H → WW* → 2l 2ν search in CMS with 2011 and 2012 DATA

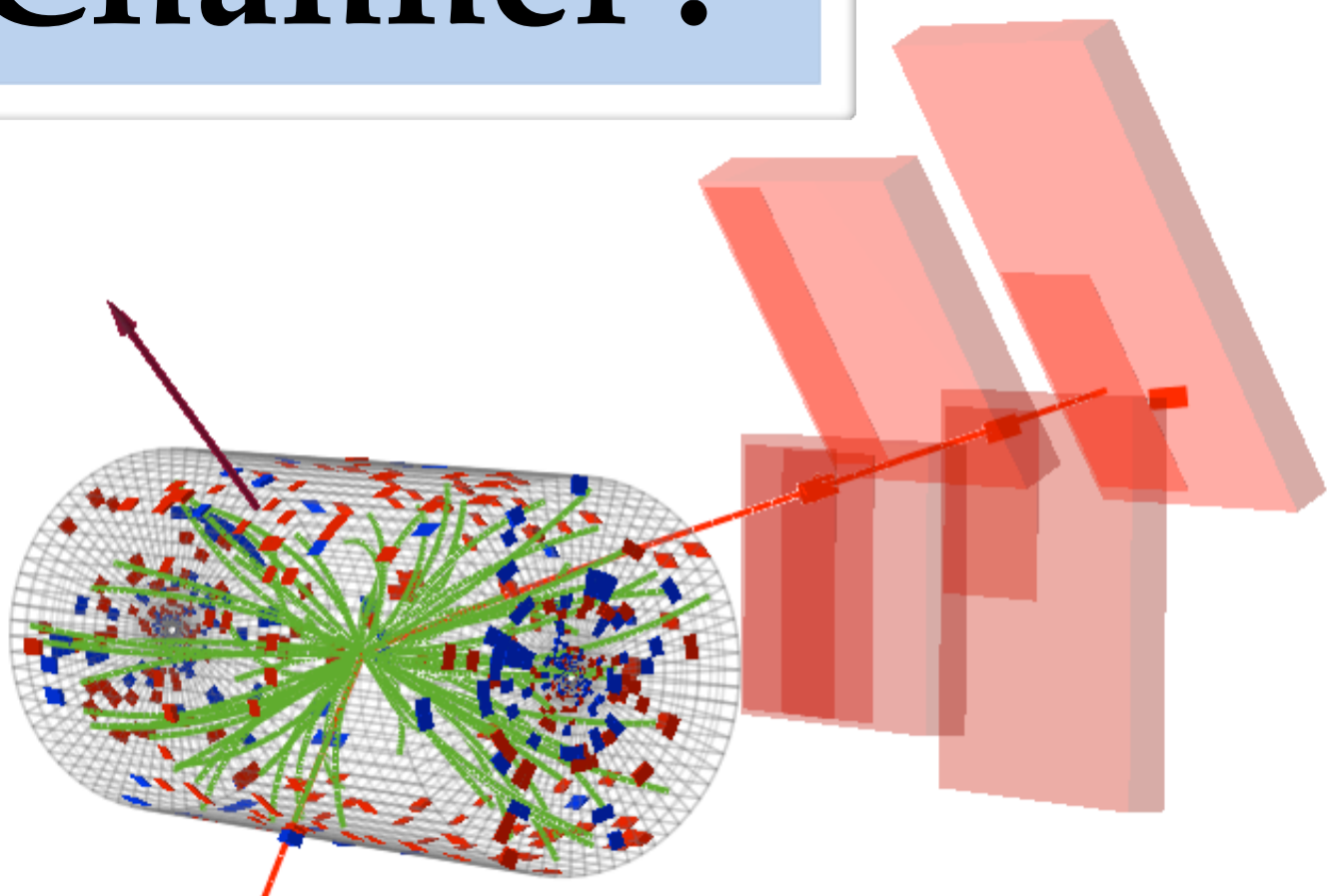Hugues BRUN, Lara LLORET IGLESIAS Universidad de Oviedo

1) Channel :

Signal :

- large $\sigma \times BR$
- clear signature : 2 high P_T leptons and missing E_T
- no mass peak → controlling the background is critical

Backgrounds :

- irreducible : WW
- reducible : W+Jets, DY, ttbar, W+$\gamma^{(*)}$, other di-boson
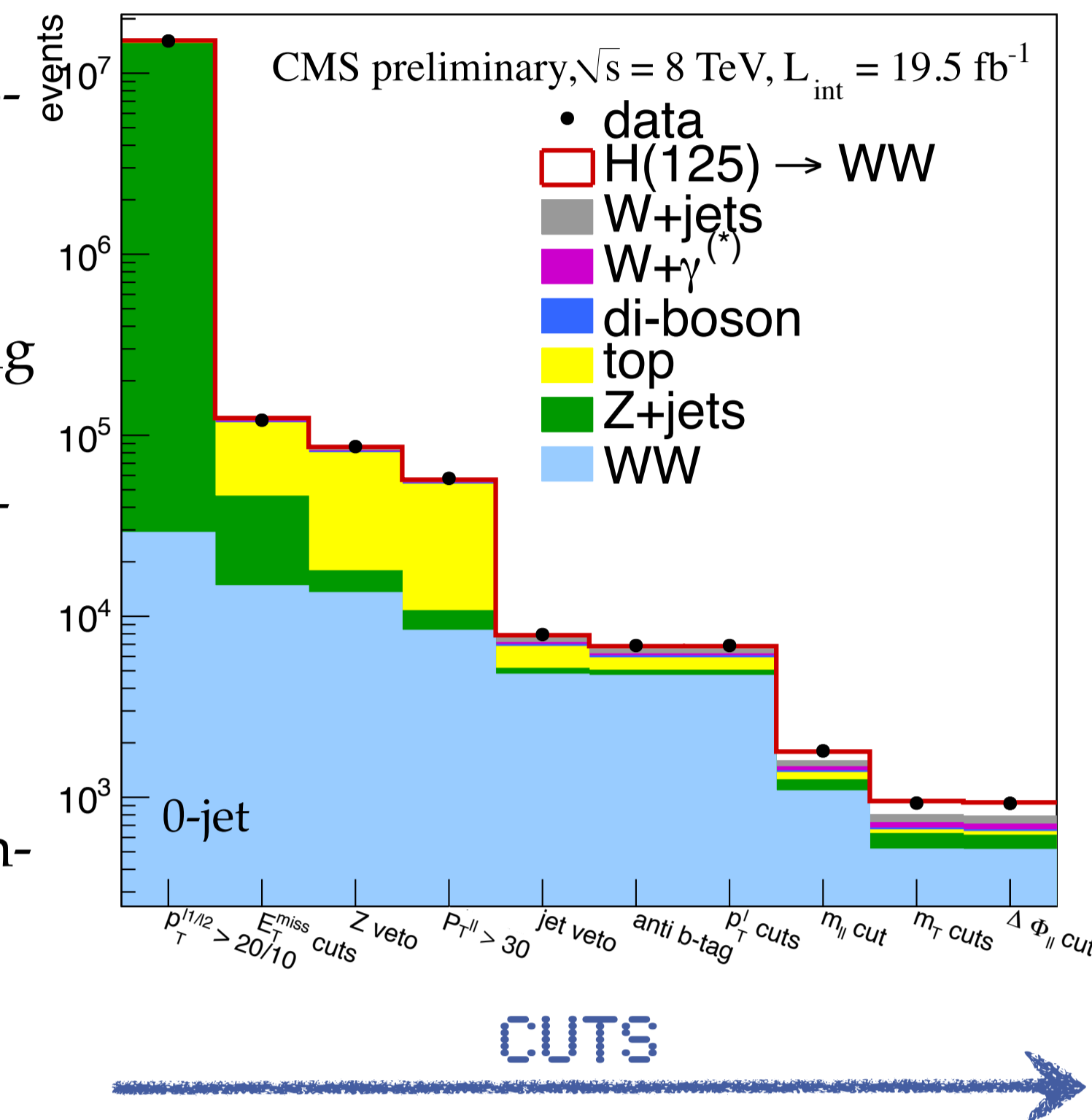
2) Event Selection :

Analyse in 4 categories :
- same flavour or different flavour
- 0 or 1 jet

Acceptance :
- 2 leptons (e ou μ) with $P_T > 20$ and 10 GeV/c
- $|\eta| < 2.5$ for e, $|\eta| < 2.4$ for μ

Cuts :
- **to reject W+Jets :** lepton ID and isolation, leptons coming from primary vertex, $P_T^{ll} > 30$ GeV/c
- **to reject Drell-Yann :** cut on missing E_T, additional cuts in same flavour events : Z veto + kinematics and topological cuts (in a MVA in 2012)
- **to reject top :** b-tagging and soft muons vetos
- **to reject W+$\gamma^{(*)}$ and di-bosons :** converted photons rejection, $m_{ll} > 12$ GeV/c², no 3rd lepton
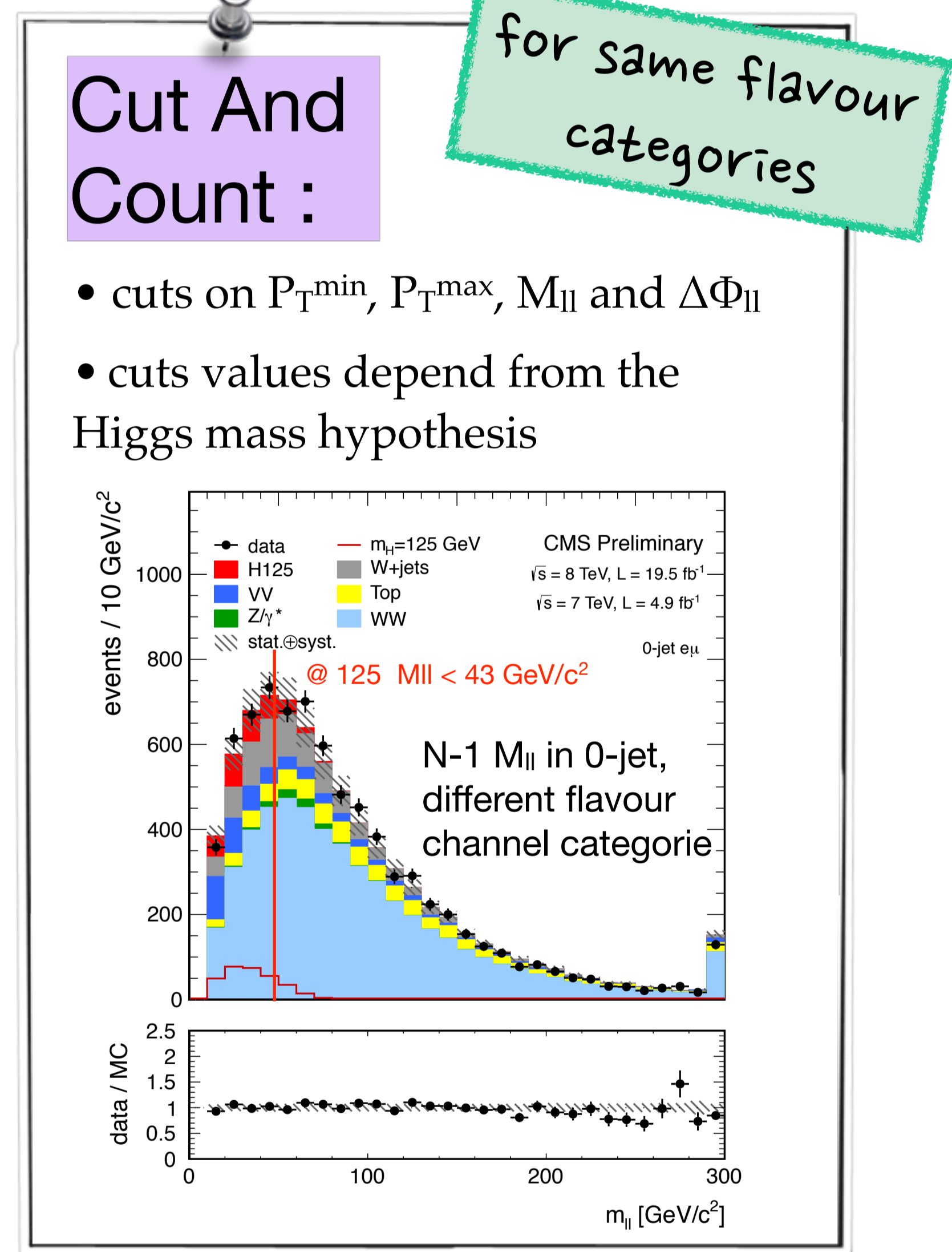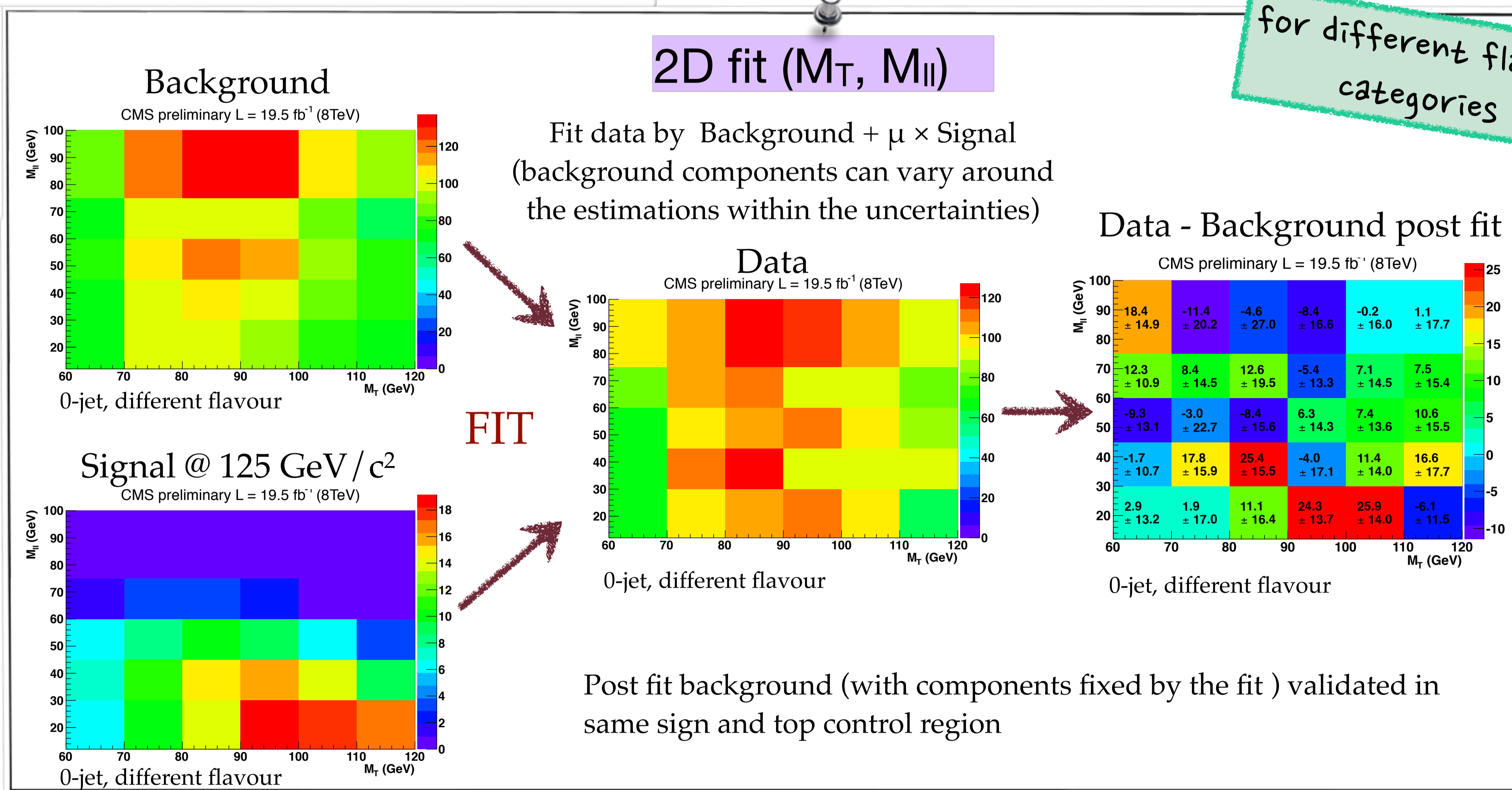

3) Background Estimation :

Normalisation of main backgrounds from data :

- **W+Jets :** fake rate method
- **DY :** from Z peak in data
- **top :** control region from b-tagged sample
- **W+γ^* :** 3 leptons events used to normalise simulation
- **WW :** in a signal free region ($M_{ll} > 100$ GeV/c²) for $M_H < 200$ GeV/c²
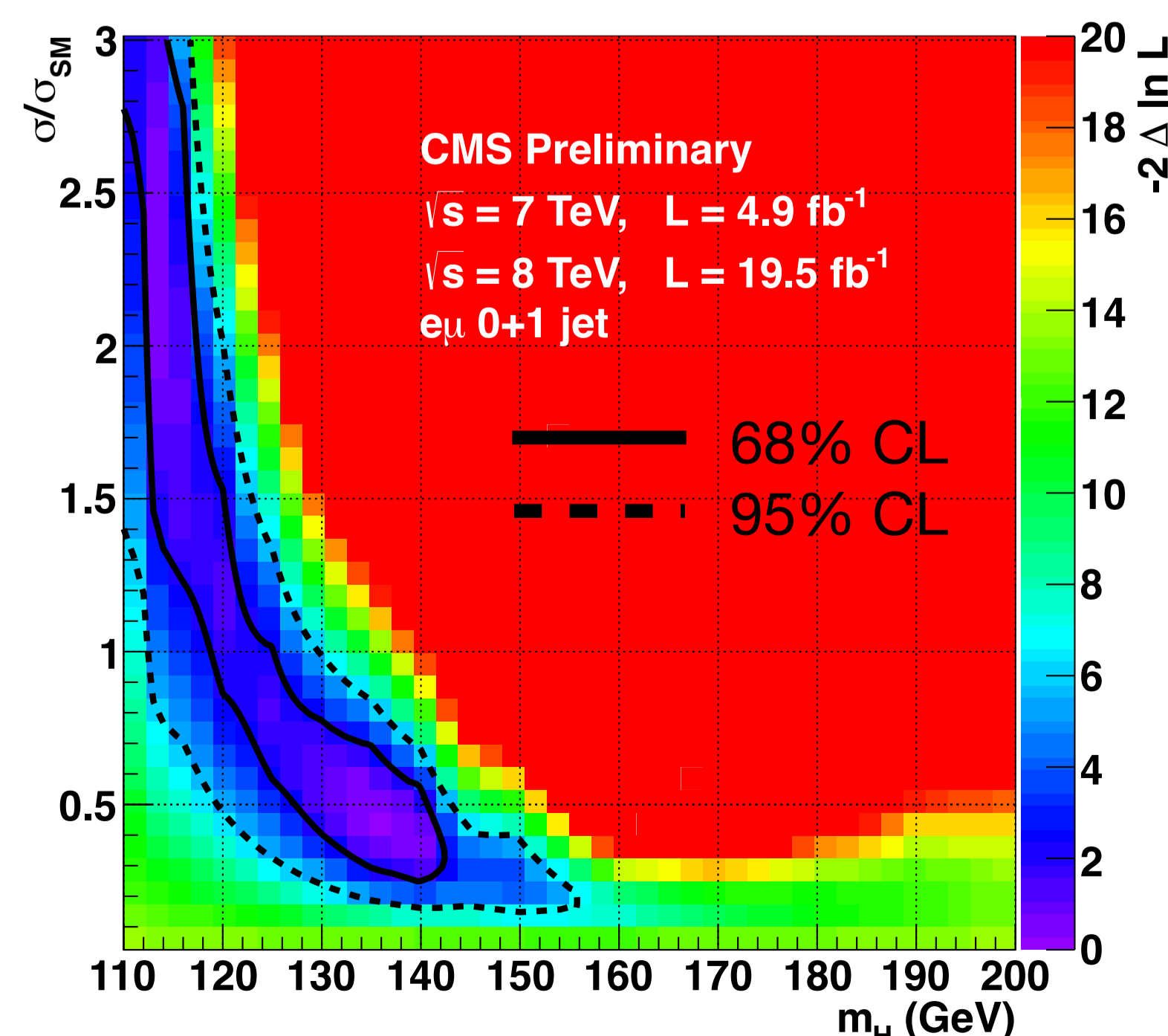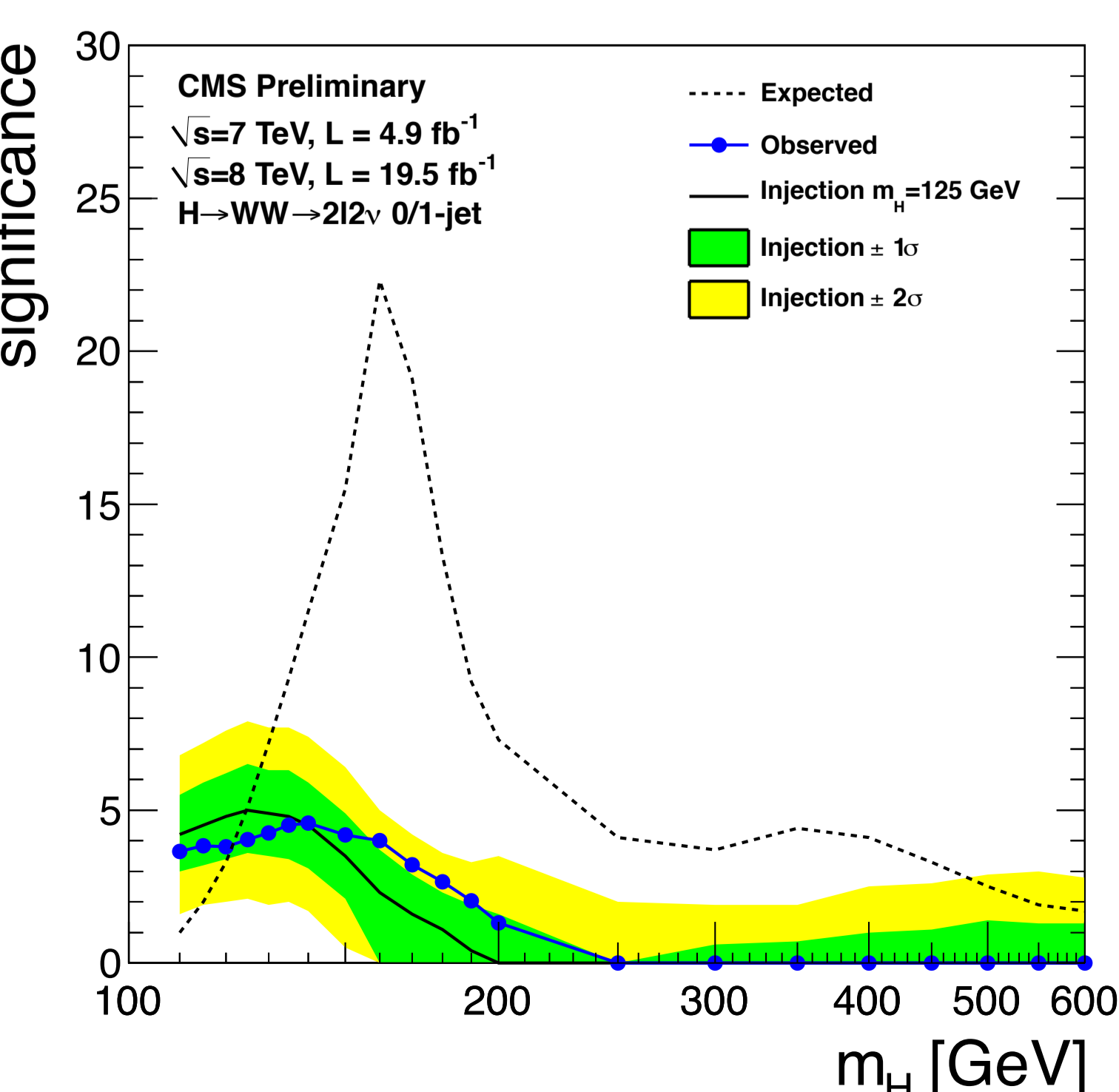
Other backgrounds from simulations

4) Signal Extraction :

two approaches : 2D fit and "Cut And Count"

for different flavour categories

2D fit (M_T, M_{ll})

Fit data by Background + μ × Signal (background components can vary around the estimations within the uncertainties)

Post fit background (with components fixed by the fit) validated in same sign and top control region

for same flavour categories

Cut And Count :

- cuts on P_T^{min}, P_T^{max}, M_{ll} and $\Delta\Phi_{ll}$
- cuts values depend from the Higgs mass hypothesis

N-1 M_{ll} in 0-jet, different flavour channel categorie
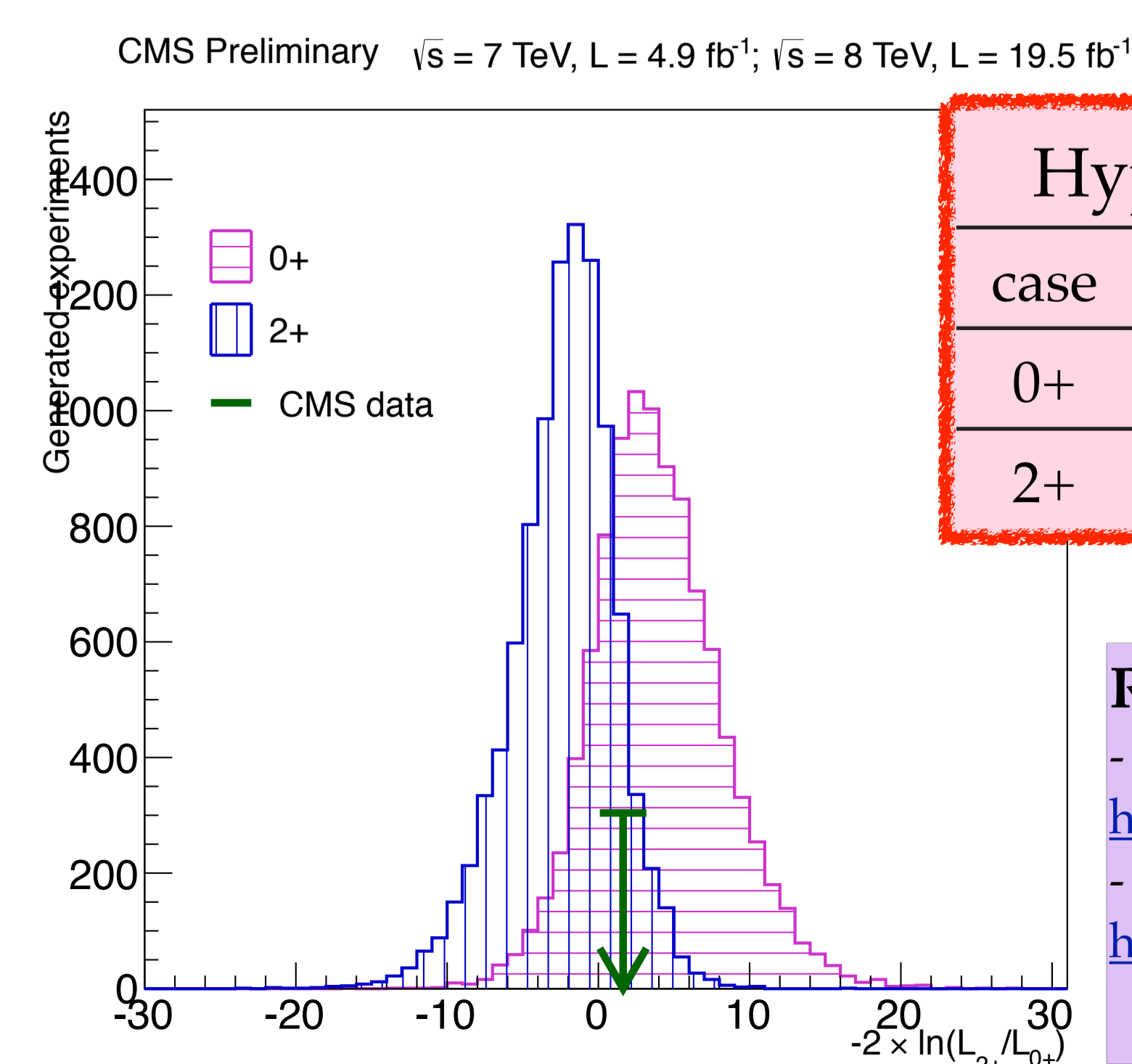
5) Results :

At 125 GeV/c² :
best fit μ value : 0.76 ± 0.21 ($\mu = \sigma_{Fit}/\sigma_{SM}$)
expected significance = 5.1 σ
observed significance = 4.0 σ

6) Spin :

to distinguish SM (0⁺) Higgs at 125 GeV/c² from a spin 2 resonance coupling with di-bosons through minimal couplings (2⁺)

in different flavour categories only, 2D fit used

Hypothesis separation :

case	expected :	observed :
0+	1.5 σ	0.6 σ
2+	1.9 σ	1.3 σ

References :
- CMS-PAS-HIG-13-003, http://cds.cern.ch/record/1523673
- more plots in : http://cern.ch/go/pNx7