

## Annexe X

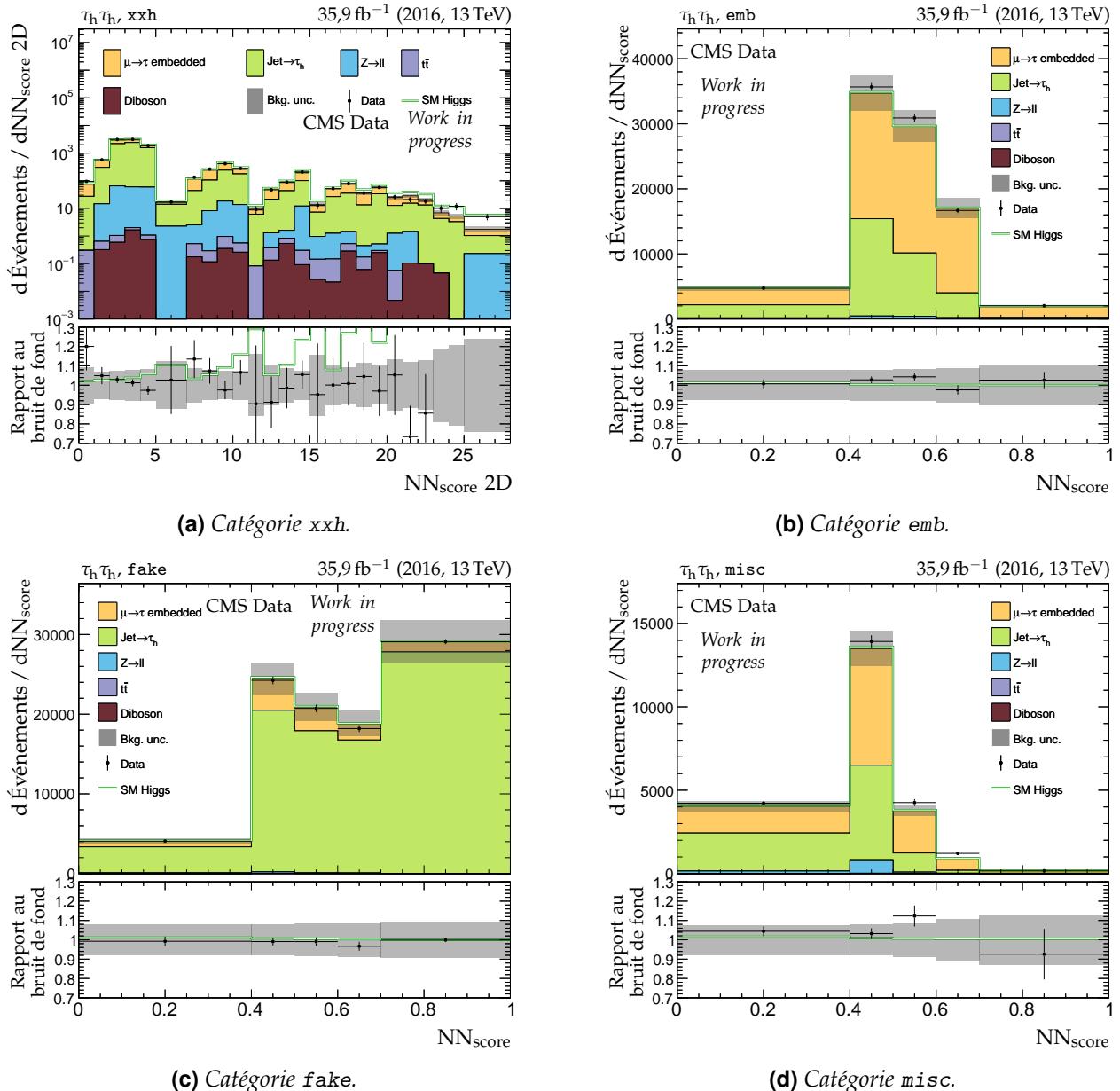
### **Distributions des variables discriminantes – $H \rightarrow \tau\tau$**

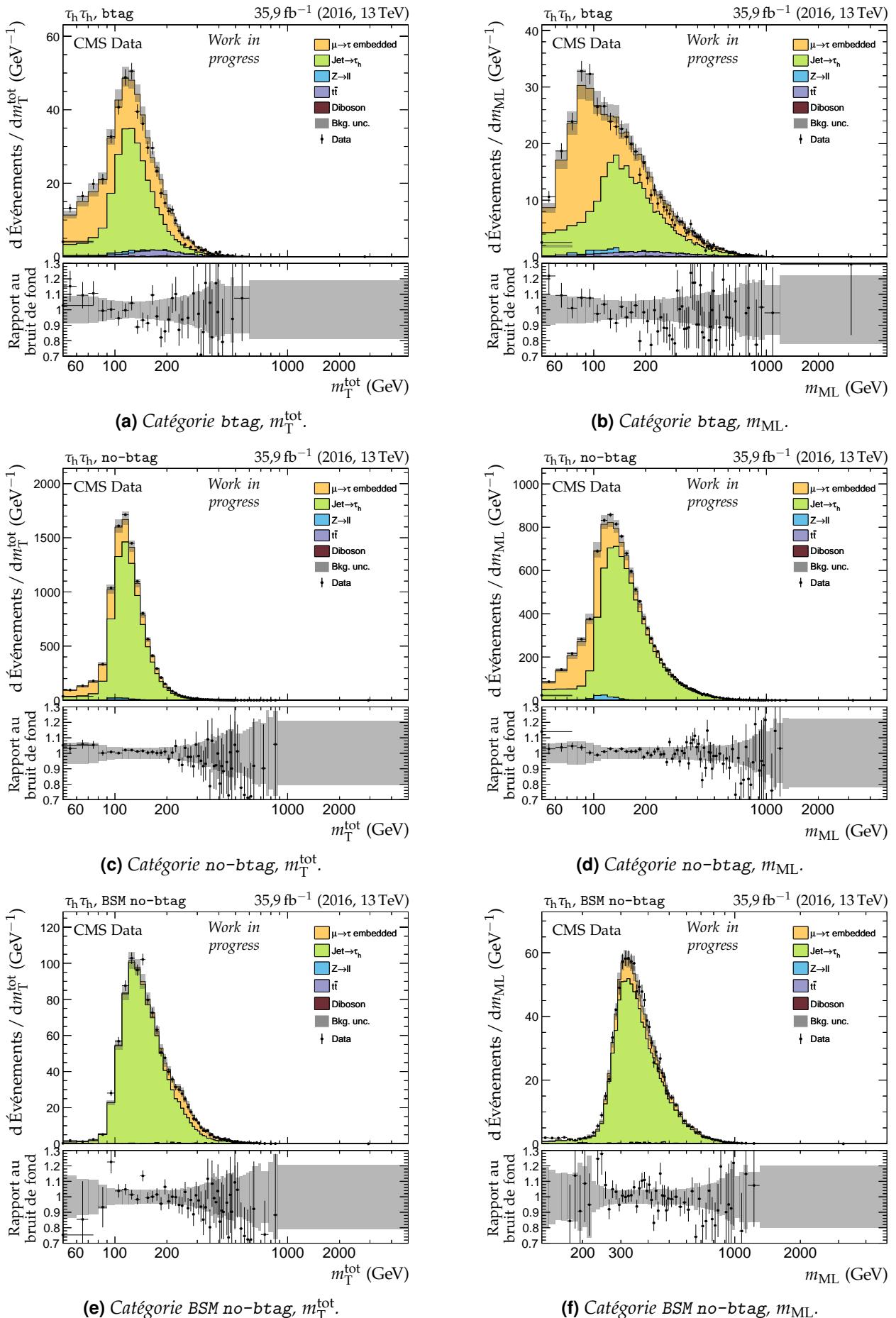
Cette annexe présente des distributions des variables discriminantes sur les événements utilisés dans l'analyse des événements  $H \rightarrow \tau\tau$  présentée dans le chapitre 4.

Pour chacune des trois années de prise de données (2016, 2017, 2018), chacun des quatre canaux ( $\tau_h\tau_h$ ,  $\mu\tau_h$ ,  $e\tau_h$ ,  $e\mu$ ) et chacune des catégories définies au chapitre 4, la distribution de la variable discriminante associée est donnée.

Dans chacun des graphiques, les données observées (points noirs) sont comparées à la modélisation des bruits de fond (histogrammes remplis en couleur et empilés). Les bandes grisées correspondent à l'incertitude totale (statistique et systématique) sur le bruit de fond avant ajustement des paramètres de nuisance par COMBINE. Le rapport au bruit de fond est donné dans la partie inférieure des graphiques.

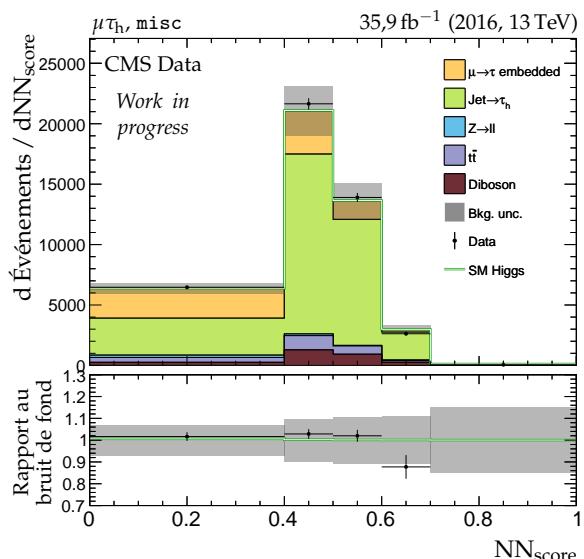
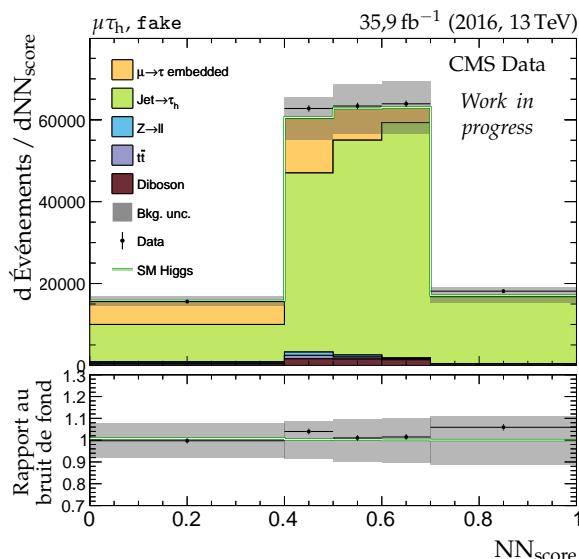
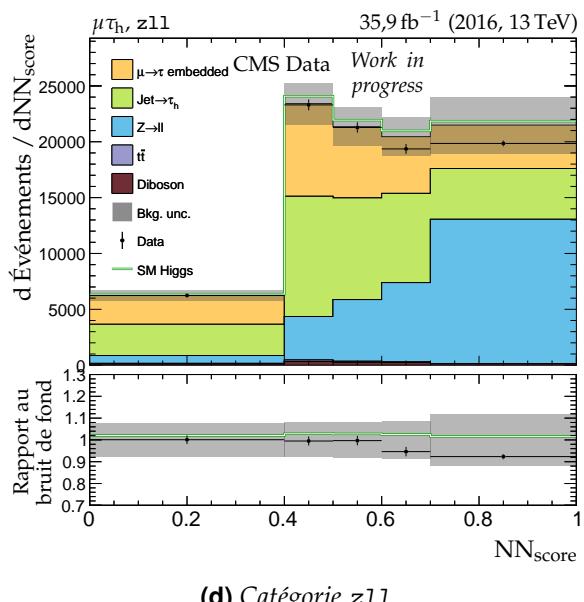
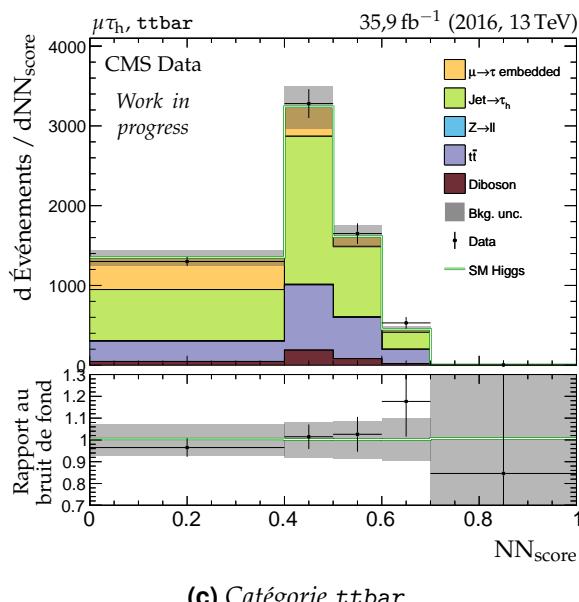
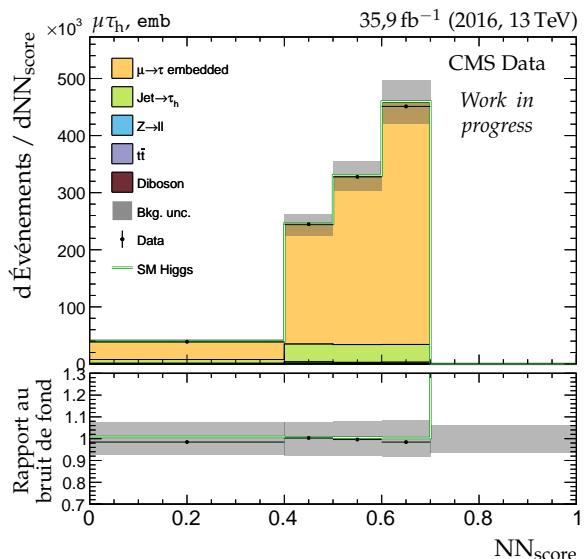
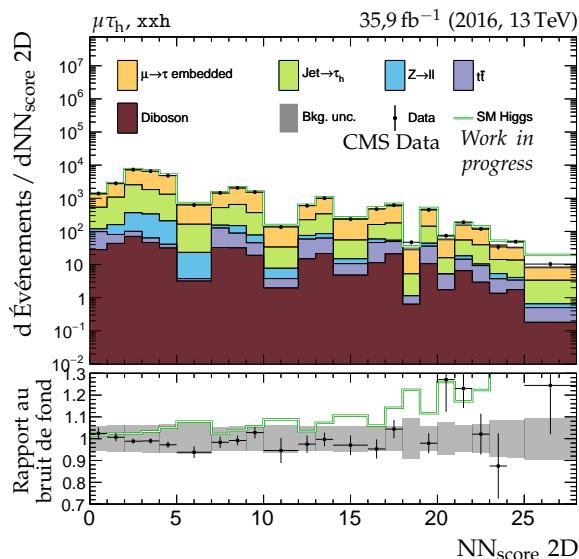
## 2 ANNEXE X. DISTRIBUTIONS DES VARIABLES DISCRIMINANTES – $H \rightarrow \tau\tau$



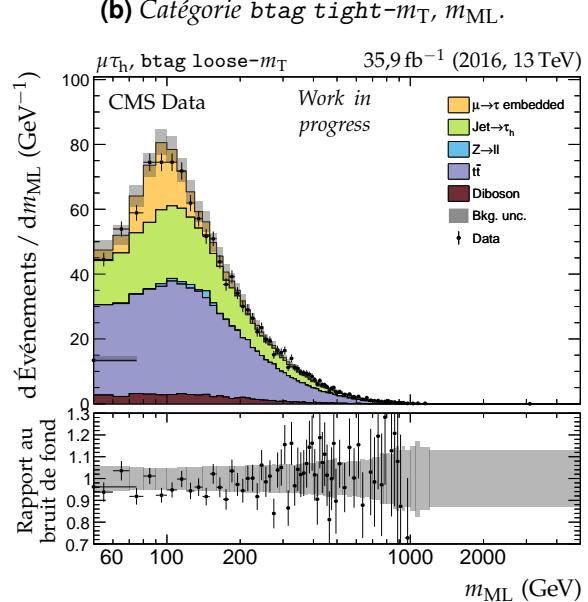
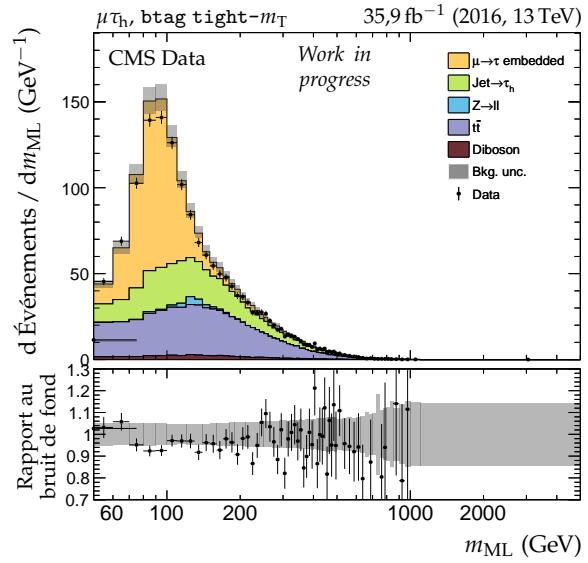
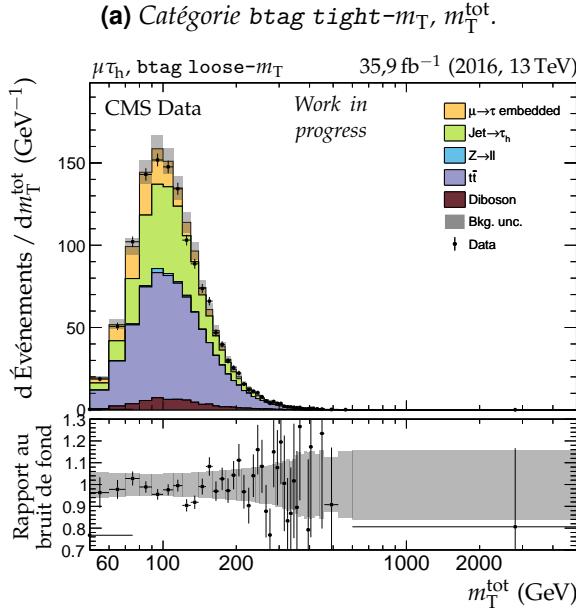
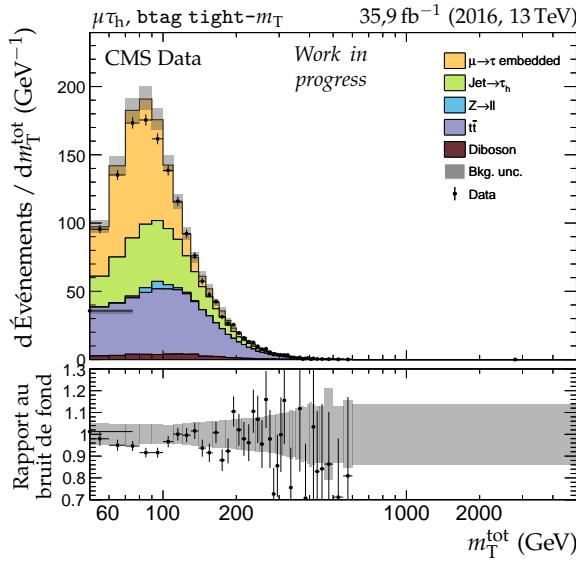


**Figure X.2 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2016 dans le canal  $\tau_h \tau_h$ .**

#### 4 ANNEXE X. DISTRIBUTIONS DES VARIABLES DISCRIMINANTES – $H \rightarrow \tau\tau$

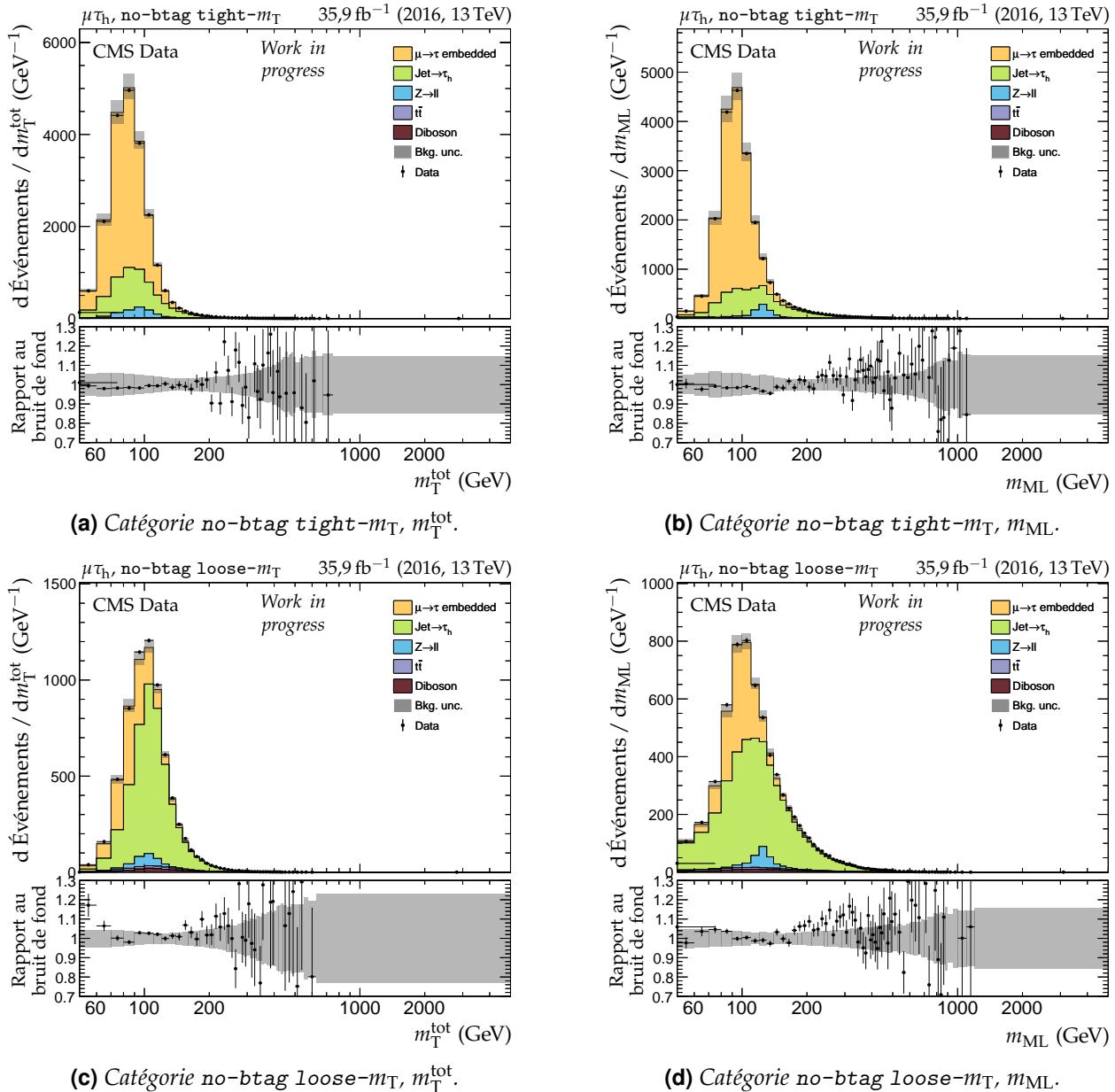


**Figure X.3 – Distributions de  $NN_{\text{score}}$  en 2016 dans le canal  $\mu\tau_h$ .**

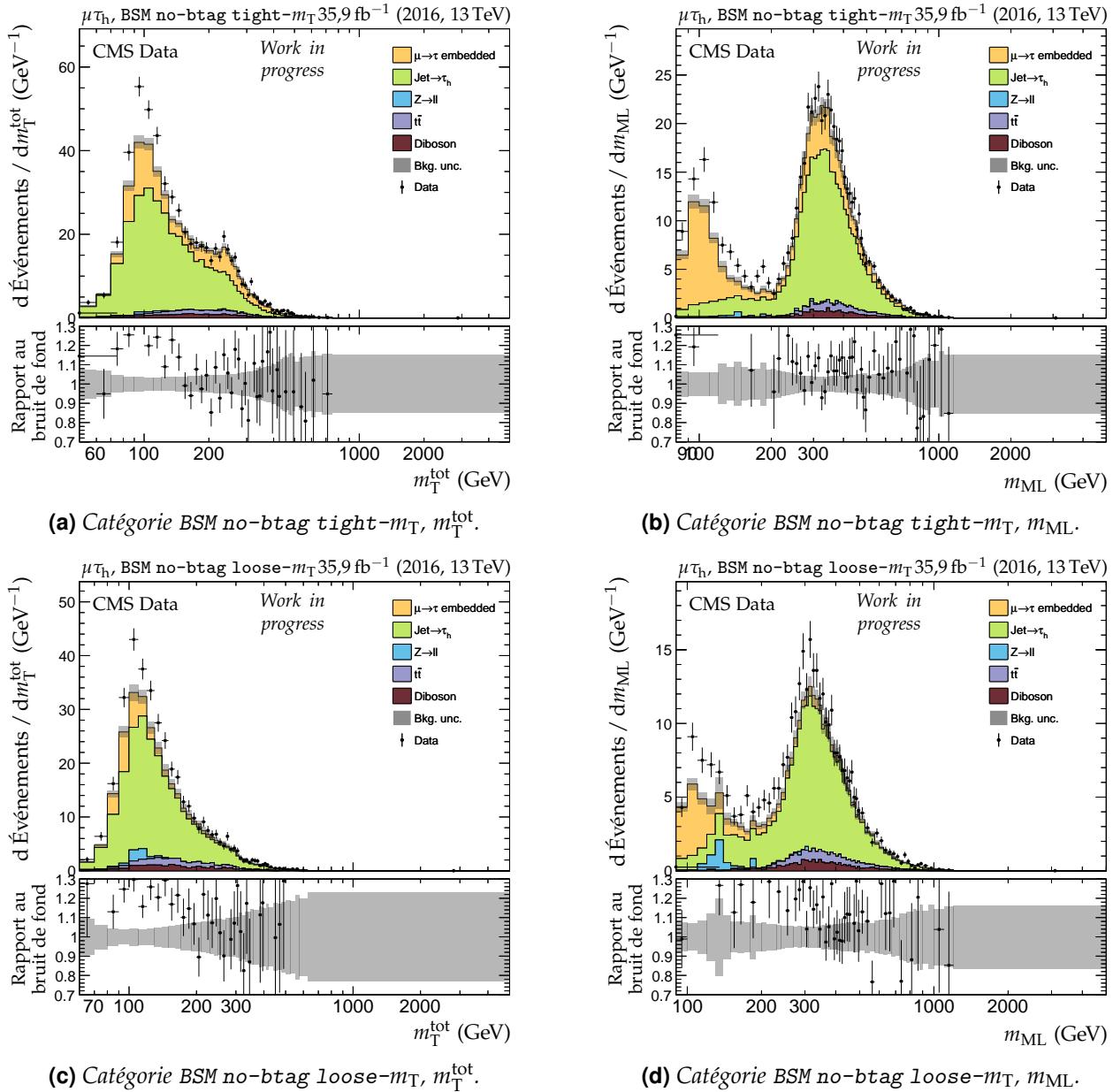


**Figure X.4 – Distributions de  $m_{\text{T}}^{\text{tot}}$  et  $m_{\text{ML}}$  en 2016 dans le canal  $\mu\tau_h$ , catégories  $b\text{tag}$ .**

## 6 ANNEXE X. DISTRIBUTIONS DES VARIABLES DISCRIMINANTES – $H \rightarrow \tau\tau$

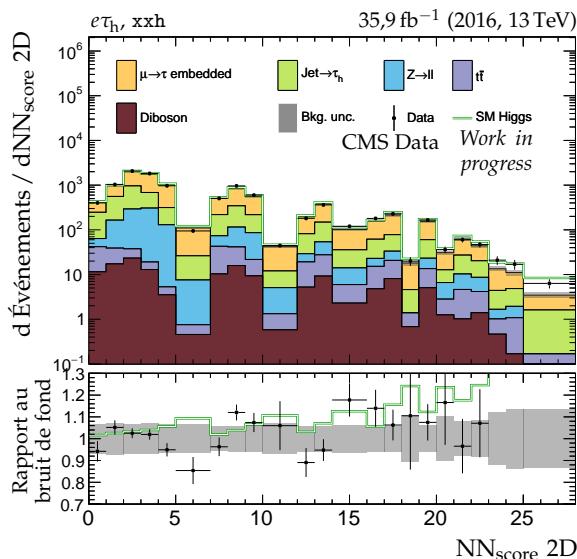


**Figure X.5 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2016 dans le canal  $\mu\tau_h$ , catégories no-btag.**

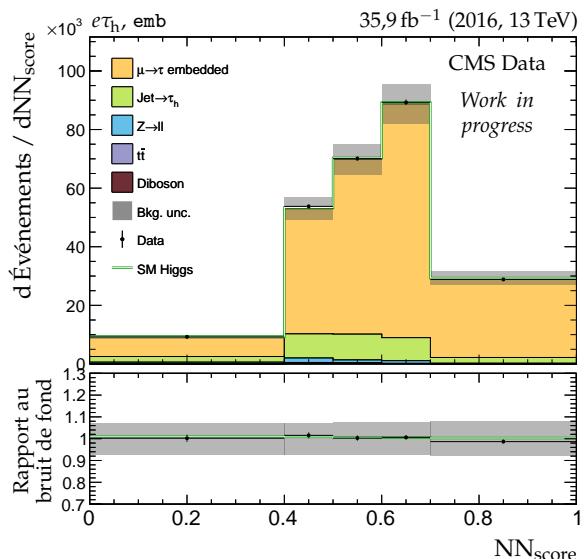


**Figure X.6 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2016 dans le canal  $\mu\tau_h$ , catégories no-btag avec  $m_{\text{SVFIT}} \geq 250 \text{ GeV}$ .**

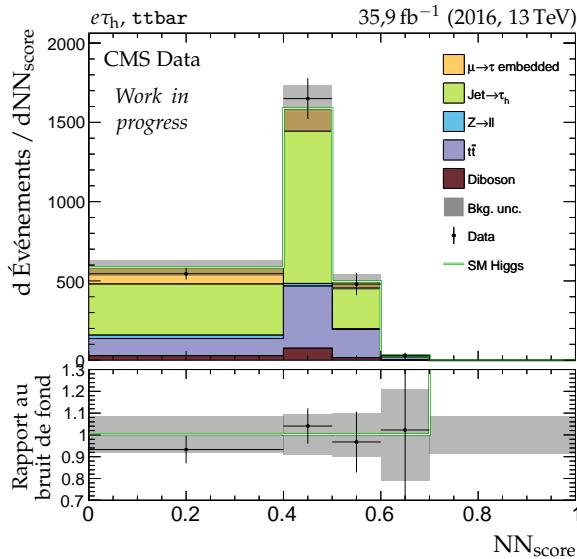
## 8 ANNEXE X. DISTRIBUTIONS DES VARIABLES DISCRIMINANTES – $H \rightarrow \tau\tau$



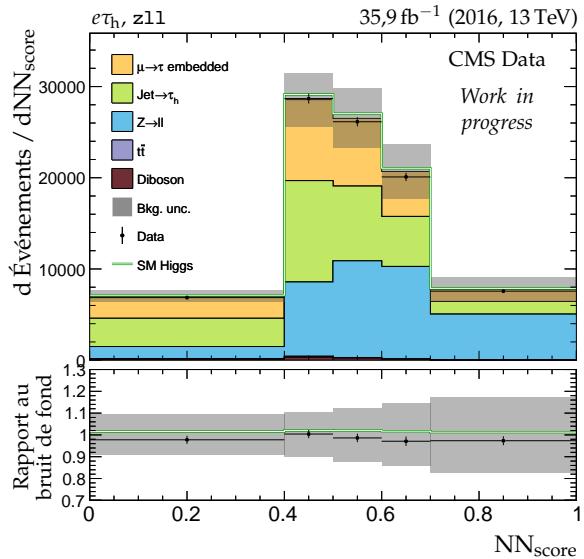
(a) Catégorie  $xxh$ .



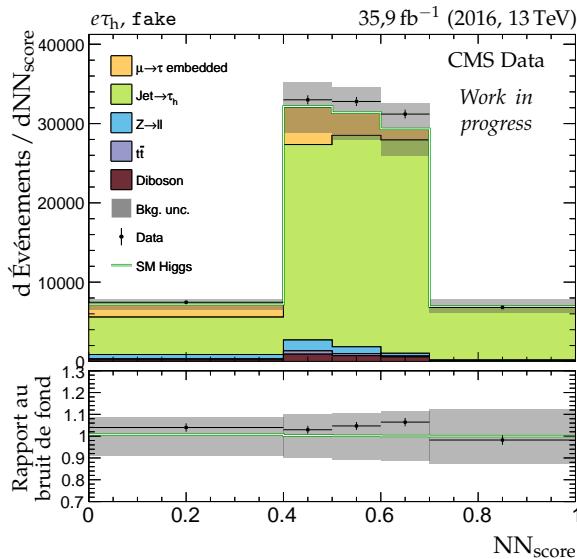
(b) Catégorie  $emb$ .



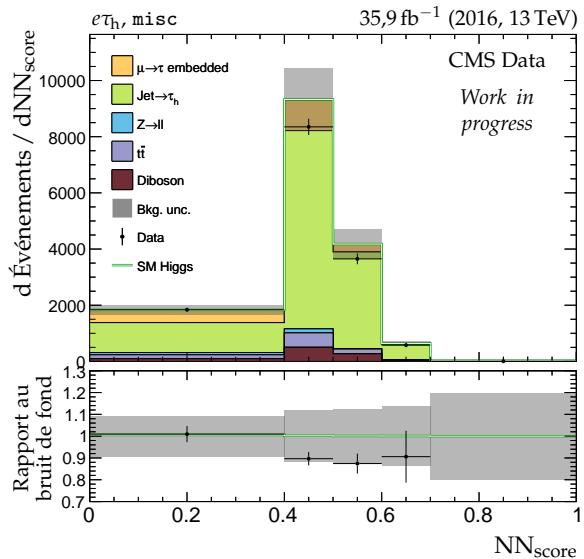
(c) Catégorie  $ttbar$ .



(d) Catégorie  $zll$ .

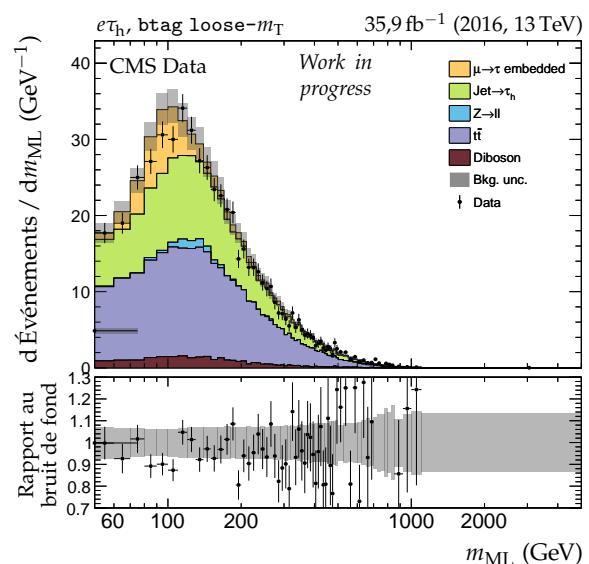
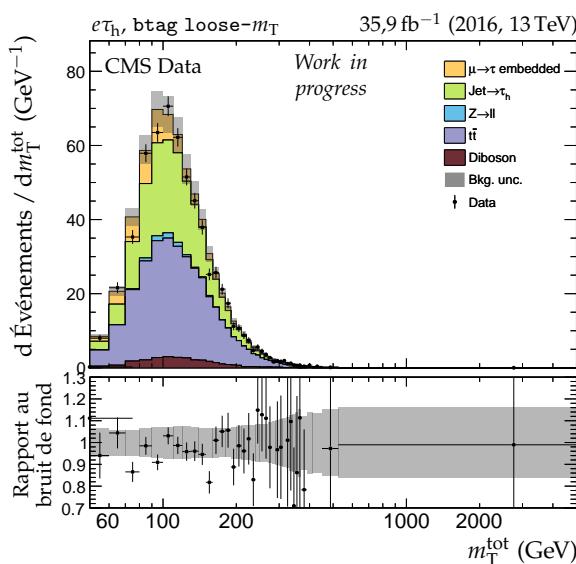
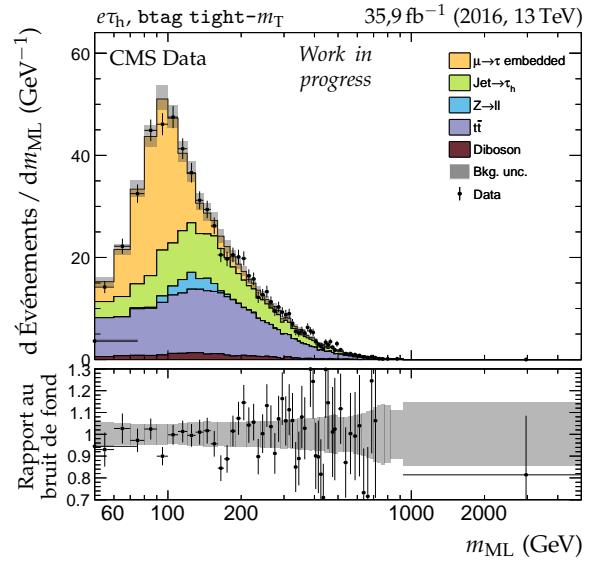
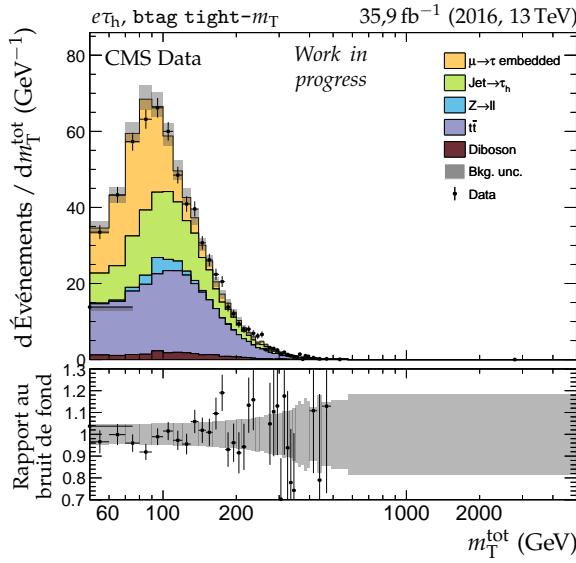


(e) Catégorie  $fake$ .

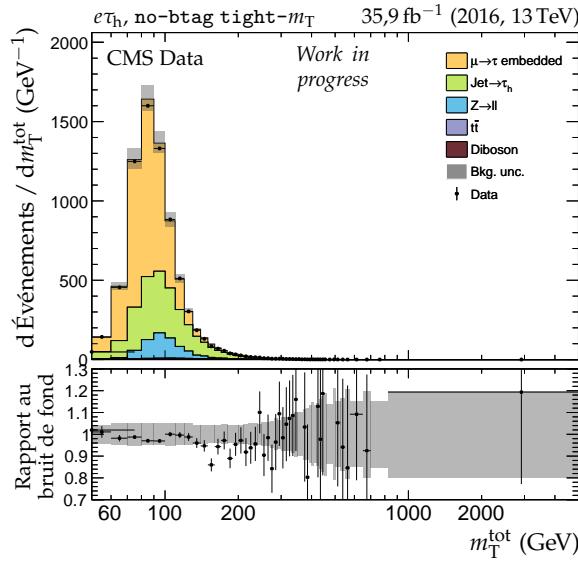


(f) Catégorie  $misc$ .

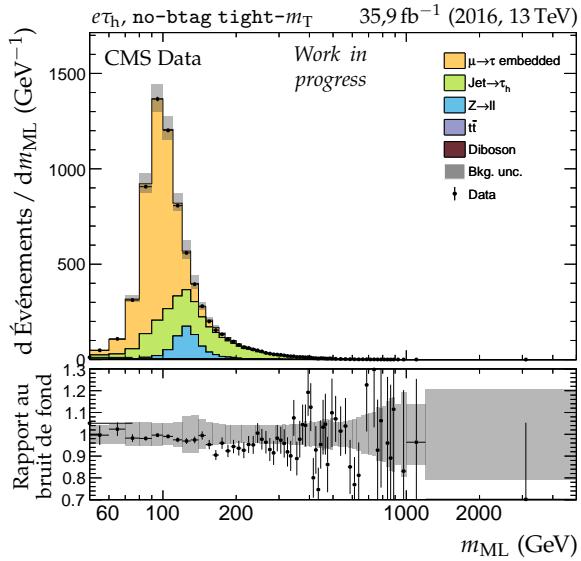
**Figure X.7 – Distributions de  $NN_{score}$  en 2016 dans le canal  $e\tau_h$ .**



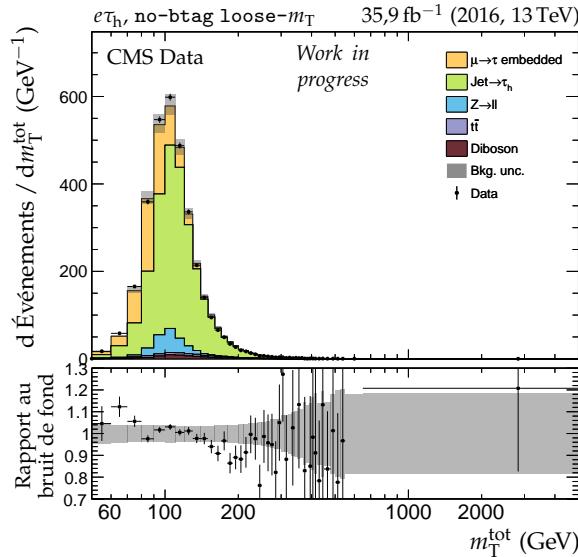
**Figure X.8 – Distributions de  $m_{\text{T}}^{\text{tot}}$  et  $m_{\text{ML}}$  en 2016 dans le canal  $e\tau_h$ , catégories  $b\text{tag}$ .**



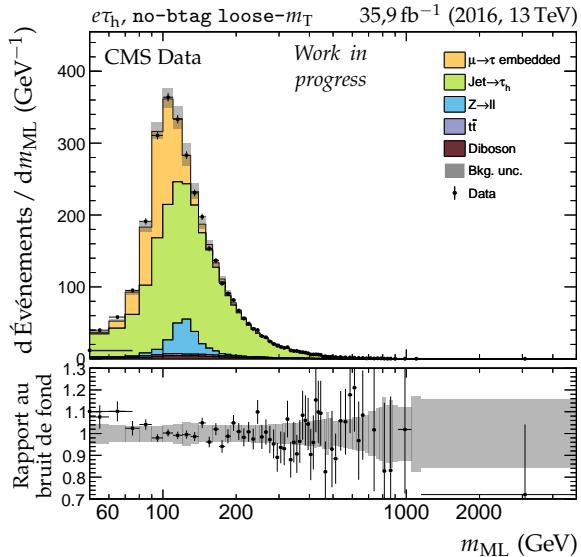
(a) Catégorie no-btag tight- $m_T$ ,  $m_T^{\text{tot}}$ .



(b) Catégorie no-btag tight- $m_T$ ,  $m_{\text{ML}}$ .

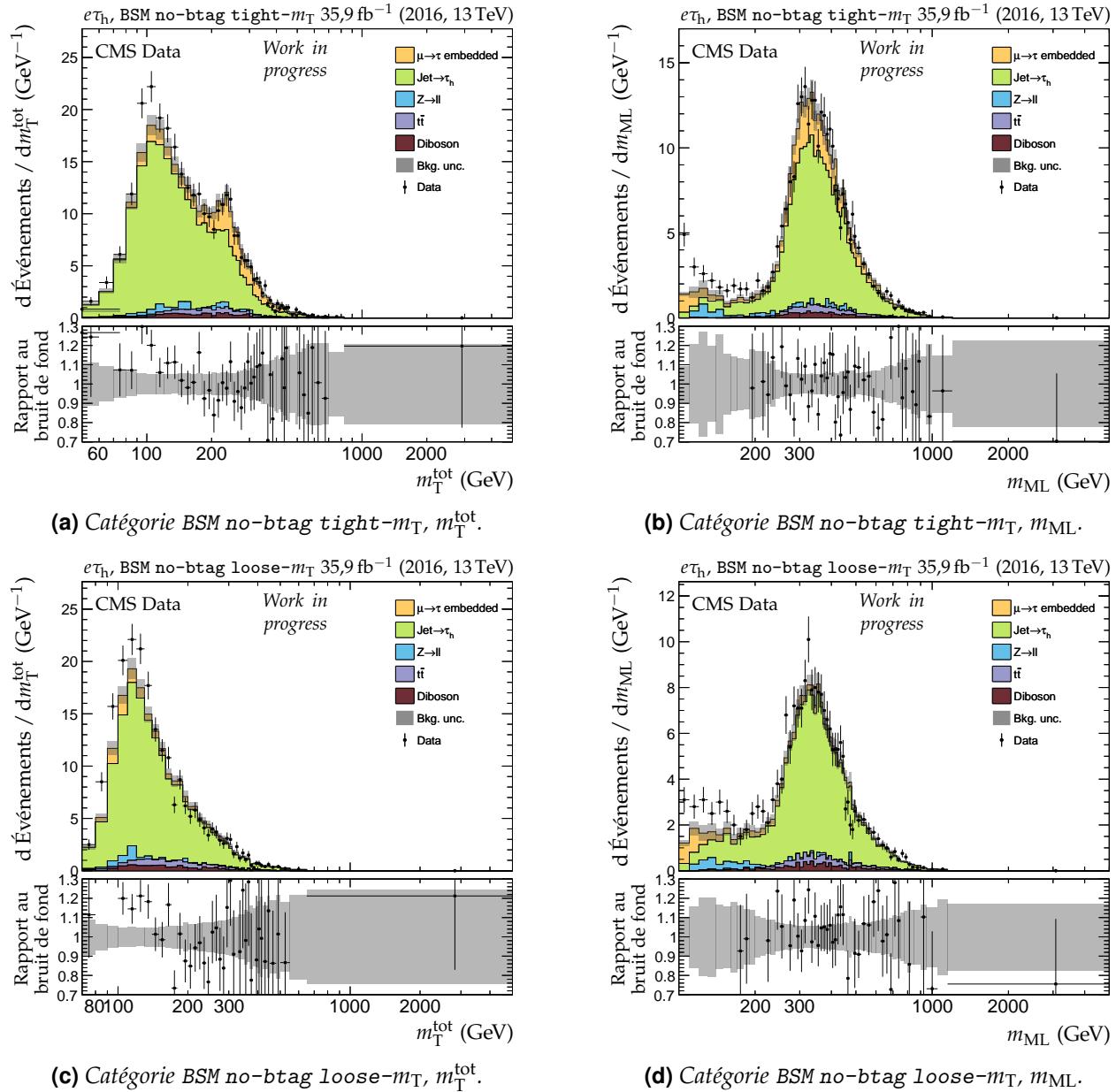


(c) Catégorie no-btag loose- $m_T$ ,  $m_T^{\text{tot}}$ .



(d) Catégorie no-btag loose- $m_T$ ,  $m_{\text{ML}}$ .

**Figure X.9** – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2016 dans le canal  $e\tau_h$ , catégories no-btag.



**Figure X.10 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2016 dans le canal  $e\tau_h$ , catégories no-btag avec  $m_{\text{SVFIT}} \geq 250 \text{ GeV}$ .**

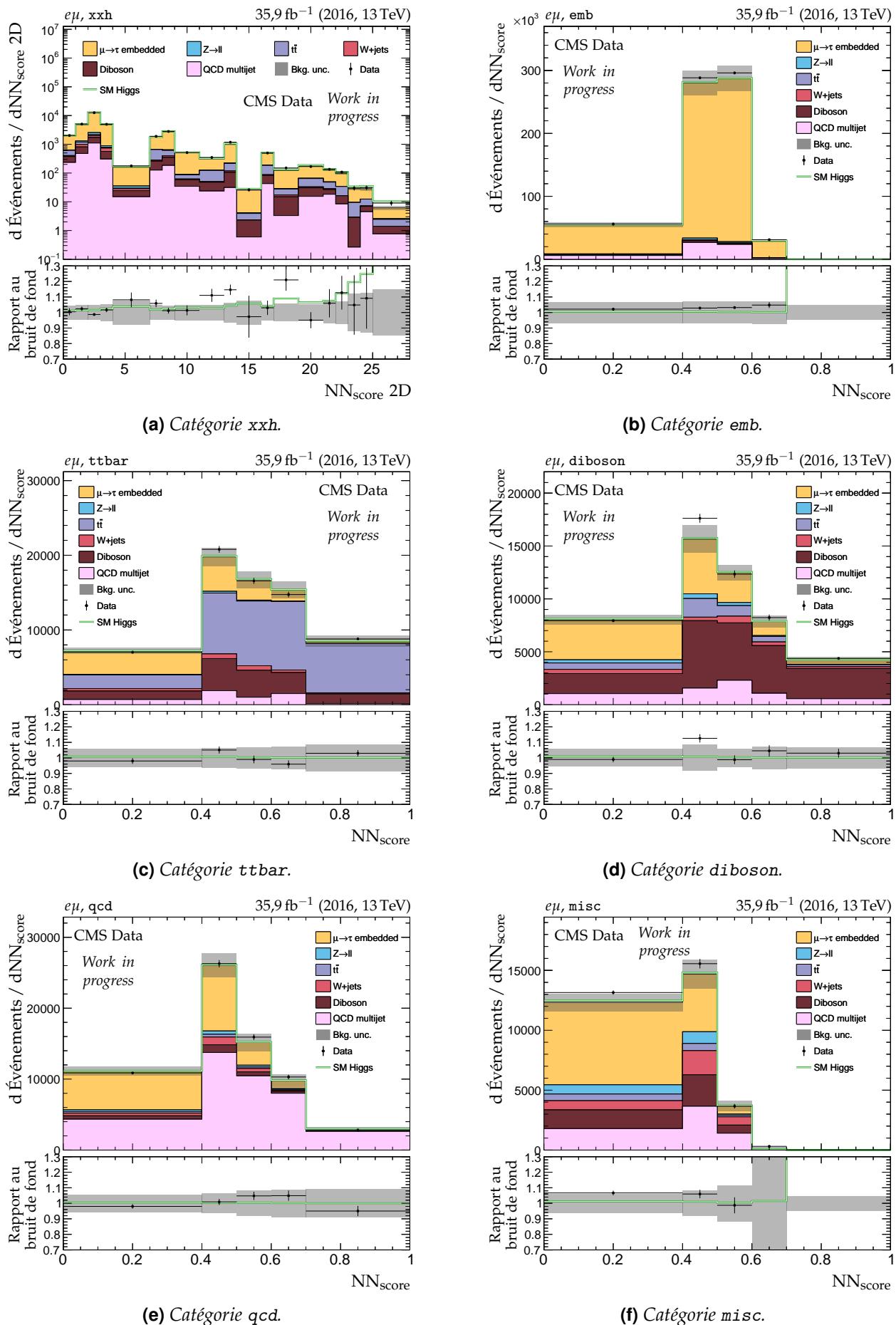
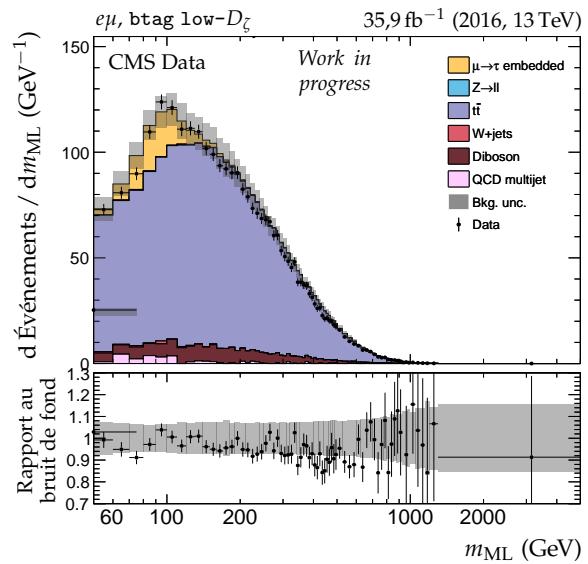
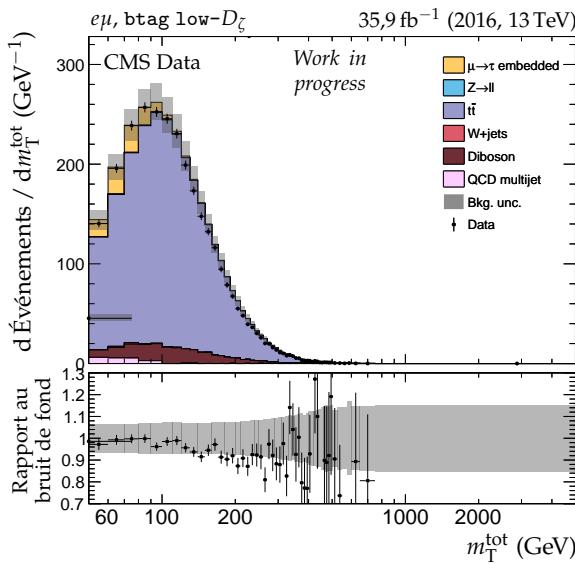
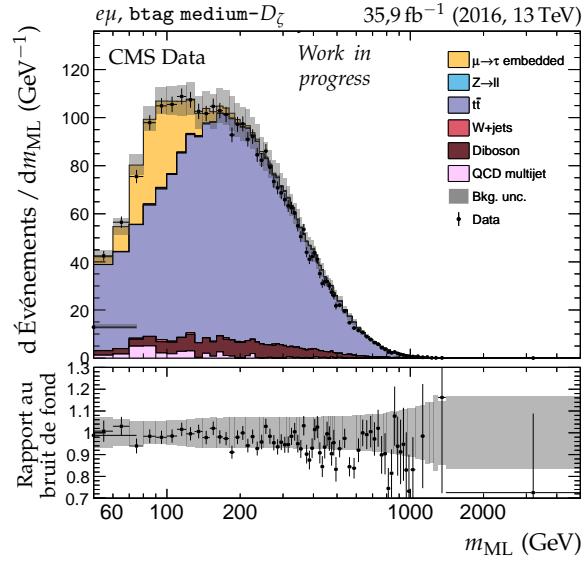
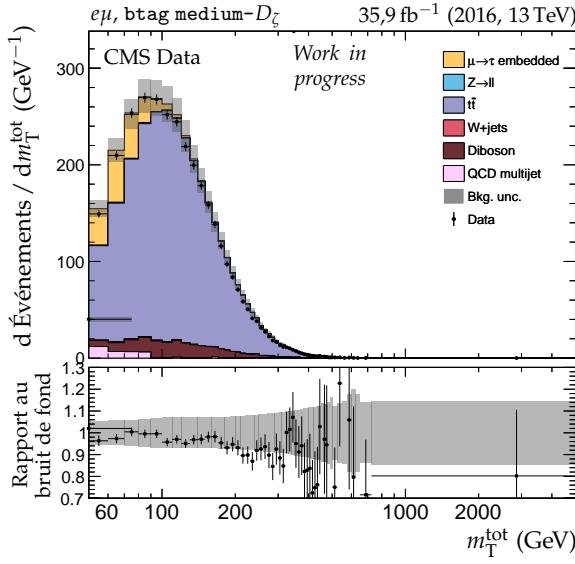
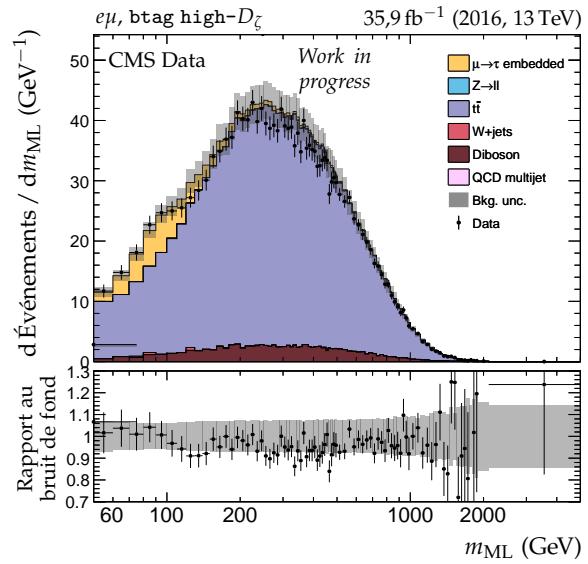
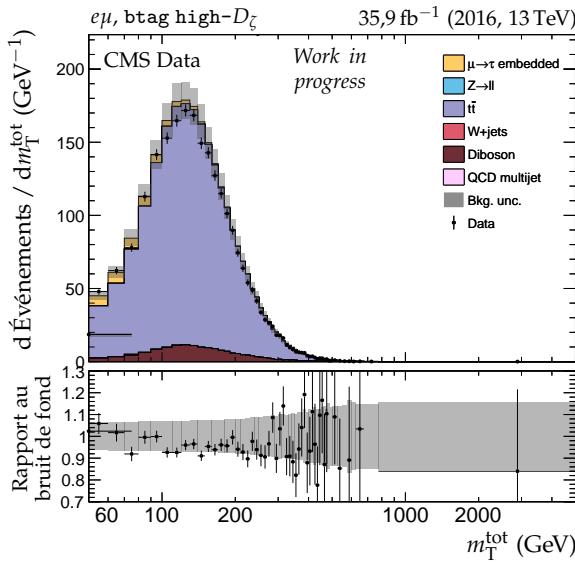
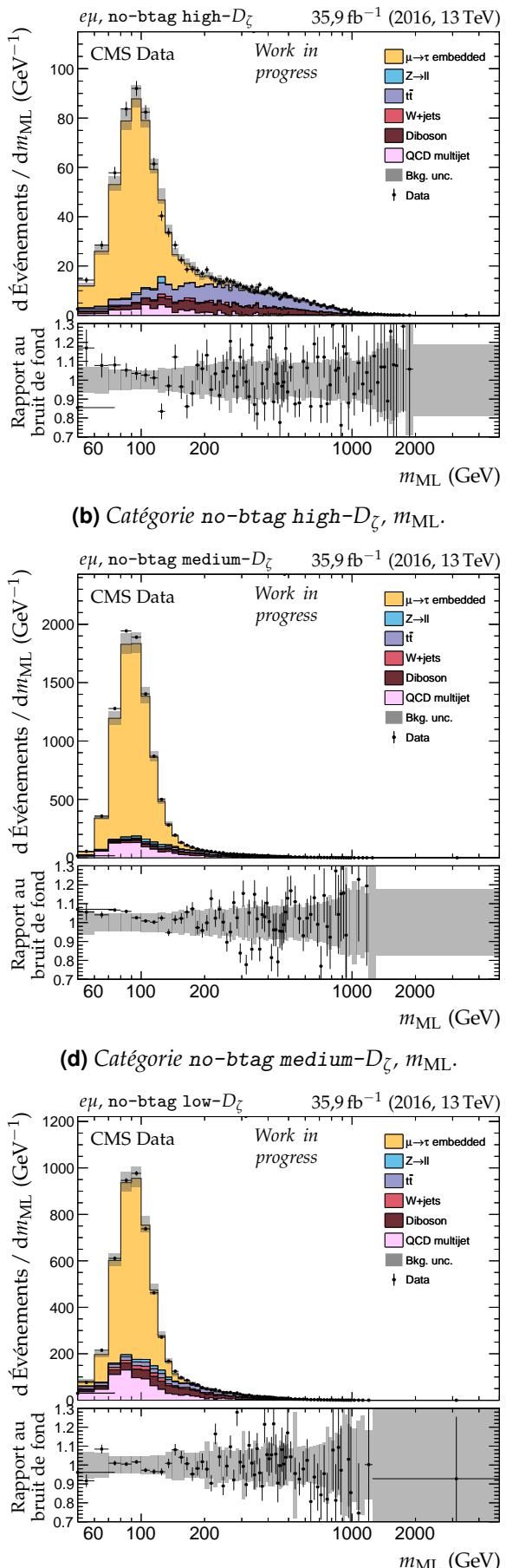
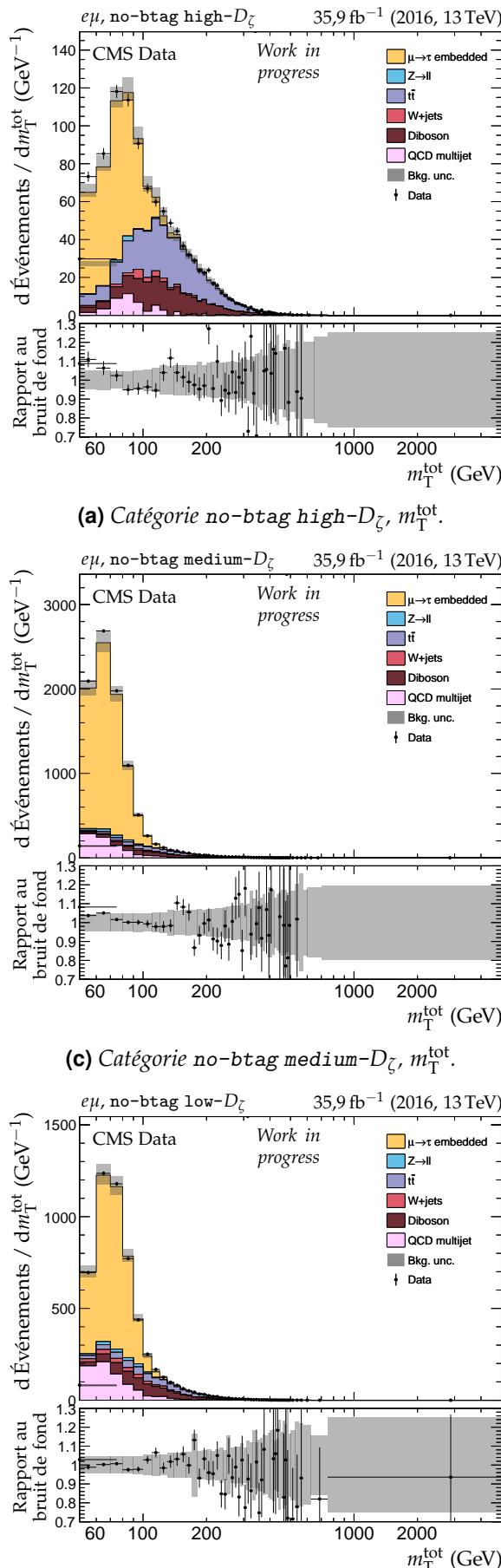


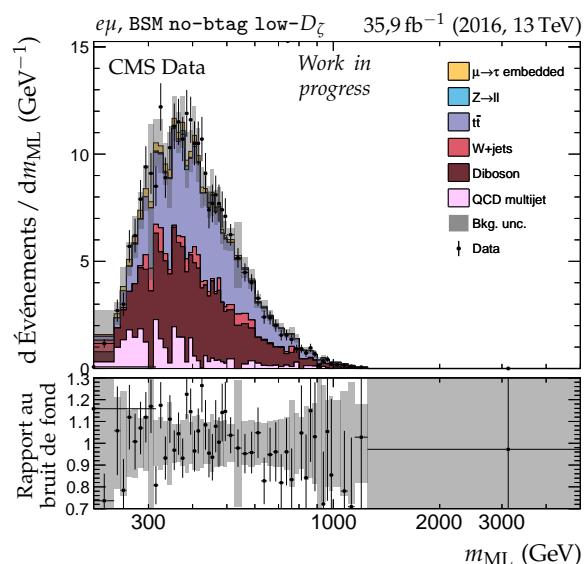
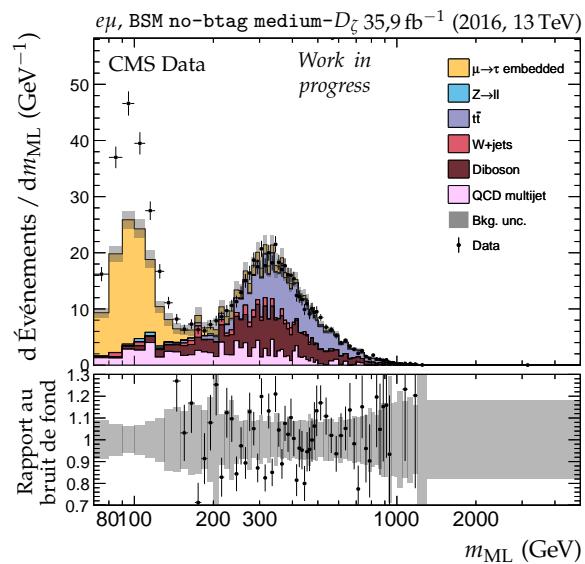
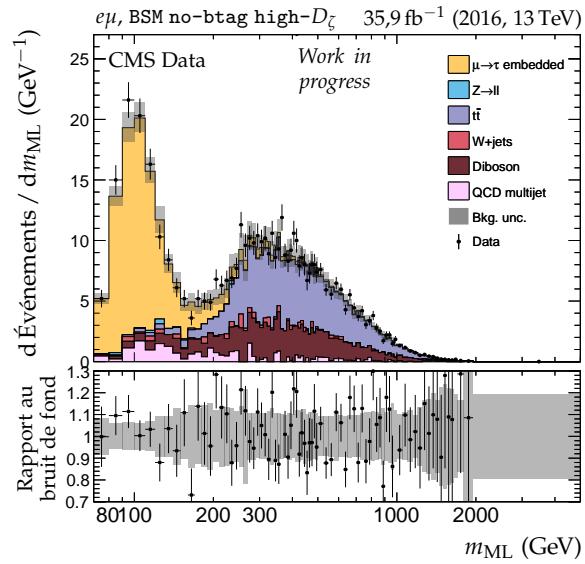
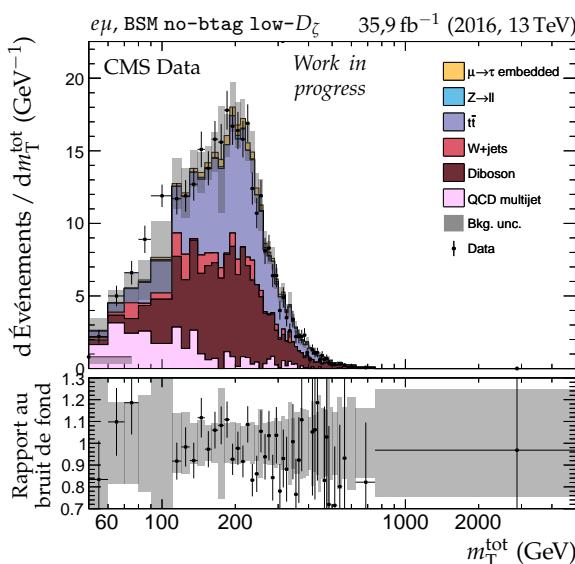
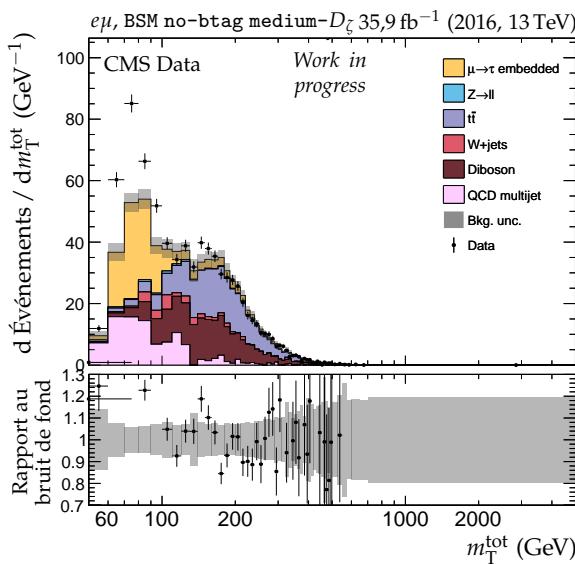
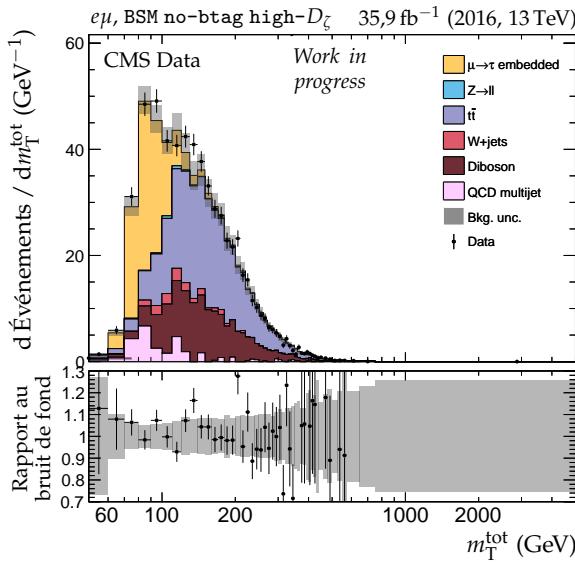
Figure X.11 – Distributions de  $NN_{\text{score}}$  en 2016 dans le canal  $e\mu$ .



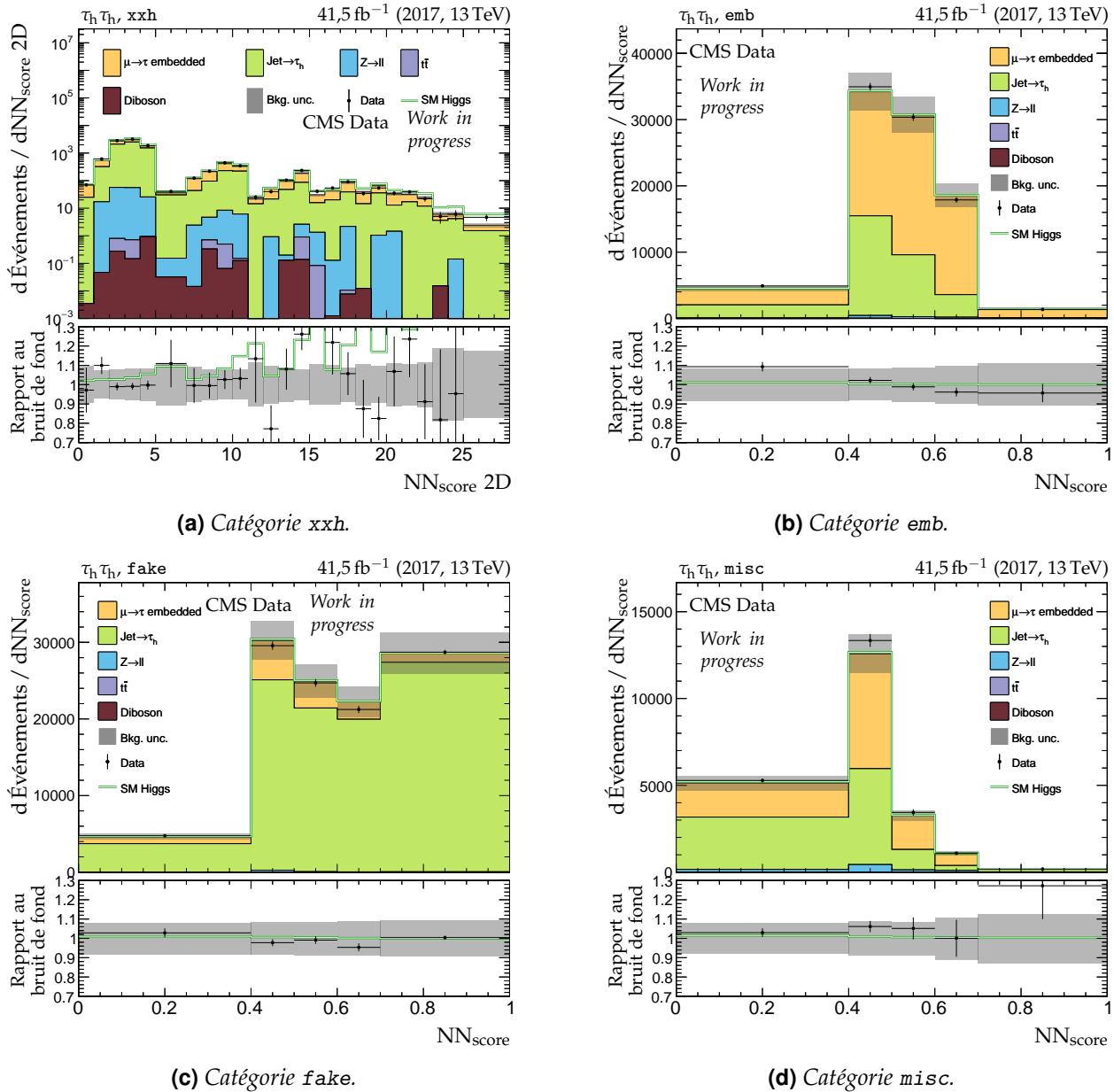
**Figure X.12 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2016 dans le canal  $e\mu$ , catégories  $b\text{tag}$ .**

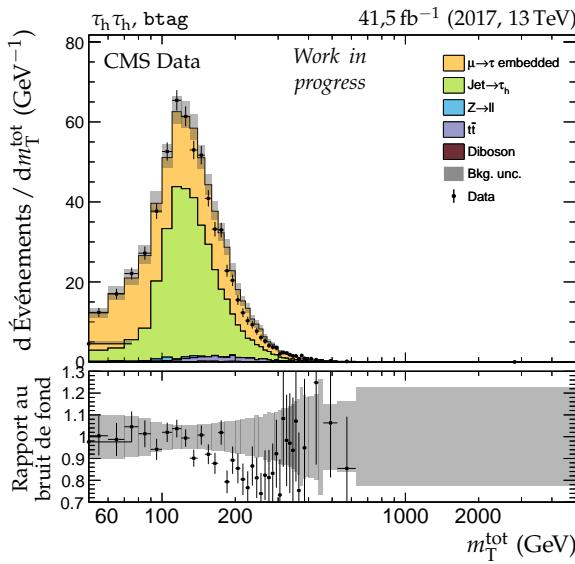
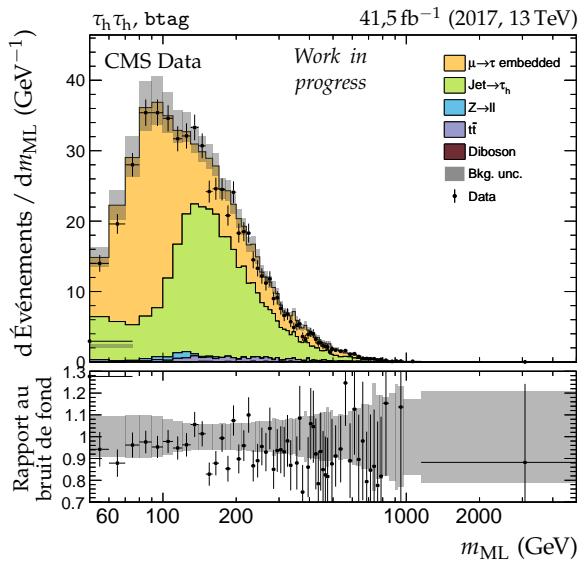
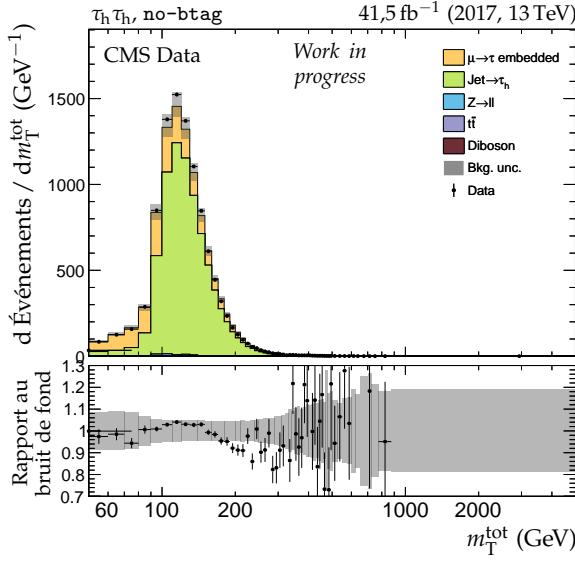
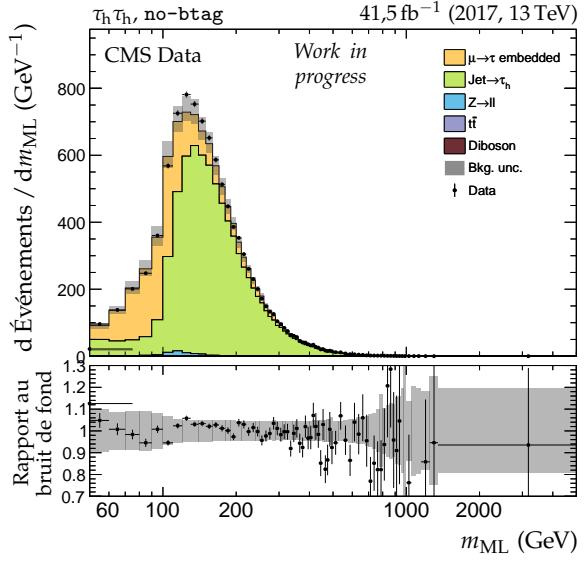
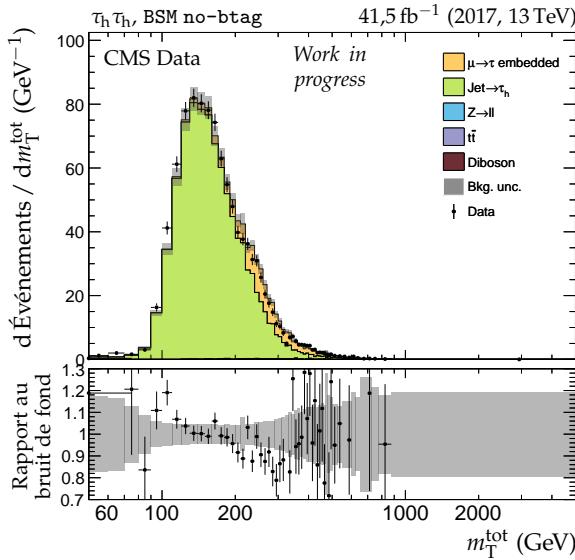
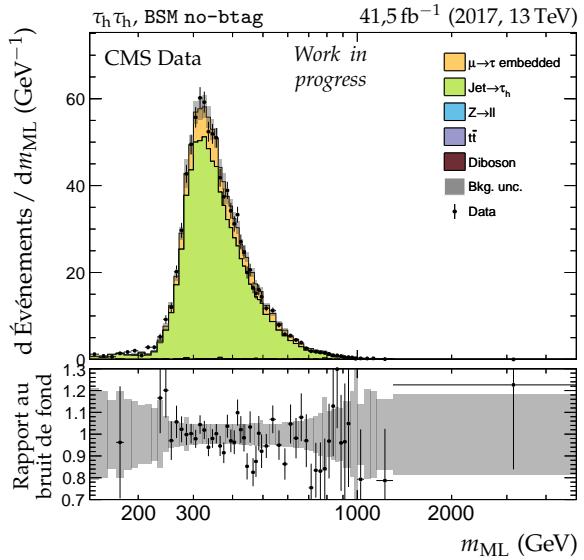


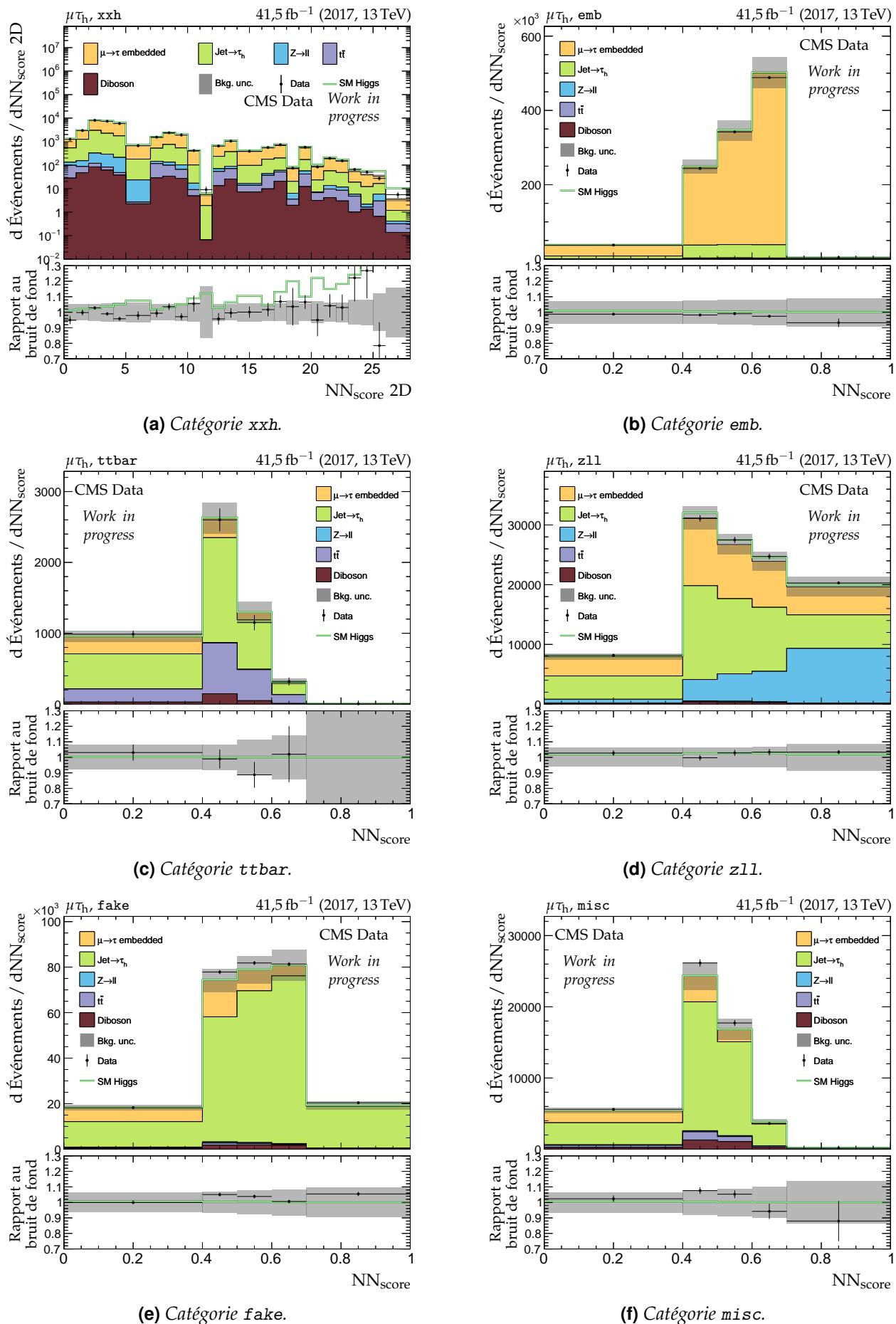
**Figure X.13 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2016 dans le canal  $e\mu$ , catégories no-btag.**

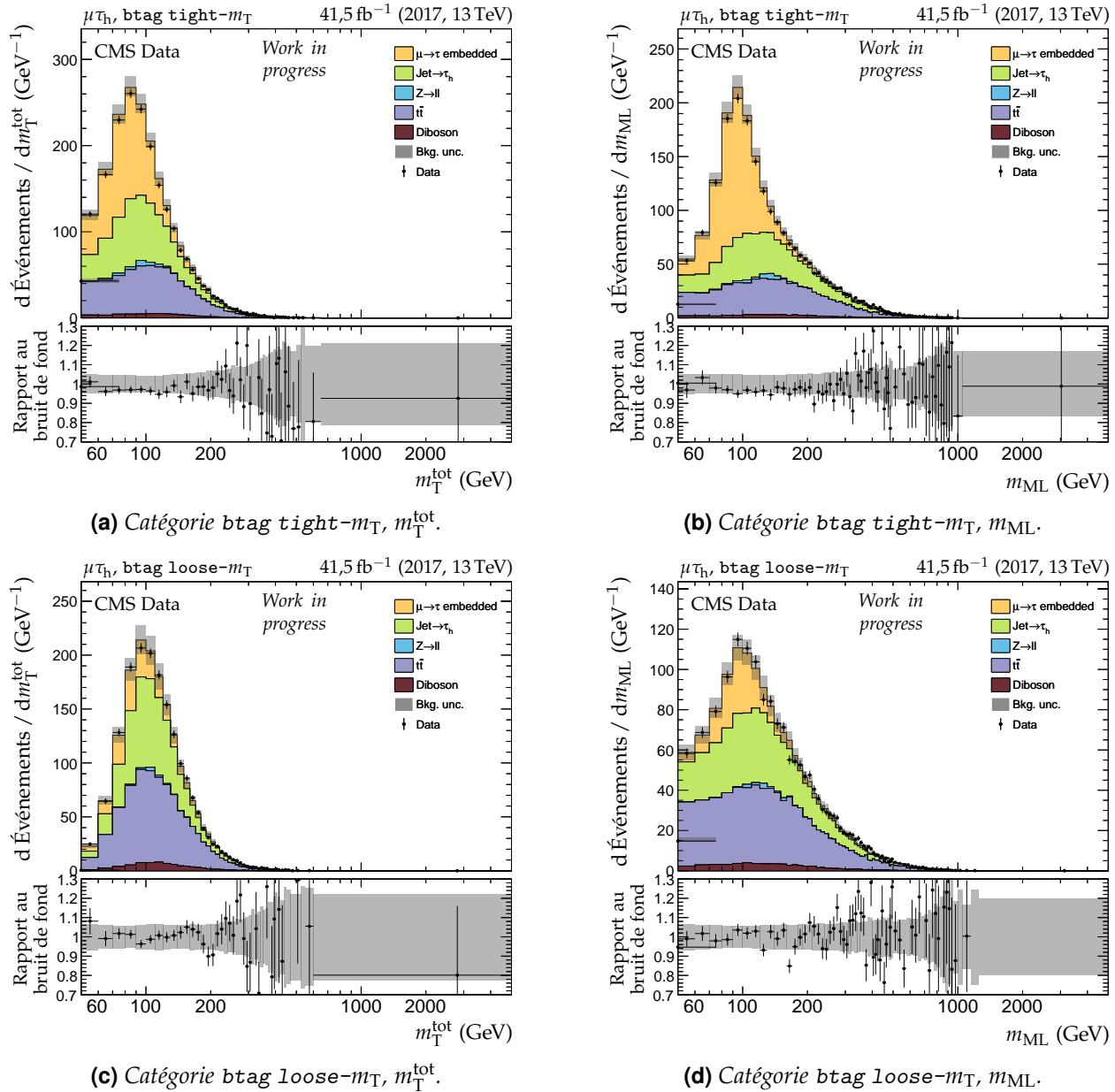


**Figure X.14 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2016 dans le canal  $e\mu$ , catégories no-btag avec  $m_{\text{SVFIT}} \geq 250 \text{ GeV}$ .**

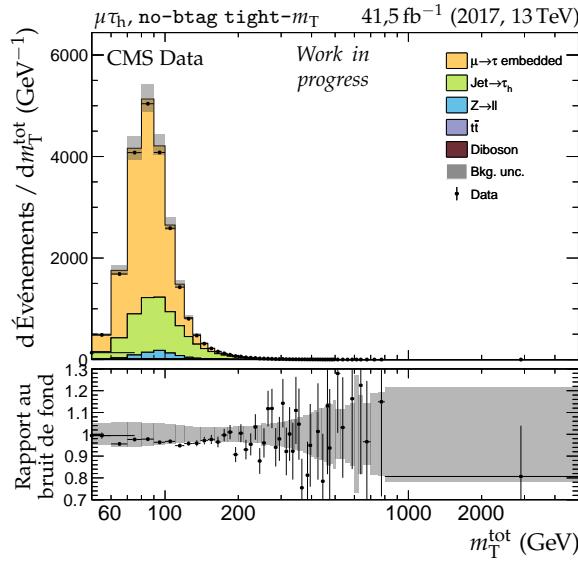


(a) Catégorie btag,  $m_T^{\text{tot}}$ .(b) Catégorie btag,  $m_{\text{ML}}$ .(c) Catégorie no-btag,  $m_T^{\text{tot}}$ .(d) Catégorie no-btag,  $m_{\text{ML}}$ .(e) Catégorie BSM no-btag,  $m_T^{\text{tot}}$ .(f) Catégorie BSM no-btag,  $m_{\text{ML}}$ .**Figure X.16** – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2017 dans le canal  $\tau_h \tau_h$ .

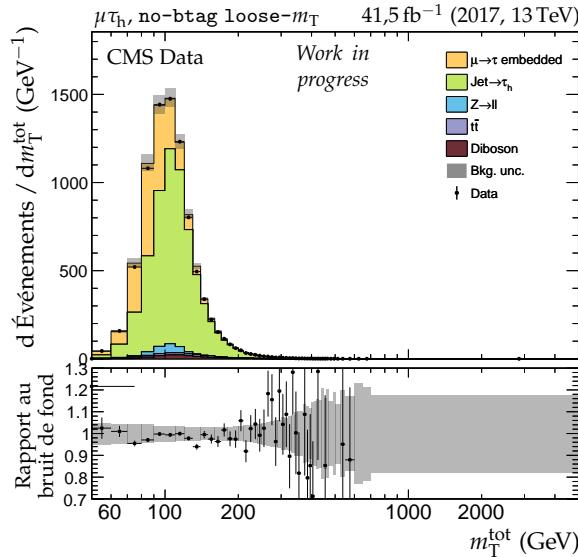




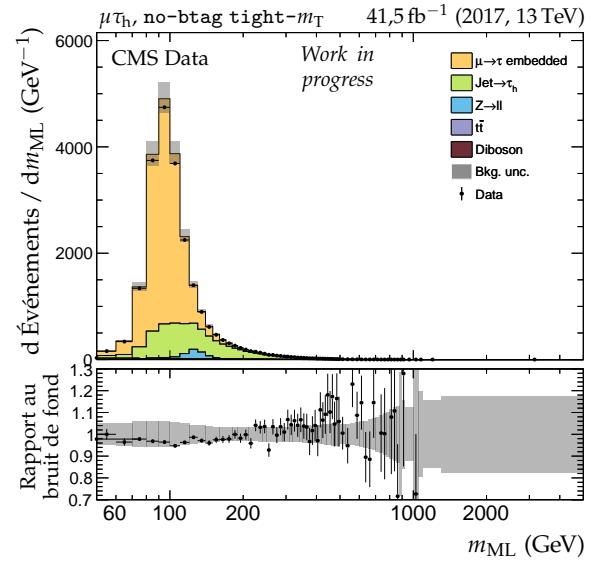
**Figure X.18 – Distributions de  $m_{\text{T}}^{\text{tot}}$  et  $m_{\text{ML}}$  en 2017 dans le canal  $\mu\tau_h$ , catégories  $b\text{tag}$ .**



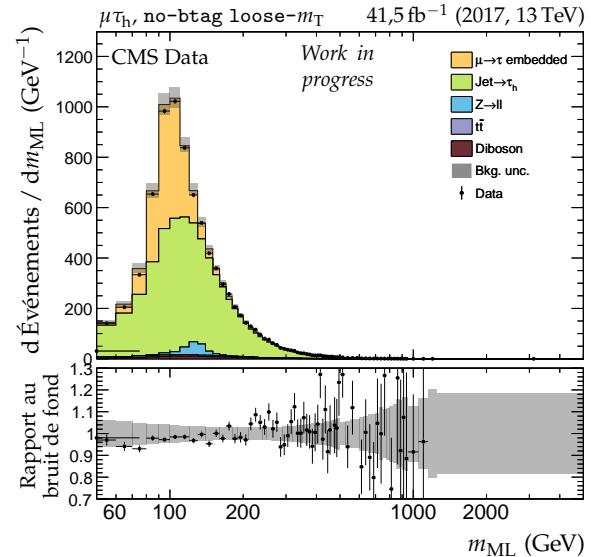
(a) Catégorie no-btag tight- $m_T$ ,  $m_T^{\text{tot}}$ .



(c) Catégorie no-btag loose- $m_T$ ,  $m_T^{\text{tot}}$ .

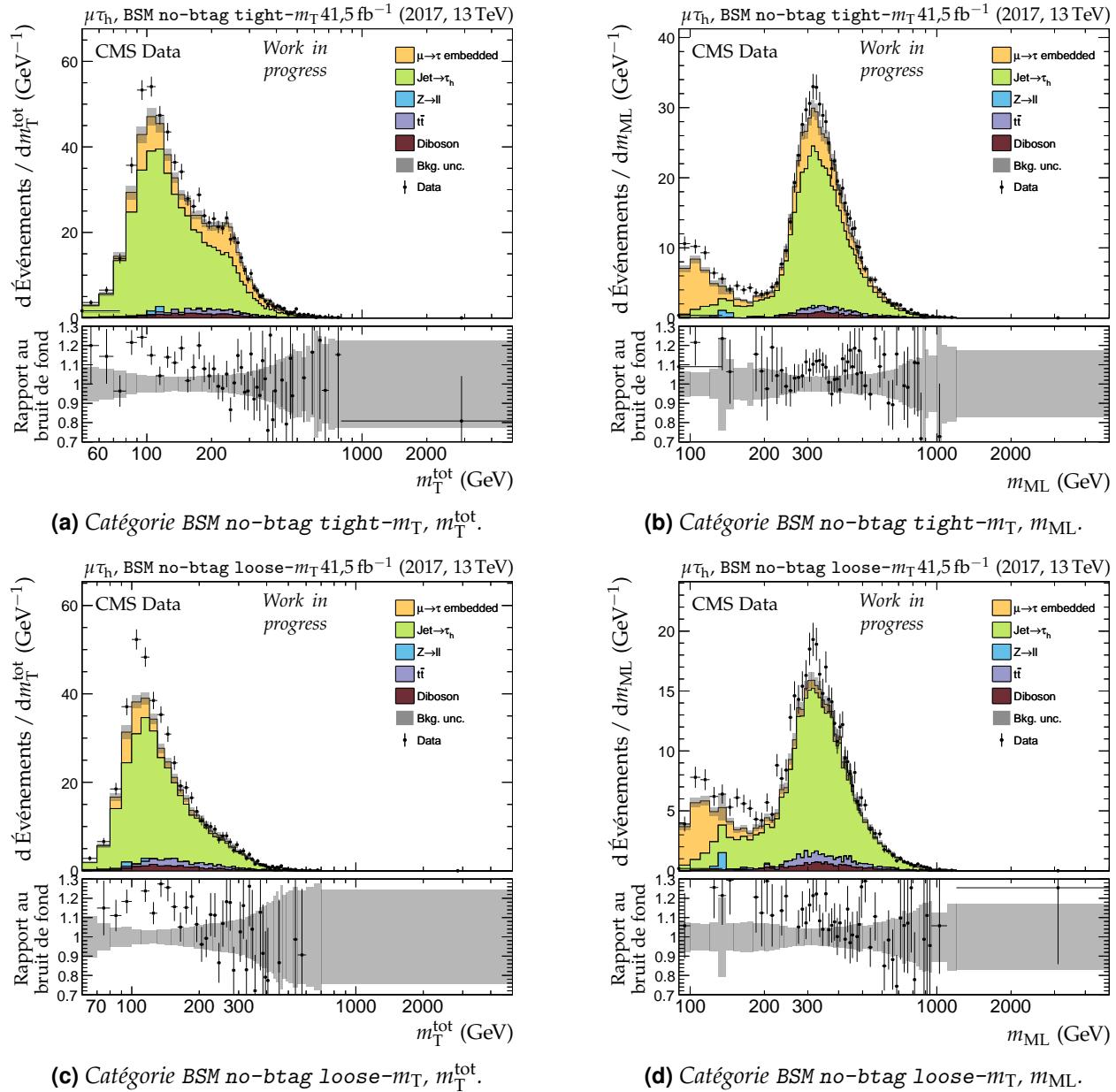


(b) Catégorie no-btag tight- $m_T$ ,  $m_{\text{ML}}$ .

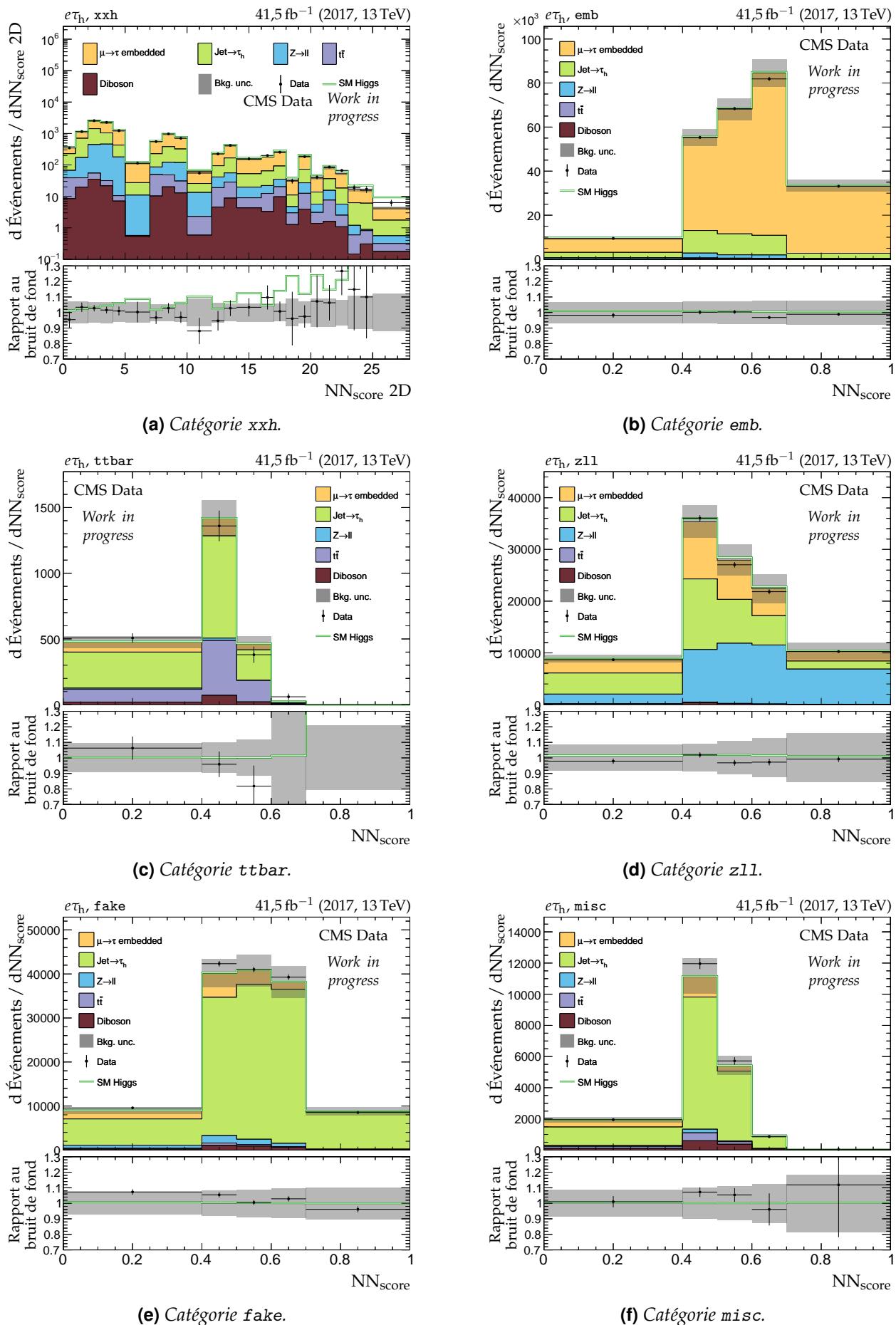


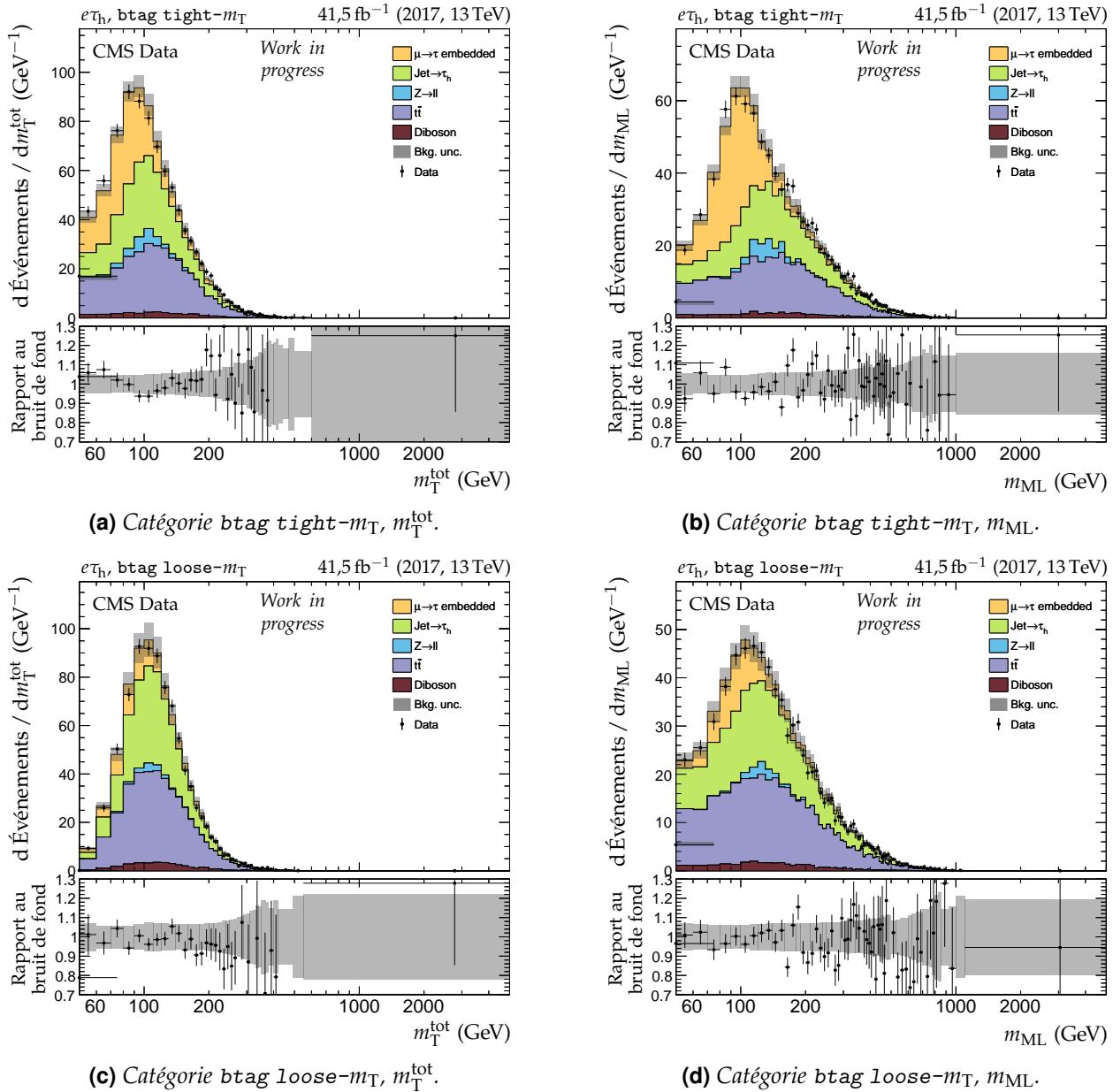
(d) Catégorie no-btag loose- $m_T$ ,  $m_{\text{ML}}$ .

**Figure X.19** – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2017 dans le canal  $\mu\tau_h$ , catégories no-btag.

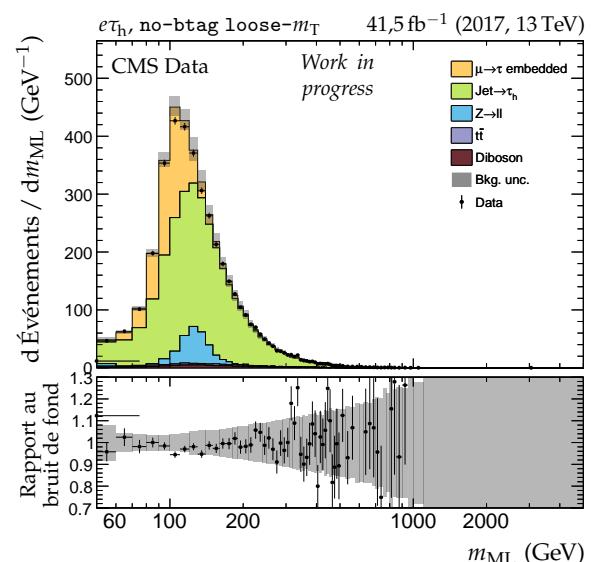
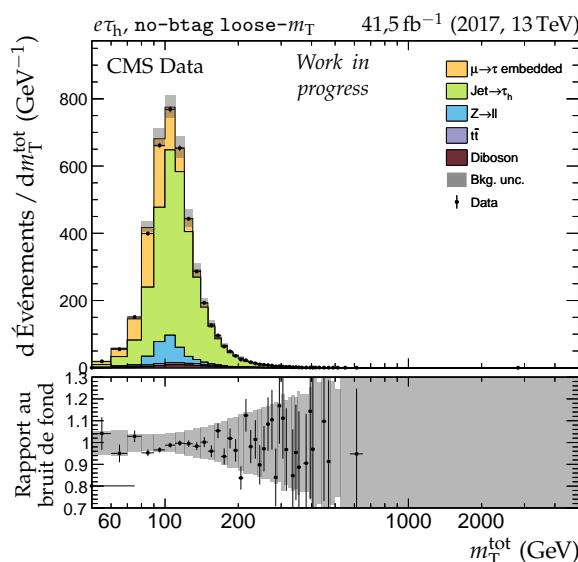
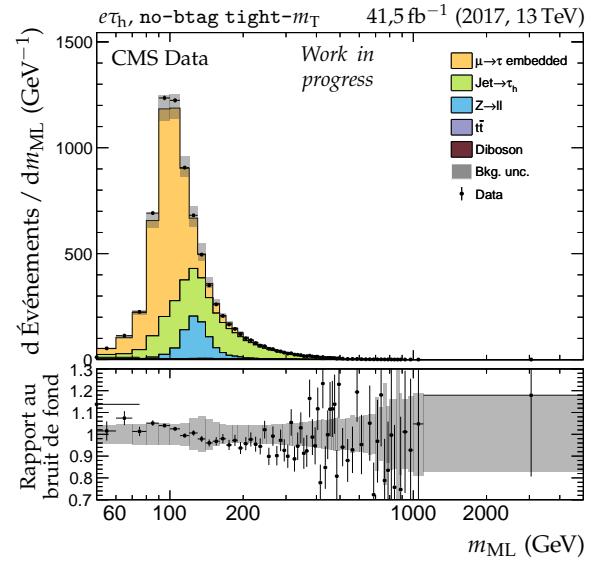
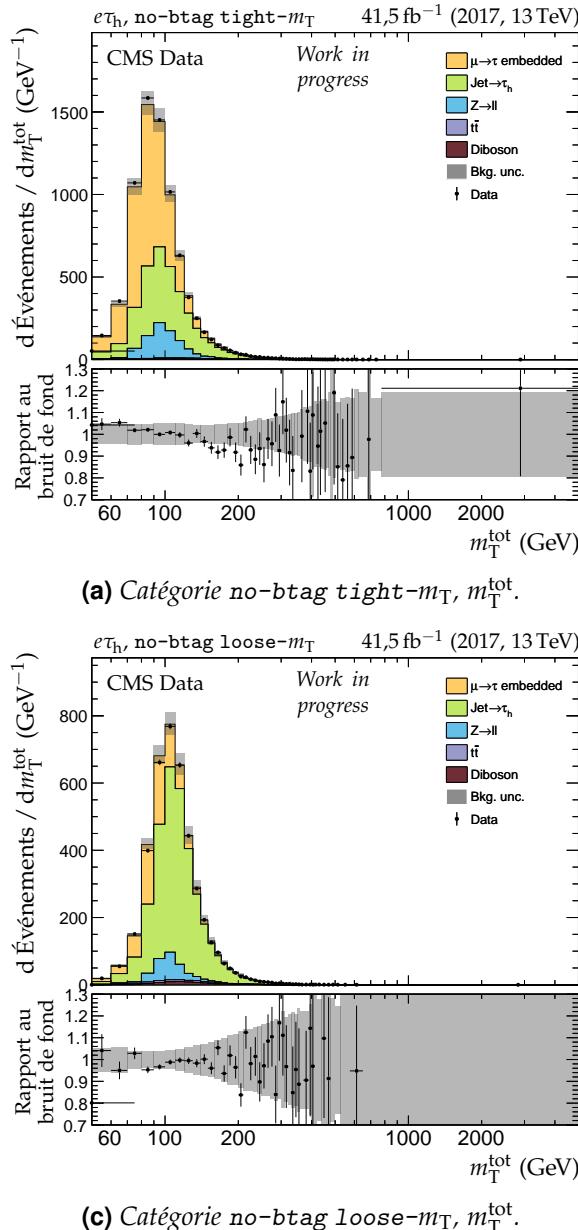


**Figure X.20 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2017 dans le canal  $\mu\tau_h$ , catégories no-btag avec  $m_{\text{SVFIT}} \geq 250 \text{ GeV}$ .**

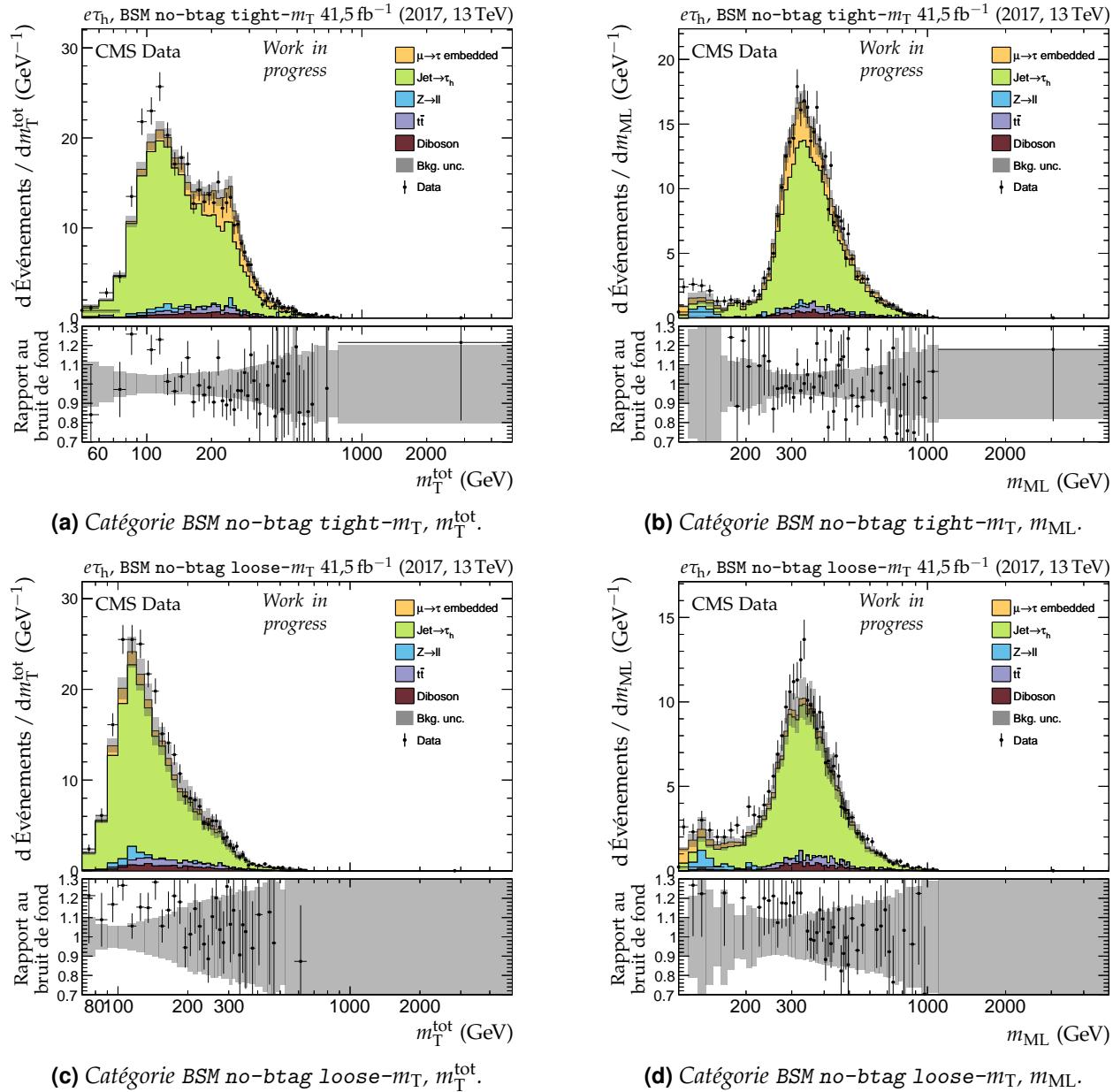




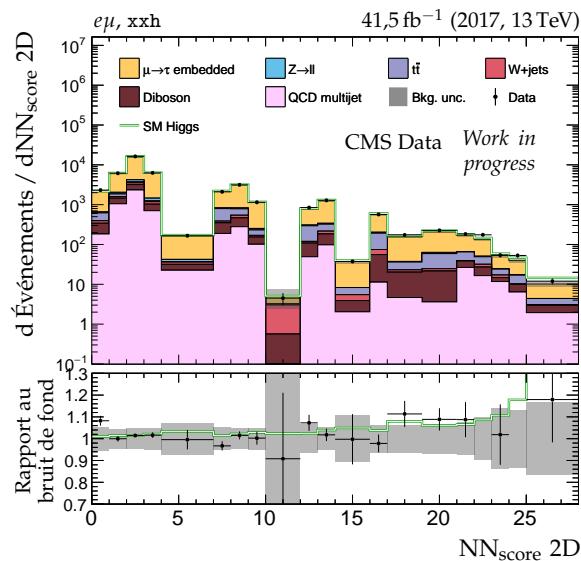
**Figure X.22 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2017 dans le canal  $e\tau_h$ , catégories btag.**



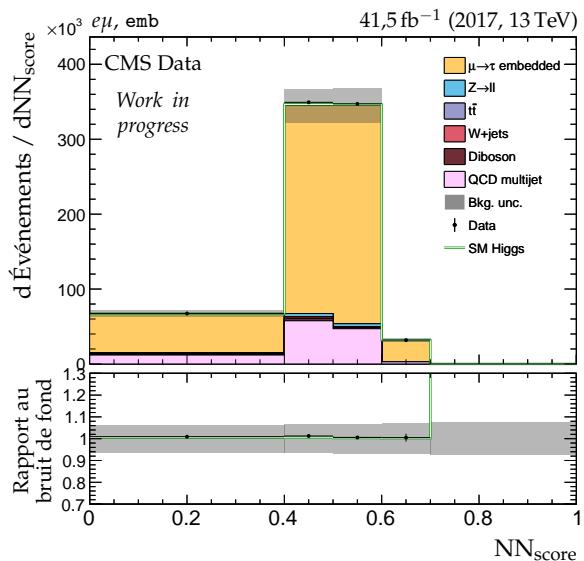
**Figure X.23 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2017 dans le canal  $e\tau_h$ , catégories no-btag.**



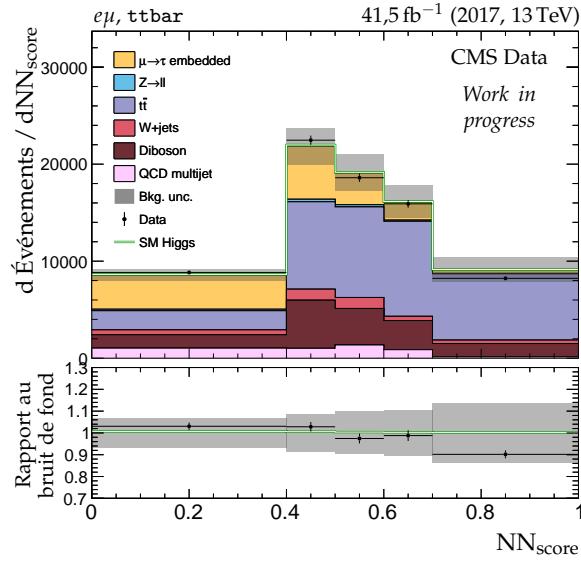
**Figure X.24 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2017 dans le canal  $e\tau_h$ , catégories no-btag avec  $m_{\text{SVFIT}} \geq 250 \text{ GeV}$ .**



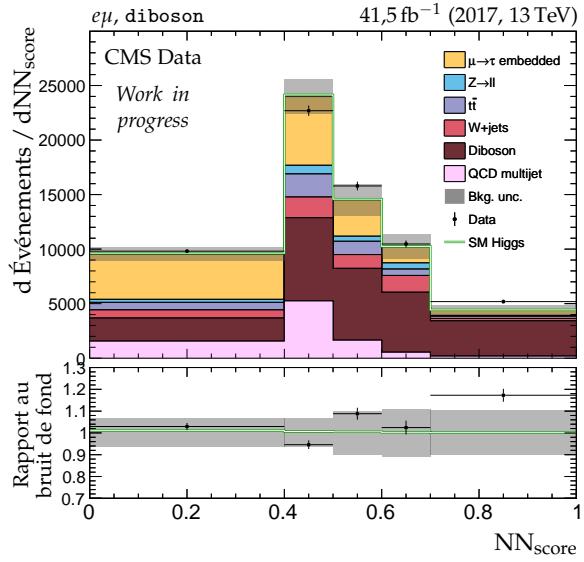
(a) Catégorie xxh.



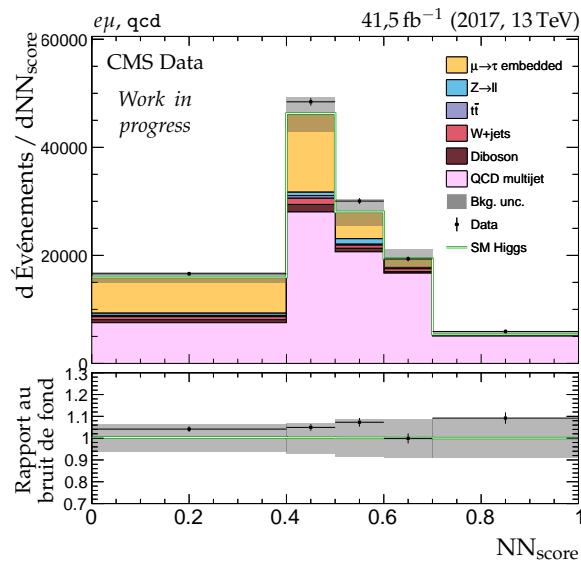
(b) Catégorie emb.



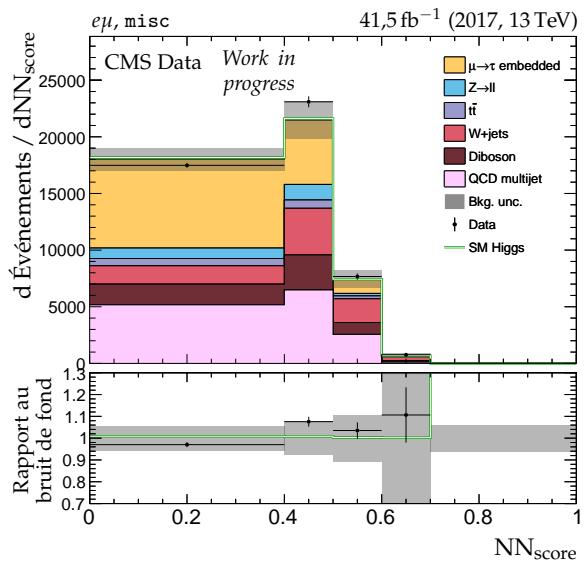
(c) Catégorie ttbar.



(d) Catégorie diboson.

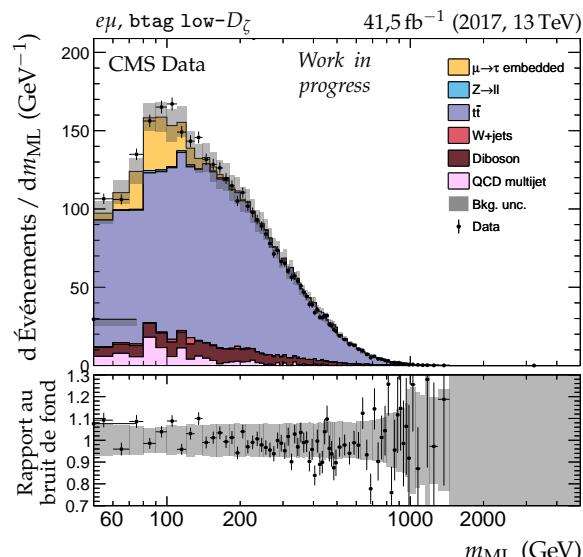
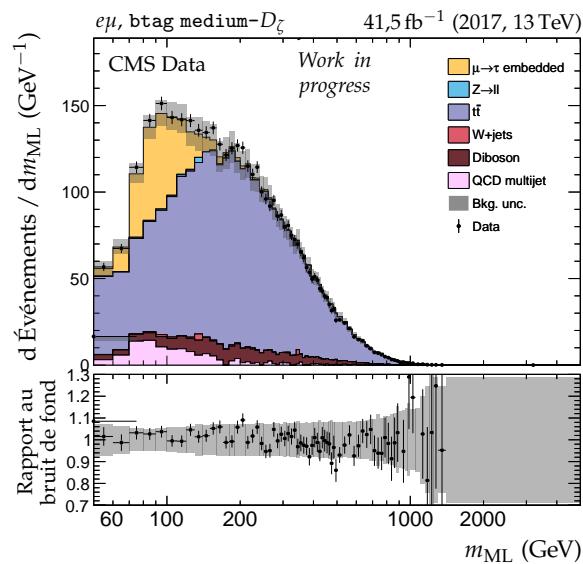
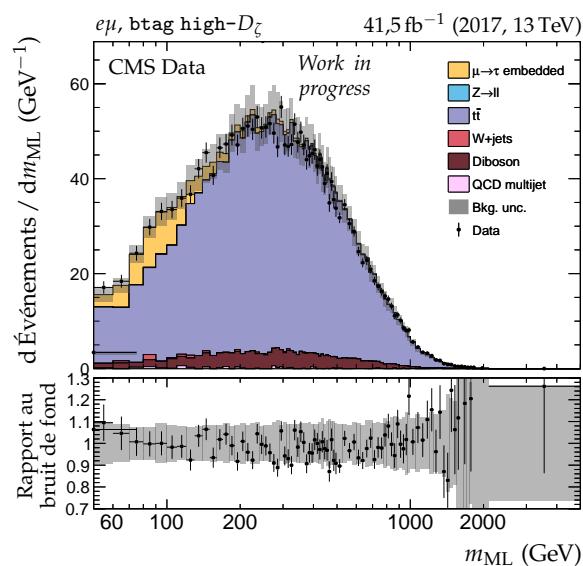
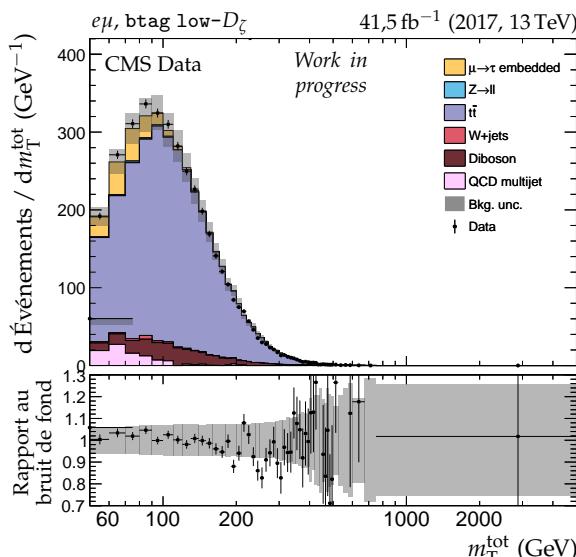
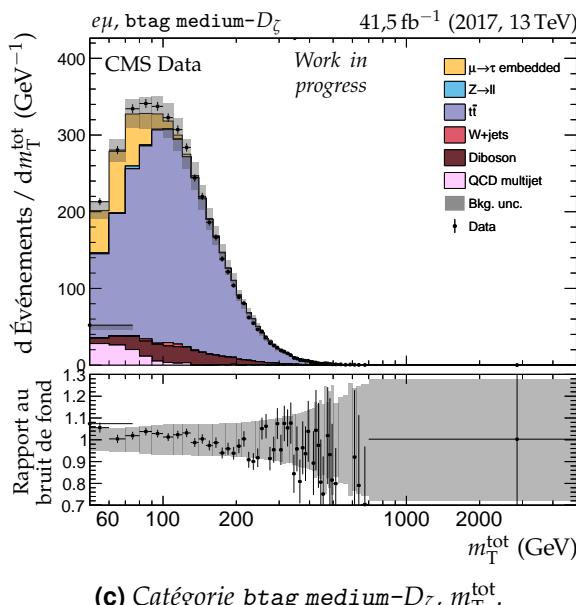
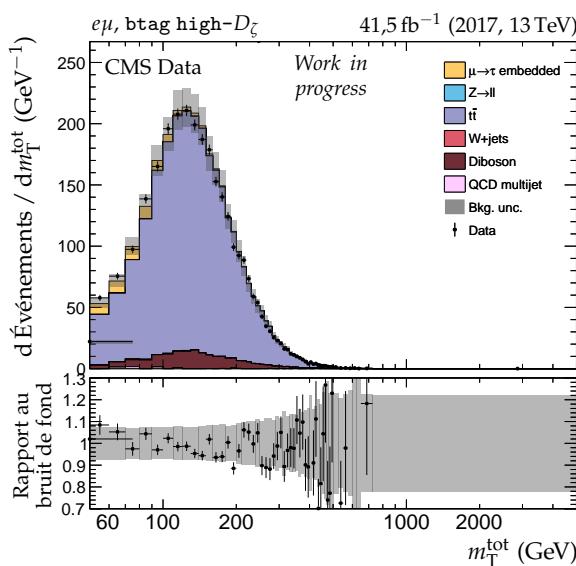


(e) Catégorie qcd.

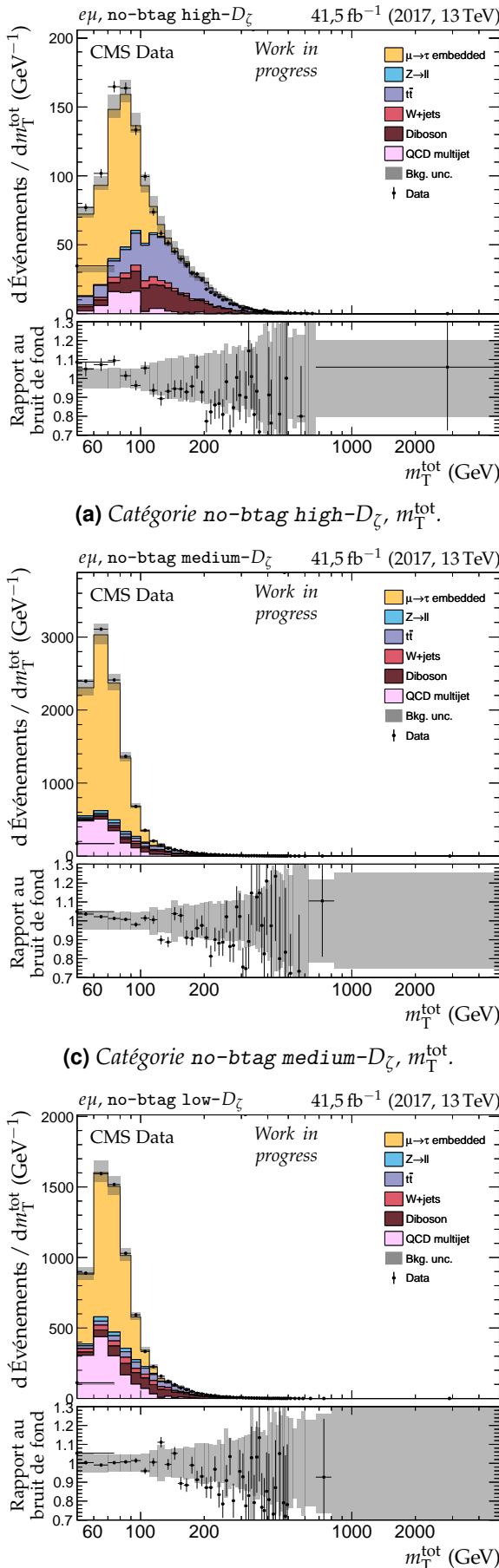


(f) Catégorie misc.

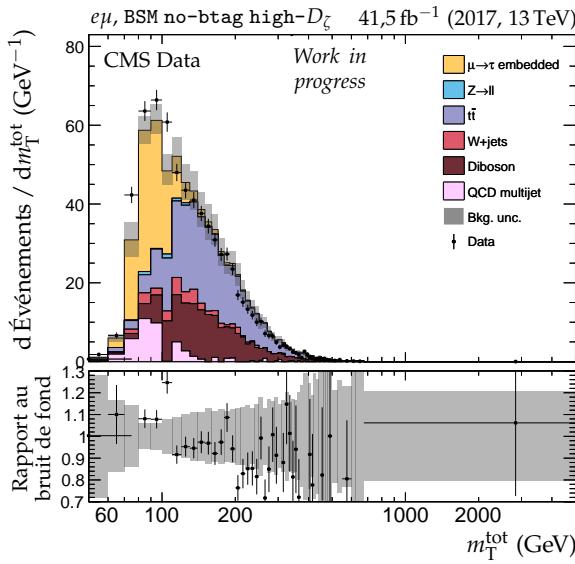
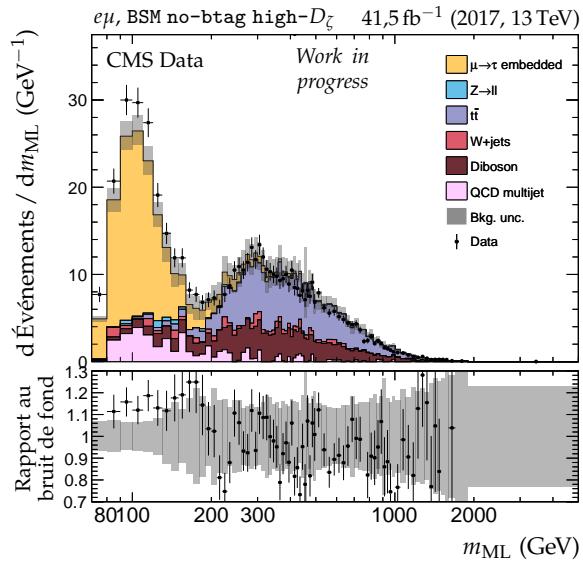
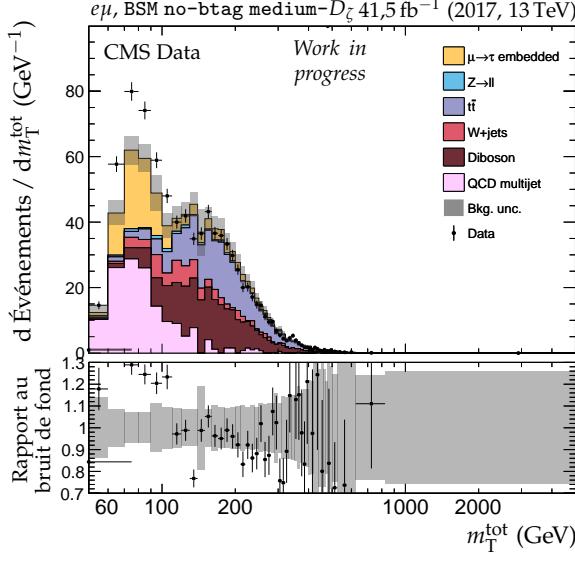
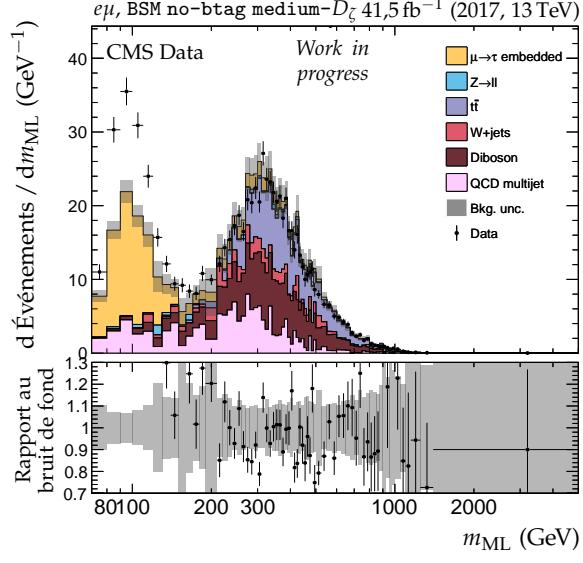
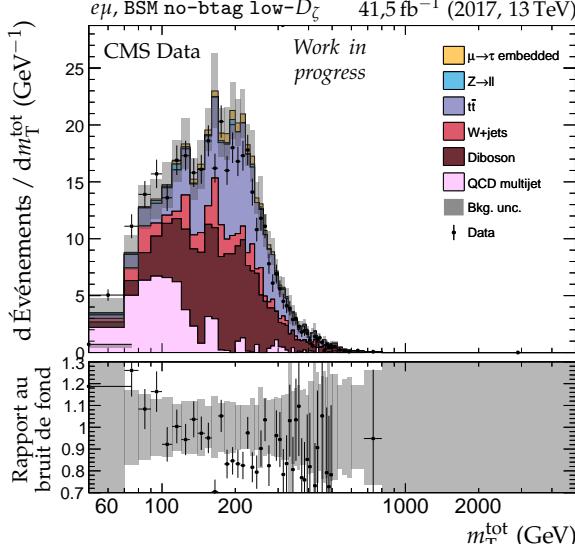
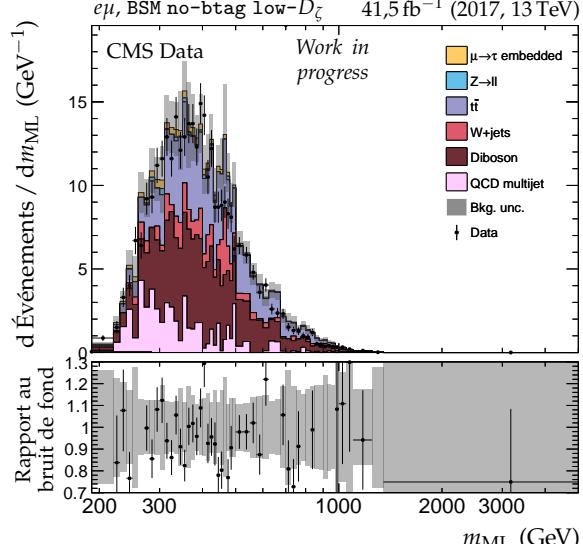
Figure X.25 – Distributions de NN<sub>score</sub> en 2017 dans le canal e $\mu$ .



**Figure X.26 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2017 dans le canal  $e\mu$ , catégories btag.**



**Figure X.27** – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2017 dans le canal  $e\mu$ , catégories no-btag.

(a) Catégorie BSM no-btag high- $D_\zeta$ , m<sub>T</sub><sup>tot</sup>.(b) Catégorie BSM no-btag high- $D_\zeta$ , m<sub>ML</sub>.(c) Catégorie BSM no-btag medium- $D_\zeta$ , m<sub>T</sub><sup>tot</sup>.(d) Catégorie BSM no-btag medium- $D_\zeta$ , m<sub>ML</sub>.(e) Catégorie BSM no-btag low- $D_\zeta$ , m<sub>T</sub><sup>tot</sup>.(f) Catégorie BSM no-btag low- $D_\zeta$ , m<sub>ML</sub>.**Figure X.28** – Distributions de m<sub>T</sub><sup>tot</sup> et m<sub>ML</sub> en 2017 dans le canal e $\mu$ , catégories no-btag avec m<sub>SVFIT</sub>  $\geqslant$  250 GeV.

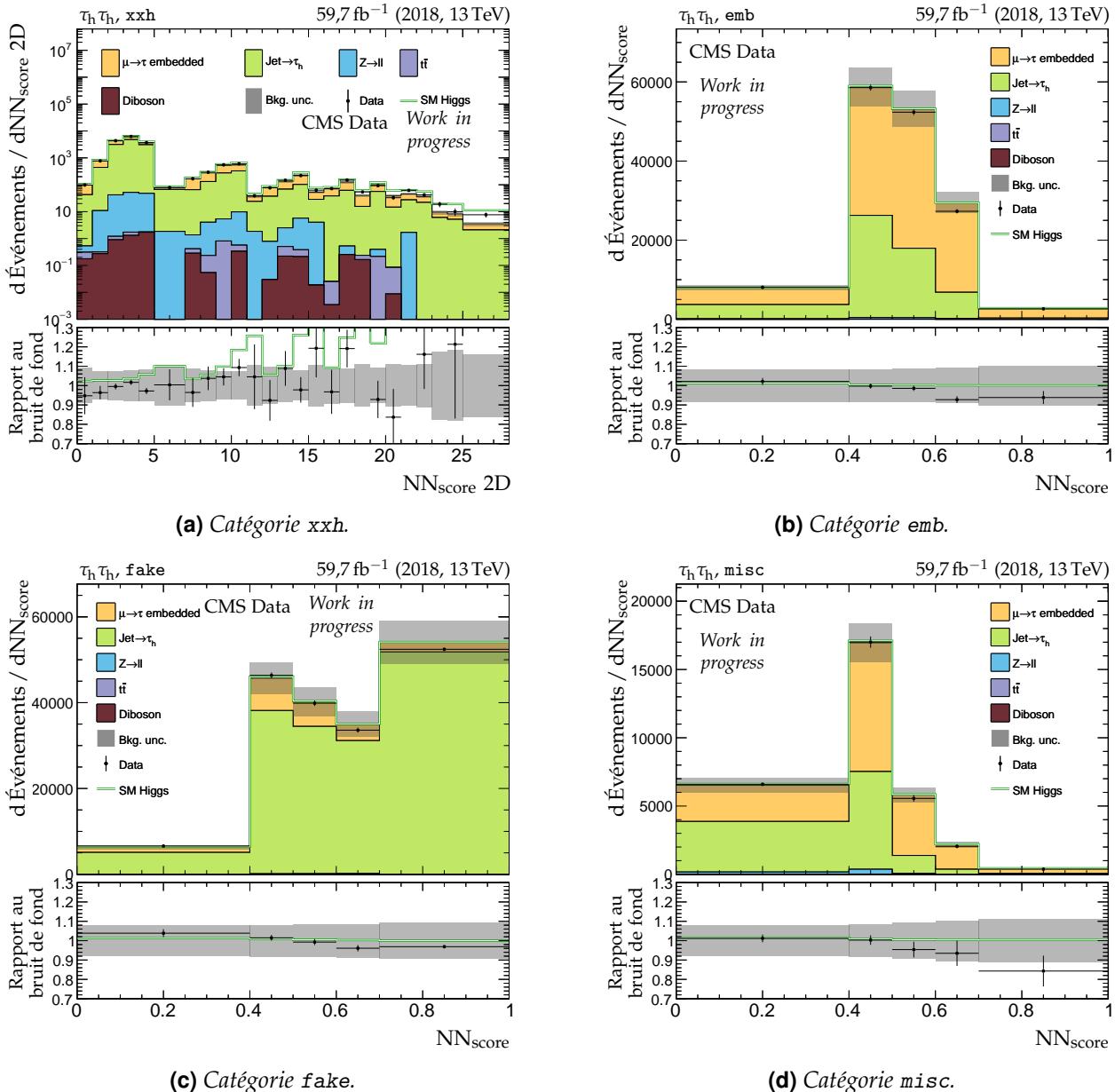
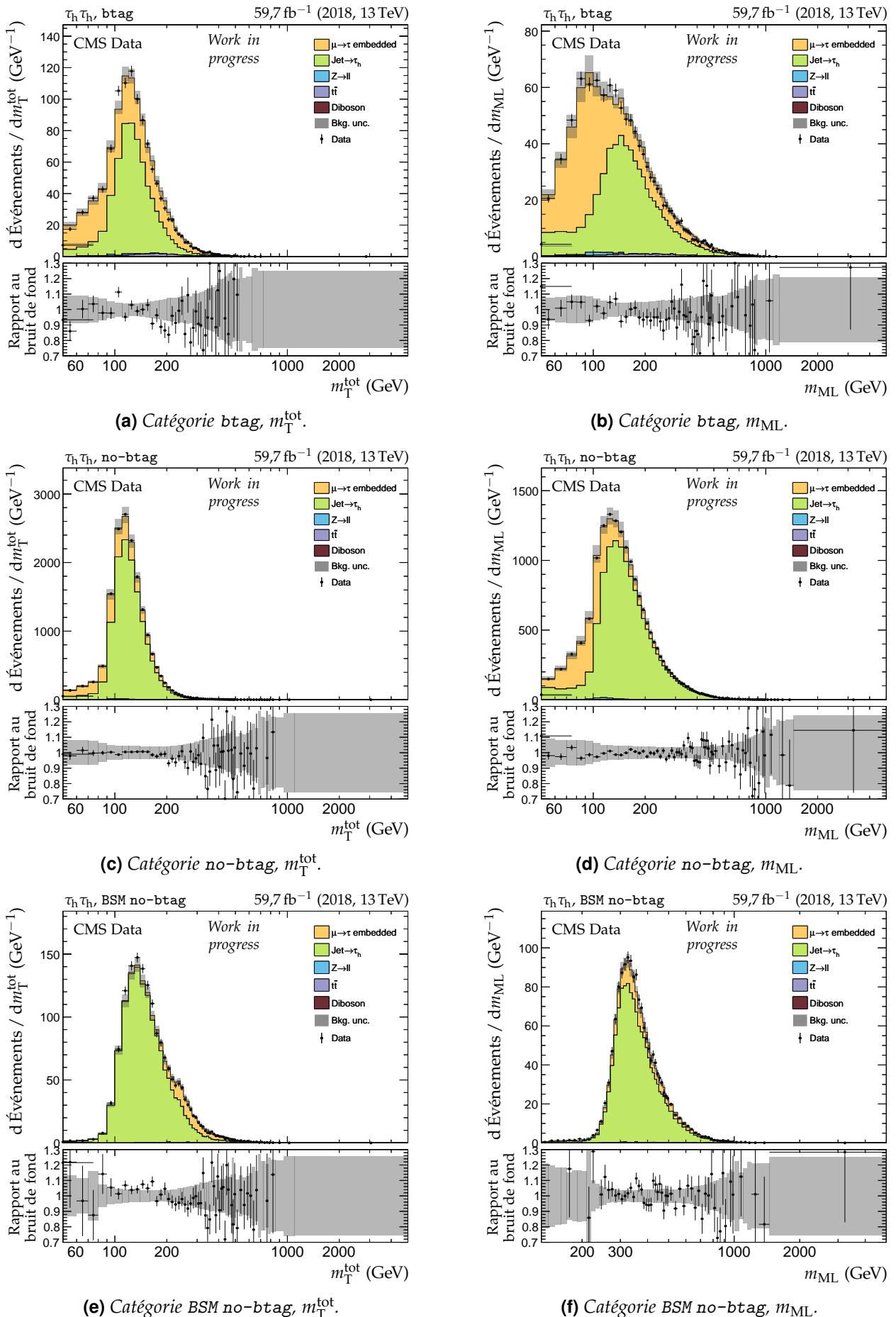


Figure X.29 – Distributions de  $NN_{\text{score}}$  en 2018 dans le canal  $\tau_h \tau_h$ .



**Figure X.30 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2018 dans le canal  $\tau_h \tau_h$ .**

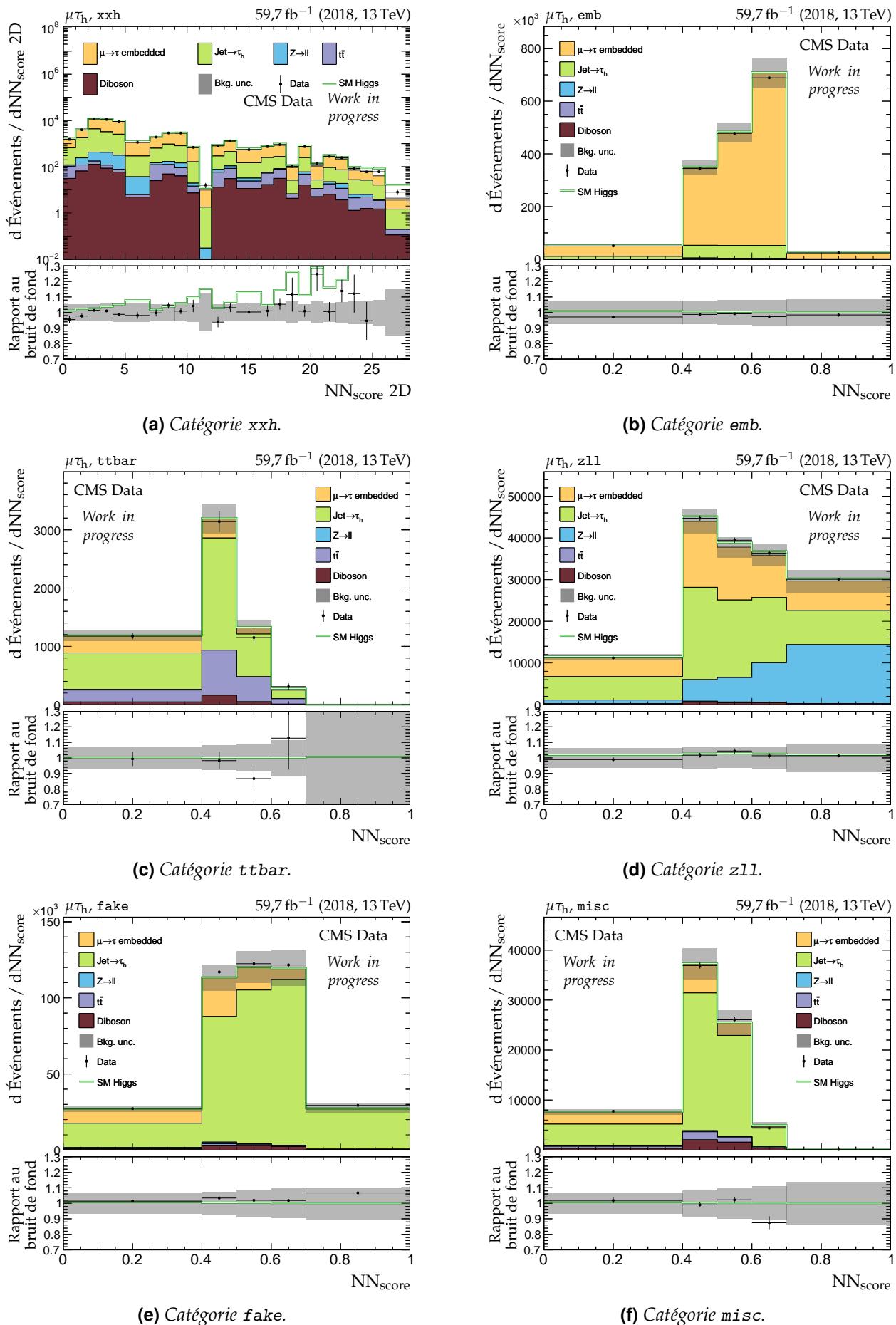
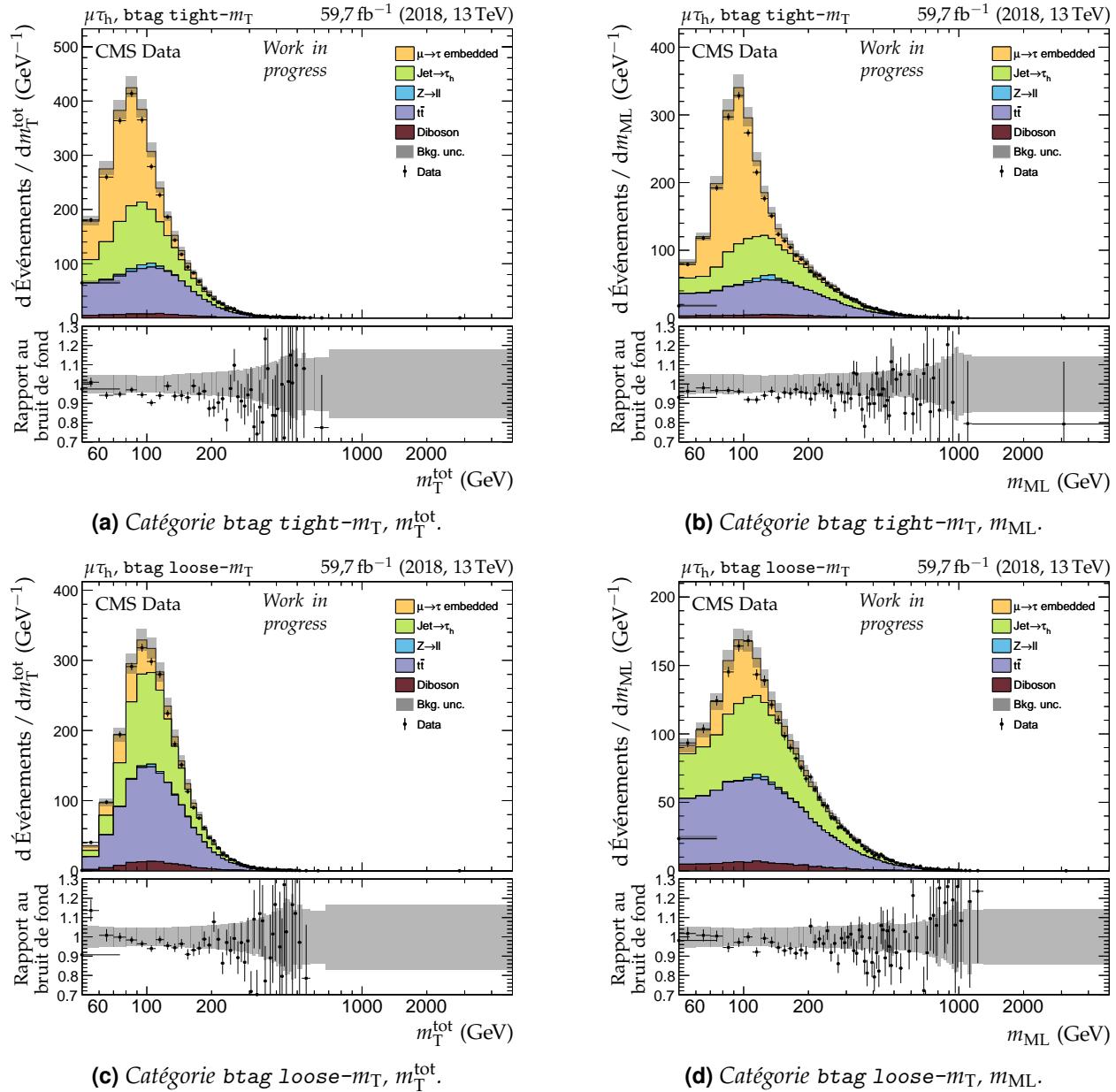
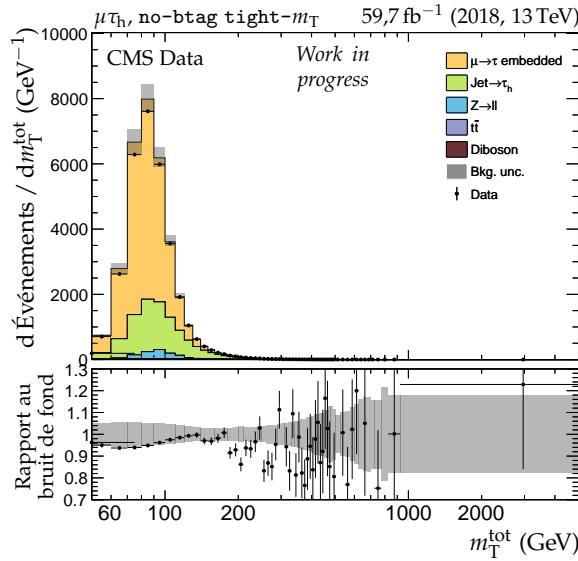
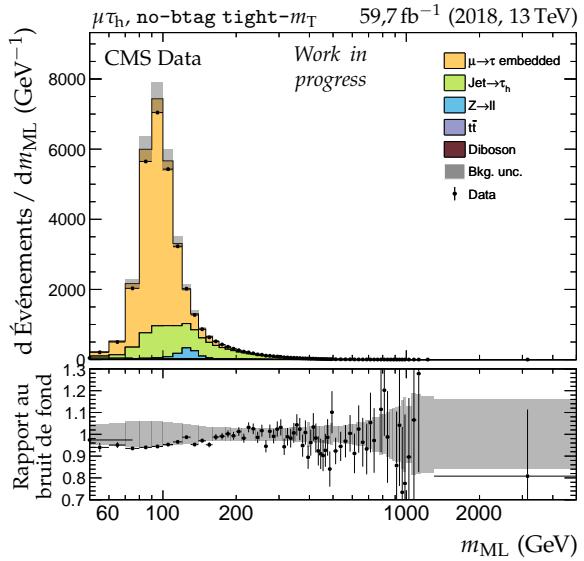
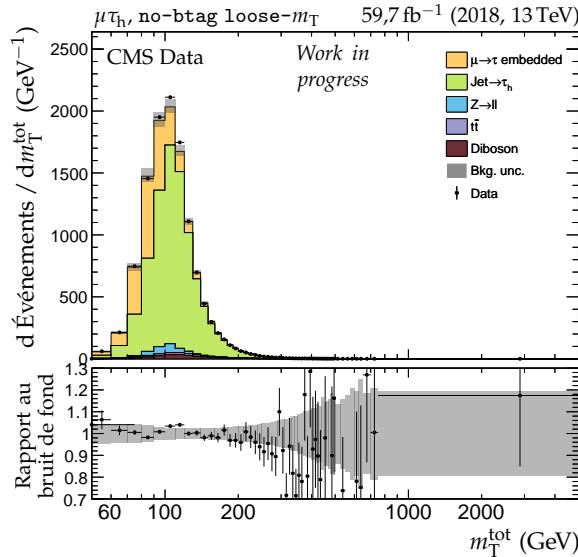
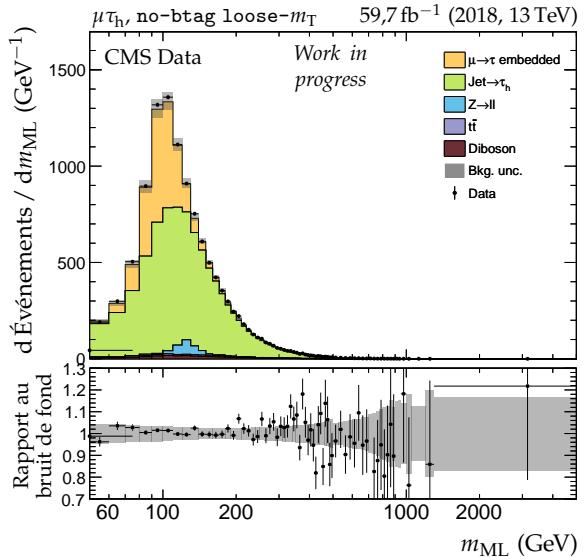
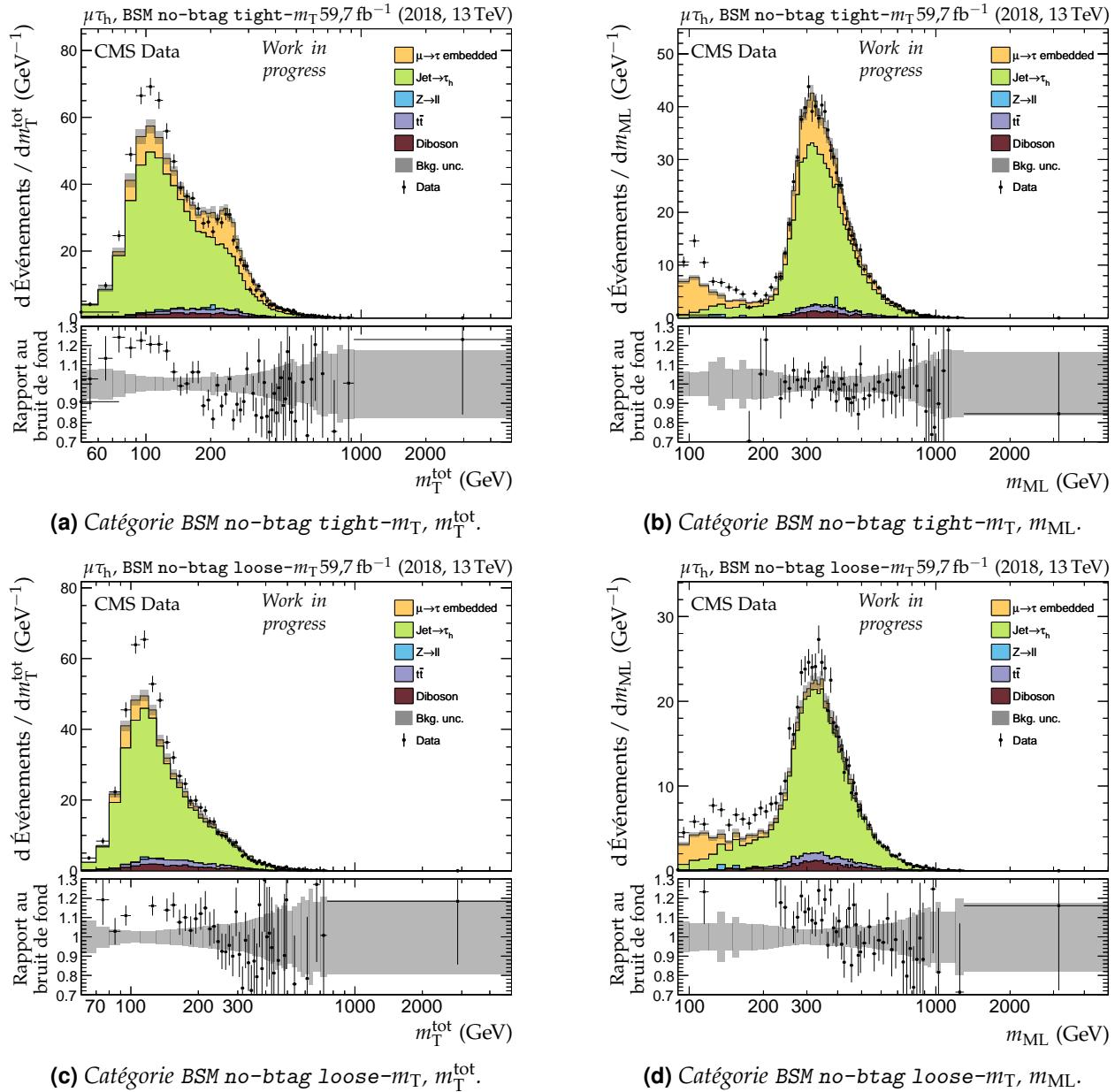


Figure X.31 – Distributions de  $NN_{score}$  en 2018 dans le canal  $\mu\tau_h$ .



**Figure X.32 – Distributions de  $m_{\text{T}}^{\text{tot}}$  et  $m_{\text{ML}}$  en 2018 dans le canal  $\mu\tau_h$ , catégories  $b\text{tag}$ .**

(a) Catégorie no-btag tight- $m_T$ ,  $m_T^{\text{tot}}$ .(b) Catégorie no-btag tight- $m_T$ ,  $m_{\text{ML}}$ .(c) Catégorie no-btag loose- $m_T$ ,  $m_T^{\text{tot}}$ .(d) Catégorie no-btag loose- $m_T$ ,  $m_{\text{ML}}$ .**Figure X.33** – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2018 dans le canal  $\mu\tau_h$ , catégories no-btag.



**Figure X.34 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2018 dans le canal  $\mu \tau_h$ , catégories no-btag avec  $m_{\text{SVFIT}} \geq 250 \text{ GeV}$ .**

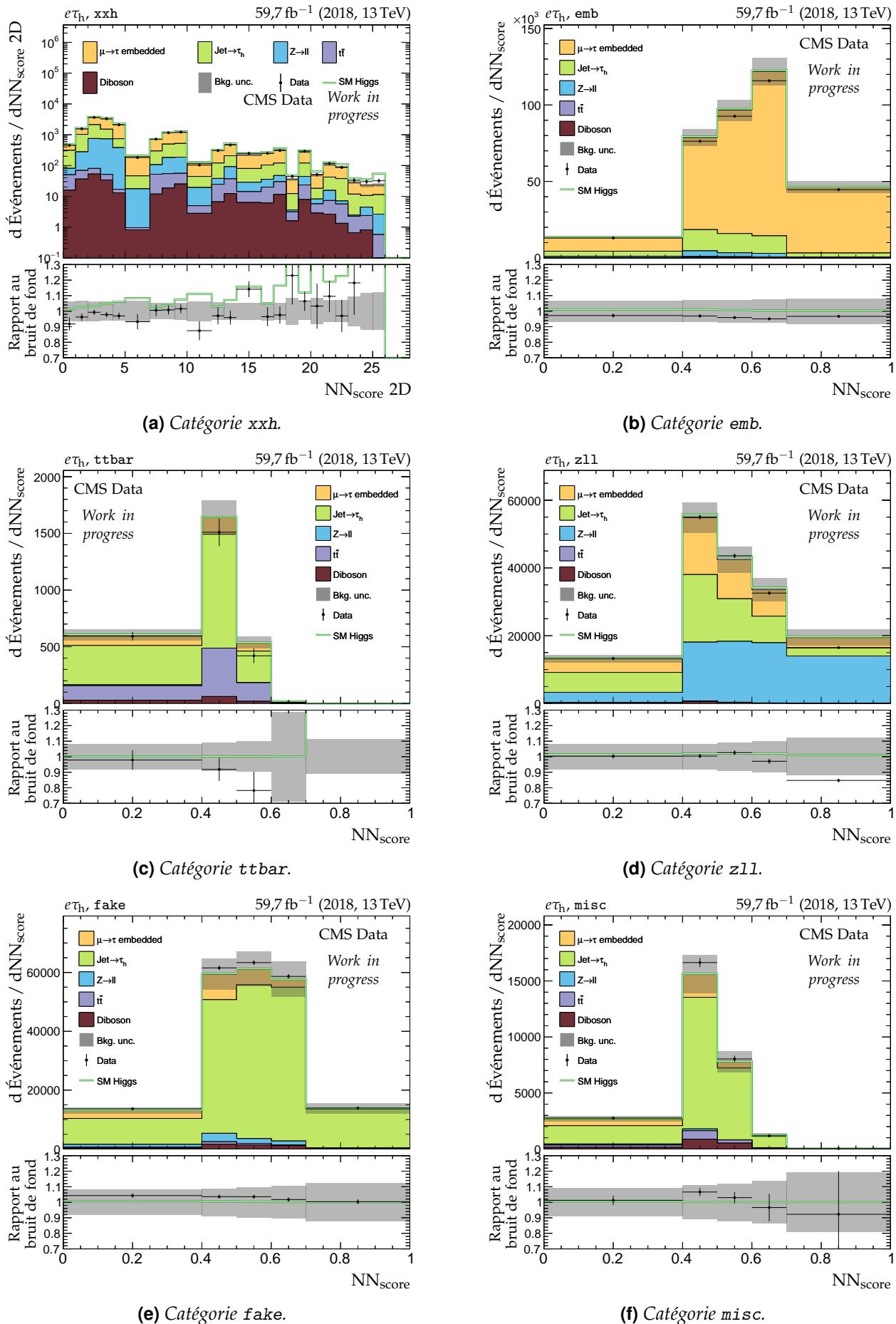
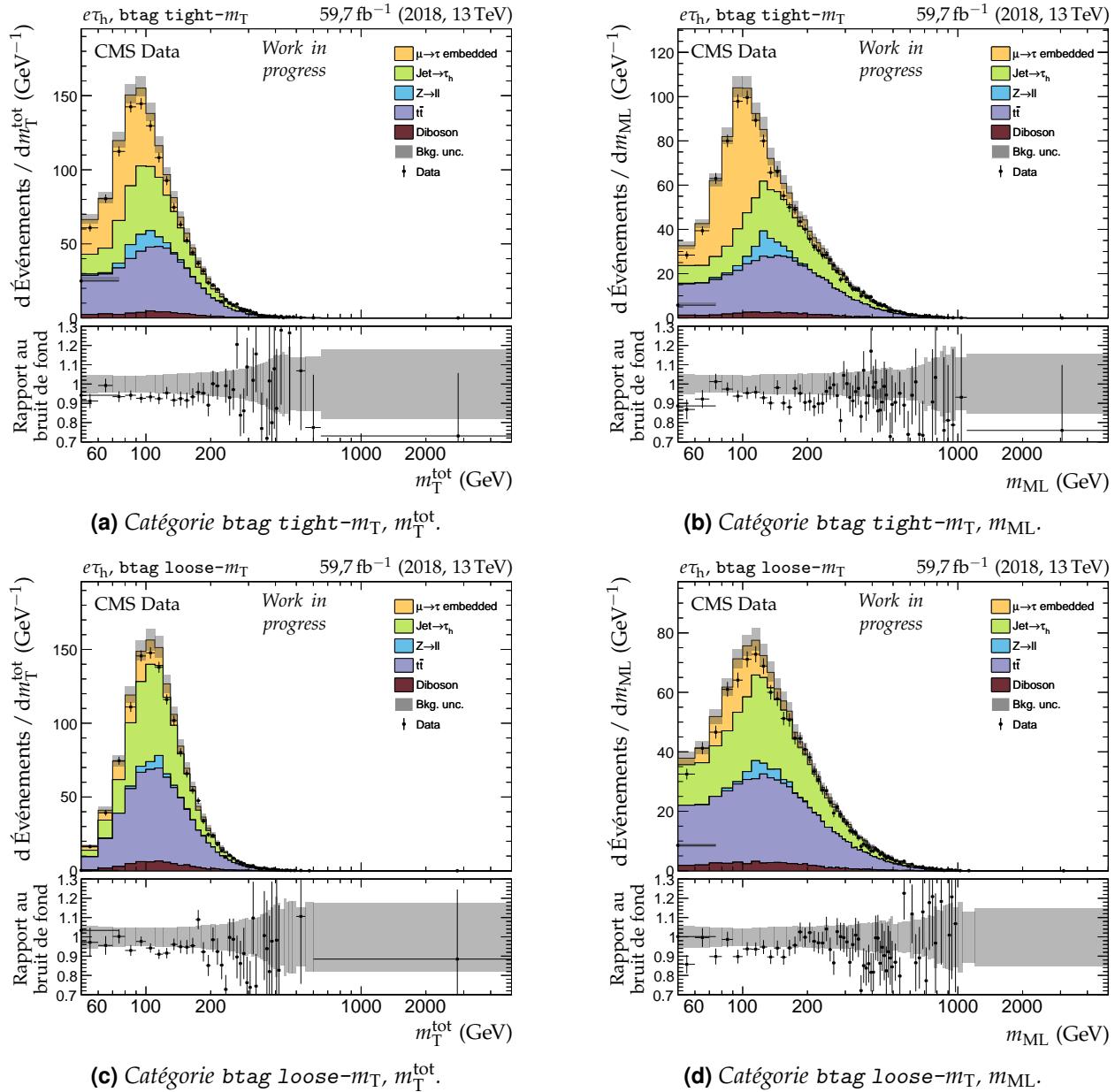
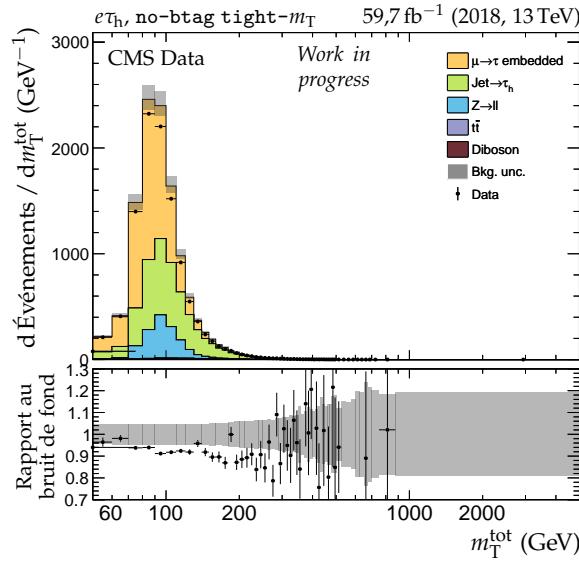
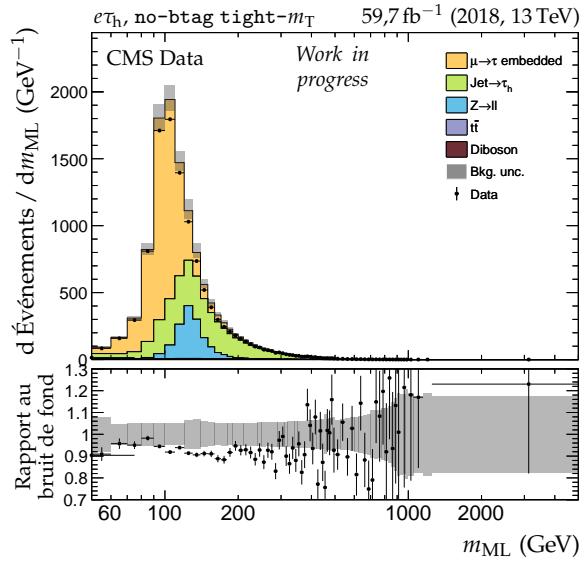
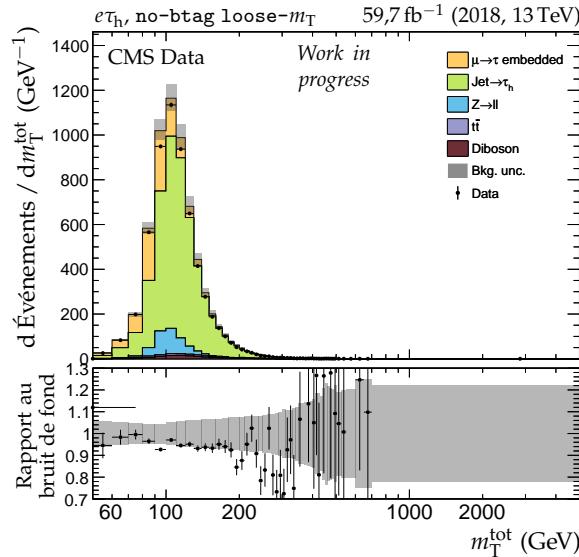
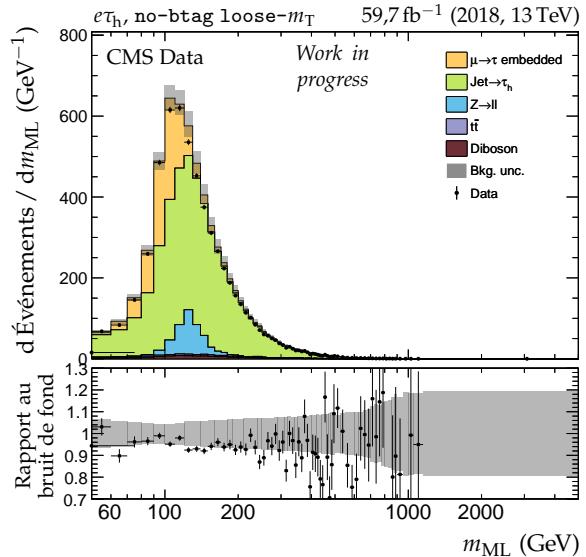
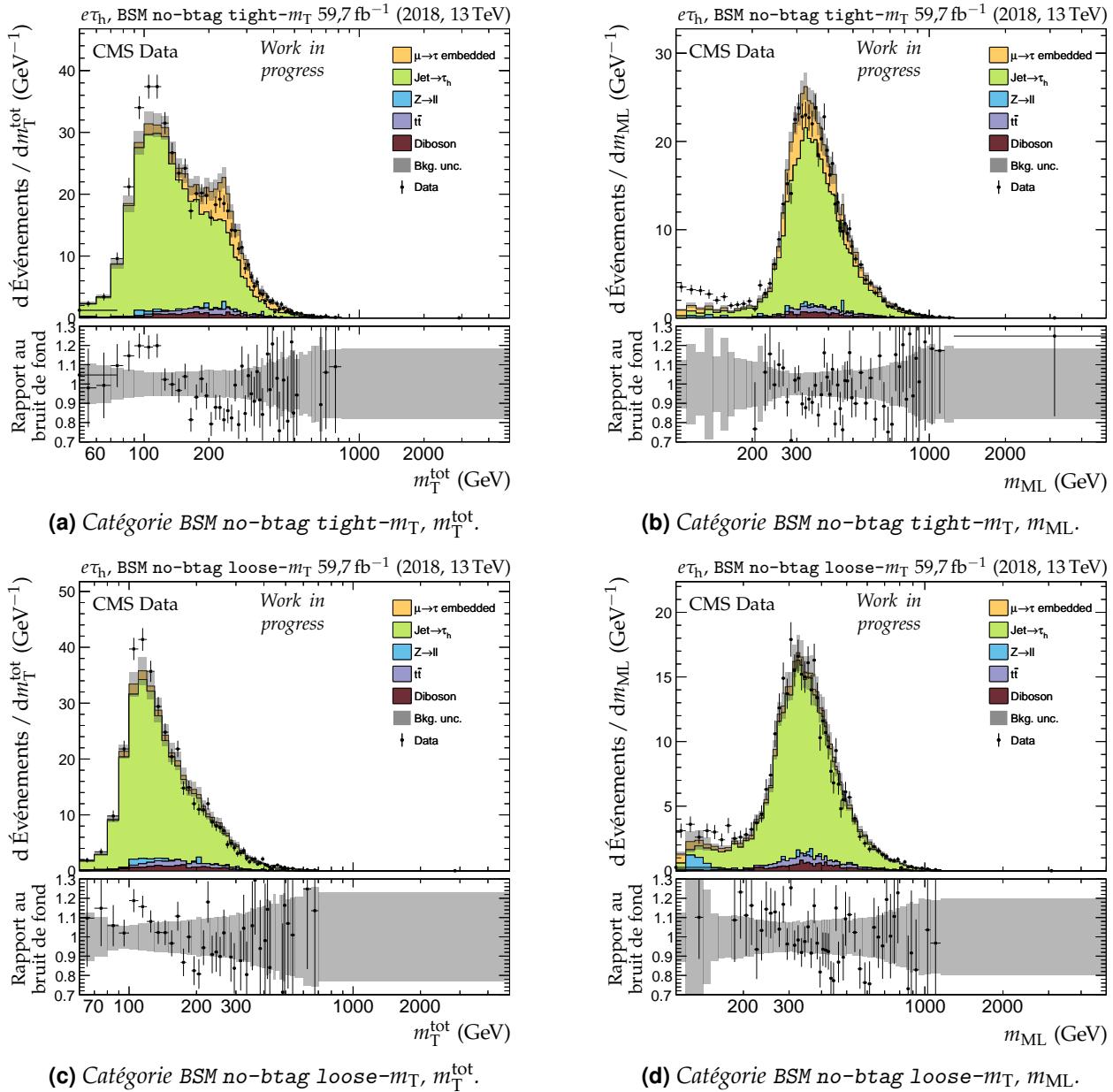


Figure X.35 – Distributions de  $NN_{score}$  en 2018 dans le canal  $e\tau_h$ .

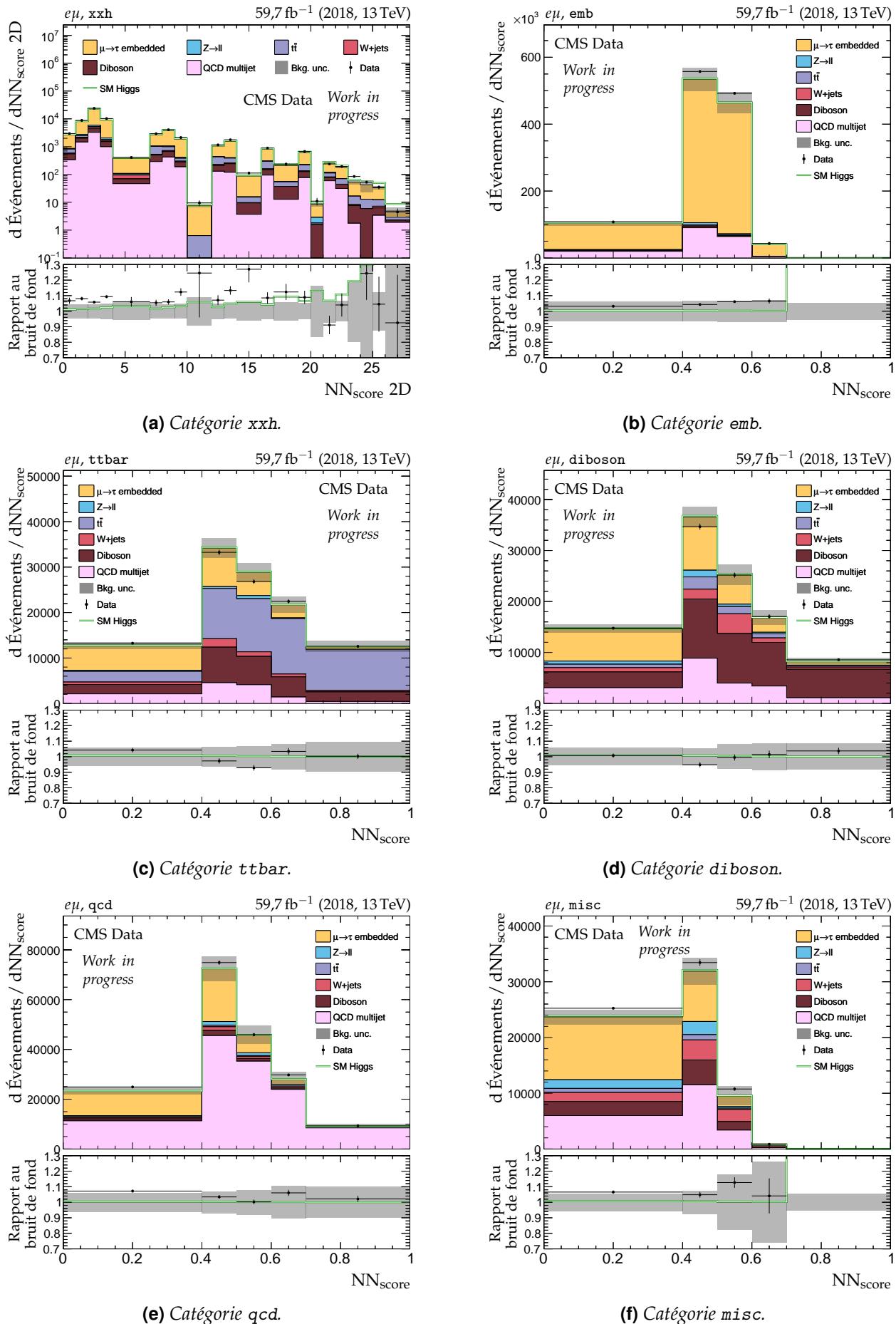


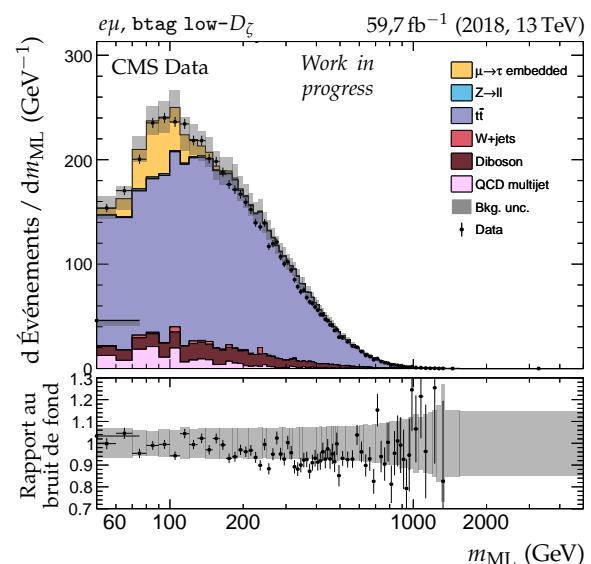
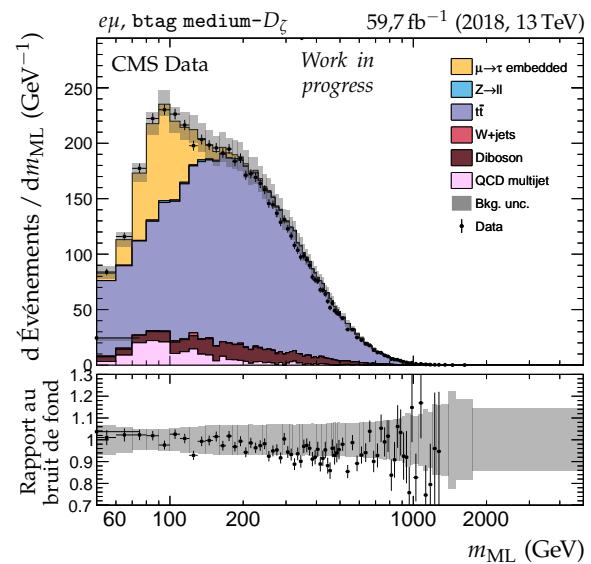
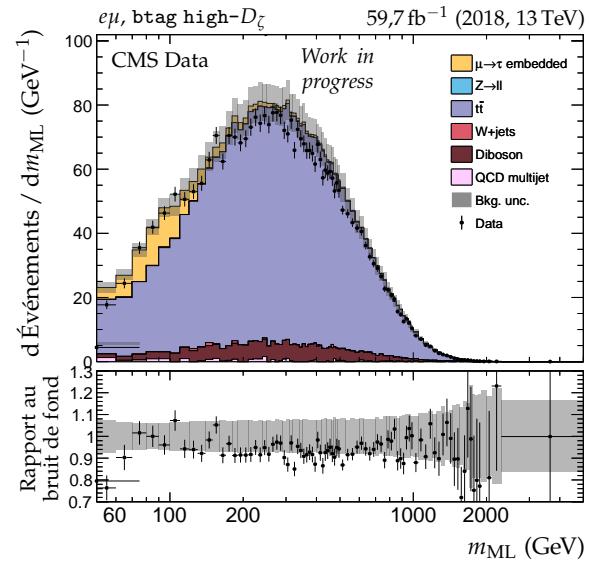
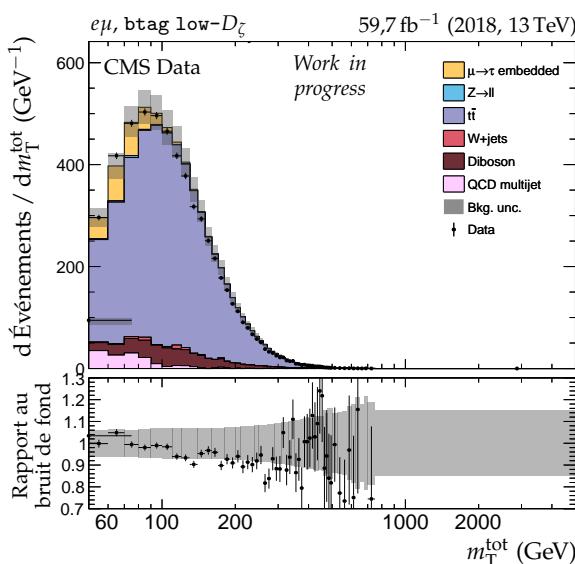
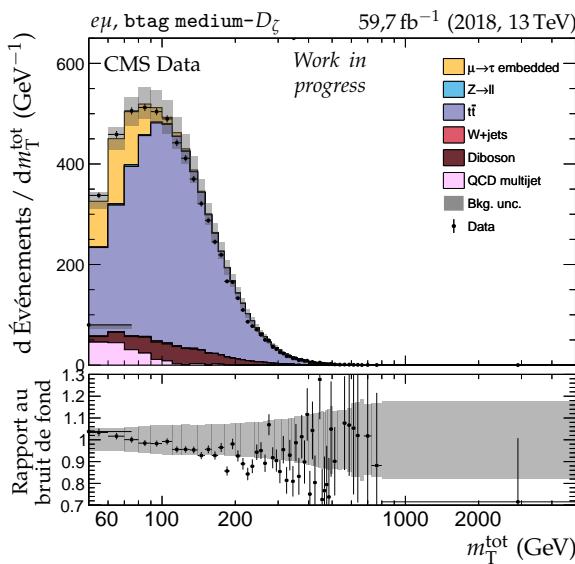
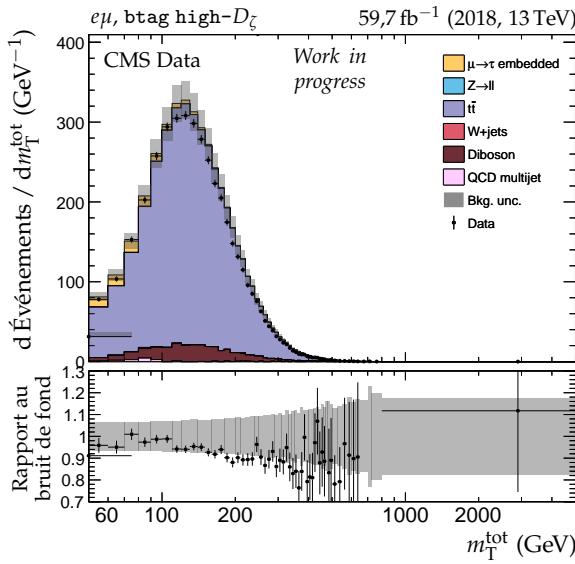
**Figure X.36 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2018 dans le canal  $e\tau_h$ , catégories  $btag$ .**

(a) Catégorie no-btag tight- $m_T$ ,  $m_T^{\text{tot}}$ .(b) Catégorie no-btag tight- $m_T$ ,  $m_{\text{ML}}$ .(c) Catégorie no-btag loose- $m_T$ ,  $m_T^{\text{tot}}$ .(d) Catégorie no-btag loose- $m_T$ ,  $m_{\text{ML}}$ .**Figure X.37** – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2018 dans le canal  $e\tau_h$ , catégories no-btag.

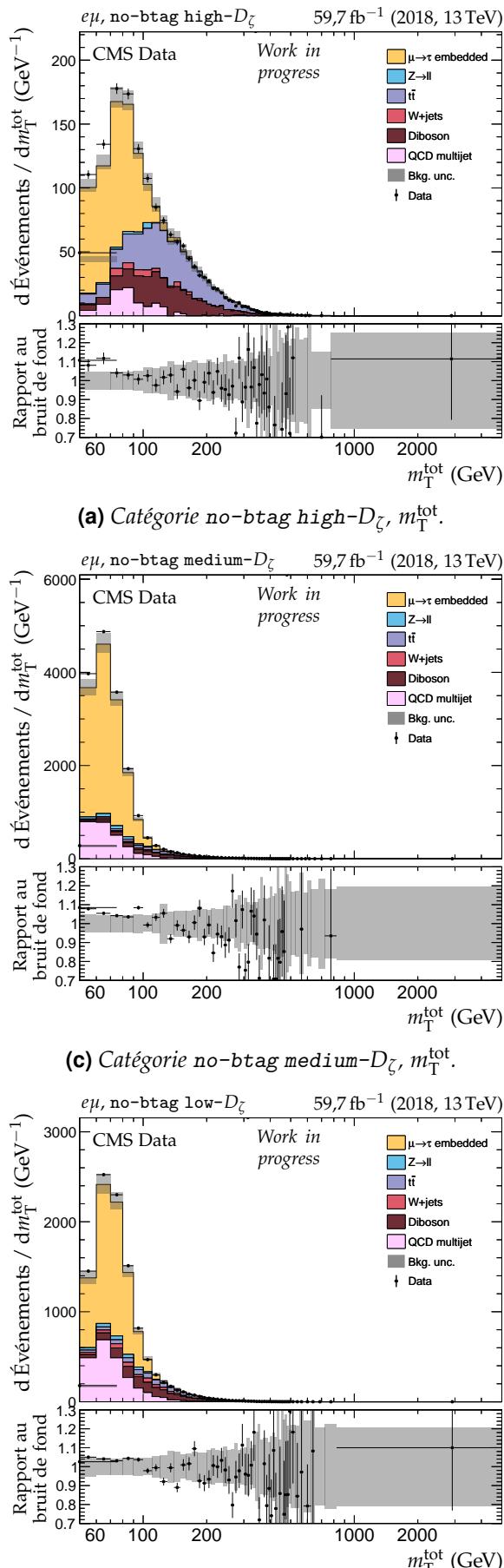


**Figure X.38 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2018 dans le canal  $e\tau_h$ , catégories no-btag avec  $m_{\text{SVFIT}} \geq 250 \text{ GeV}$ .**

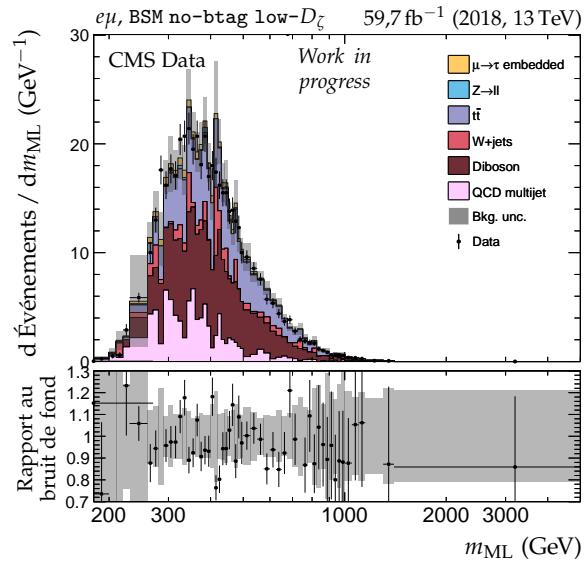
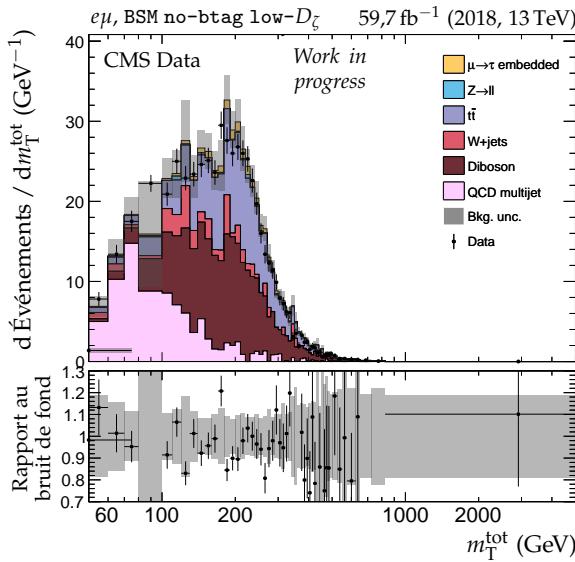
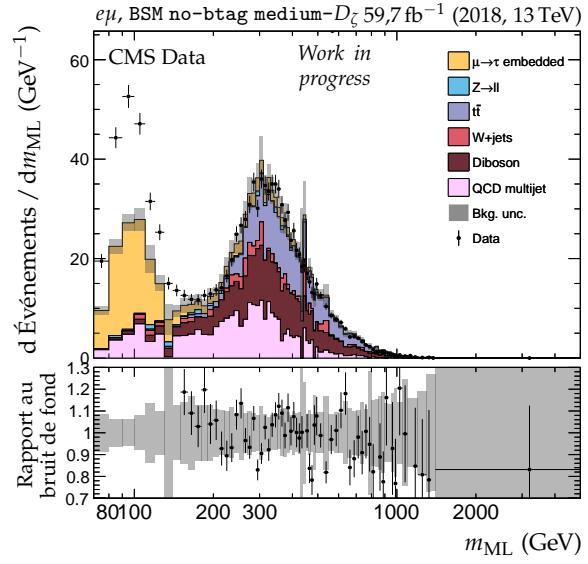
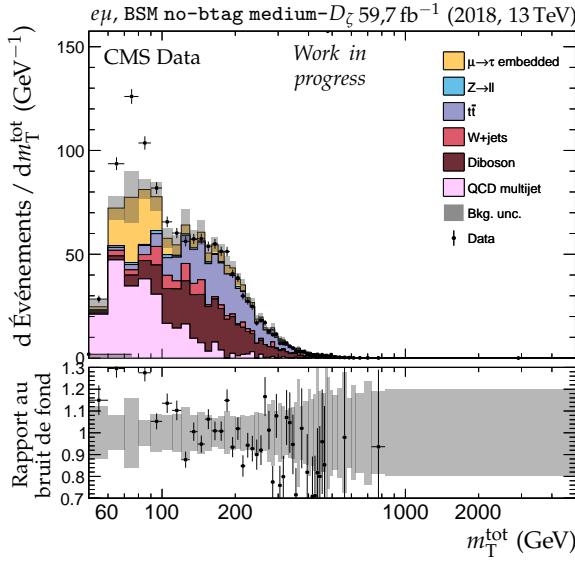
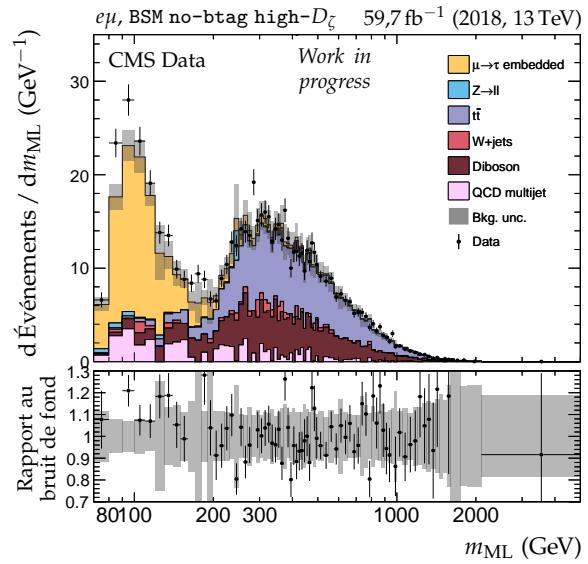
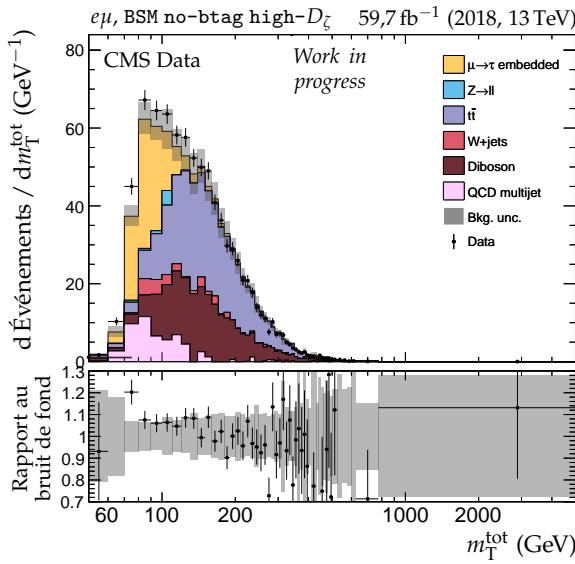
**Figure X.39 – Distributions de  $NN_{\text{score}}$  en 2018 dans le canal  $e\mu$ .**



**Figure X.40 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2018 dans le canal  $e\mu$ , catégories  $b\text{tag}$ .**



**Figure X.41** – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2018 dans le canal  $e\mu$ , catégories no-btag.



**Figure X.42 – Distributions de  $m_T^{\text{tot}}$  et  $m_{\text{ML}}$  en 2018 dans le canal  $e\mu$ , catégories no-btag avec  $m_{\text{SVFIT}} \geq 250 \text{ GeV}$ .**

