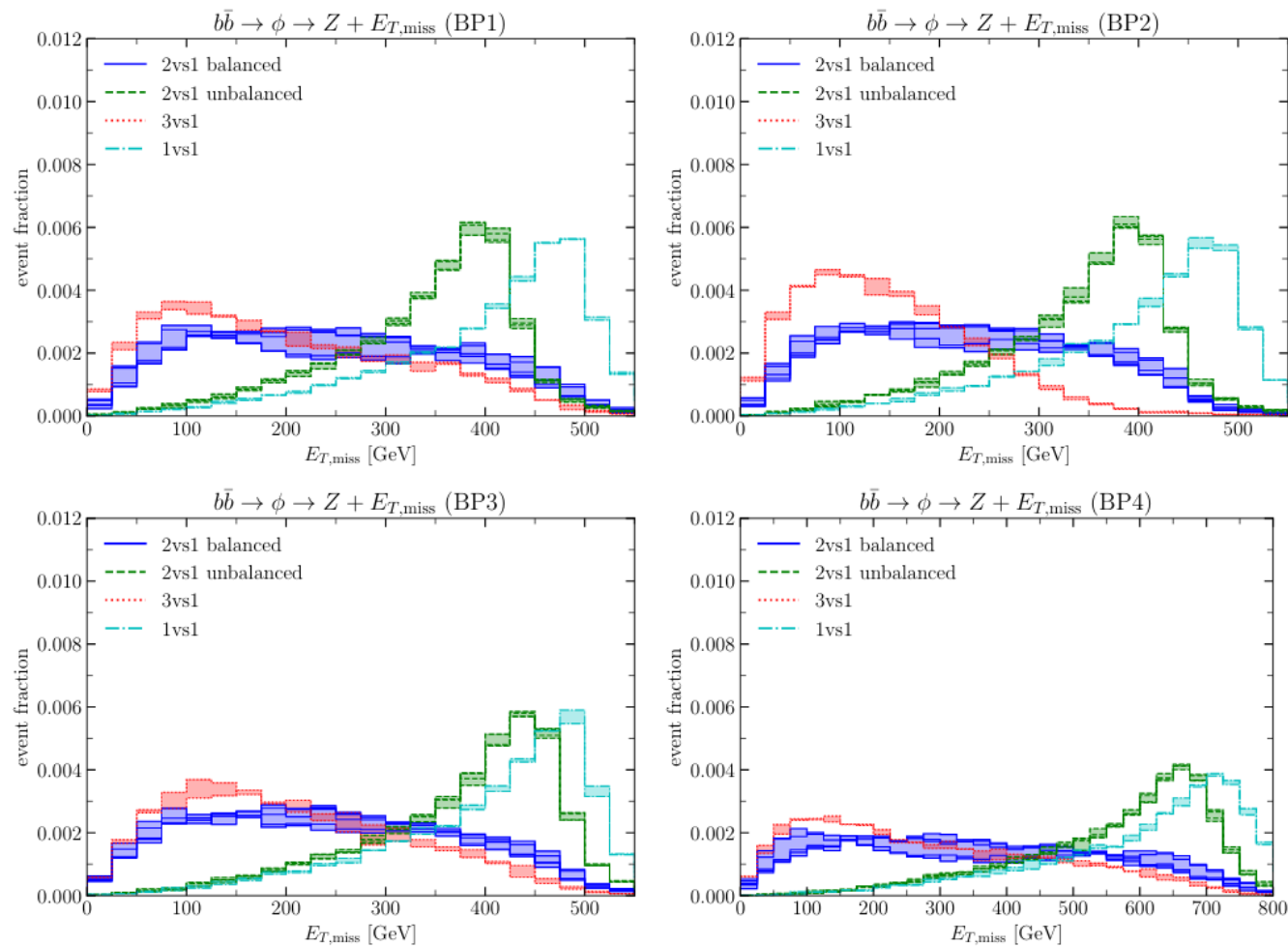
Z + MET.

Parton Level:
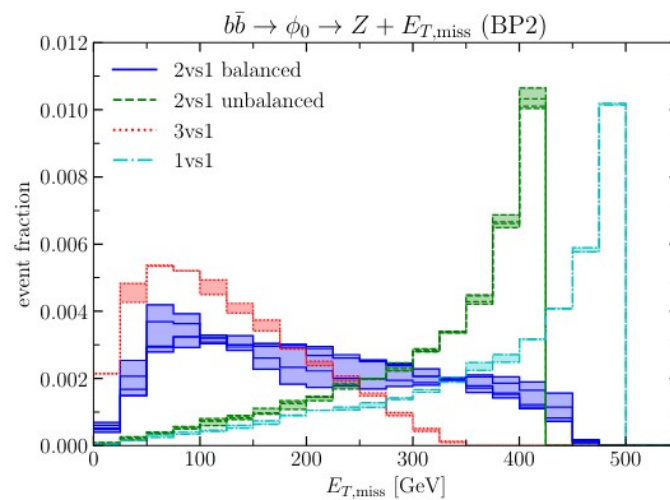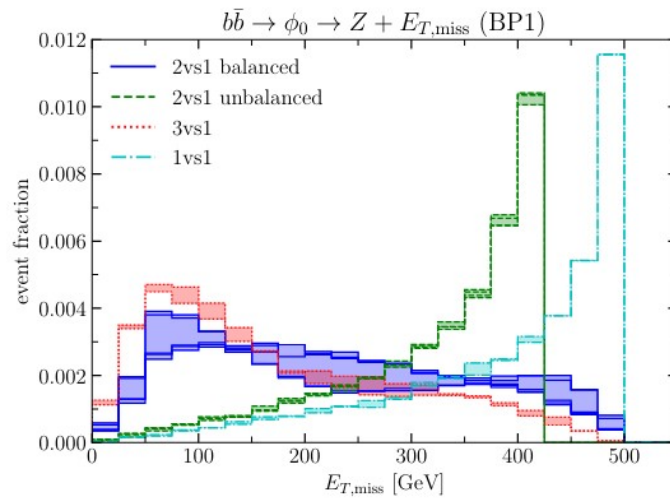
Z + MET.

Parton Level:

Z + MET.

Detector Level:

Z + MET.

Detector Level:
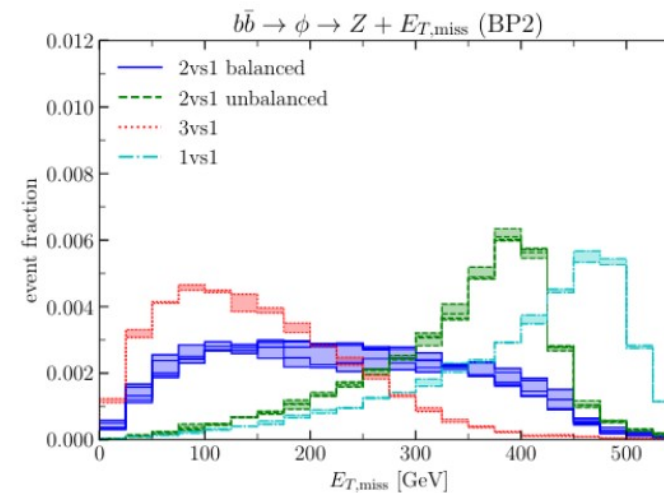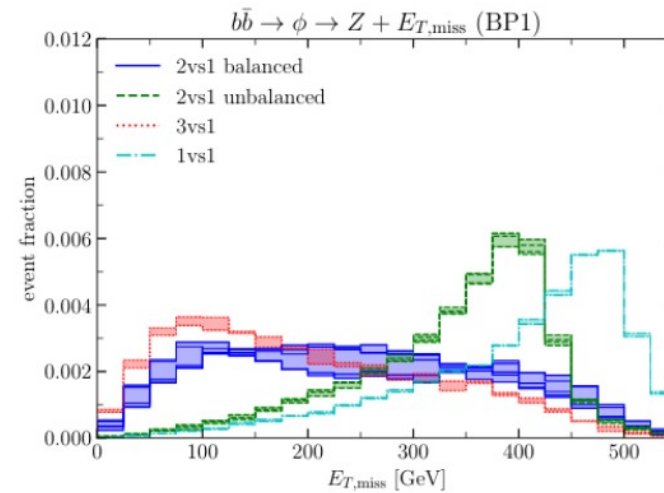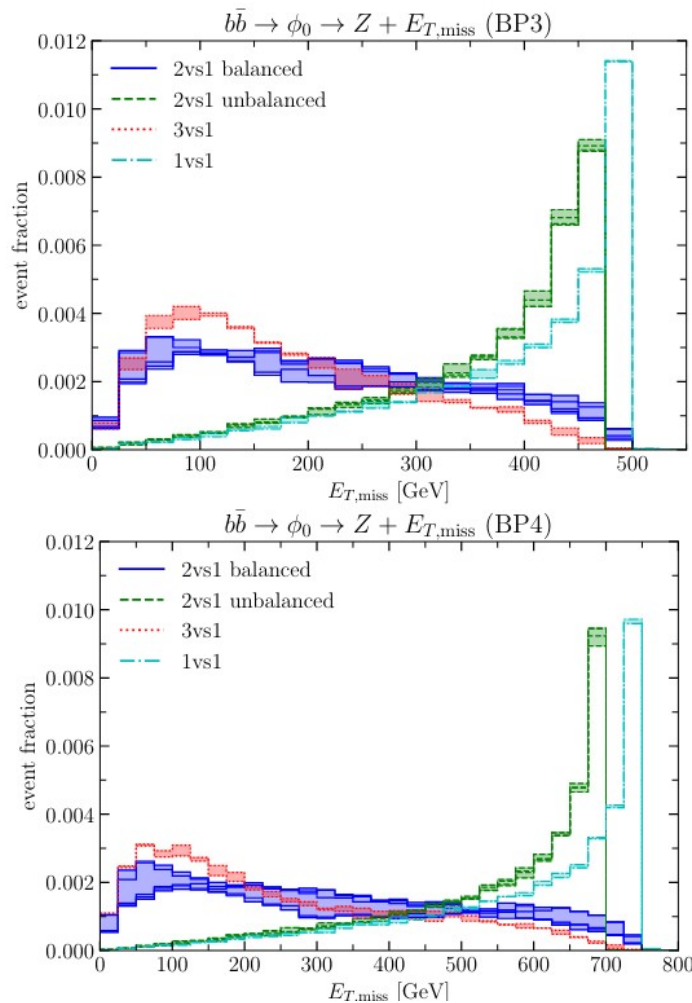
Z + MET.
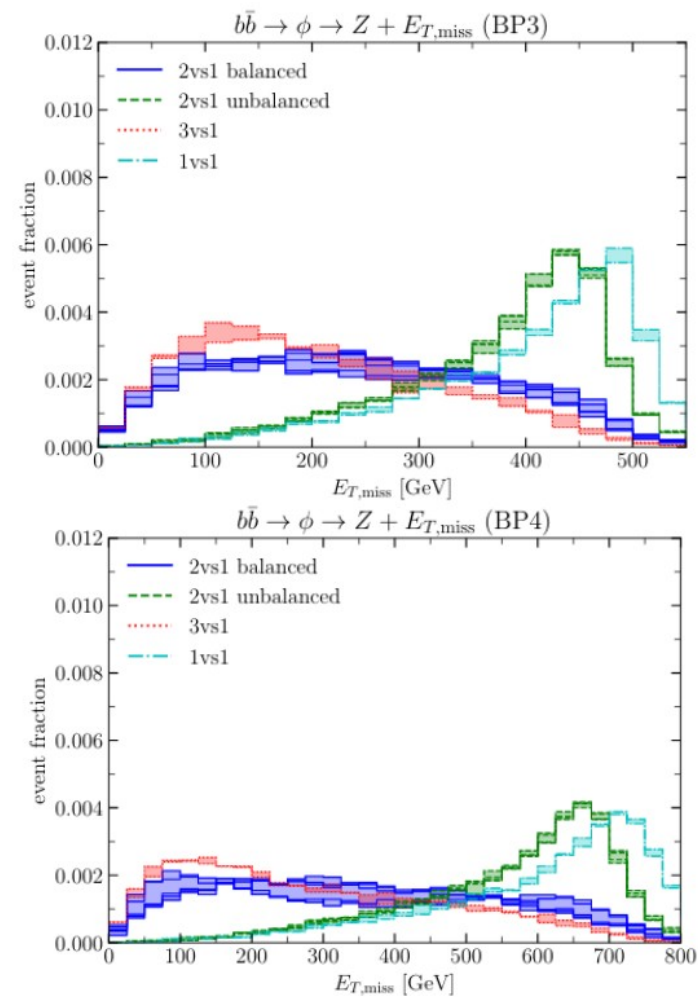
Parton Level

Detector Level

Z + MET.

Parton Level

Detector Level

Z + MET.

Limits on the (m_ϕ , m_M) for fixed values of m_I
(like SUSY searches)