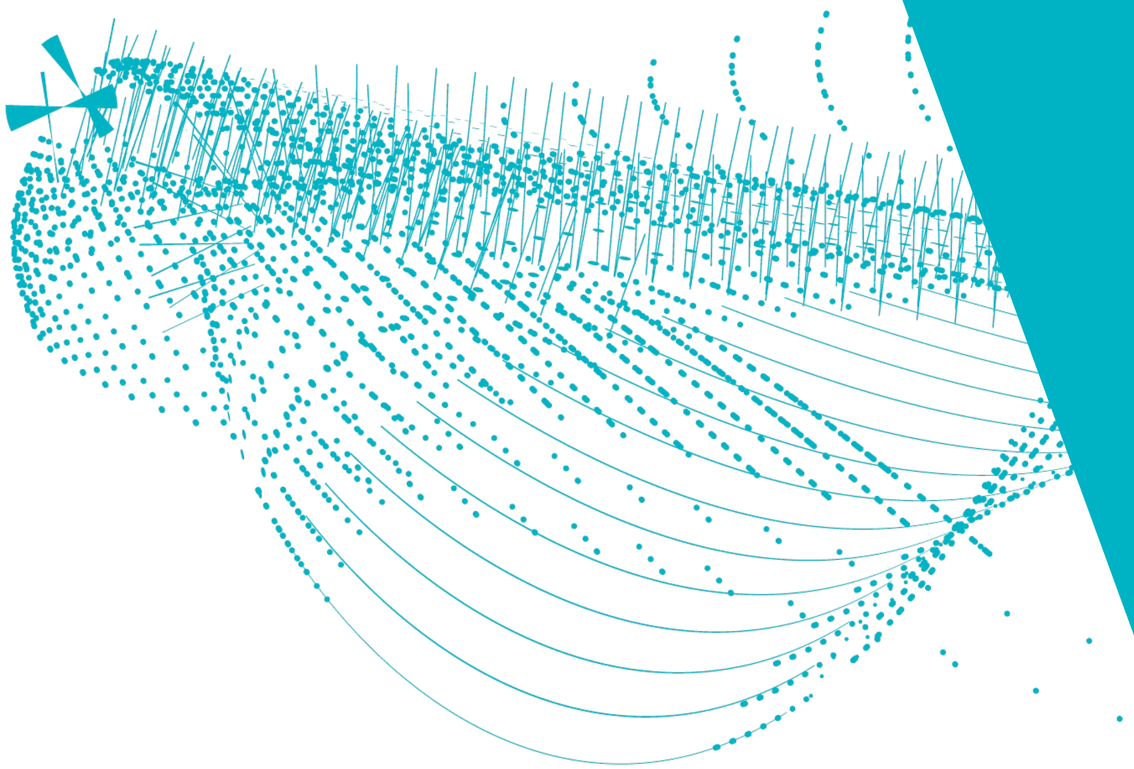
University of Amsterdam

Nikhef

NWO



ATLAS
Supersymmetry

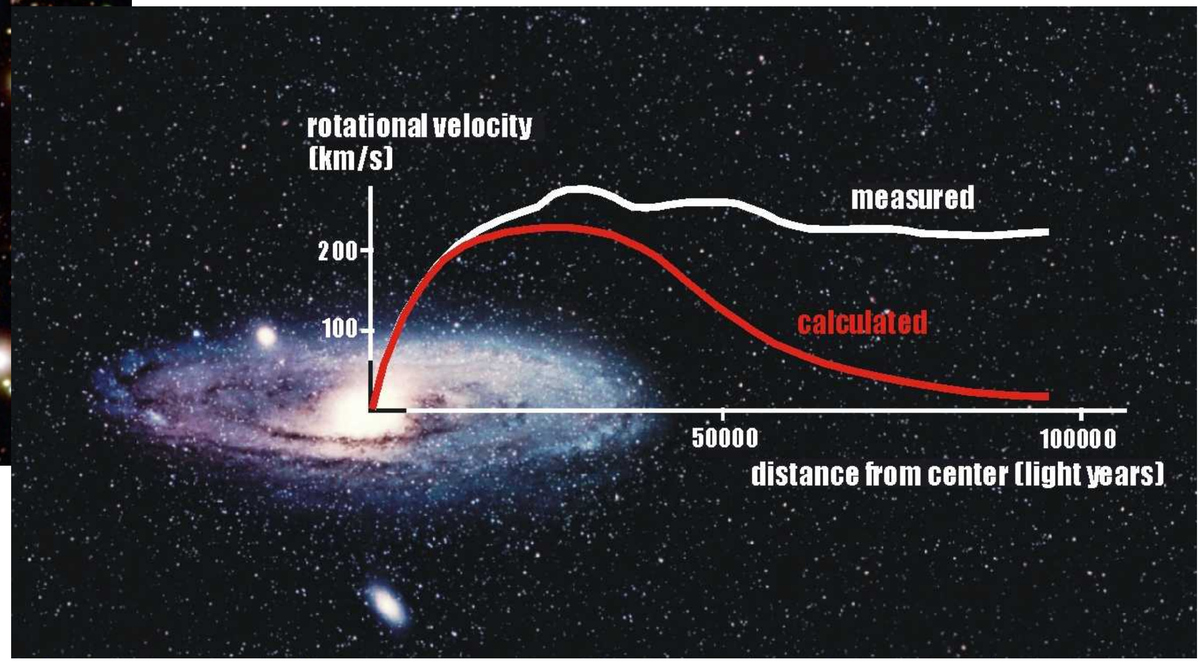
16/12/19

Broos Vermeulen

The elephant in the room

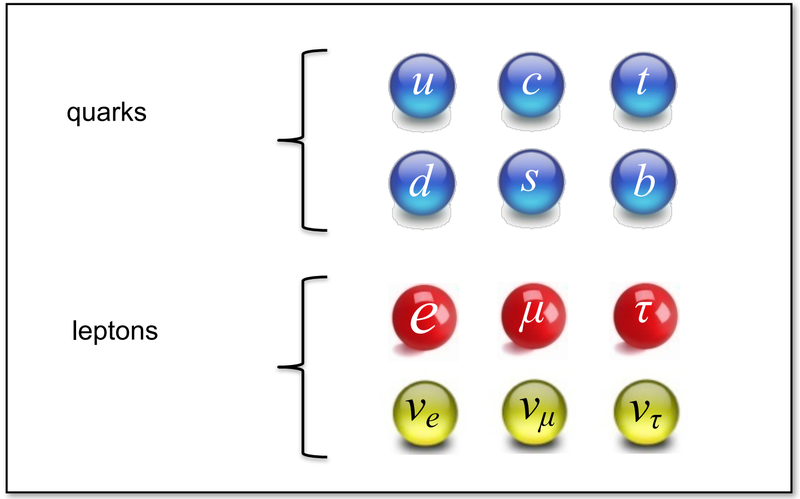
The elephant in the room

We have unexplained phenomena



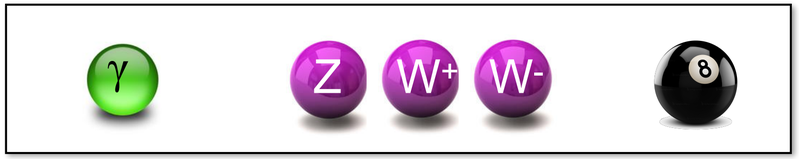
Gives us extra particles

FERMIONS



quarks and leptons

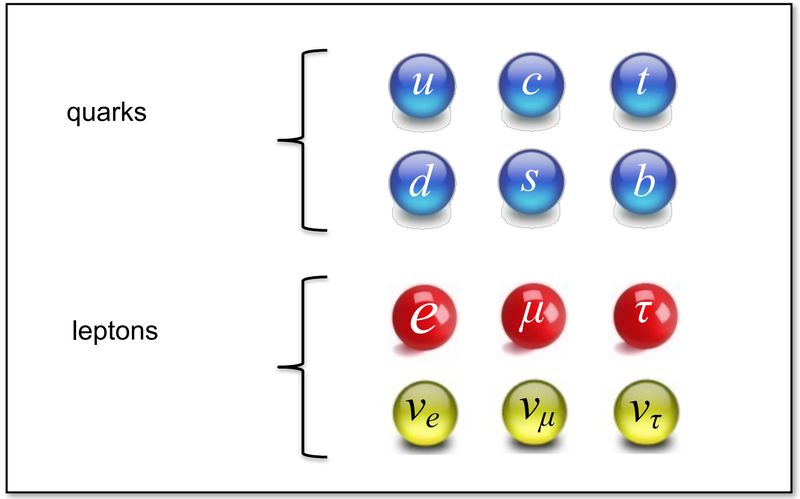
BOSONS



gauge bosons

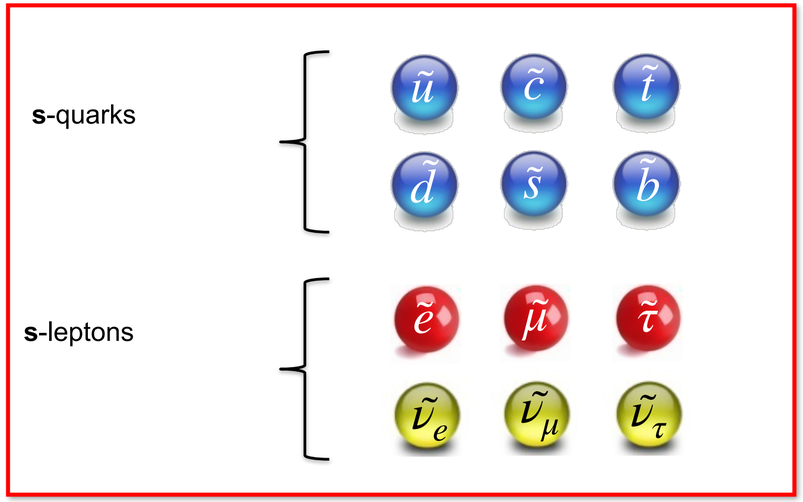
Gives us extra particles

FERMIONS

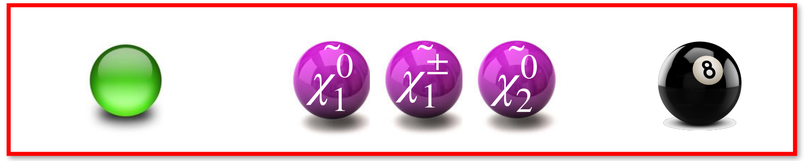


quarks and leptons

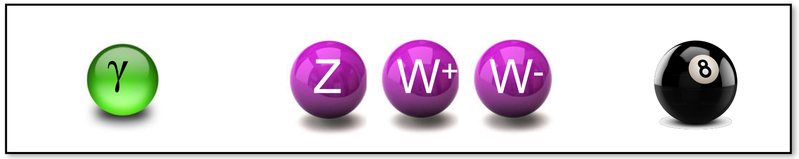
BOSONS



squarks and sleptons

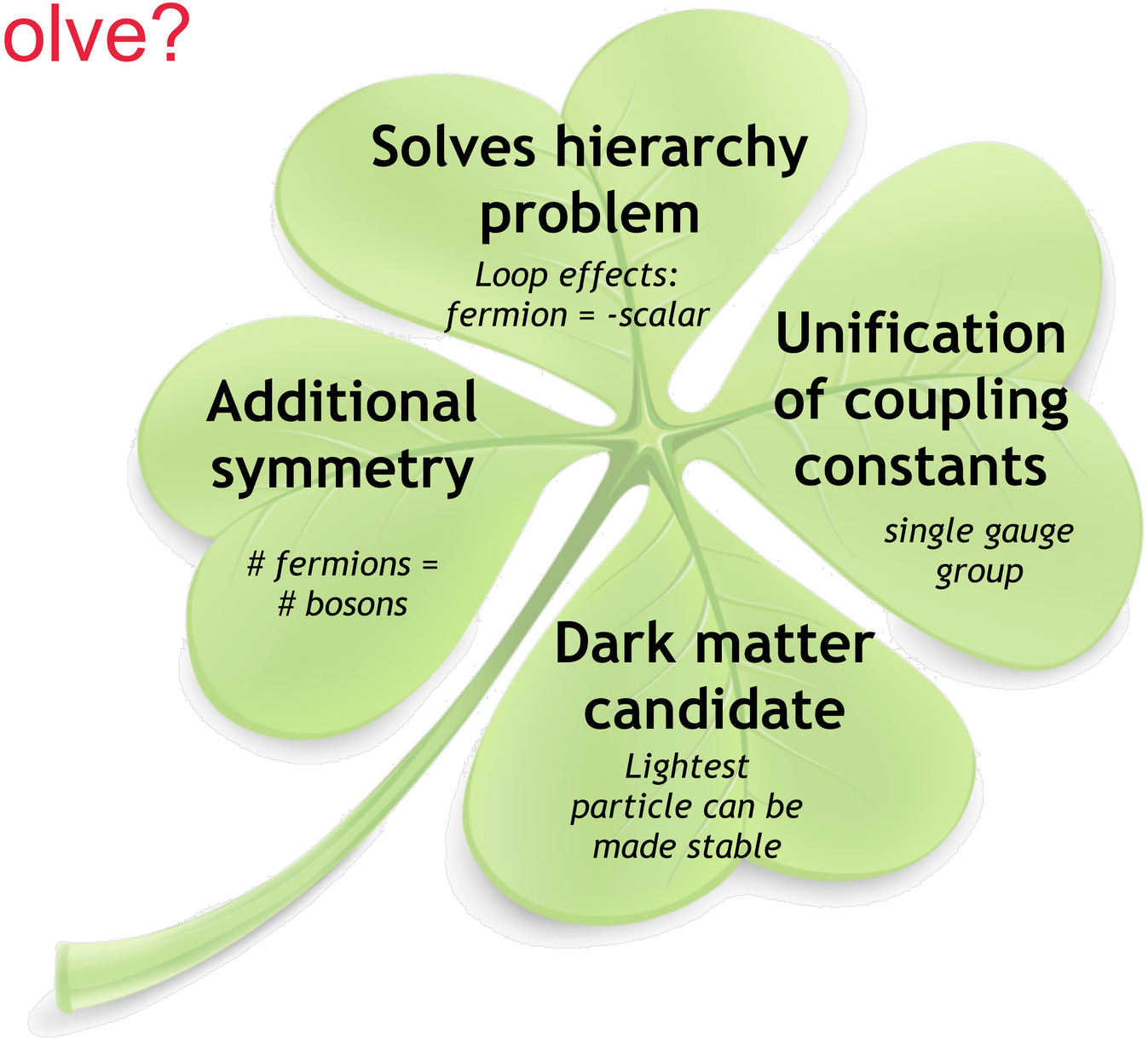


gaugino's

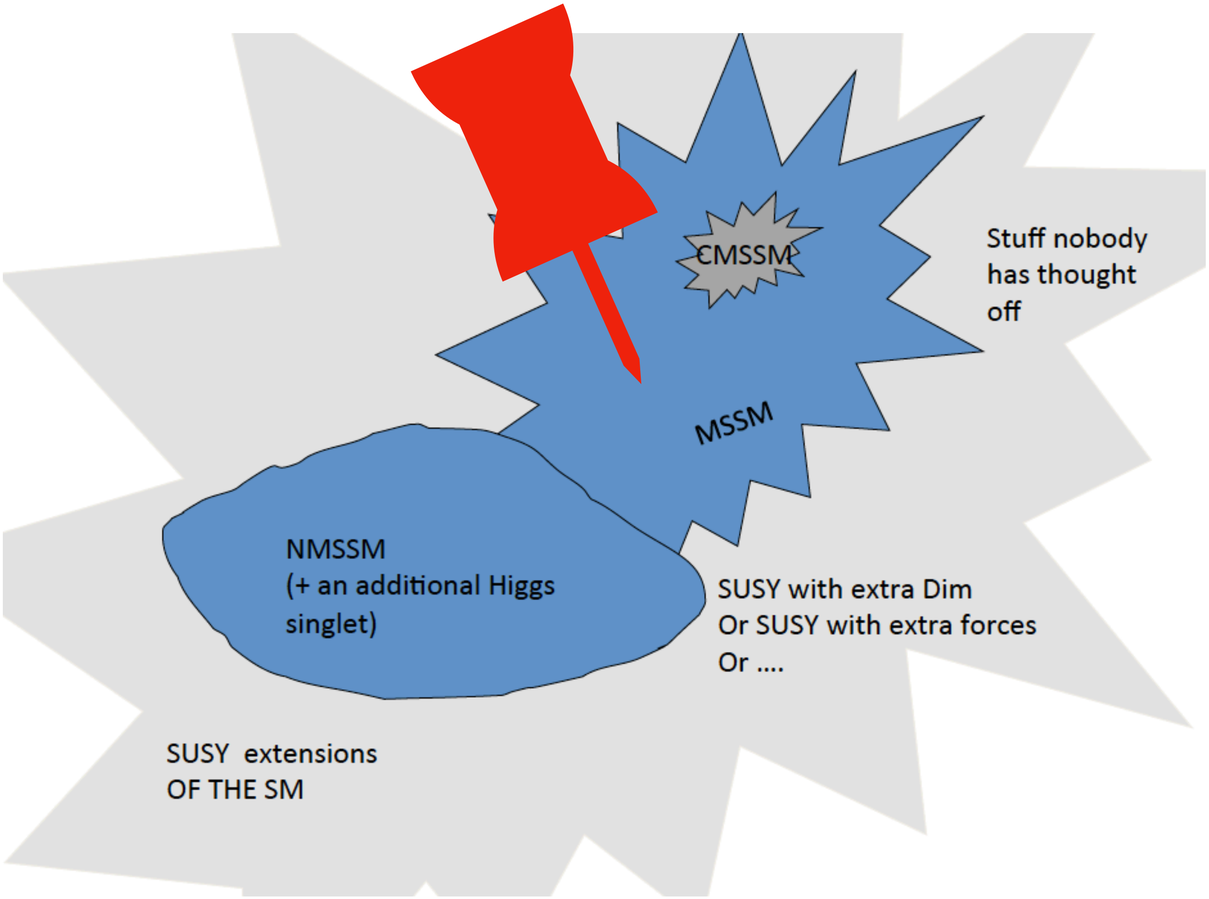


gauge bosons

What does it solve?



However…



Been looking for long already…

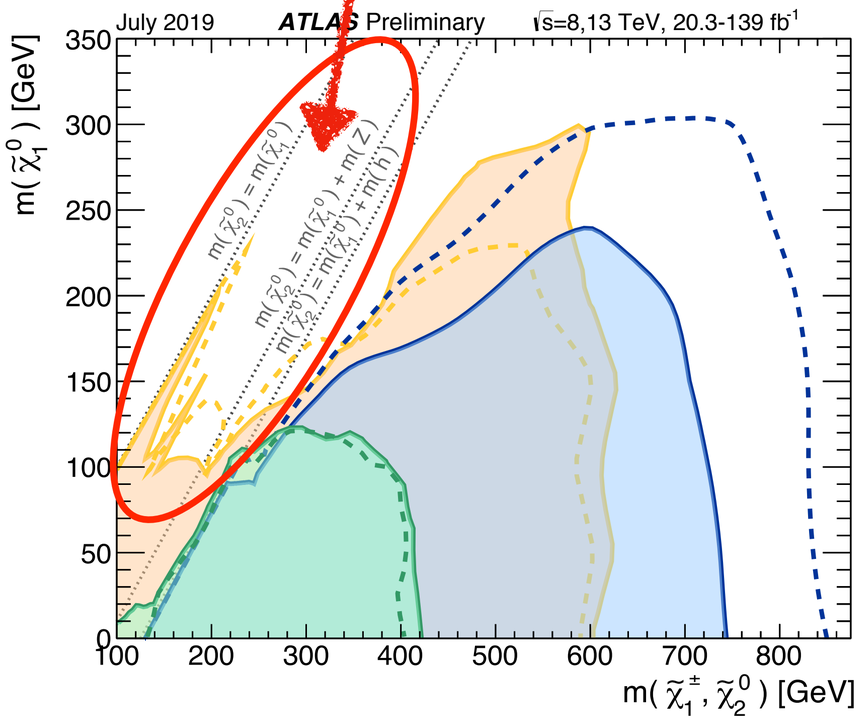
MSSM = Minimal Supersymmetric Standard Model

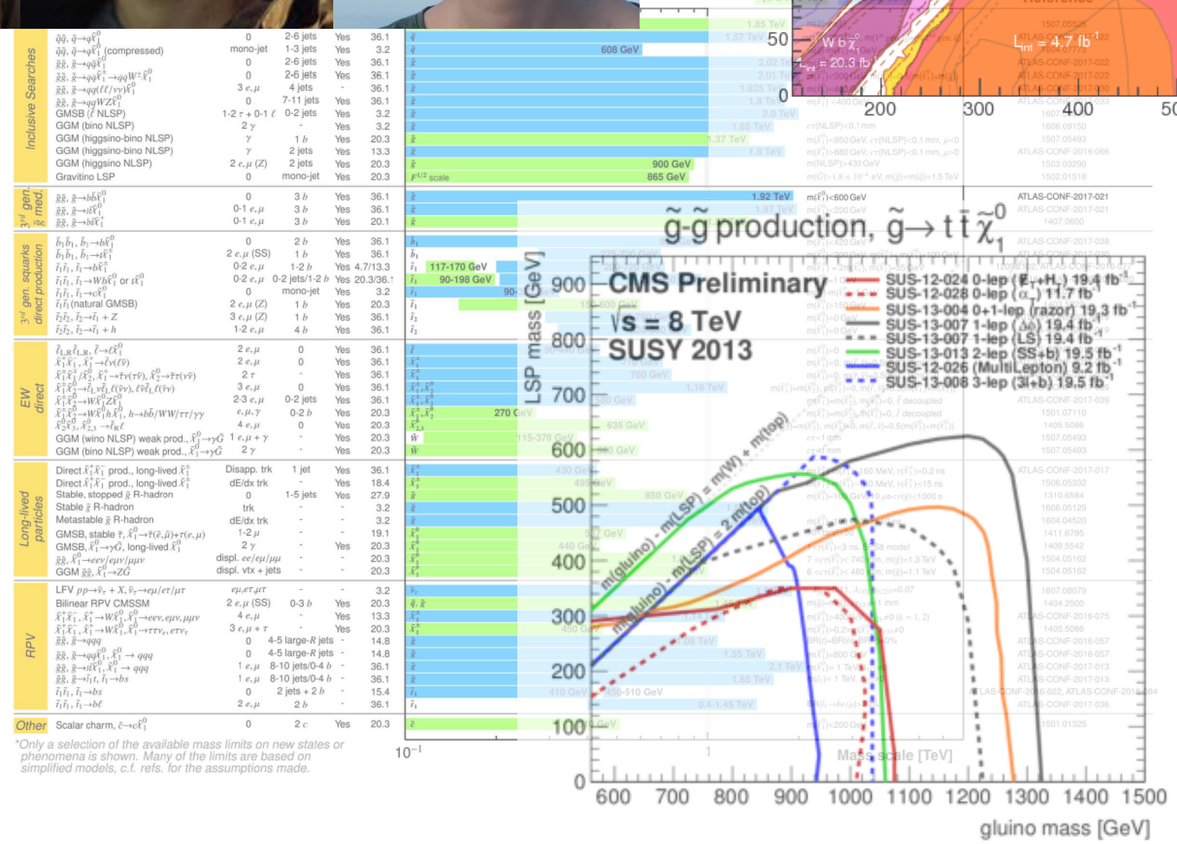
120 new parameters in the MSSM

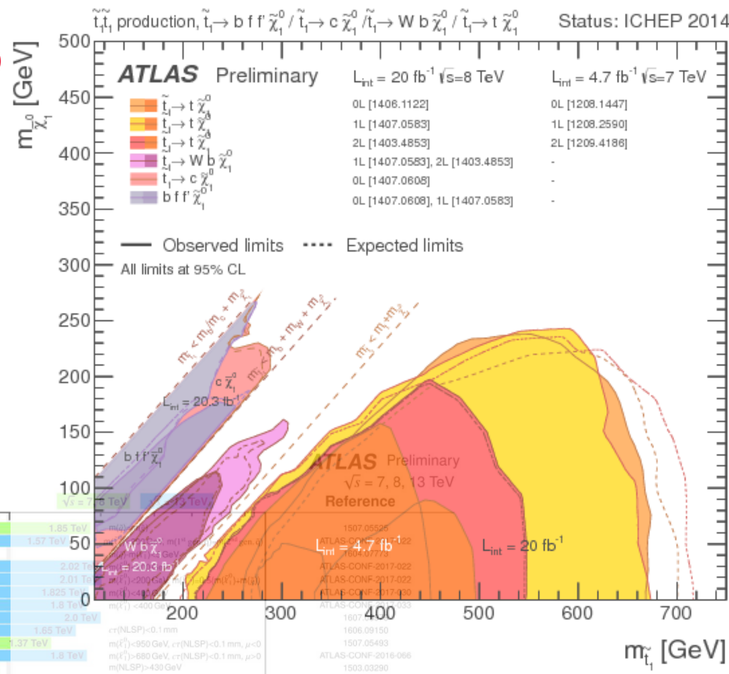
How do you explore this parameter space?

Nikhef

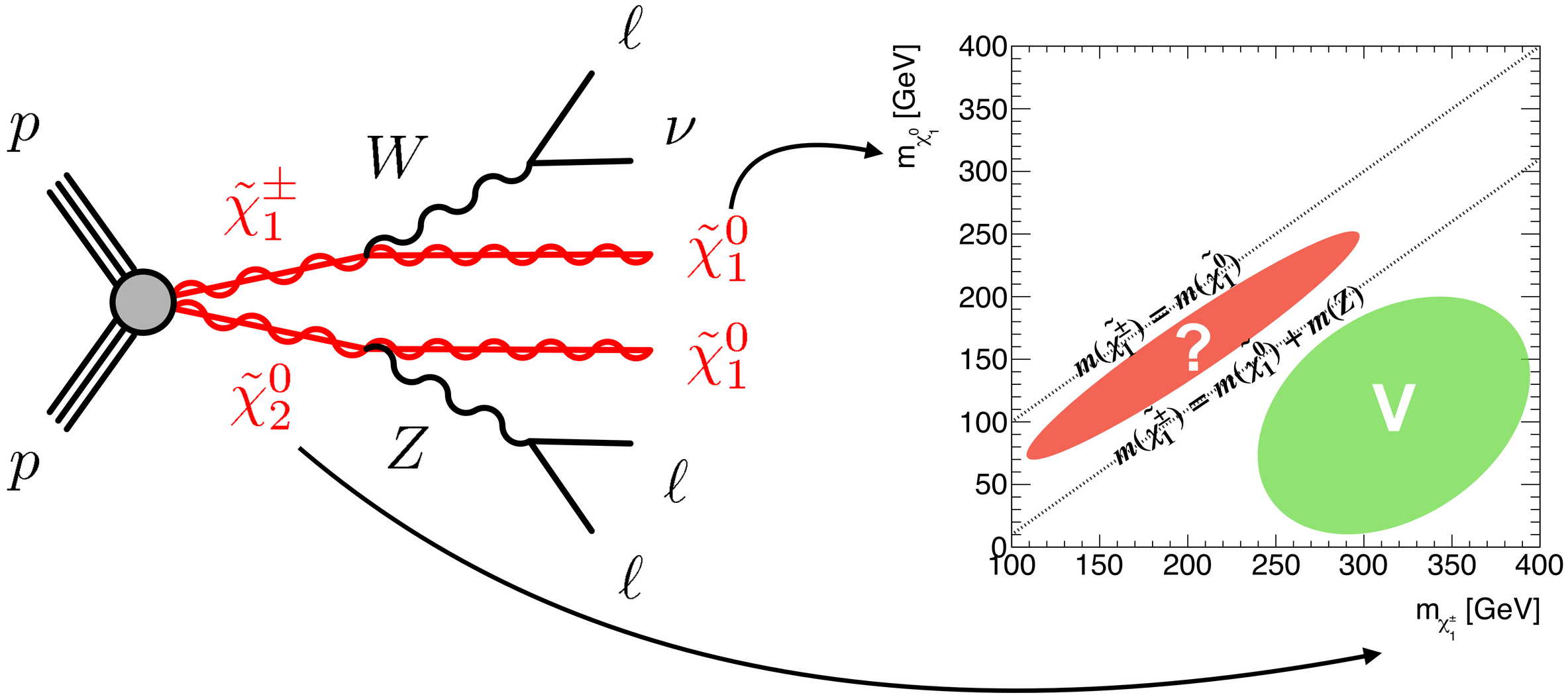
We decided to look here





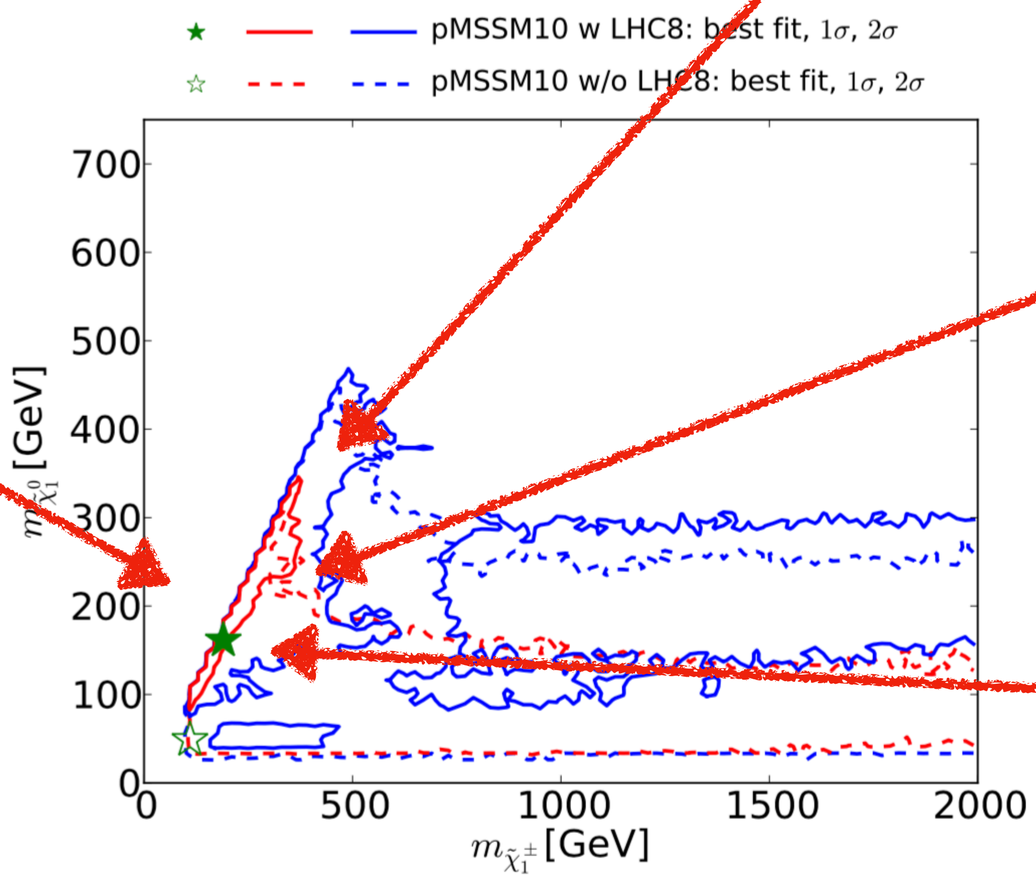


We want to detect this signal

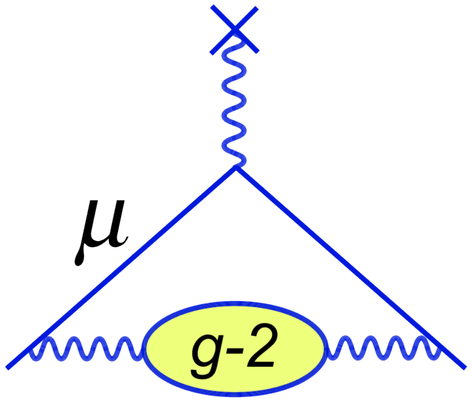


Why look here?

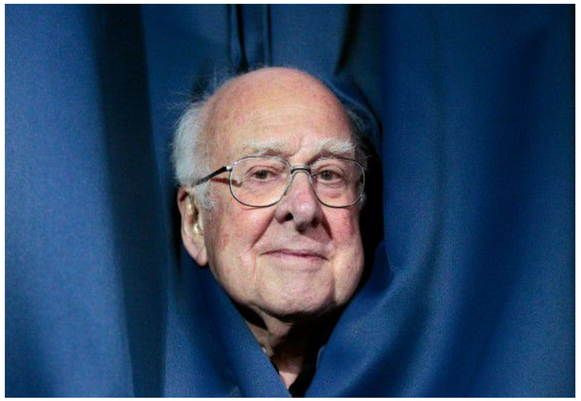
B-physics observables



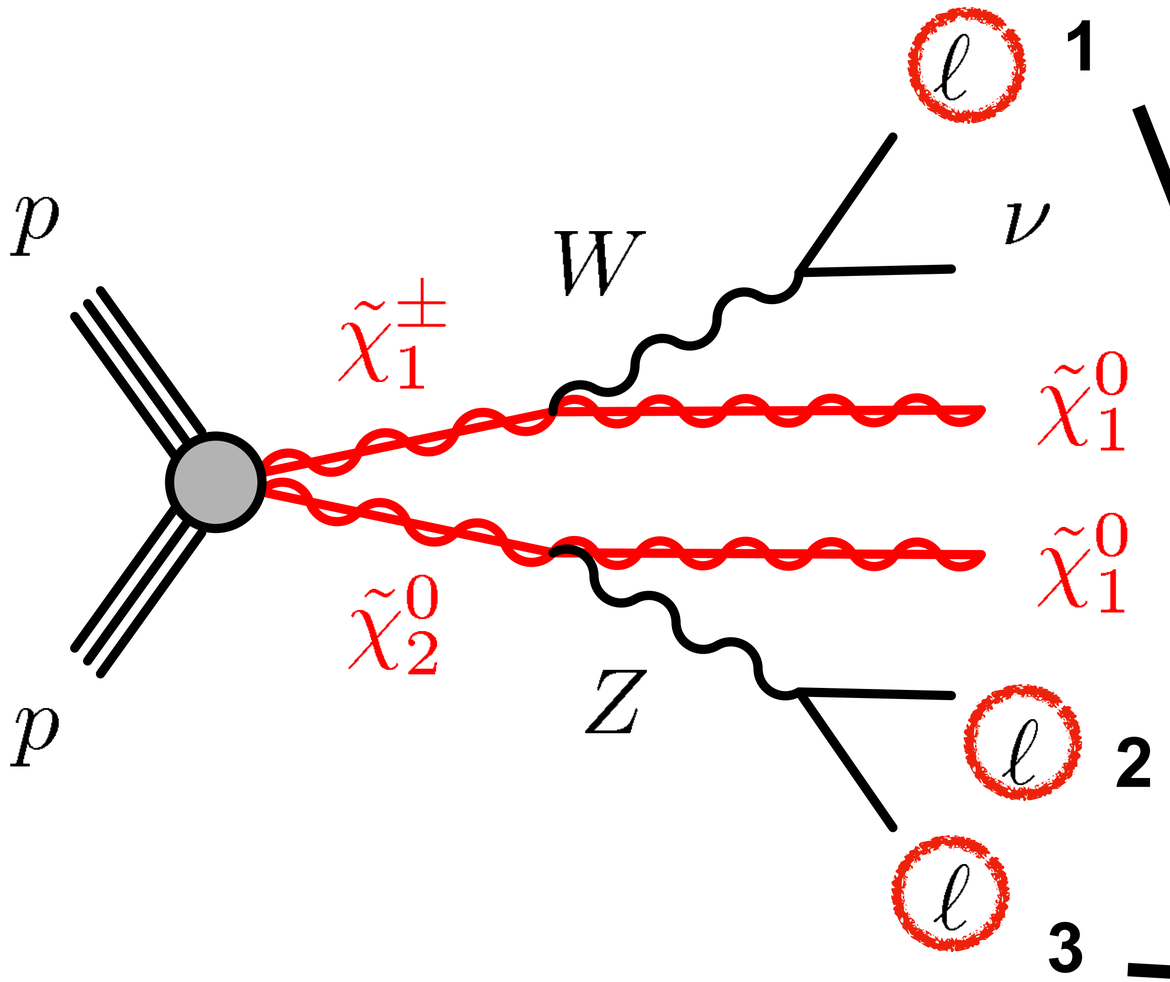
Relic density

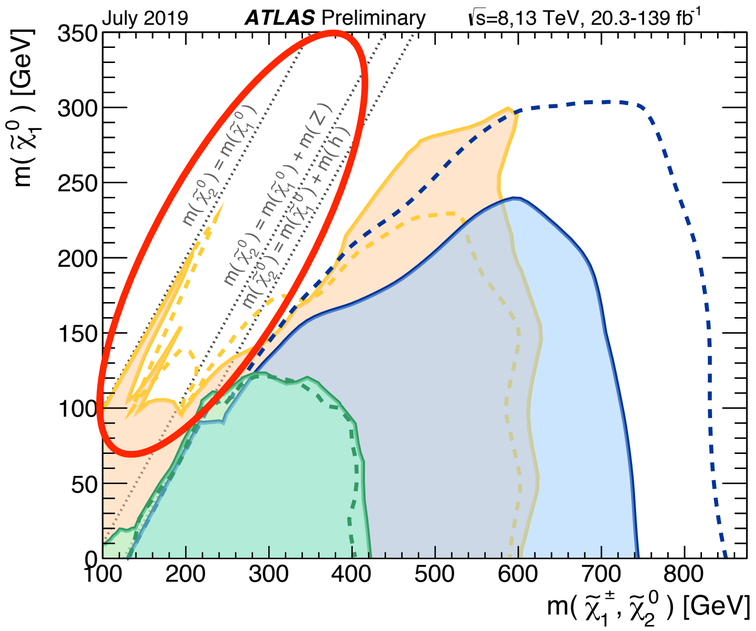


Higgs constraints



How do we look?





Our SUSY models depends on:

$$m(\tilde{\chi}_1^{\pm}), m(\tilde{\chi}_1^0)$$

Use a variable that is sensitive to this:

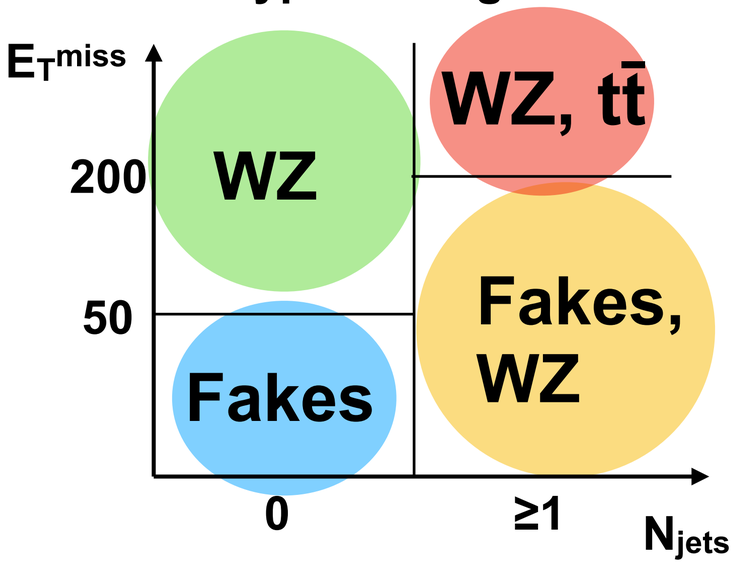
Minimum of $m(l_1,l_2)$ $m(l_1,l_3)$ $m(l_2,l_3)$
=
min. m_{ll}

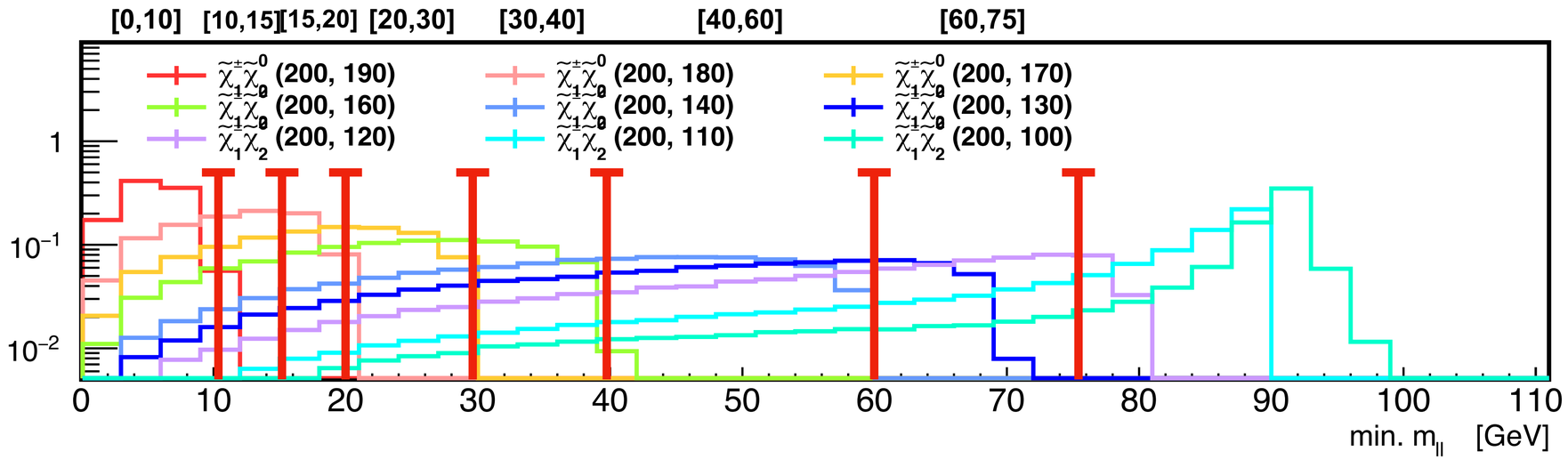
Many search regions

Based on the mass difference

- Many search regions binned in min. m_{ll}
- Each region is subject to an optimised set of cuts

Four types of regions:



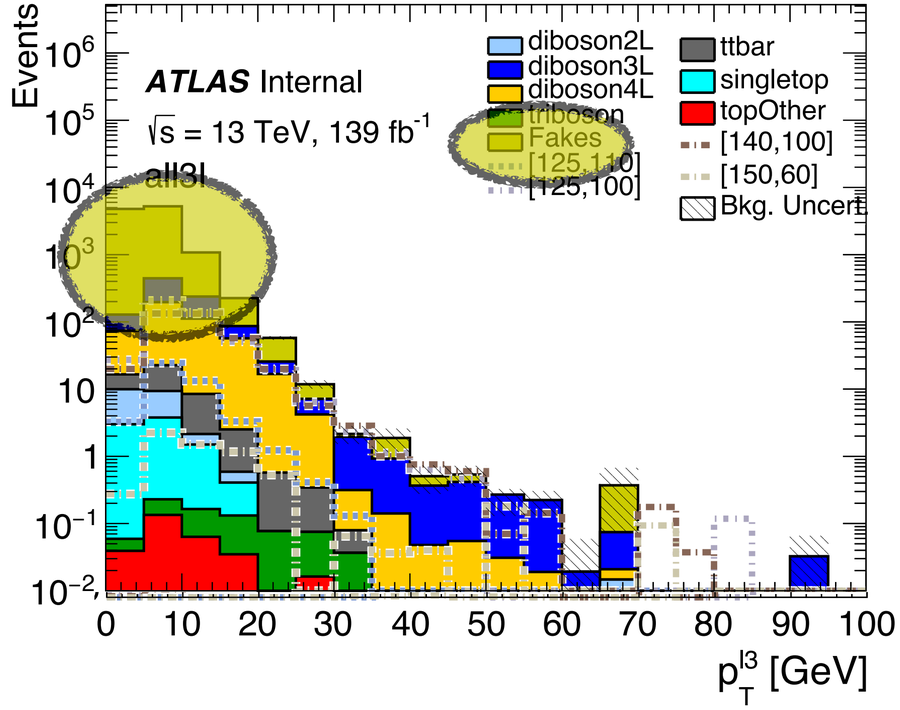


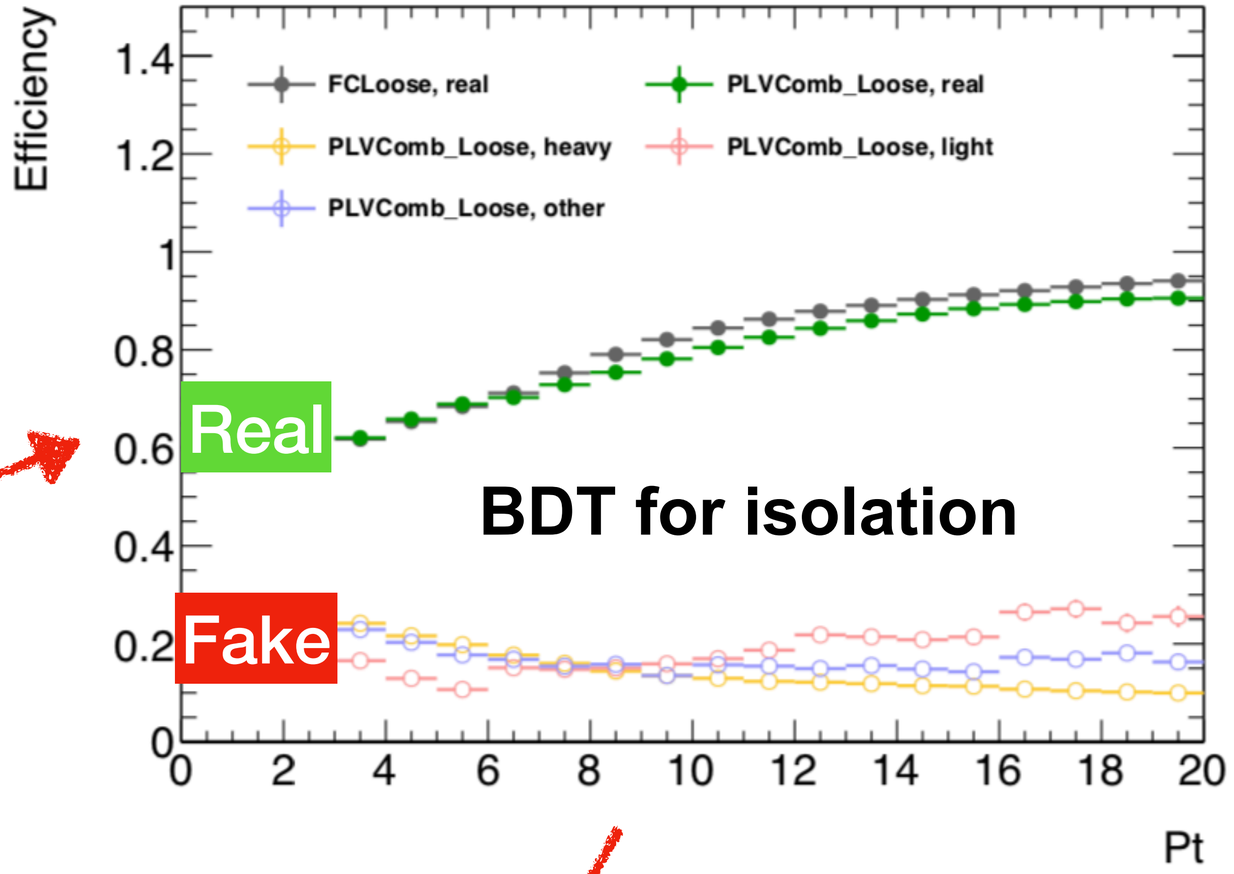
Difficult kinematics

Fake and non-prompt leptons

1) *Fake*: light flavor jet identified as a lepton
2) *Non-prompt*: heavy flavor hadron decays semileptonically
3) *Non-prompt*: photon converts into a pair of leptons

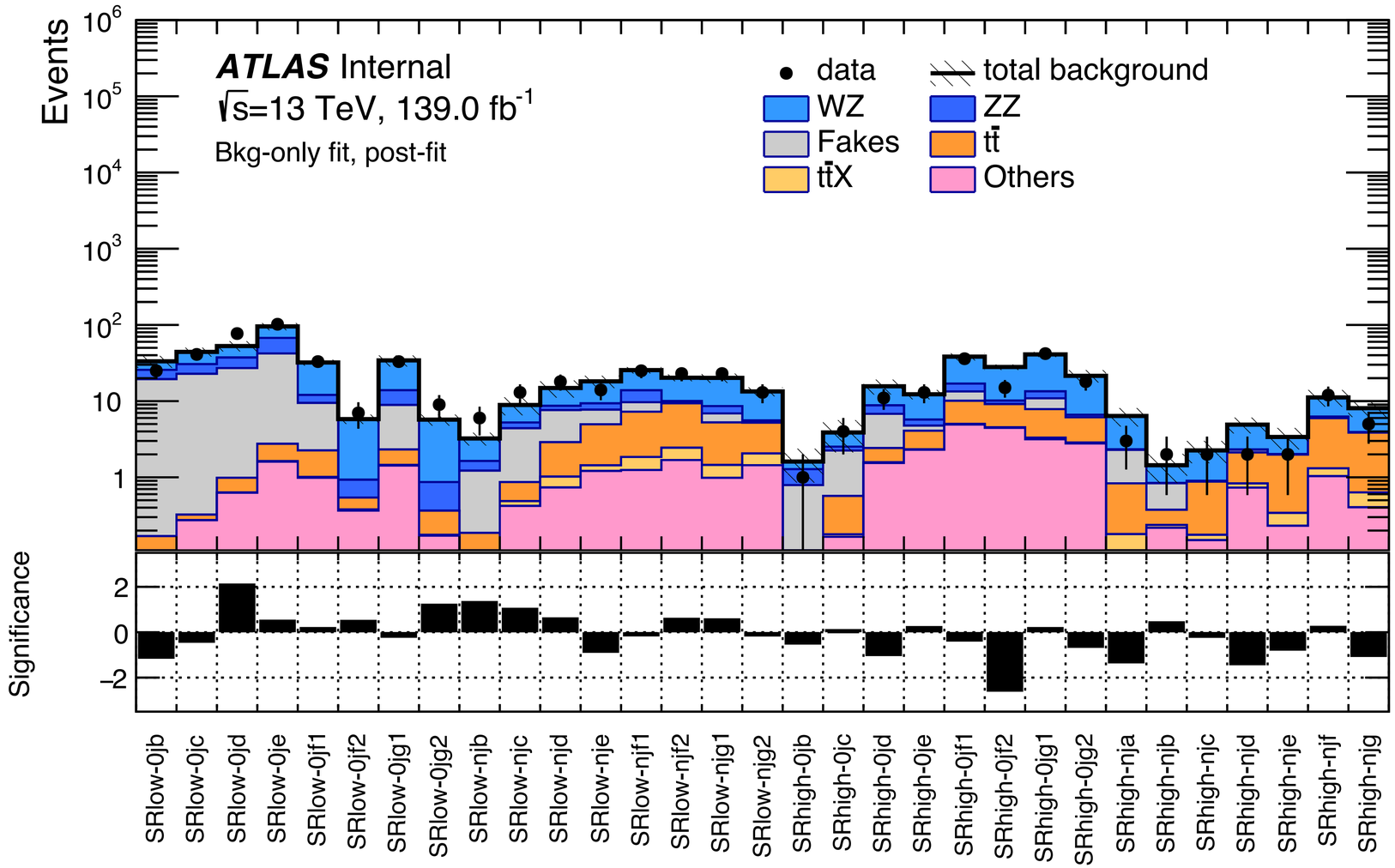
Fakes can be the largest background in soft-lepton analysis!



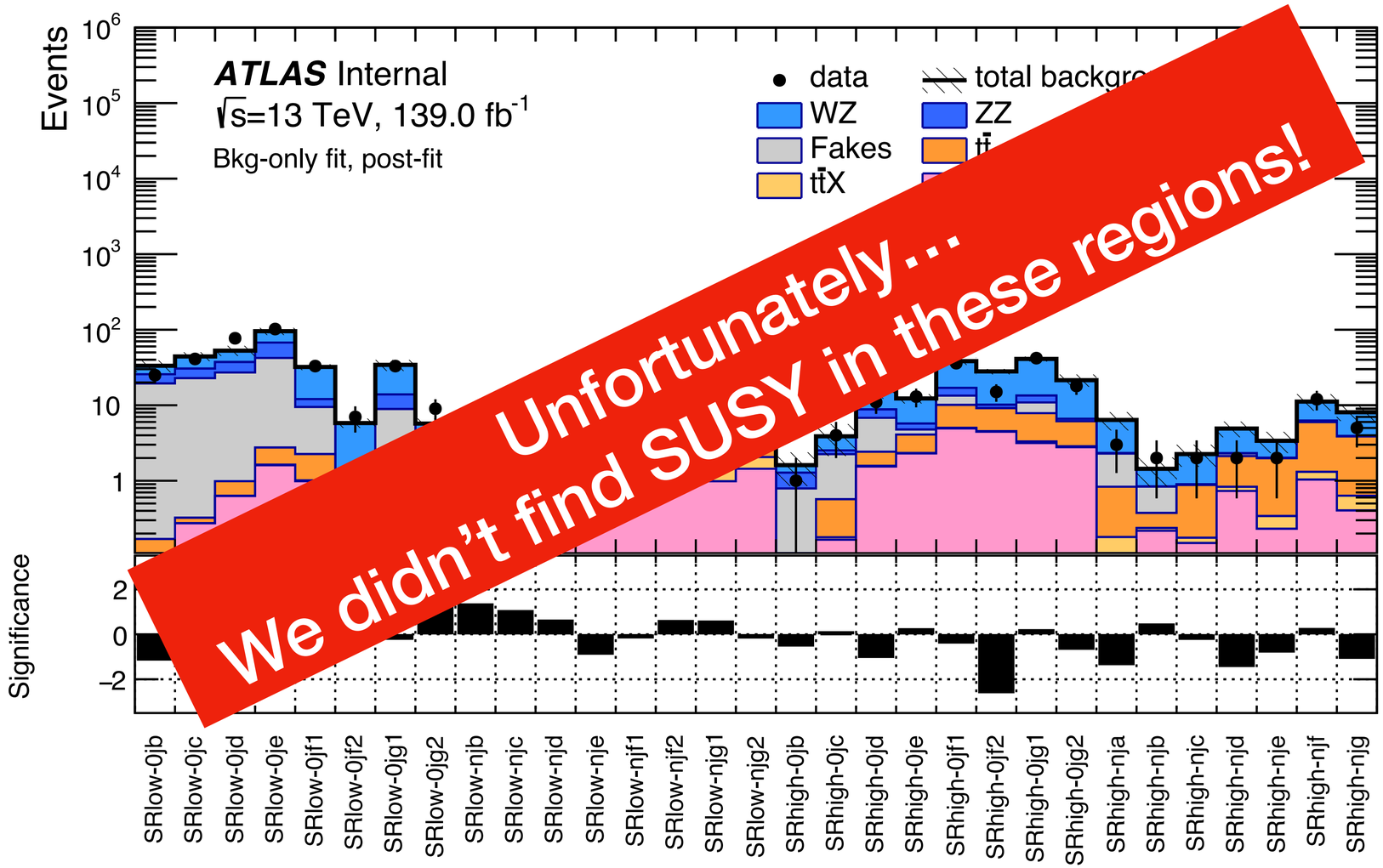


We made this available to other analyses in ATLAS

What did we observe?

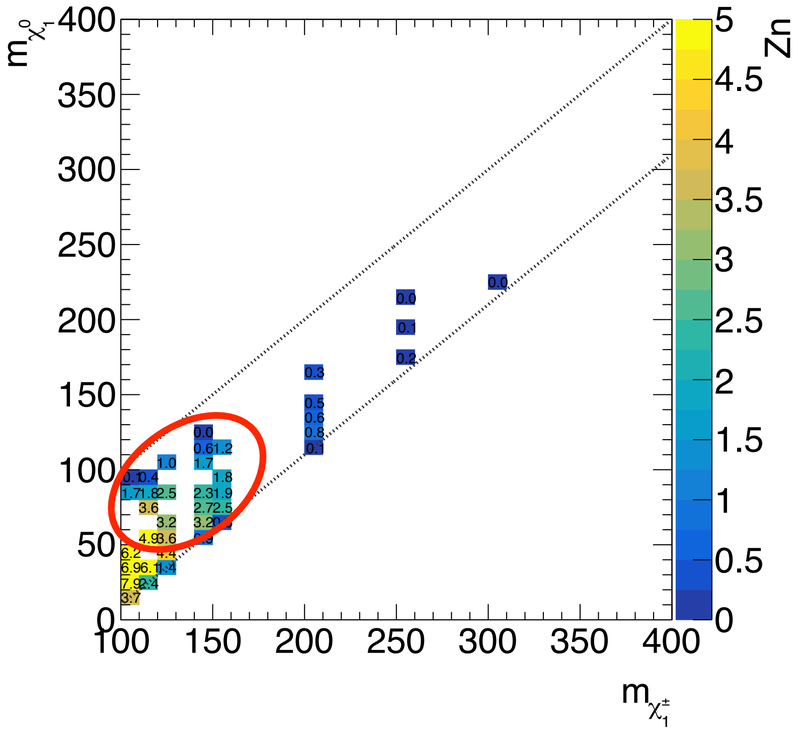


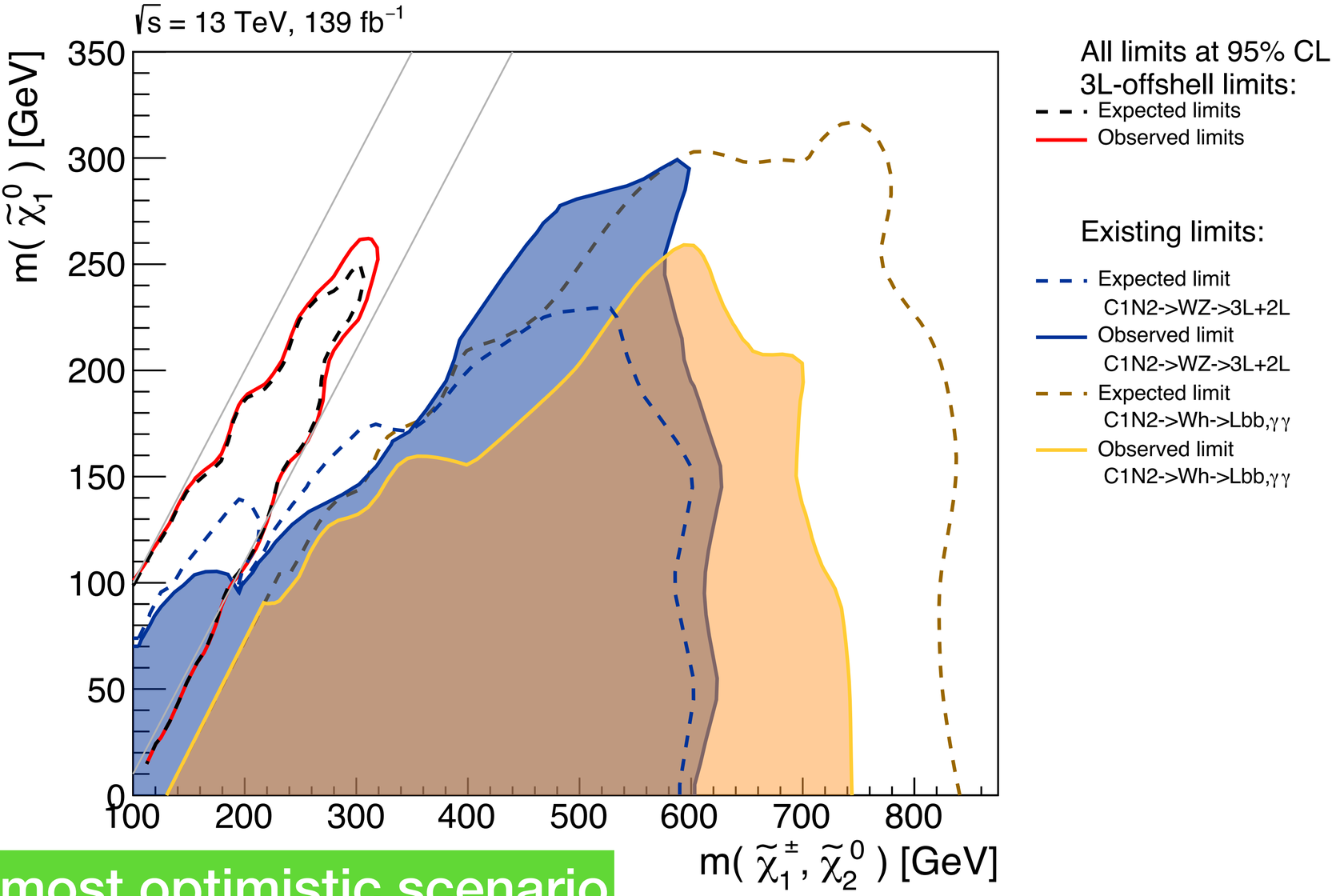
What did we observe?



Unfortunately…
We didn't find SUSY in these regions!

But we can exclude





Cross section is taken in the most optimistic scenario

We exclude in two dimensions. SUSY has many more dimensions

Take home message

Supersymmetry:

- Gives answer to unexplained phenomena
- At Nikhef we have done a challenging search
- Can manifest in many ways