Search for charged Higgs bosons decaying to $W^{\pm}W^{\pm}$ or $W^{\pm}Z$ in 139 fb^{-1} of $\sqrt{13}$ TeV pp collinsions with the ATLAS detector

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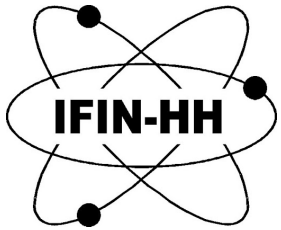


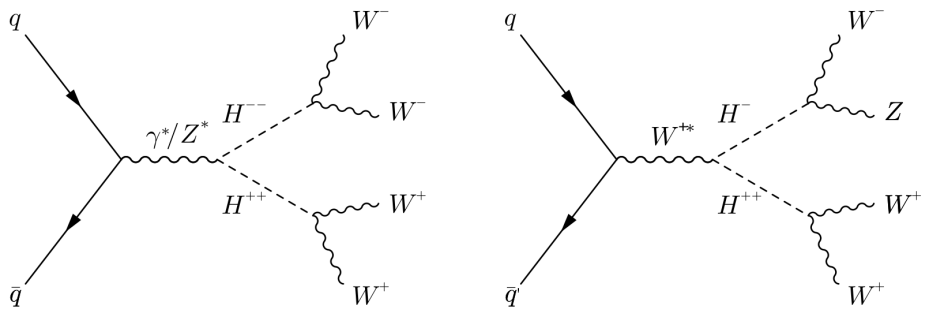
Signal Model

Type-II seesaw Model (Phys. Rev. D84(2011)095005) $\rightarrow$ can explain the small neutrino masses

- Extends the scalar sector of the SM with a scalar triplet (Δ)
- EWSM achieved by requiring the neutral components of the SM Higgs and Δ to acquire vacuum expectation values (v_d and v_v)
- After EWSB $\rightarrow$ $H^{\pm\pm}$, $H^{\pm}$, A^0 (CP odd), H^0 (CP even), h^0 (SM Higgs) scalar bosons
- Main assumption: $v_v = 0.1$ GeV

Two production mechanisms of the $H^{\pm\pm}$ and $H^{\pm}$ bosons considered:

- Pair Production (figure a): only $H^{\pm\pm}$ and SM h^0 in the observable range
- Assosciated Production (figure b): $m_{H^{\pm}} \approx m_{H^{\pm\pm}}$ (5 GeV difference)



Analysis Strategy

Three final states (channels)

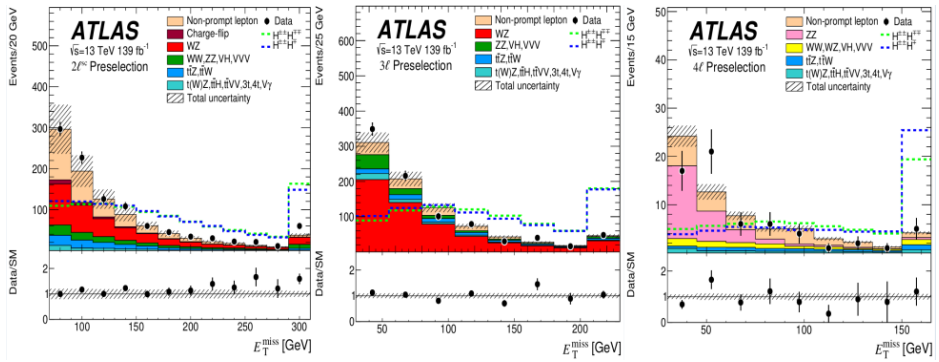
classified according to the number of leptons: $2\ell^{SC}$, 3ℓ and 4ℓ

- $2\ell^{SC}$ channel divided in ee, $e\mu$ and $\mu\mu$ sub-channels
- 3ℓ divided in two sub-channels, depending on the no. of SFOC pairs (SFOC0 and SFOC1,2)

Selection criteria	$2\ell^{\mathrm{sc}}$	3ℓ	4ℓ
At least one offline tight lepton with $p_{\mathrm{T}}^{\ell} > 30$ GeV that triggered the event			
N_ℓ (type L)	=2	=3	=4
N_ℓ (type L*)	–	–	=4
N_ℓ (type T)	=2	≥ 2 ($\ell_{1,2}$)	≥ 1
$\lvert\sum Q_\ell\rvert$	=2	=1	$\neq 4$
Lepton p_{T}	$p_{\mathrm{T}}^{\ell_1,\ell_2} > 30, 20$ GeV	$p_{\mathrm{T}}^{\ell_0,\ell_1,\ell_2} > 10, 20, 20$ GeV	$p_{\mathrm{T}}^{\ell_1,\ell_2,\ell_3,\ell_4} > 10$ GeV
$E_{\mathrm{T}}^{\mathrm{miss}}$	> 70 GeV	> 30 GeV	> 30 GeV
N_{jets}	≥ 3	≥ 2	–
$N_{b\text{-jets}}$	=0		
Low SFOC $m_{\ell\ell}$ veto	–	$m_{\ell\ell}^{\mathrm{oc}} > 15$ GeV	
Z boson decay veto	$\lvert m_{ee}^{\mathrm{sc}} - m_Z\rvert > 10$ GeV	$\lvert m_{\ell\ell}^{\mathrm{oc}} - m_Z\rvert > 10$ GeV	

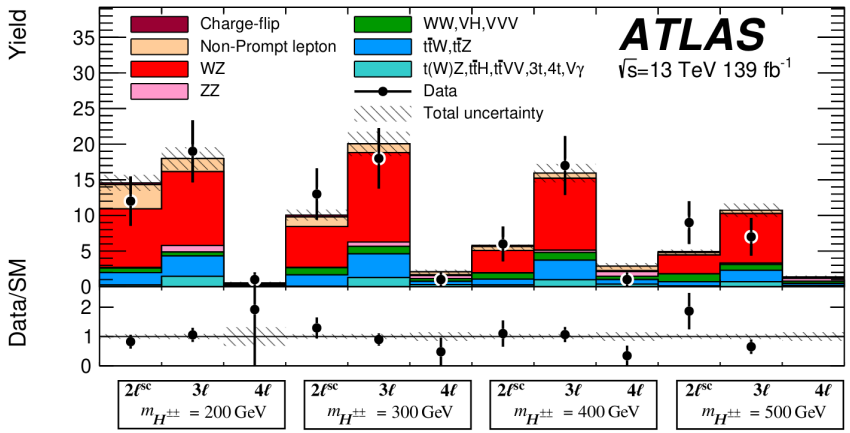
Two main background categories:

- SM background: leptons from prompt leptonic decays of W and Z bosons
- Detector background:
  - electron charge-flip (↘ by ECIDS tool)
  - fake/non-prompt leptons (↘ by non-prompt lepton veto)



Results and Limits

- The uncertainties associated to the charge-flip background is small in all SRs
- The statistical uncertainties on the fake/NP leptons estimate or the theory uncertainty are dominant in the SRs
- No significant excess in any of the signal regions is observed



- For the charged Higgs pair production and associated production cross-section times branching fraction (95% CL)
- Obtained from the combination of $2\ell^{SC}$, 3ℓ and 4ℓ SRs
- Charge Higgs boson masses excluded up to 350 GeV for the PP mode and up to 220 GeV for the AP mode