

## Annexe X

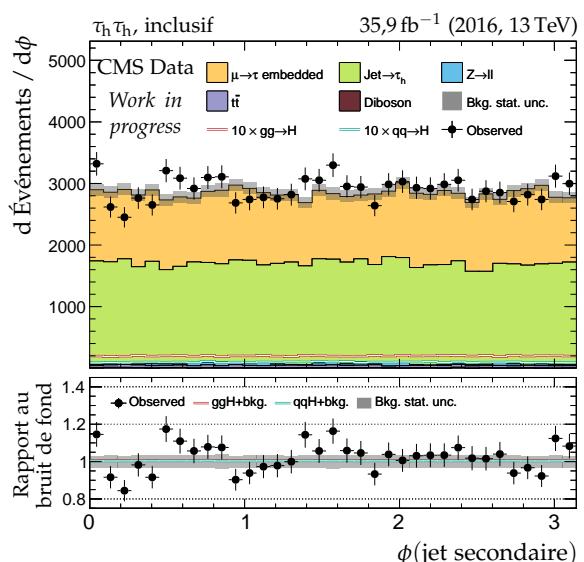
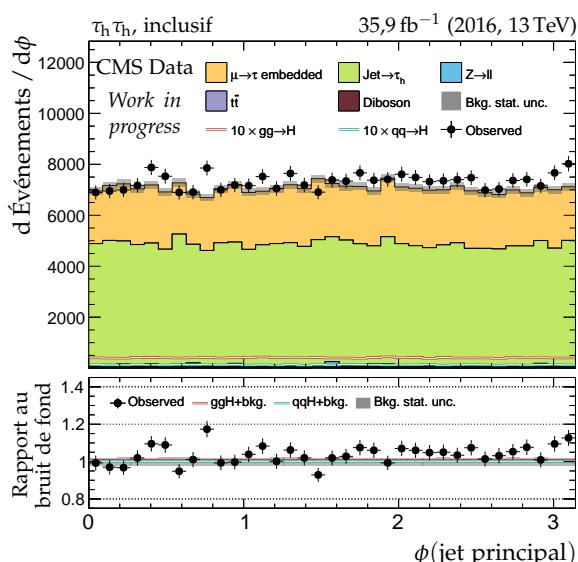
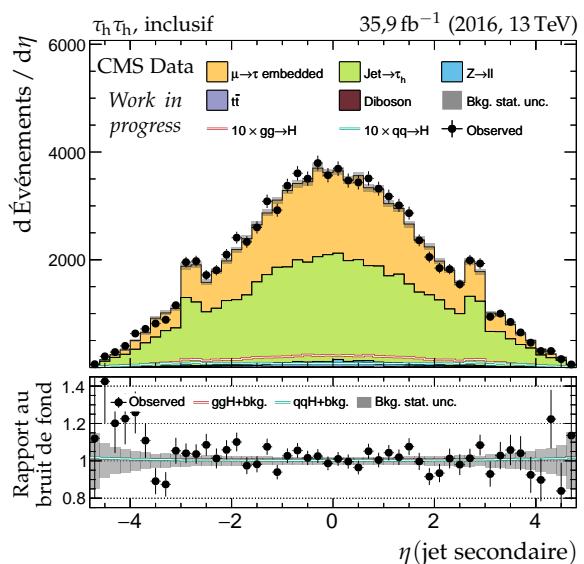
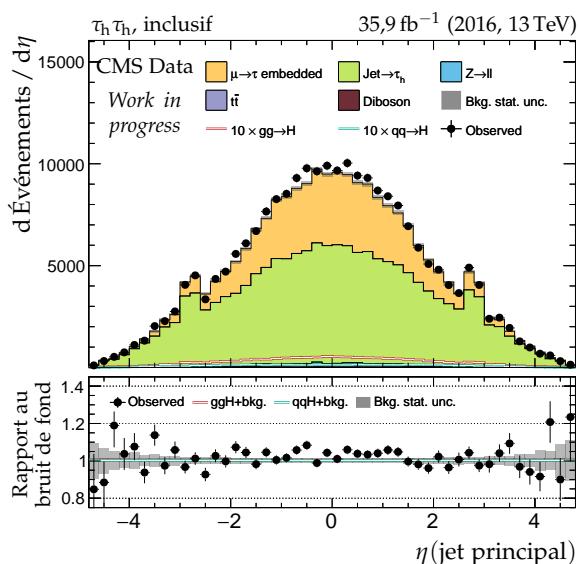
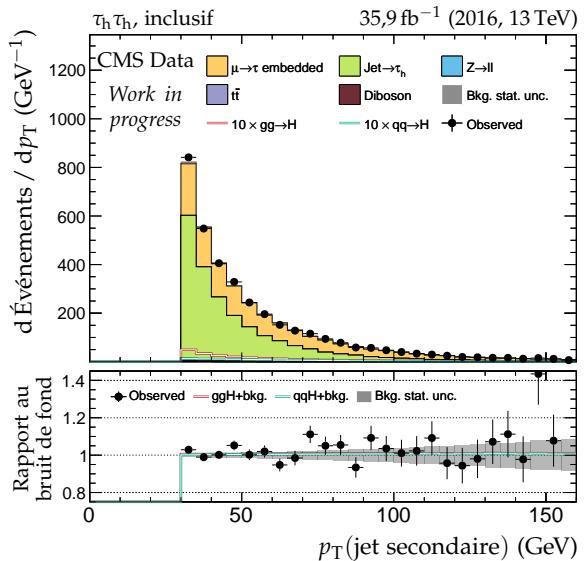
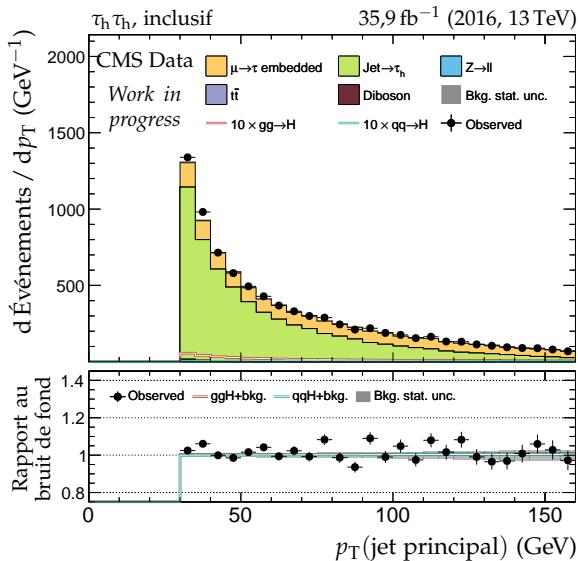
### Distributions de contrôle – $H \rightarrow \tau\tau$

Cette annexe présente des distributions de contrôle sur les événements utilisés dans l’analyse des événements  $H \rightarrow \tau\tau$  présentée dans le chapitre 4. La sélection est « inclusive », les événements sont ceux sélectionnés par la définition de la région de signal, sans coupure sur  $m_T^\ell$  (canaux  $\mu\tau_h$ ,  $e\tau_h$ ) ni  $D_\zeta$  (canal  $e\mu$ ).

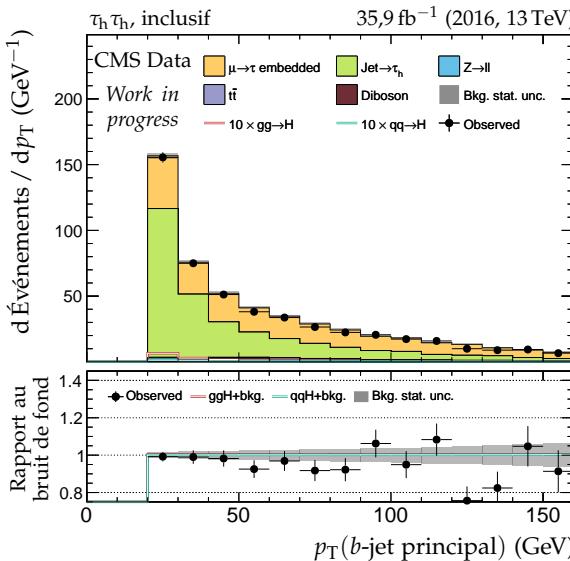
Pour chacune des trois années de prise de données (2016, 2017, 2018) et chacun des quatre canaux ( $\tau_h\tau_h$ ,  $\mu\tau_h$ ,  $e\tau_h$ ,  $e\mu$ ), les distributions de plusieurs variables sont données.

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 statistique totale sur le bruit de fond. Le rapport au bruit de fond est donné dans la partie inférieure des graphiques.

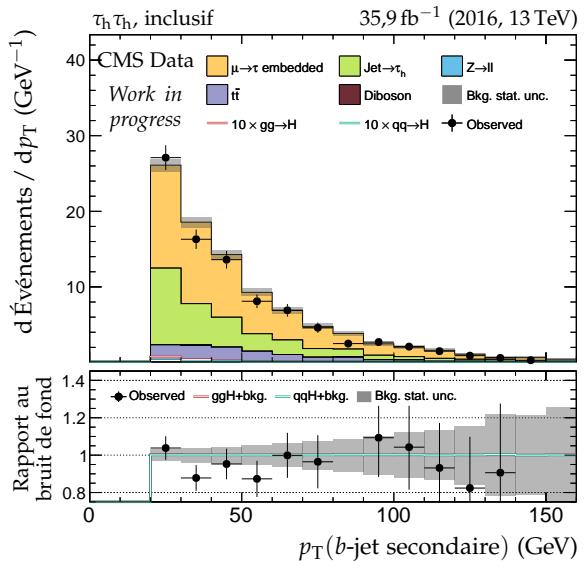
## 2 ANNEXE X. DISTRIBUTIONS DE CONTRÔLE – $H \rightarrow \tau\tau$



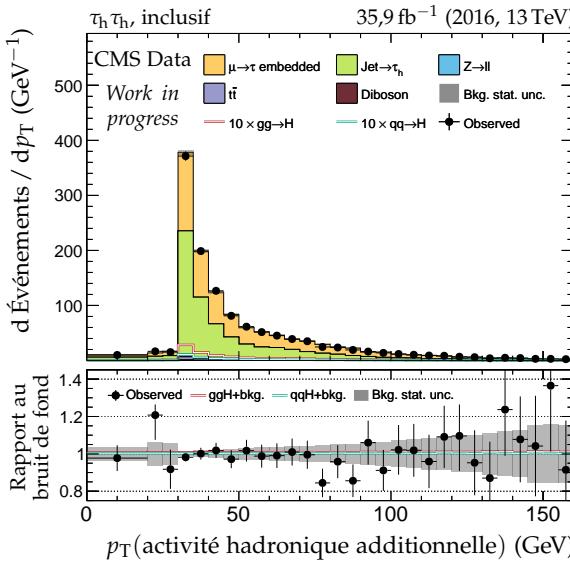
**Figure X.1 – Canal  $\tau_h\tau_h$ , 2016 : cinématique des deux jets principaux.**



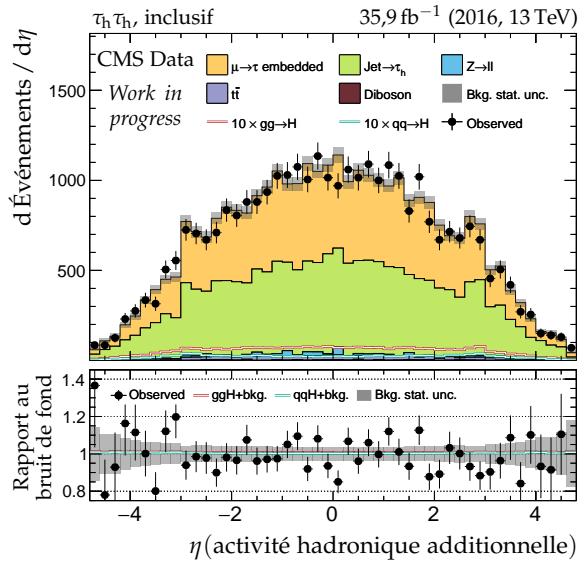
(a) Impulsion transverse du b-jet principal.



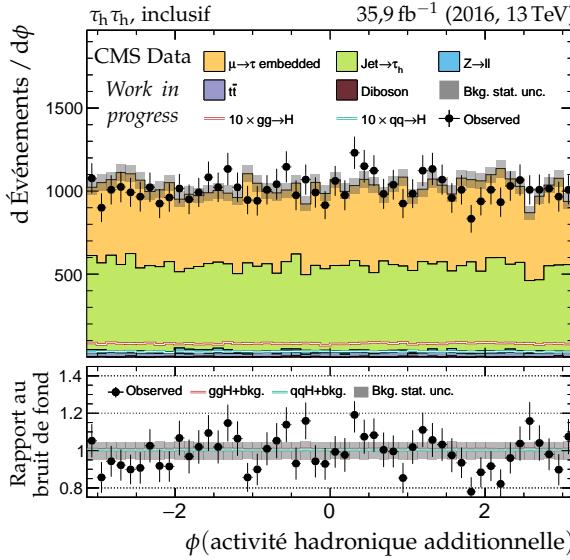
(b) Impulsion transverse du b-jet secondaire.



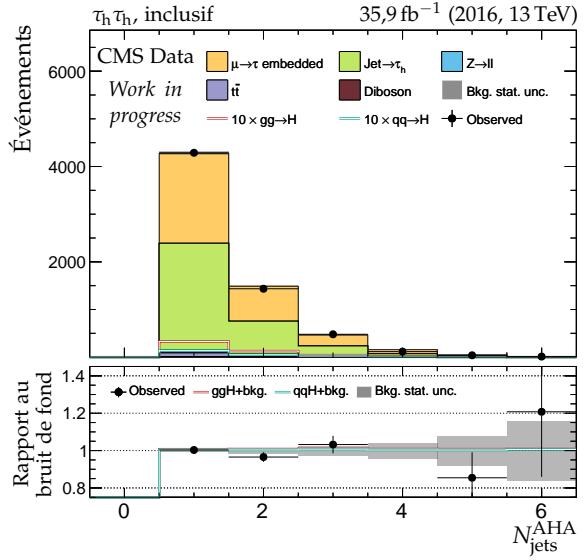
(c) Impulsion transverse de l'AHA.



(d) Pseudo-rapidité de l'AHA.



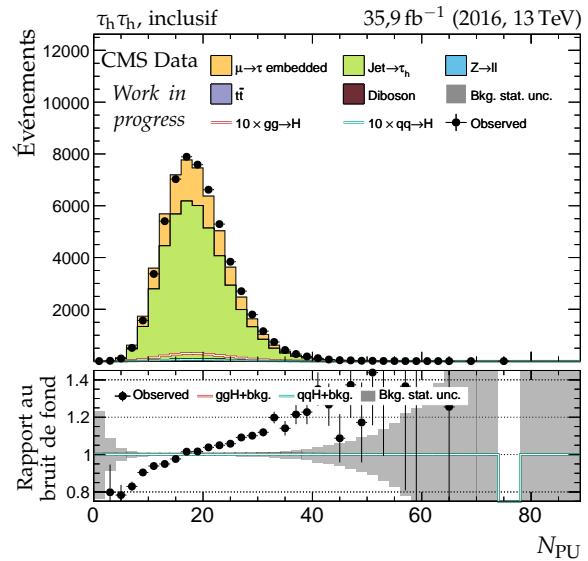
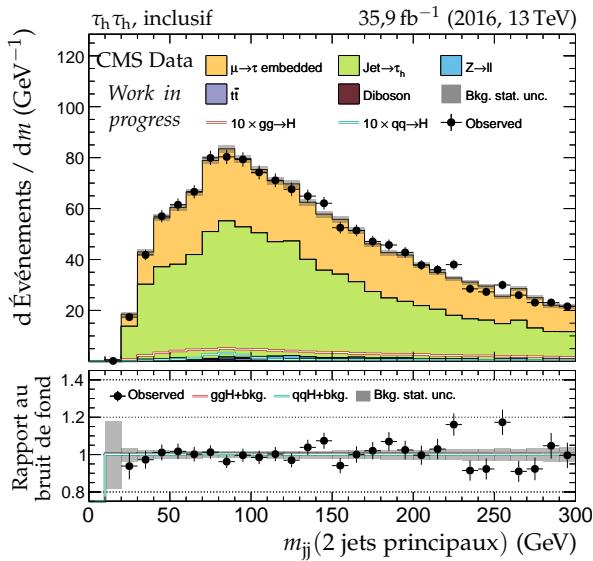
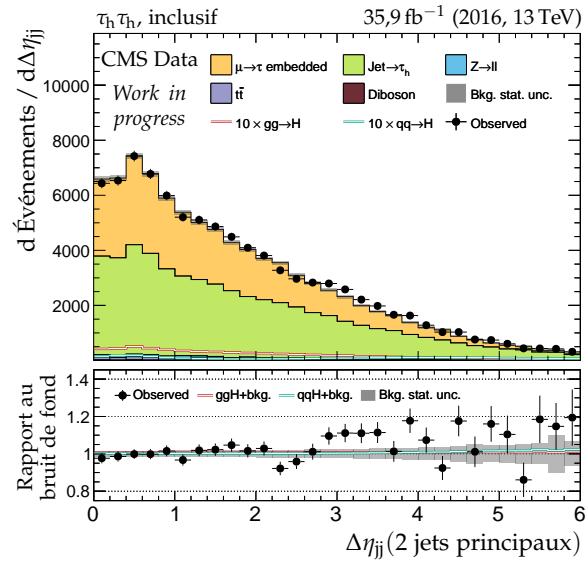
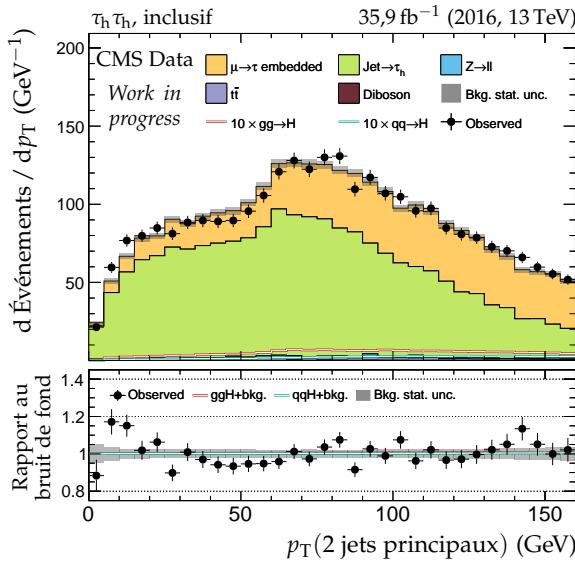
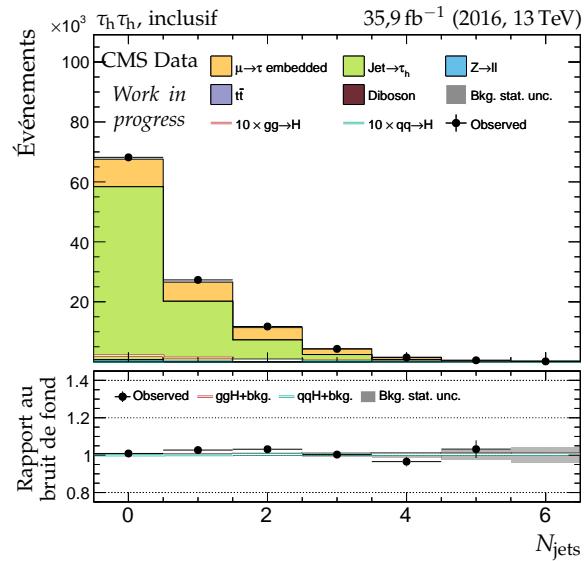
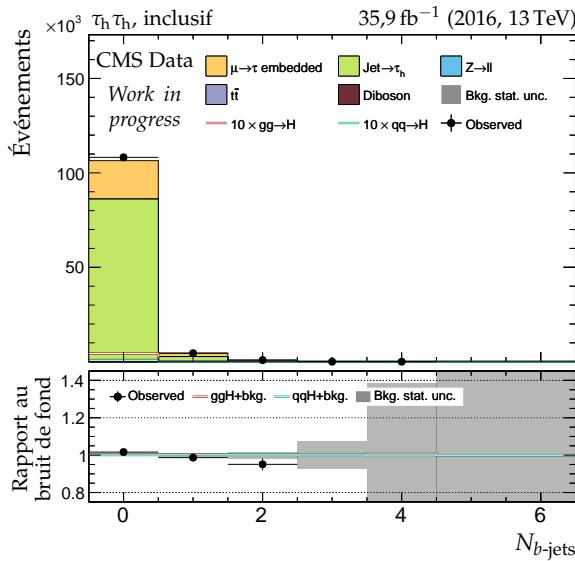
(e) Angle azimutal de l'AHA.



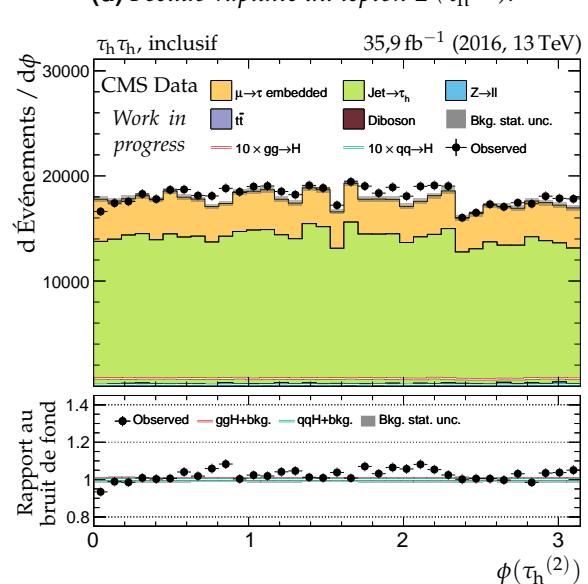
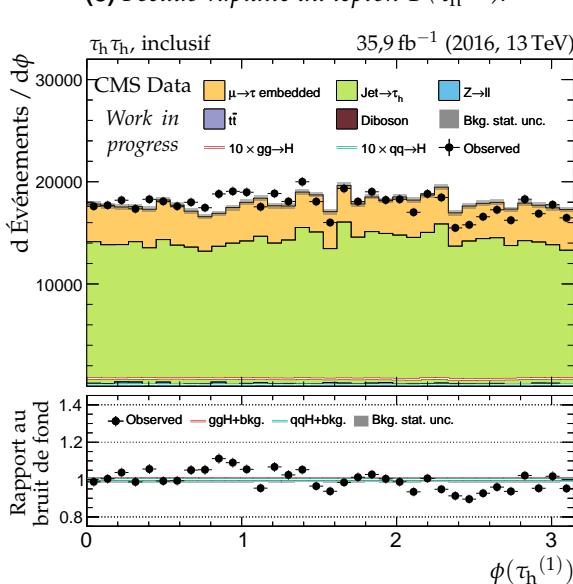
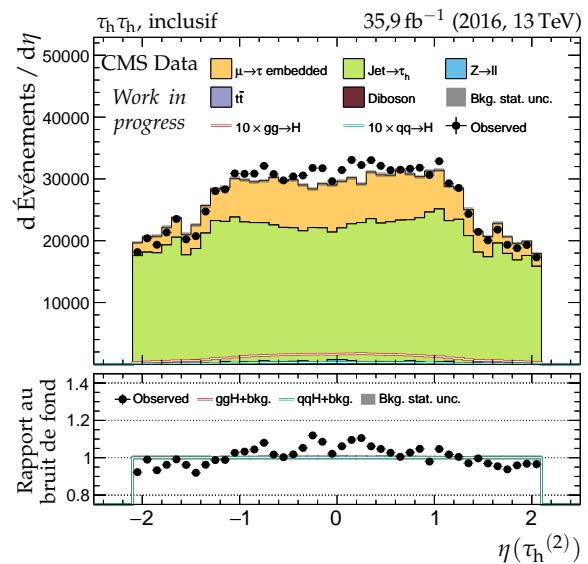
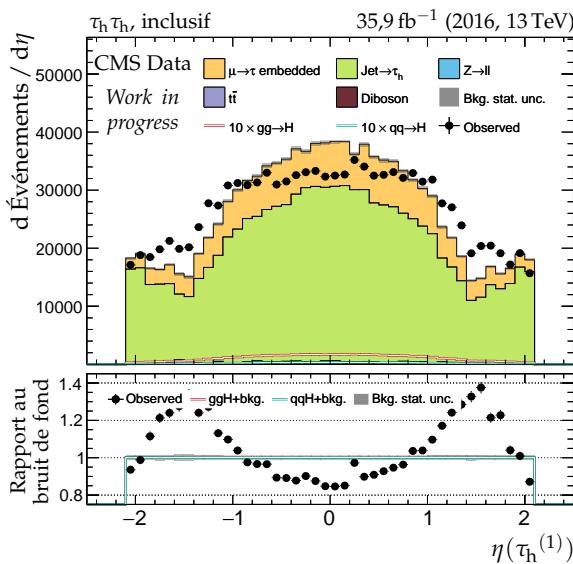
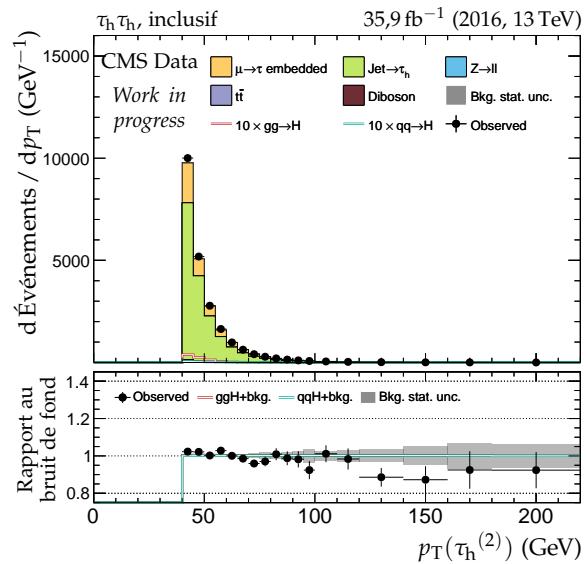
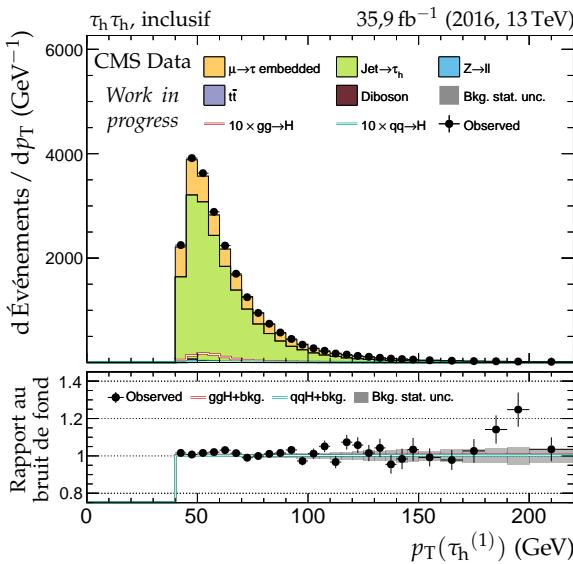
(f) Nombre de jets dans l'AHA.

**Figure X.2 – Canal  $\tau_h \tau_h$ , 2016 : b-jets et activité hadronique additionnelle.**

#### 4 ANNEXE X. DISTRIBUTIONS DE CONTRÔLE – $H \rightarrow \tau\tau$

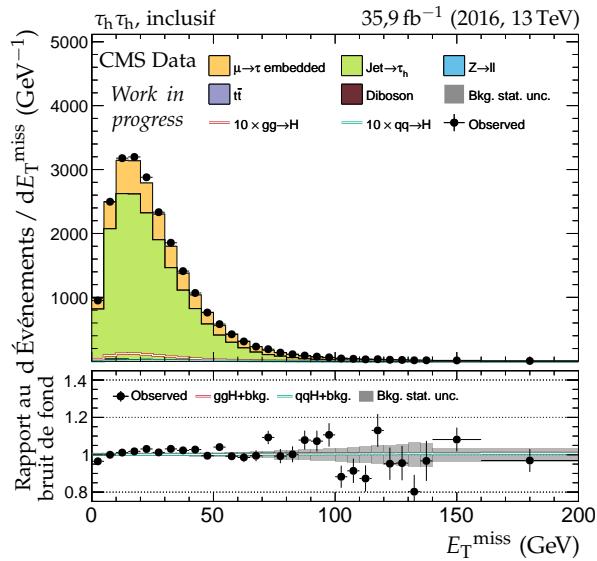


**Figure X.3 – Canal  $\tau_h\tau_h$ , 2016 : nombre de jets, système des deux jets principaux et empilement.**

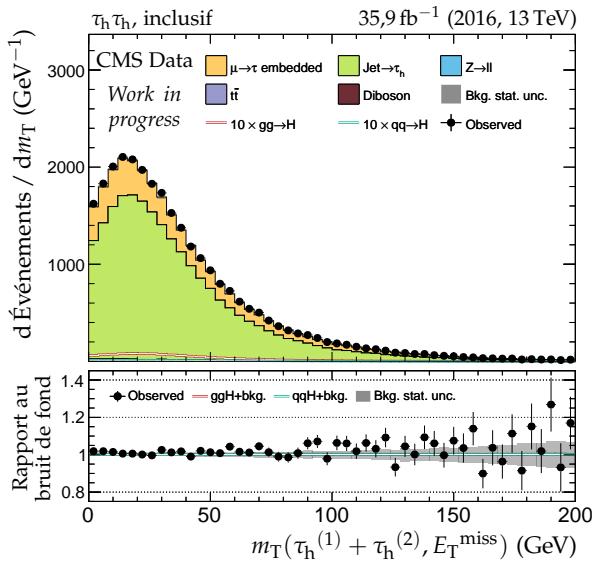


**Figure X.4 – Canal  $\tau_h\tau_h$ , 2016 : cinématique des leptons ( $\tau_h^{(1)}, \tau_h^{(2)}$ ).**

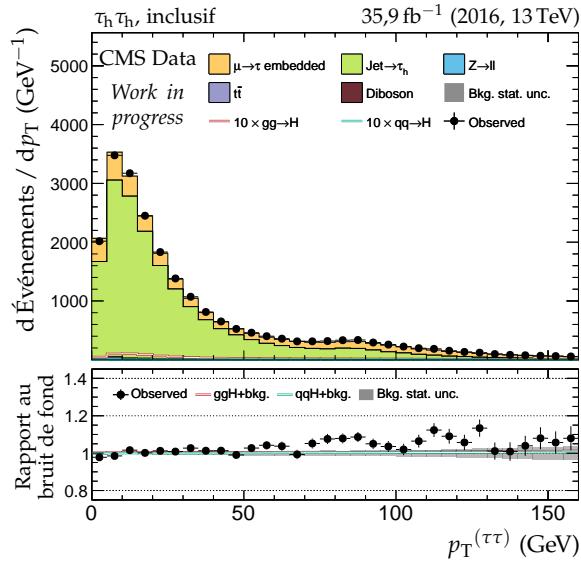
## 6 ANNEXE X. DISTRIBUTIONS DE CONTRÔLE – $H \rightarrow \tau\tau$



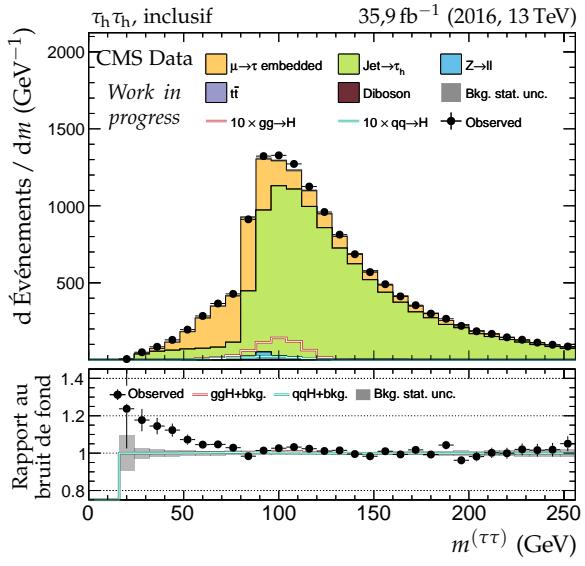
(a) Énergie transverse manquante.



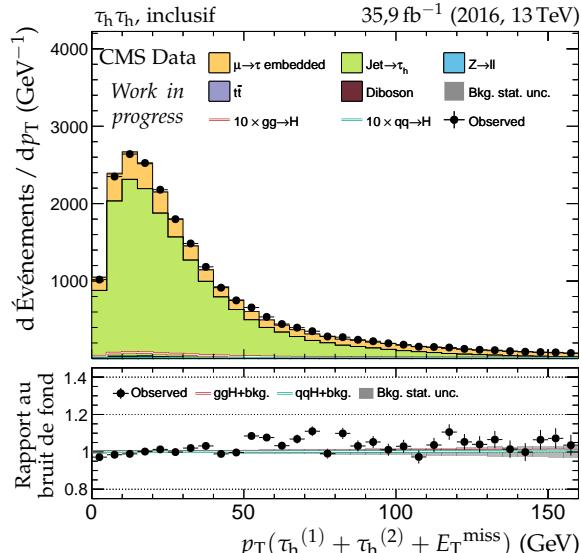
(b) Masse transverse du dilepton.



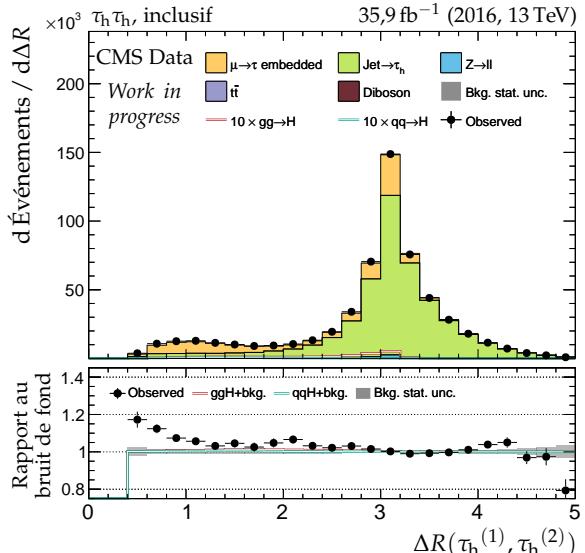
(c) Impulsion transverse du dilepton.



(d) Masse visible du dilepton.

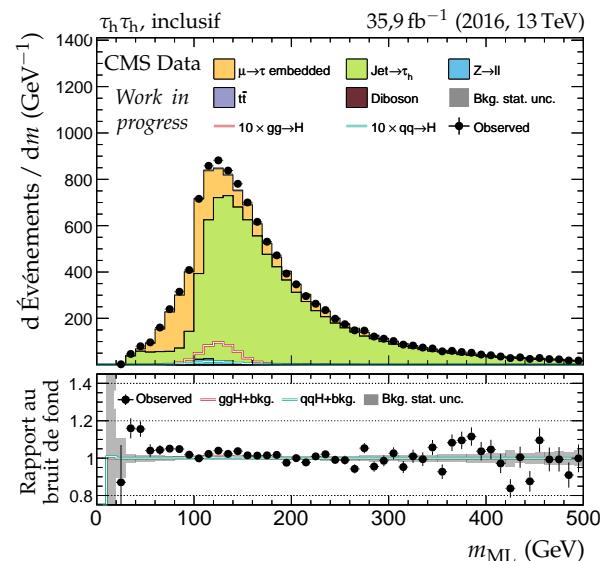
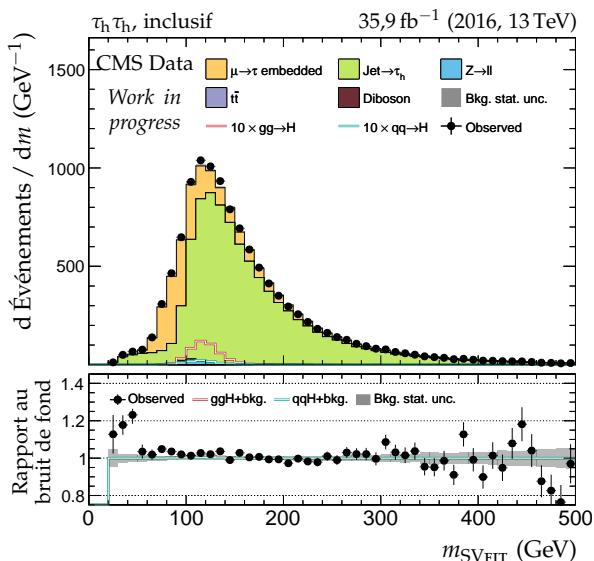
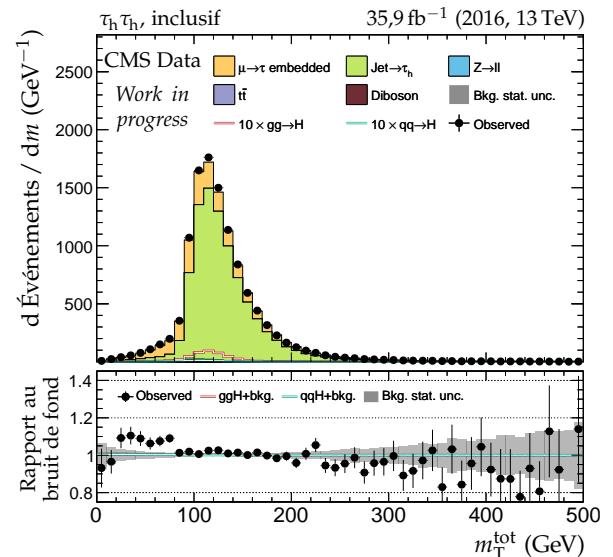
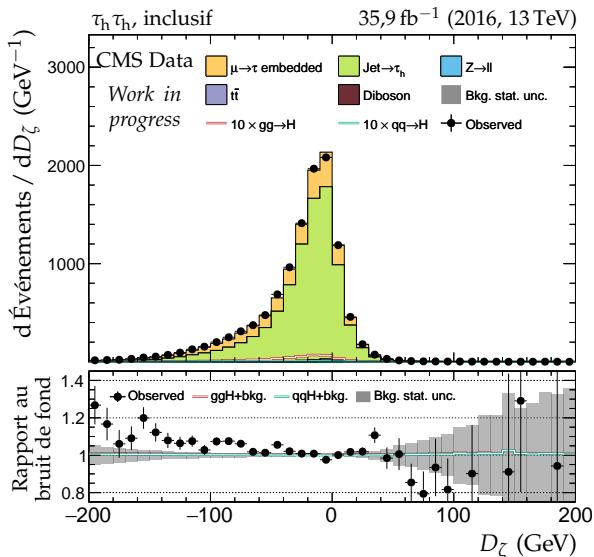
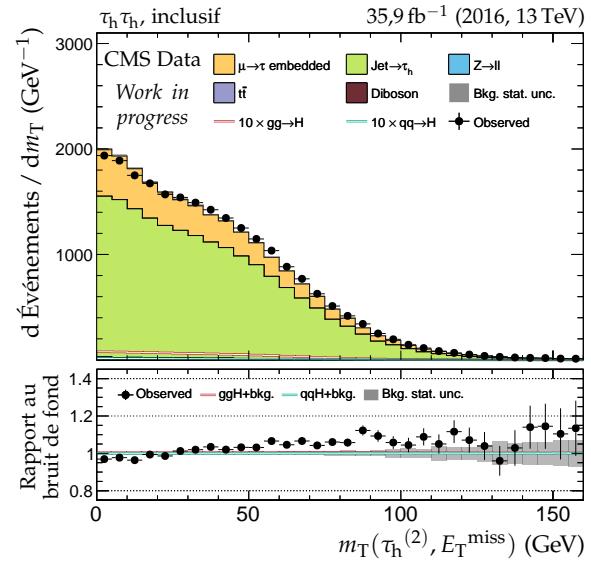
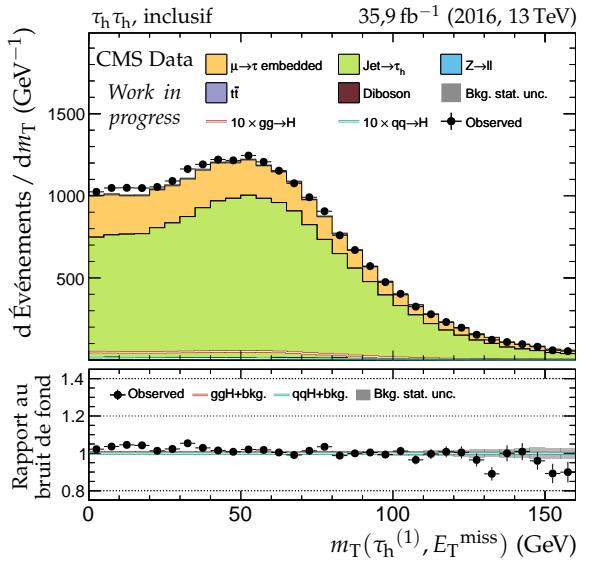


(e) Impulsion transverse du système di- $\tau$ .



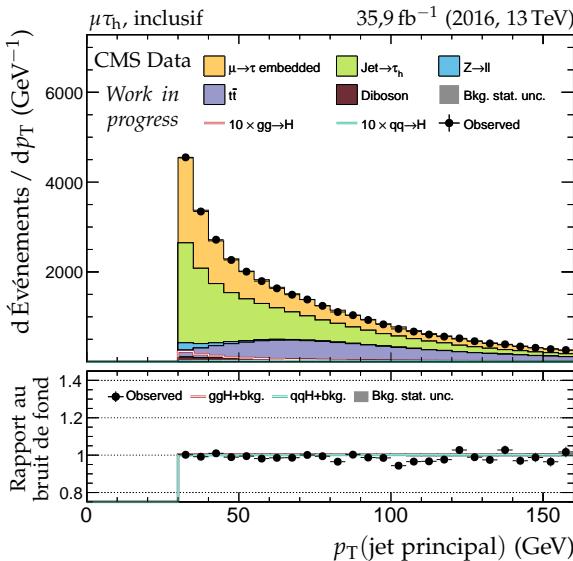
(f) Distance  $\Delta R$  entre les leptons ( $\tau_h^{(1)}, \tau_h^{(2)}$ ).

Figure X.5 – Canal  $\tau_h \tau_h$ , 2016 : dilepton et énergie transverse manquante.

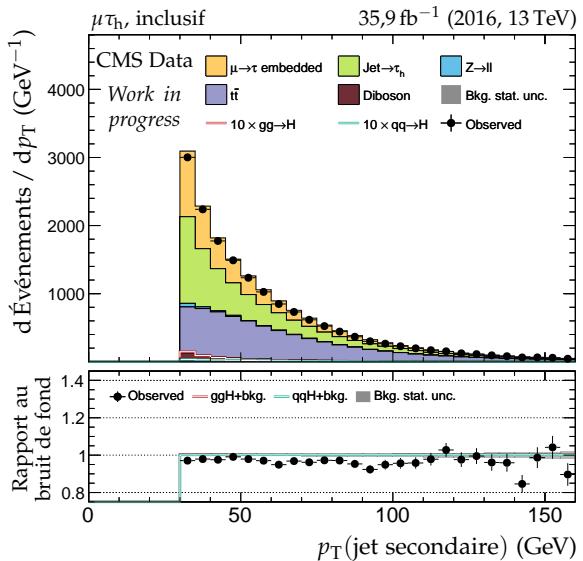


**Figure X.6 – Canal  $\tau_h \tau_h$ , 2016 : masses transverses,  $D_\zeta$  et masses.**

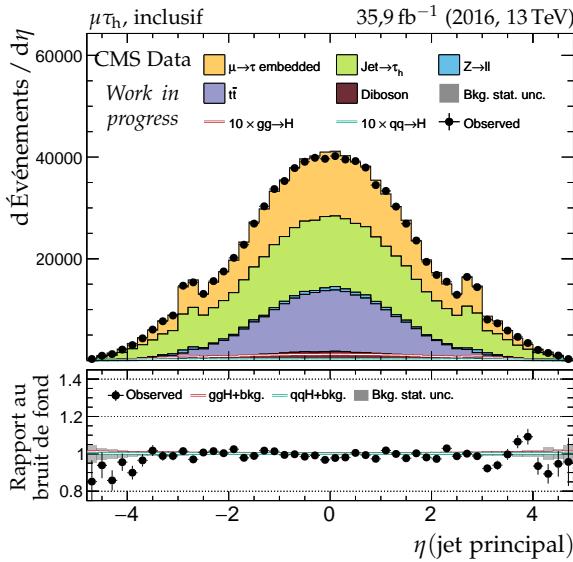
## 8 ANNEXE X. DISTRIBUTIONS DE CONTRÔLE – $H \rightarrow \tau\tau$



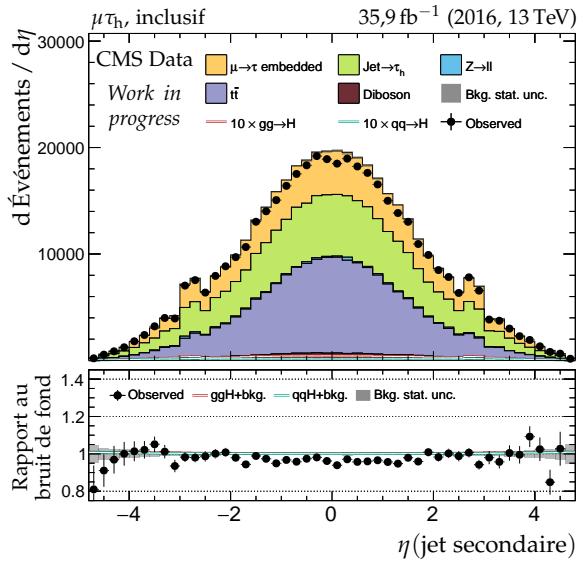
(a) Impulsion transverse du jet principal.



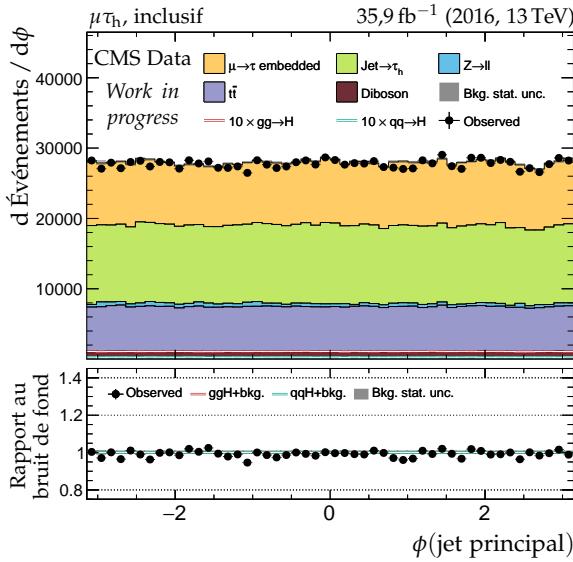
(b) Impulsion transverse du jet secondaire.



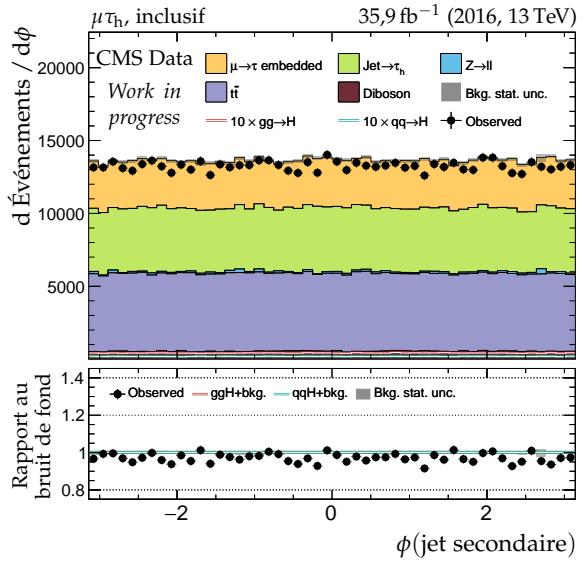
(c) Pseudo-rapidité du jet principal.



(d) Pseudo-rapidité du jet secondaire.

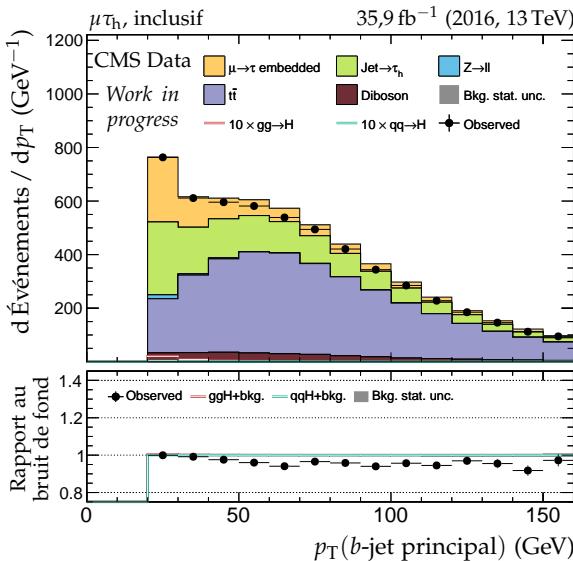


(e) Angle azimutal du jet principal.

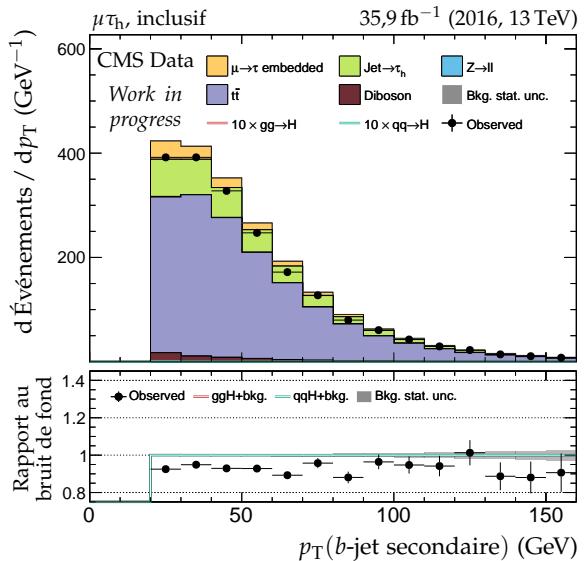


(f) Angle azimutal du jet secondaire.

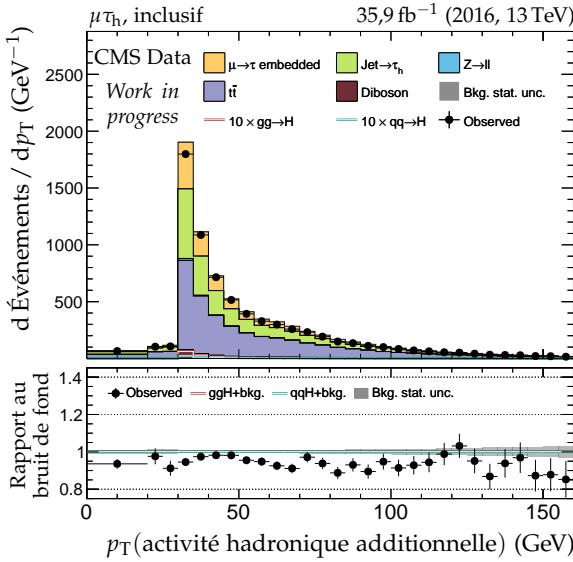
Figure X.7 – Canal  $\mu\tau_h$ , 2016 : cinématique des deux jets principaux.



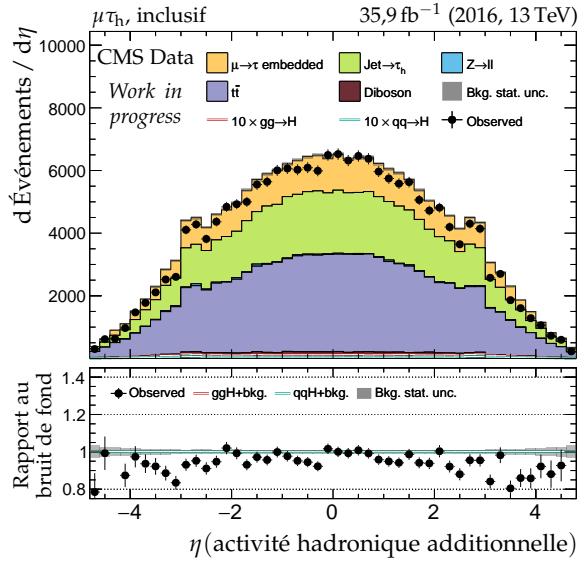
(a) Impulsion transverse du b-jet principal.



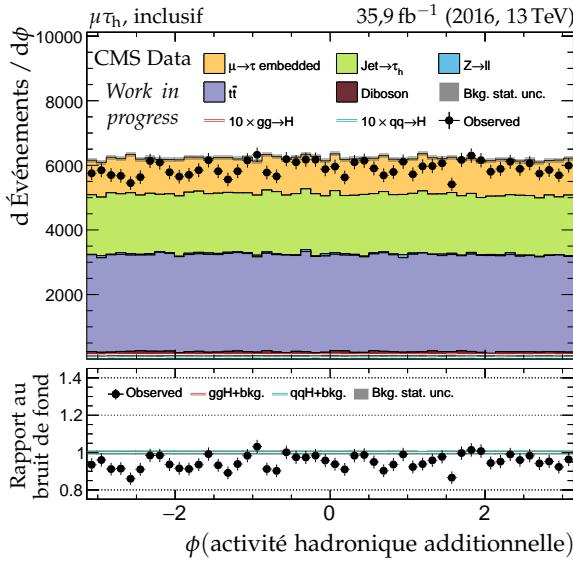
(b) Impulsion transverse du b-jet secondaire.



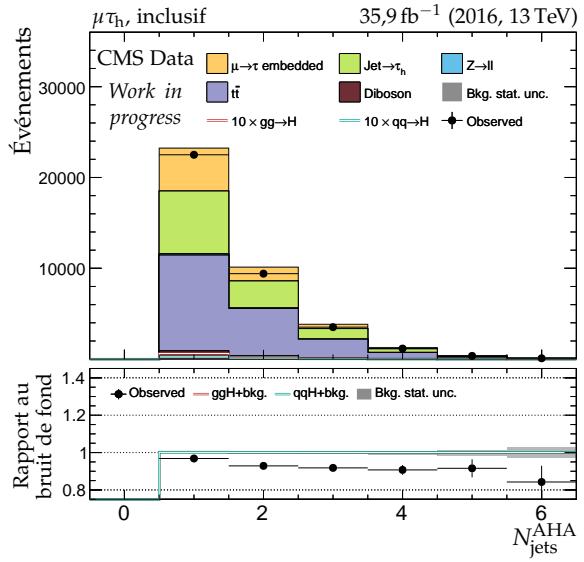
(c) Impulsion transverse de l'AHA.



(d) Pseudo-rapidité de l'AHA.



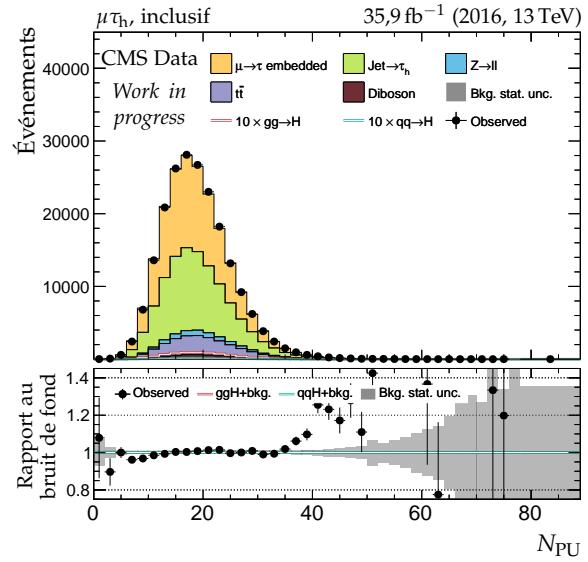
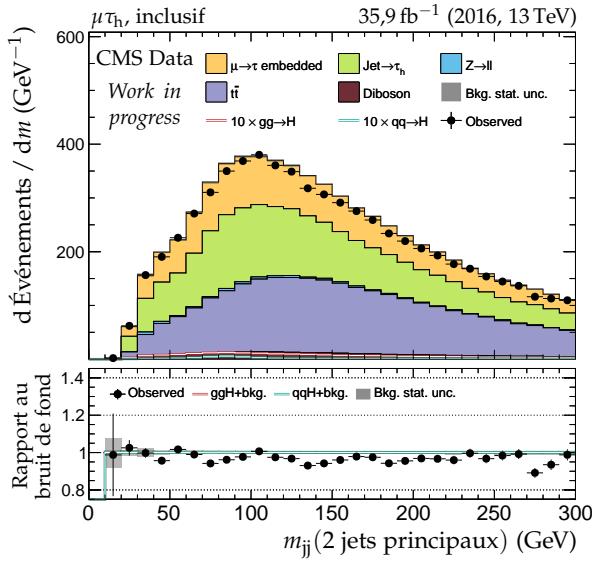
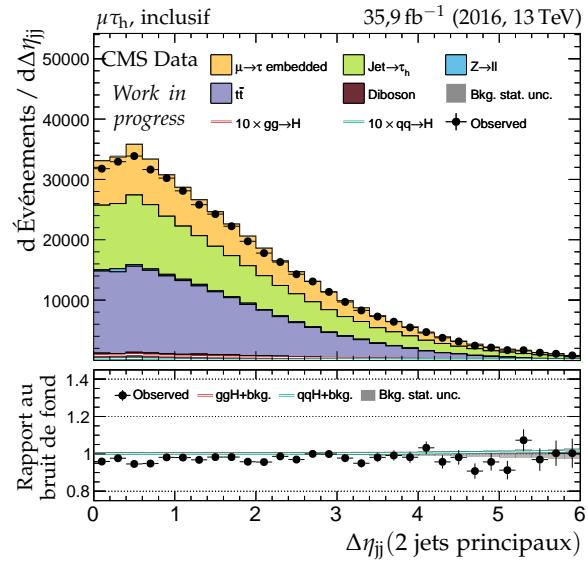
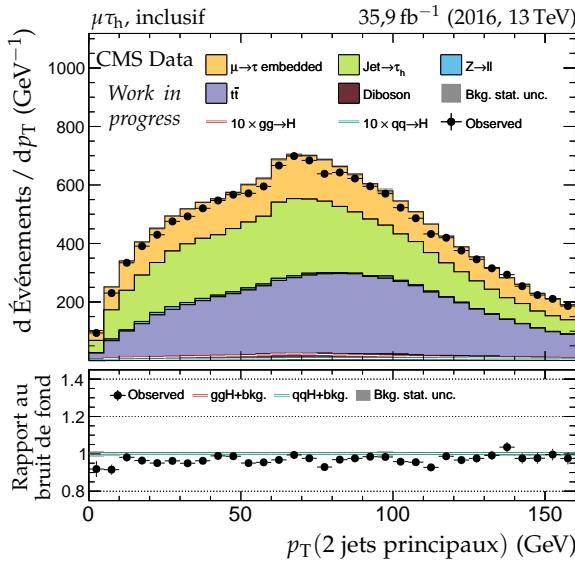
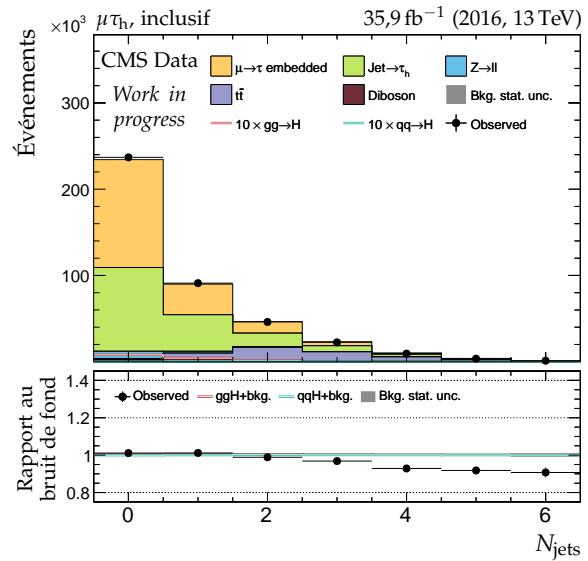
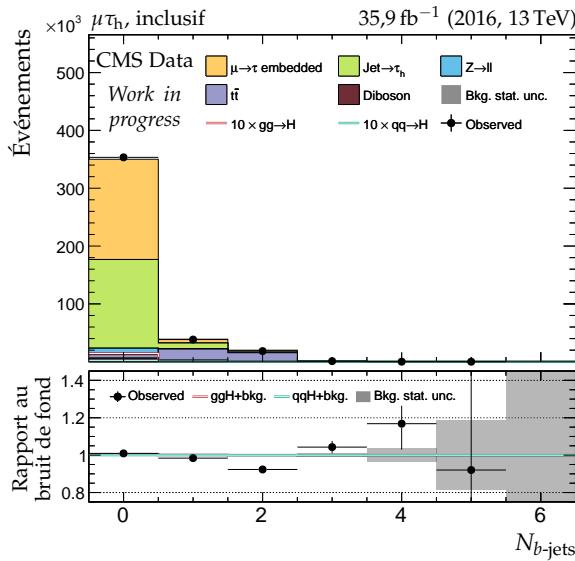
(e) Angle azimutal de l'AHA.



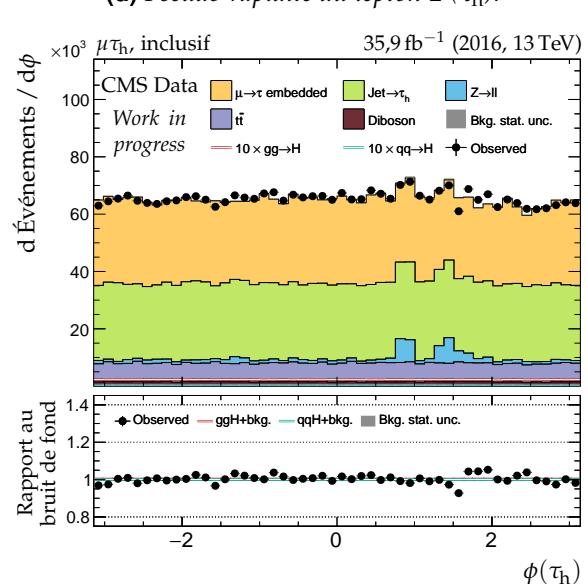
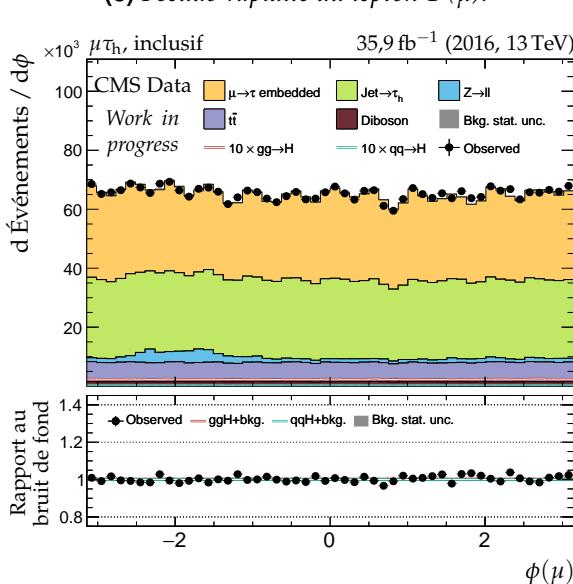
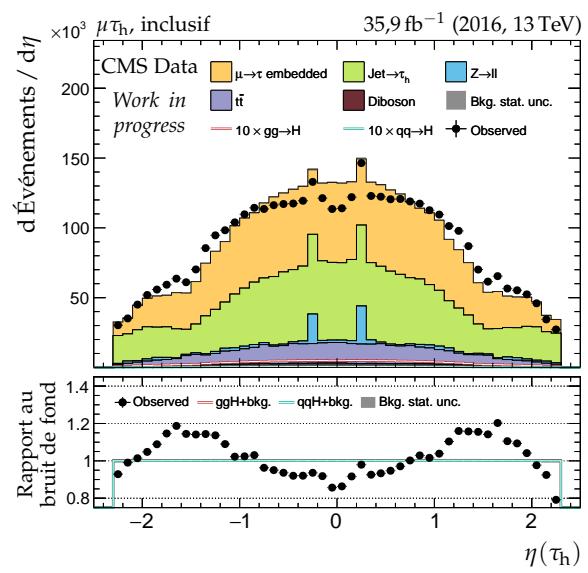
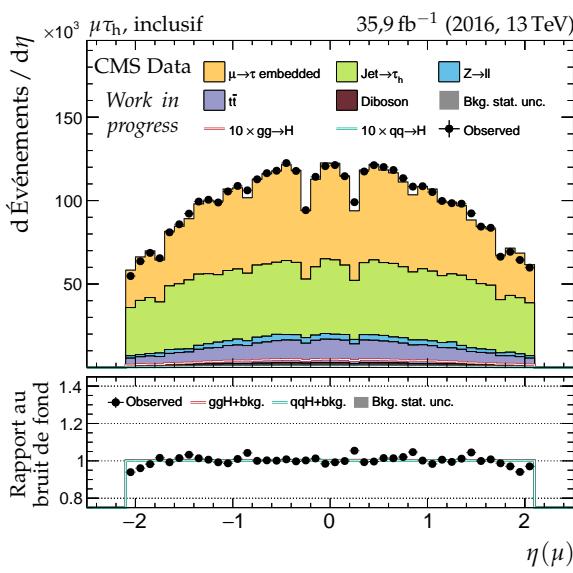
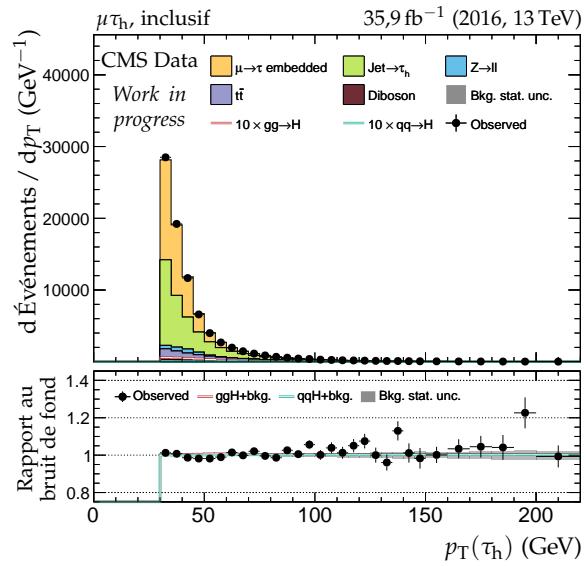
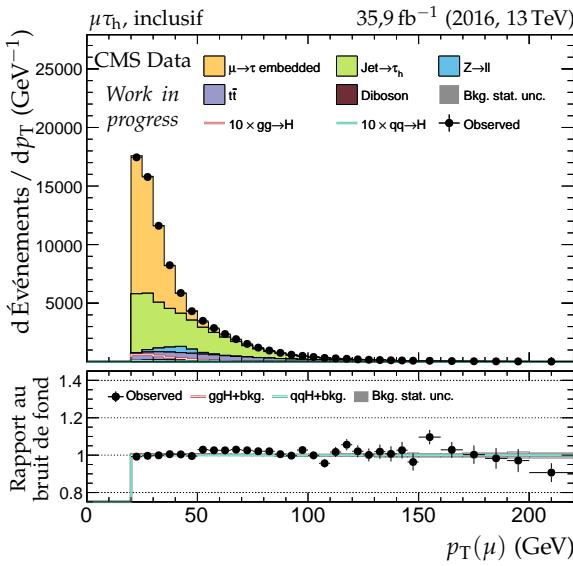
(f) Nombre de jets dans l'AHA.

**Figure X.8 – Canal  $\mu\tau_h$ , 2016 : b-jets et activité hadronique additionnelle.**

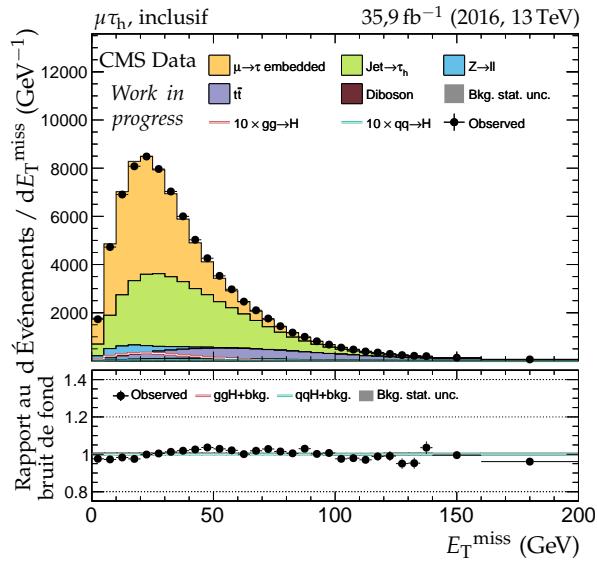
## 10 ANNEXE X. DISTRIBUTIONS DE CONTRÔLE – $H \rightarrow \tau\tau$



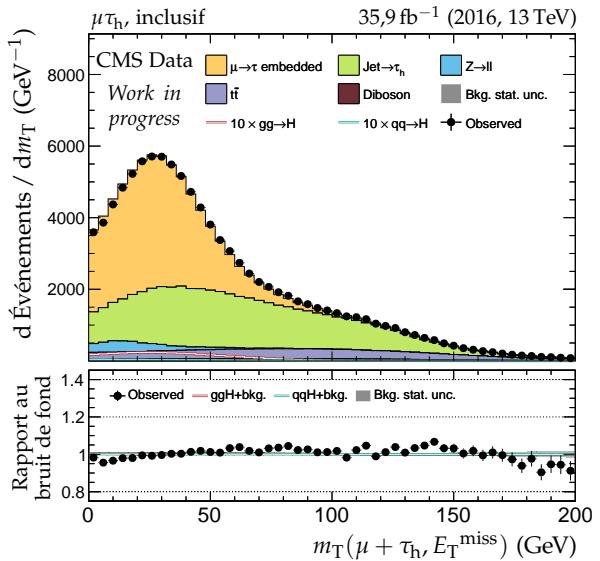
**Figure X.9 – Canal  $\mu\tau_h$ , 2016 : nombre de jets, système des deux jets principaux et empilement.**



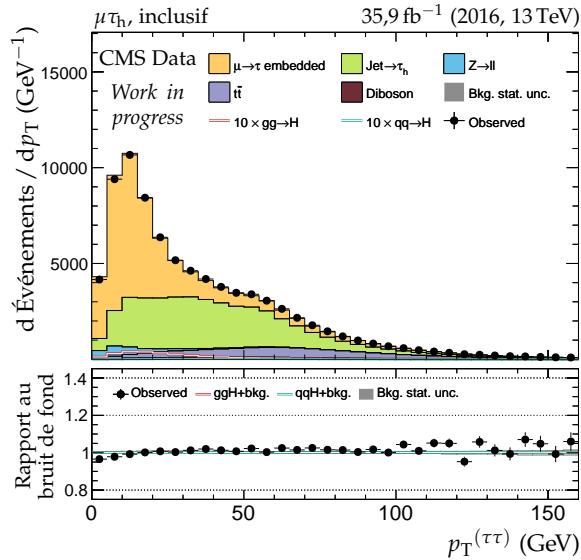
**Figure X.10 – Canal  $\mu\tau_h$ , 2016 : cinématique des leptons ( $\mu, \tau_h$ ).**



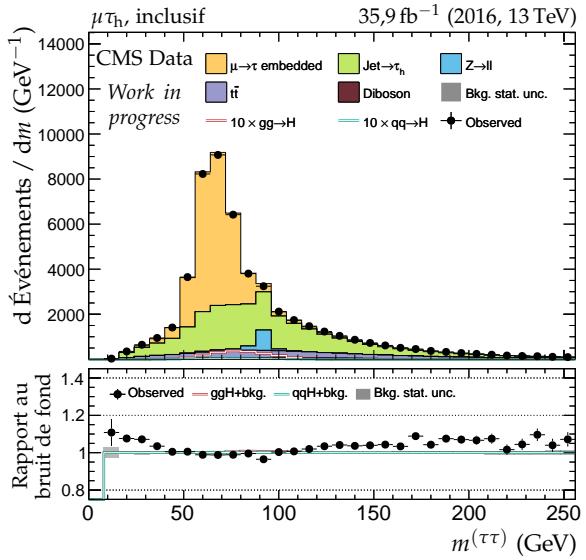
(a) Énergie transverse manquante.



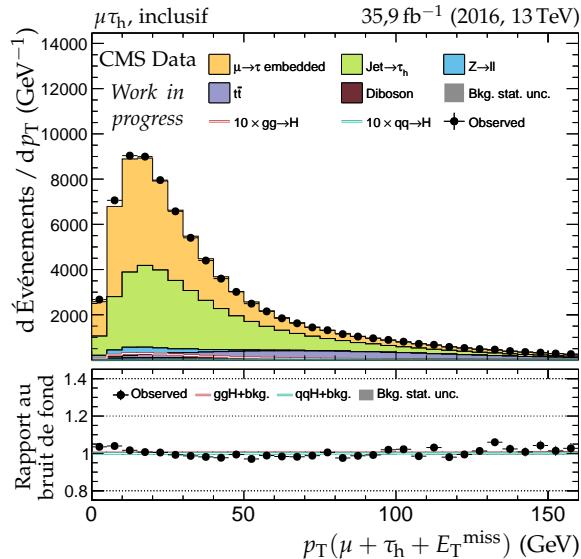
(b) Masse transverse du dilepton.



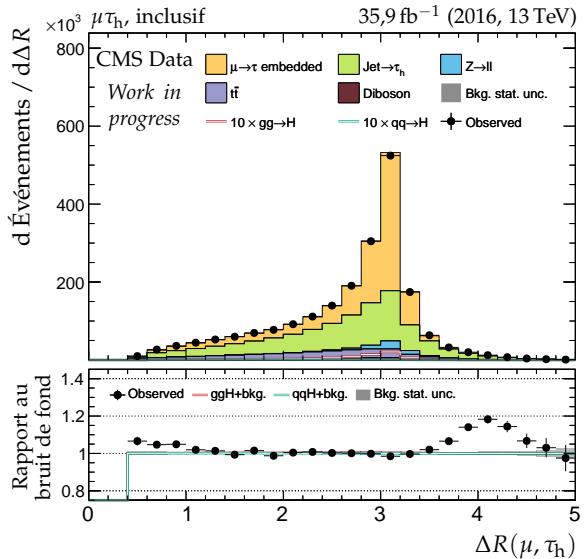
(c) Impulsion transverse du dilepton.



(d) Masse visible du dilepton.

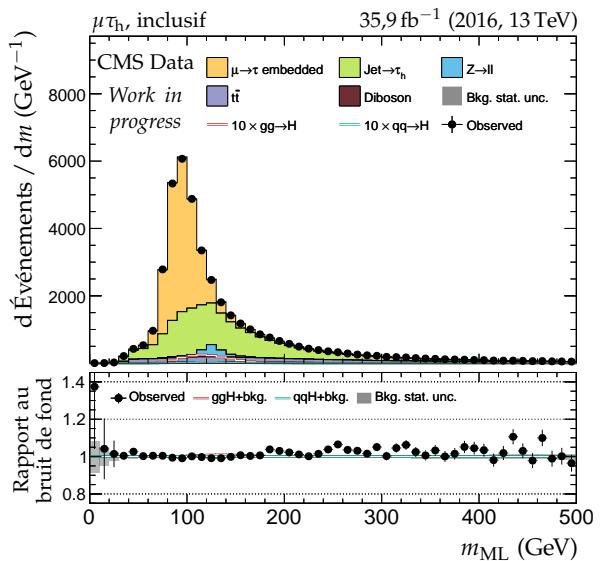
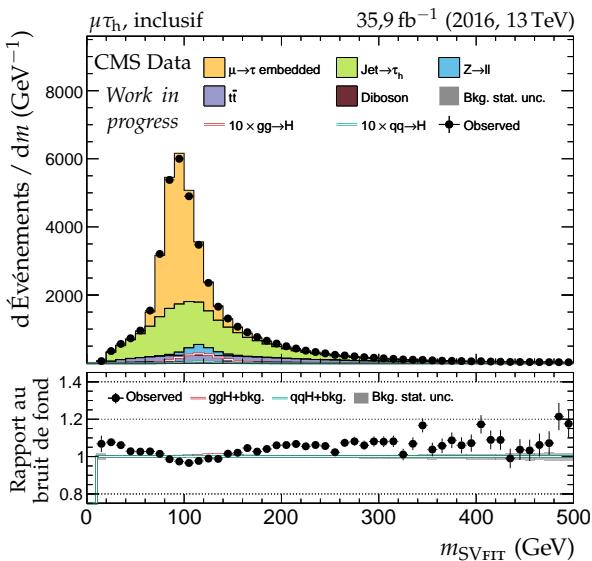
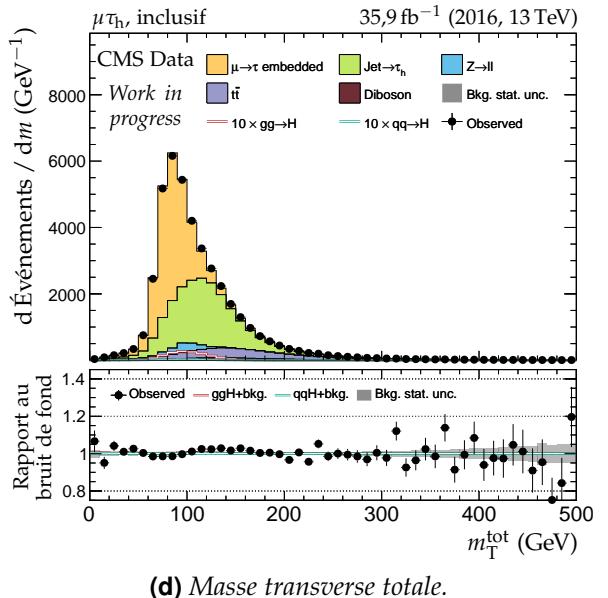
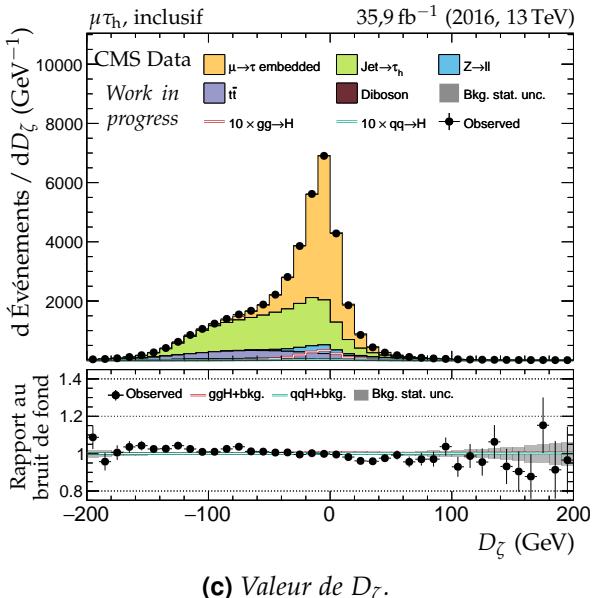
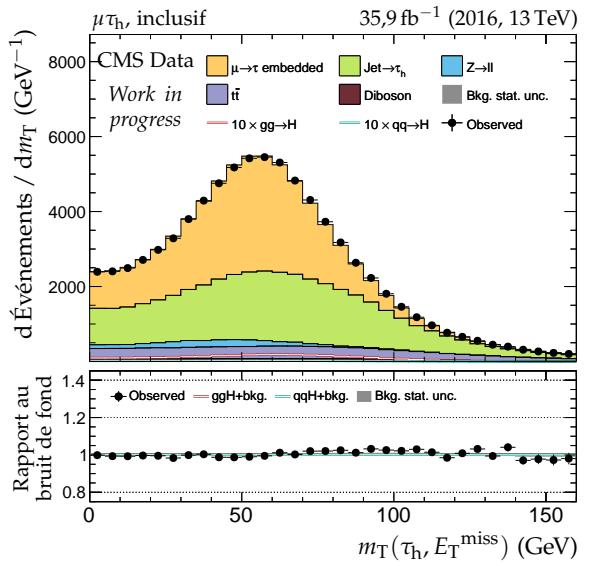
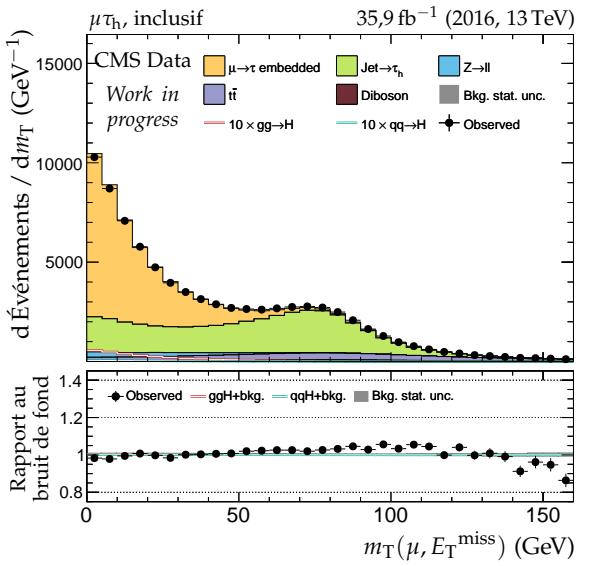


(e) Impulsion transverse du système di- $\tau$ .

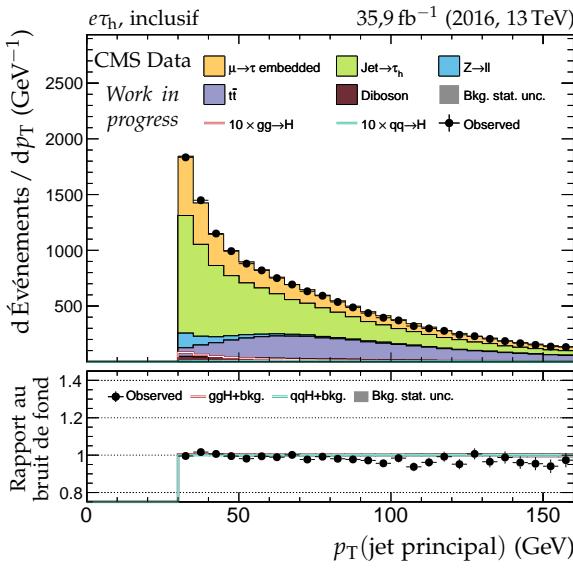


(f) Distance  $\Delta R$  entre les leptons ( $\mu, \tau_h$ ).

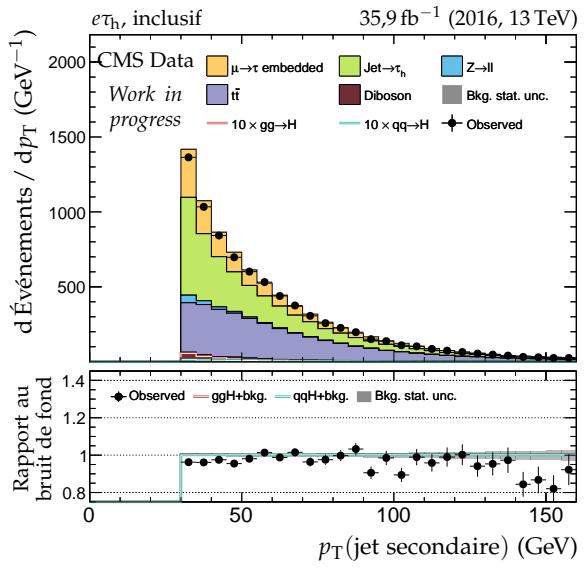
Figure X.11 – Canal  $\mu\tau_h$ , 2016 : dilepton et énergie transverse manquante.



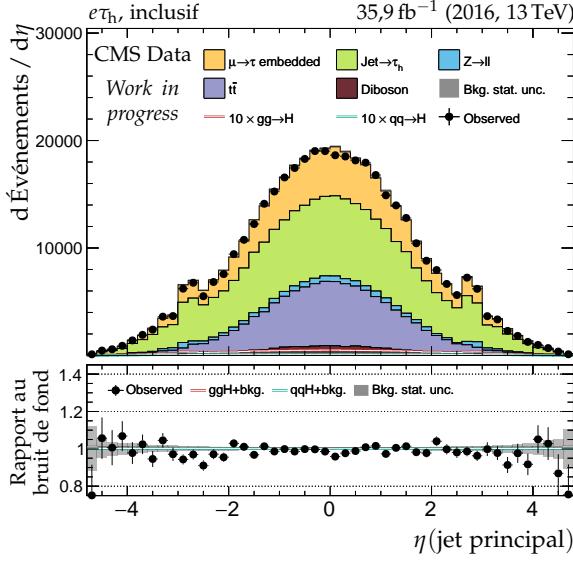
**Figure X.12 – Canal  $\mu\tau_h$ , 2016 : masses transverses,  $D_\zeta$  et masses.**



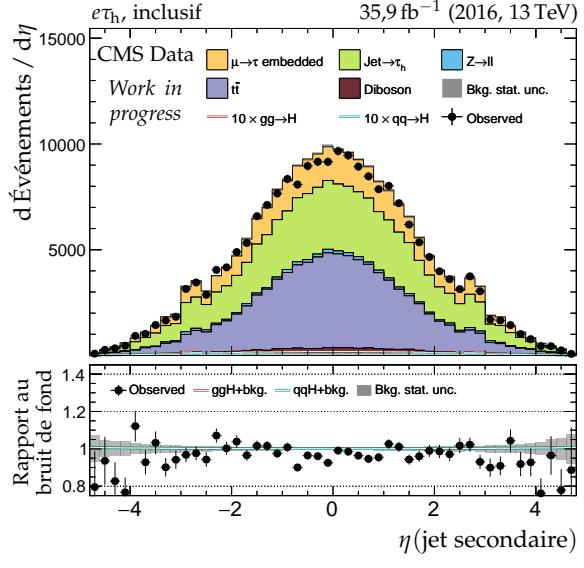
**(a)** Impulsion transverse du jet principal.



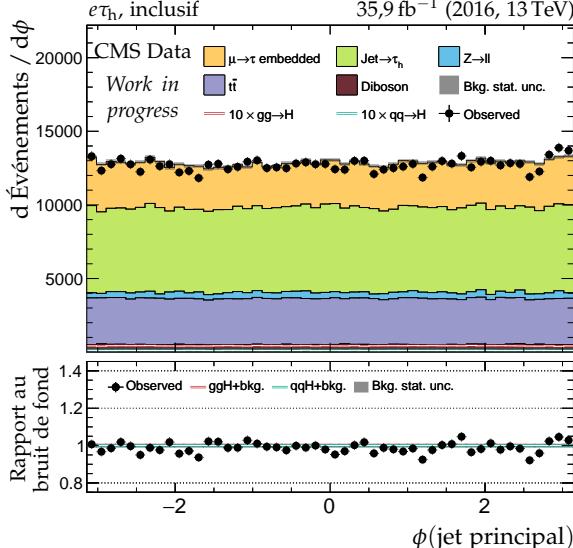
**(b)** Impulsion transverse du jet secondaire.



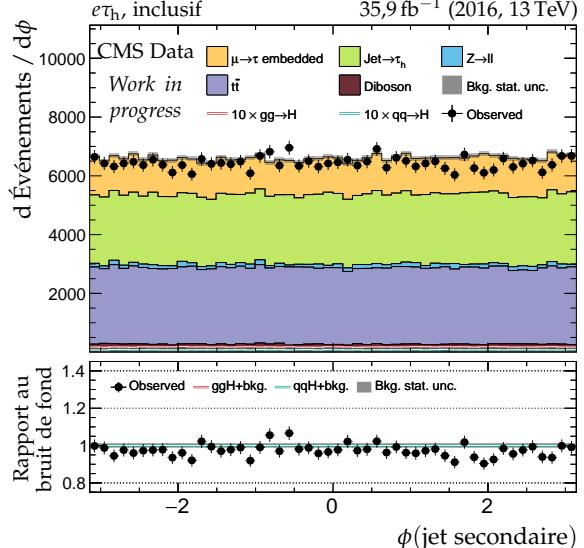
**(c)** Pseudo-rapidité du jet principal.



**(d)** Pseudo-rapidité du jet secondaire.

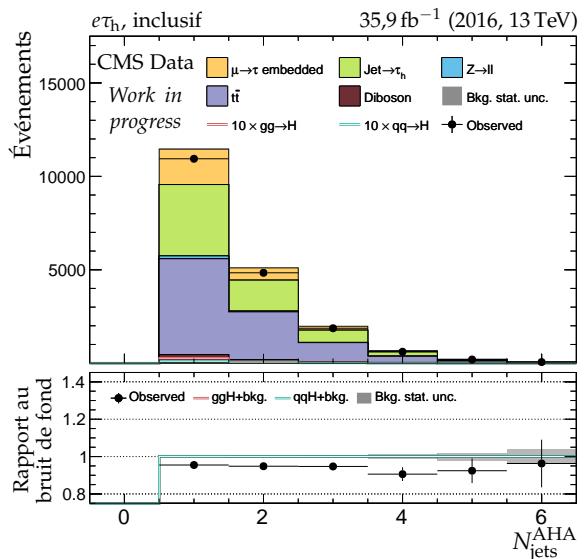
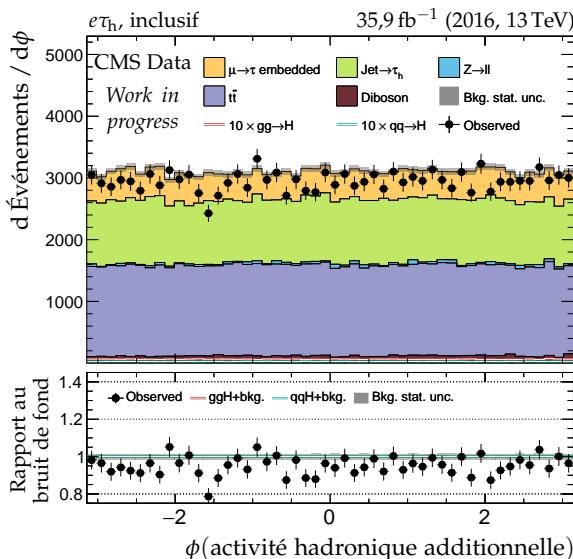
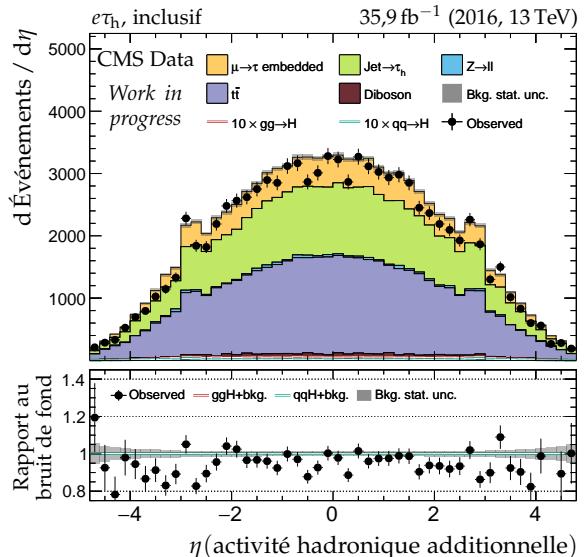
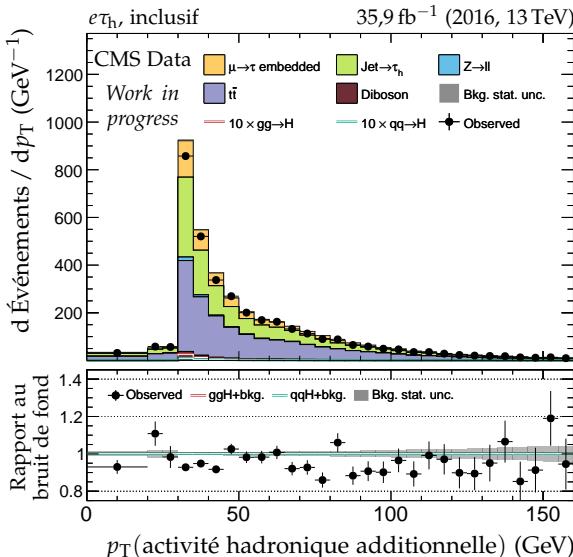
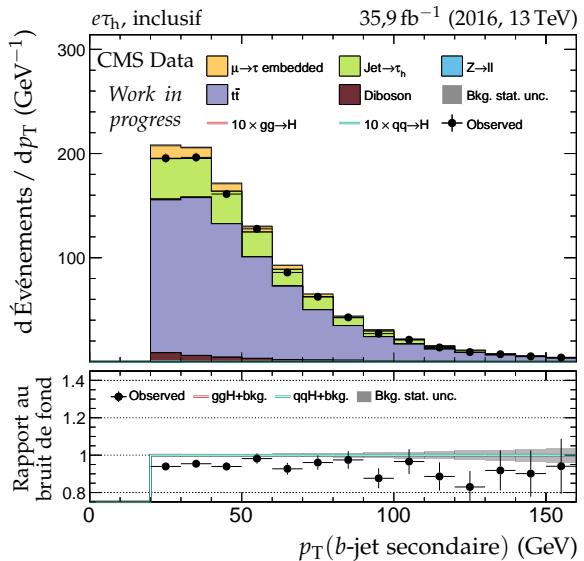
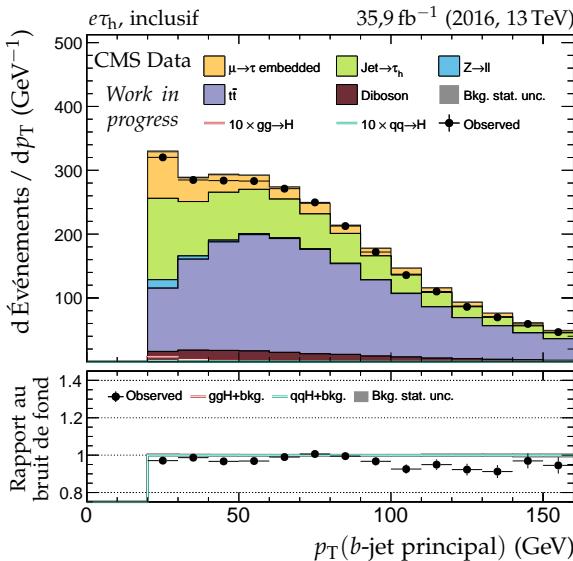


**(e)** Angle azimutal du jet principal.

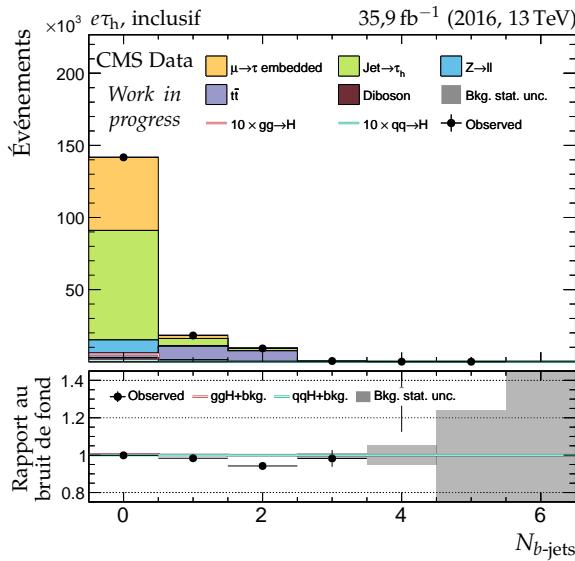
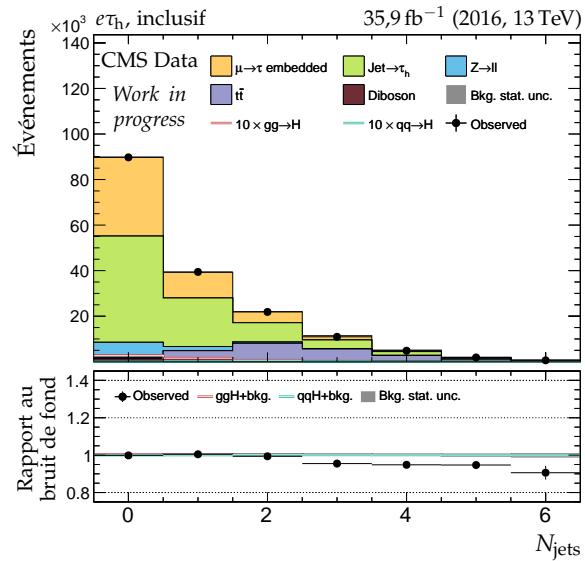


**(f)** Angle azimutal du jet secondaire.

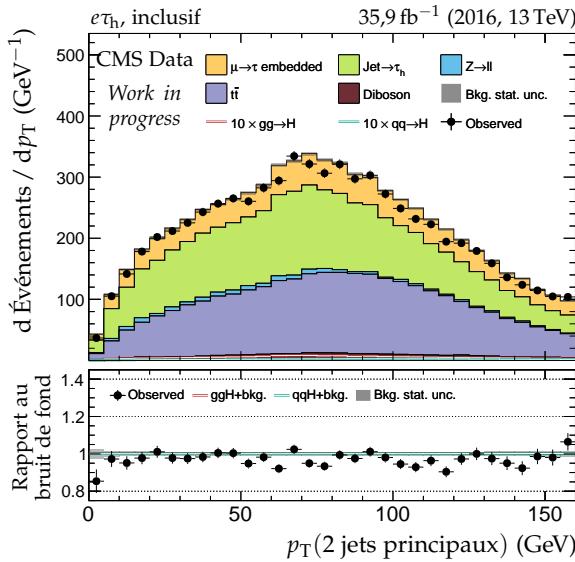
**Figure X.13 – Canal  $e\tau_h$ , 2016 : cinématique des deux jets principaux.**



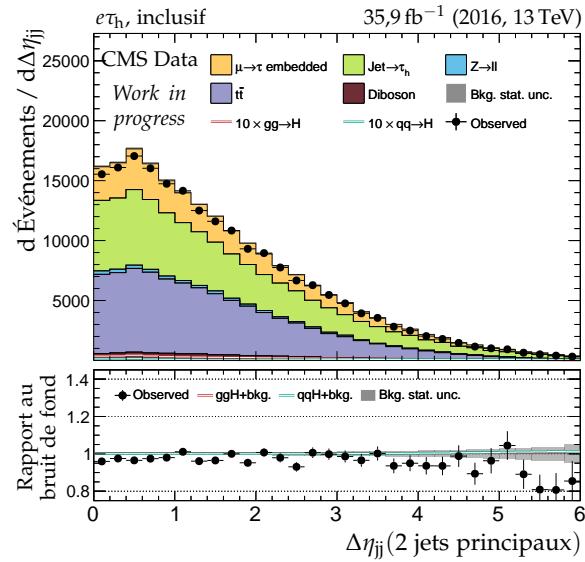
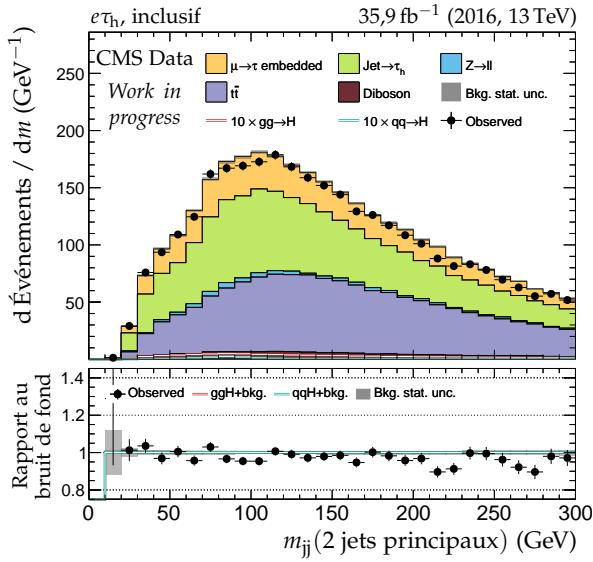
**Figure X.14 – Canal  $e\tau_h$ , 2016 : b-jets et activité hadronique additionnelle.**


 (a) Nombre de  $b$ -jets.


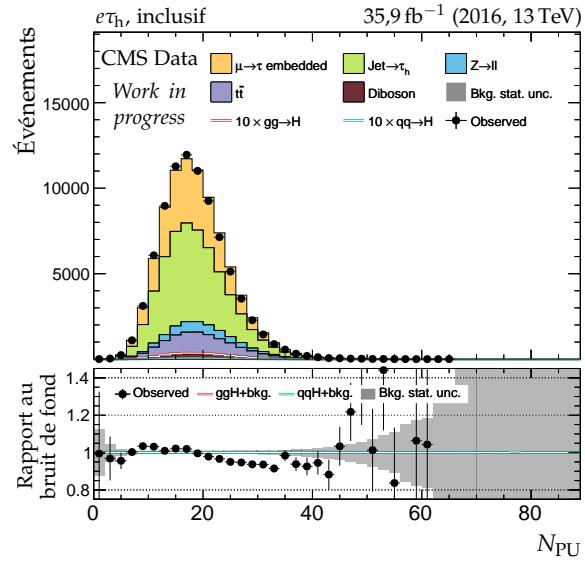
(b) Nombre de jets.



(c) Impulsion transverse du système des deux jets.

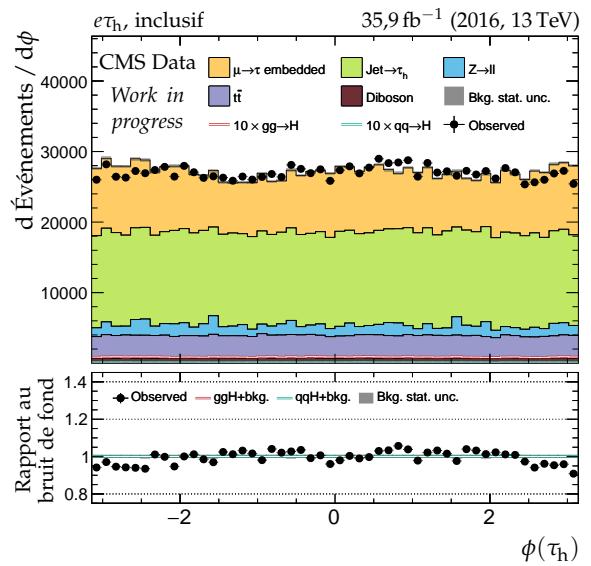
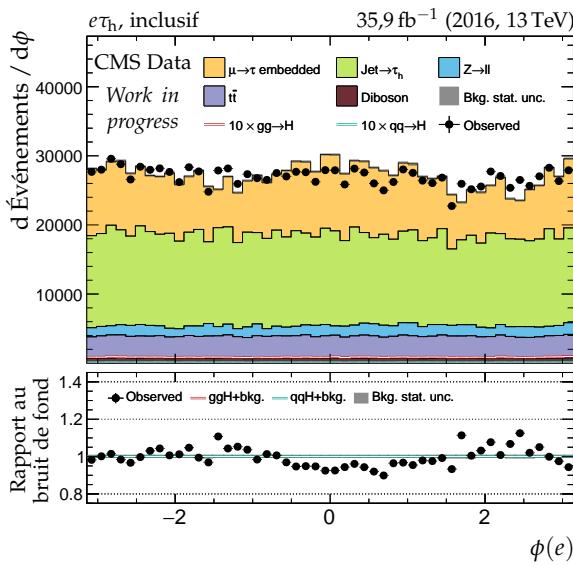
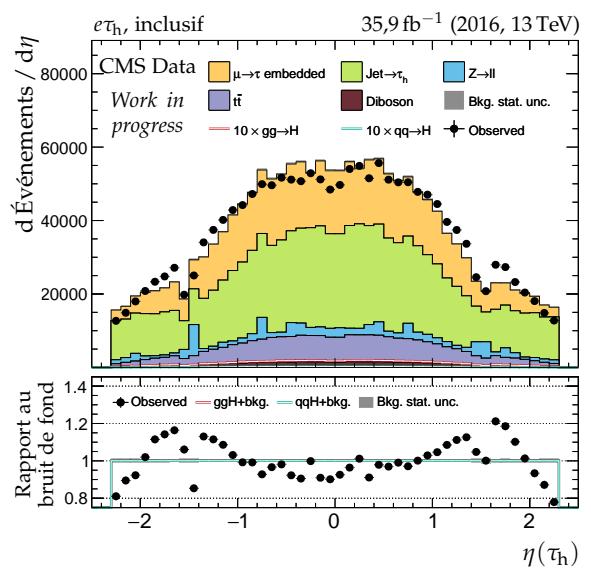
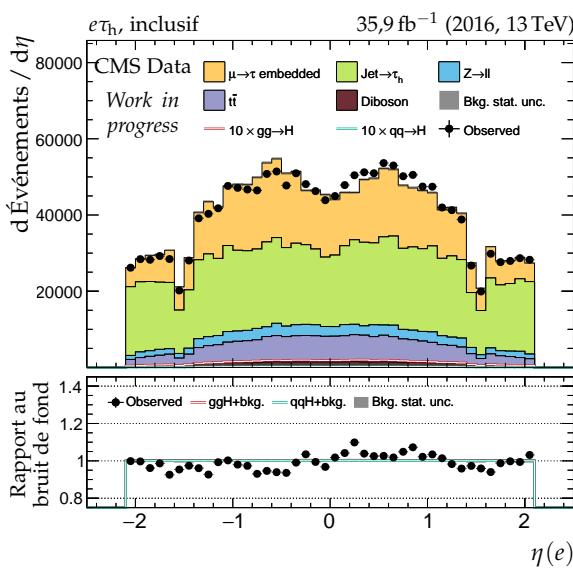
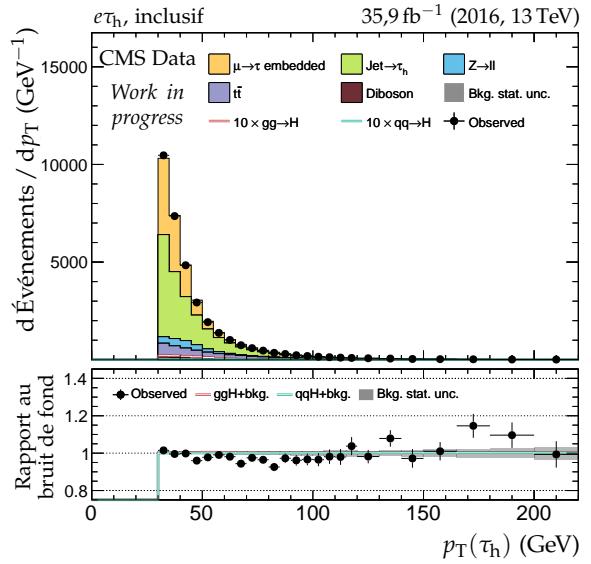
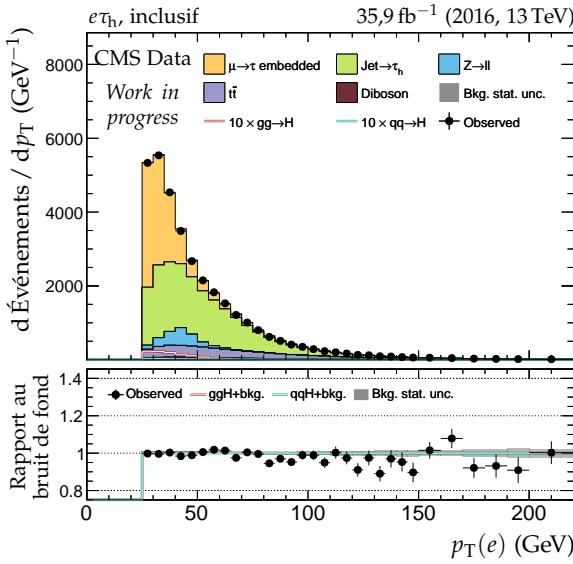

 (d) Distance en  $\eta$  entre les deux jets.


(e) Masse invariante du système des deux jets.

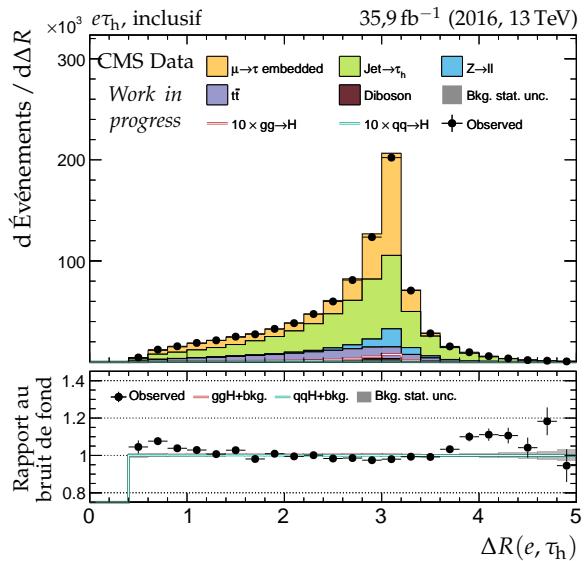
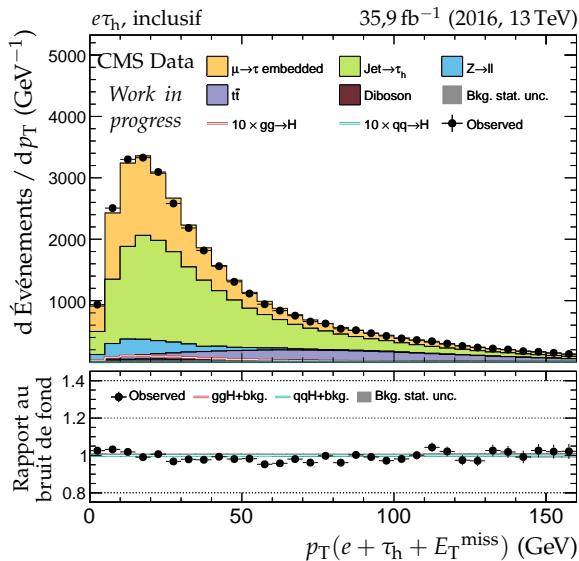
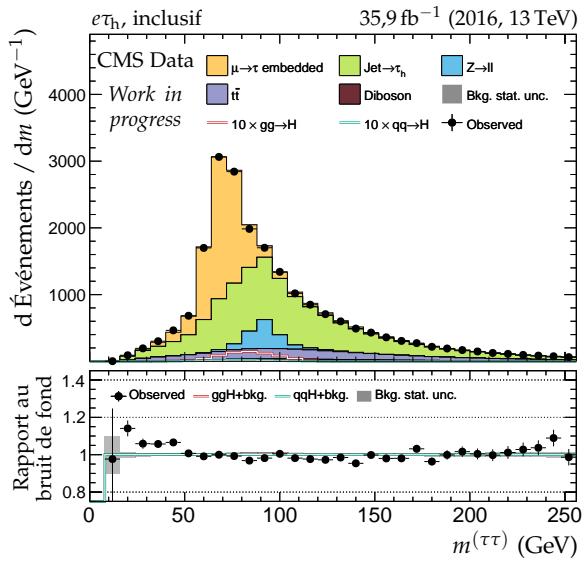
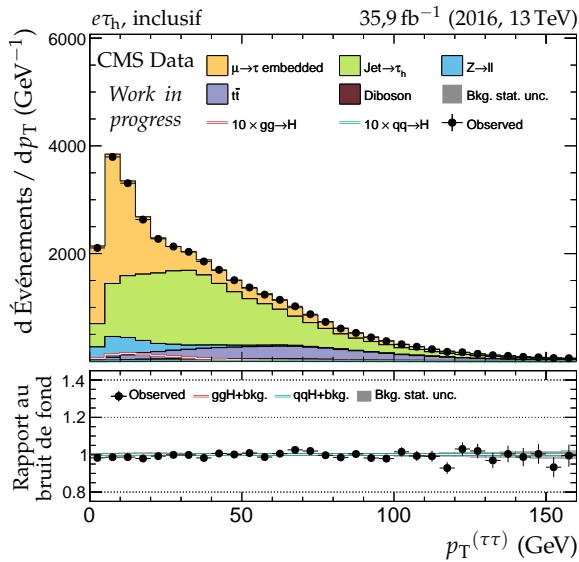
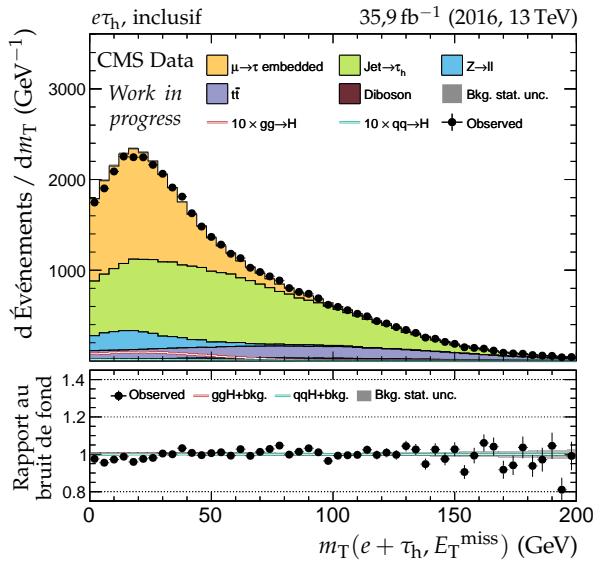
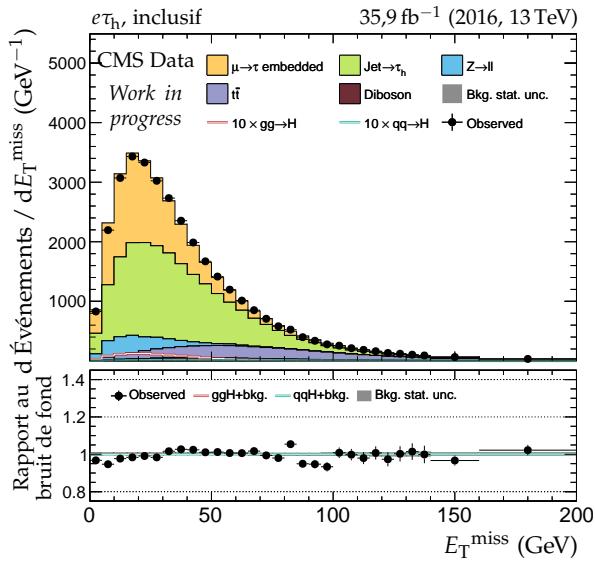


(f) Nombre de vertex d'empilement.

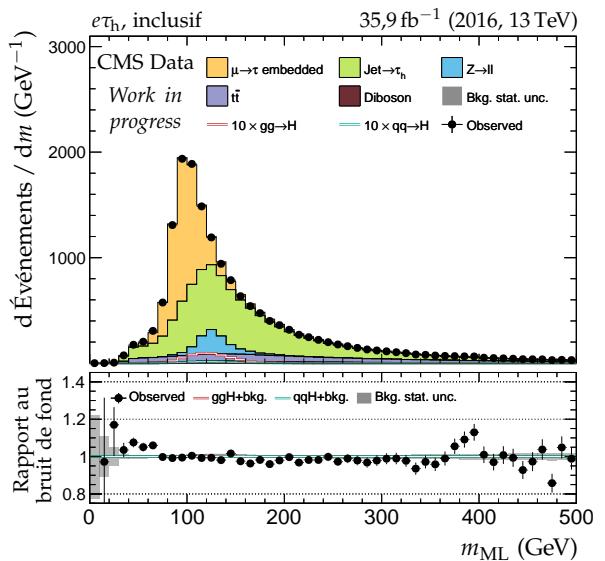
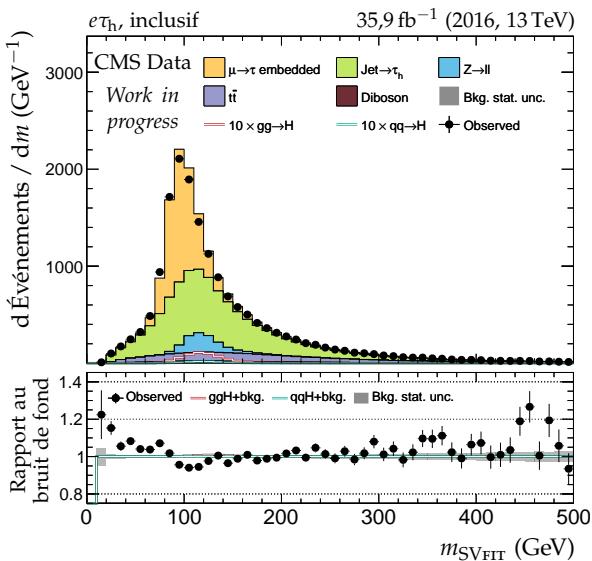
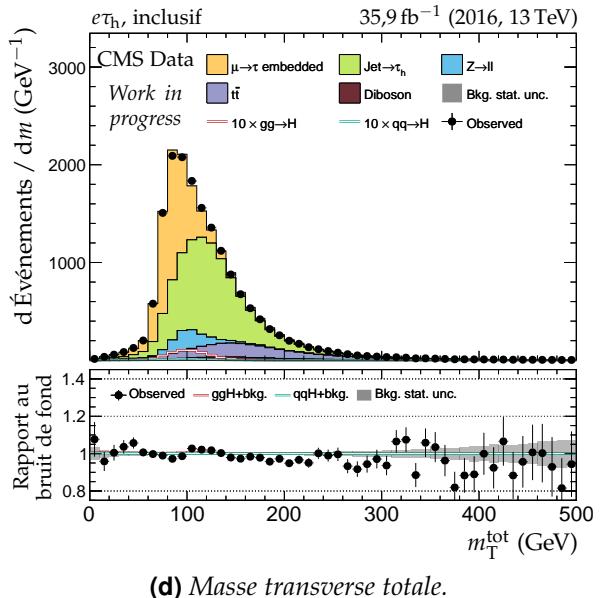
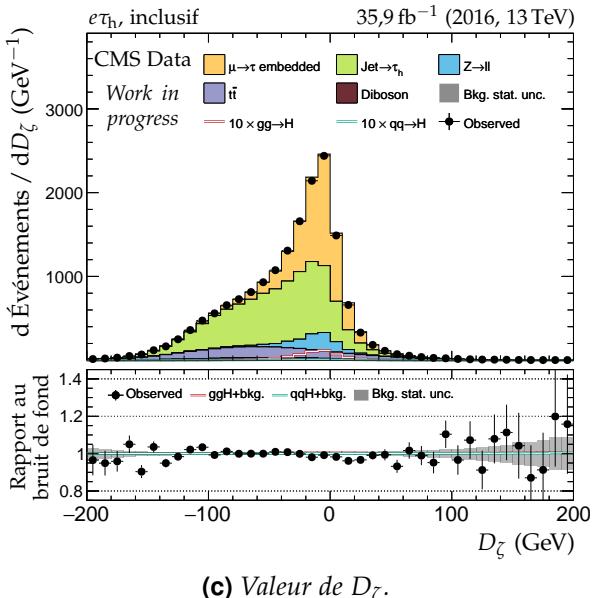
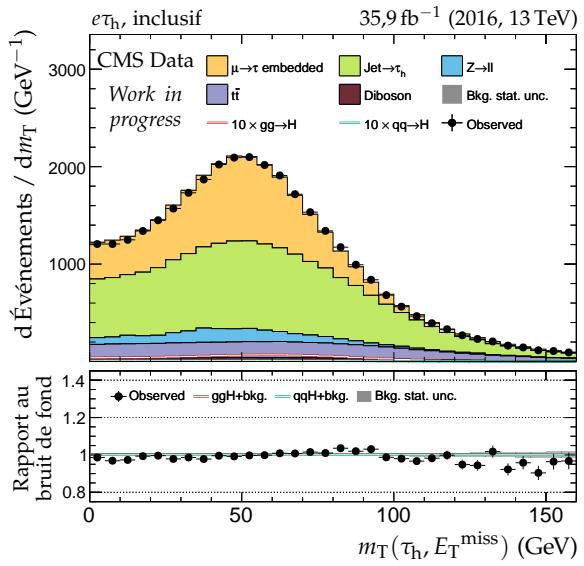
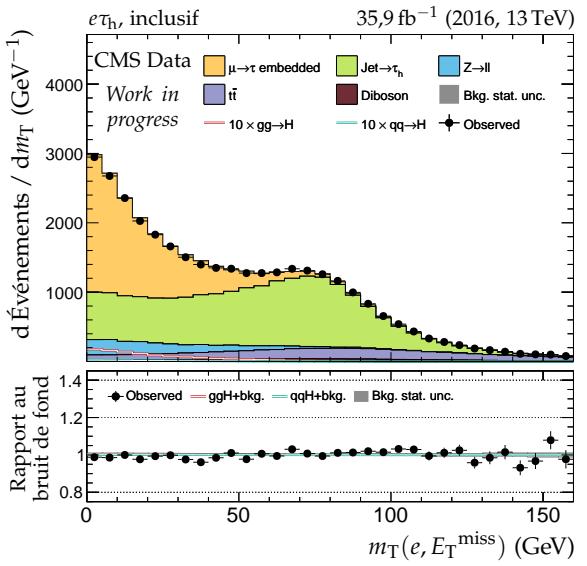
 Figure X.15 – Canal  $e\tau_h$ , 2016 : nombre de jets, système des deux jets principaux et empilement.



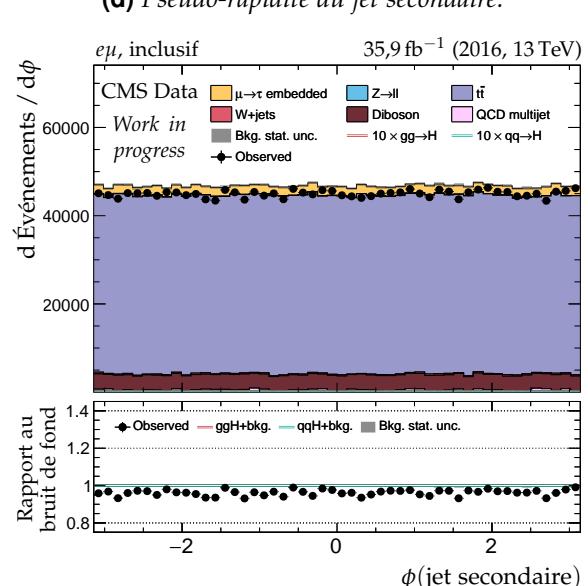
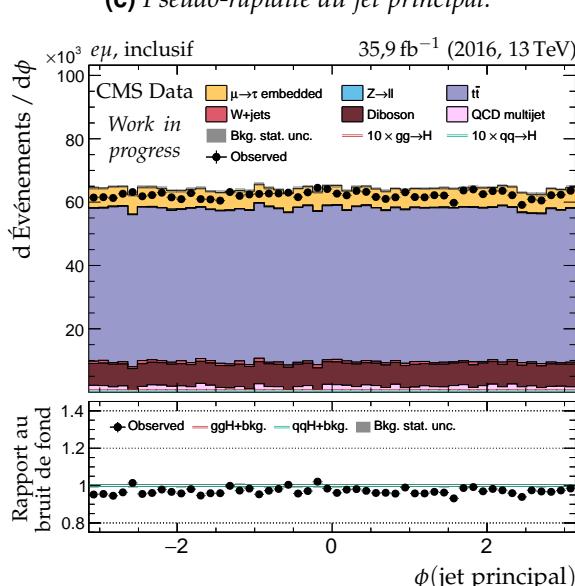
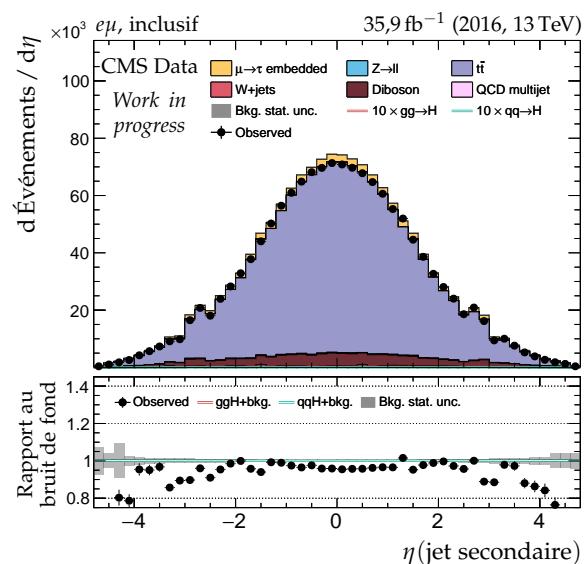
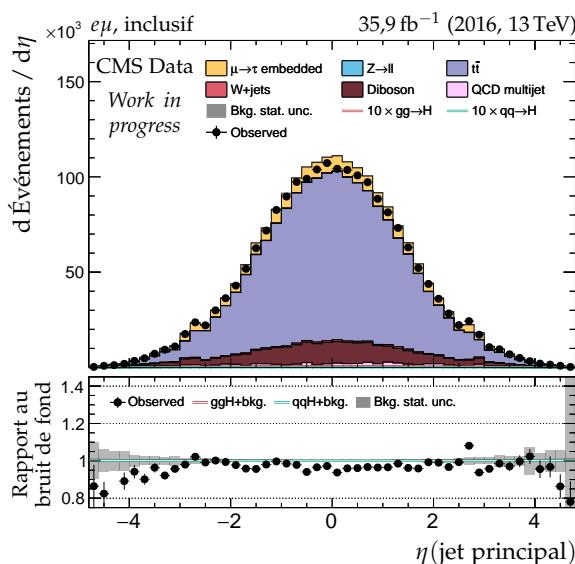
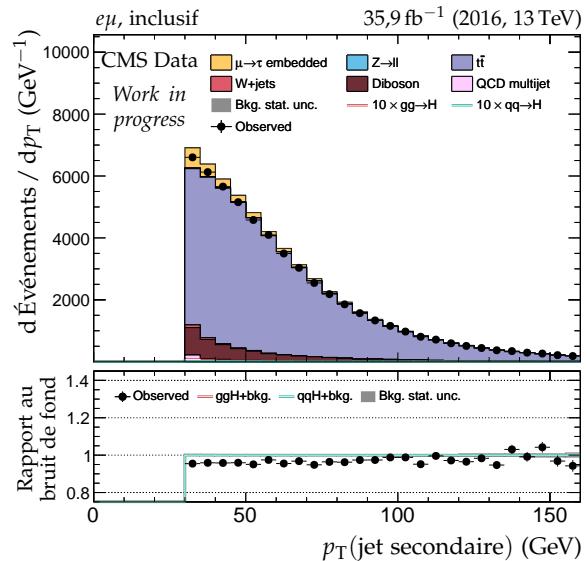
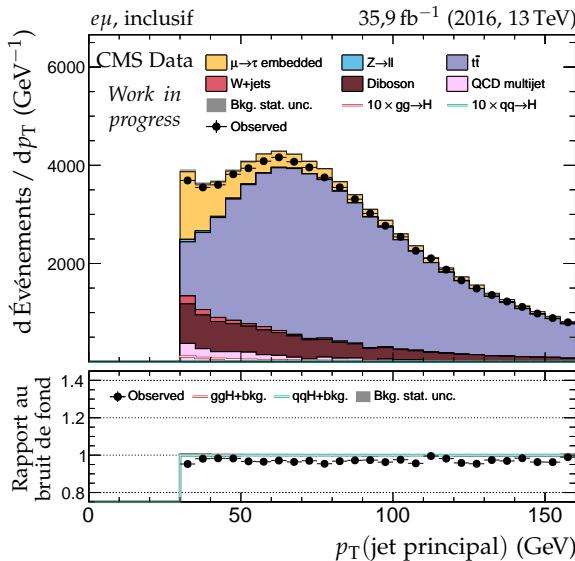
**Figure X.16 – Canal  $e\tau_h$ , 2016 : cinématique des leptons ( $e, \tau_h$ ).**



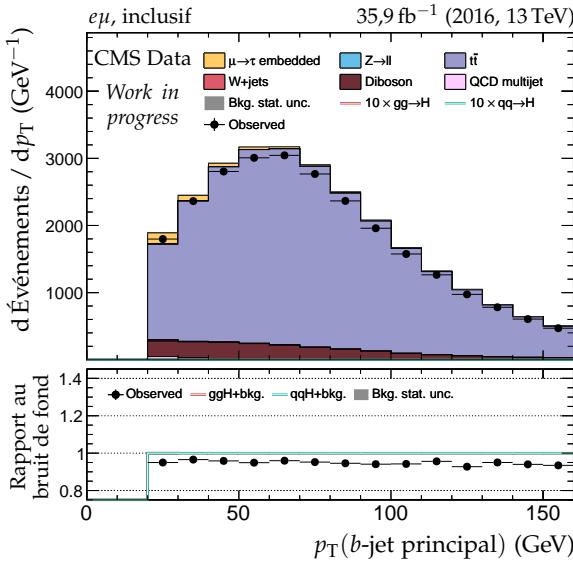
**Figure X.17 – Canal  $e\tau_h$ , 2016 : dilepton et énergie transverse manquante.**



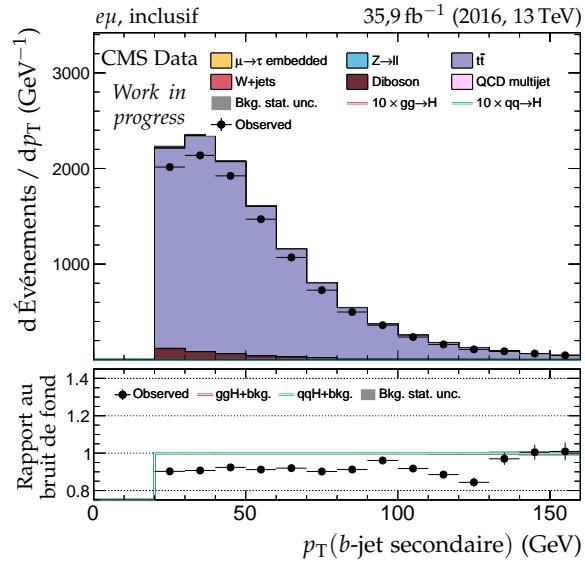
**Figure X.18 – Canal  $e\tau_h$ , 2016 : masses transverses,  $D_\zeta$  et masses.**



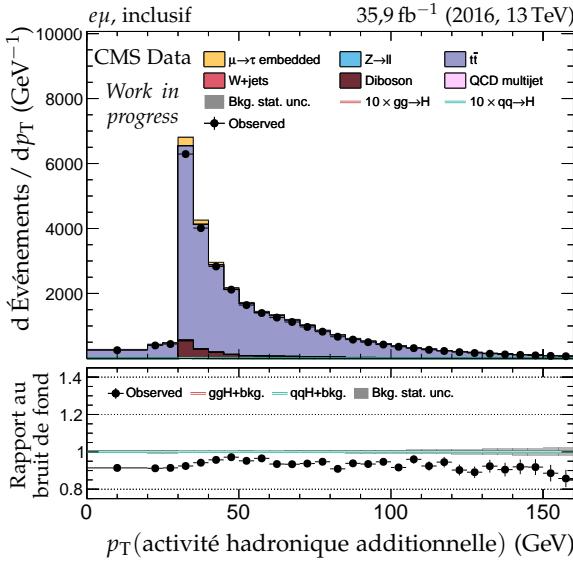
**Figure X.19 – Canal  $e\mu$ , 2016 : cinématique des deux jets principaux.**



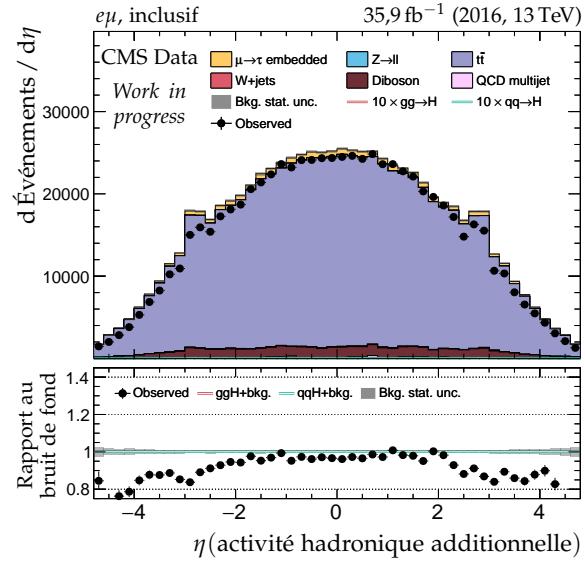
(a) Impulsion transverse du b-jet principal.



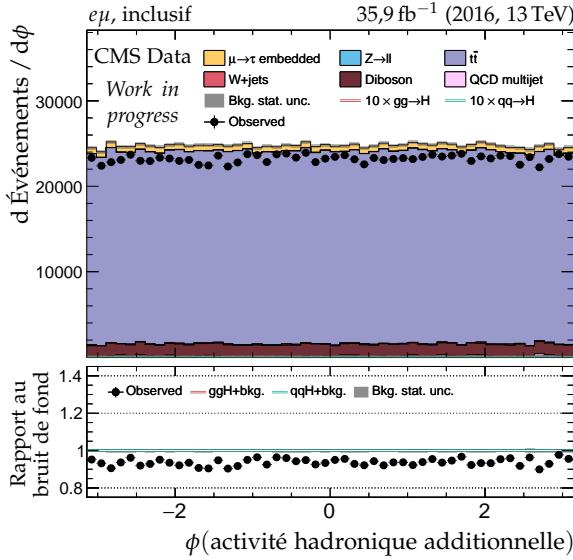
(b) Impulsion transverse du b-jet secondaire.



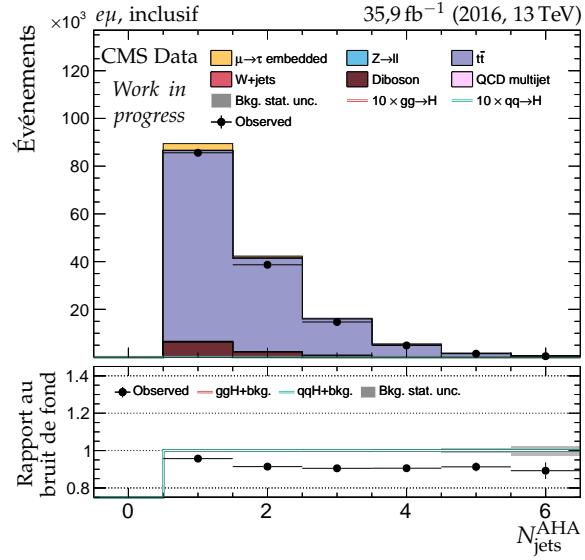
(c) Impulsion transverse de l'AHA.



(d) Pseudo-rapidité de l'AHA.

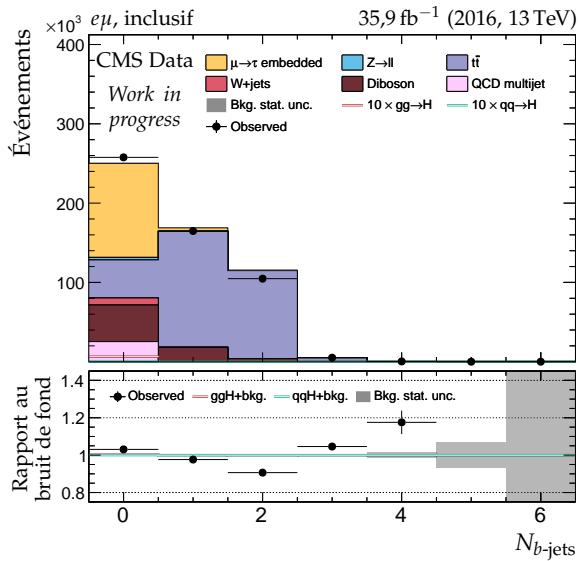
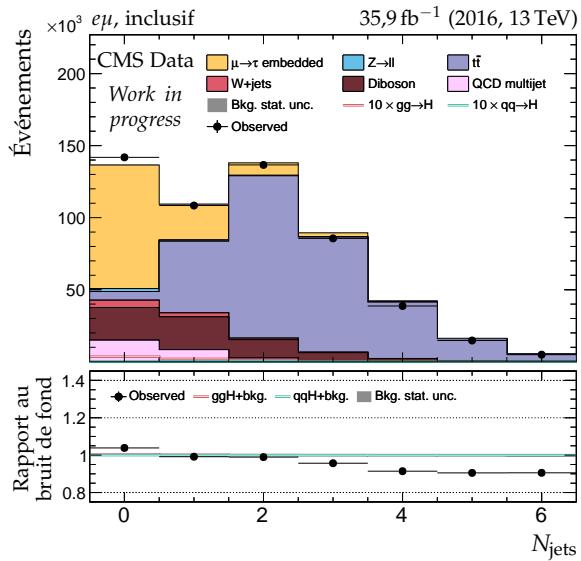


(e) Angle azimutal de l'AHA.

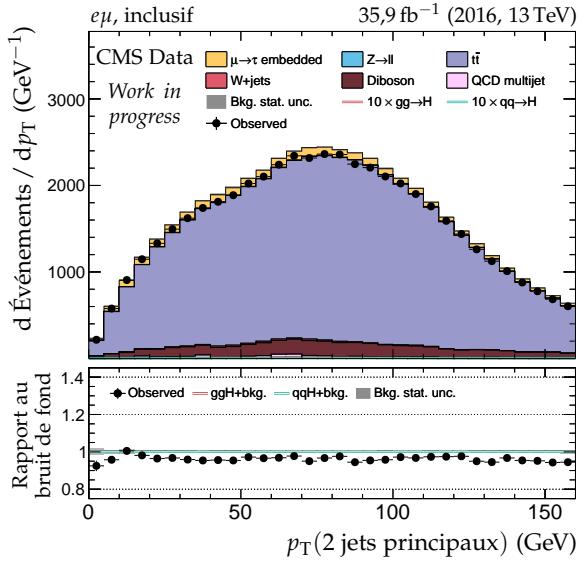


(f) Nombre de jets dans l'AHA.

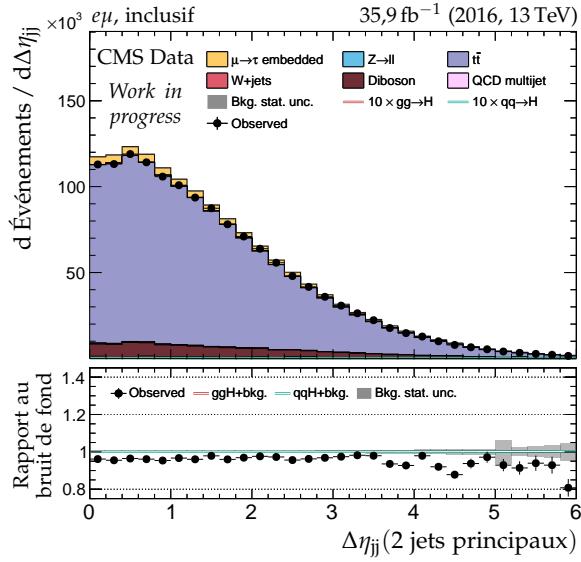
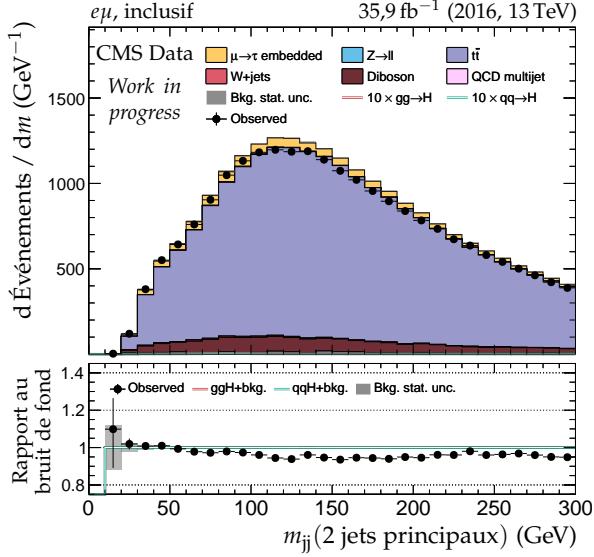
**Figure X.20 – Canal  $e\mu$ , 2016 : b-jets et activité hadronique additionnelle.**


 (a) Nombre de  $b$ -jets.


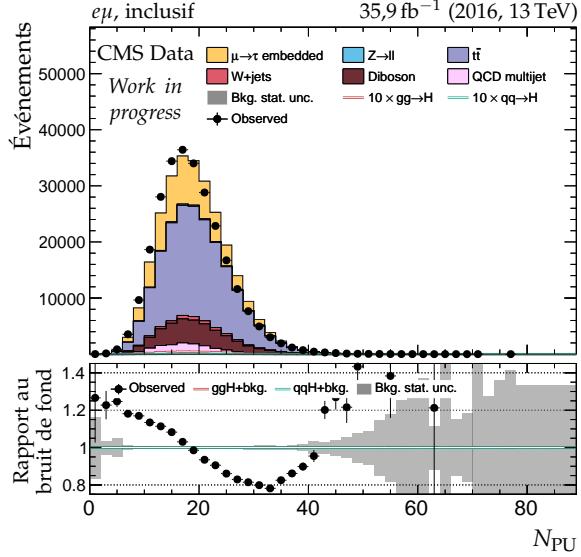
(b) Nombre de jets.



(c) Impulsion transverse du système des deux jets.

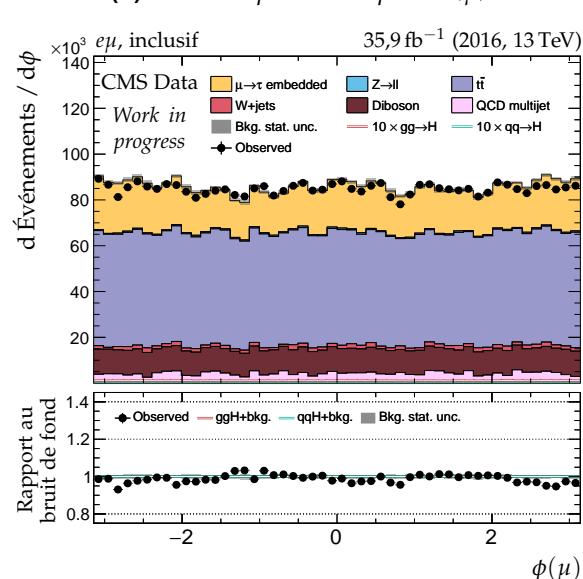
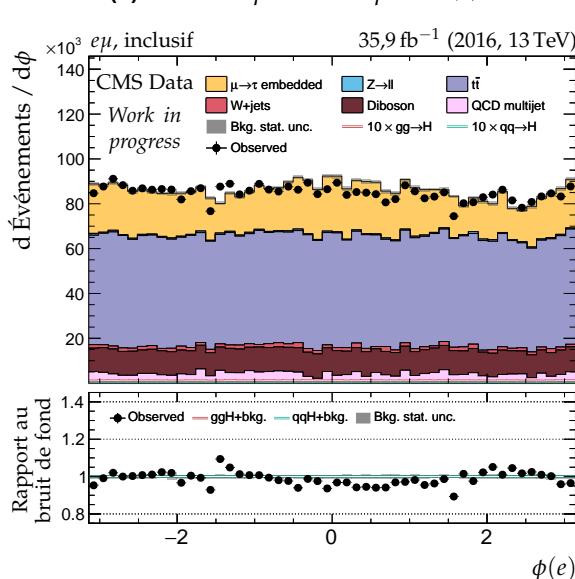
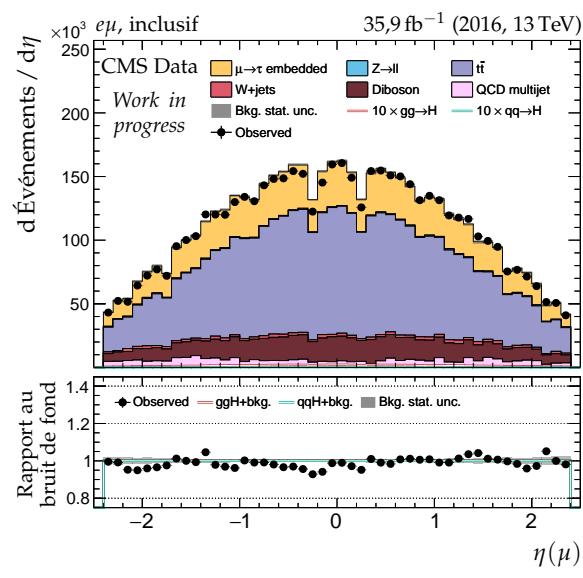
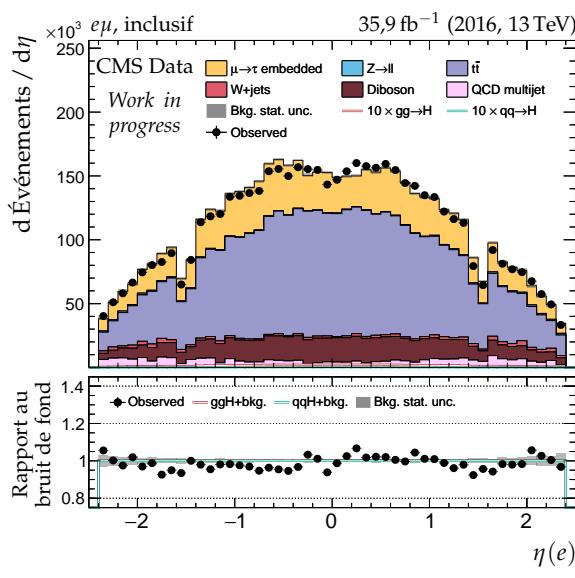
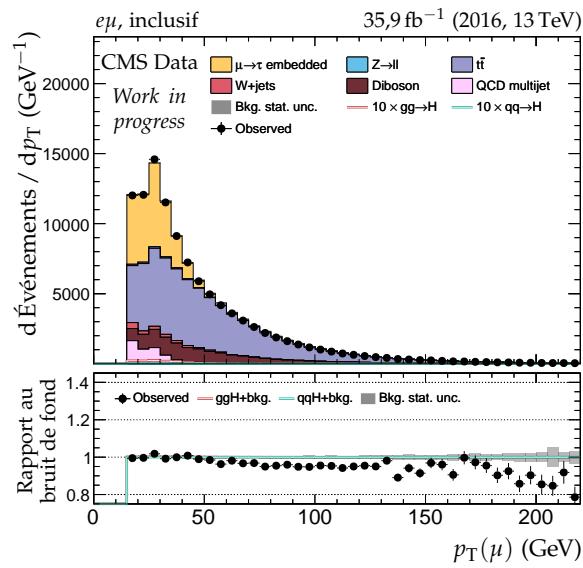
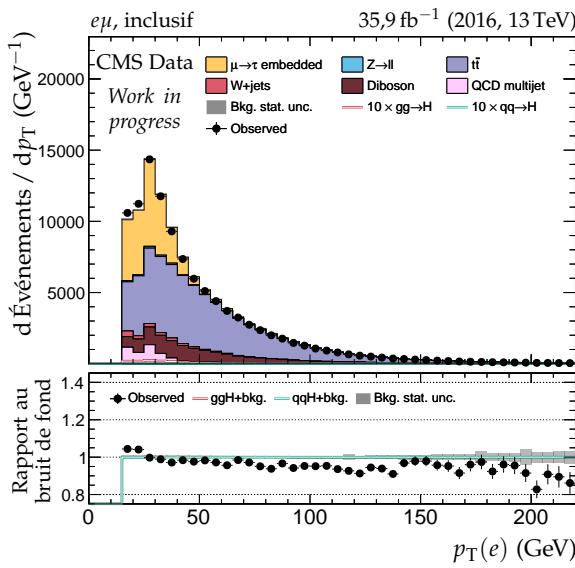

 (d) Distance en  $\eta$  entre les deux jets.


(e) Masse invariante du système des deux jets.

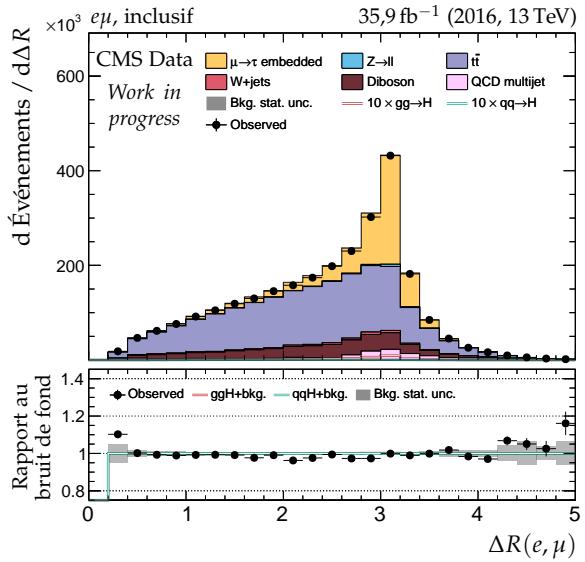
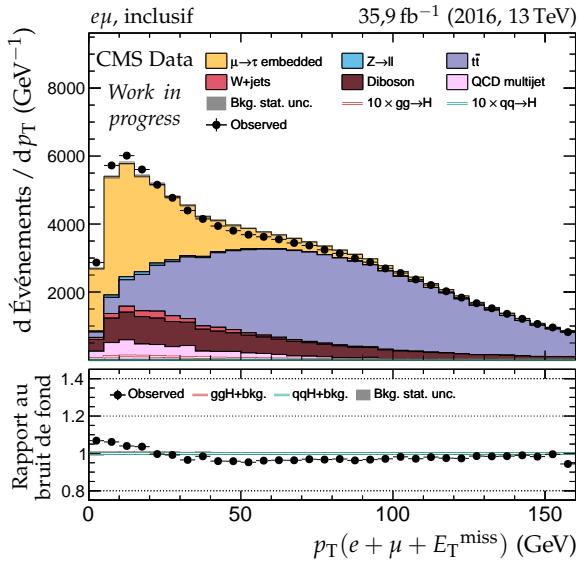
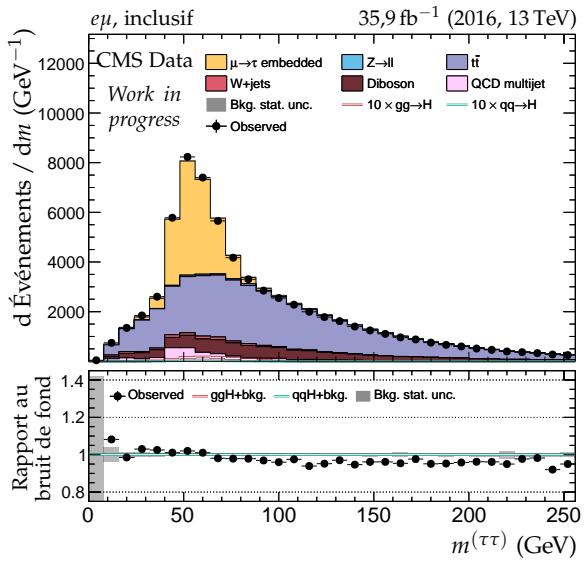
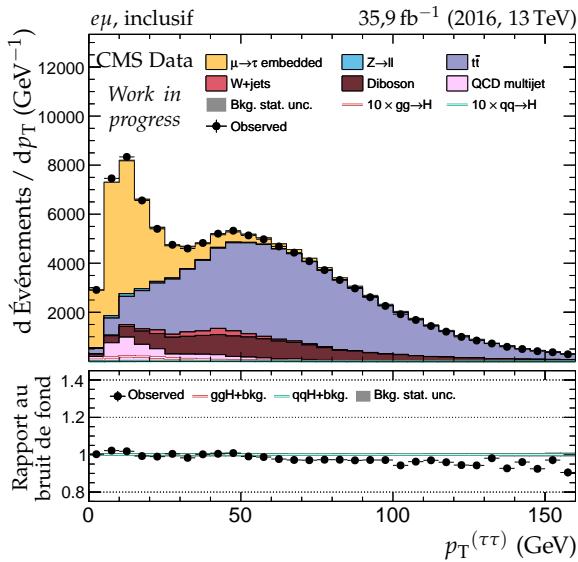
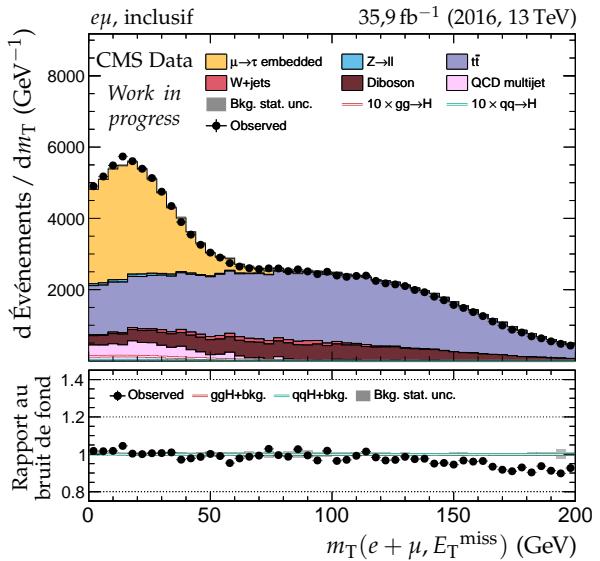
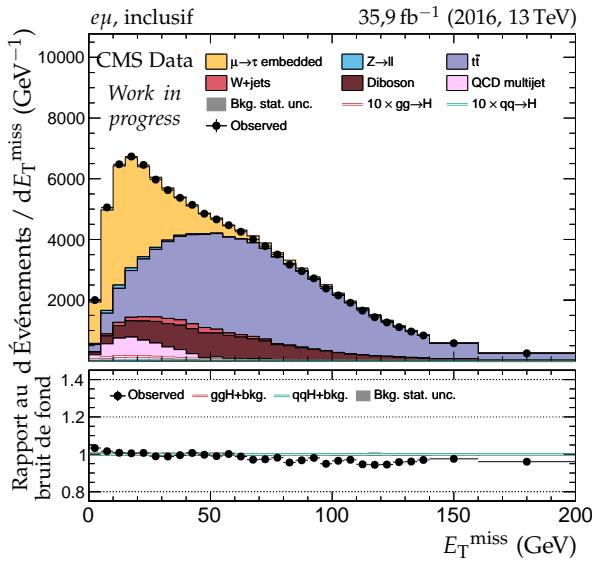


(f) Nombre de vertex d'empilement.

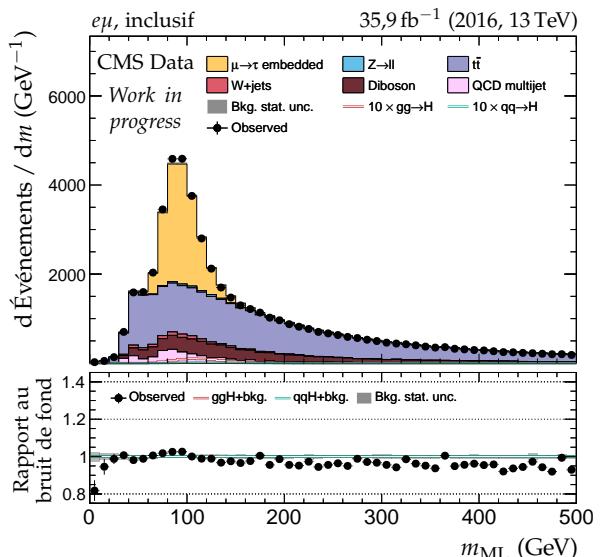
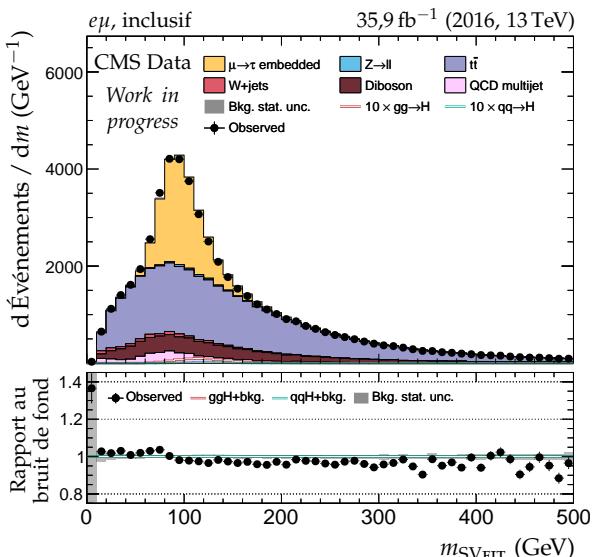
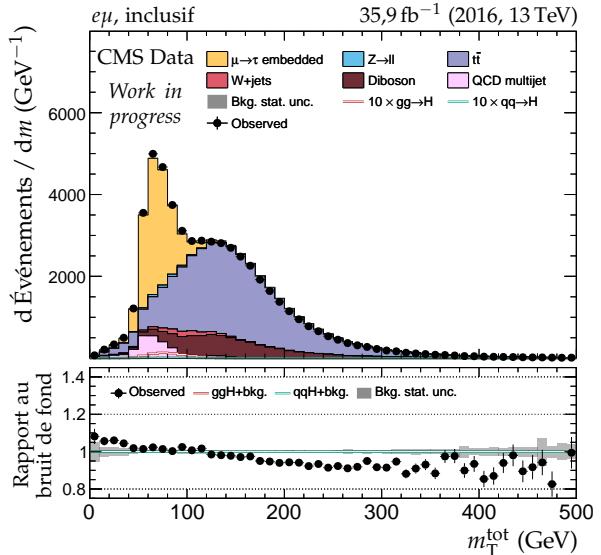
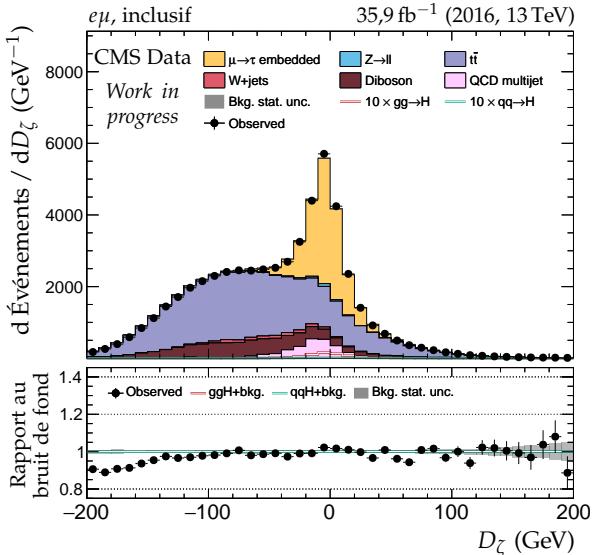
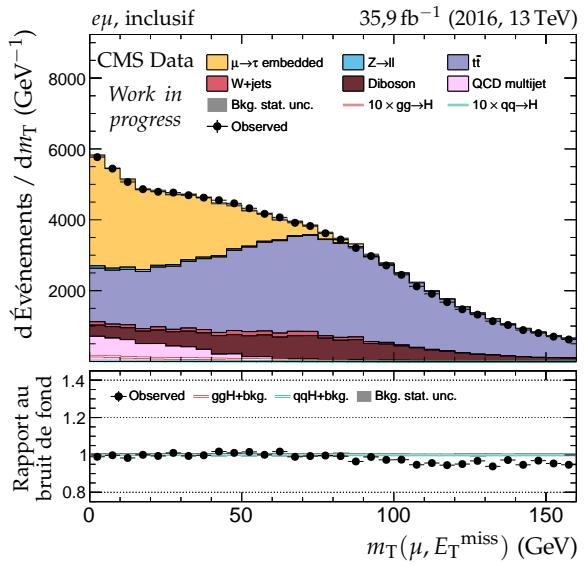
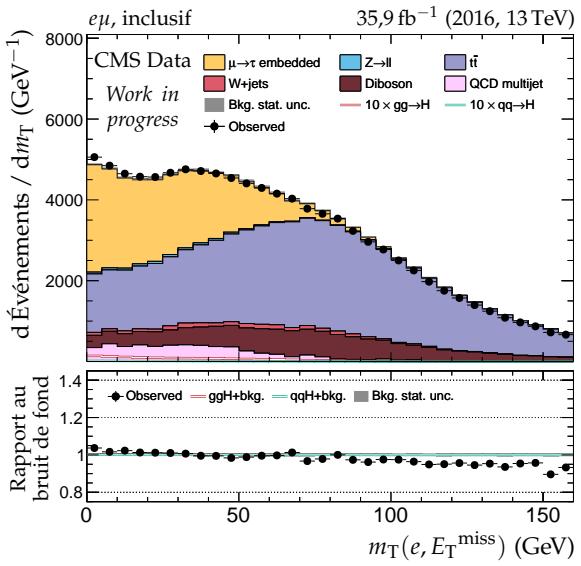
 Figure X.21 – Canal  $e\mu$ , 2016 : nombre de jets, système des deux jets principaux et empilement.



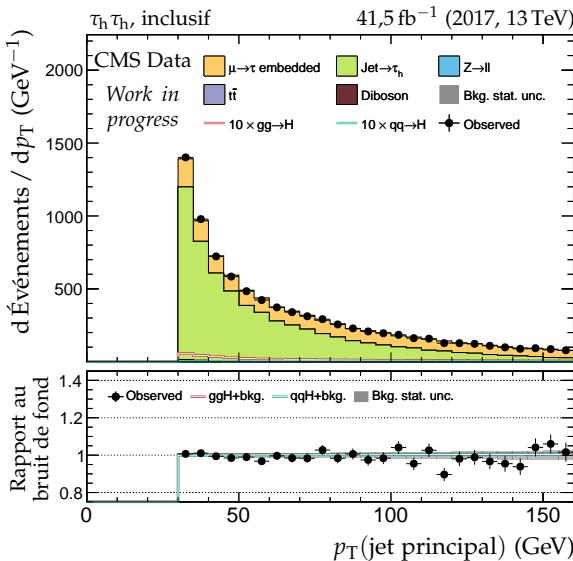
**Figure X.22 – Canal  $e\mu$ , 2016 : cinématique des leptons ( $e, \mu$ ).**



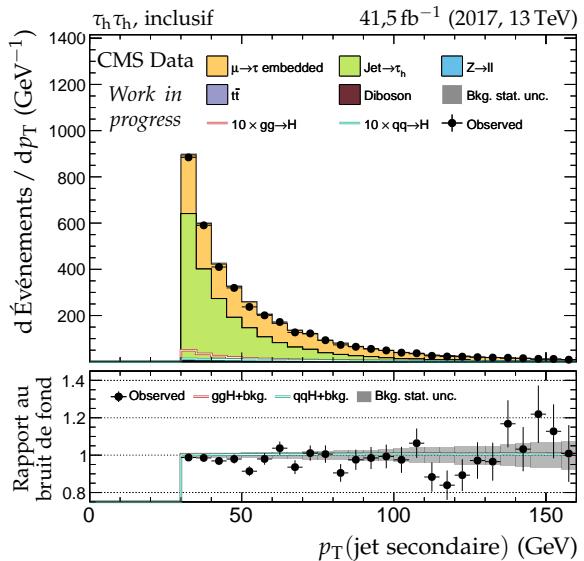
**Figure X.23 – Canal  $e\mu$ , 2016 : dilepton et énergie transverse manquante.**



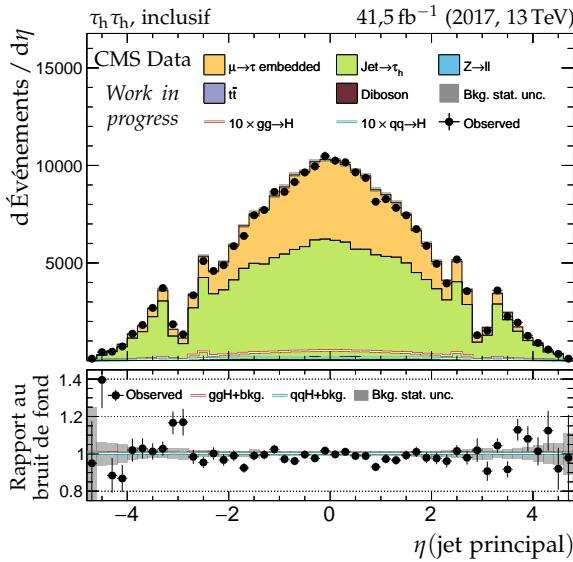
**Figure X.24 – Canal  $e\mu$ , 2016 : masses transverses,  $D_\zeta$  et masses.**



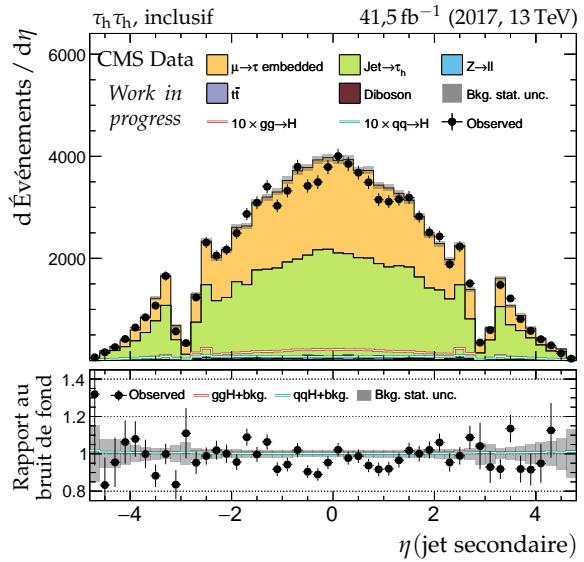
(a) Impulsion transverse du jet principal.



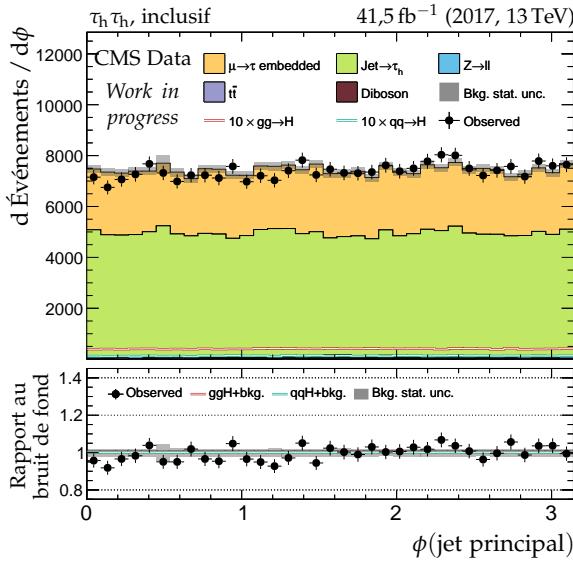
(b) Impulsion transverse du jet secondaire.



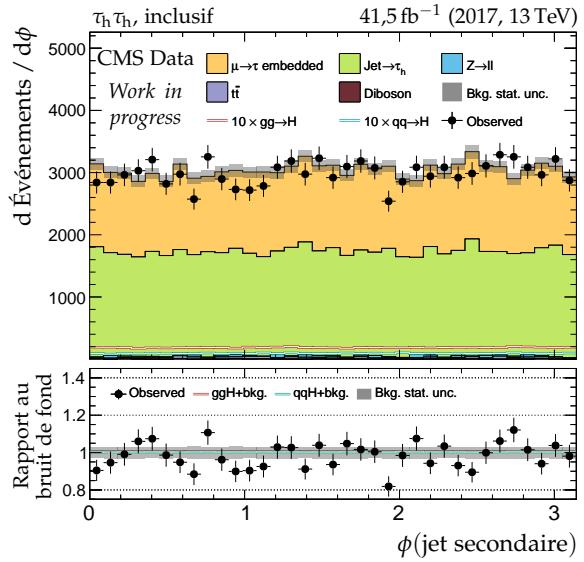
(c) Pseudo-rapidité du jet principal.



(d) Pseudo-rapidité du jet secondaire.

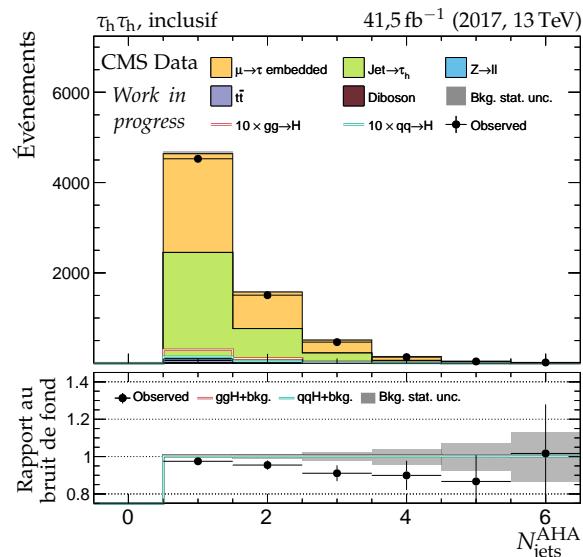
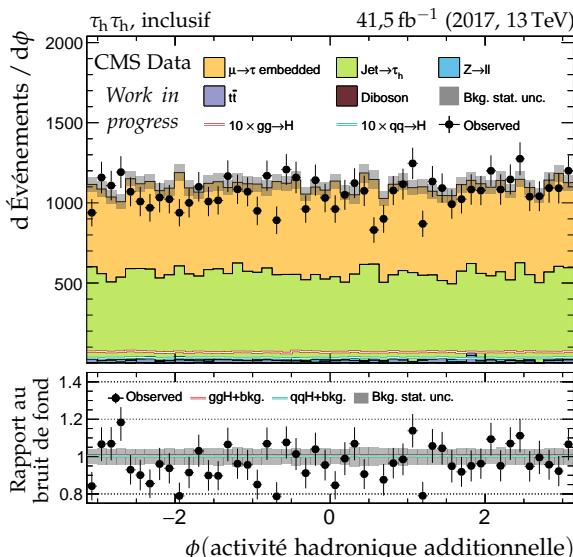
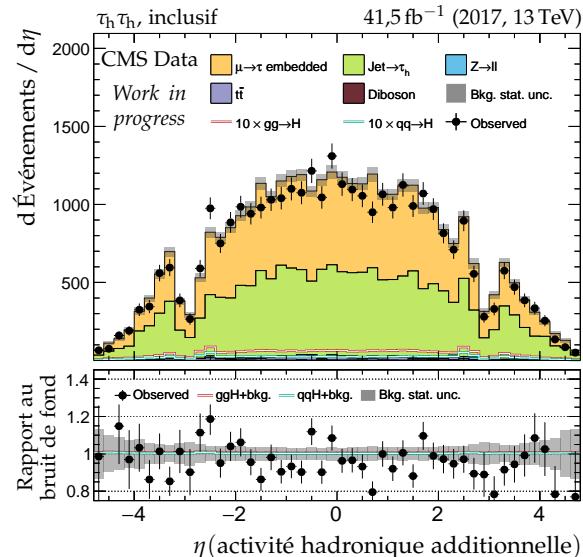
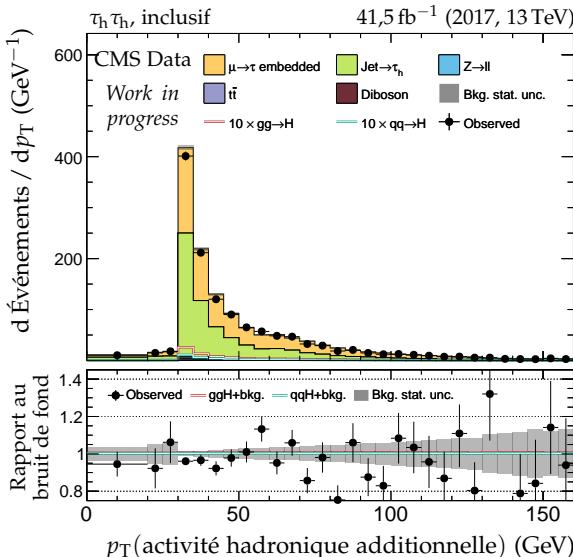
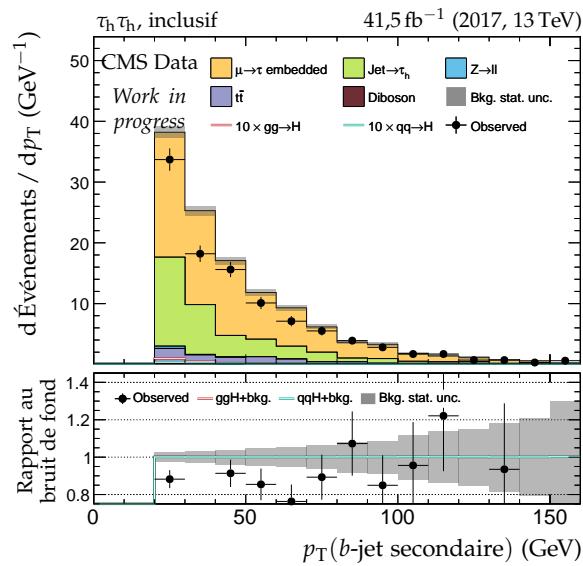
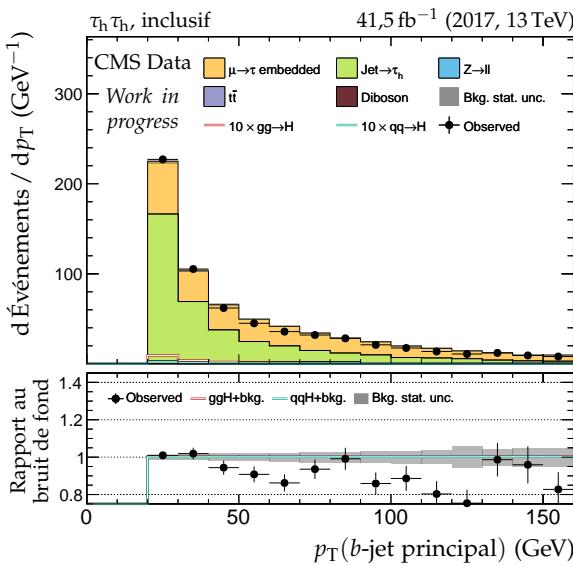


(e) Angle azimutal du jet principal.

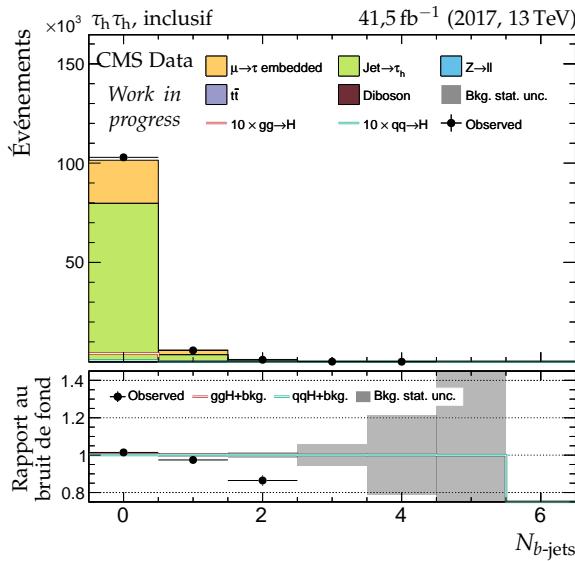
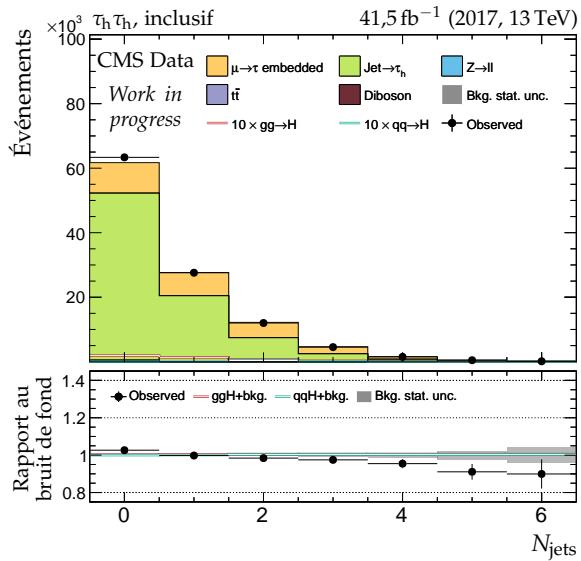


(f) Angle azimutal du jet secondaire.

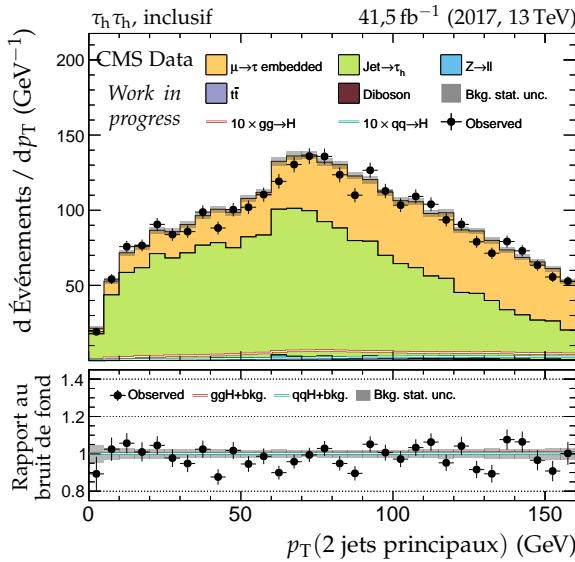
Figure X.25 – Canal  $\tau_h \tau_h$ , 2017 : cinématique des deux jets principaux.



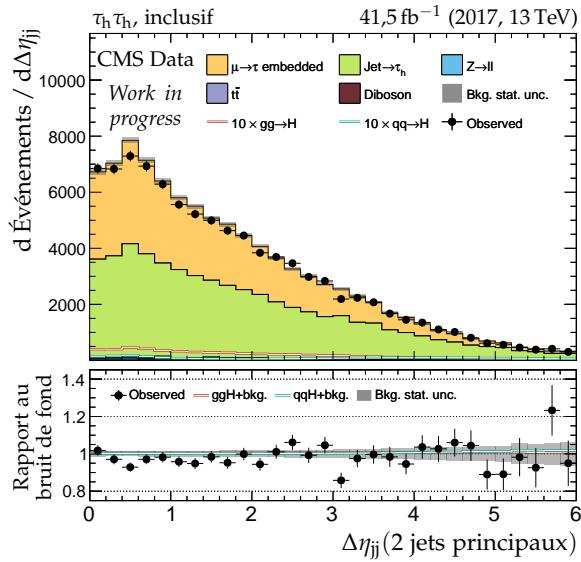
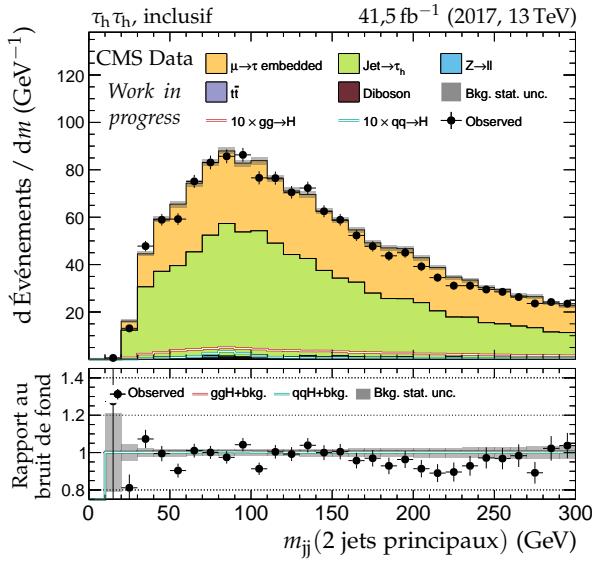
**Figure X.26 – Canal  $\tau_h \tau_h$ , 2017 : b-jets et activité hadronique additionnelle.**

(a) Nombre de  $b$ -jets.

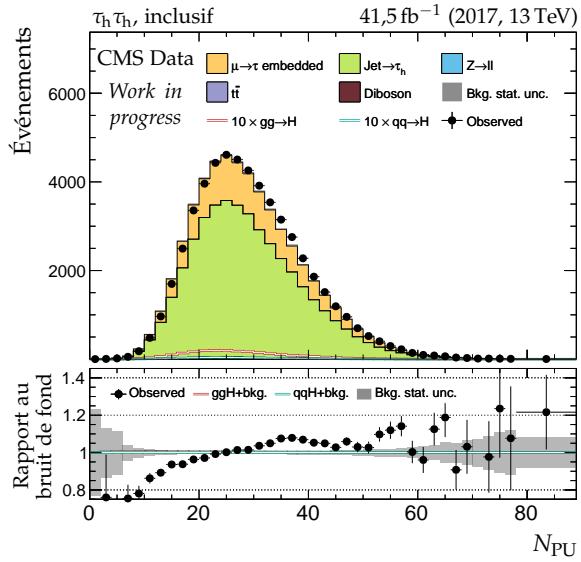
(b) Nombre de jets.



(c) Impulsion transverse du système des deux jets.

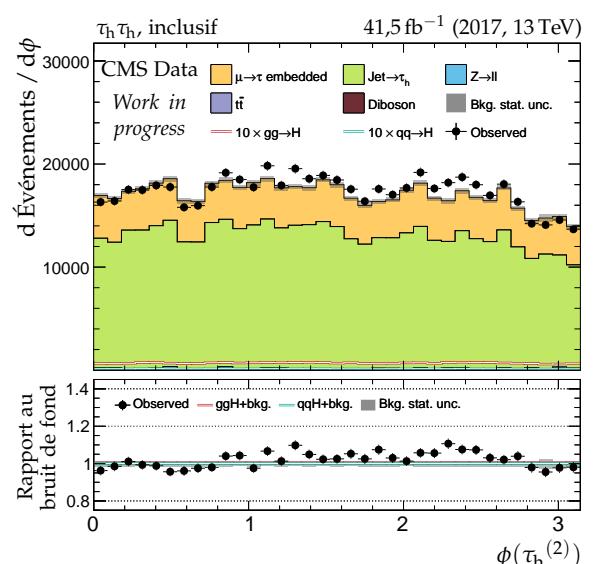
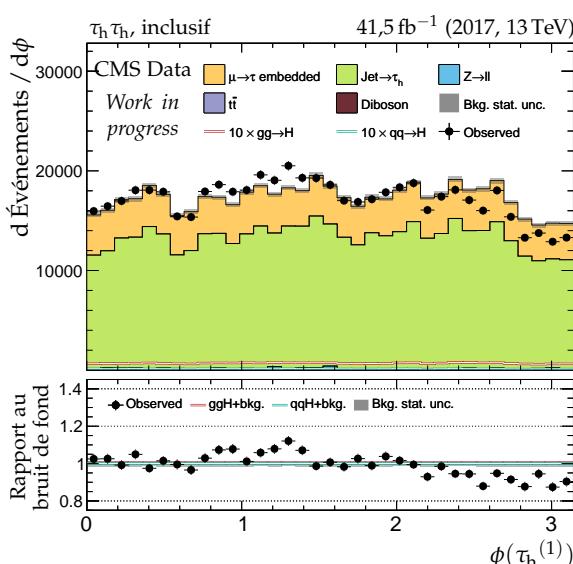
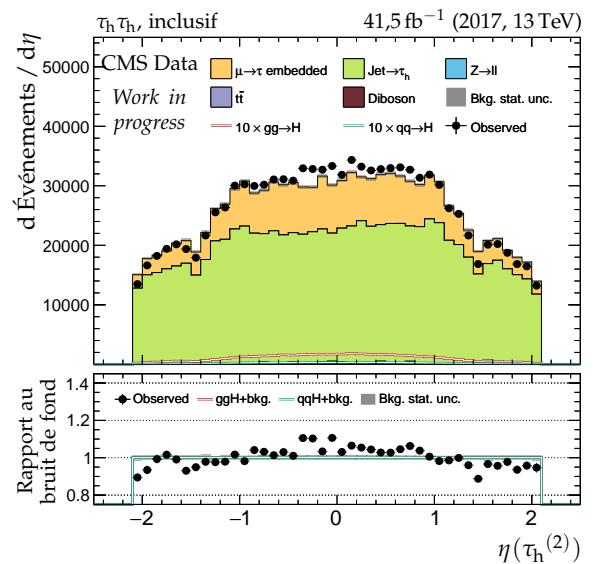
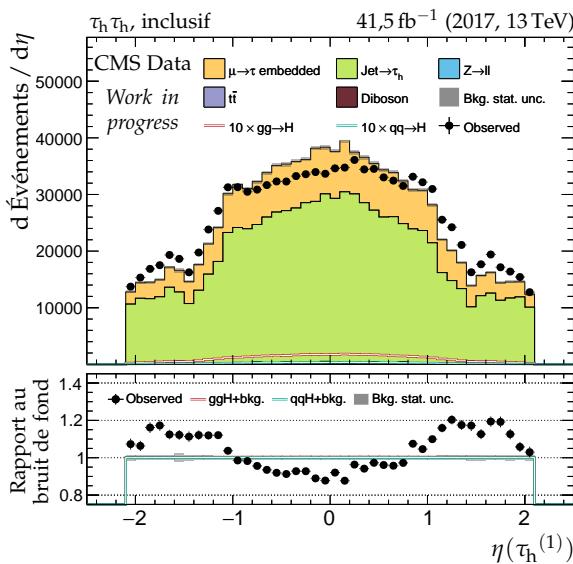
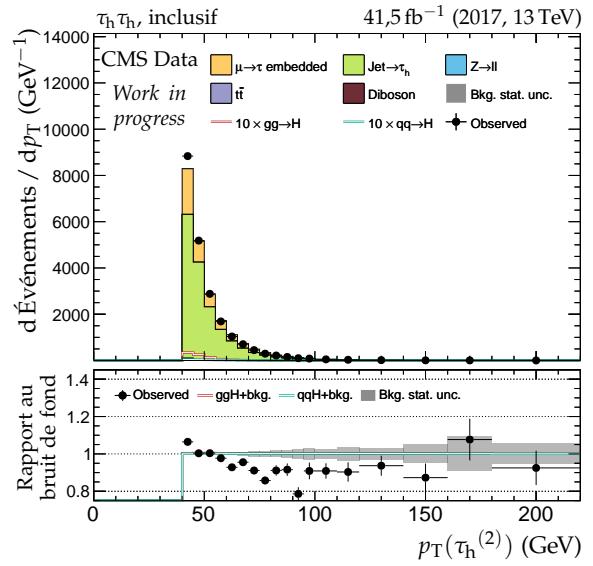
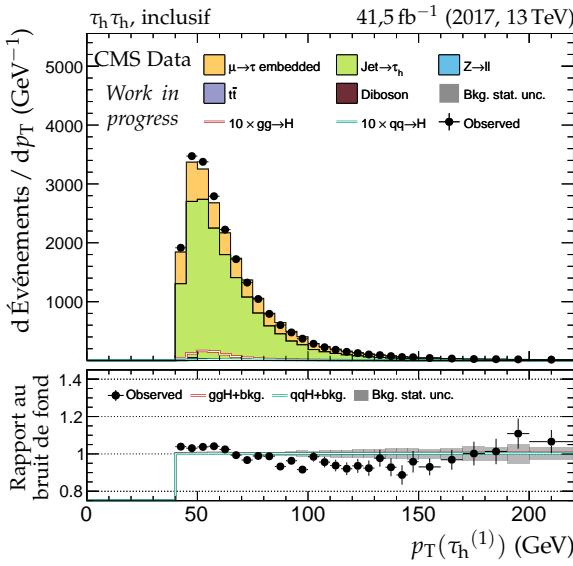
(d) Distance en  $\eta$  entre les deux jets.

(e) Masse invariante du système des deux jets.

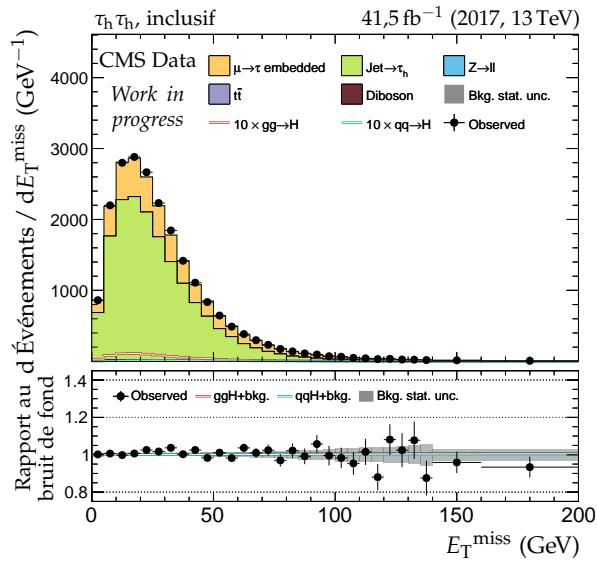


(f) Nombre de vertex d'empilement.

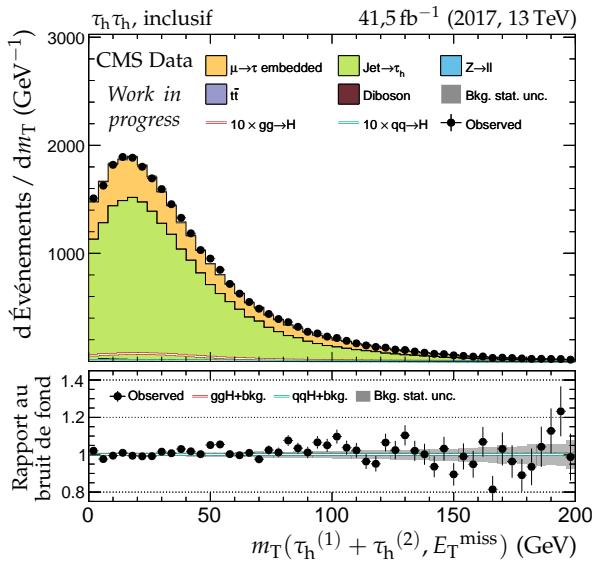
**Figure X.27** – Canal  $\tau_h \tau_h$ , 2017 : nombre de jets, système des deux jets principaux et empilement.



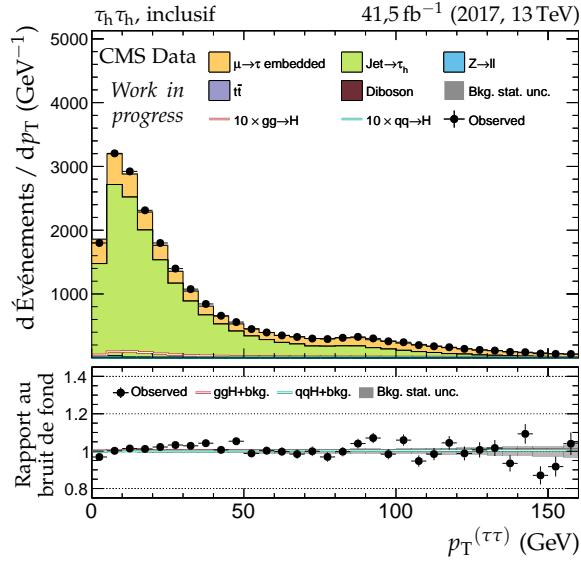
**Figure X.28 – Canal  $\tau_h \tau_h$ , 2017 : cinématique des leptons ( $\tau_h^{(1)}, \tau_h^{(2)}$ ).**



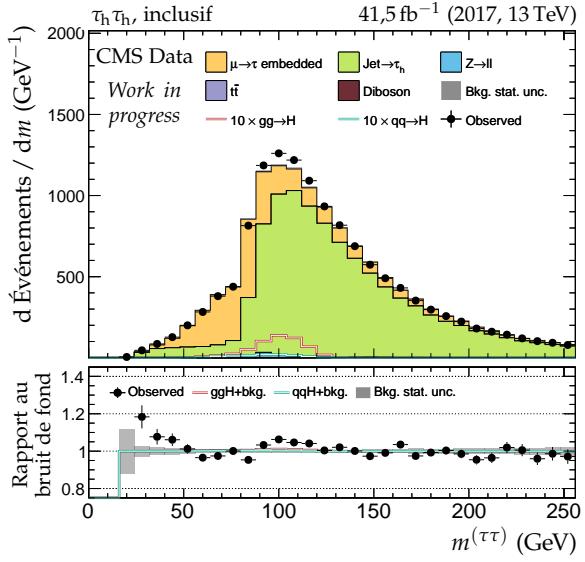
(a) Énergie transverse manquante.



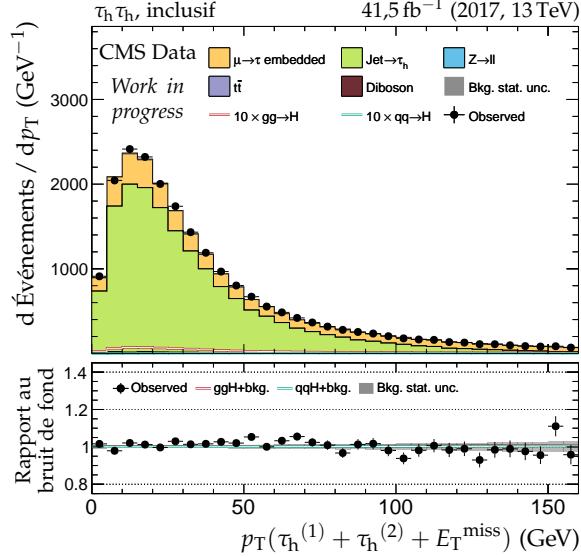
(b) Masse transverse du dilepton.



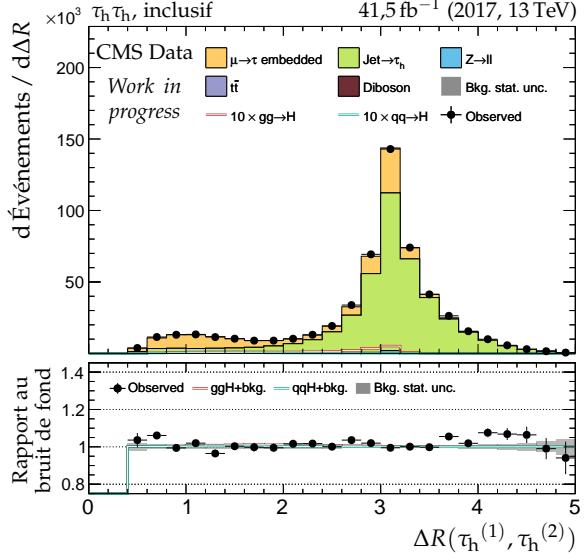
(c) Impulsion transverse du dilepton.



(d) Masse visible du dilepton.

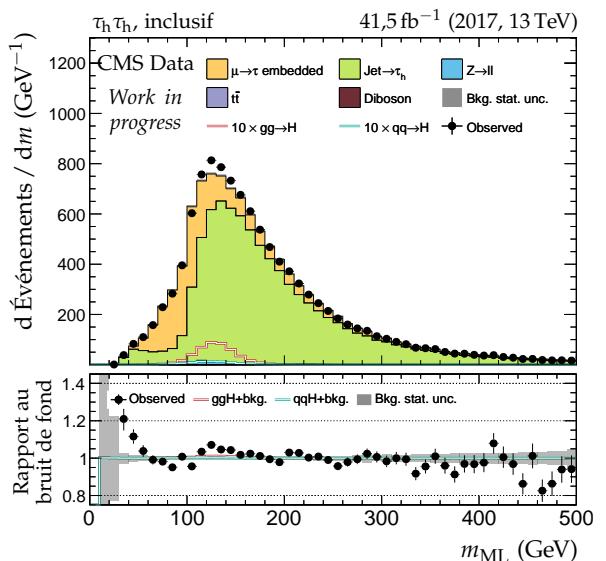
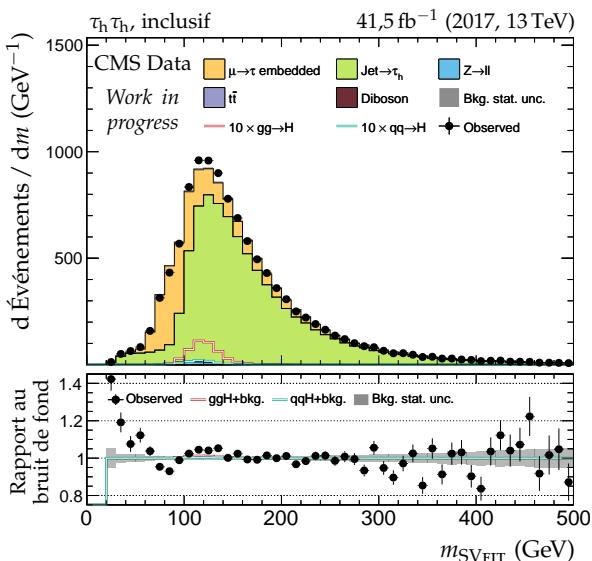
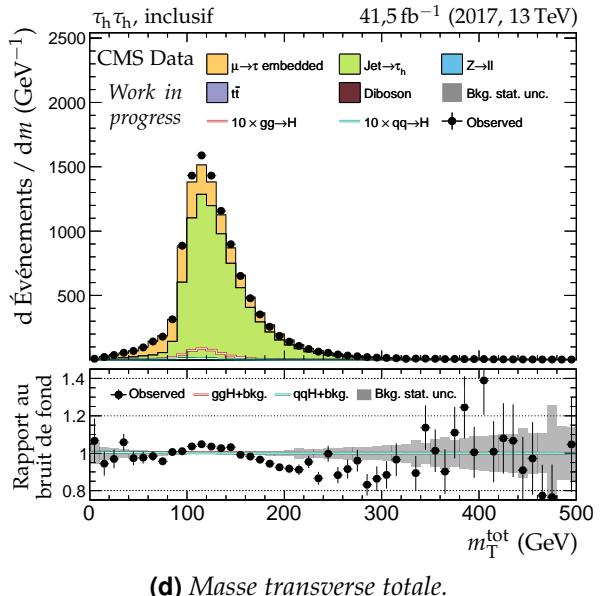
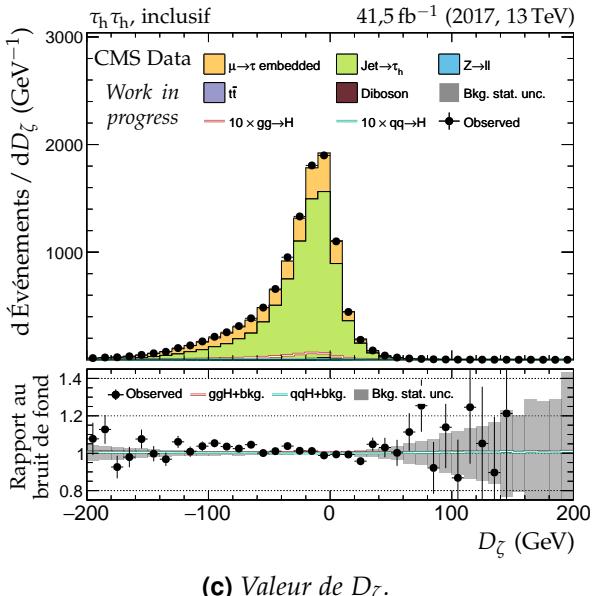
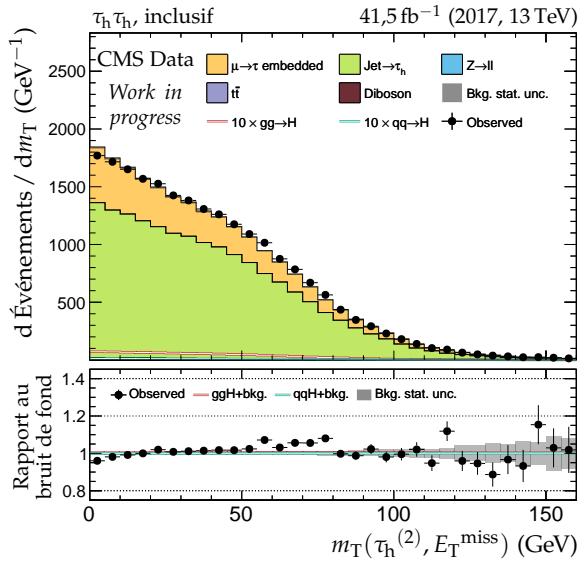
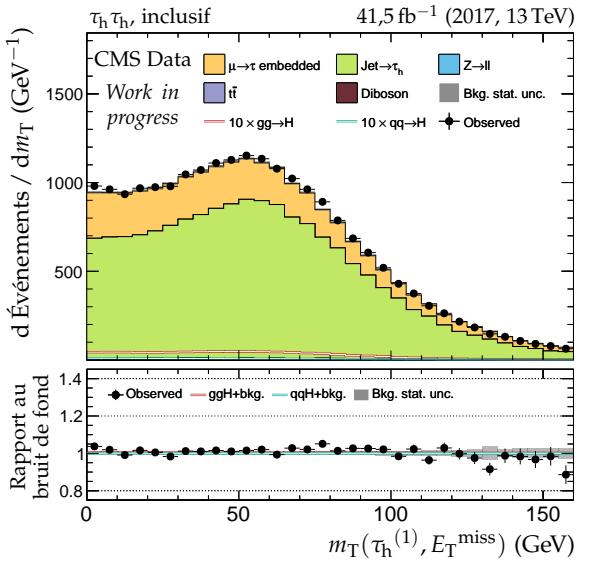


(e) Impulsion transverse du système di- $\tau$ .

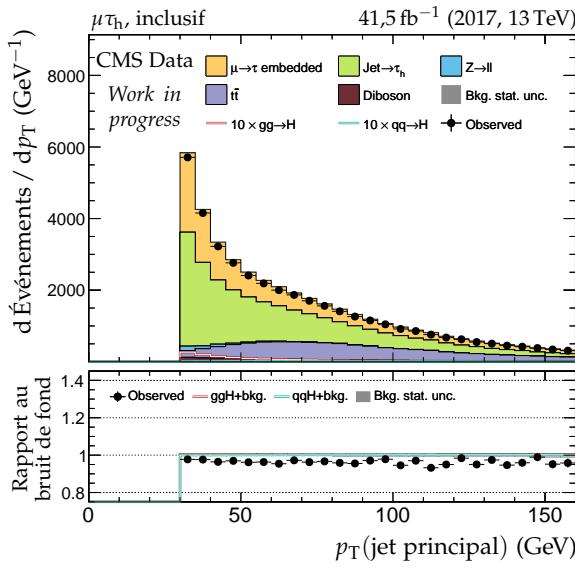


(f) Distance  $\Delta R$  entre les leptons ( $\tau_h^{(1)}, \tau_h^{(2)}$ ).

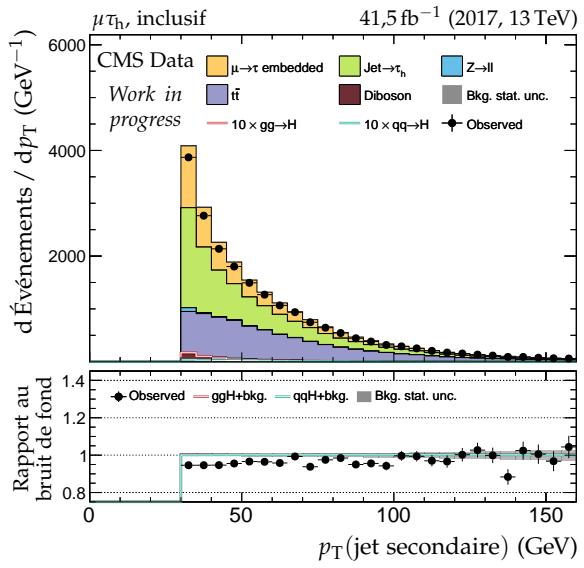
Figure X.29 – Canal  $\tau_h \tau_h$ , 2017 : dilepton et énergie transverse manquante.



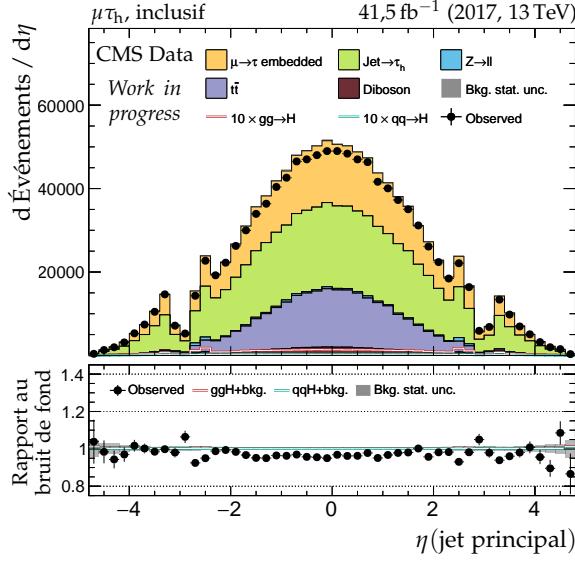
**Figure X.30 – Canal  $\tau_h \tau_h$ , 2017 : masses transverses,  $D_\zeta$  et masses.**



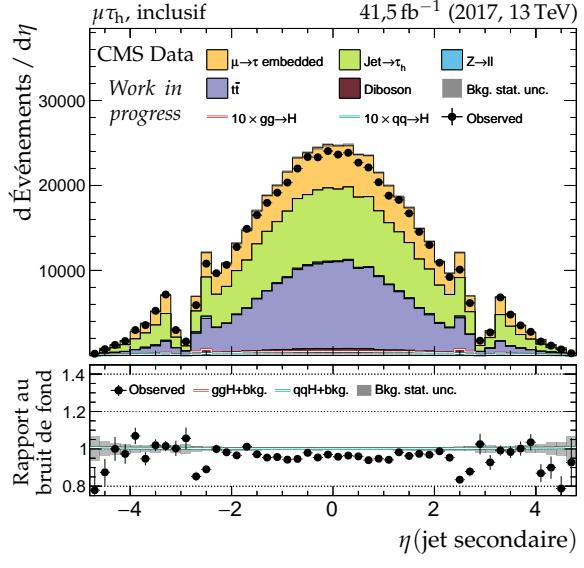
(a) Impulsion transverse du jet principal.



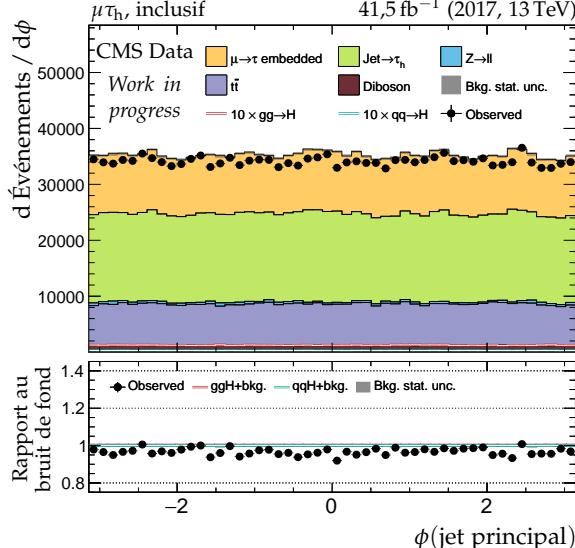
(b) Impulsion transverse du jet secondaire.



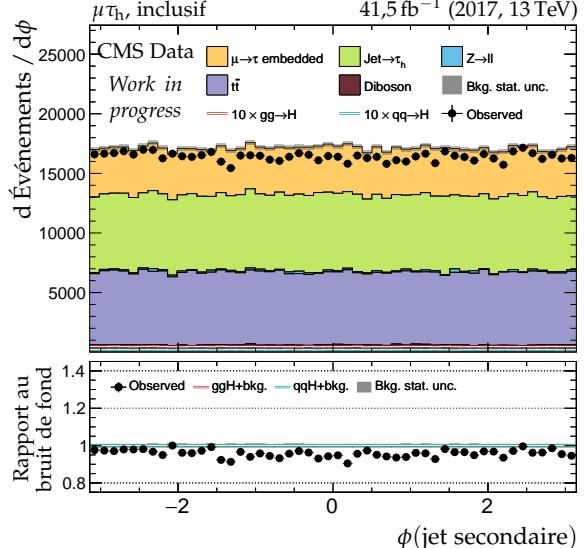
(c) Pseudo-rapidité du jet principal.



(d) Pseudo-rapidité du jet secondaire.

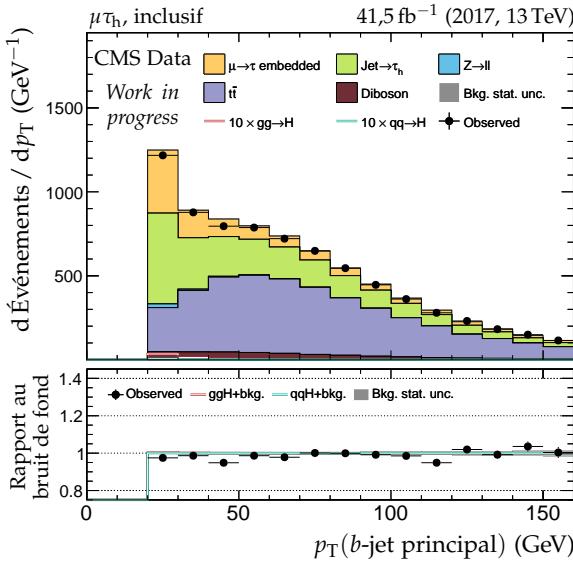


(e) Angle azimutal du jet principal.

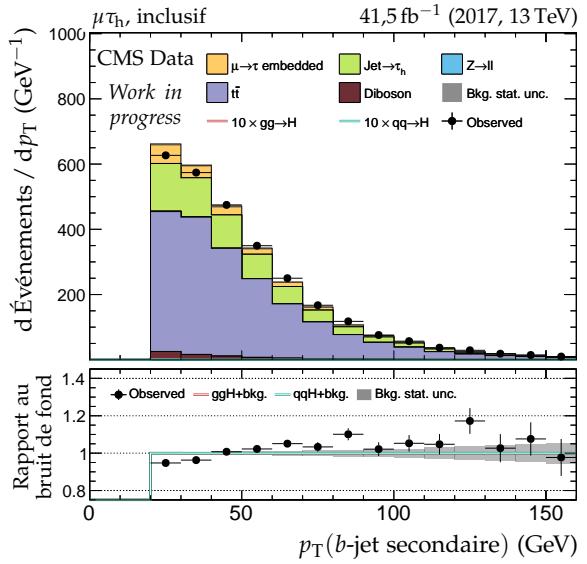


(f) Angle azimutal du jet secondaire.

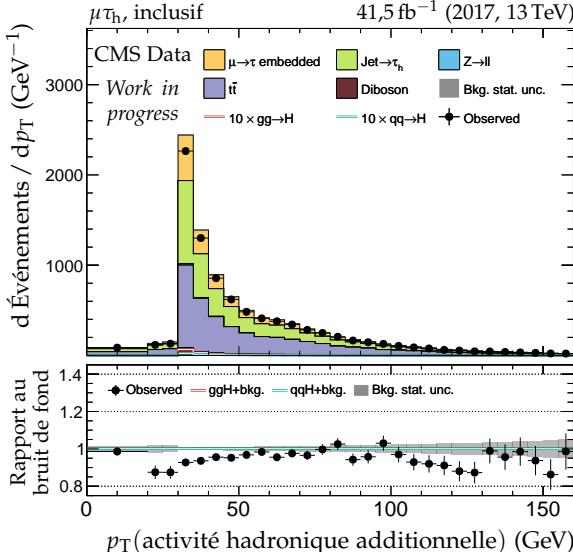
Figure X.31 – Canal  $\mu\tau_h$ , 2017 : cinématique des deux jets principaux.



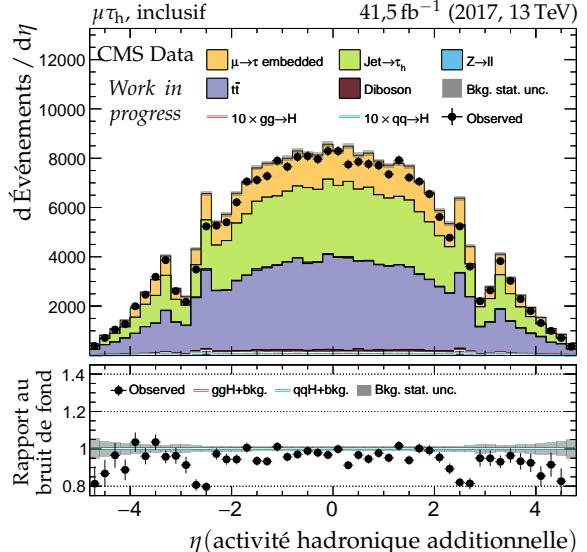
(a) Impulsion transverse du b-jet principal.



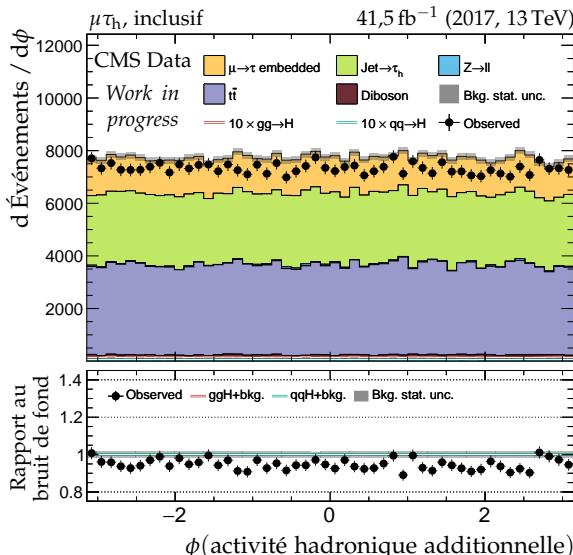
(b) Impulsion transverse du b-jet secondaire.



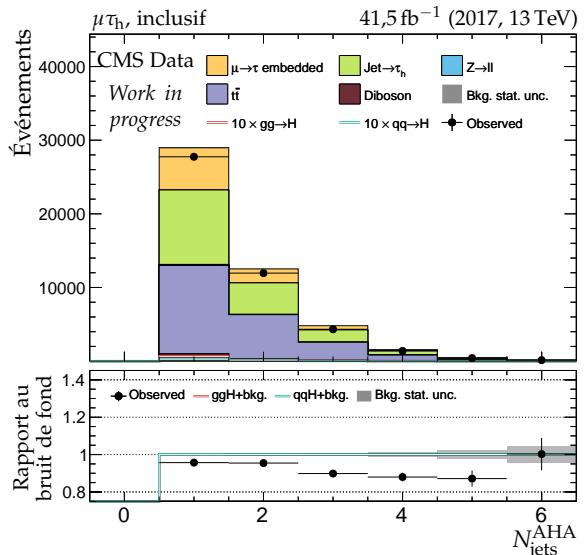
(c) Impulsion transverse de l'AHA.



(d) Pseudo-rapidité de l'AHA.

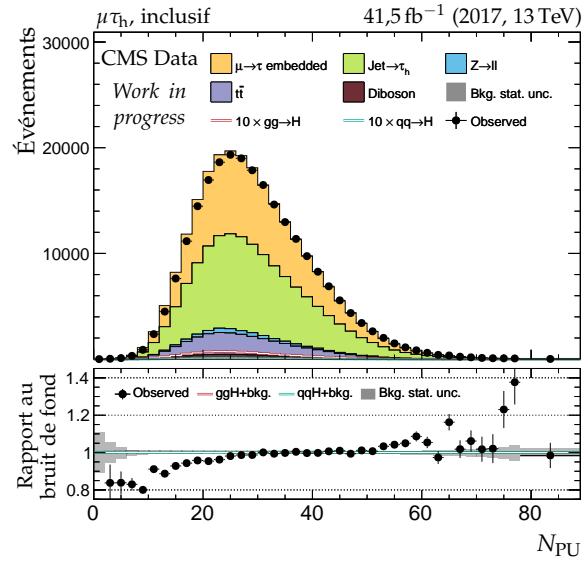
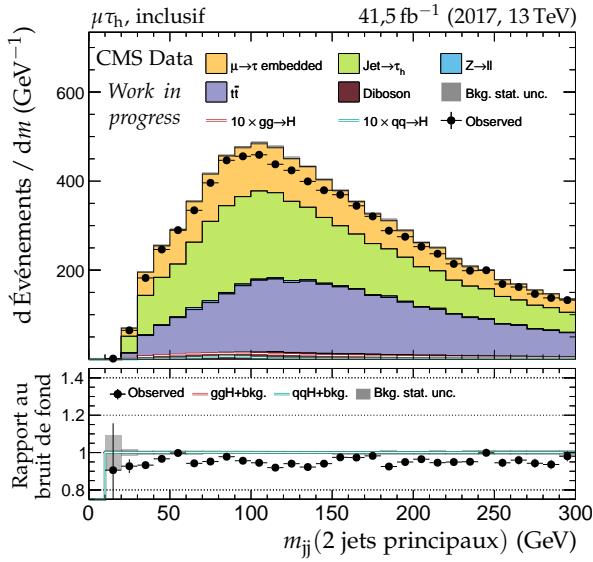
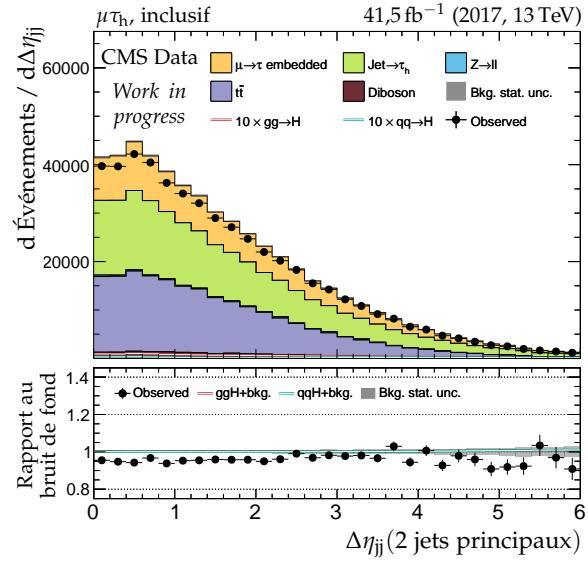
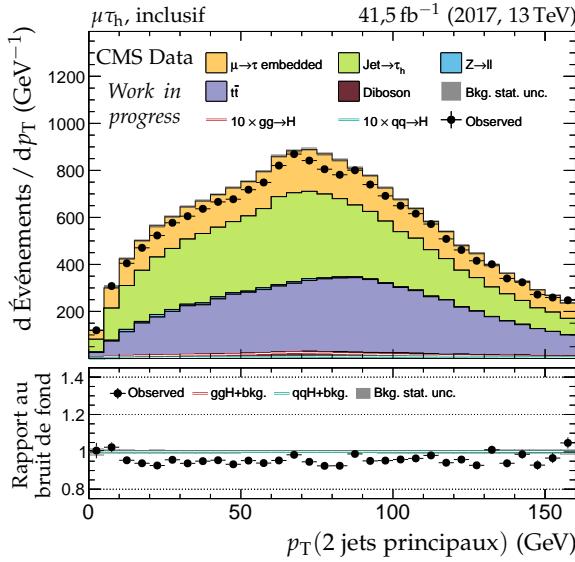
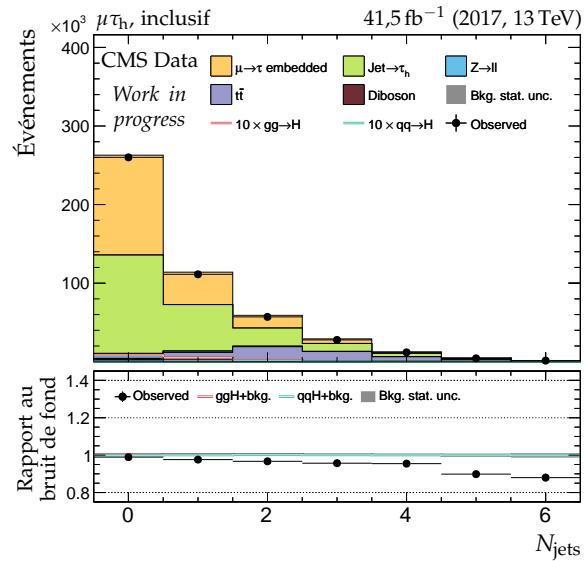
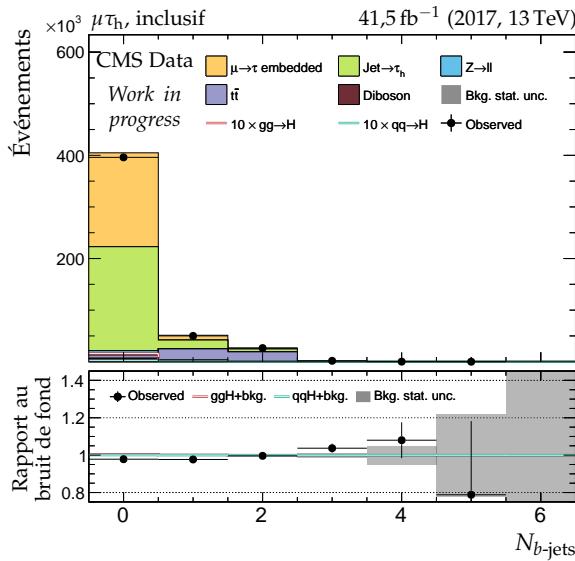


(e) Angle azimutal de l'AHA.

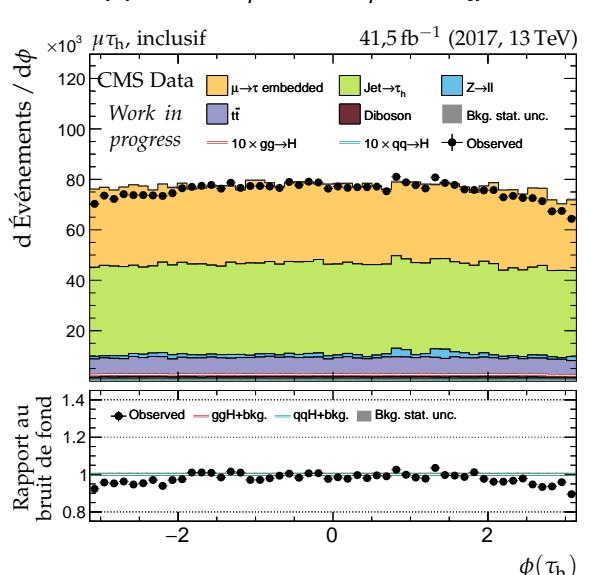
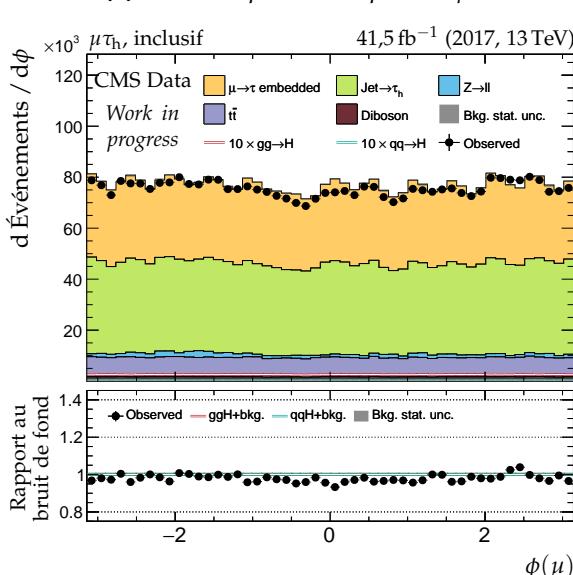
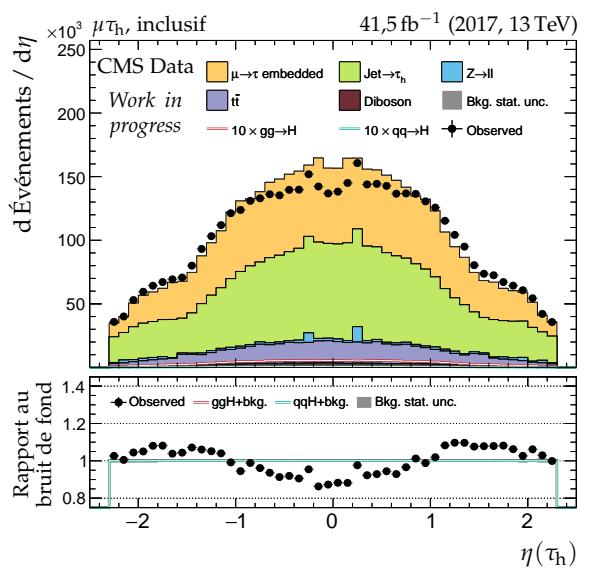
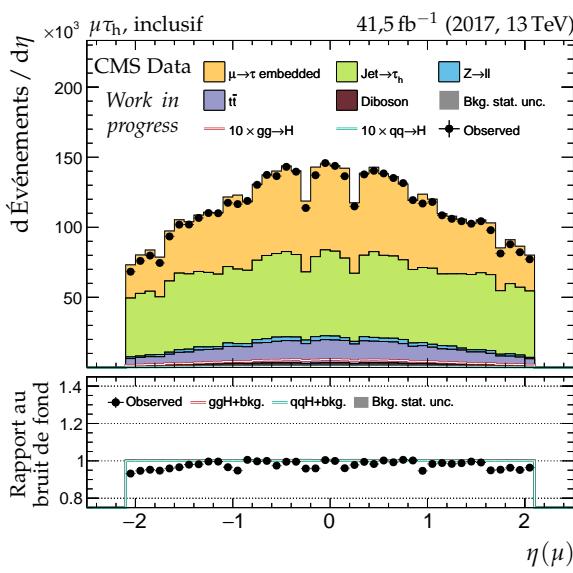
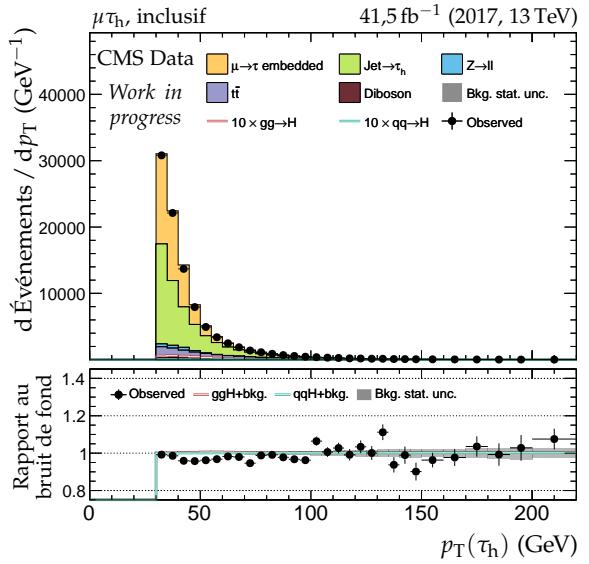
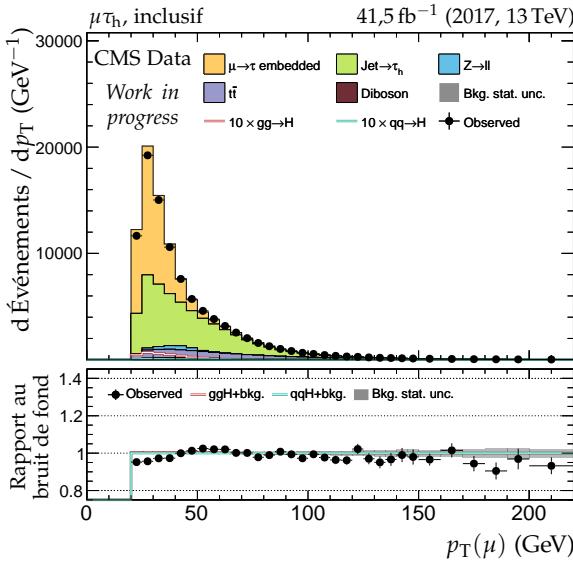


(f) Nombre de jets dans l'AHA.

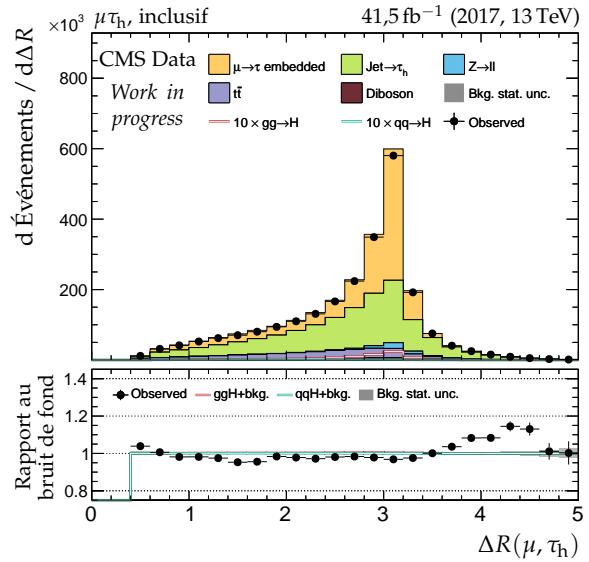
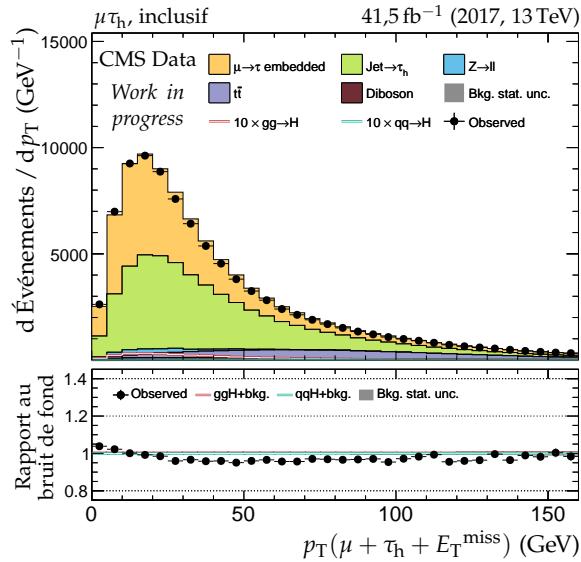
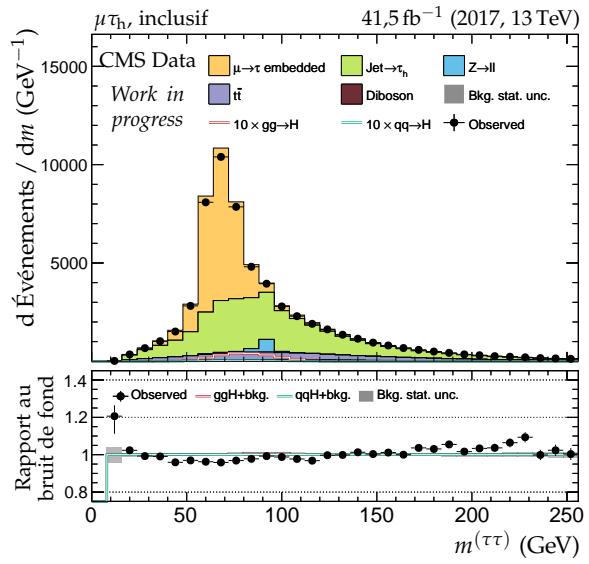
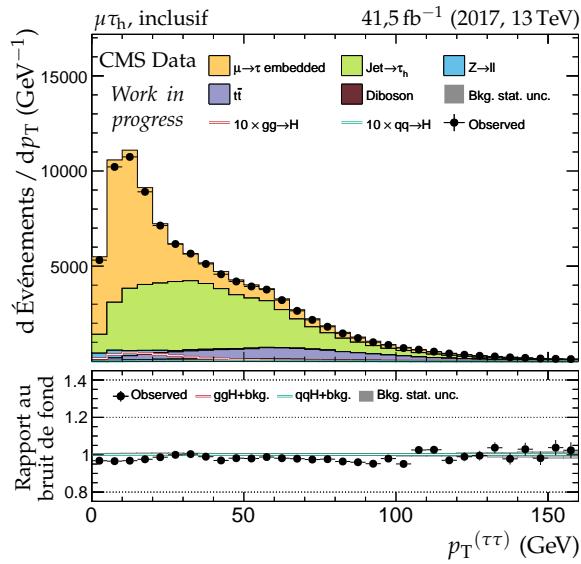
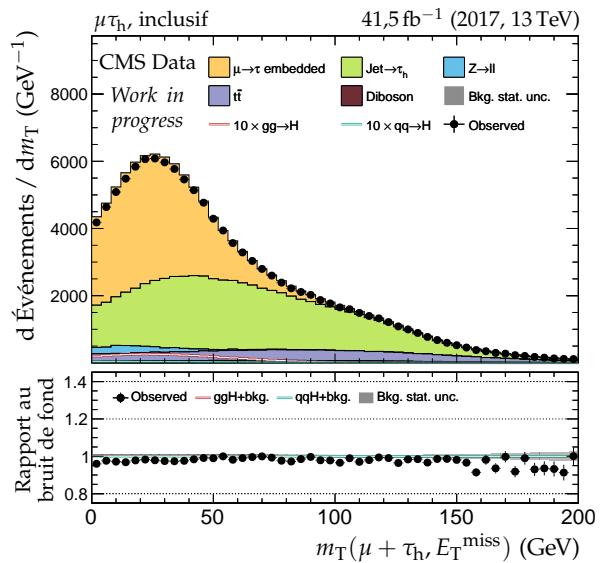
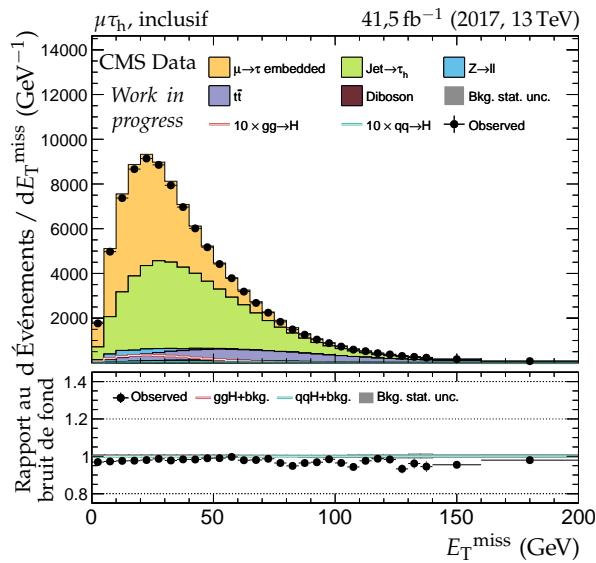
**Figure X.32 – Canal  $\mu\tau_h$ , 2017 : b-jets et activité hadronique additionnelle.**



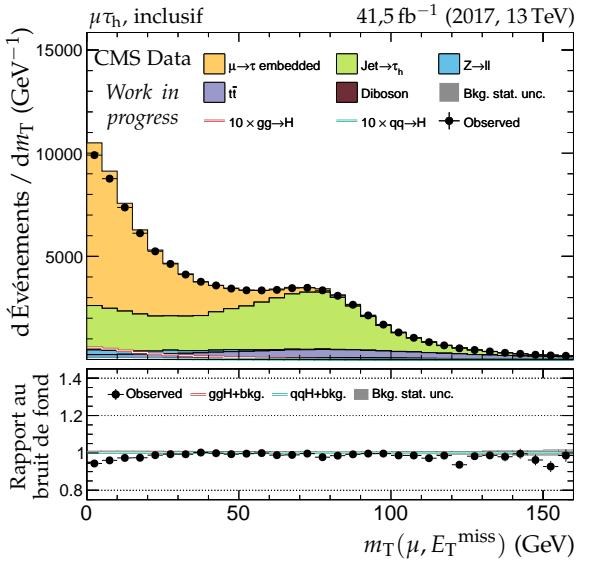
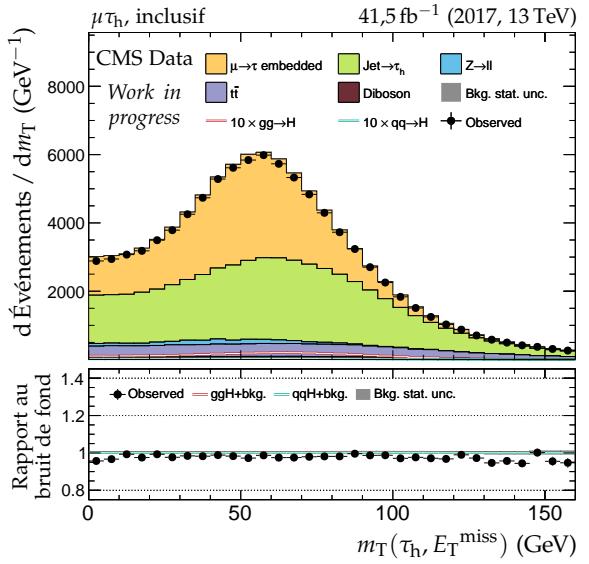
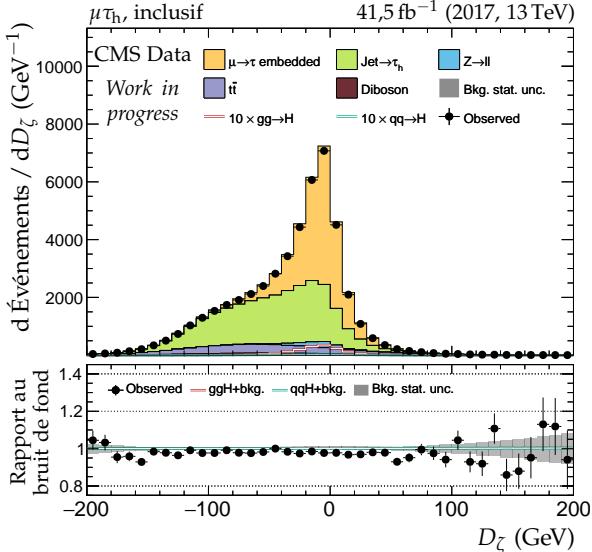
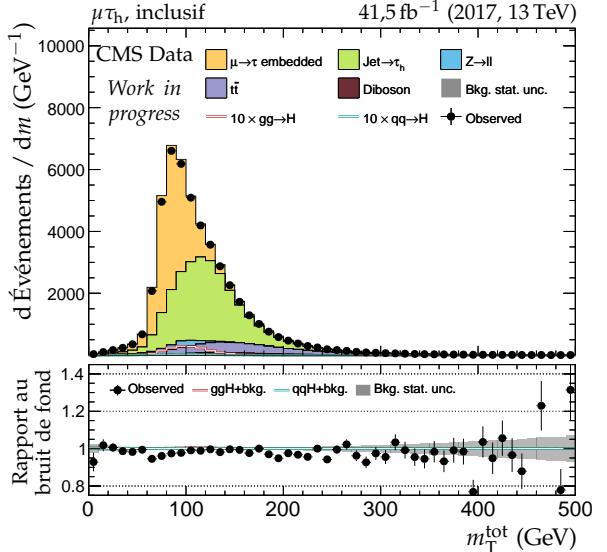
**Figure X.33 – Canal  $\mu\tau_h$ , 2017 : nombre de jets, système des deux jets principaux et empilement.**



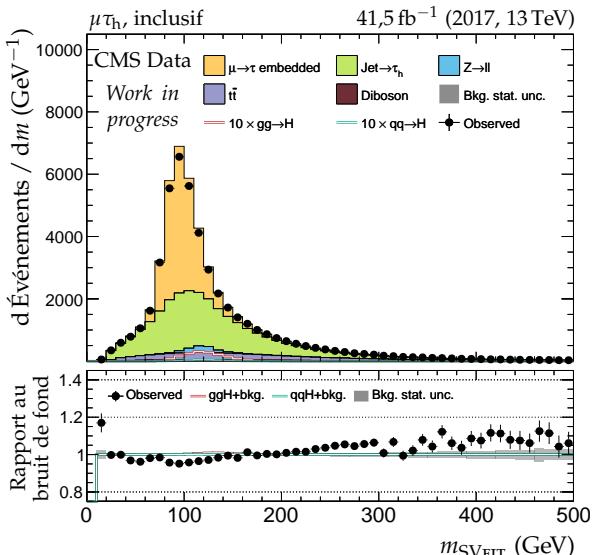
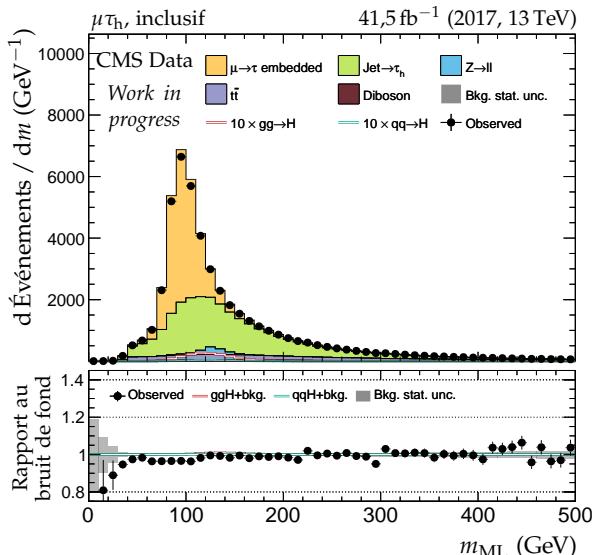
**Figure X.34 – Canal  $\mu\tau_h$ , 2017 : cinématique des leptons ( $\mu, \tau_h$ ).**

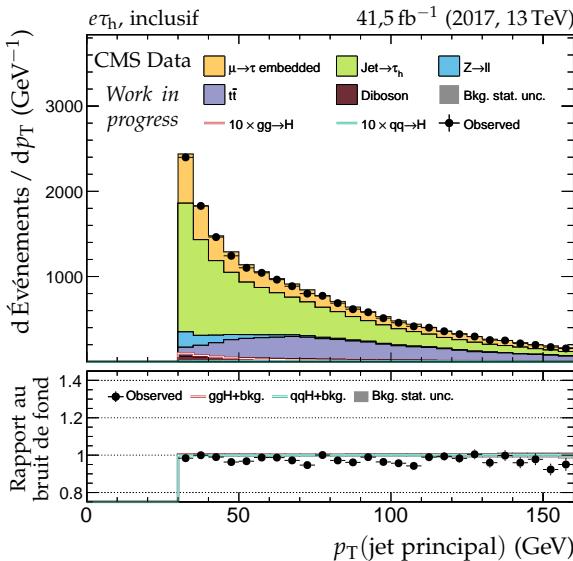


**Figure X.35 – Canal  $\mu\tau_h$ , 2017 : dilepton et énergie transverse manquante.**

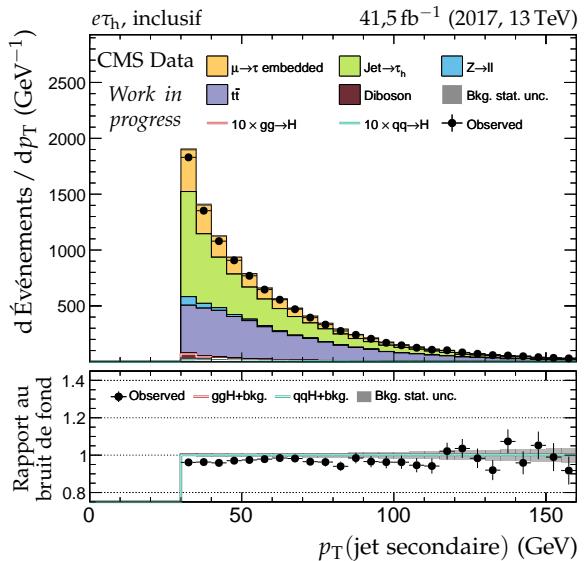
(a) Masse transverse du lepton 1 ( $\mu$ ).(b) Masse transverse du lepton 2 ( $\tau_h$ ).(c) Valeur de  $D_\zeta$ .

(d) Masse transverse totale.

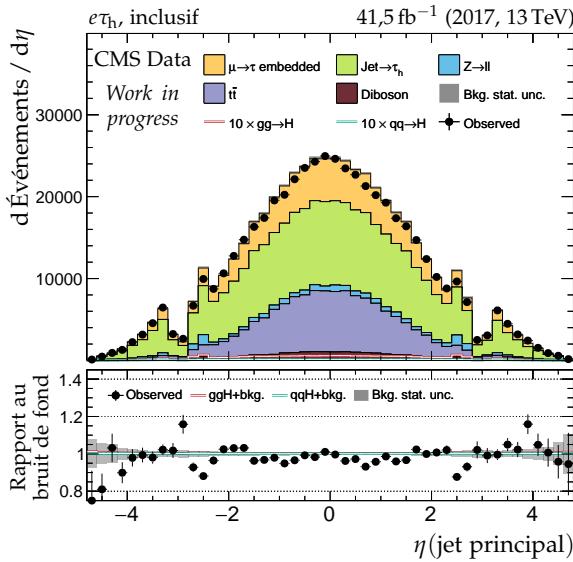
(e) Masse du système di- $\tau$  d'après SVFIT.(f) Masse du système di- $\tau$  d'après le ML.**Figure X.36 – Canal  $\mu\tau_h$ , 2017 : masses transverses,  $D_\zeta$  et masses.**



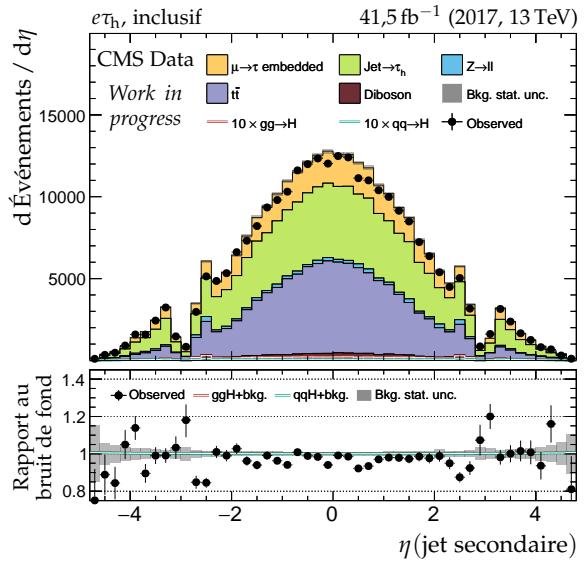
(a) Impulsion transverse du jet principal.



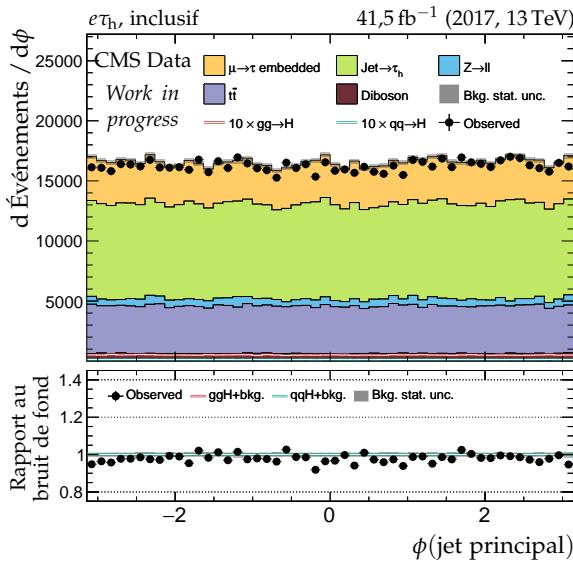
(b) Impulsion transverse du jet secondaire.



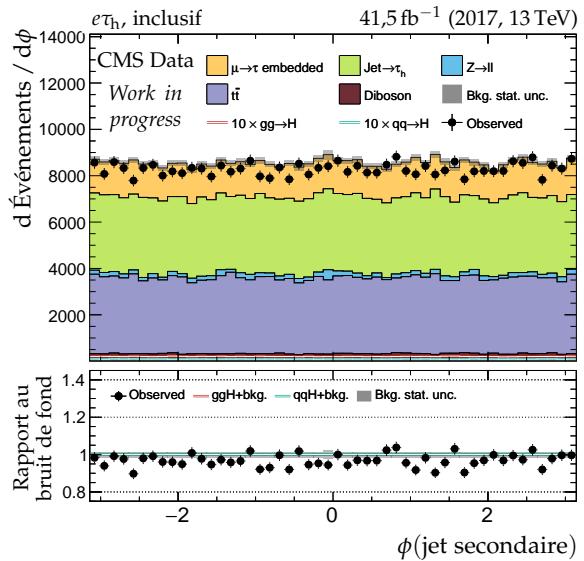
(c) Pseudo-rapidité du jet principal.



(d) Pseudo-rapidité du jet secondaire.

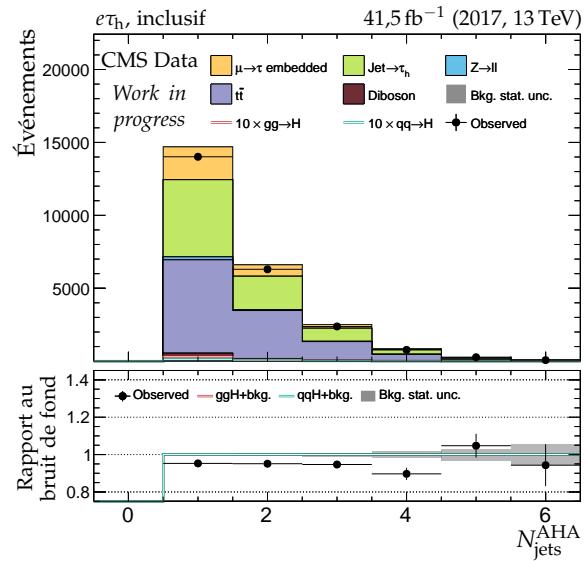
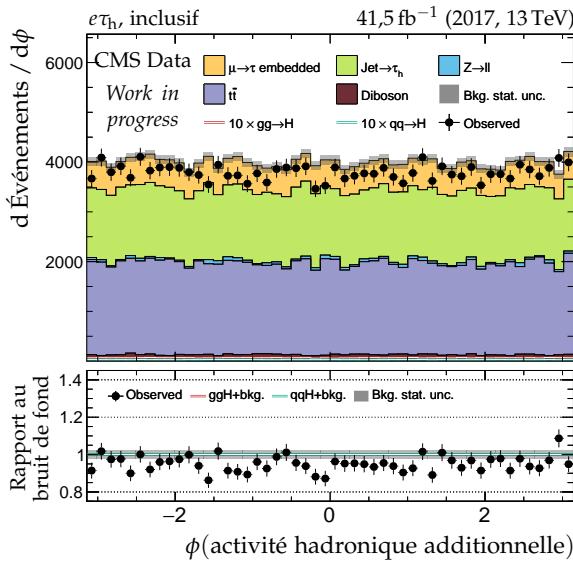
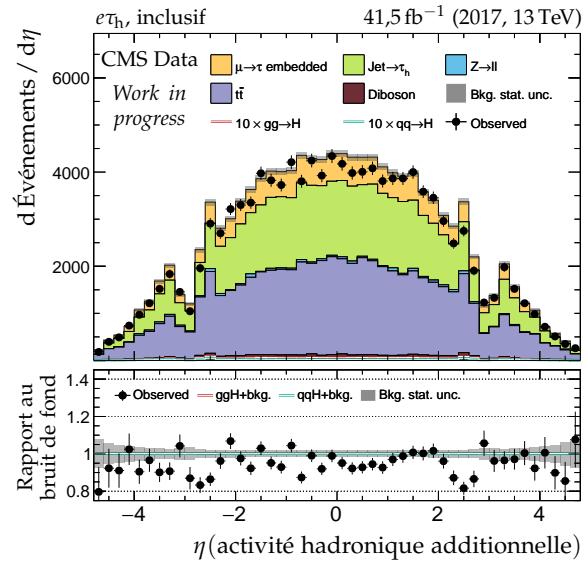
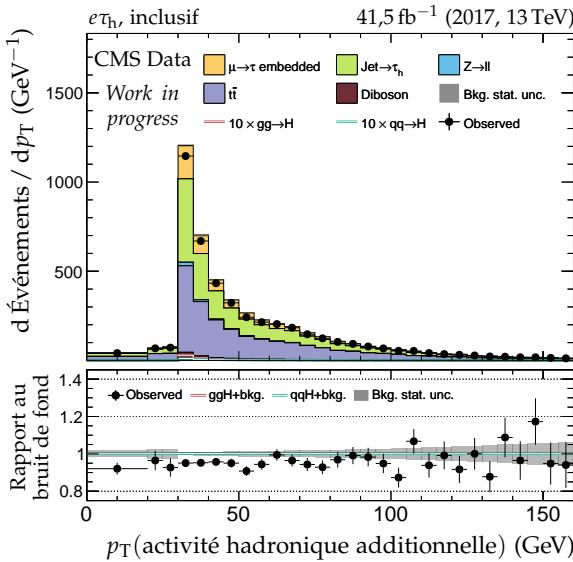
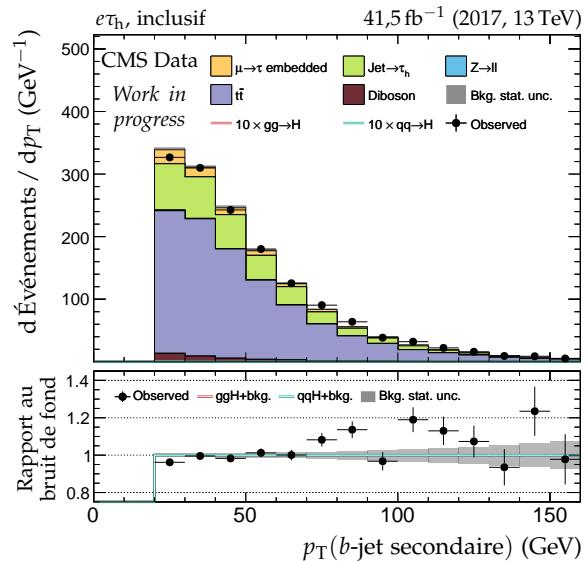
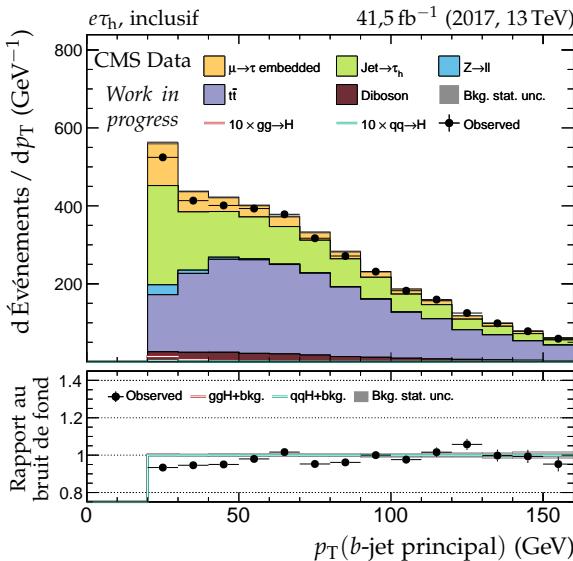


(e) Angle azimutal du jet principal.

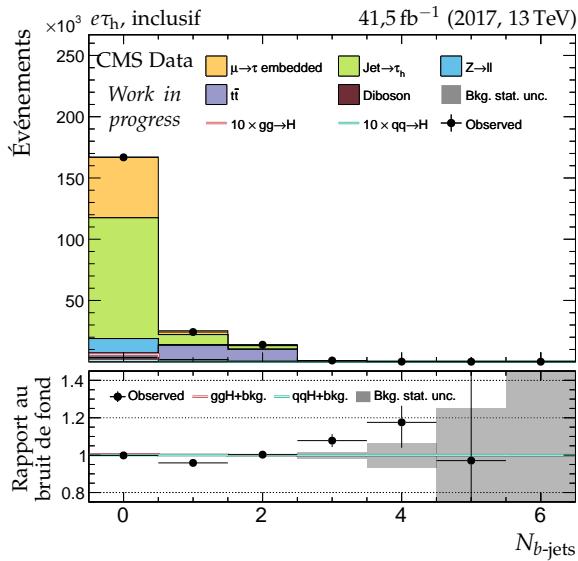
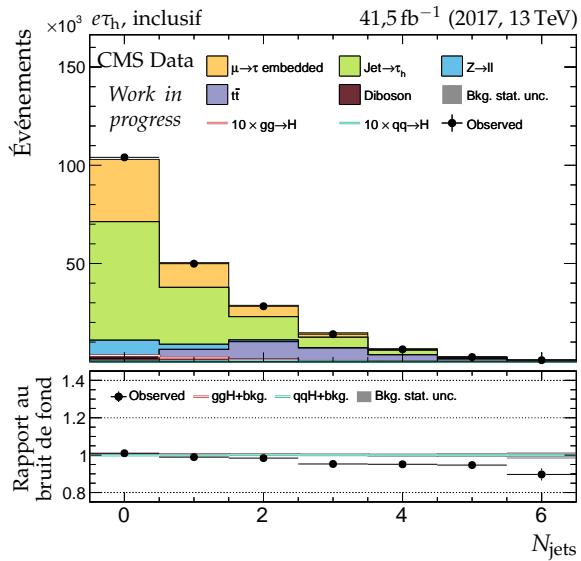


(f) Angle azimutal du jet secondaire.

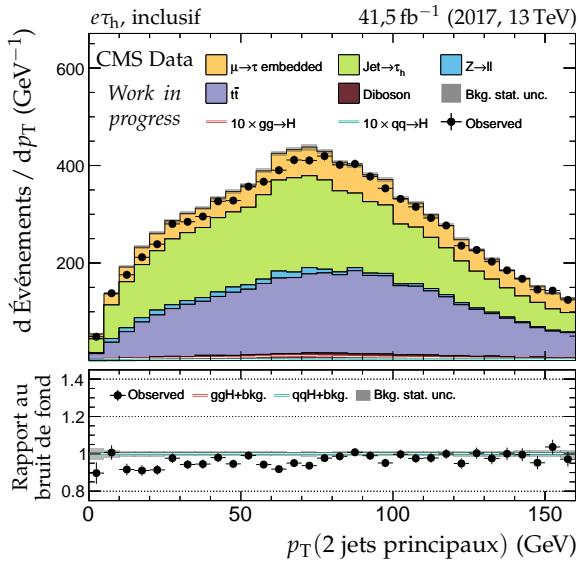
Figure X.37 – Canal  $e\tau_h$ , 2017 : cinématique des deux jets principaux.



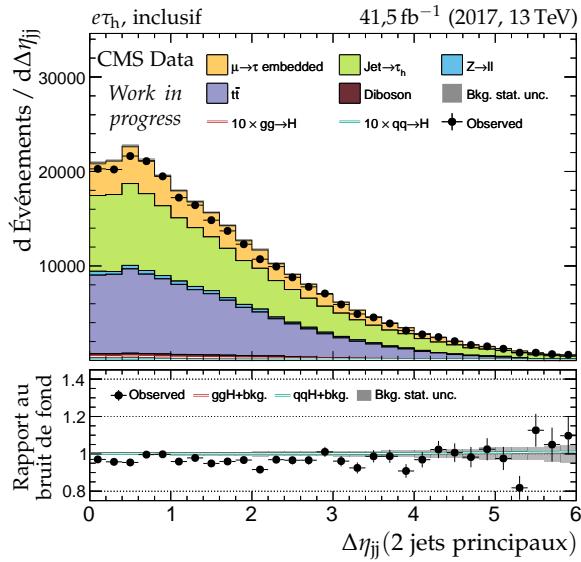
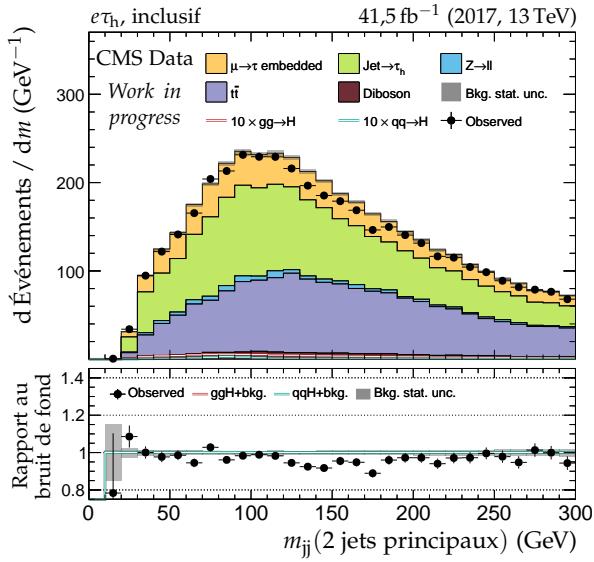
**Figure X.38 – Canal  $e\tau_h$ , 2017 : b-jets et activité hadronique additionnelle.**


 (a) Nombre de  $b$ -jets.


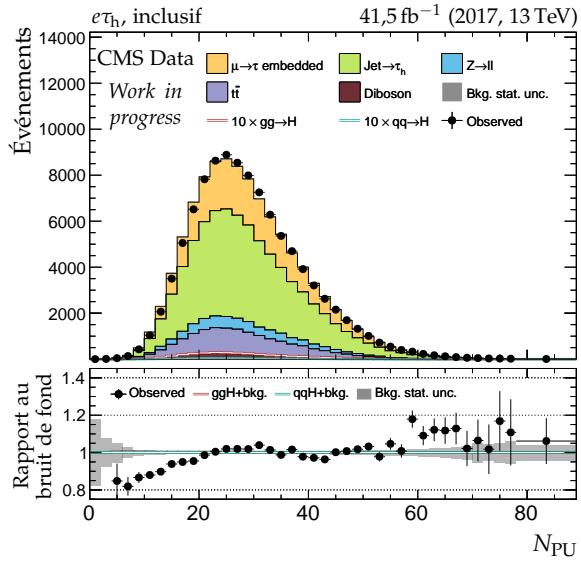
(b) Nombre de jets.



(c) Impulsion transverse du système des deux jets.

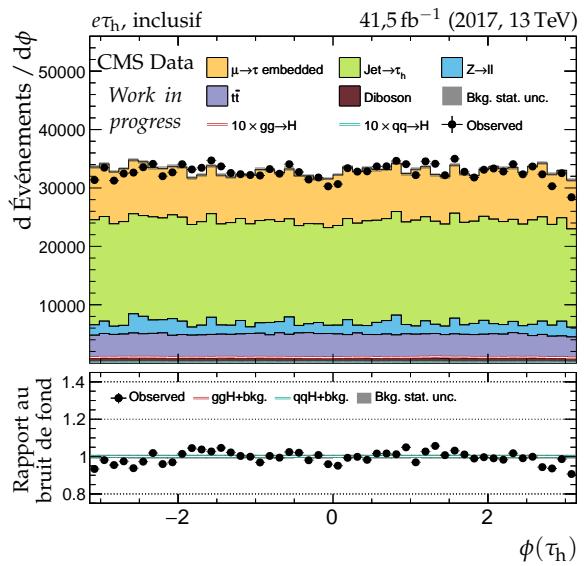
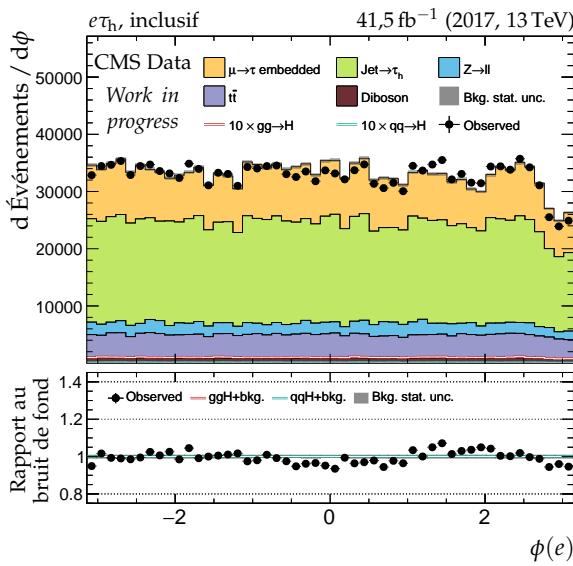
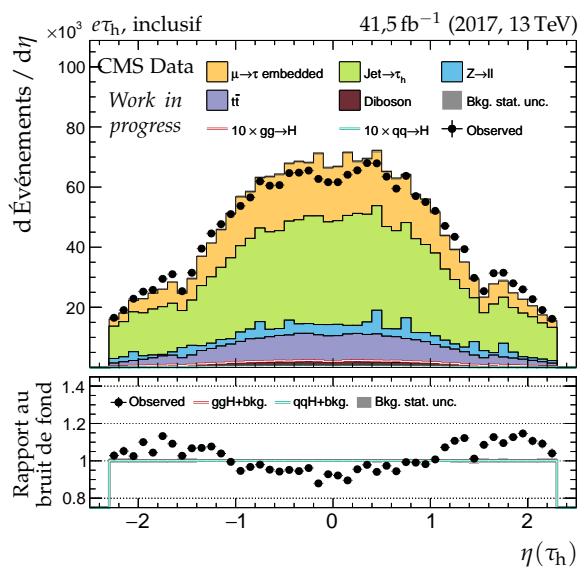
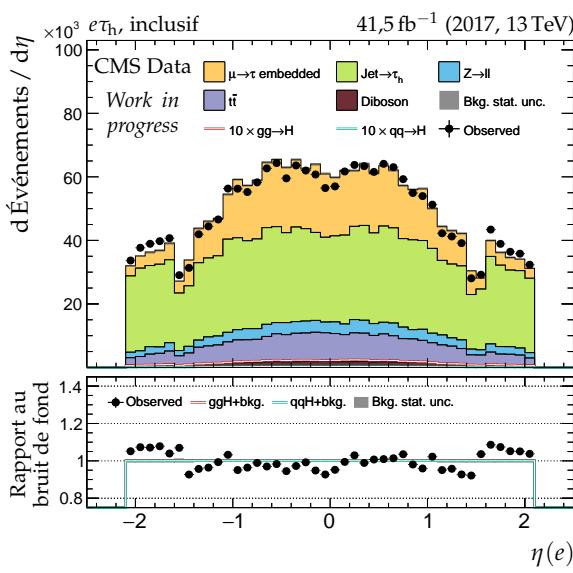
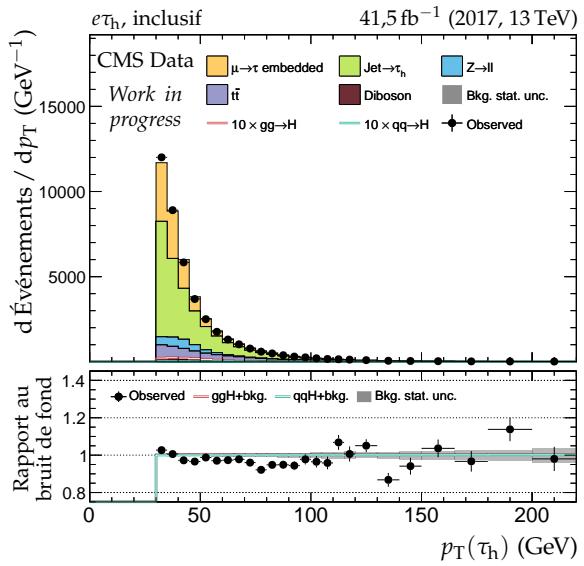
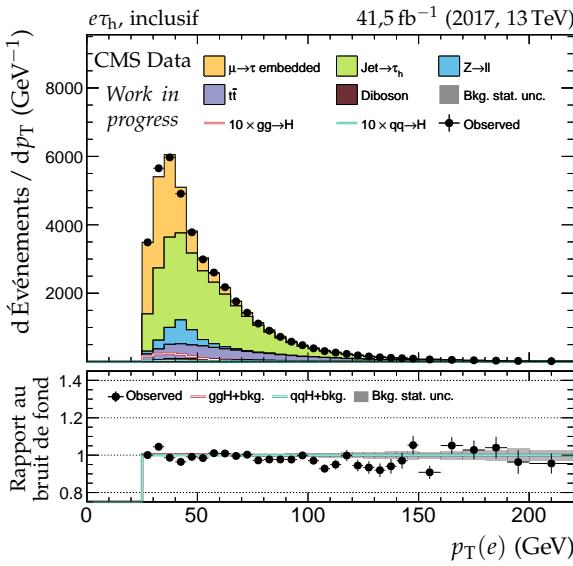

 (d) Distance en  $\eta$  entre les deux jets.


(e) Masse invariante du système des deux jets.

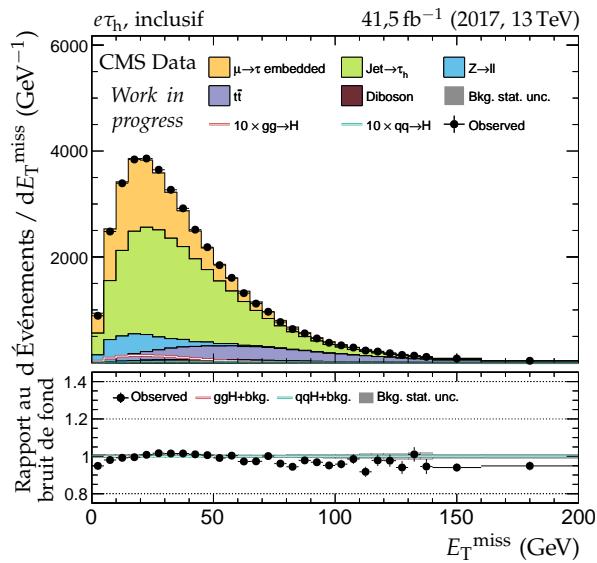


(f) Nombre de vertex d'empilement.

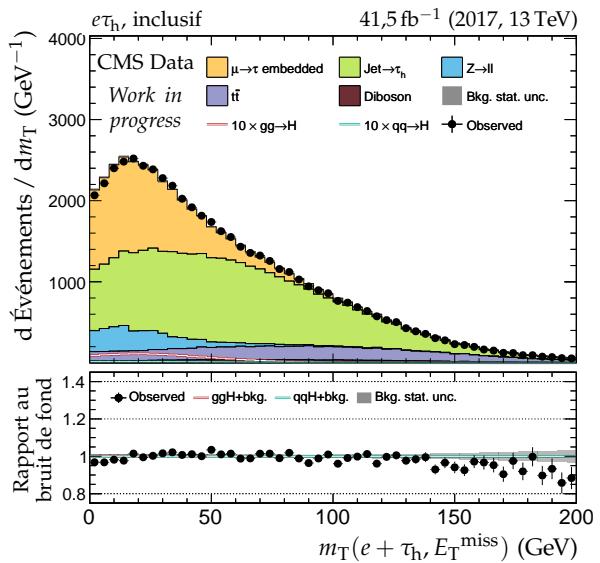
 Figure X.39 – Canal  $e\tau_h$ , 2017 : nombre de jets, système des deux jets principaux et empilement.



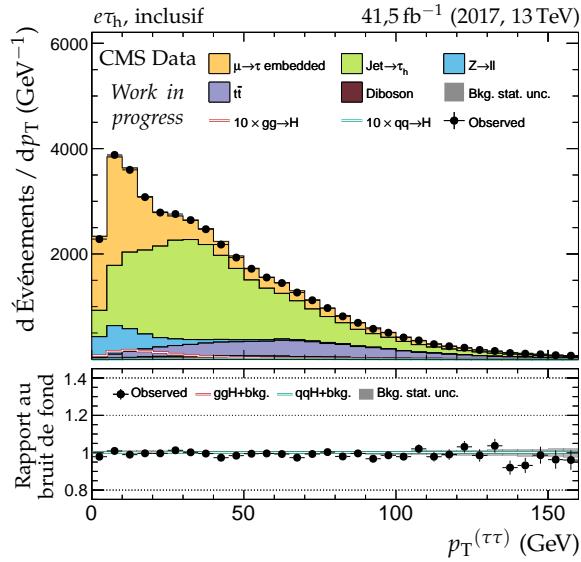
**Figure X.40 – Canal  $e\tau_h$ , 2017 : cinématique des leptons ( $e, \tau_h$ ).**



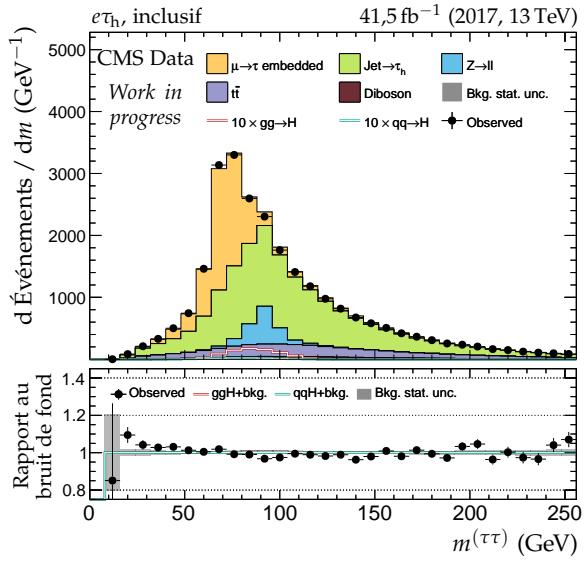
(a) Énergie transverse manquante.



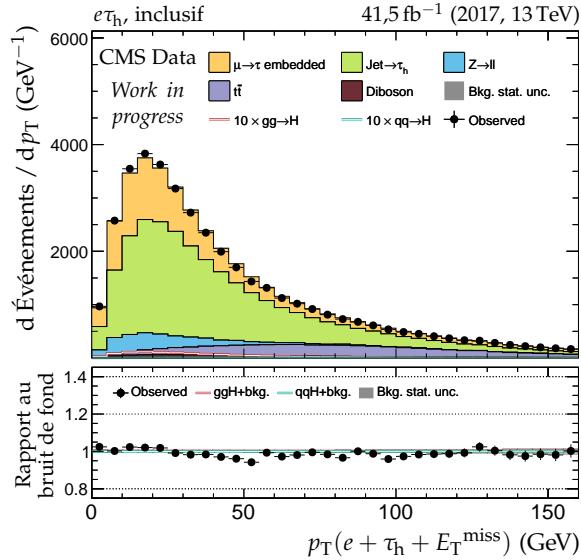
(b) Masse transverse du dilepton.



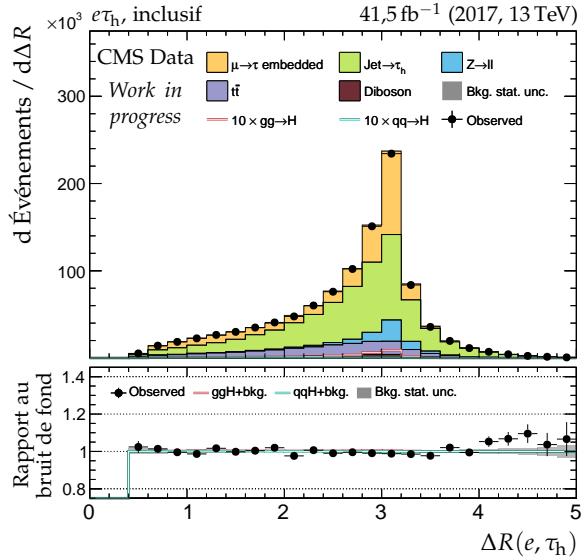
(c) Impulsion transverse du dilepton.



(d) Masse visible du dilepton.

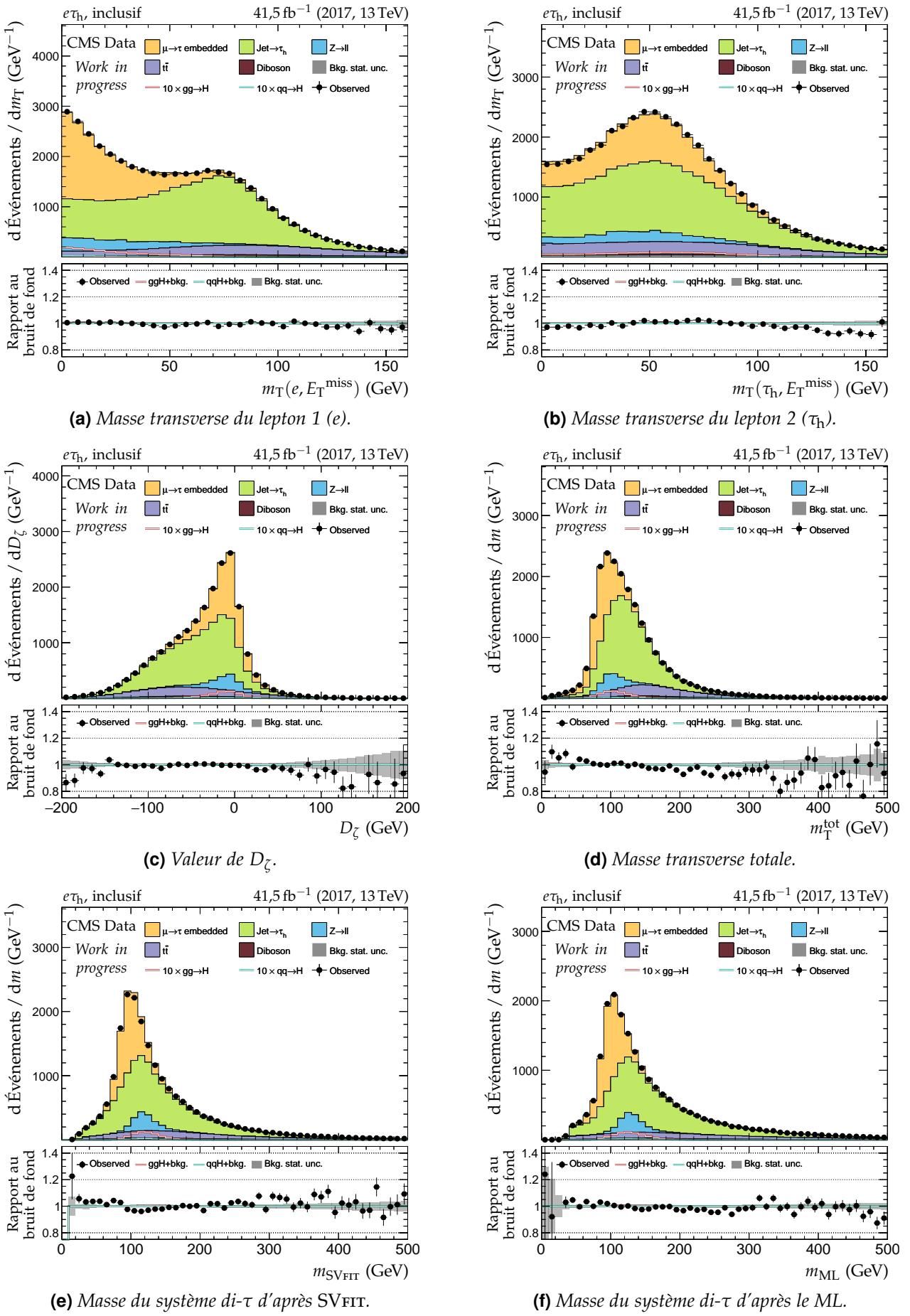


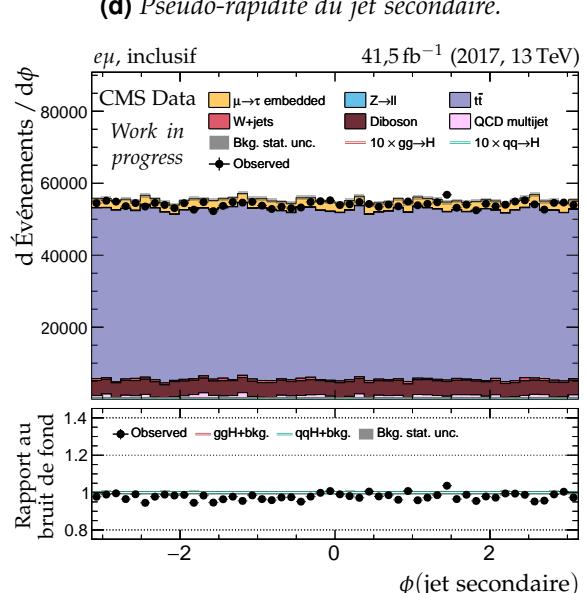
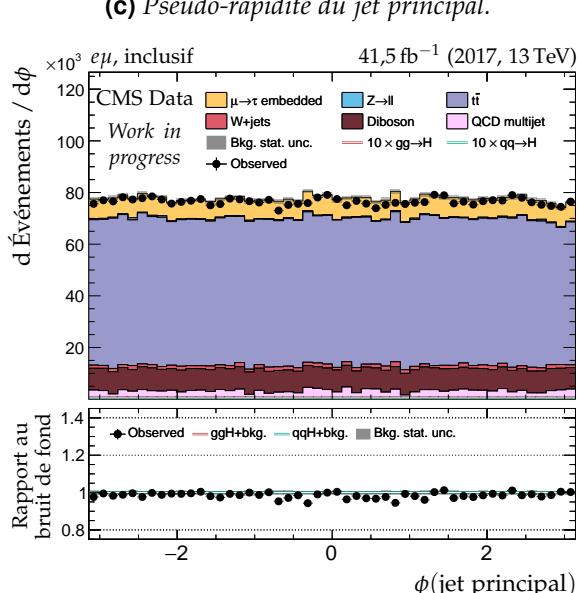
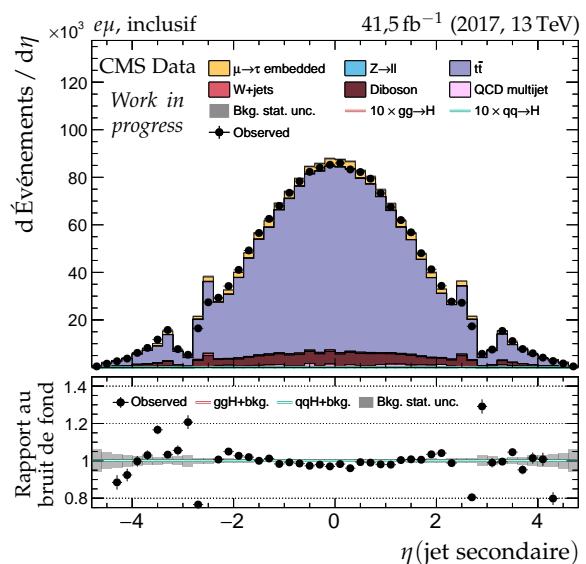
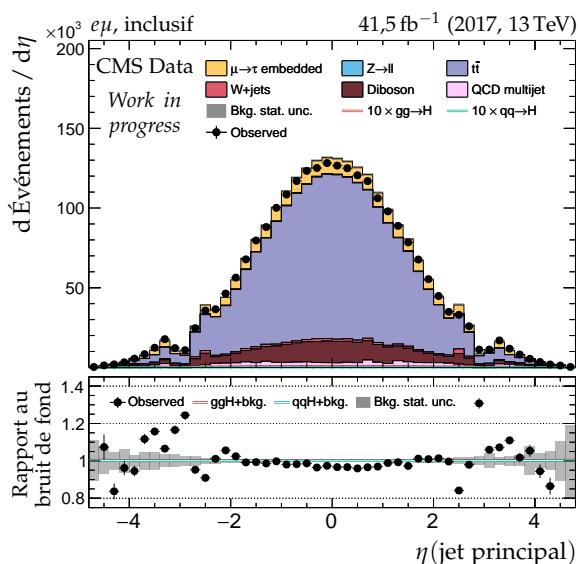
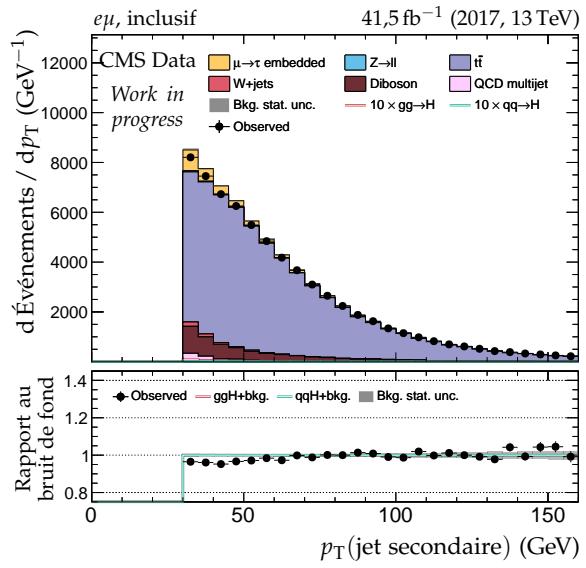
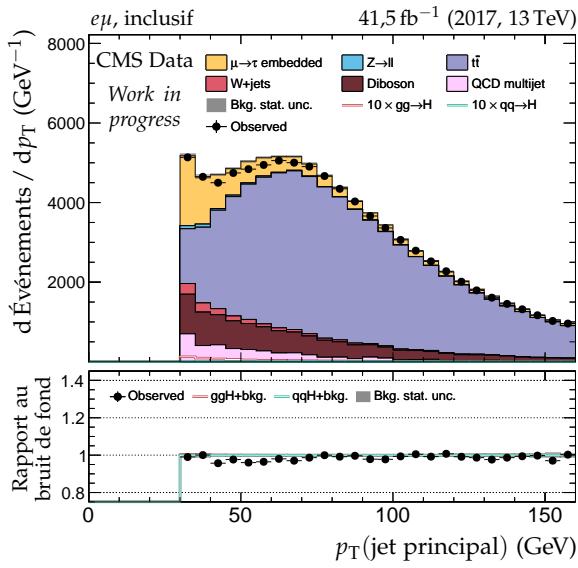
(e) Impulsion transverse du système di-\tau.



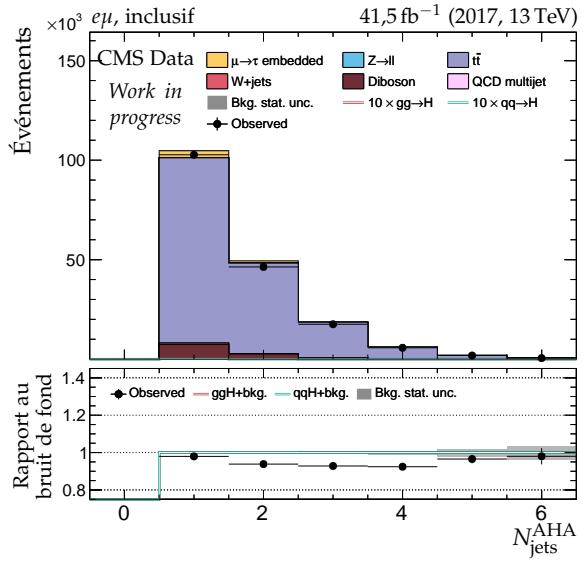
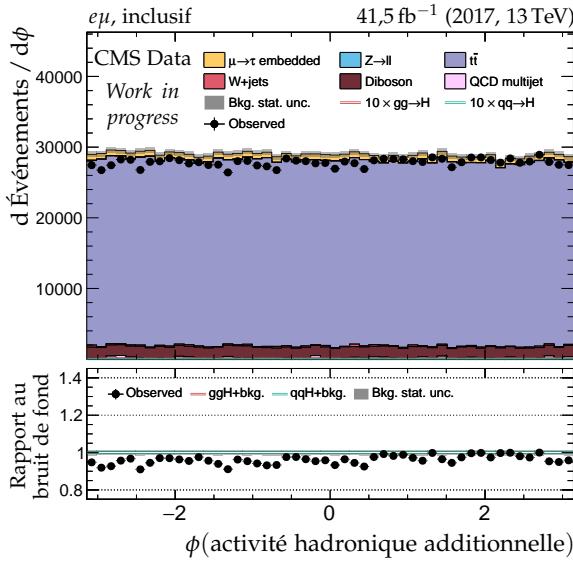
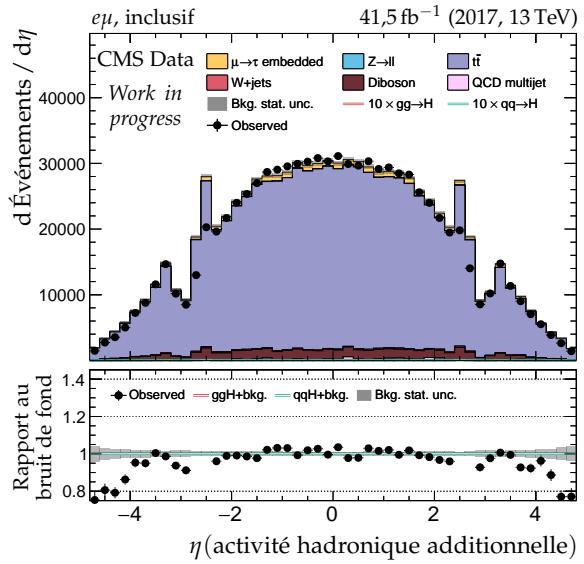
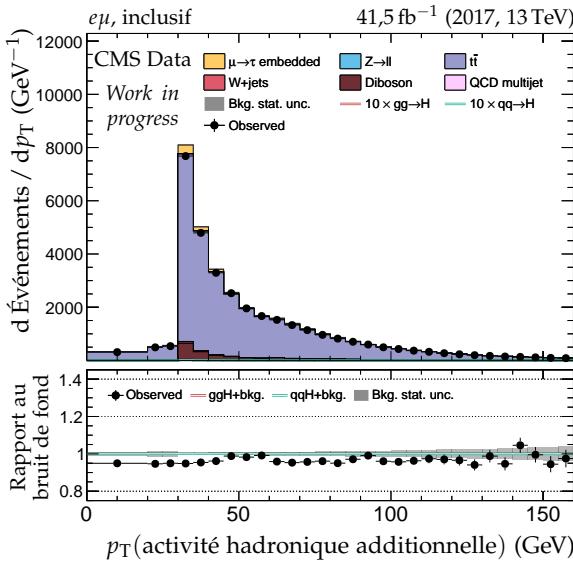
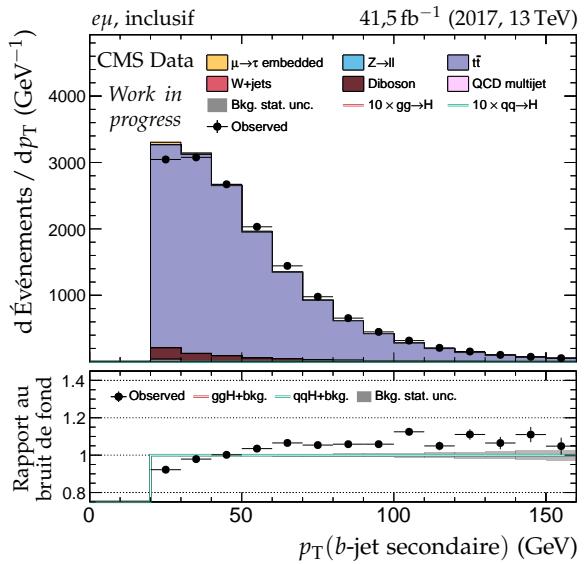
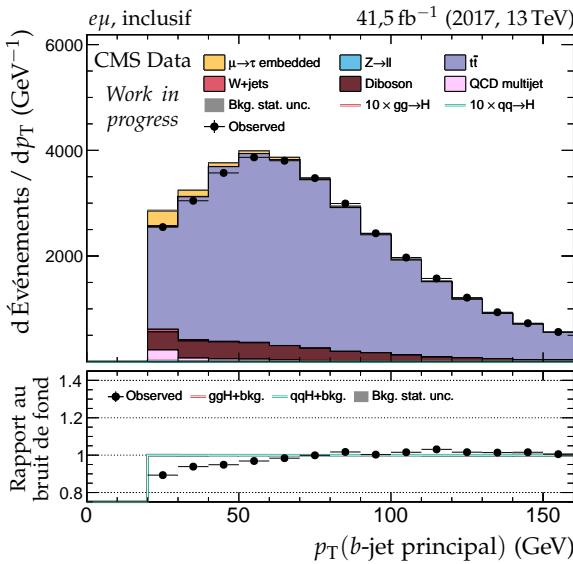
(f) Distance \Delta R entre les leptons ( $e, \tau_h$ ).

Figure X.41 – Canal  $e\tau_h$ , 2017 : dilepton et énergie transverse manquante.

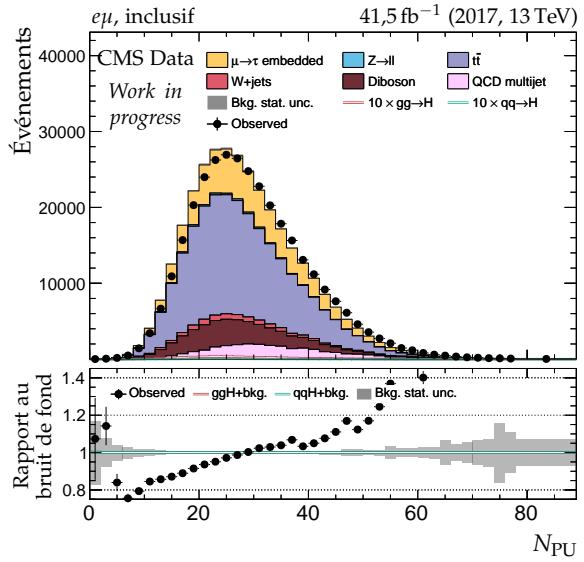
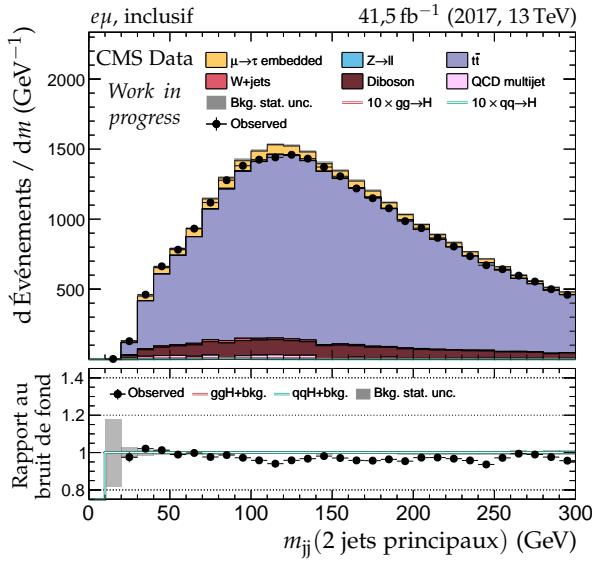
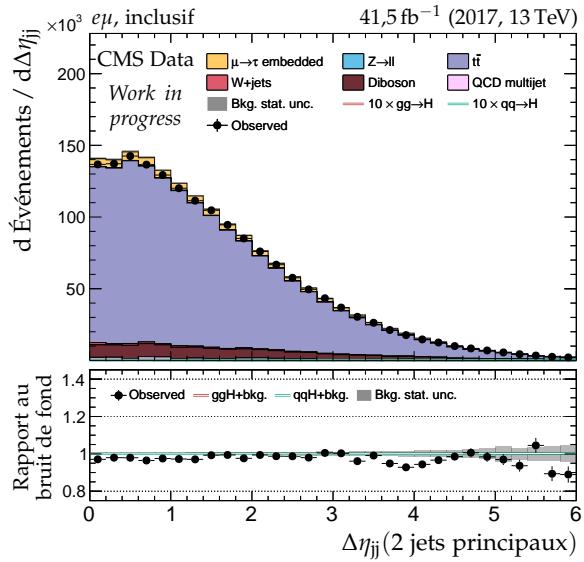
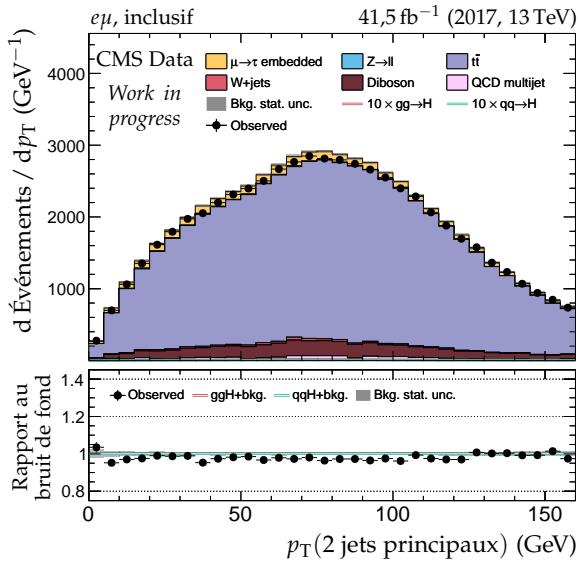
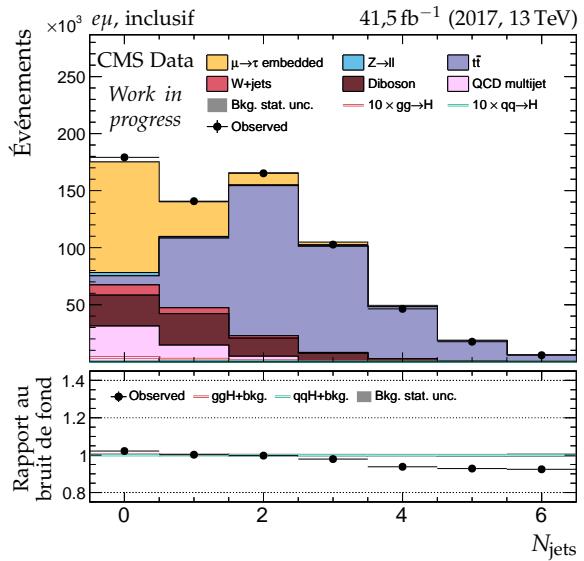
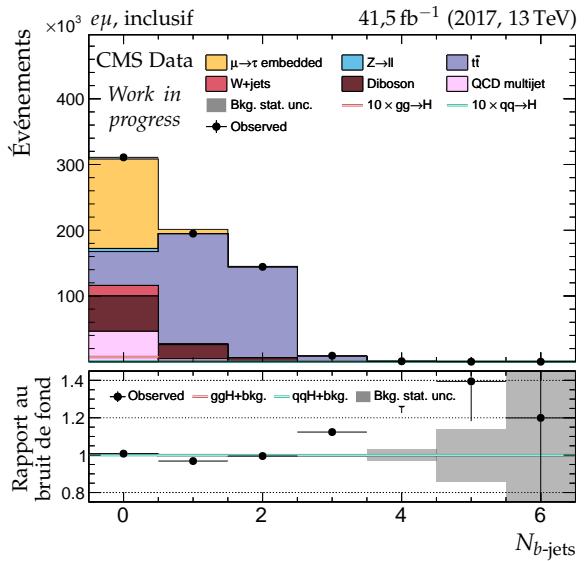




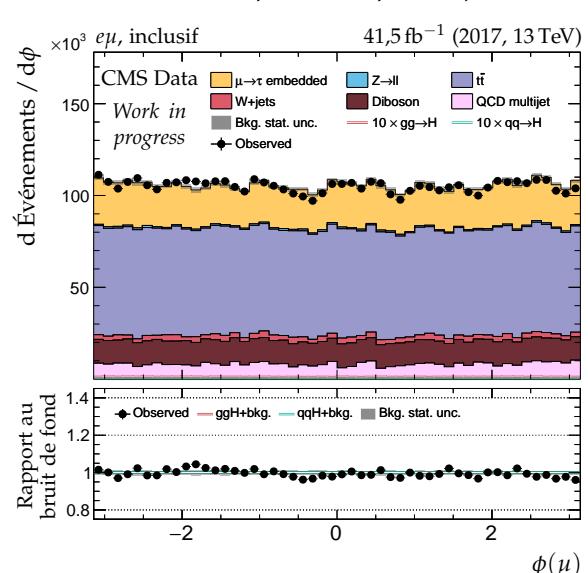
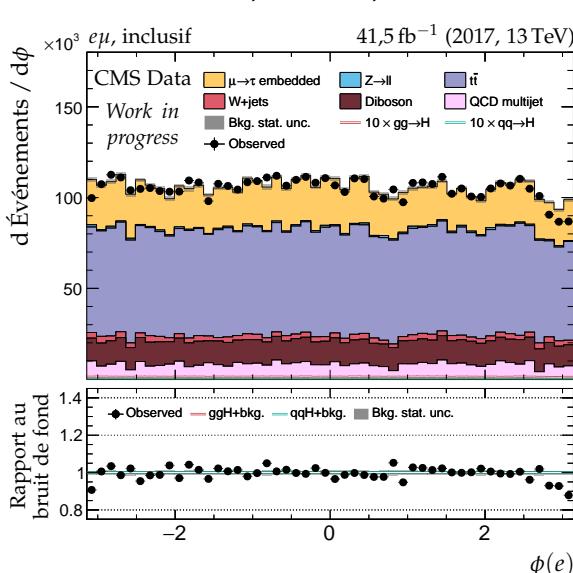
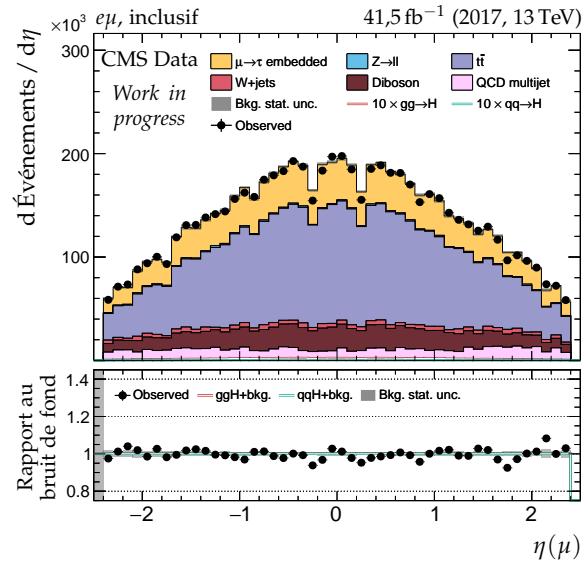
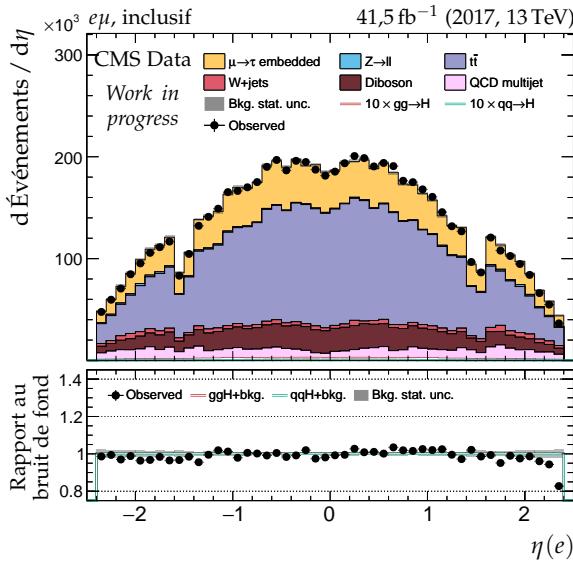
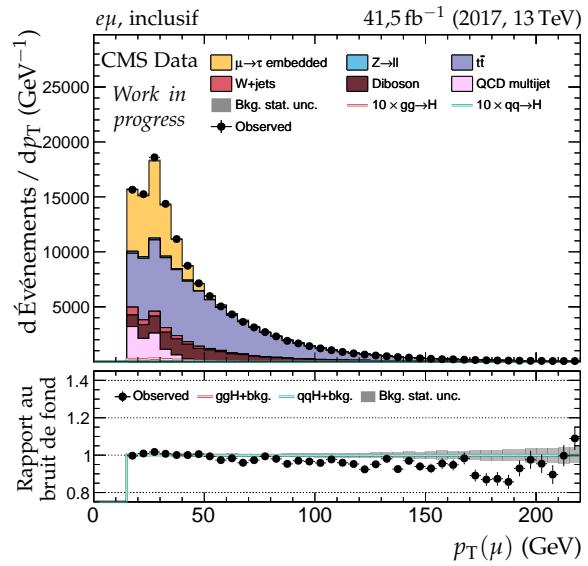
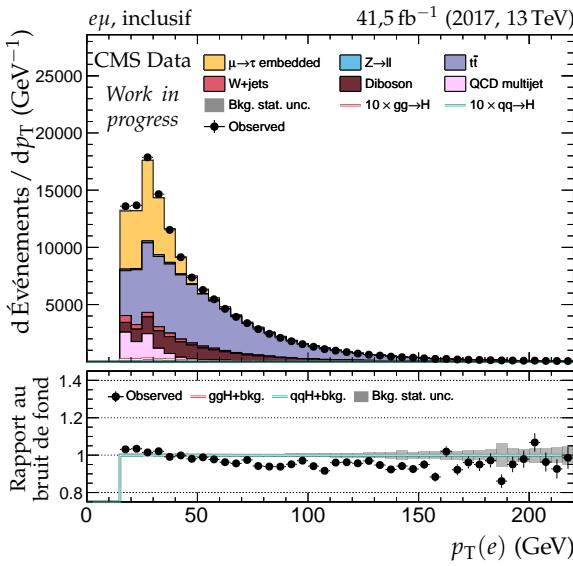
**Figure X.43 – Canal  $e\mu$ , 2017 : cinématique des deux jets principaux.**



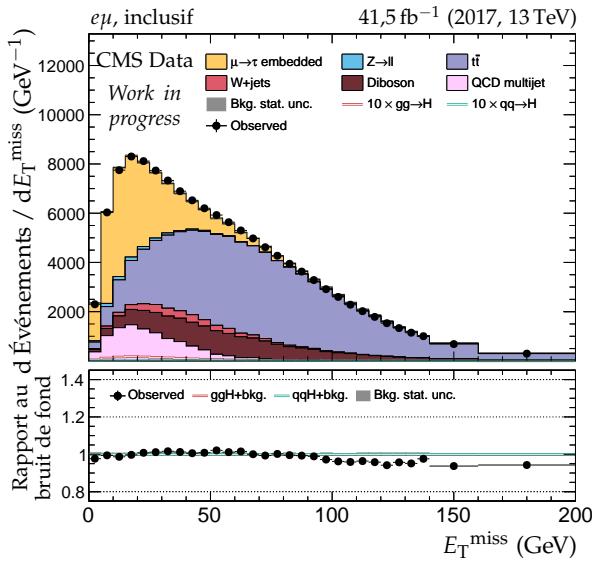
**Figure X.44 – Canal  $e\mu$ , 2017 : b-jets et activité hadronique additionnelle.**



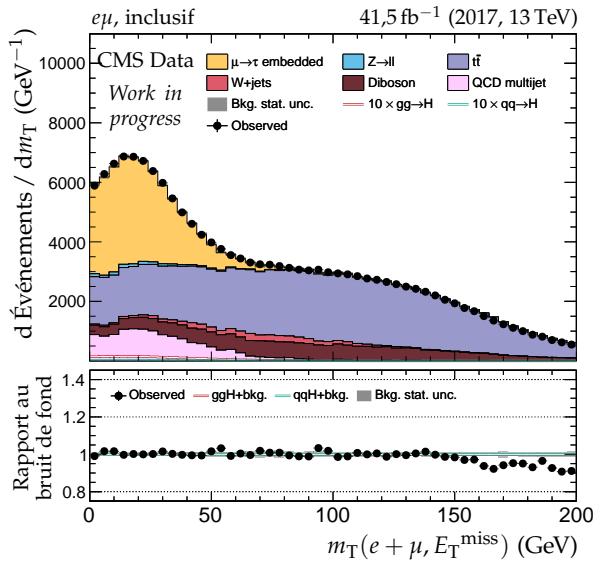
**Figure X.45 – Canal  $e\mu$ , 2017 : nombre de jets, système des deux jets principaux et empilement.**



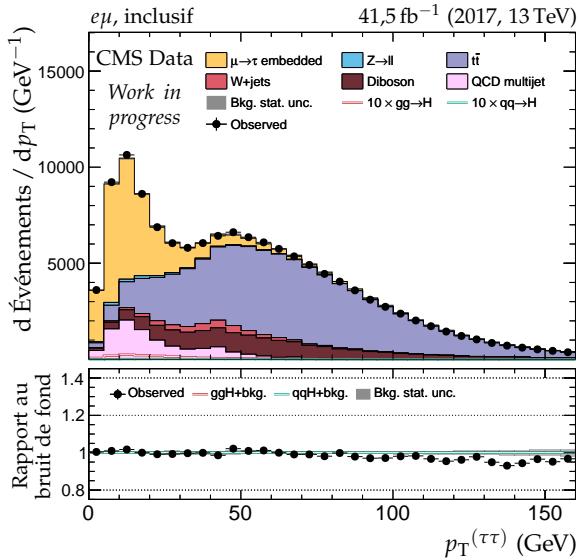
**Figure X.46 – Canal  $e\mu$ , 2017 : cinématique des leptons ( $e, \mu$ ).**



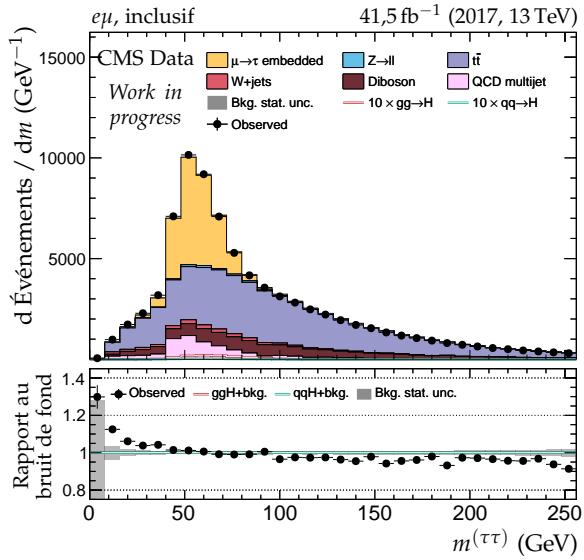
(a) Énergie transverse manquante.



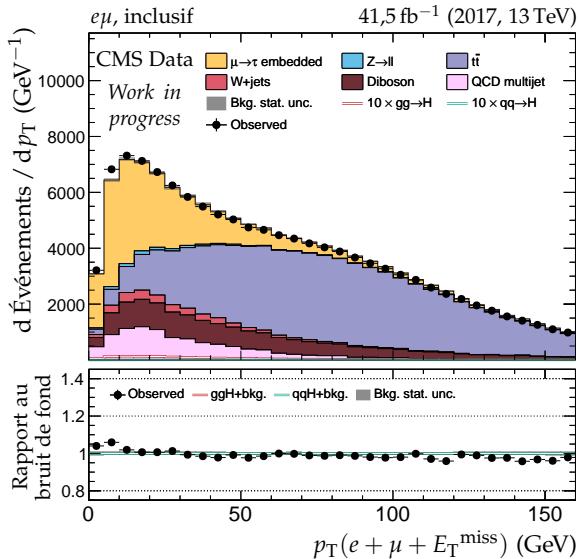
(b) Masse transverse du dilepton.



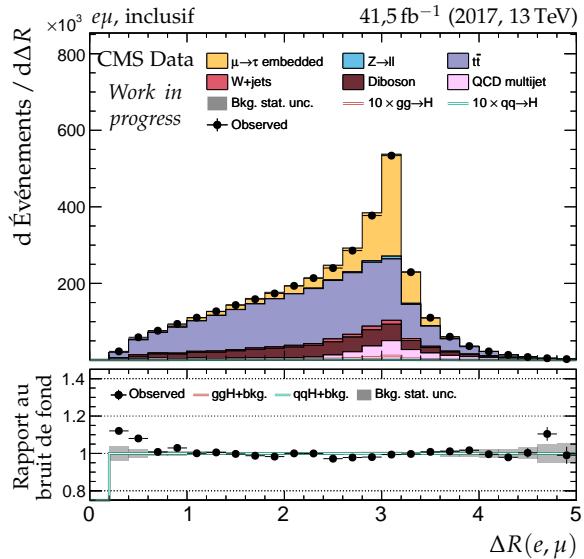
(c) Impulsion transverse du dilepton.



(d) Masse visible du dilepton.

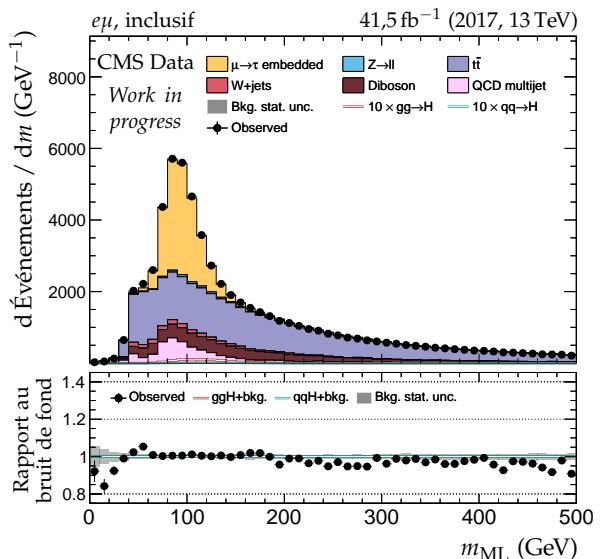
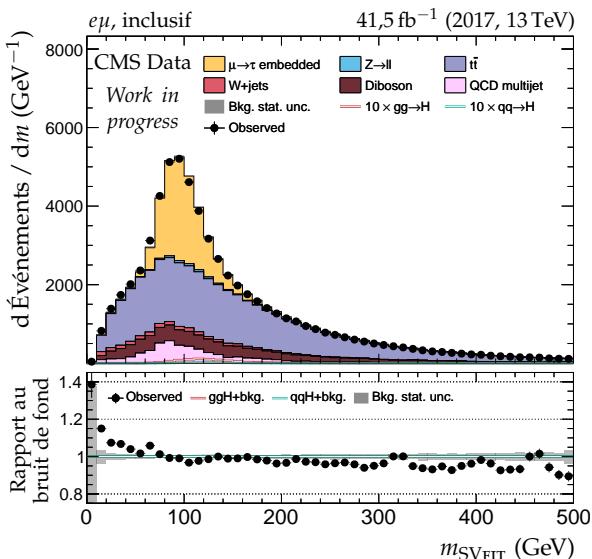
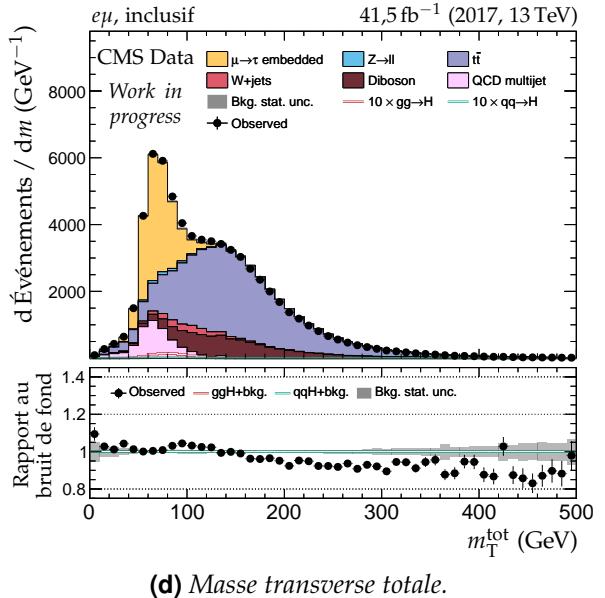
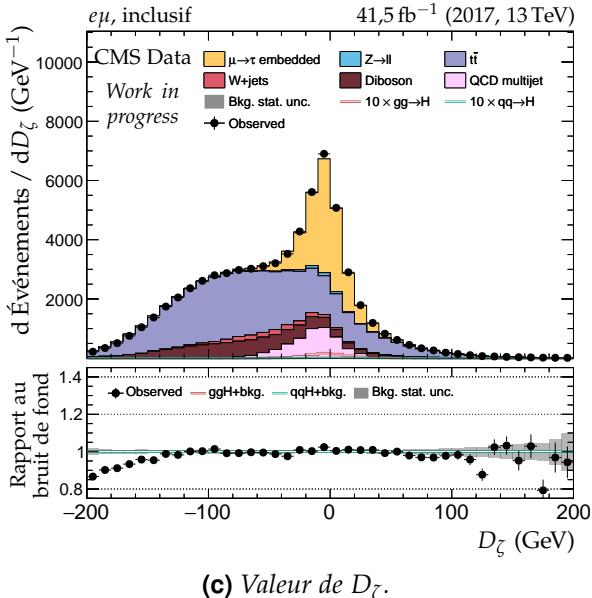
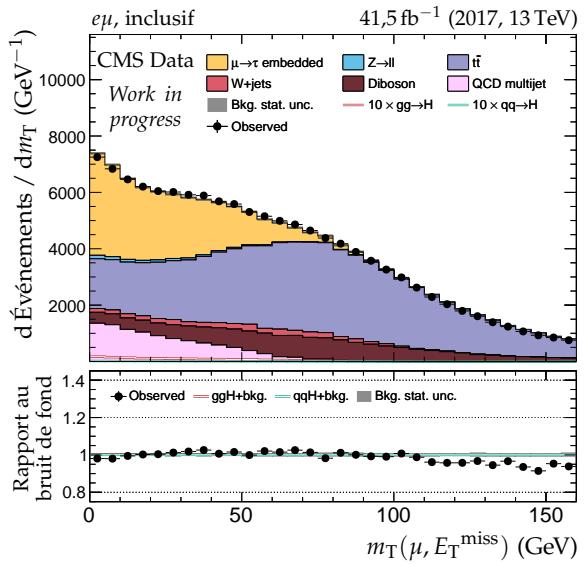
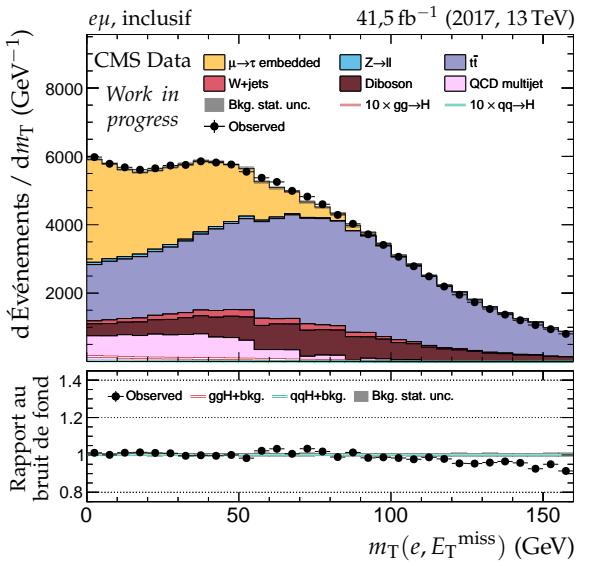


(e) Impulsion transverse du système di-τ.

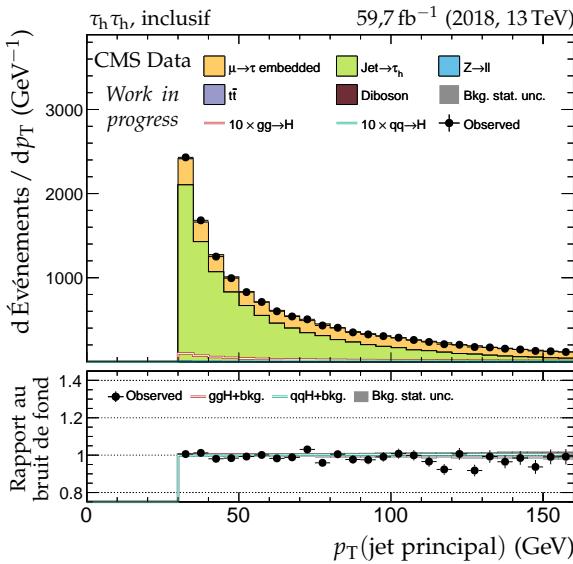


(f) Distance ΔR entre les leptons (e, μ).

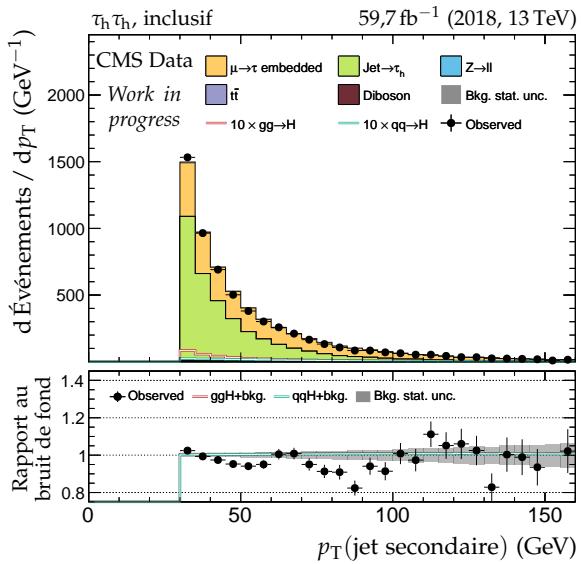
Figure X.47 – Canal eμ, 2017 : dilepton et énergie transverse manquante.



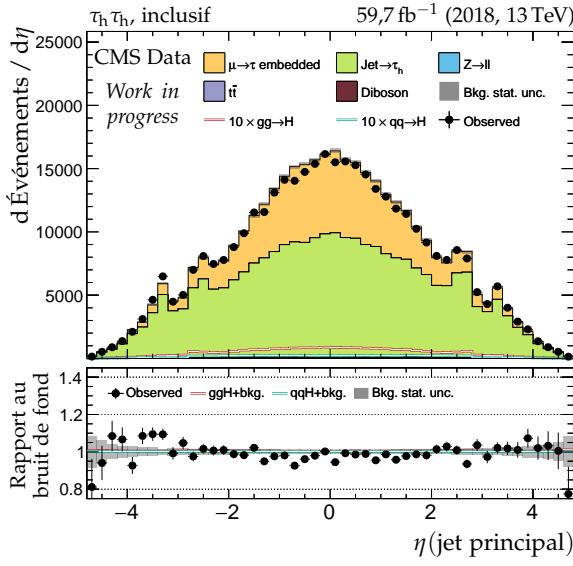
**Figure X.48 – Canal  $e\mu$ , 2017 : masses transverses,  $D_\zeta$  et masses.**



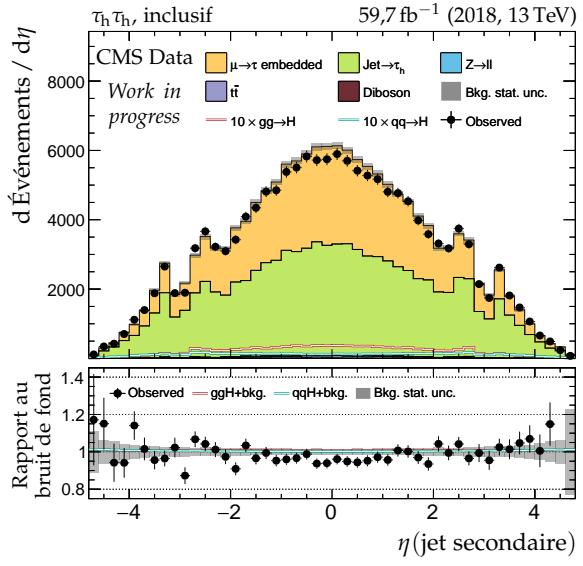
(a) Impulsion transverse du jet principal.



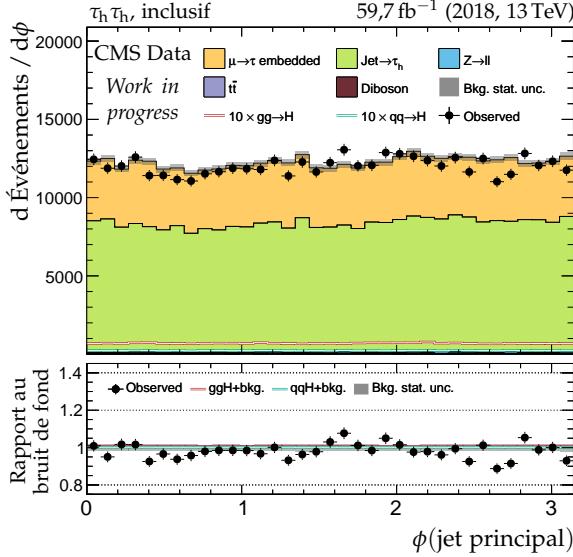
(b) Impulsion transverse du jet secondaire.



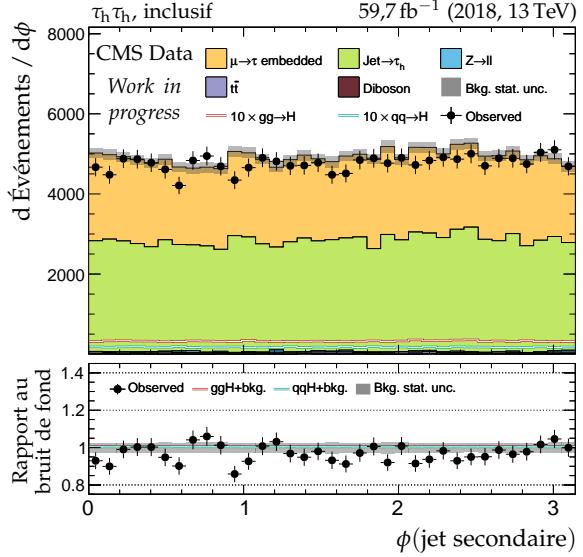
(c) Pseudo-rapidité du jet principal.



(d) Pseudo-rapidité du jet secondaire.

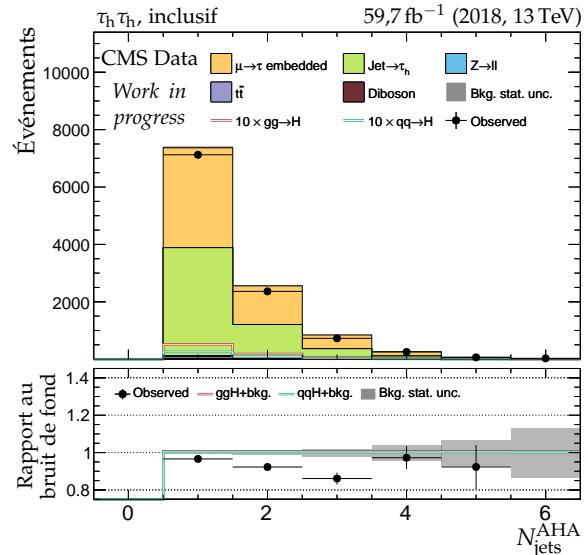
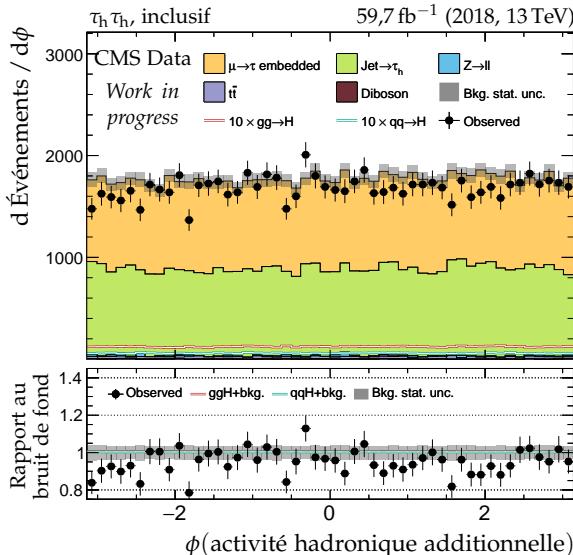
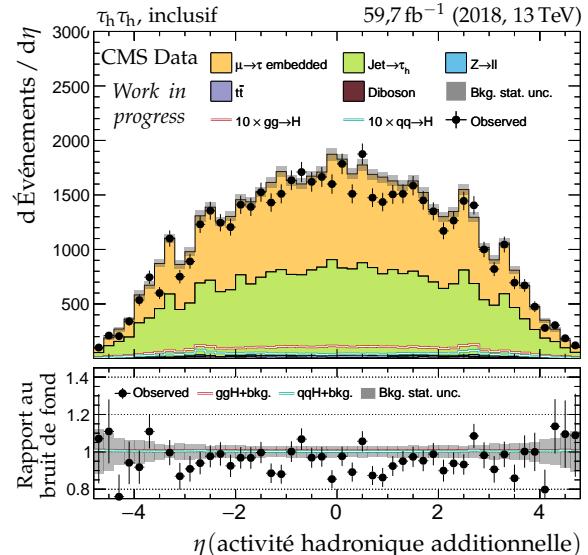
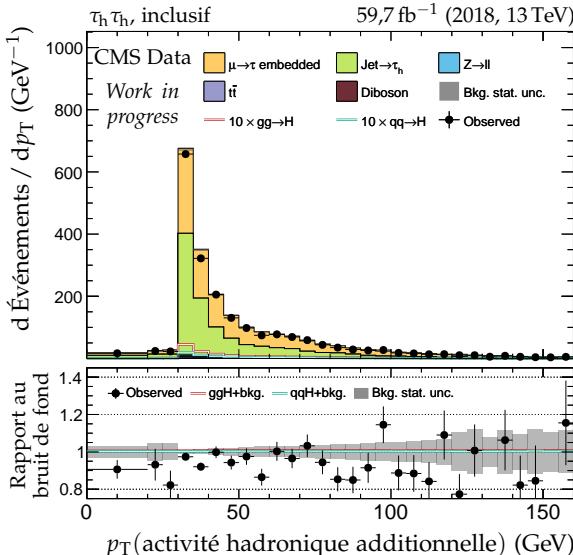
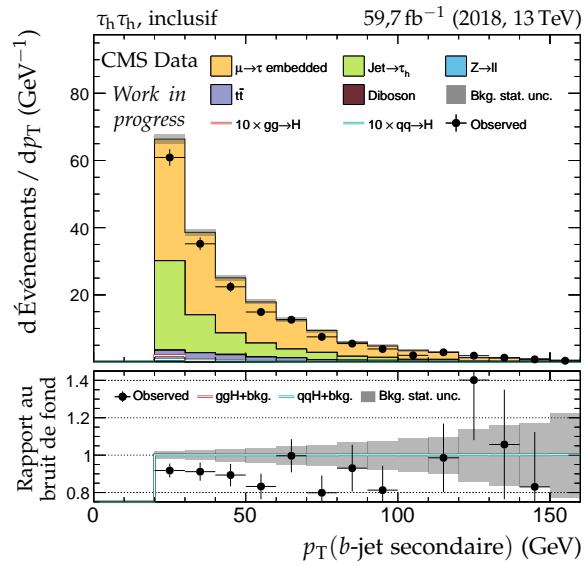
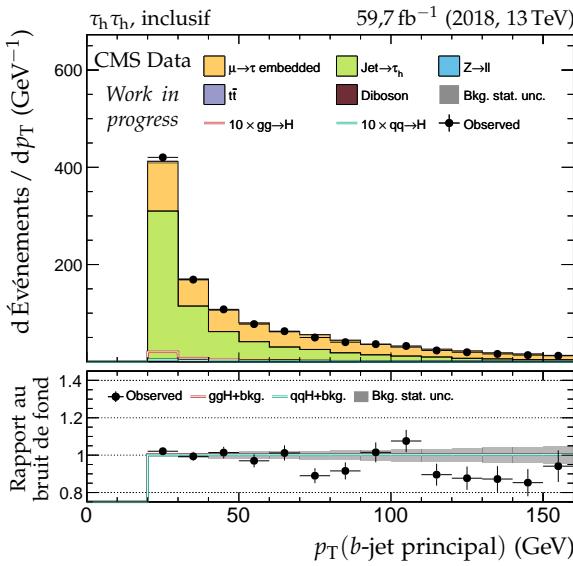


(e) Angle azimutal du jet principal.

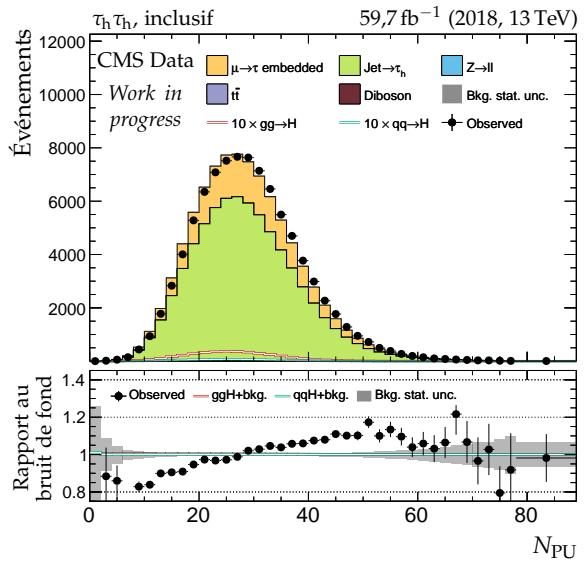
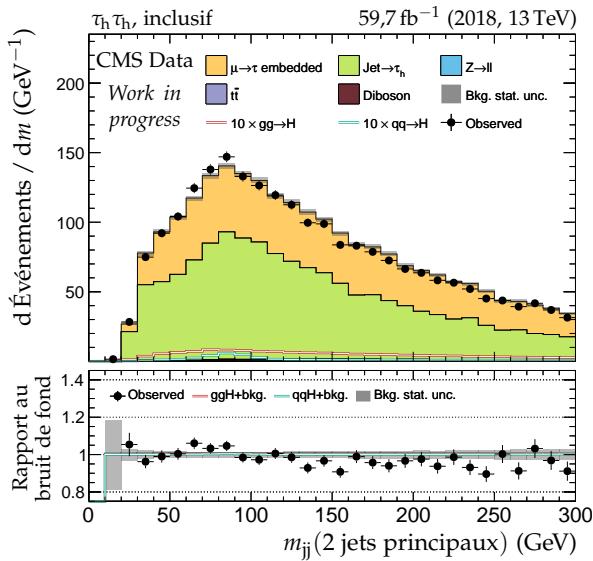
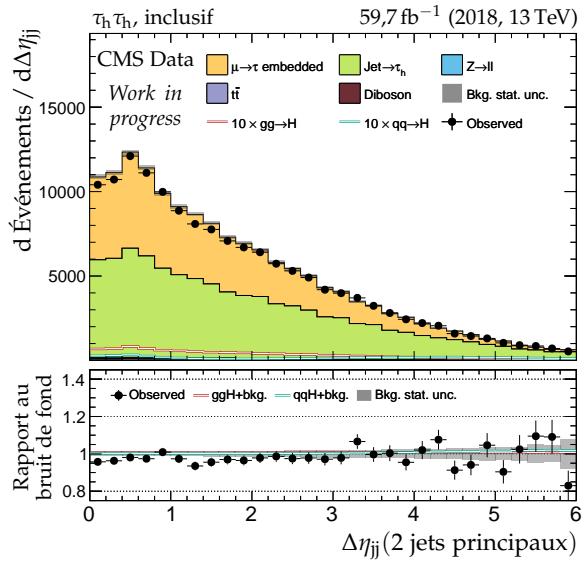
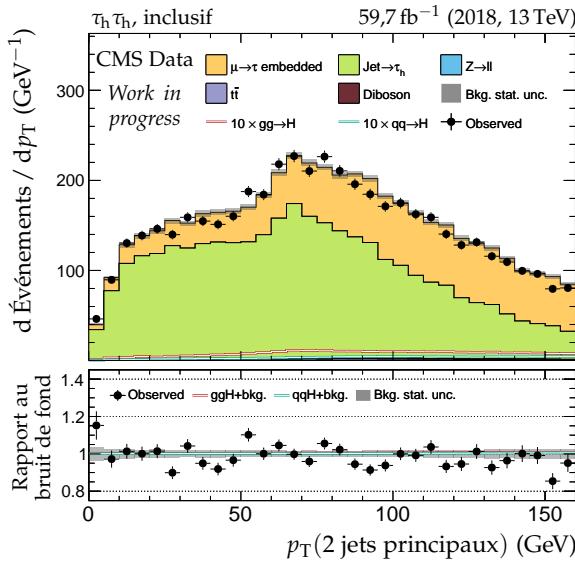
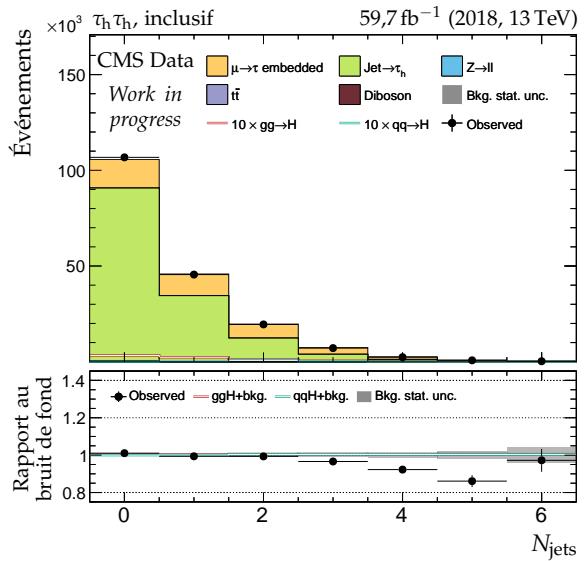
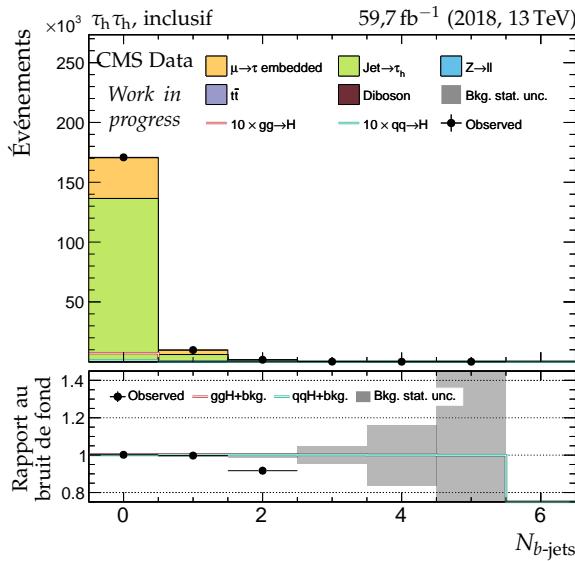


(f) Angle azimutal du jet secondaire.

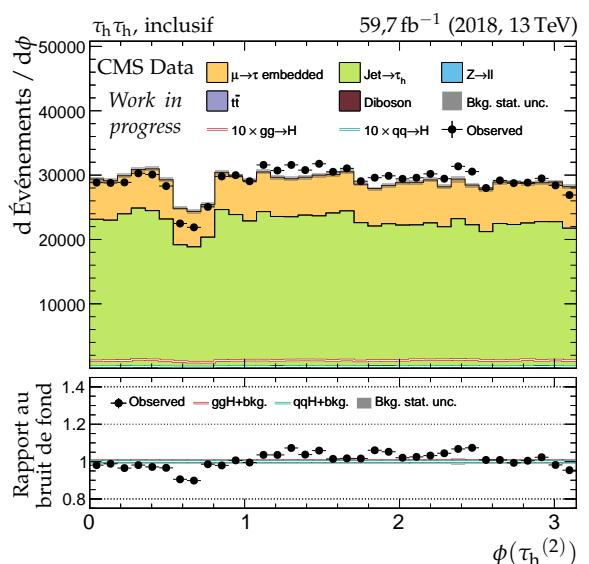
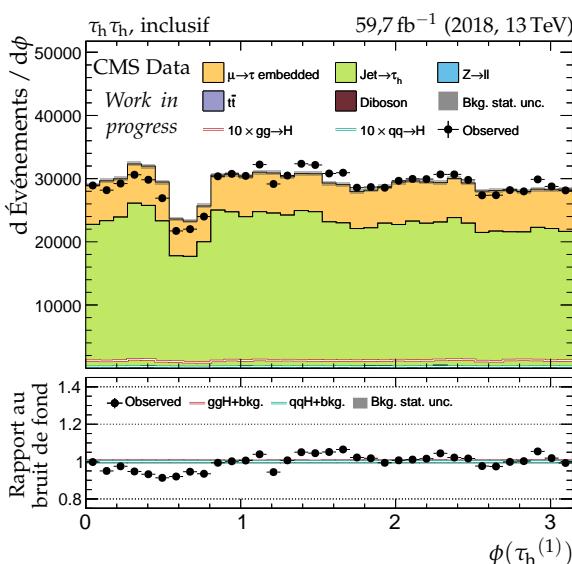
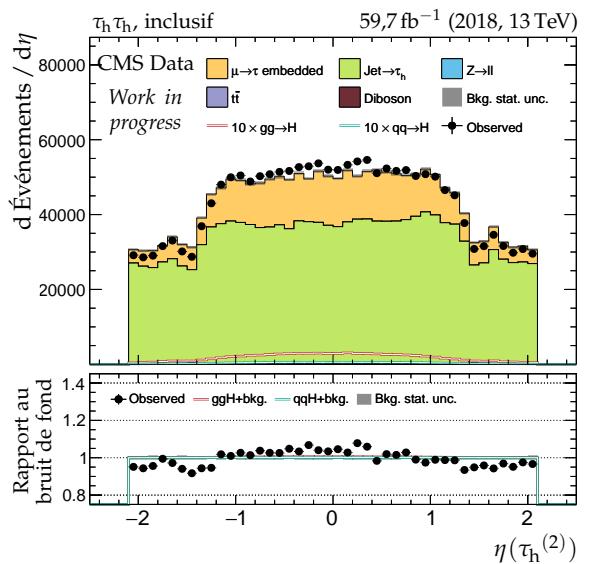
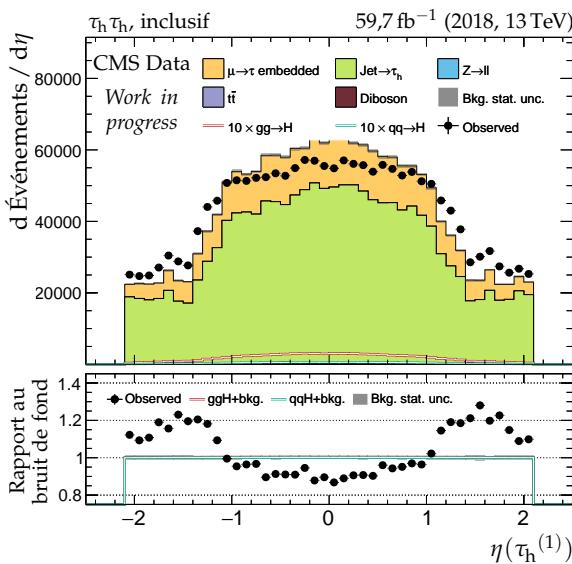
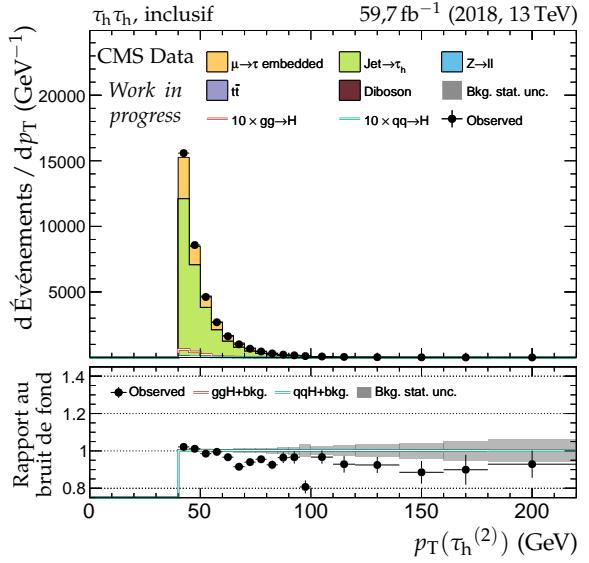
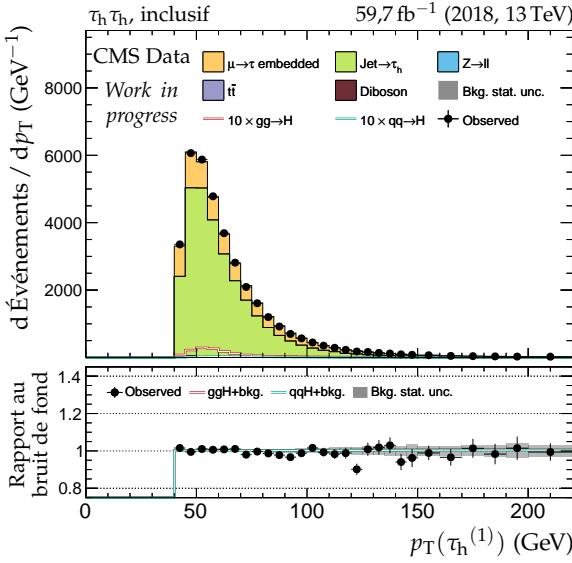
Figure X.49 – Canal  $\tau_h \tau_h$ , 2018 : cinématique des deux jets principaux.



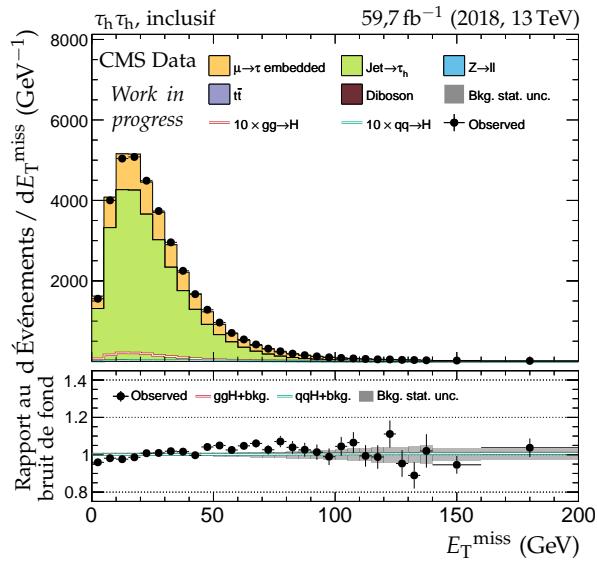
**Figure X.50 – Canal  $\tau_h \tau_h$ , 2018 : b-jets et activité hadronique additionnelle.**



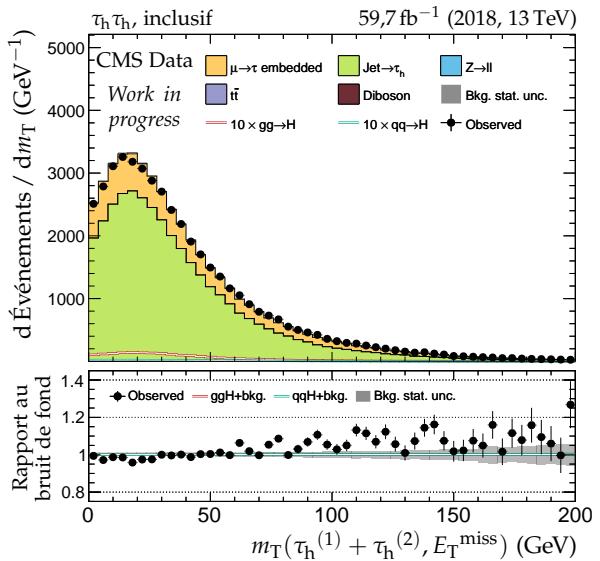
**Figure X.51 – Canal  $\tau_h \tau_h$ , 2018 : nombre de jets, système des deux jets principaux et empilement.**



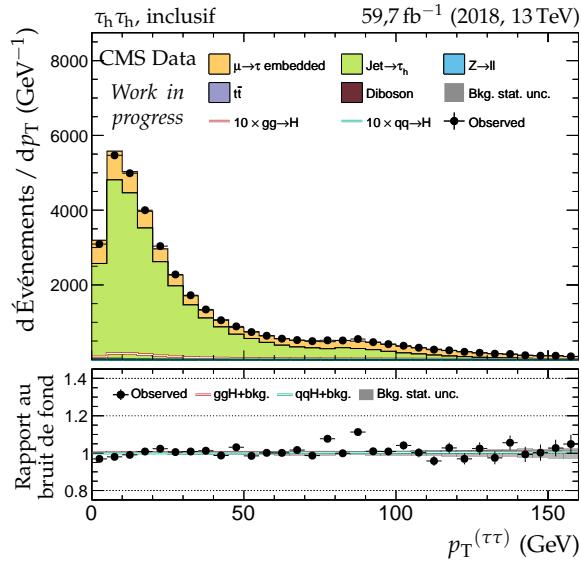
**Figure X.52 – Canal  $\tau_h \tau_h$ , 2018 : cinématique des leptons ( $\tau_h^{(1)}, \tau_h^{(2)}$ ).**



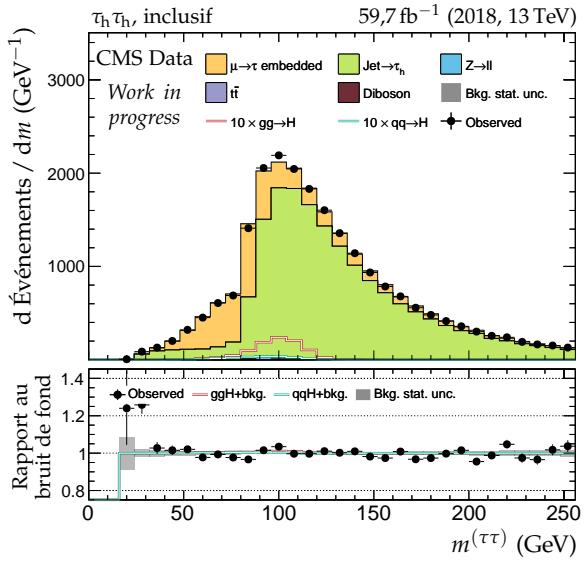
(a) Énergie transverse manquante.



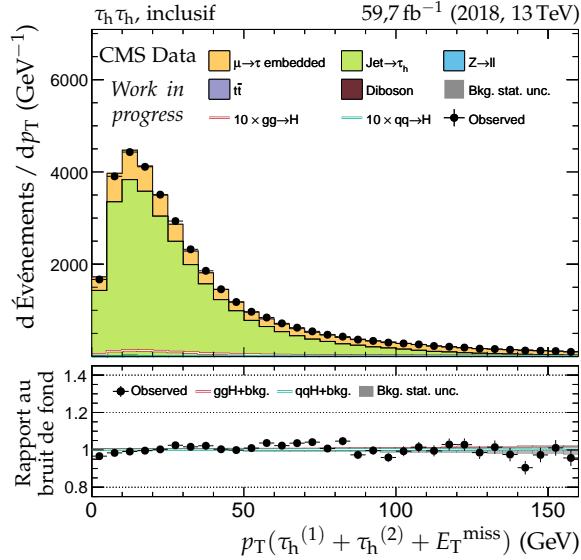
(b) Masse transverse du dilepton.



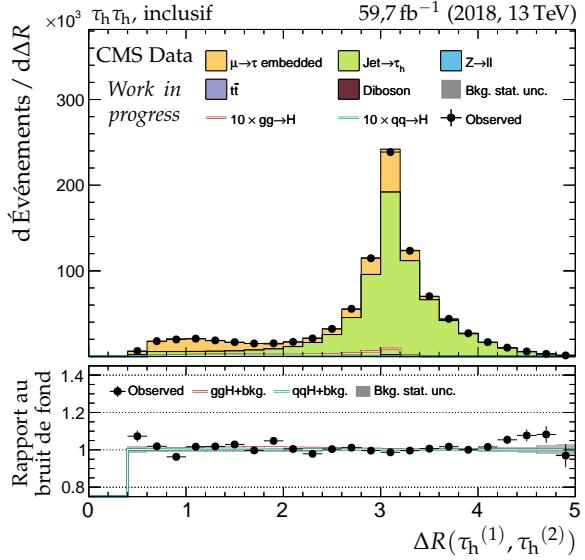
(c) Impulsion transverse du dilepton.



(d) Masse visible du dilepton.

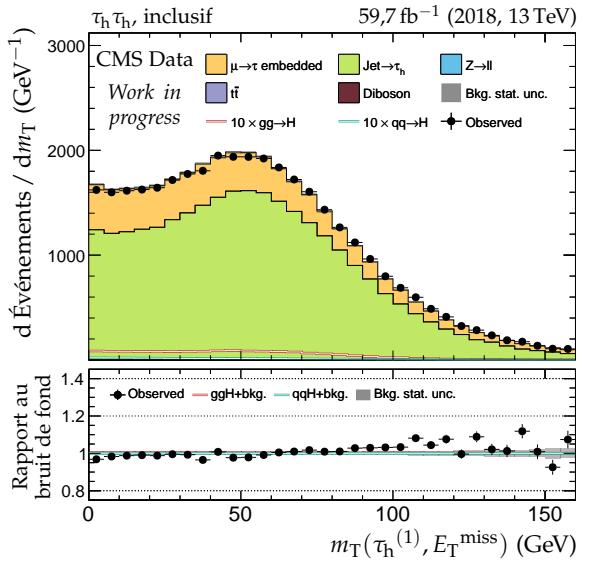
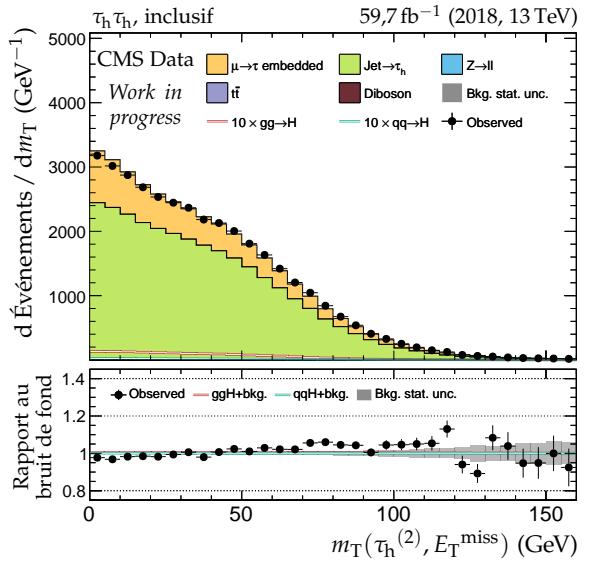
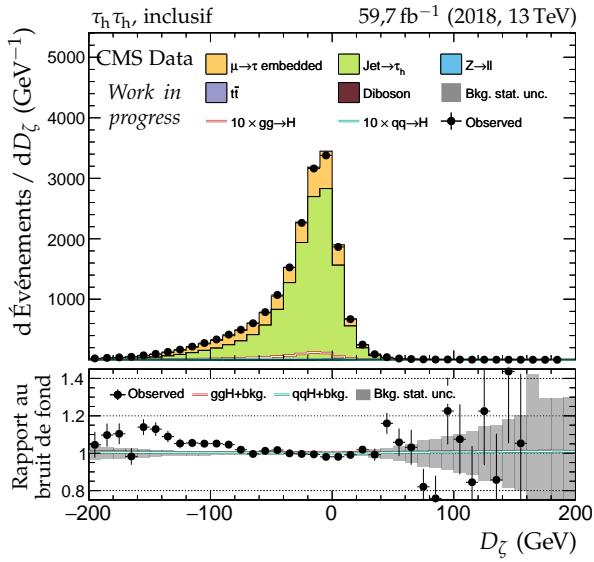
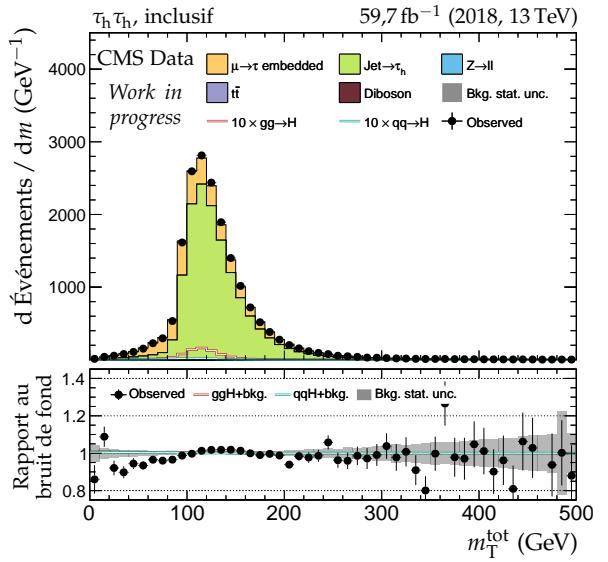


(e) Impulsion transverse du système di- $\tau$ .

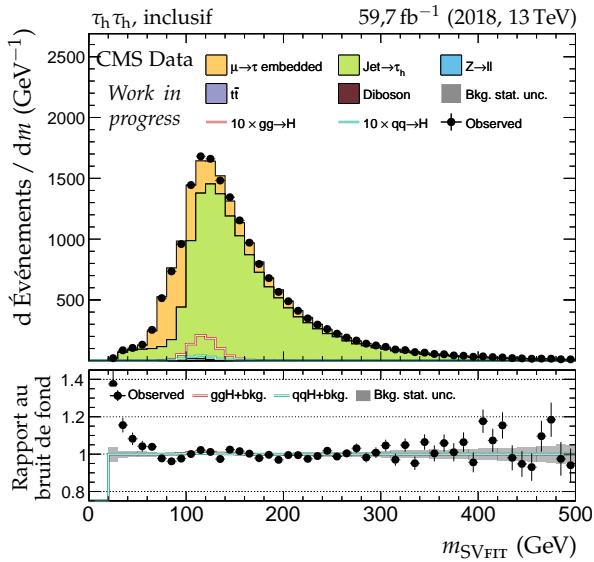
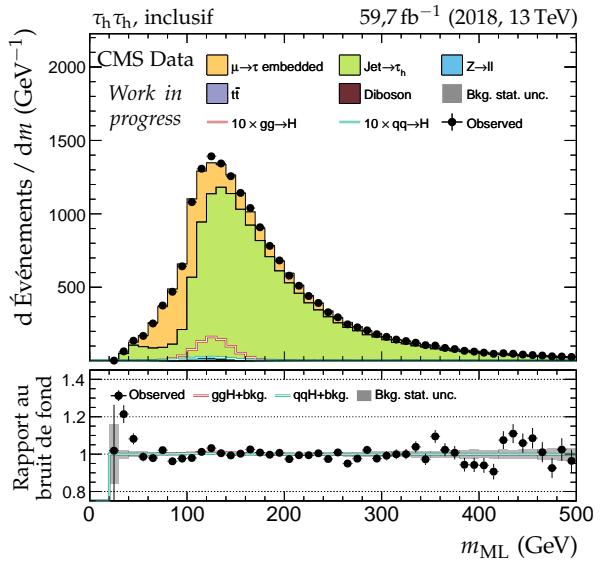


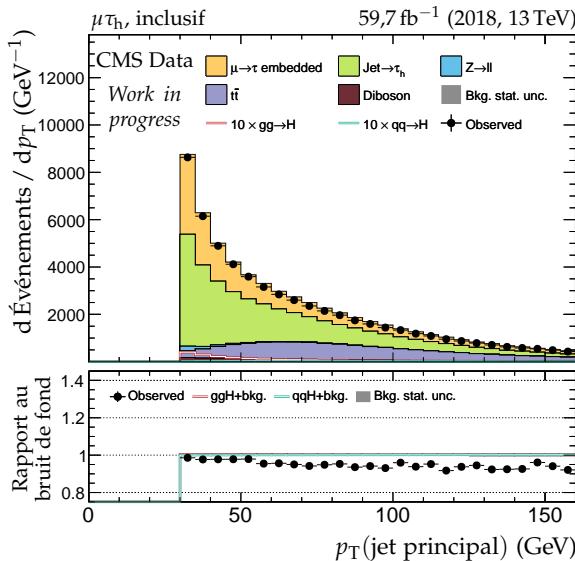
(f) Distance  $\Delta R$  entre les leptons ( $\tau_h^{(1)}, \tau_h^{(2)}$ ).

Figure X.53 – Canal  $\tau_h \tau_h$ , 2018 : dilepton et énergie transverse manquante.

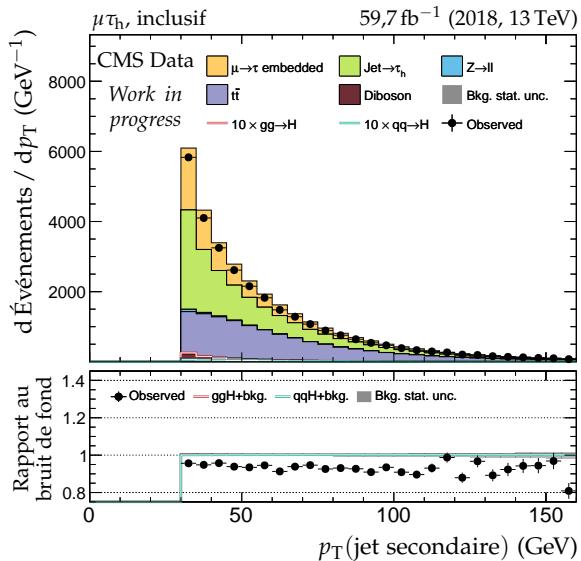
(a) Masse transverse du lepton 1 ( $\tau_h^{(1)}$ ).(b) Masse transverse du lepton 2 ( $\tau_h^{(2)}$ ).(c) Valeur de  $D_\zeta$ .

(d) Masse transverse totale.

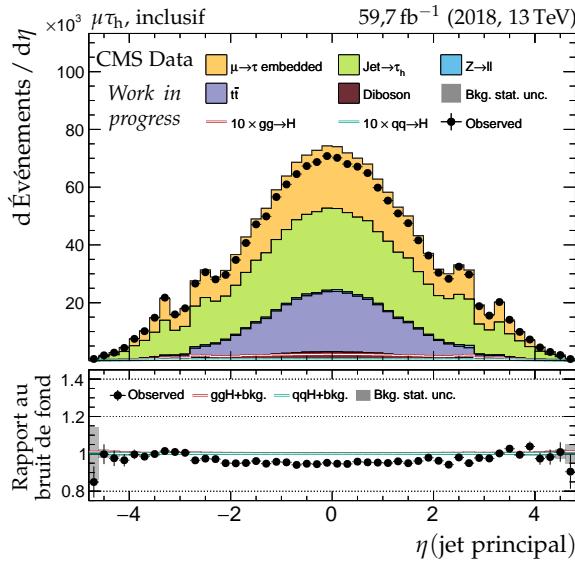
(e) Masse du système di- $\tau$  d'après SVFIT.(f) Masse du système di- $\tau$  d'après le ML.**Figure X.54 – Canal  $\tau_h \tau_h$ , 2018 : masses transverses,  $D_\zeta$  et masses.**



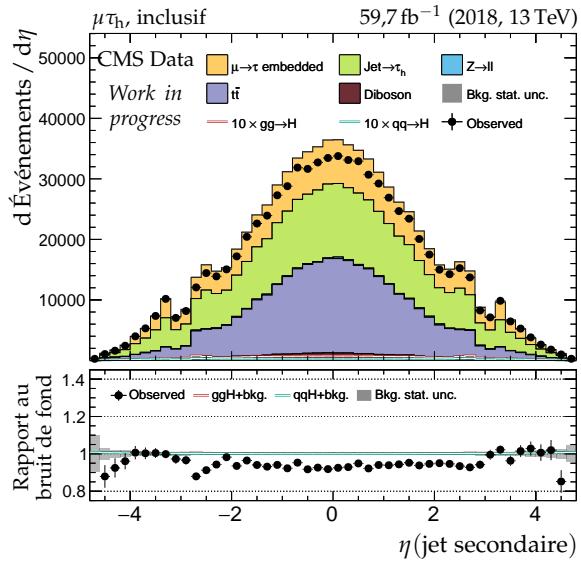
(a) Impulsion transverse du jet principal.



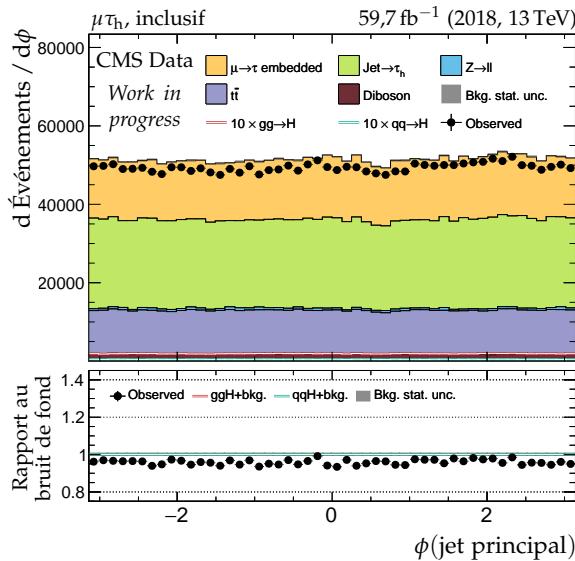
(b) Impulsion transverse du jet secondaire.



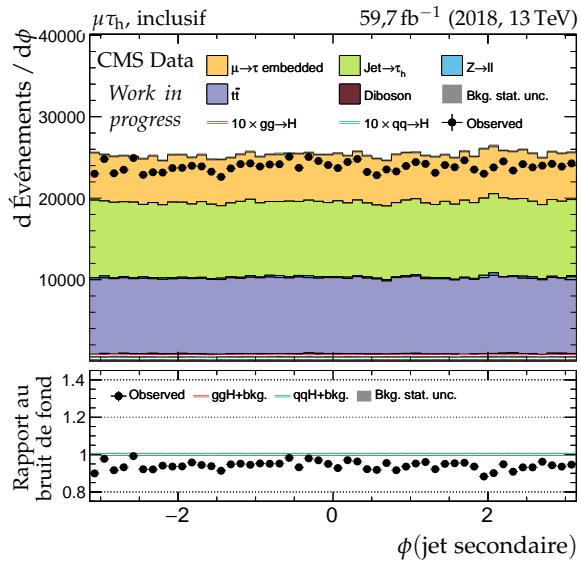
(c) Pseudo-rapidité du jet principal.



(d) Pseudo-rapidité du jet secondaire.

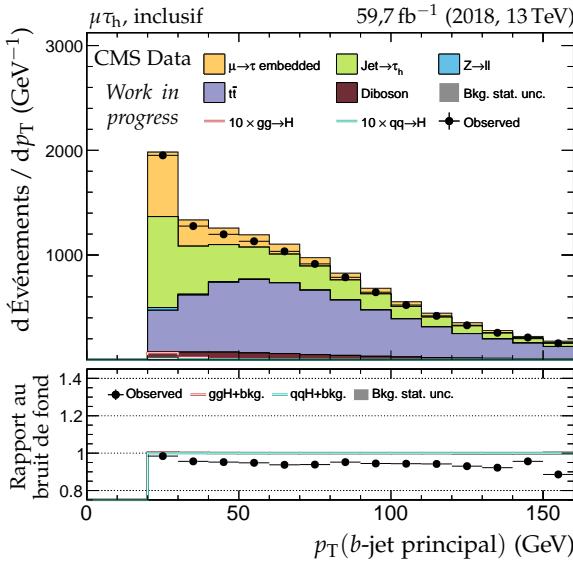


(e) Angle azimutal du jet principal.

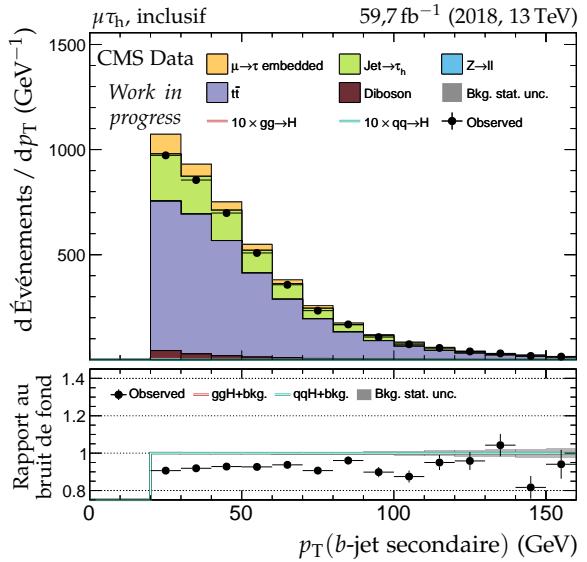


(f) Angle azimutal du jet secondaire.

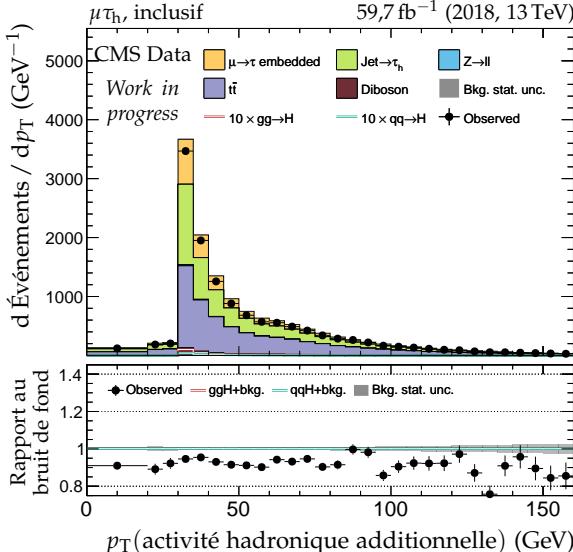
Figure X.55 – Canal  $\mu\tau_h$ , 2018 : cinématique des deux jets principaux.



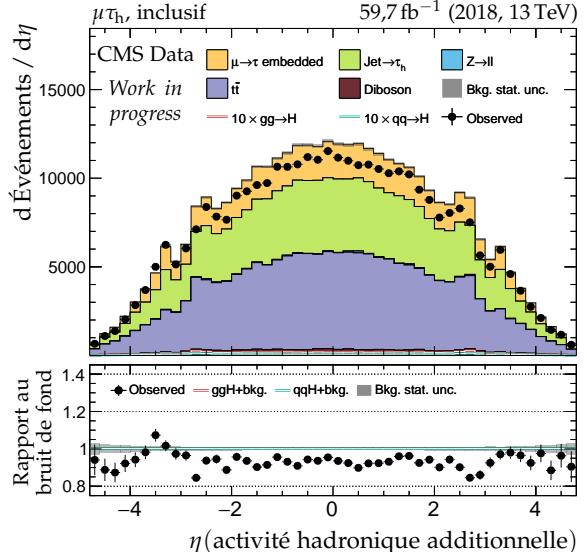
(a) Impulsion transverse du b-jet principal.



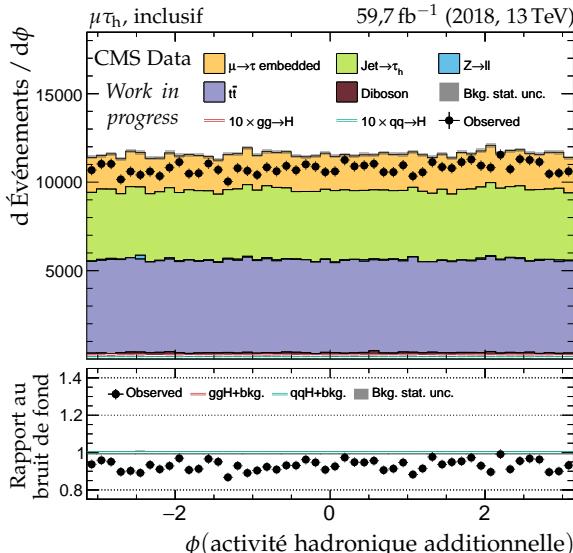
(b) Impulsion transverse du b-jet secondaire.



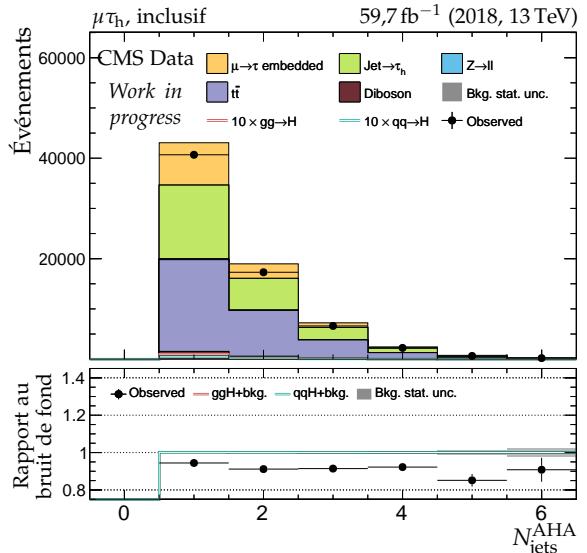
(c) Impulsion transverse de l'AHA.



(d) Pseudo-rapidité de l'AHA.

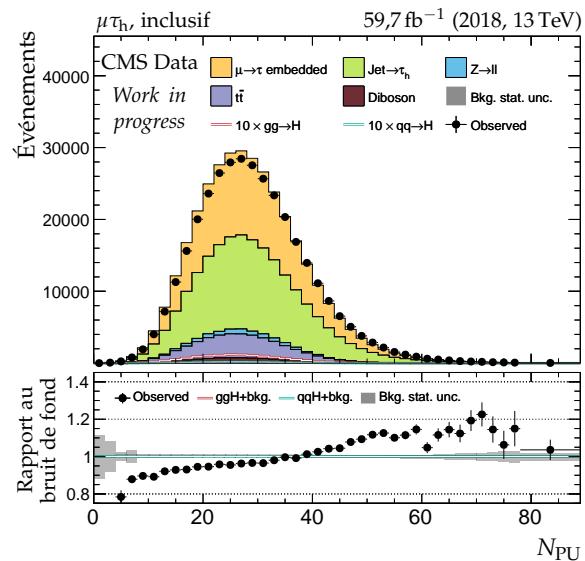
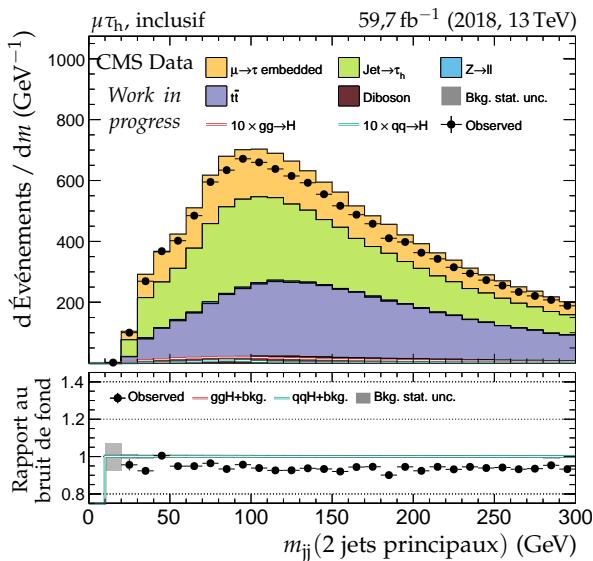
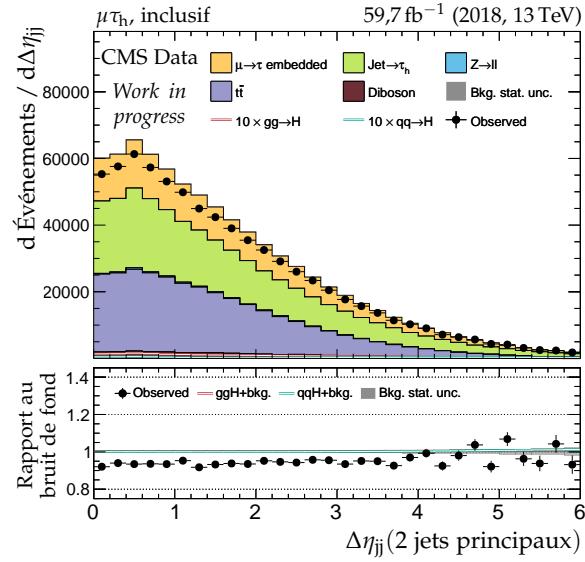
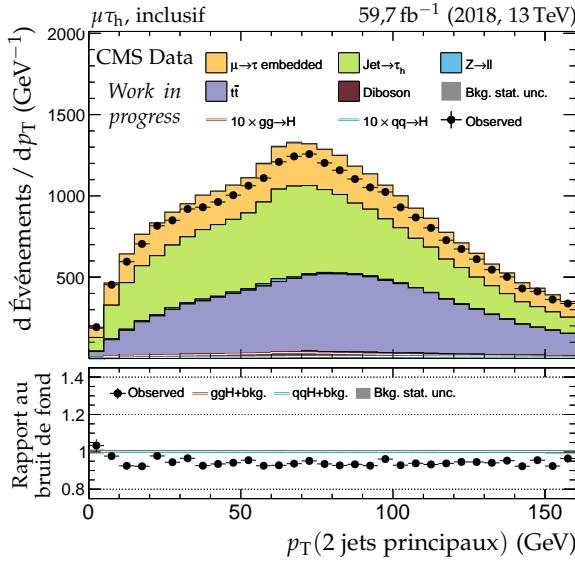
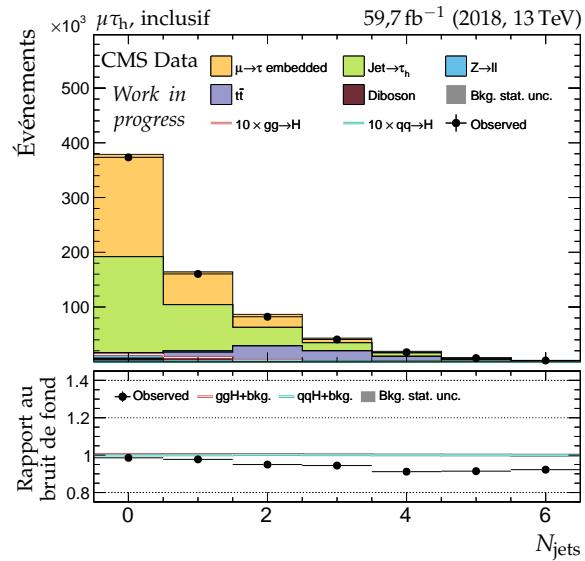
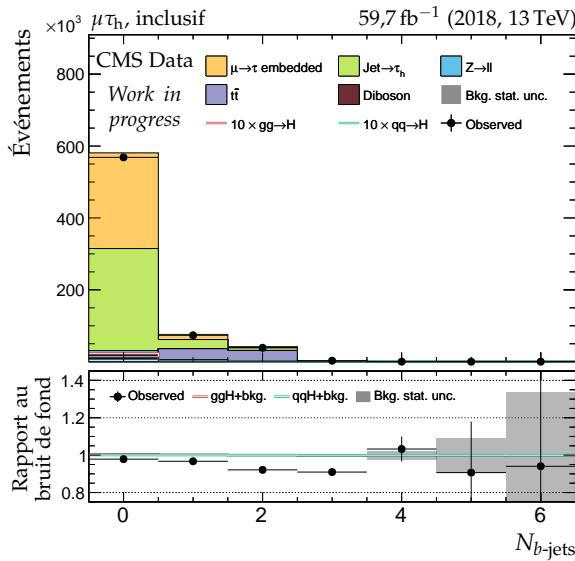


(e) Angle azimutal de l'AHA.

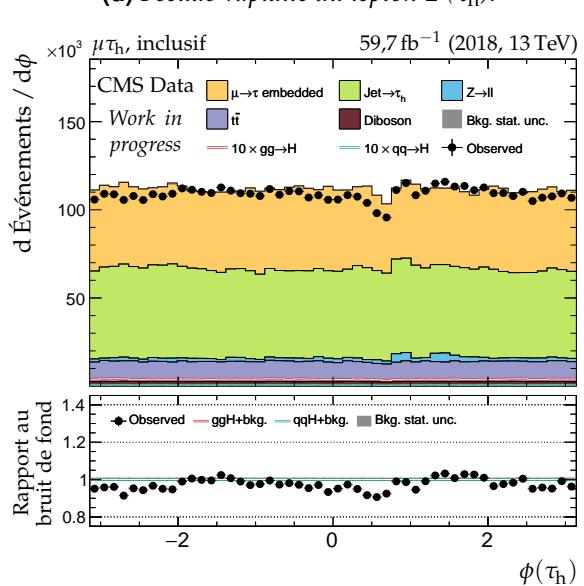
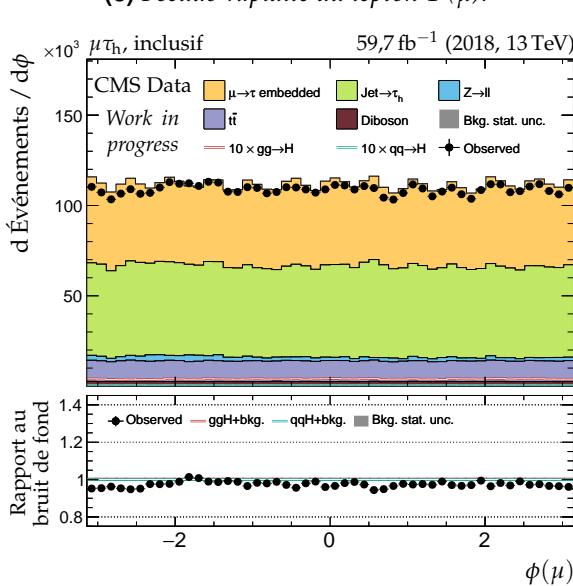
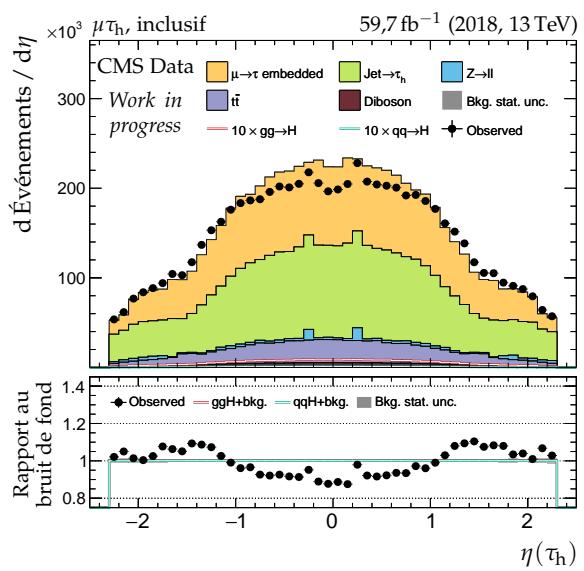
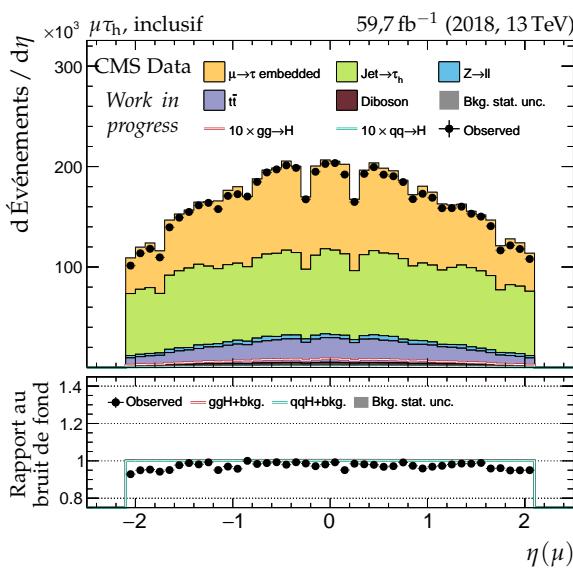
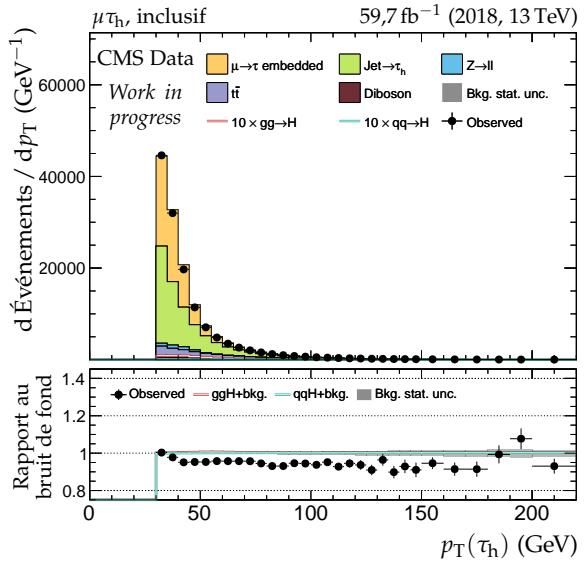
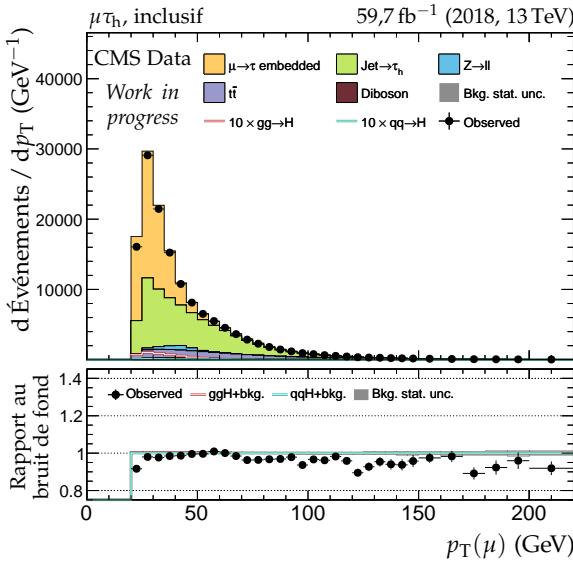


(f) Nombre de jets dans l'AHA.

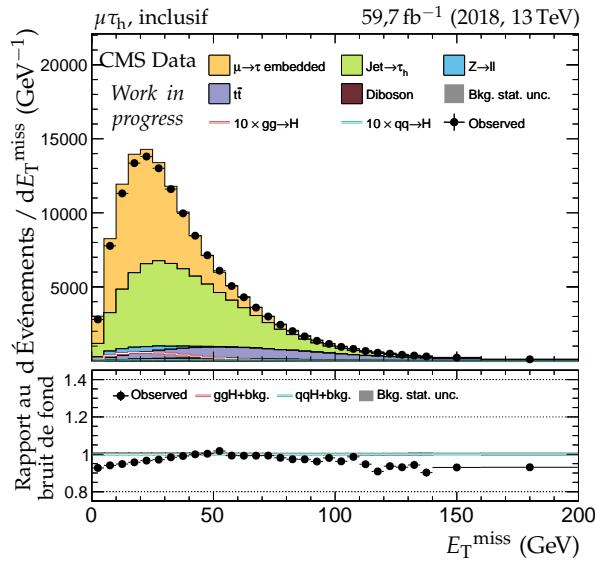
**Figure X.56 – Canal  $\mu\tau_h$ , 2018 : b-jets et activité hadronique additionnelle.**



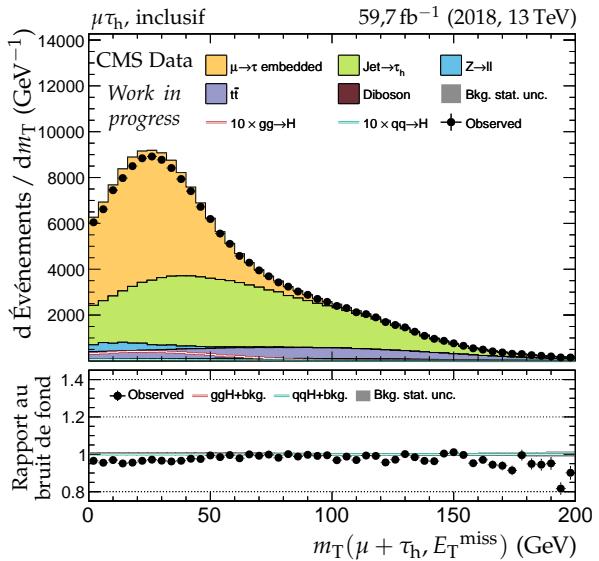
**Figure X.57 – Canal  $\mu\tau_h$ , 2018 : nombre de jets, système des deux jets principaux et empilement.**



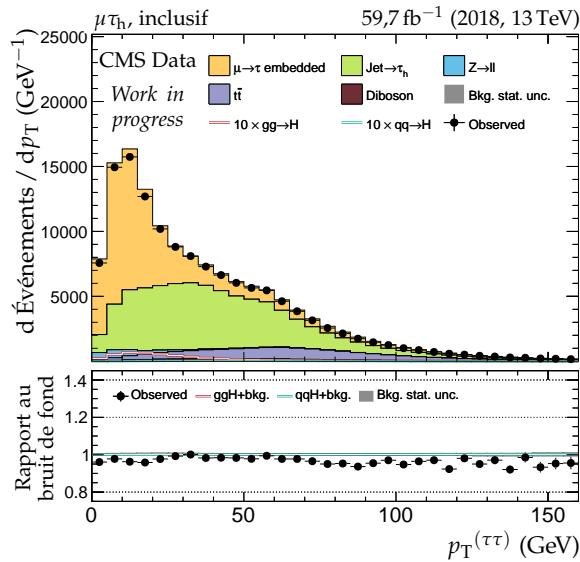
**Figure X.58 – Canal  $\mu\tau_h$ , 2018 : cinématique des leptons ( $\mu, \tau_h$ ).**



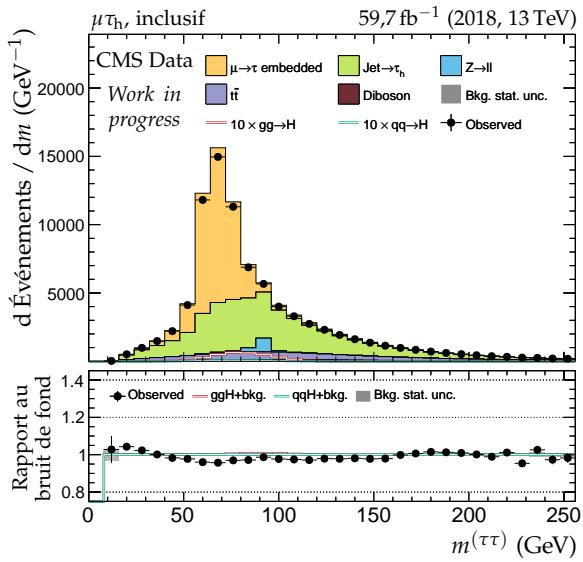
(a) Énergie transverse manquante.



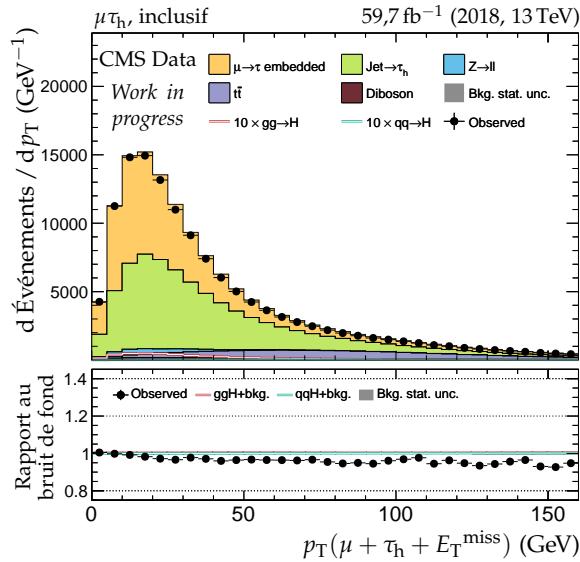
(b) Masse transverse du dilepton.



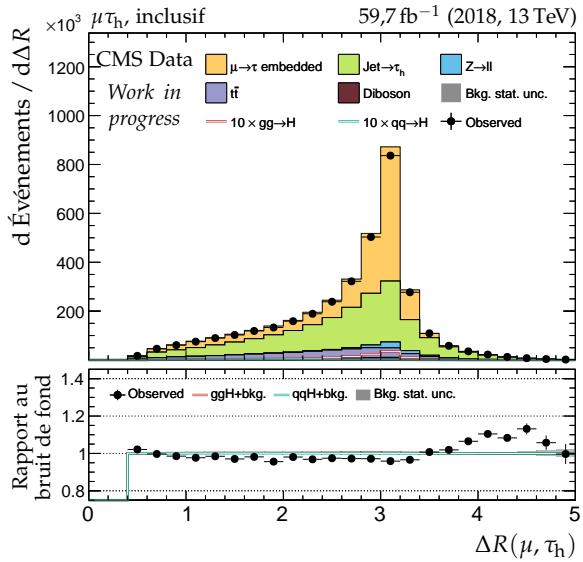
(c) Impulsion transverse du dilepton.



(d) Masse visible du dilepton.

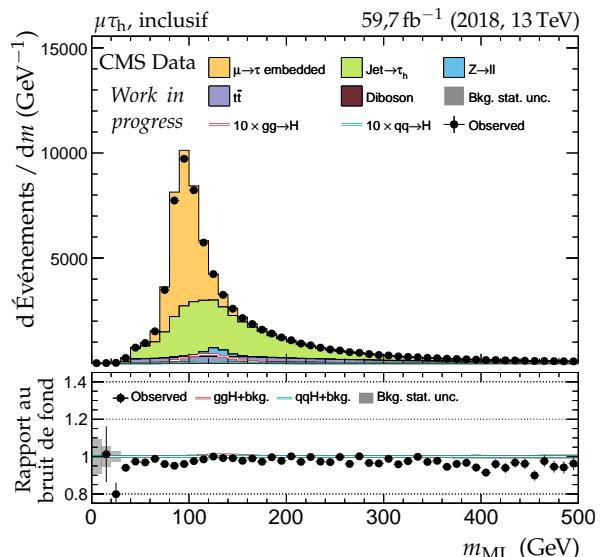
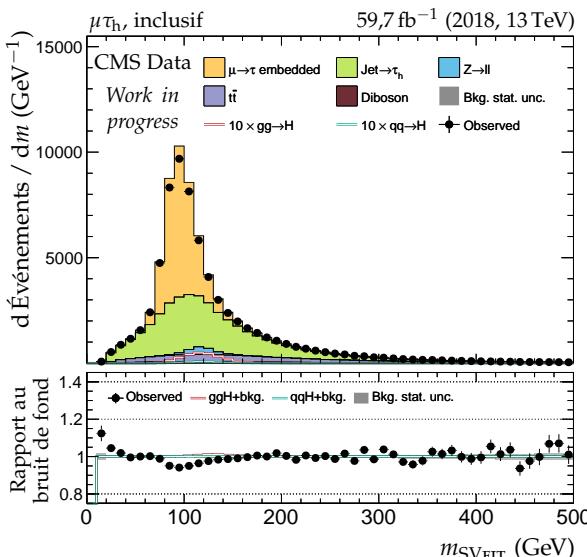
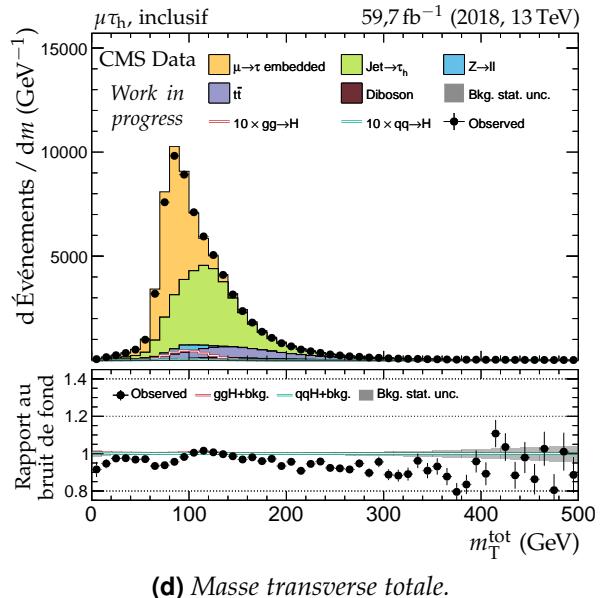
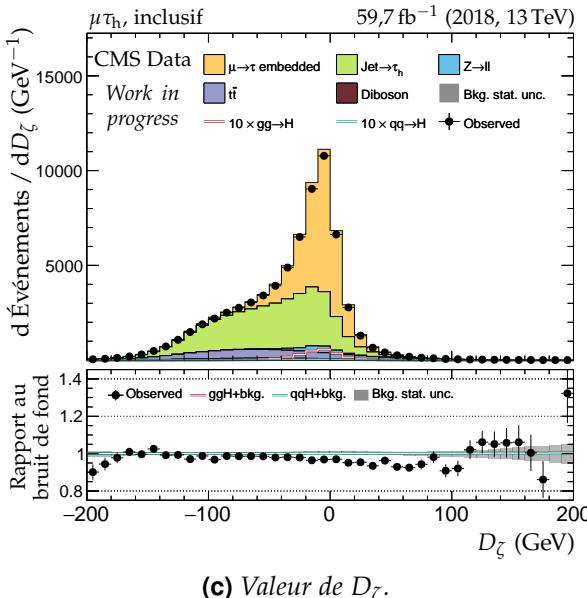
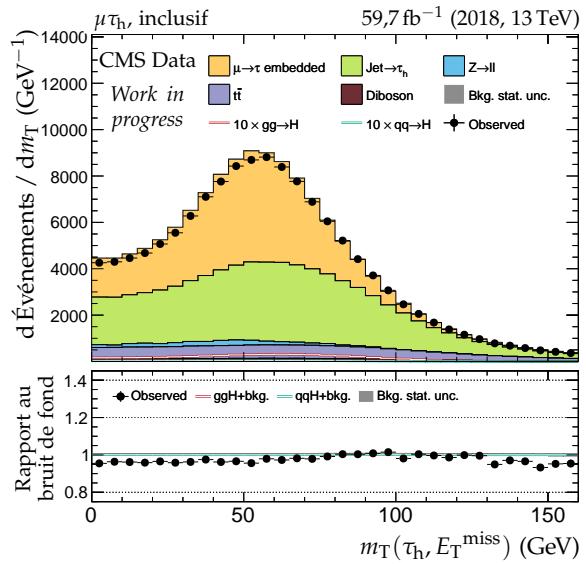
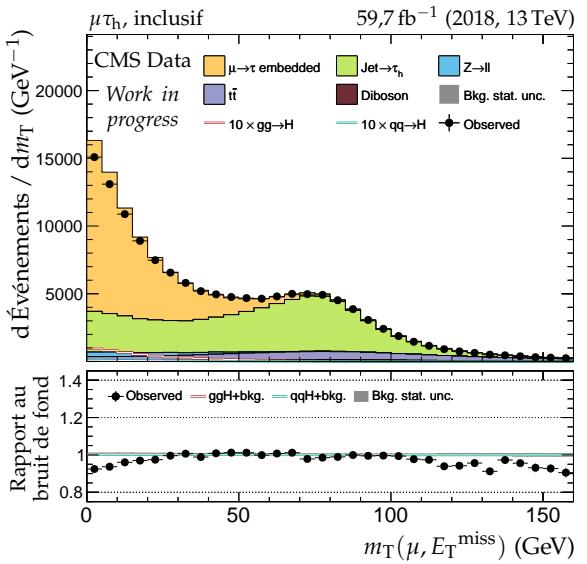


(e) Impulsion transverse du système di- $\tau$ .

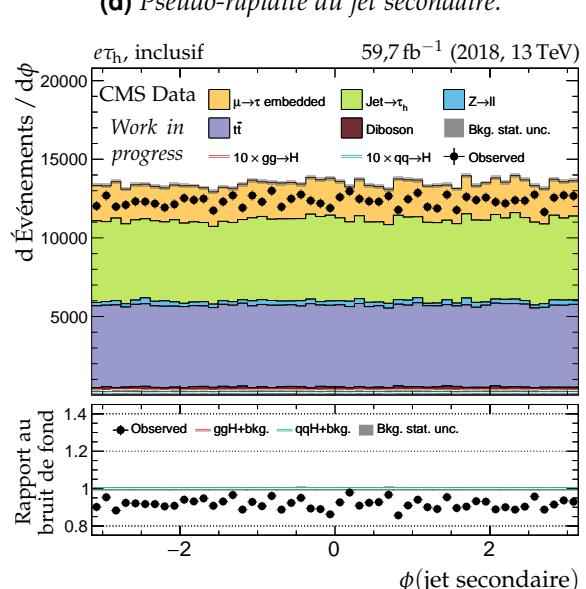
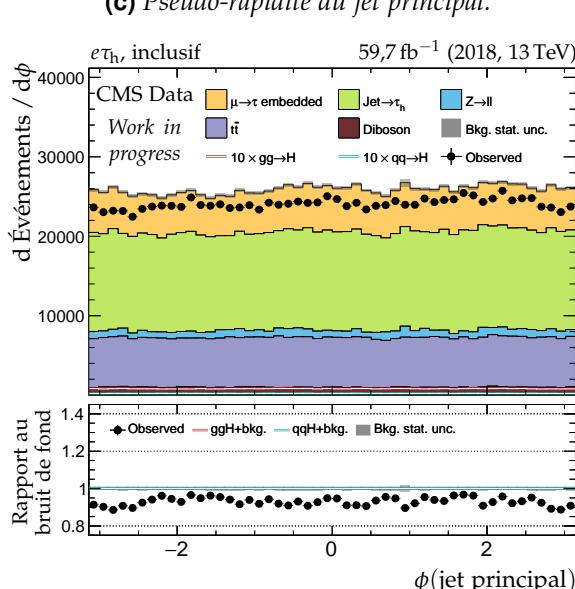
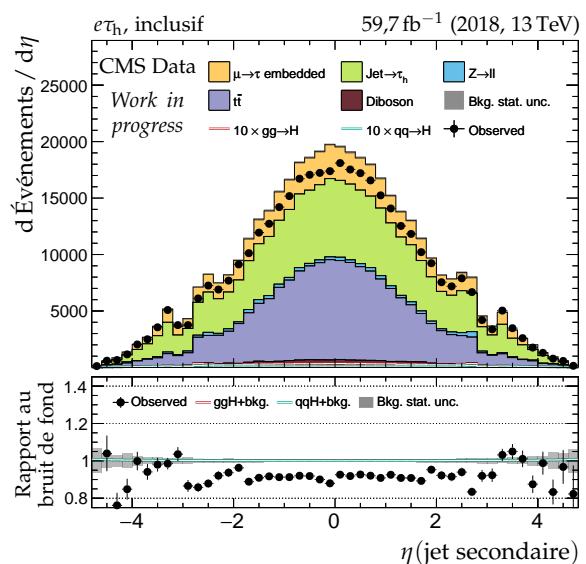
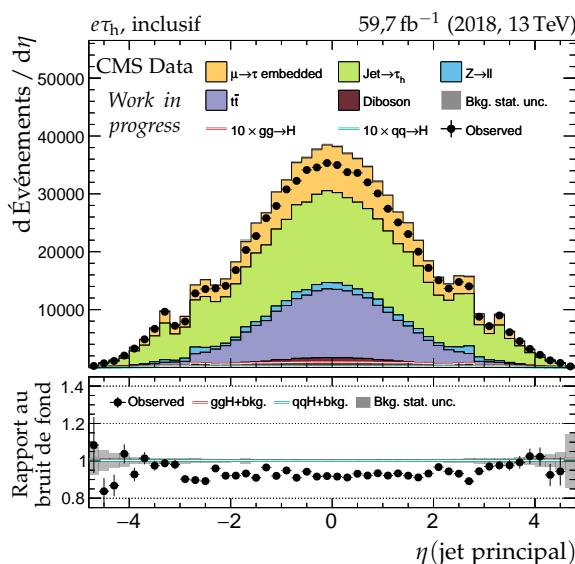
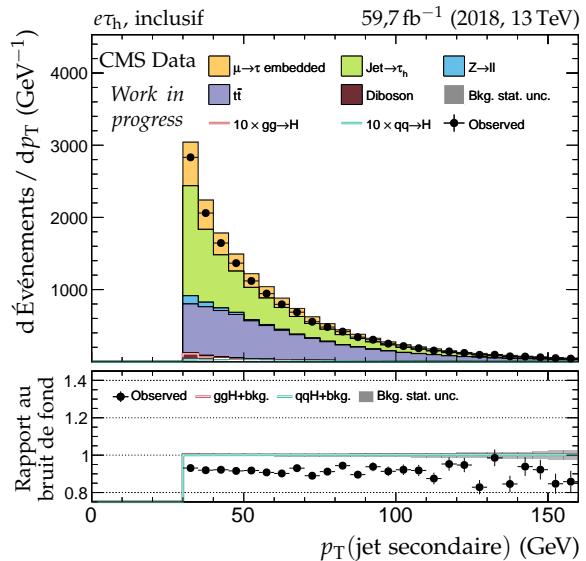
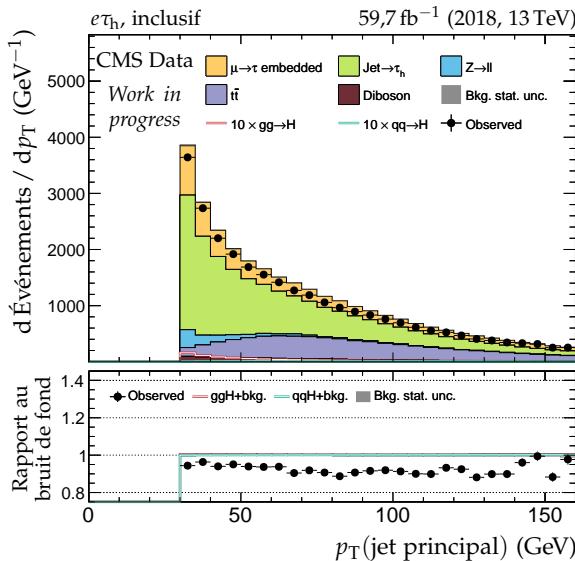


(f) Distance  $\Delta R$  entre les leptons ( $\mu, \tau_h$ ).

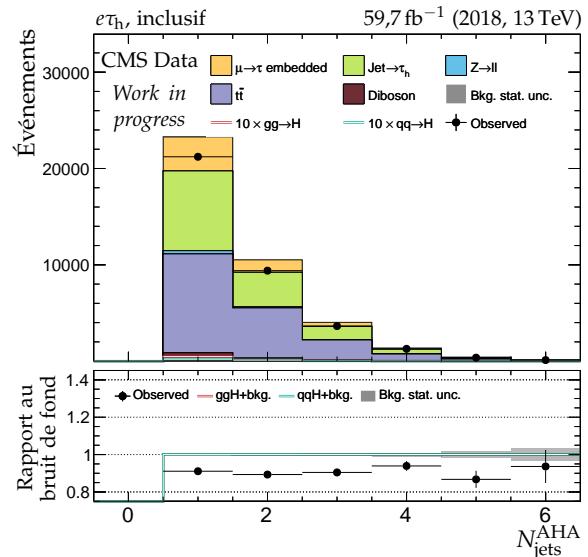
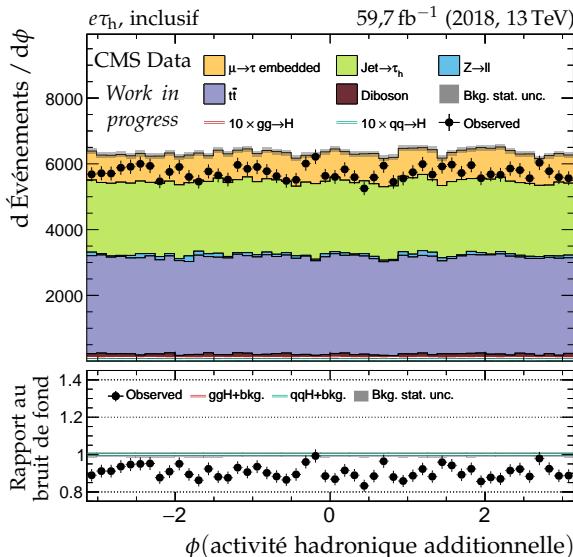
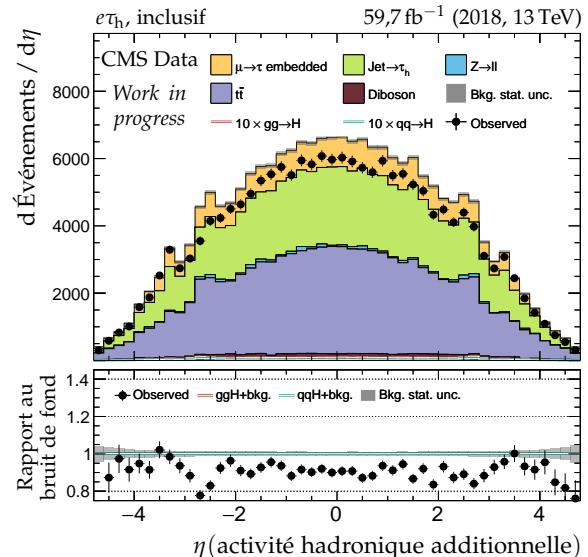
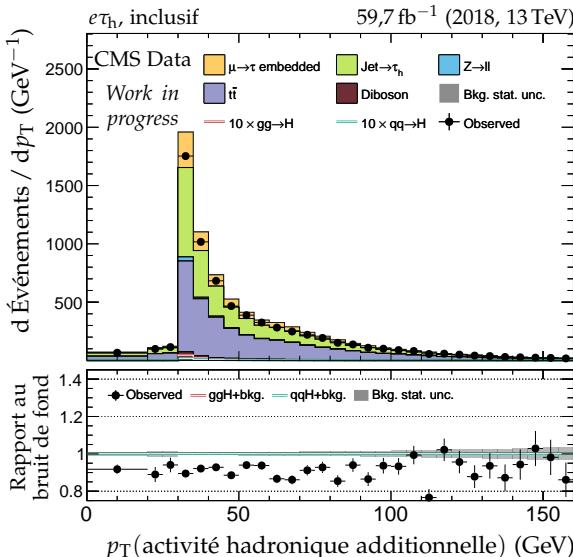
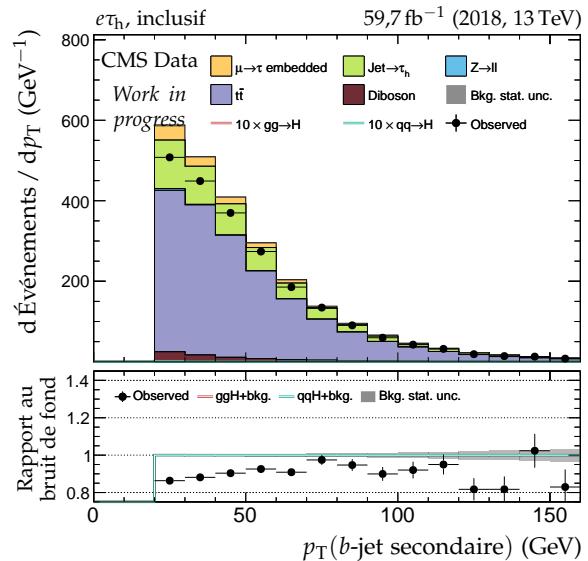
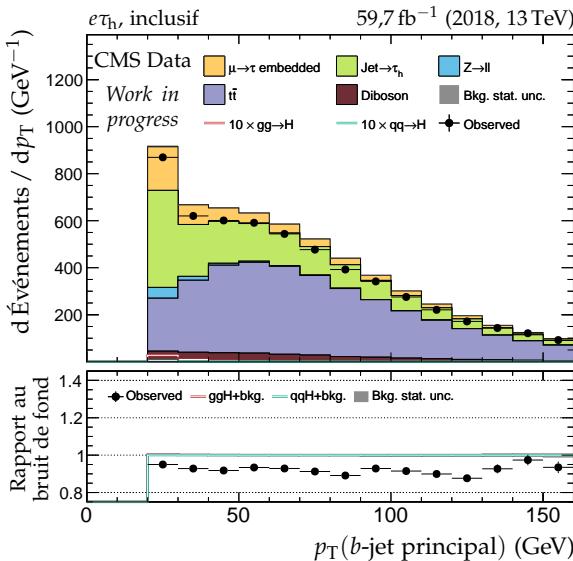
Figure X.59 – Canal  $\mu\tau_h$ , 2018 : dilepton et énergie transverse manquante.



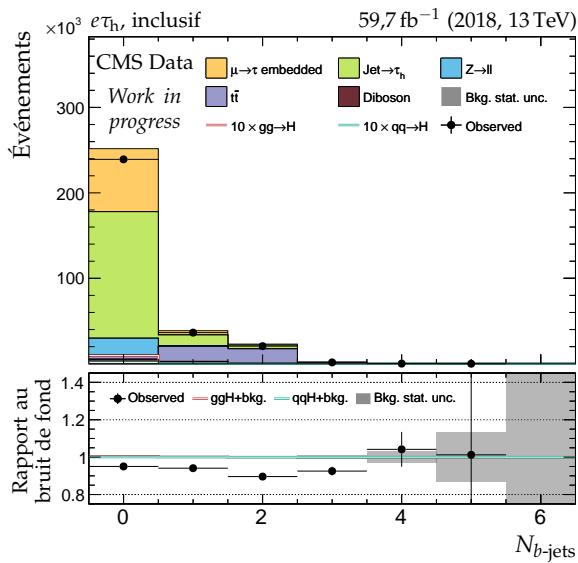
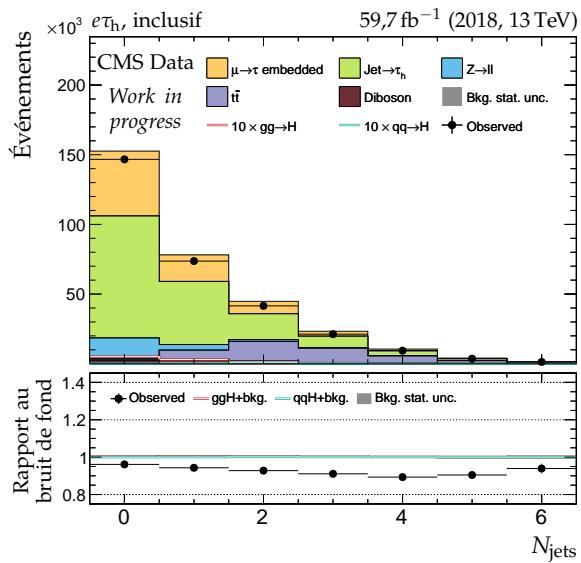
**Figure X.60 – Canal  $\mu\tau_h$ , 2018 : masses transverses,  $D_\zeta$  et masses.**



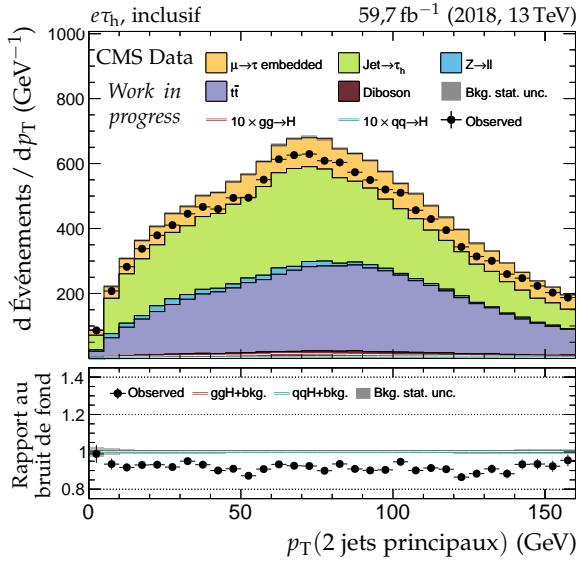
**Figure X.61 – Canal  $e\tau_h$ , 2018 : cinématique des deux jets principaux.**



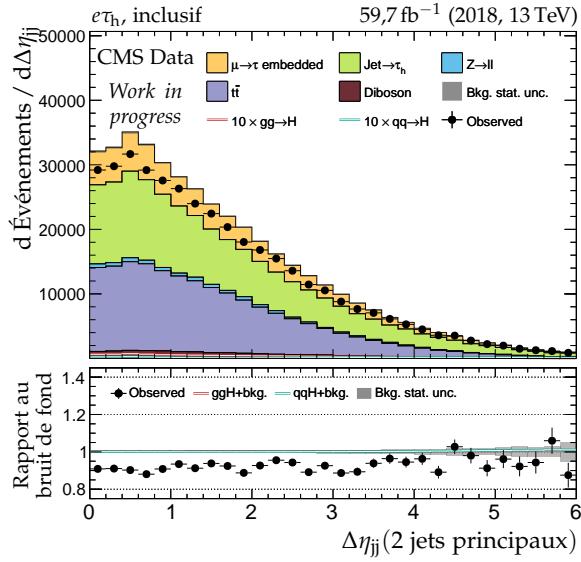
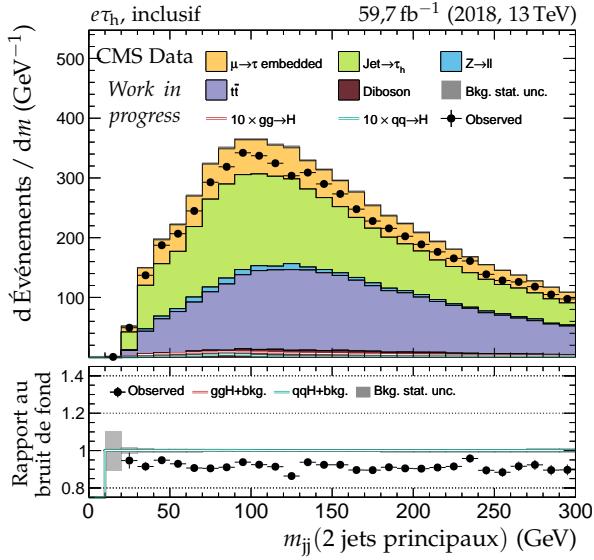
**Figure X.62 – Canal  $e\tau_h$ , 2018 :  $b$ -jets et activité hadronique additionnelle.**

(a) Nombre de  $b$ -jets.

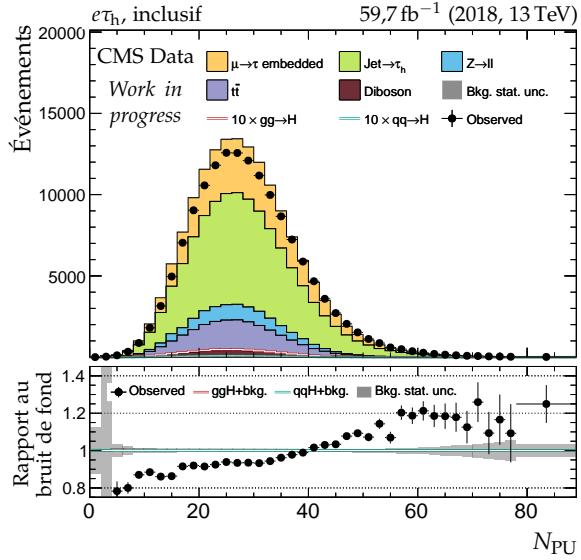
(b) Nombre de jets.



(c) Impulsion transverse du système des deux jets.

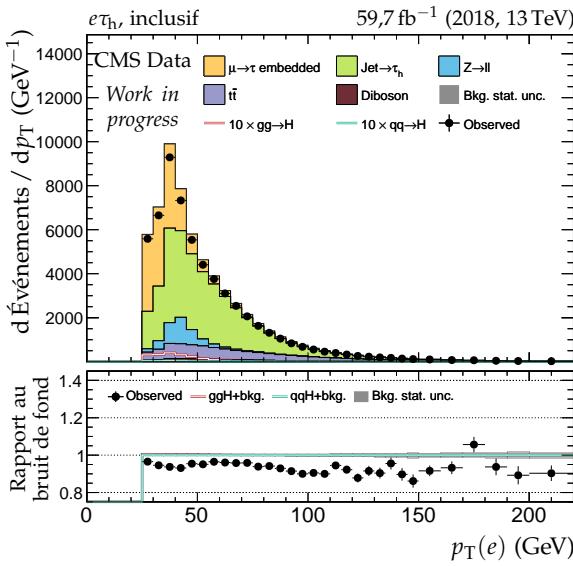
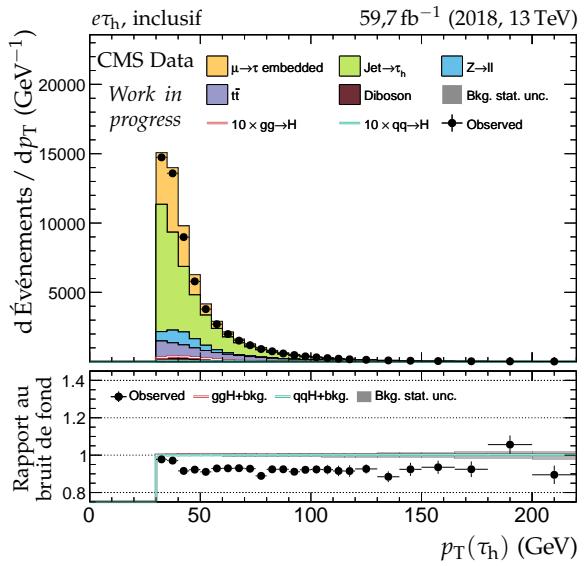
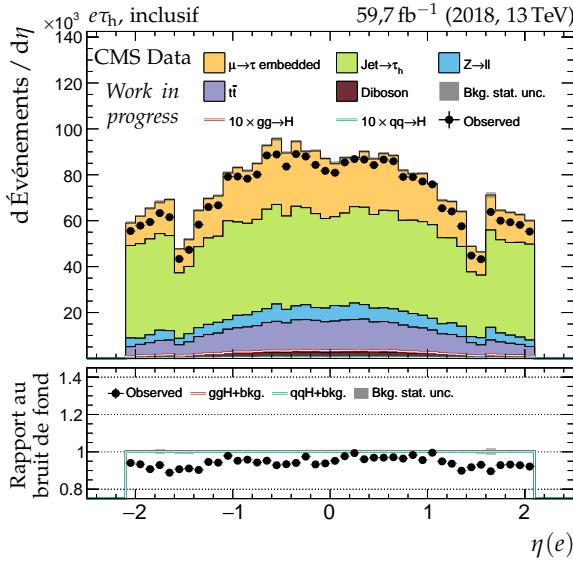
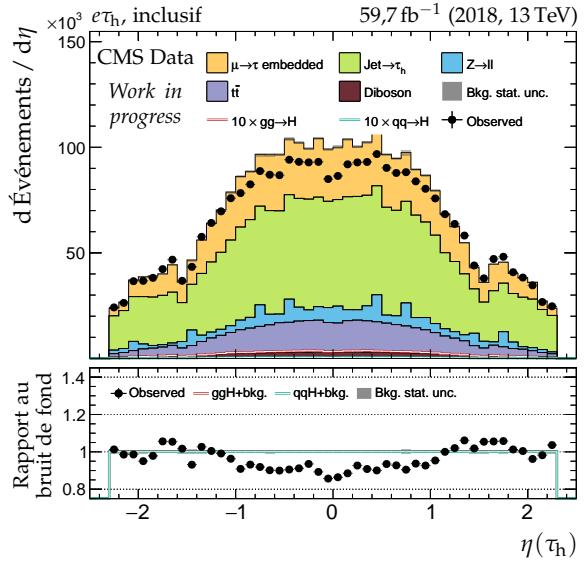
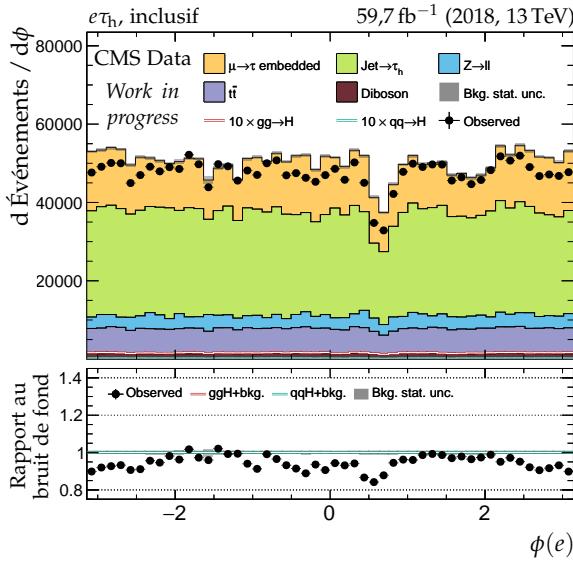
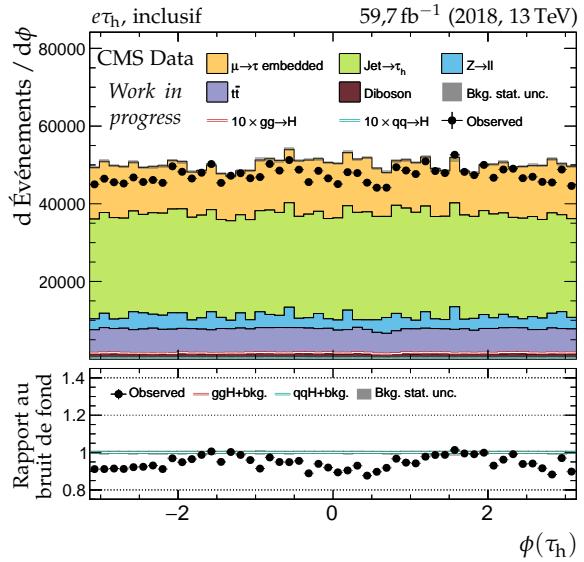
(d) Distance en  $\eta$  entre les deux jets.

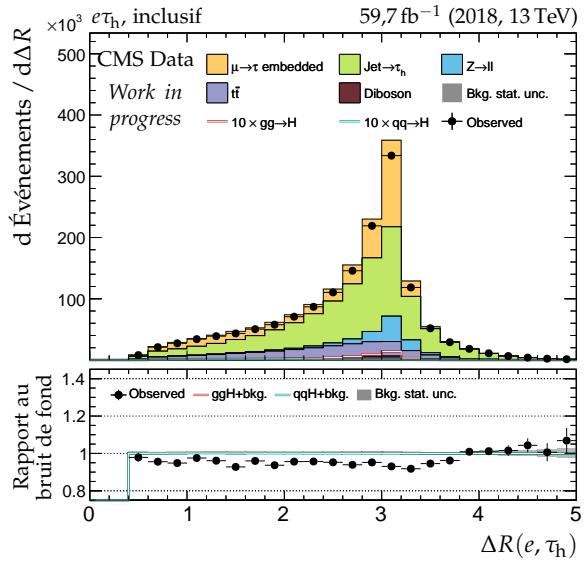
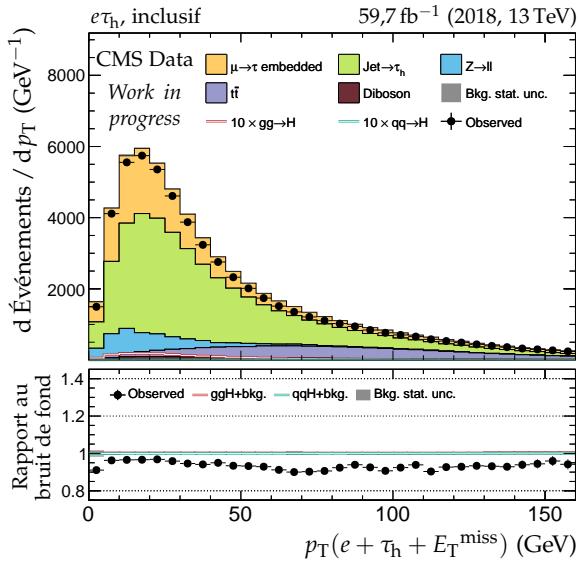
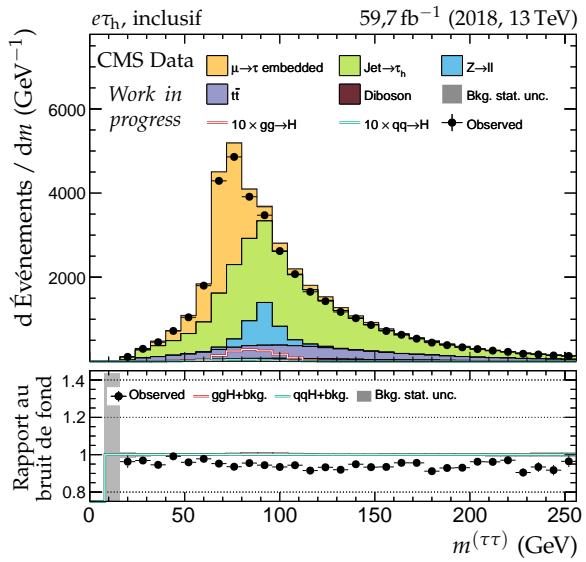
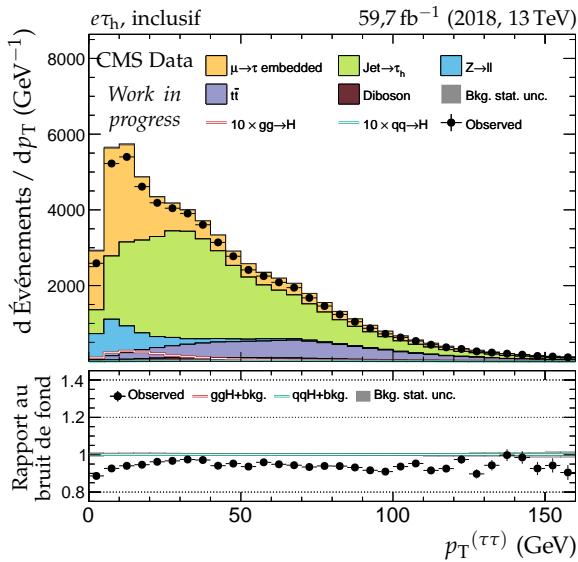
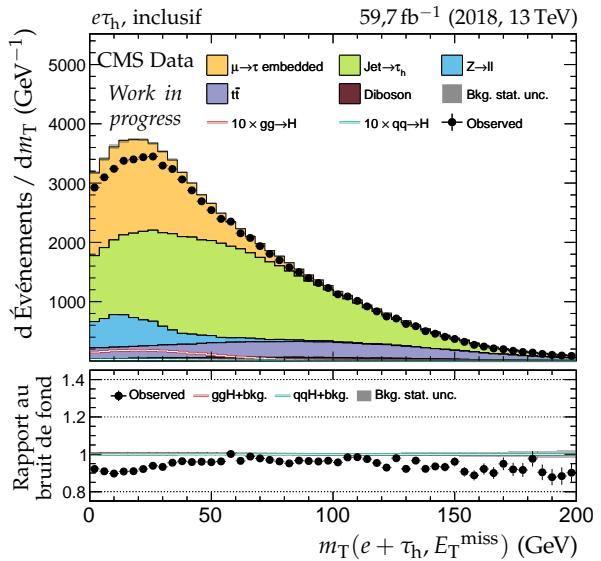
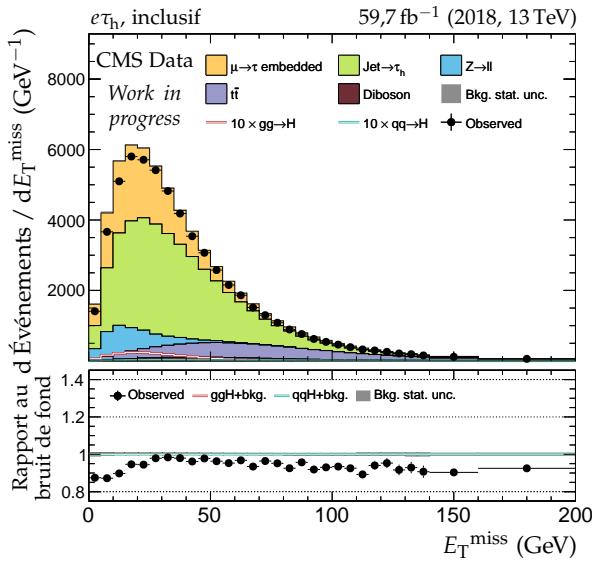
(e) Masse invariante du système des deux jets.



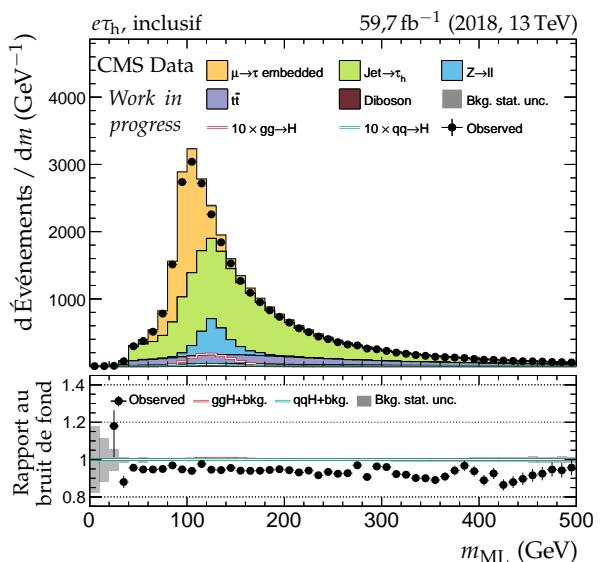
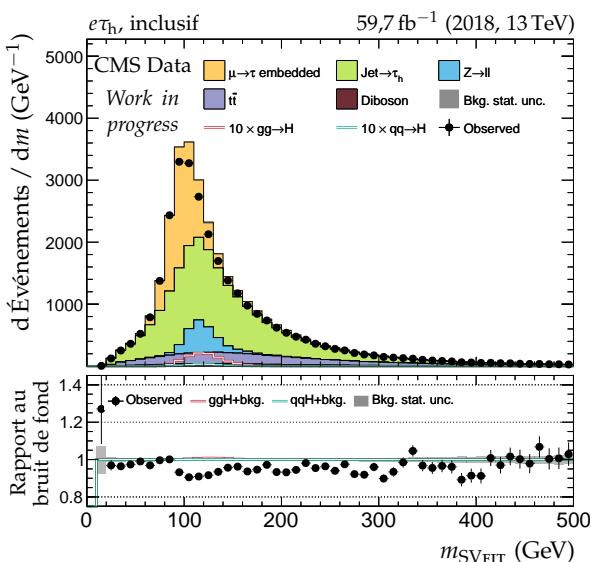
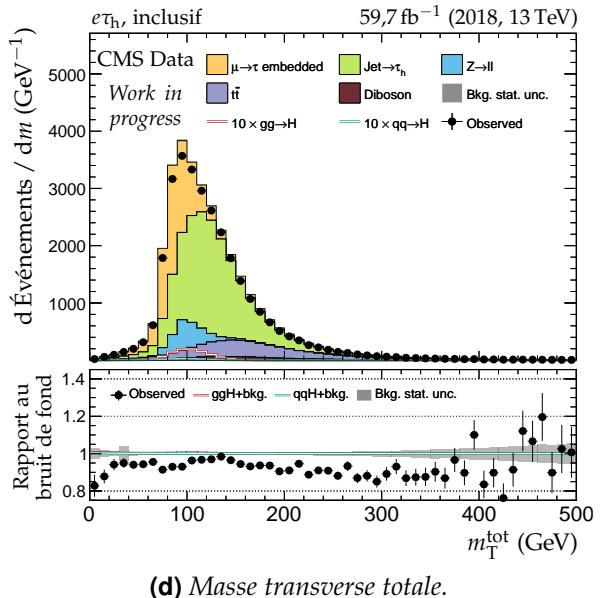
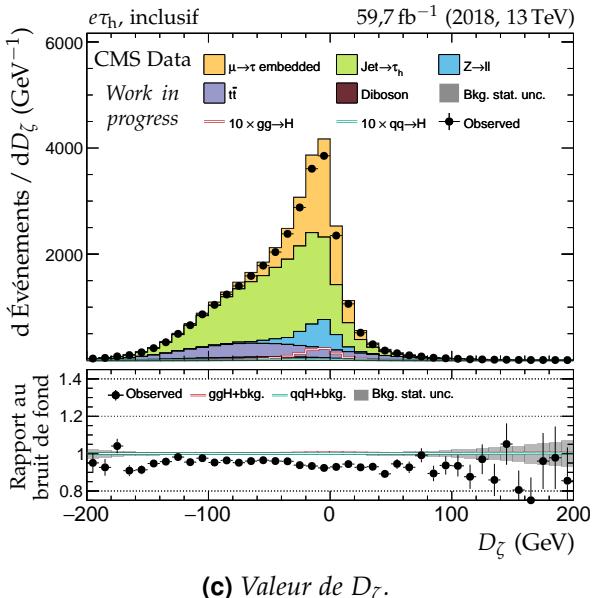
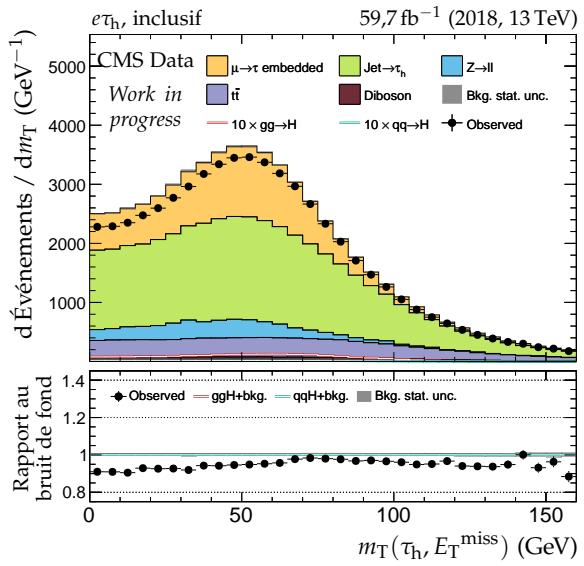
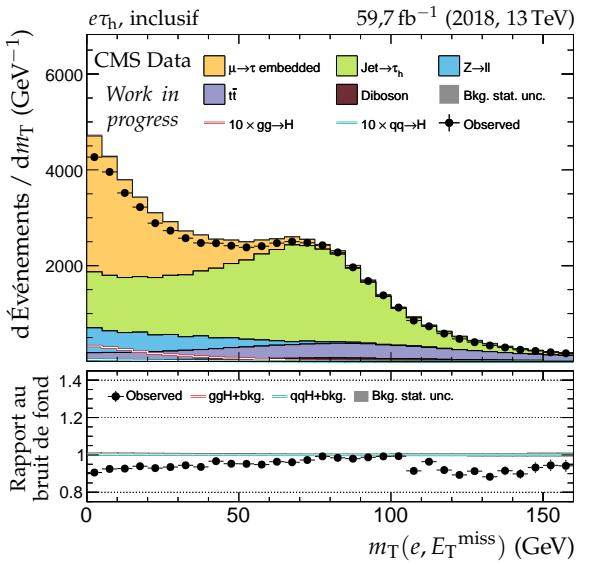
(f) Nombre de vertex d'empilement.

**Figure X.63 – Canal  $e\tau_h$ , 2018 : nombre de jets, système des deux jets principaux et empilement.**

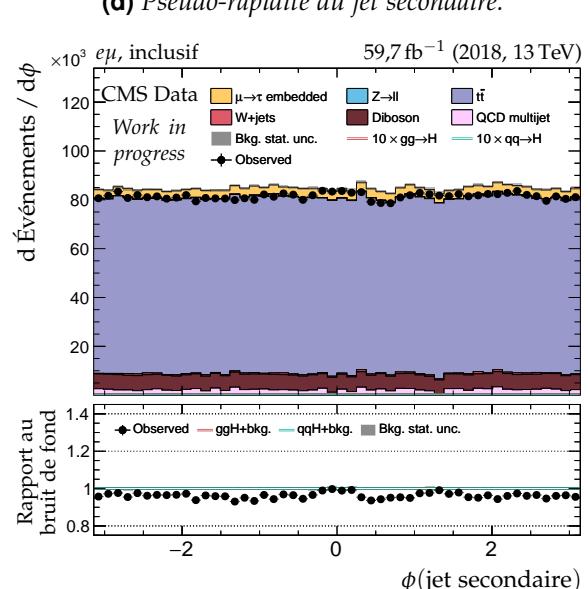
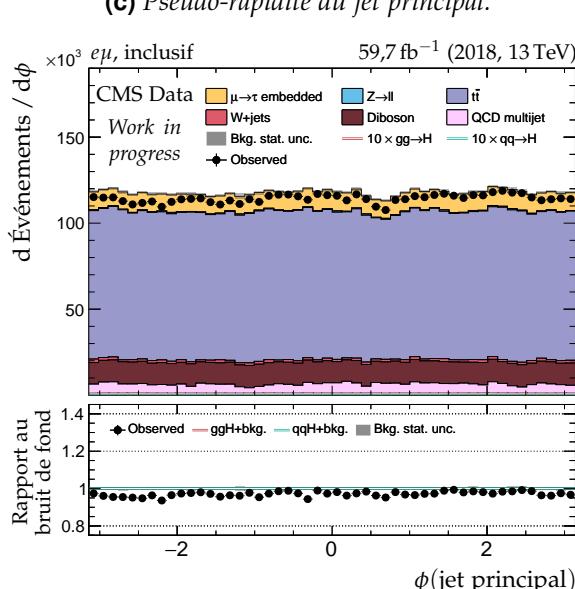
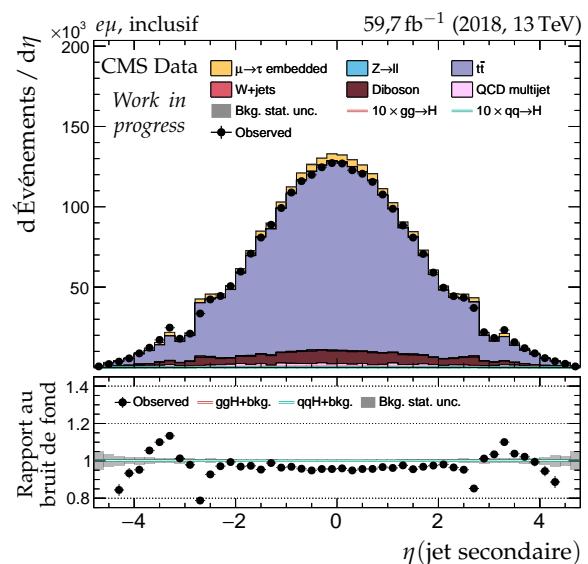
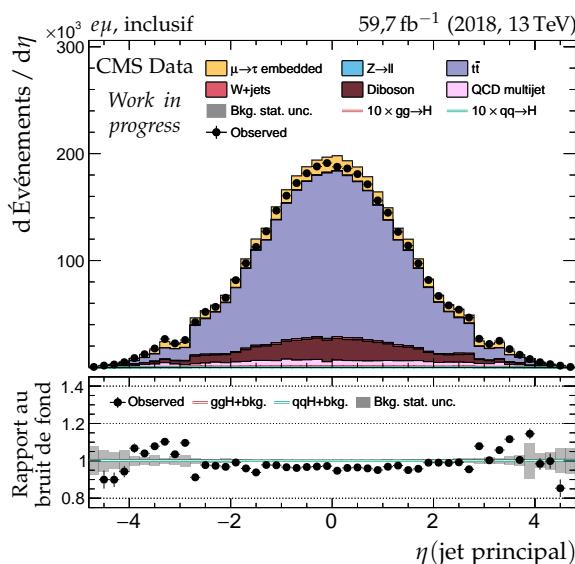
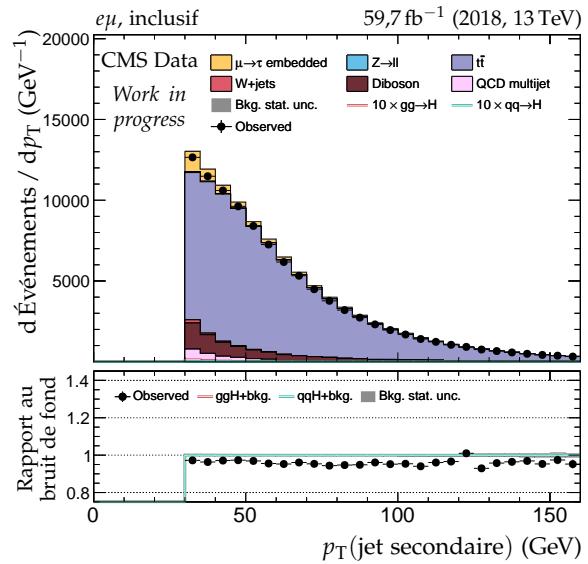
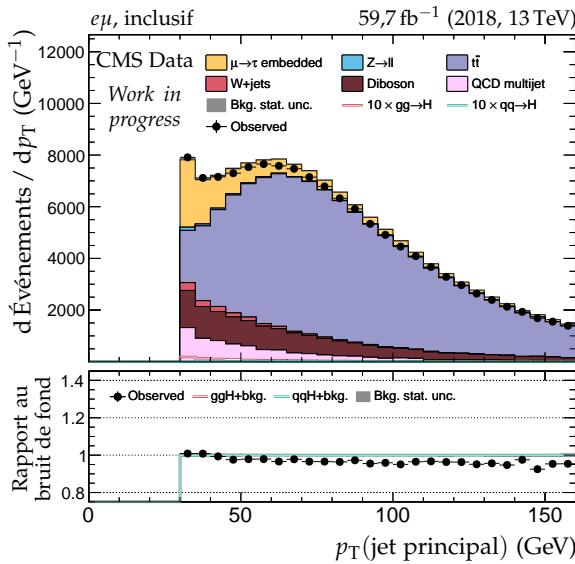
(a) Impulsion transverse du lepton 1 ( $e$ ).(b) Impulsion transverse du lepton 2 ( $\tau_h$ ).(c) Pseudo-rapidité du lepton 1 ( $e$ ).(d) Pseudo-rapidité du lepton 2 ( $\tau_h$ ).(e) Angle azimutal du lepton 1 ( $e$ ).(f) Angle azimutal du lepton 2 ( $\tau_h$ ).**Figure X.64 – Canal  $e\tau_h$ , 2018 : cinématique des leptons ( $e, \tau_h$ ).**



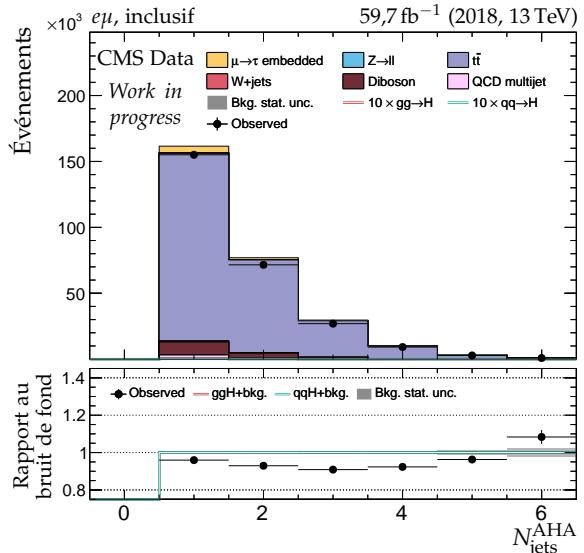
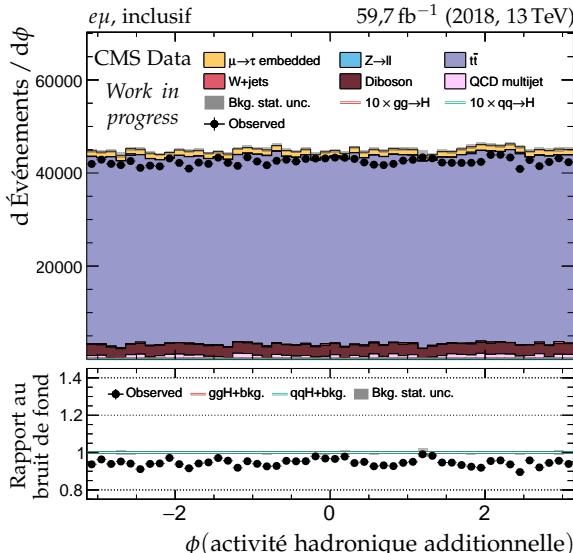
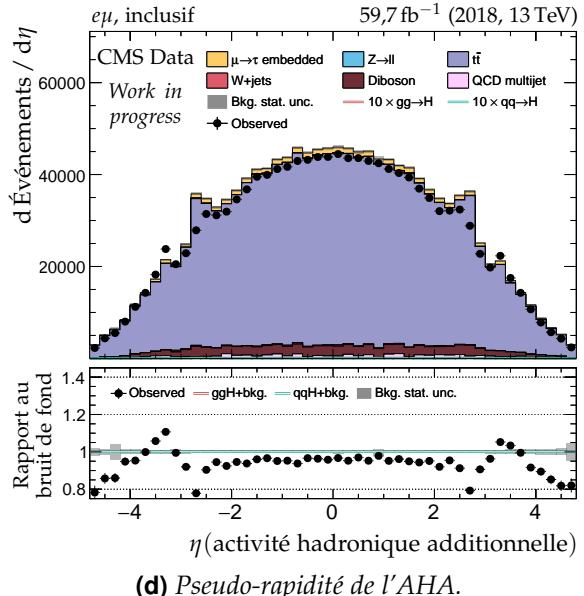
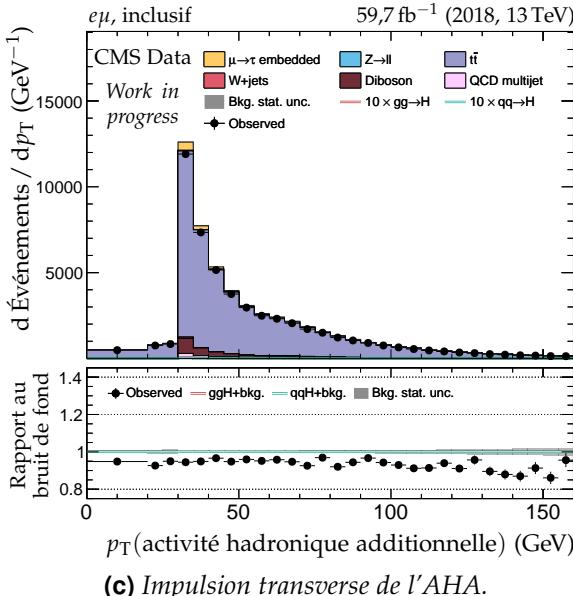
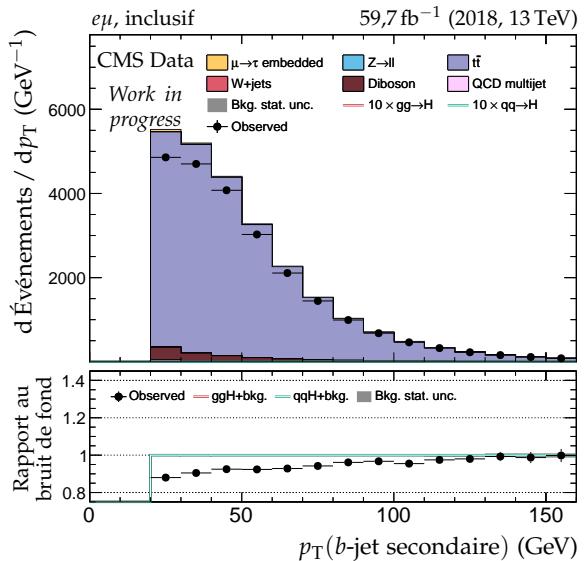
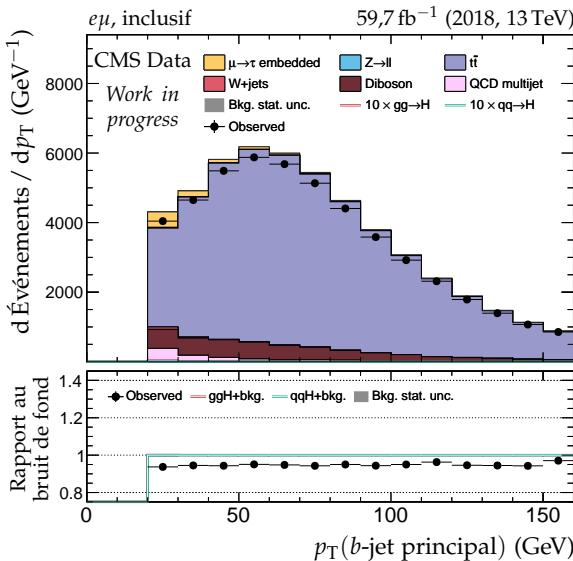
**Figure X.65 – Canal  $e\tau_h$ , 2018 : dilepton et énergie transverse manquante.**



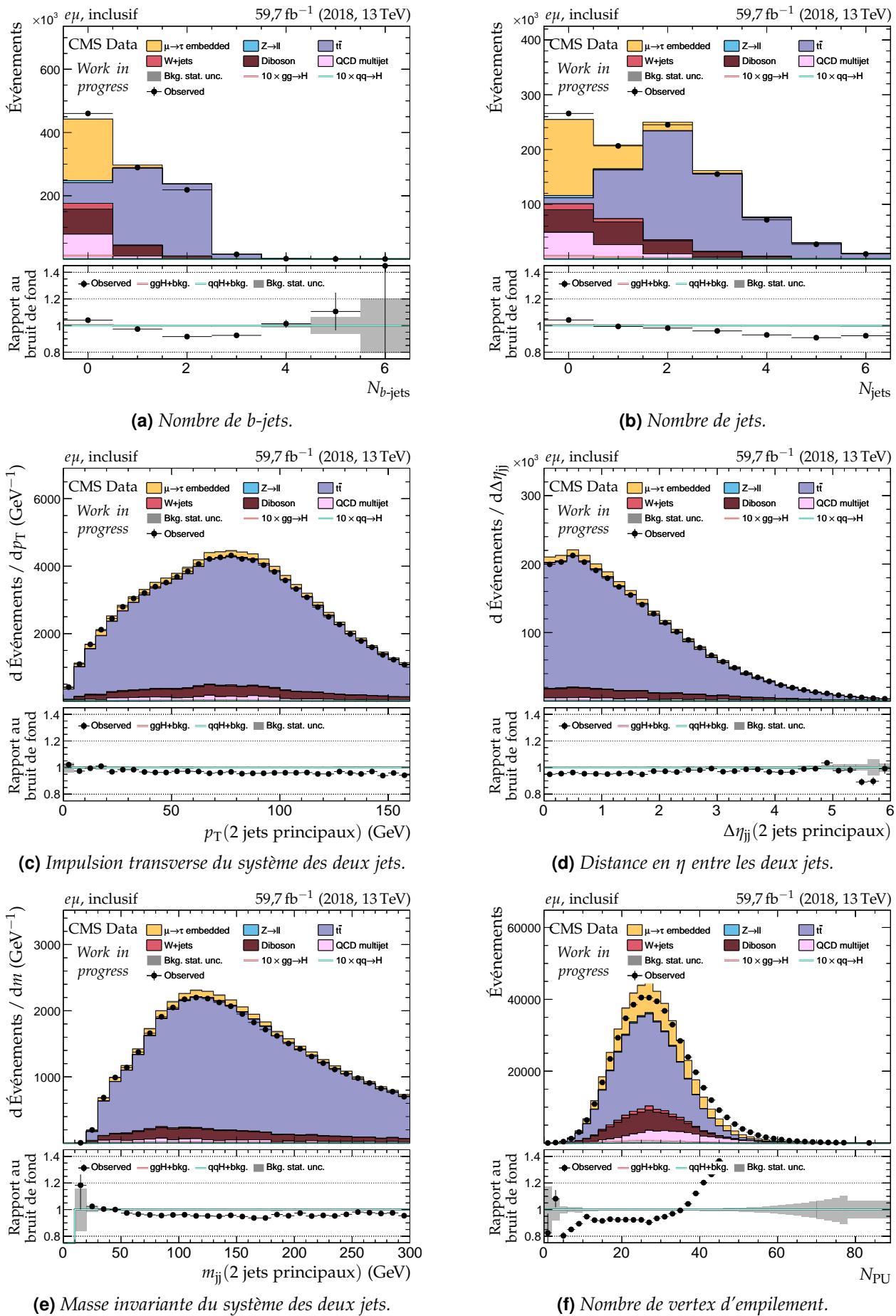
**Figure X.66 – Canal  $e\tau_h$ , 2018 : masses transverses,  $D_\zeta$  et masses.**



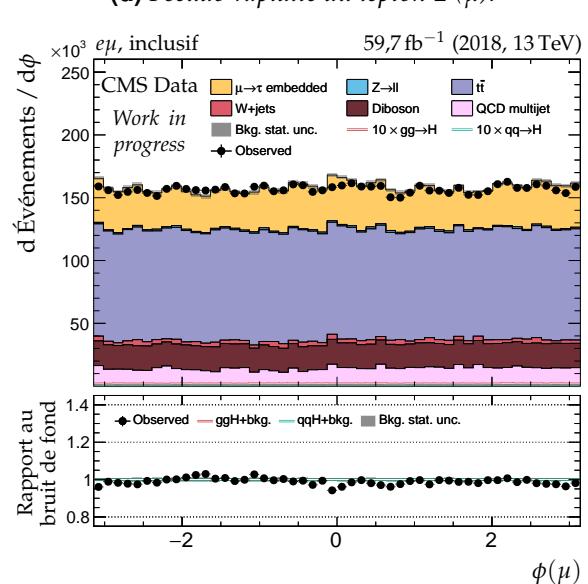
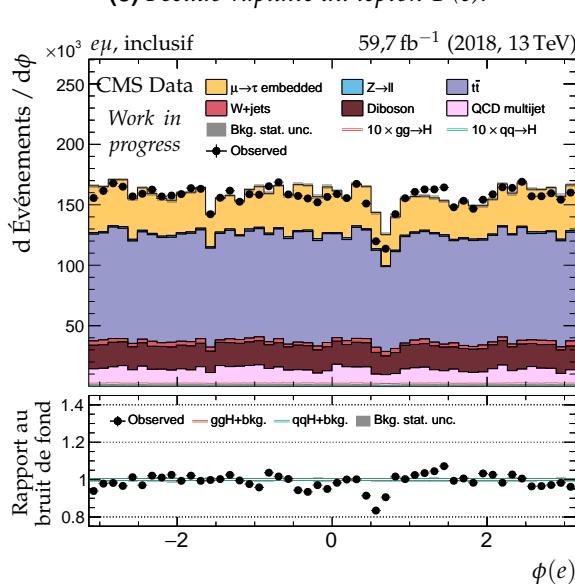
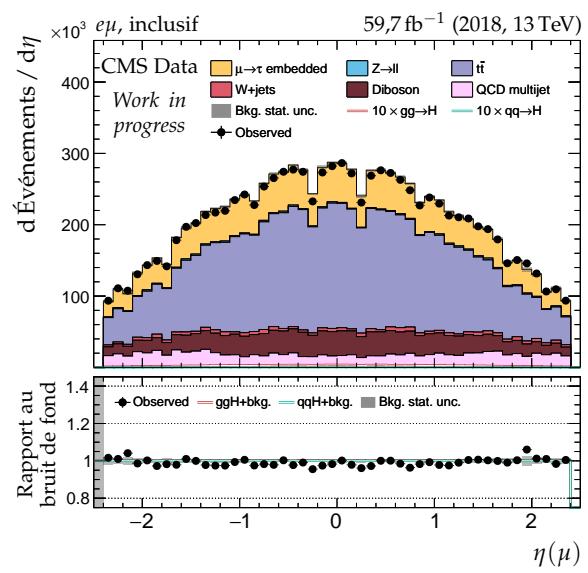
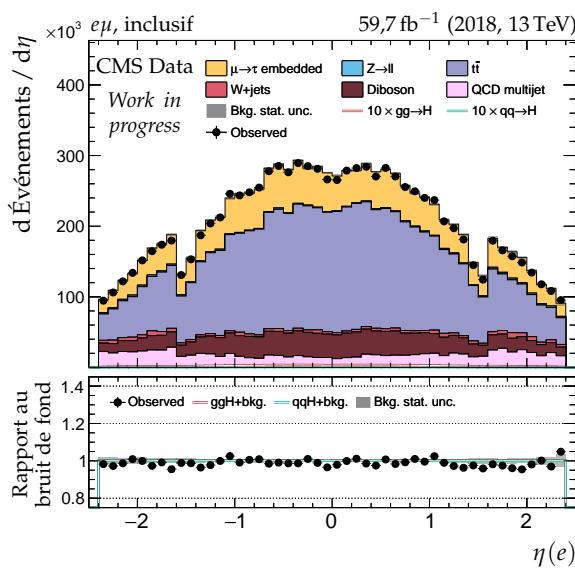
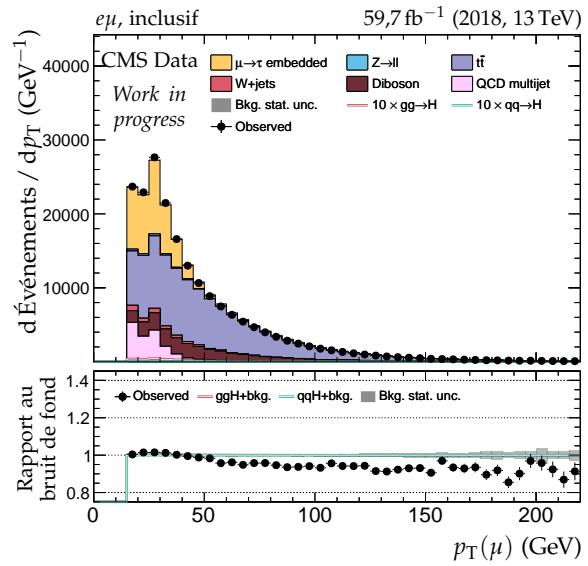
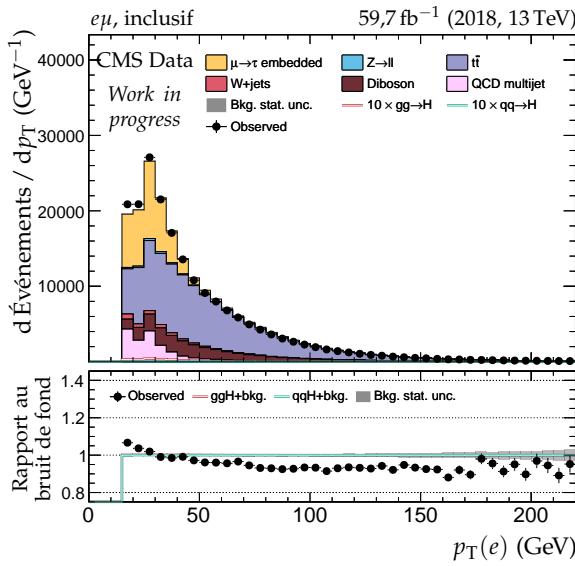
**Figure X.67 – Canal  $e\mu$ , 2018 : cinématique des deux jets principaux.**



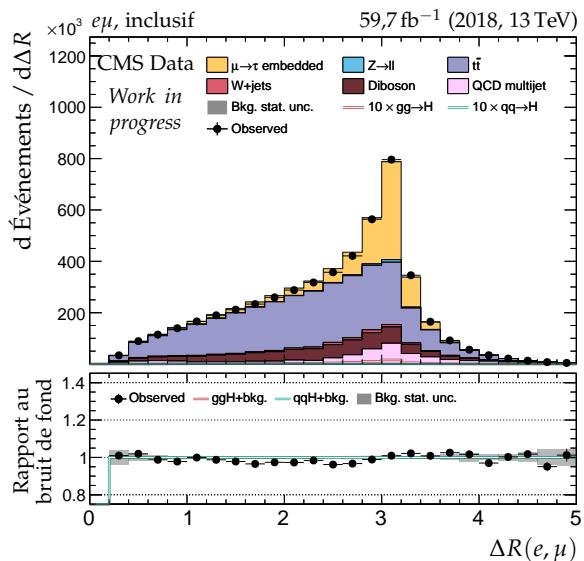
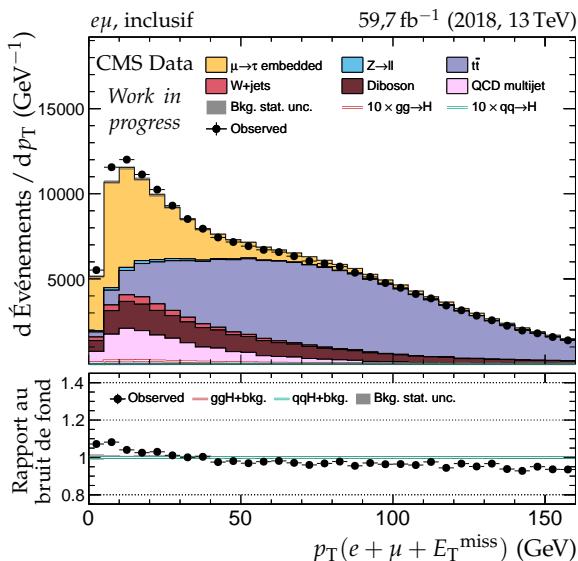
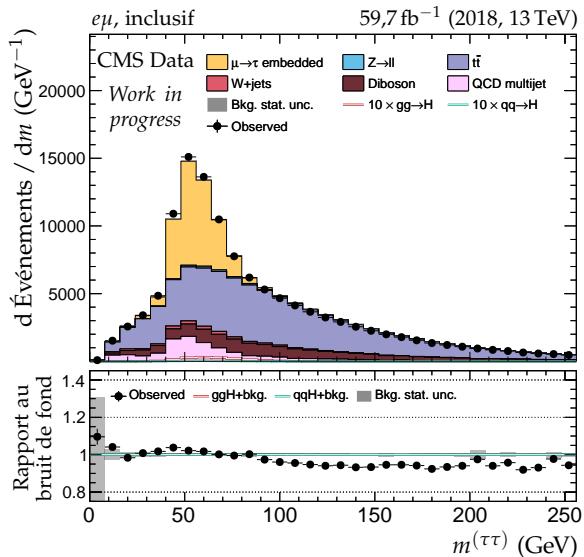
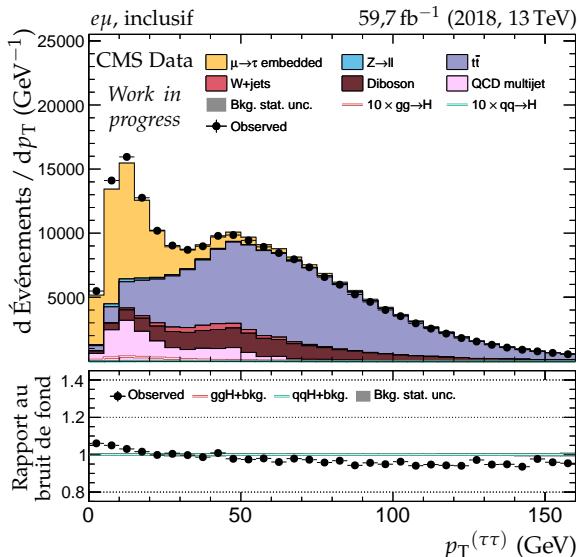
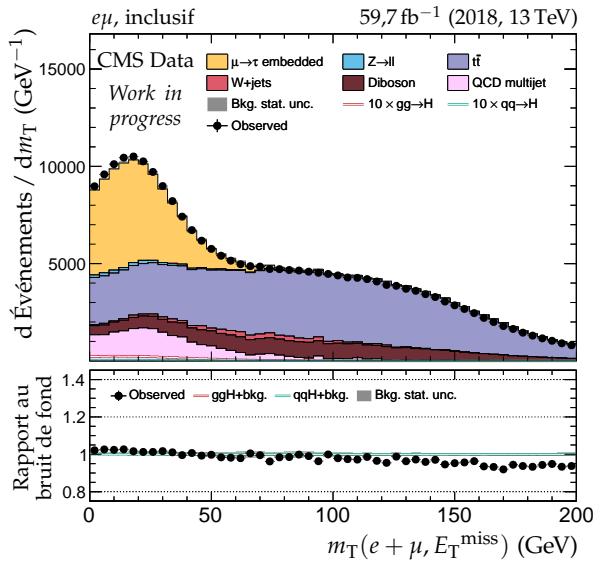
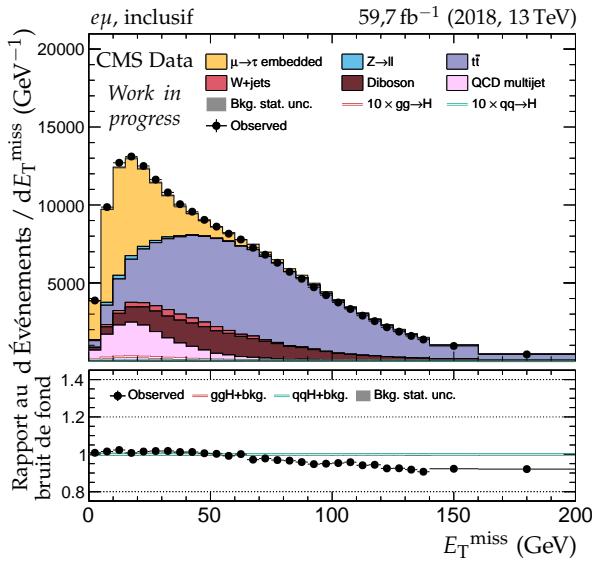
**Figure X.68 – Canal  $e\mu$ , 2018 : b-jets et activité hadronique additionnelle.**



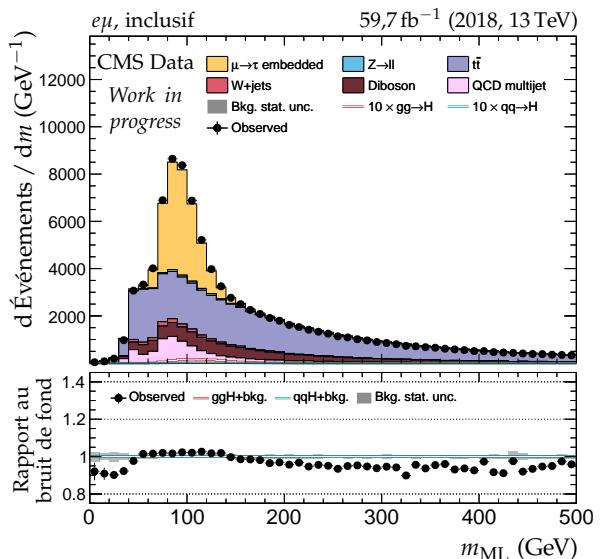
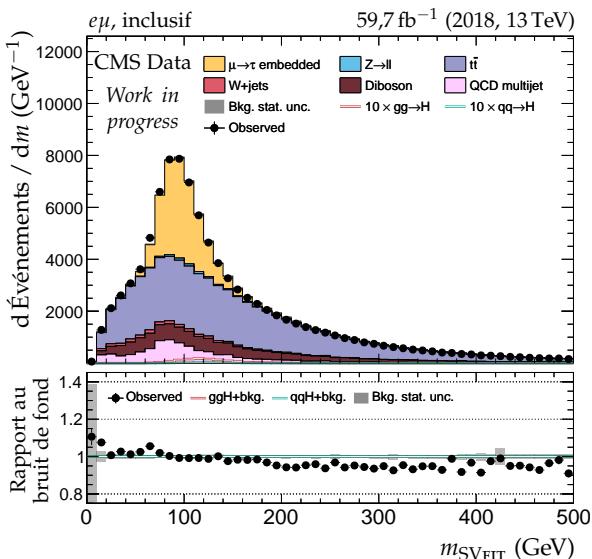
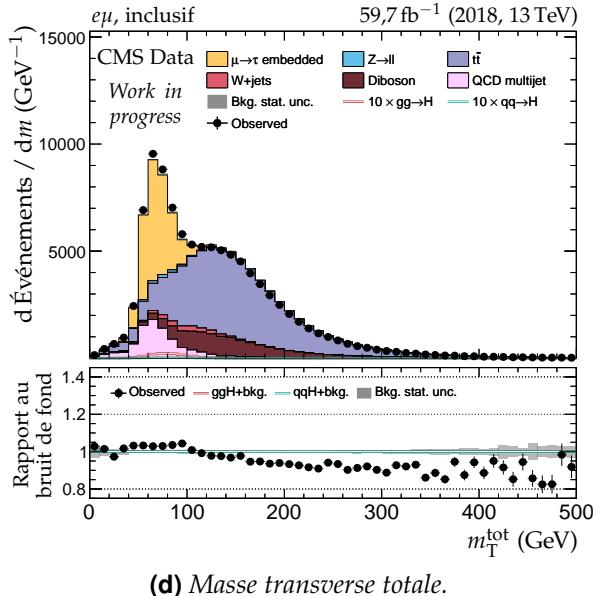
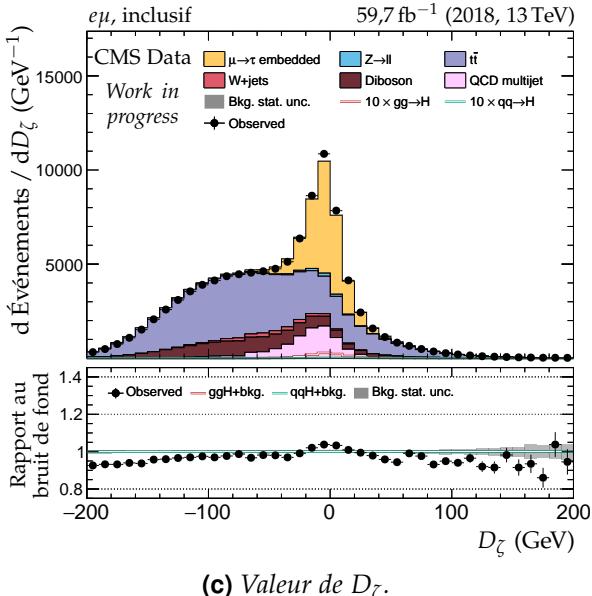
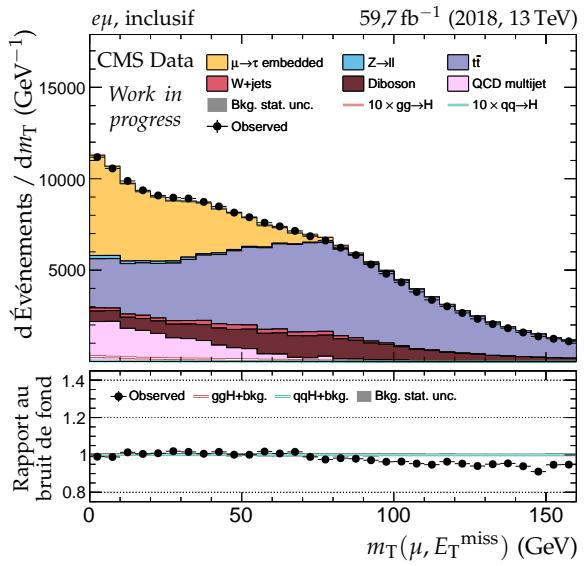
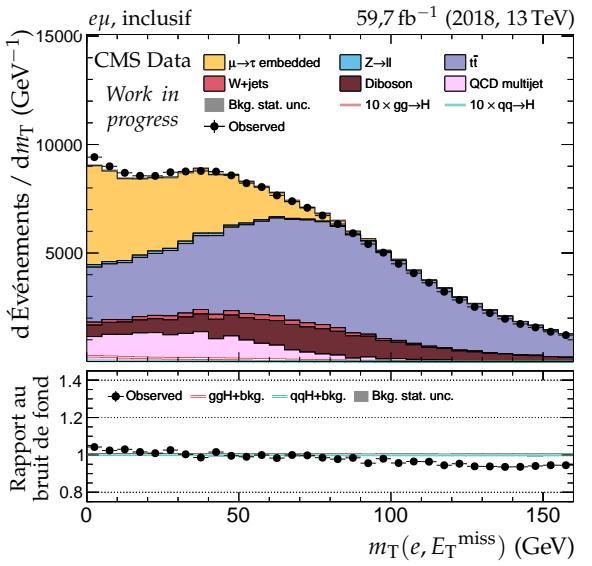
**Figure X.69 – Canal  $e\mu$ , 2018 : nombre de jets, système des deux jets principaux et empilement.**



**Figure X.70 – Canal  $e\mu$ , 2018 : cinématique des leptons ( $e, \mu$ ).**



**Figure X.71 – Canal  $e\mu$ , 2018 : dilepton et énergie transverse manquante.**



**Figure X.72 – Canal  $e\mu$ , 2018 : masses transverses,  $D_\zeta$  et masses.**

