



# ATLAS Note

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## Measurement of the $t\bar{t}H$ production cross-section in the $H \rightarrow b\bar{b}$ decay channel using $139 \text{ fb}^{-1}$ of $pp$ collision data at $\sqrt{s} = 13 \text{ TeV}$

The  $t\bar{t}H(b\bar{b})$  leptonic analysis team<sup>1</sup>

A measurement of the  $t\bar{t}H$  production cross section in the  $H \rightarrow b\bar{b}$  decay channel is presented. The analysis uses  $139 \text{ fb}^{-1}$  of  $pp$  collision data at  $\sqrt{s} = 13 \text{ TeV}$ , collected with the ATLAS detector at the LHC, corresponding to the full run-2 dataset (2015–2018). This analysis uses events with one or two electrons or muons.

The signal strength, defined as a ratio of the measured  $t\bar{t}H$  signal cross section to the Standard Model expectation is measured, assuming a Higgs boson mass of 125 GeV. The observed (expected) signal strength is  $0.35^{+0.36}_{-0.34}$  ( $1^{+0.36}_{-0.31}$ ), and the observed (expected) significance is  $1.0$  ( $2.7$ ) $\sigma$ . In addition, since the  $t\bar{t}H(b\bar{b})$  final states allow to reconstruct the Higgs boson kinematics, the signal strength is measured as a function of the Higgs boson transverse momentum  $p_T^H$ , in the simplified template cross sections (STXS) formalism. The observed signal strengths are  $0.86^{+1.04}_{-0.99}$  for  $0 \text{ GeV} < p_T^H < 120 \text{ GeV}$ ,  $-0.18^{+1.03}_{-1.02}$  for  $120 \text{ GeV} < p_T^H < 200 \text{ GeV}$ ,  $1.05^{+0.90}_{-0.86}$  for  $200 \text{ GeV} < p_T^H < 300 \text{ GeV}$ ,  $-0.19^{+0.74}_{-0.72}$  for  $300 \text{ GeV} < p_T^H < 450 \text{ GeV}$ , and  $-0.10^{+1.47}_{-1.39}$  for  $p_T^H > 450 \text{ GeV}$ .

<sup>1</sup> Full list of authors with their contributions can be found on next page.

## List of contributions

Not reviewed, for internal circulation only

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Silvia Biondi <sup>d</sup>	Single-lepton boosted: analysis contact
Mauro Villa <sup>d</sup>	Single-lepton boosted: advisory role
John Keller <sup>e</sup>	Single-lepton resolved: new ttbar modelling estimate, Data/MC studies
Jelena Jovicevic <sup>f</sup>	Leptonic resolved: analysis contact, MC preparation, STXS studies, Ntuple production
Tamara Vazquez Schroeder <sup>f</sup>	HTop sub-group convener
Georges Aad <sup>g</sup>	Single-lepton resolved: new ttbar modelling estimate, ttbar HF-filtered MC samples, STXS studies, supervision of Nihal Brahimi
Nihal Brahimi <sup>g</sup>	Single-lepton resolved: new ttbar modelling estimate, ttbar HF-filtered MC samples, data/MC, STXS studies, fit studies
Yann Coadou <sup>g</sup>	Editor of the conf-note and of the paper; single-lepton resolved: MVA optimisation studies, supervision of Ziyu Guo
Arnaud Duperrin <sup>g</sup>	Single-lepton resolved: advisory role
Ziyu Guo <sup>g</sup>	Single-lepton resolved: MVA optimisation studies
Thomas Strebler <sup>g</sup>	Single-lepton resolved: Ntuple production
Laurent Vacavant <sup>g</sup>	Single-lepton resolved: supervision of Nihal Brahimi
Lars Ferencz <sup>h</sup>	Leptonic resolved and boosted: truth-level pT <sub>bb</sub> modelling studies on ttbb background
Paul Glaysheer <sup>h</sup>	Leptonic resolved: former fit contact, Ntuple production, MVA optimisation studies, ttbb modelling studies
Judith Katzy <sup>h</sup>	Single-lepton resolved: supervision of Anastasiya Melnik, ttbar modelling; HTop sub-group convener
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Anastasiya Melnik <sup>h</sup>	Single-lepton resolved: MVA optimisation studies
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Andrea Knue <sup>i</sup>	Single-lepton resolved and boosted: Ntuple production, MC preparation, Data/MC studies, ttbar modelling, supervision of Manuel Guth
Albert Borbely <sup>j</sup>	Single-lepton boosted: DNN application
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Ian Connelly <sup>j,k</sup>	Editor of the conf-note and of the paper; dilepton, single-lepton boosted: fit contact, software and production manager, Ntuple production, release 21 code migration, supervision of Nicolas Scharmberg and Albert Borbely
Tony Doyle <sup>j</sup>	Single-lepton boosted: supervision of Michael Fenton and Albert Borbely
Michael Fenton <sup>j</sup>	Single-lepton boosted: core analysis developer, substructure variables, DNN application
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Clara Nellist <sup>l</sup>	Single-lepton resolved: Ntuple production, supervision of Jannik Geisen and Johannes Mellenthin
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Reinhild Yvonne Peters <sup>s</sup>	Dilepton: supervision of Nicolas Scharmberg
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Pedro Teixeira-Dias <sup>v</sup>	Dilepton: Z+jets and fakes estimation, supervision of Callum Dale Booth and Dave Thomas
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