



MINISTÈRE
DE L'ENSEIGNEMENT SUPÉRIEUR,
DE LA RECHERCHE
ET DE L'INNOVATION



PHAST
PHYSIQUE
ET ASTROPHYSIQUE
UNIVERSITÉ DE LYON



Recherche d'un boson de Higgs de haute masse se désintégrant en paire de taus dans l'expérience CMS au LHC

Thèse de doctorat

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Institut de Physique des deux Infinis – Lyon

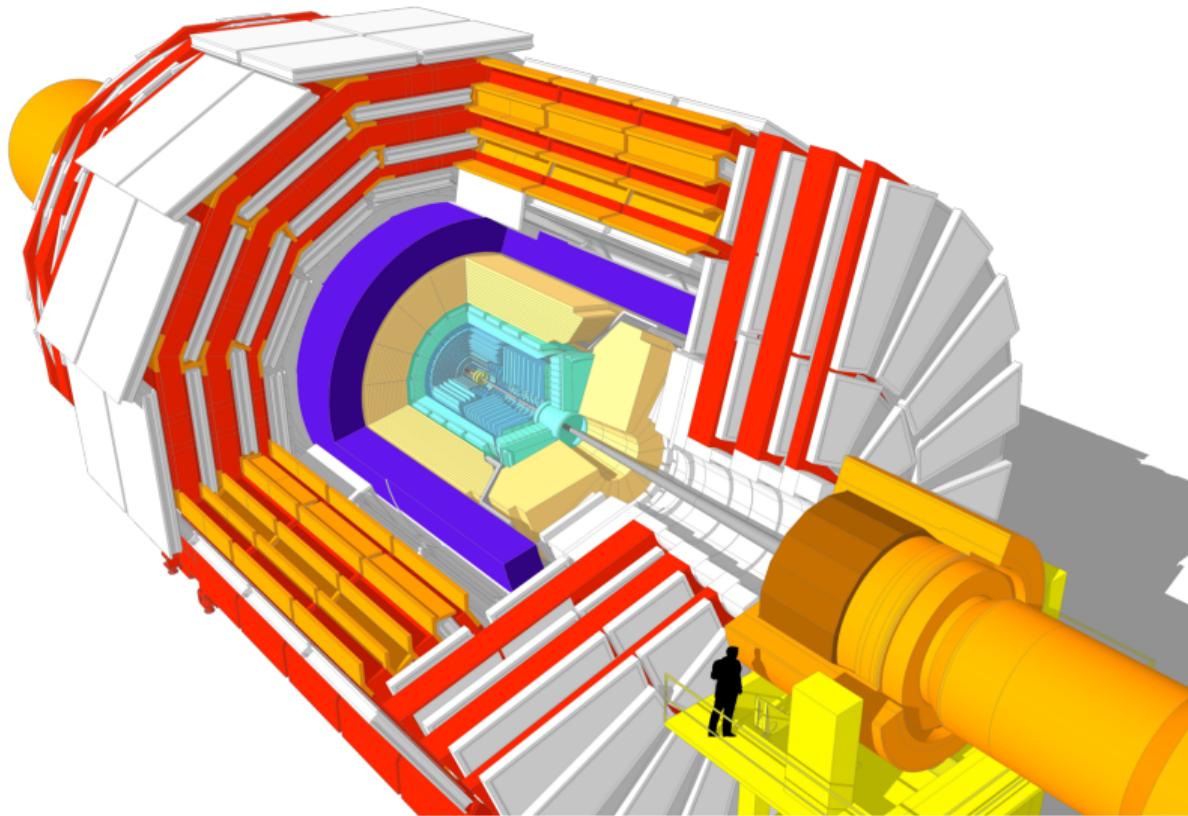
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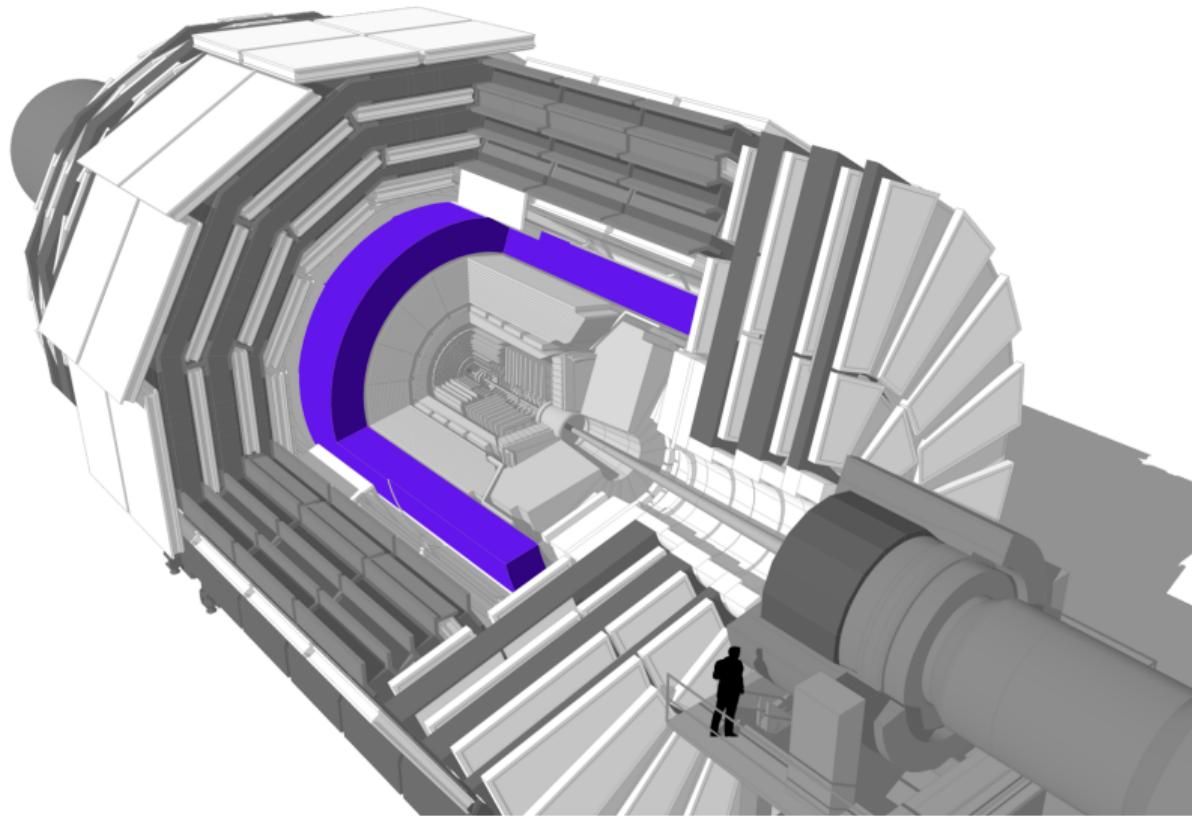


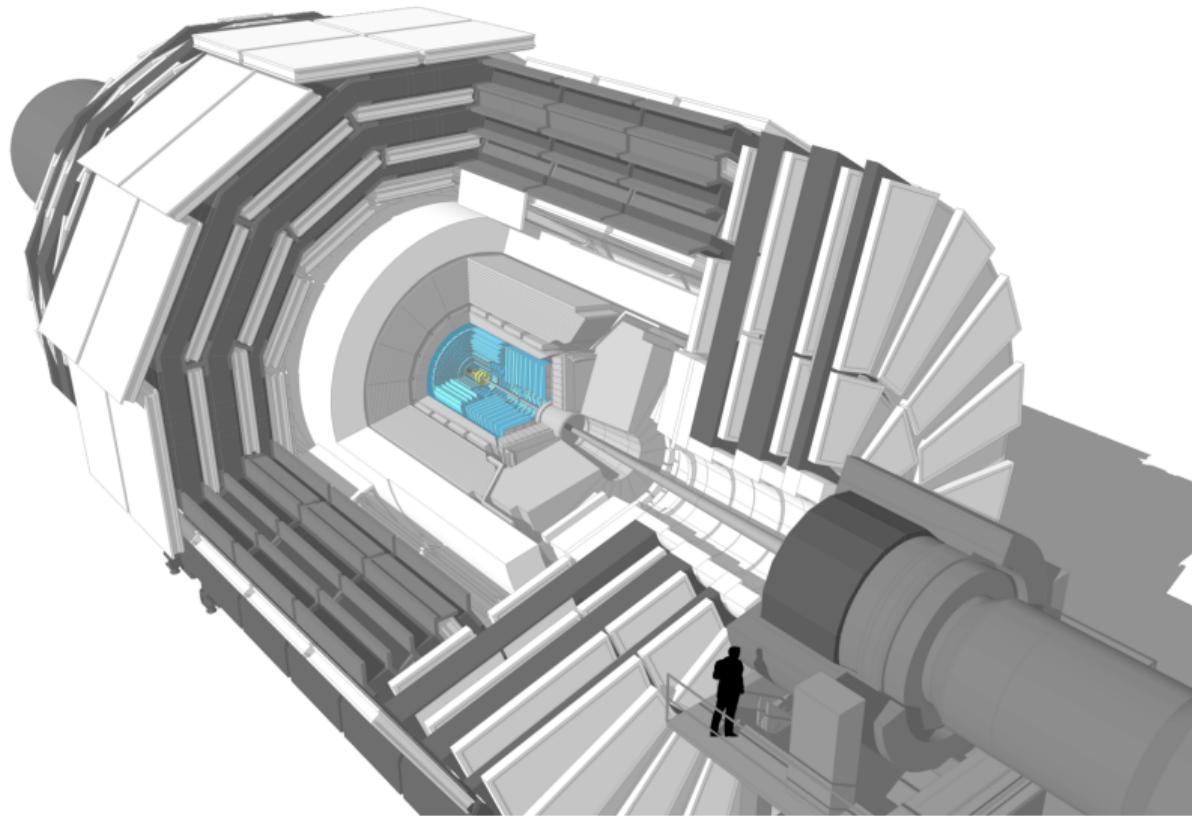
1 The CMS detector at CERN LHC

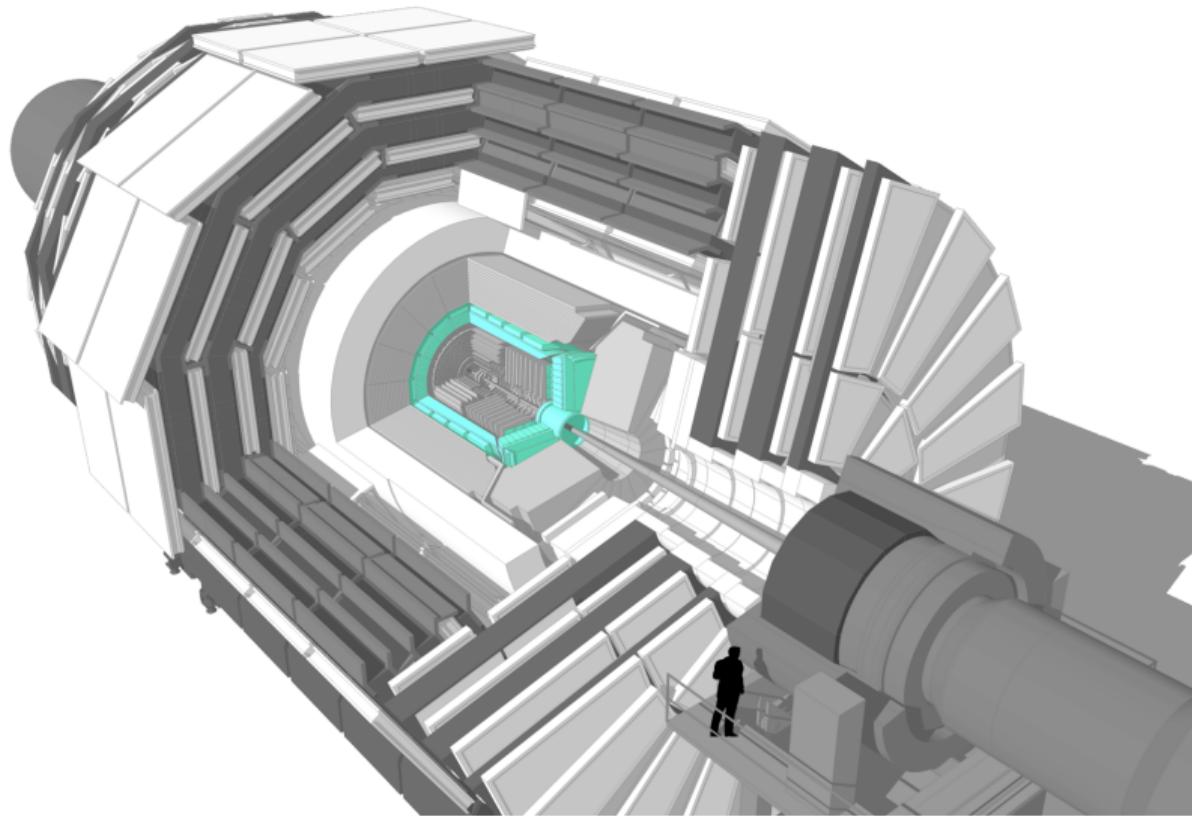
- CERN LHC
- The CMS detector

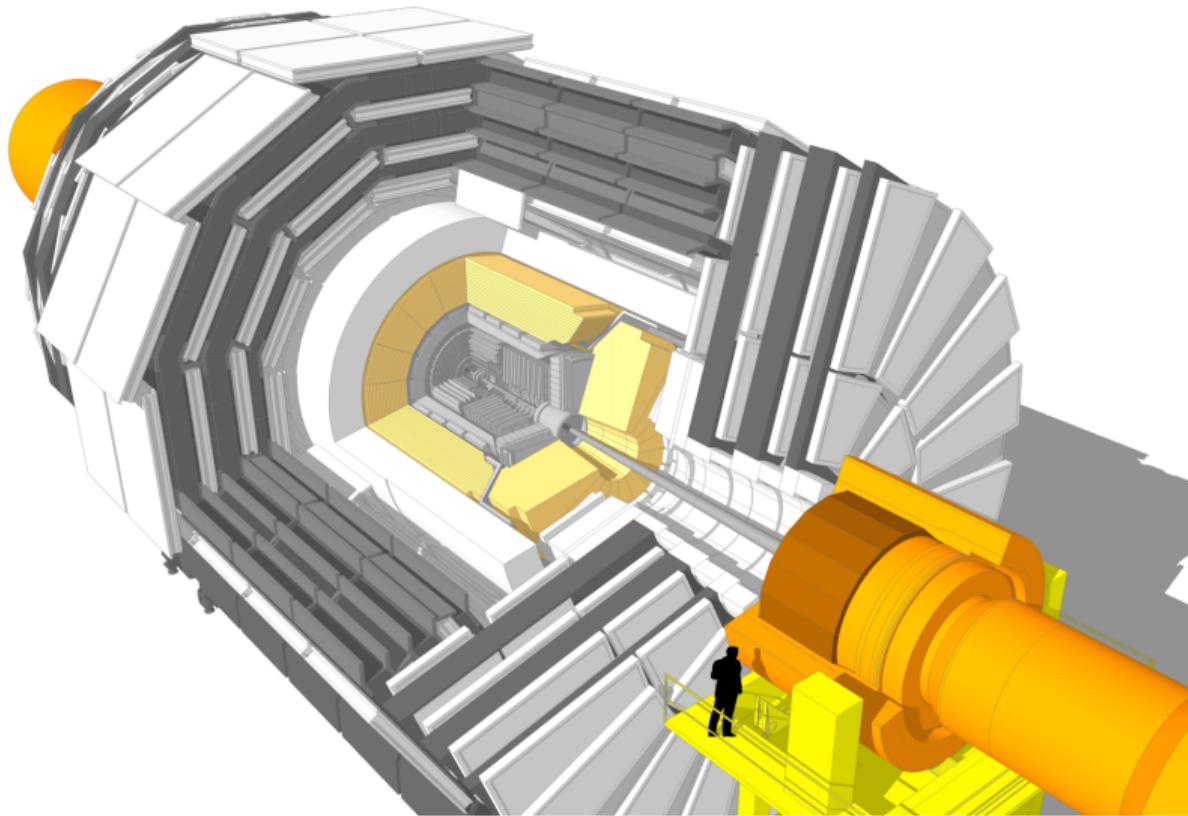
2 Calibration en énergie des jets

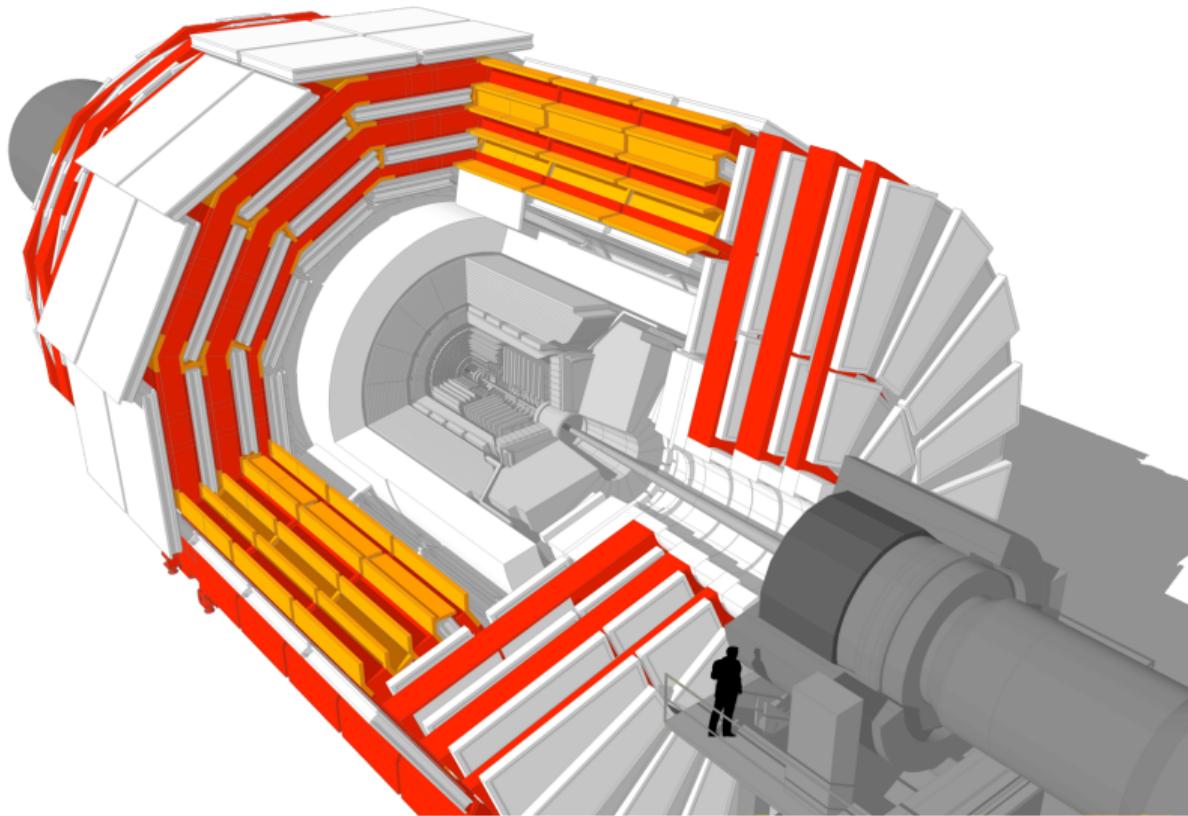


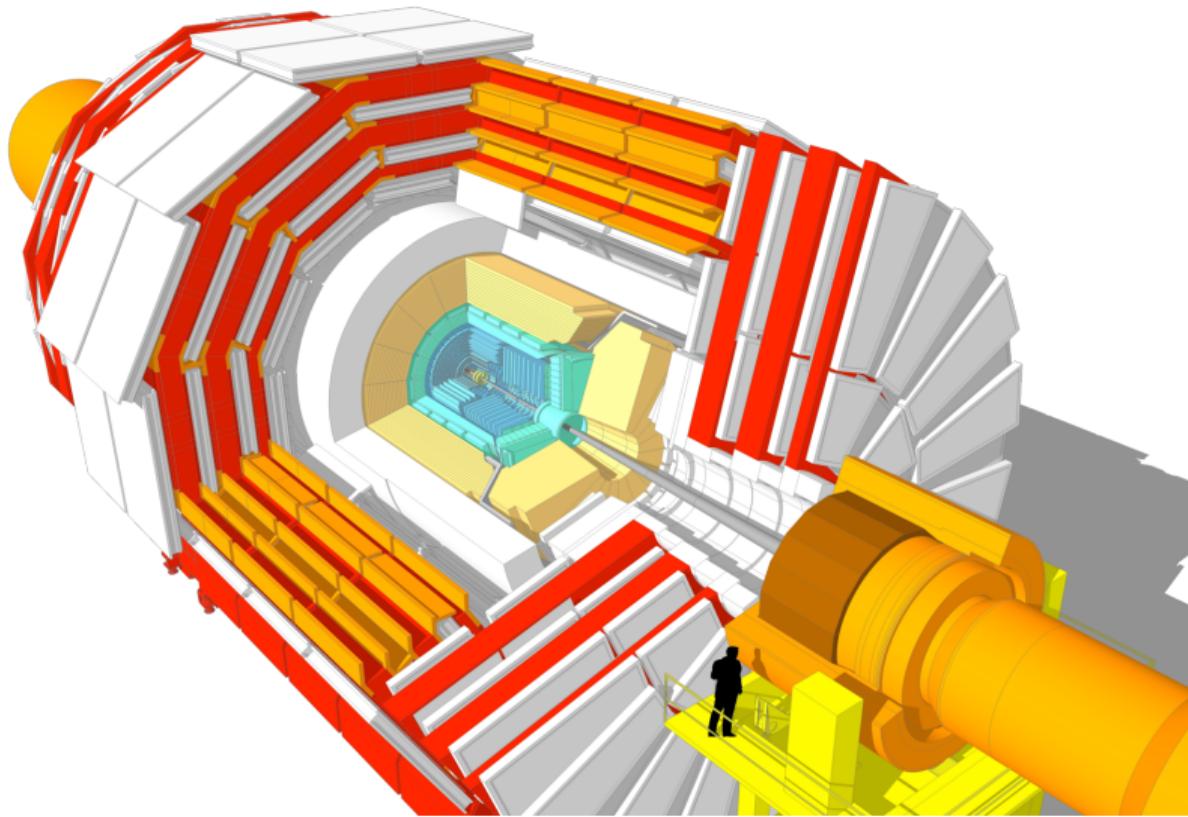








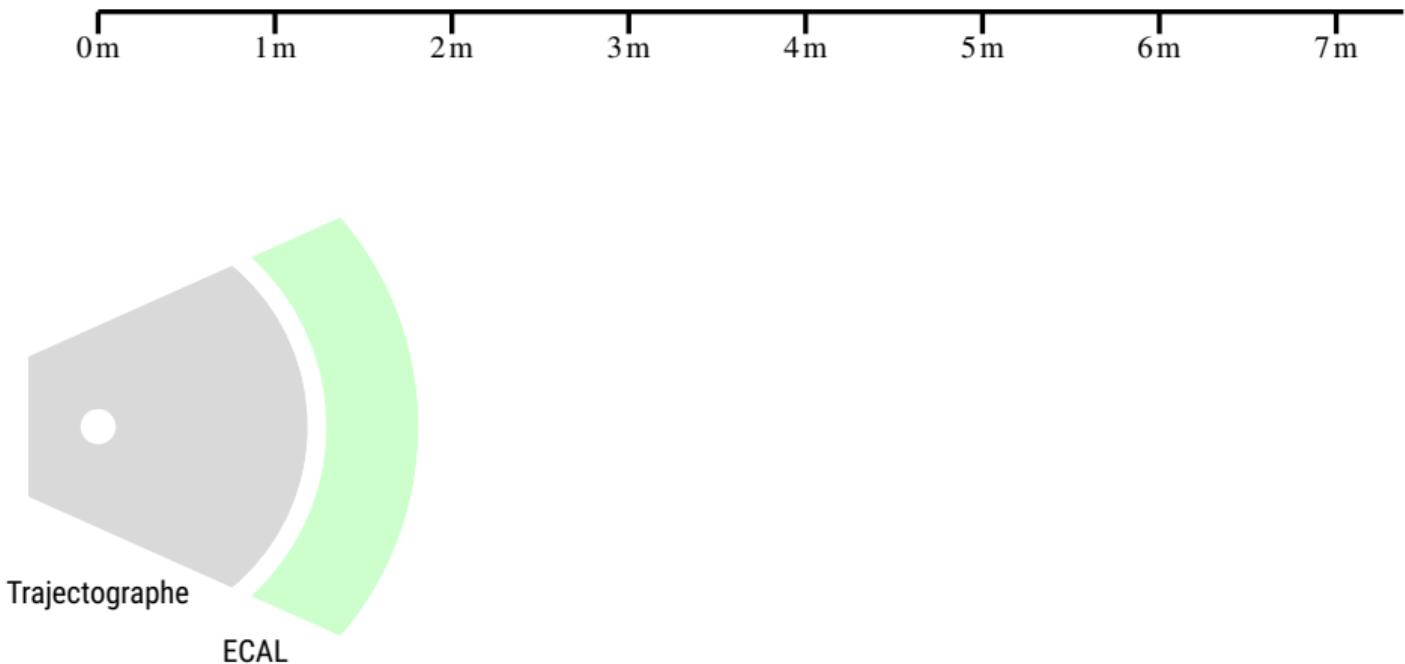


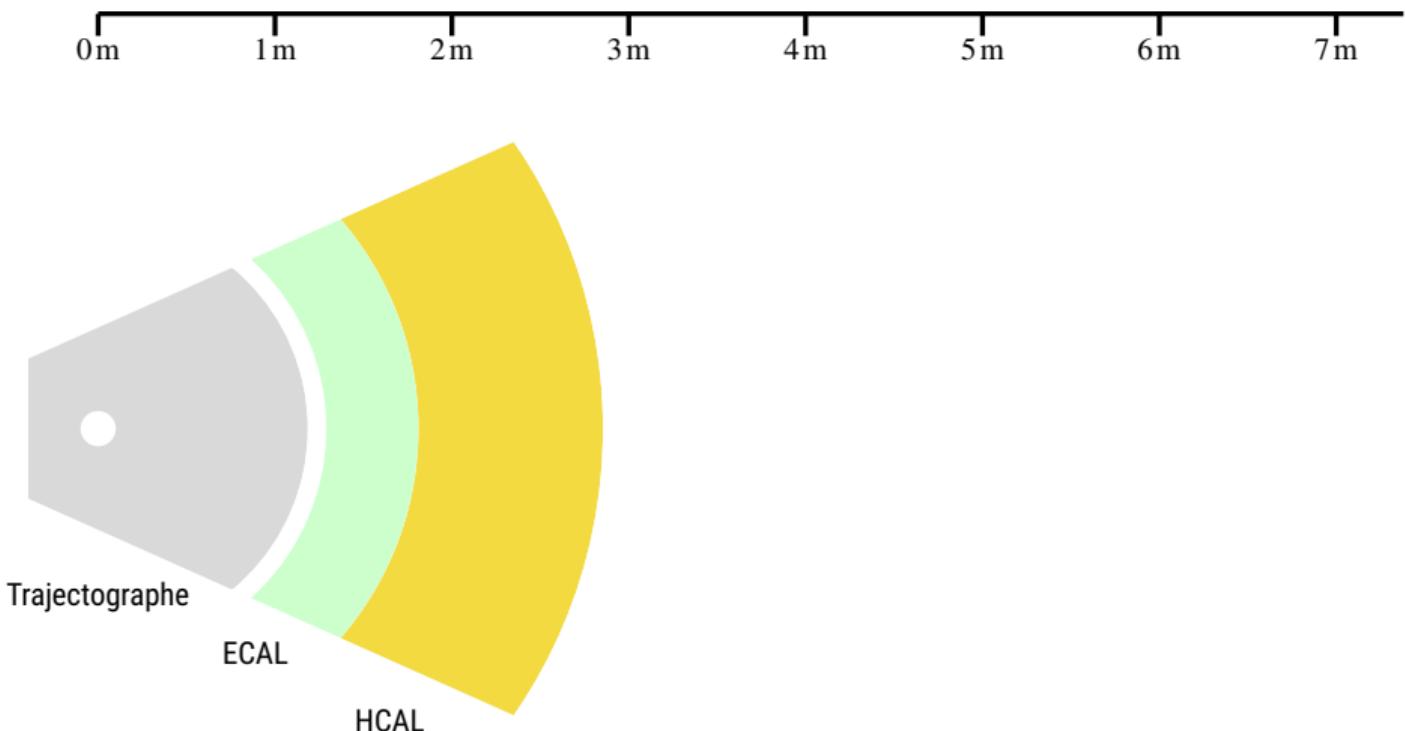


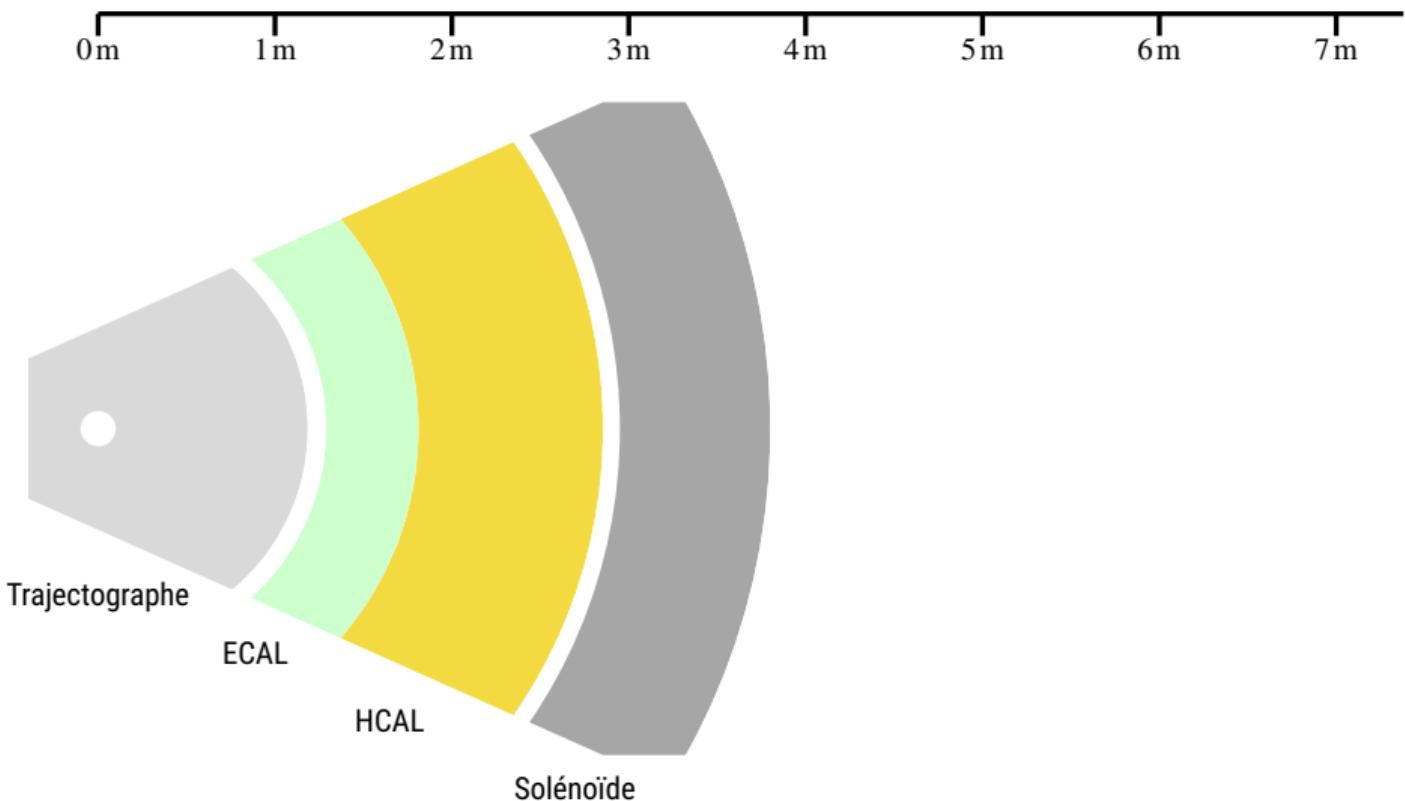


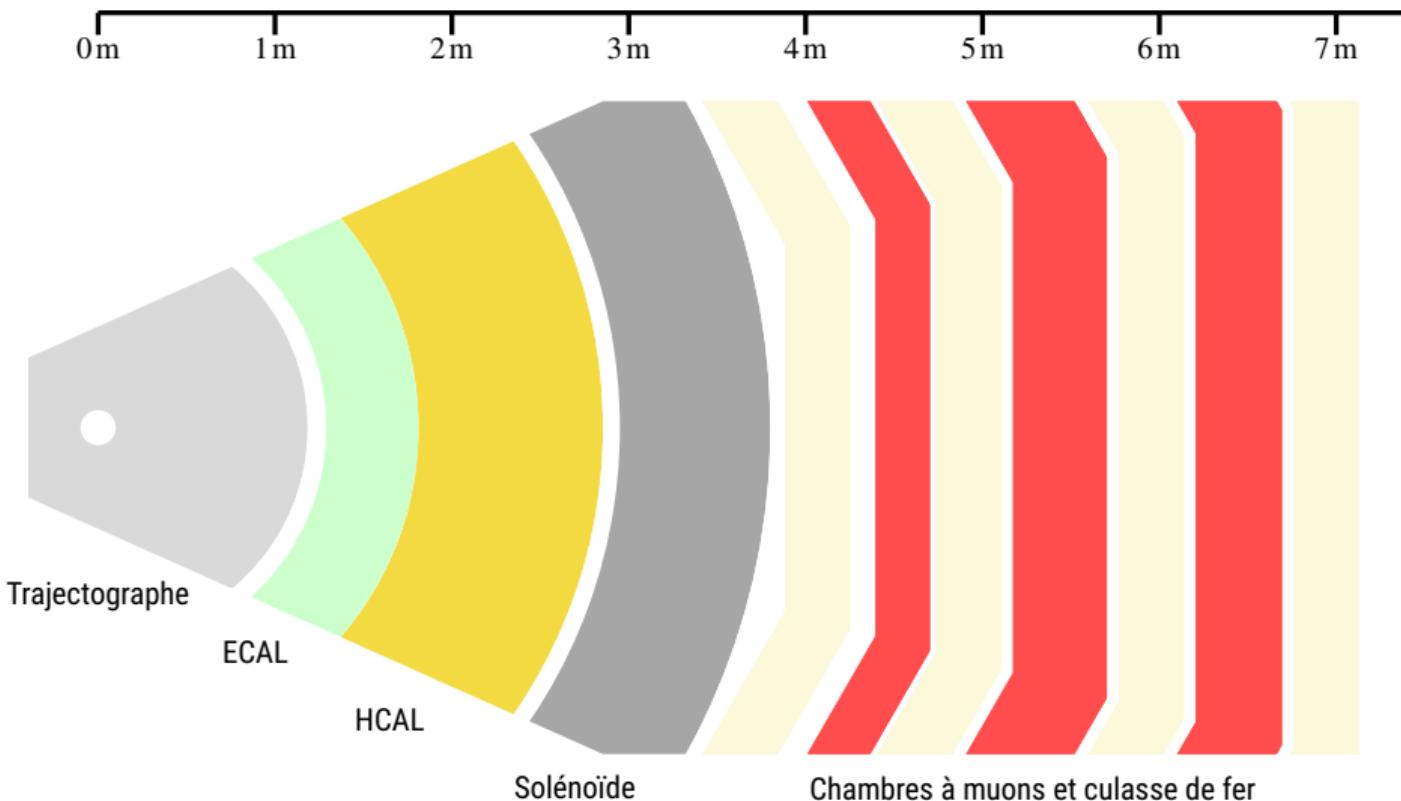


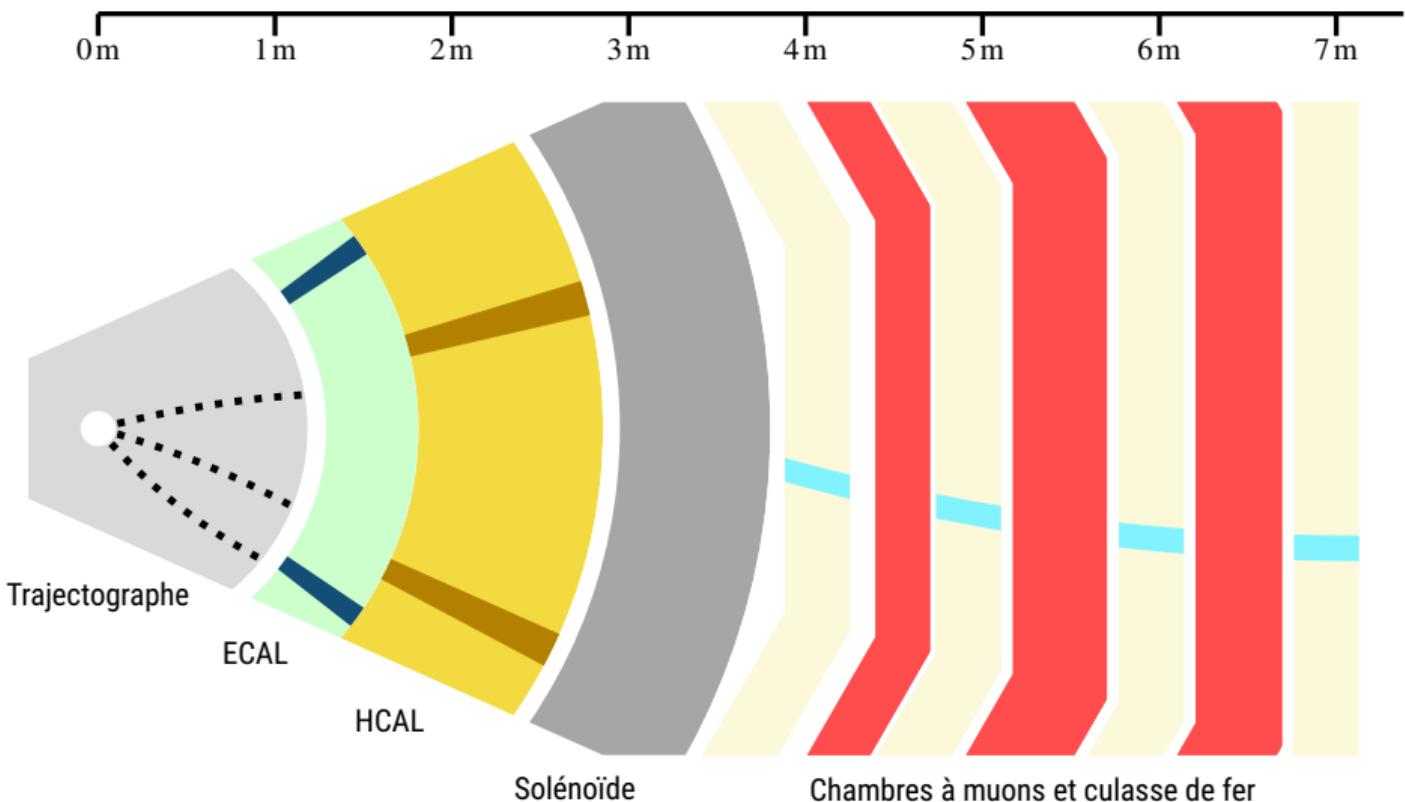
Trajectographe

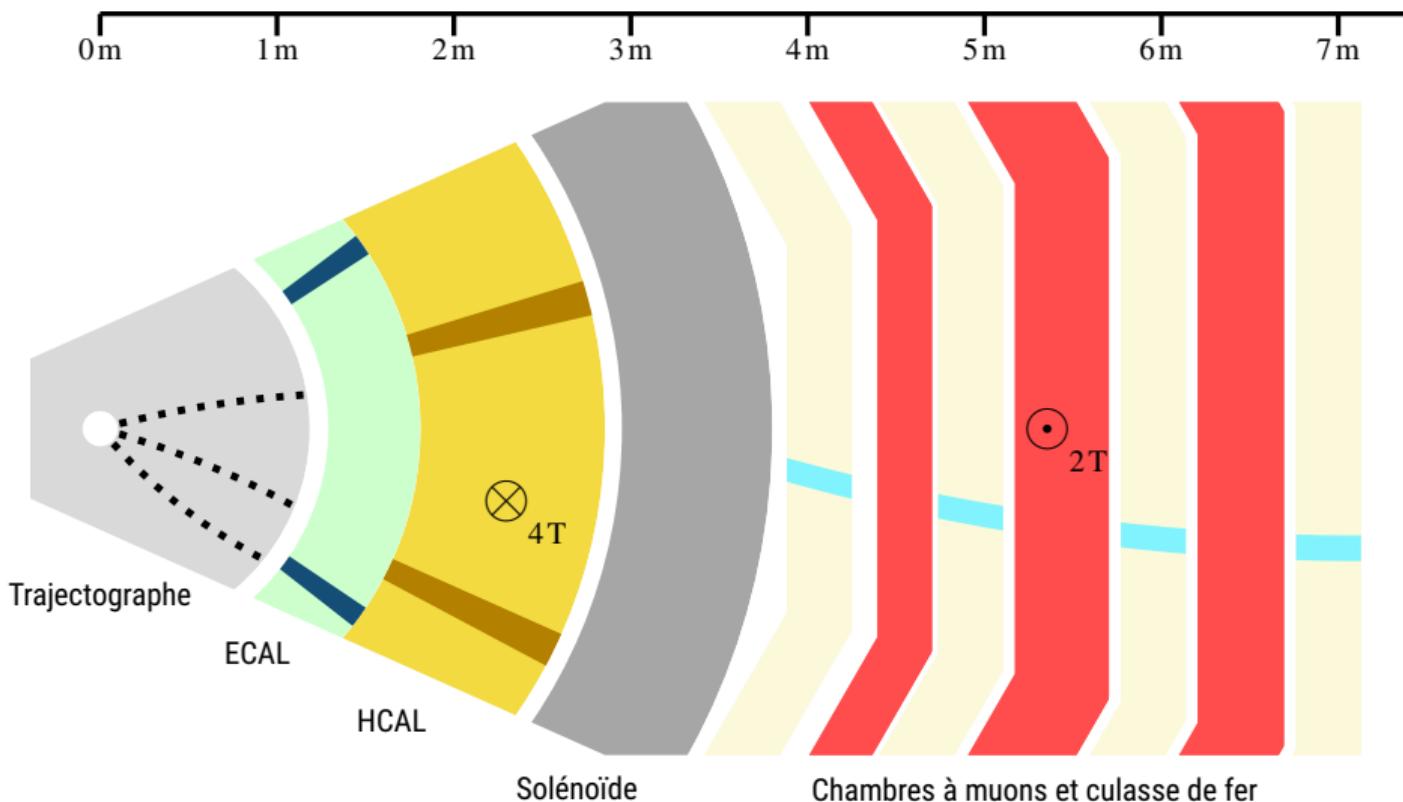


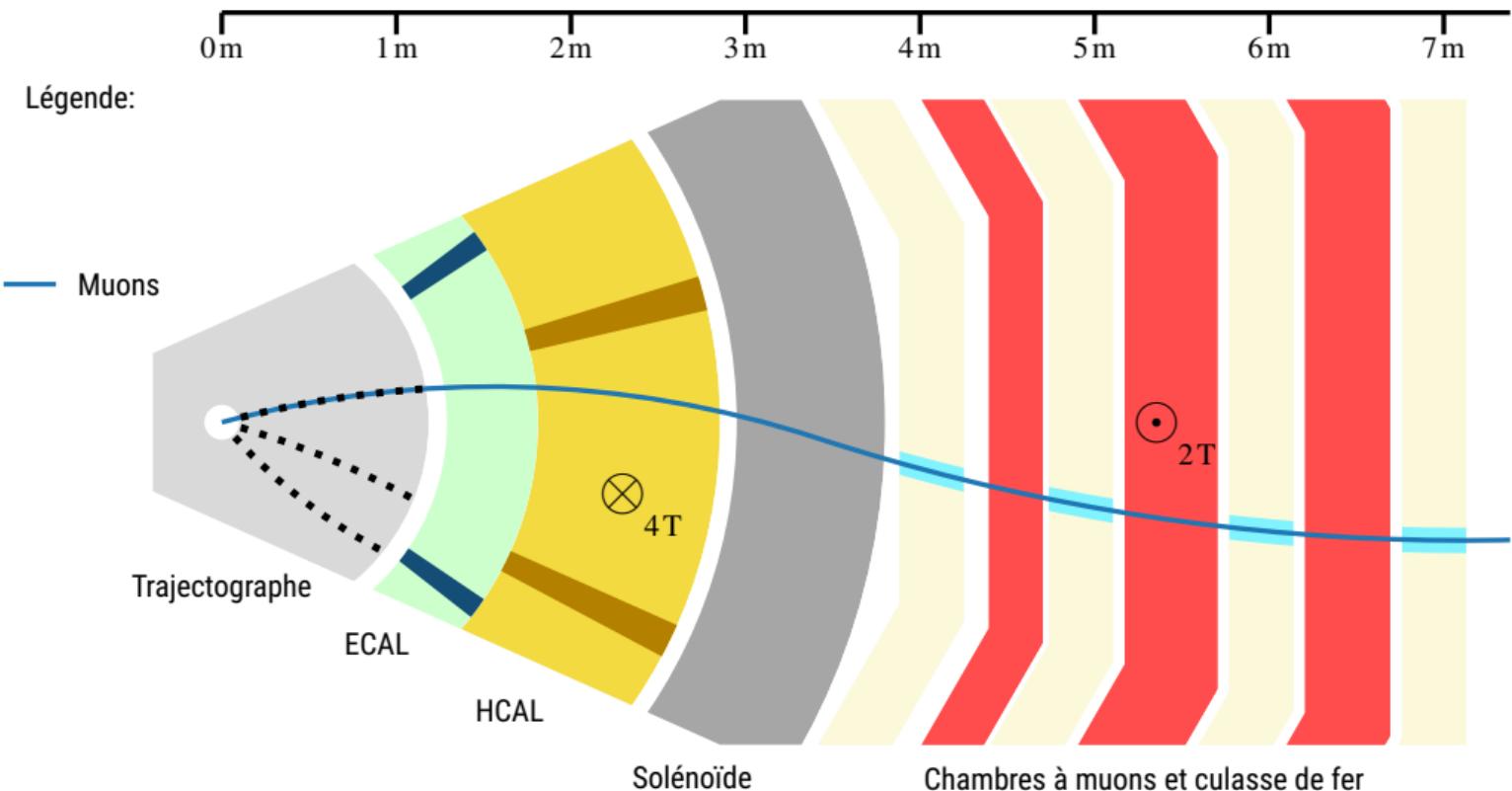


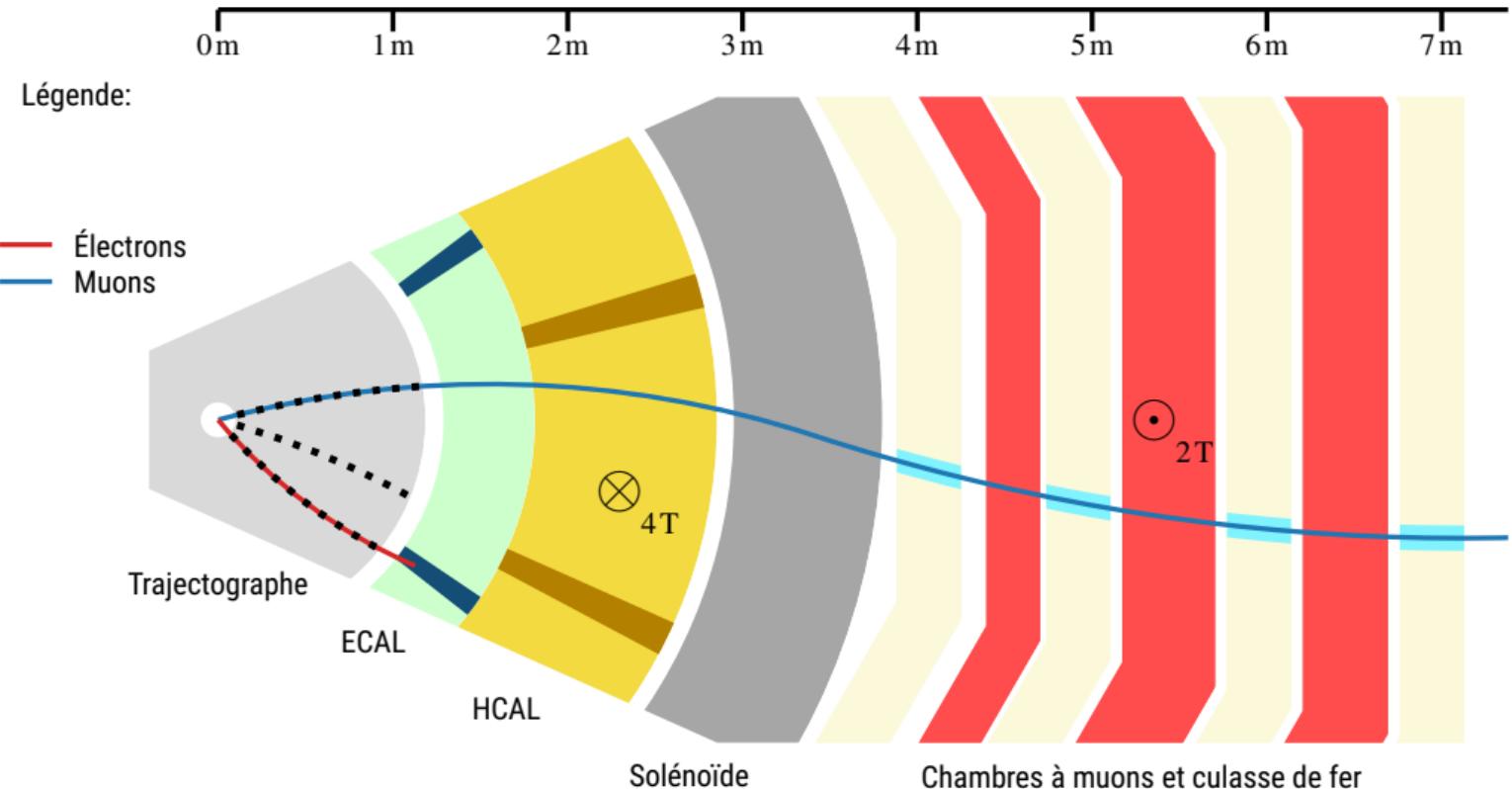


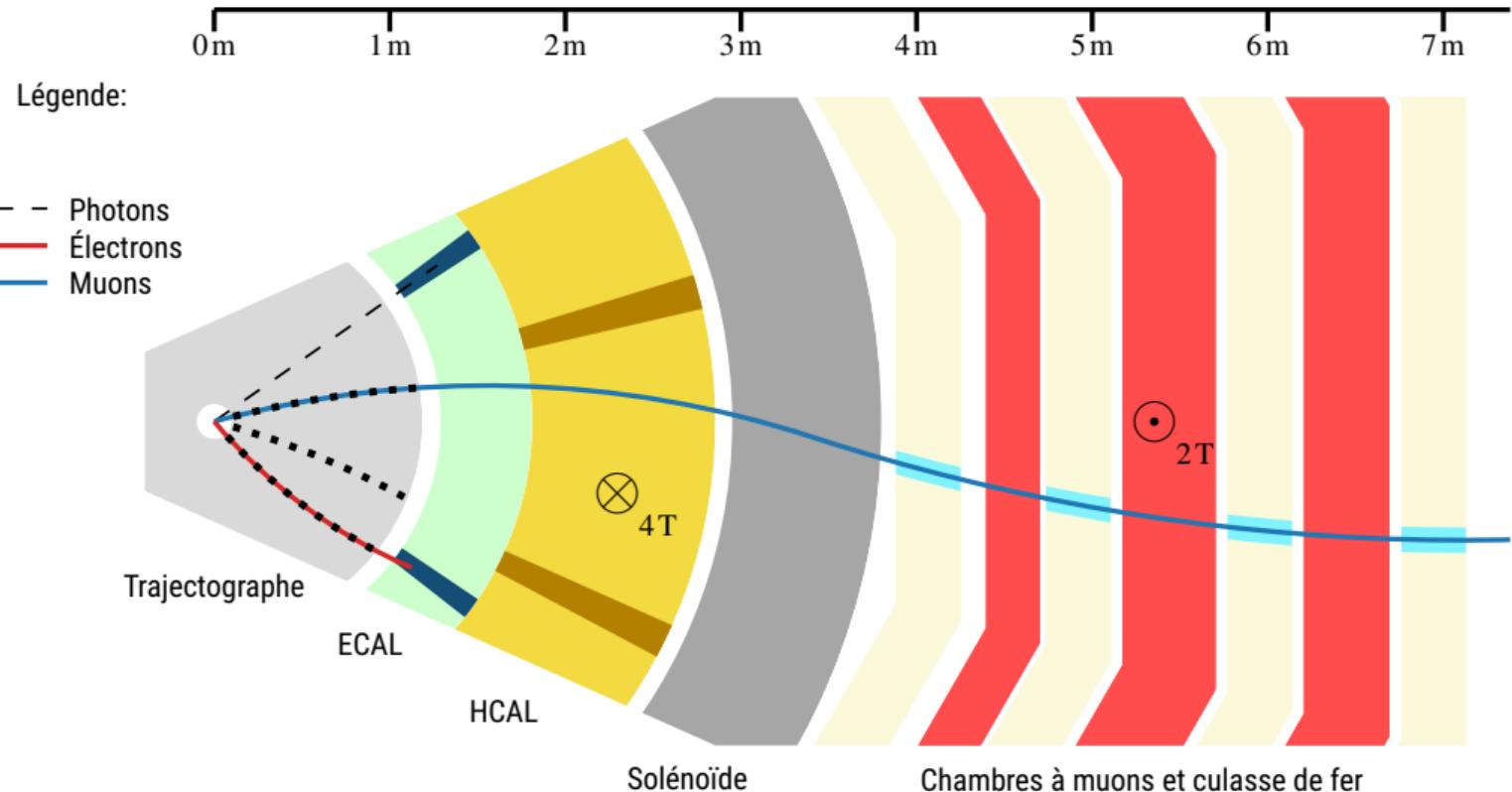


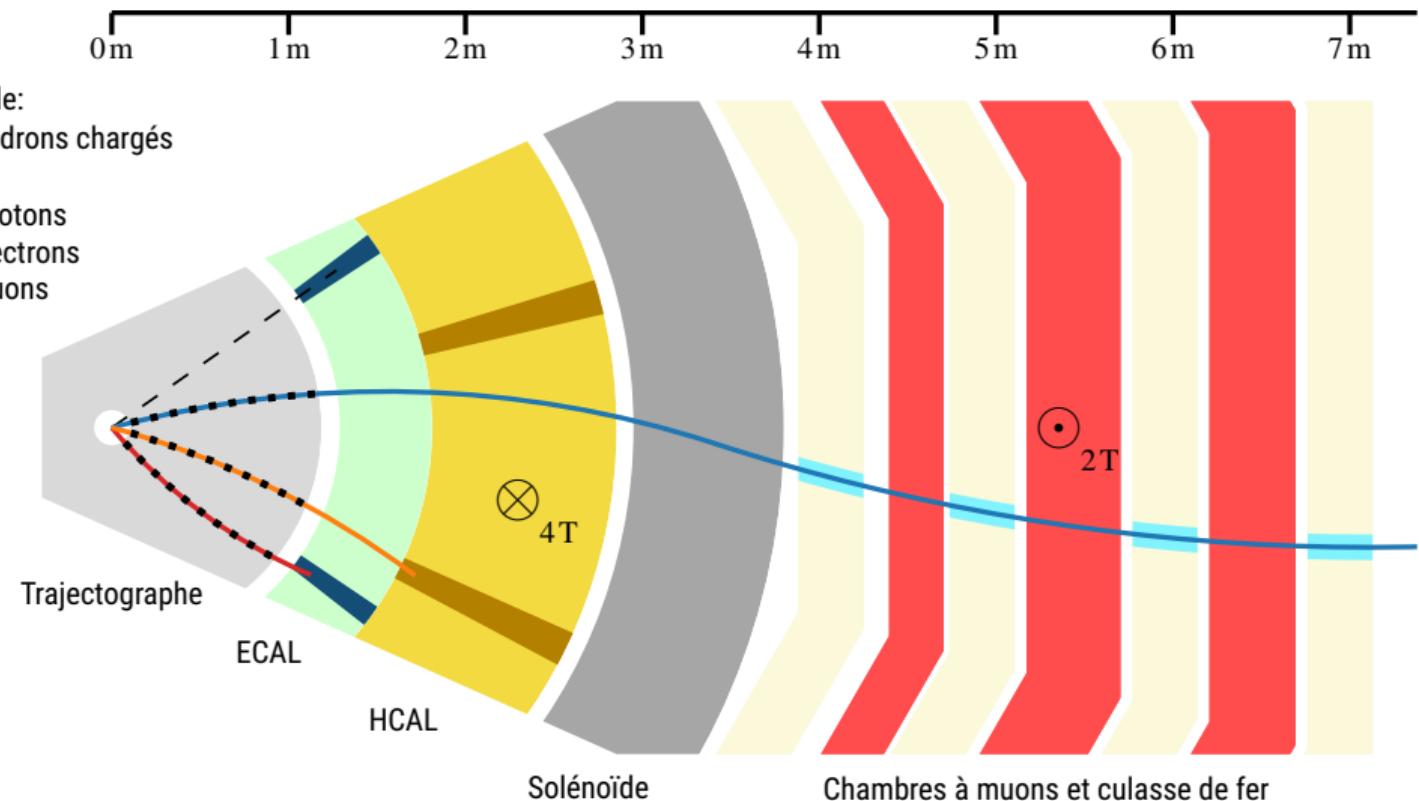


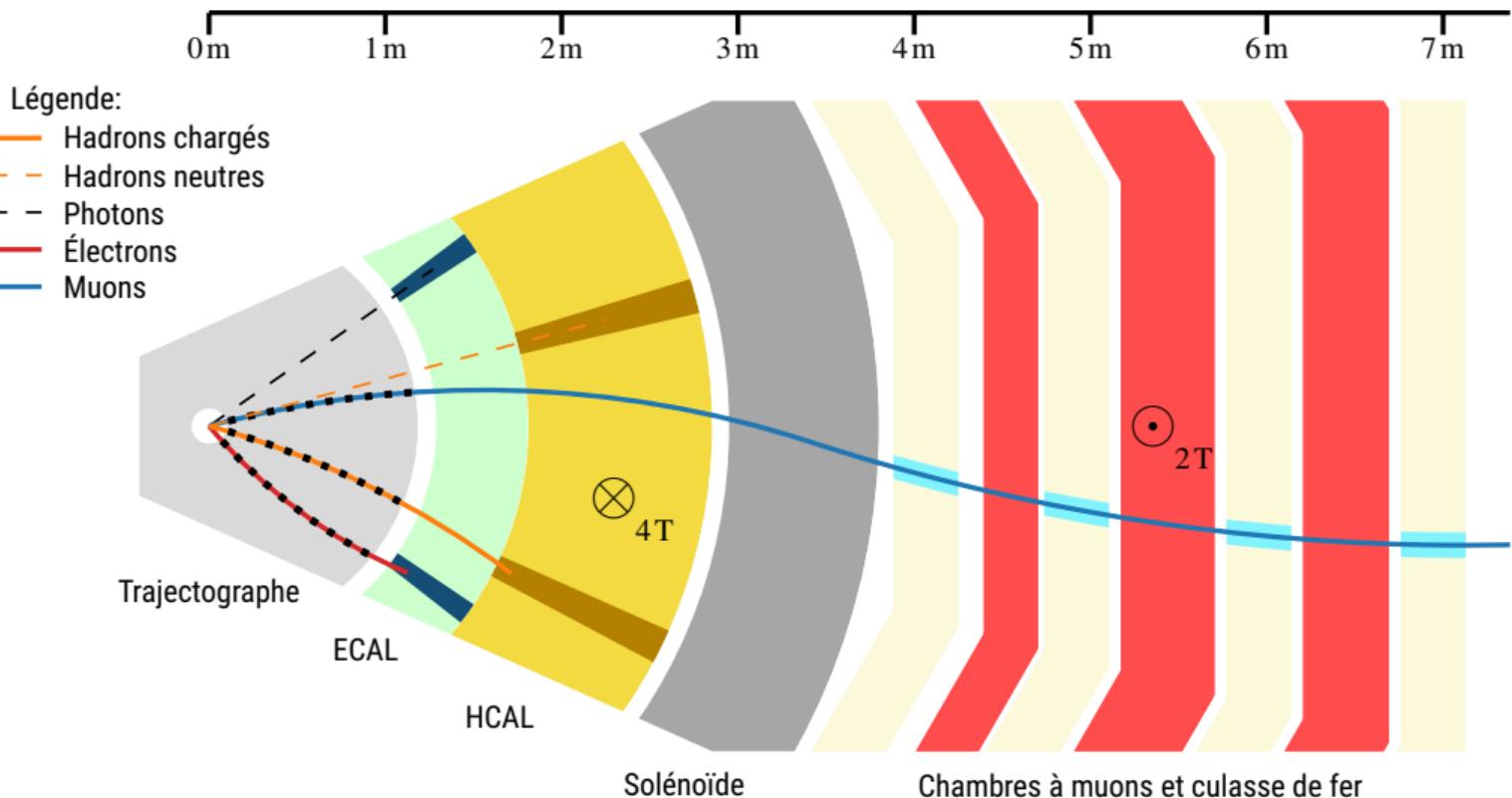












► Niveaux de connaissance

particule	(ptcl)
reconstruit	(reco)
corrigé	(corr)

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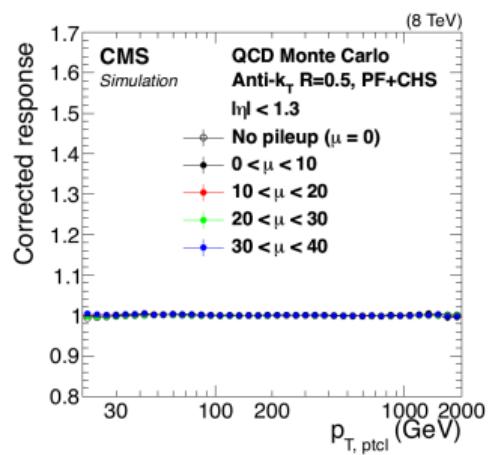
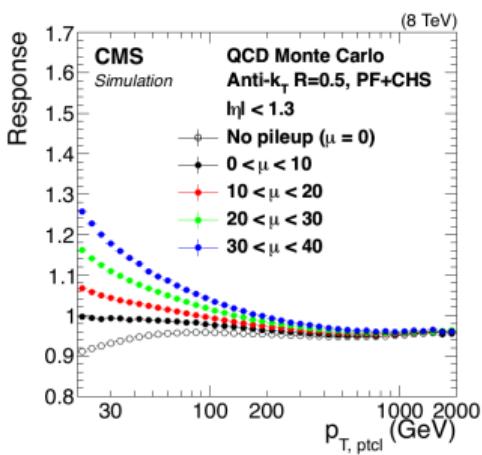
particule	(ptcl)
reconstruit	(reco)
corrigé	(corr)

► Réponse d'un jet

$$R = \frac{p_T}{p_{T\text{ptcl}}}$$

Jets
Reconstitués

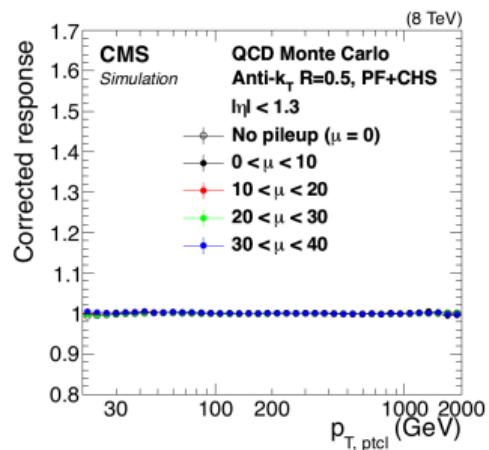
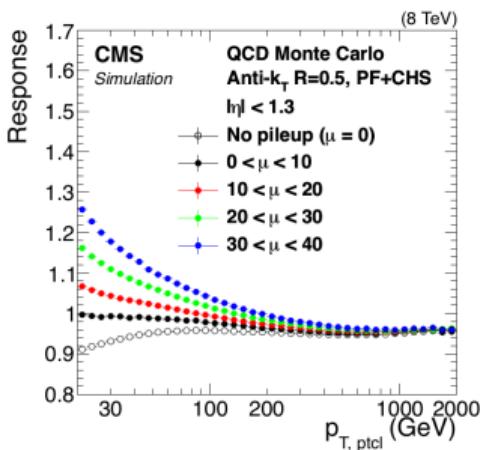
Jets
Calibrés



Appliqué aux données

Jets
ReconstituésJets
Calibrés

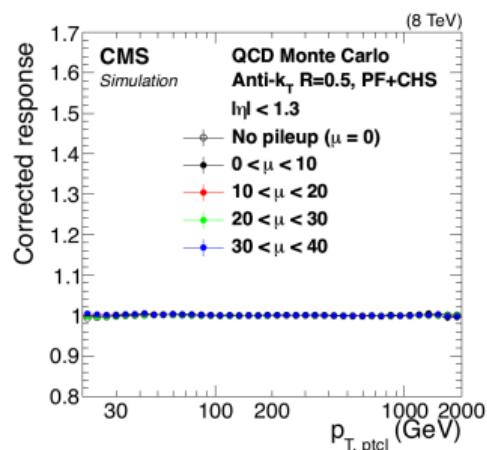
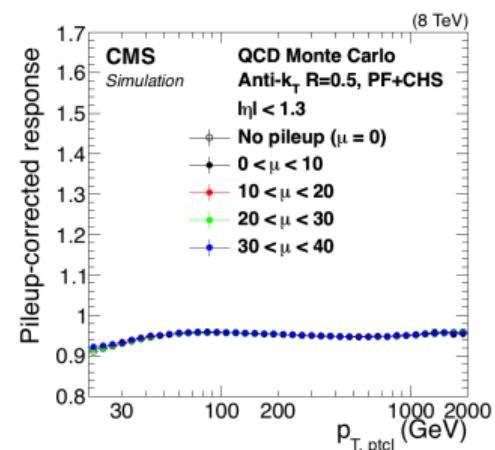
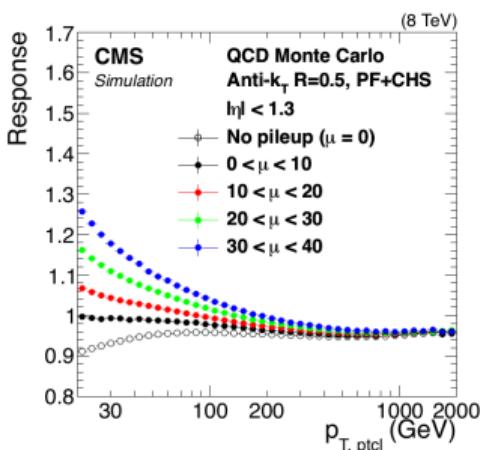
Appliqué aux simulations



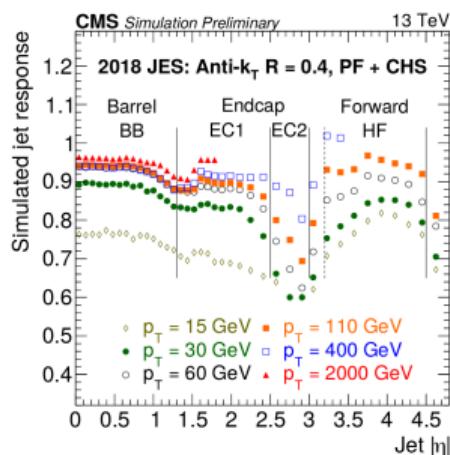
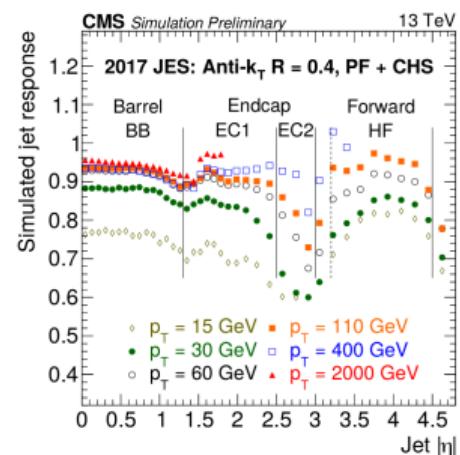
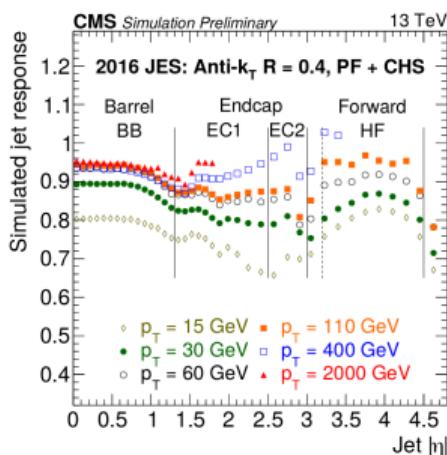
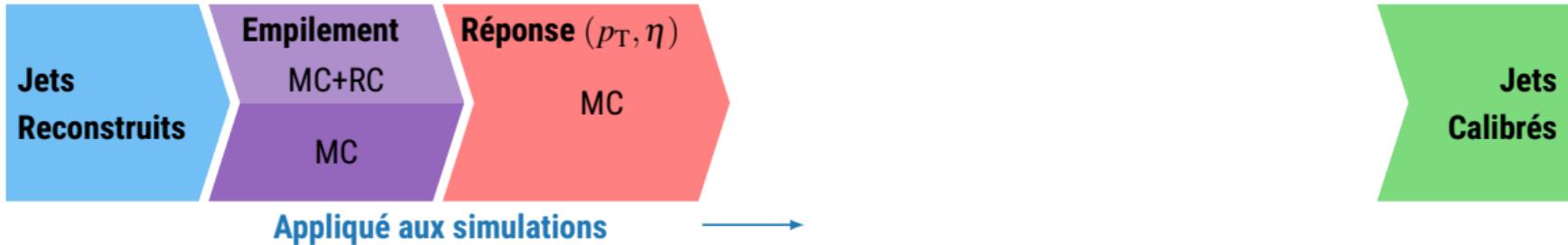
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Appliqué aux simulations



Appliqué aux données



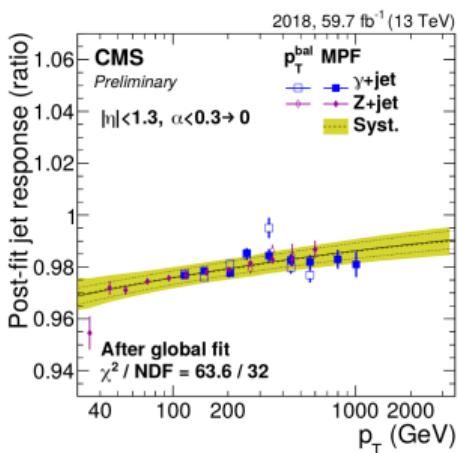
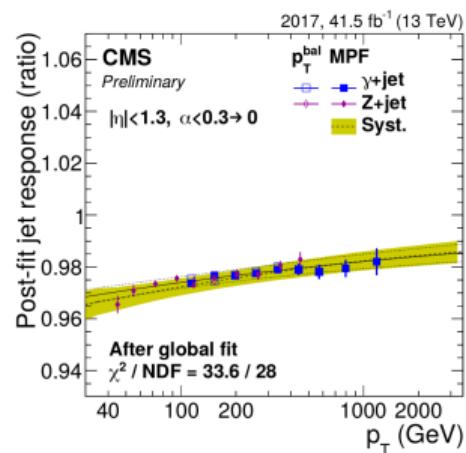
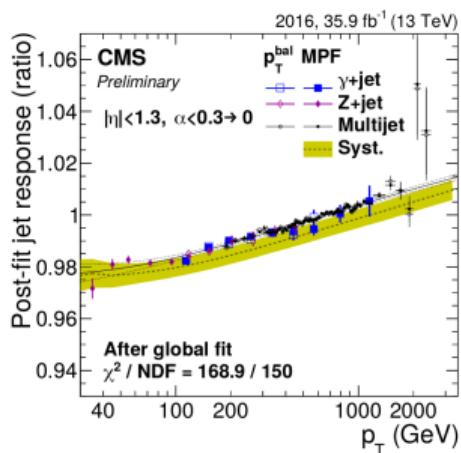
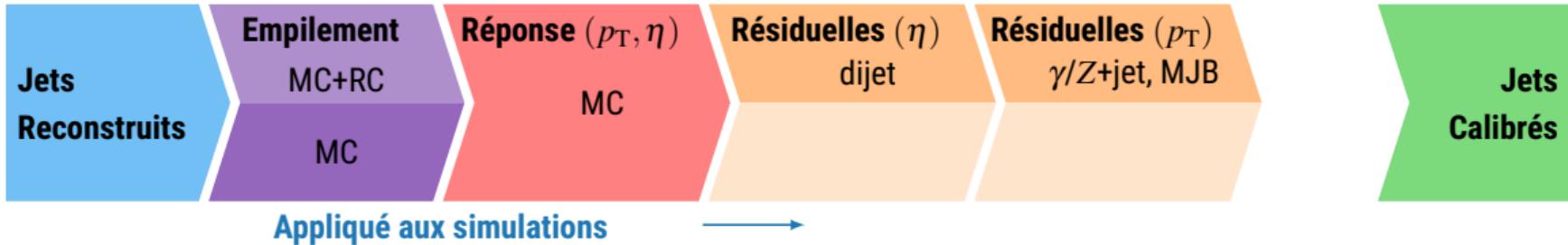
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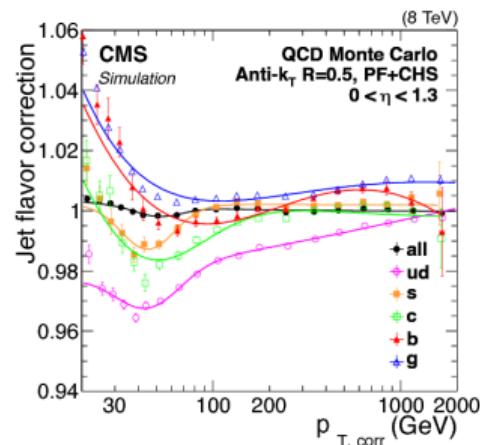
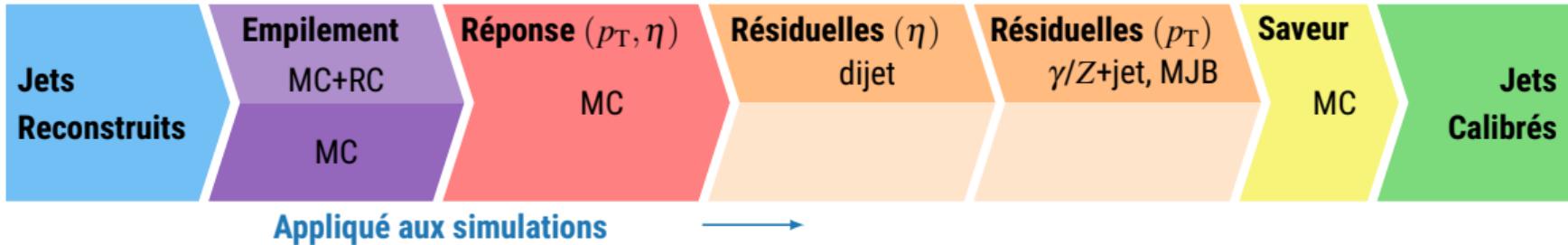
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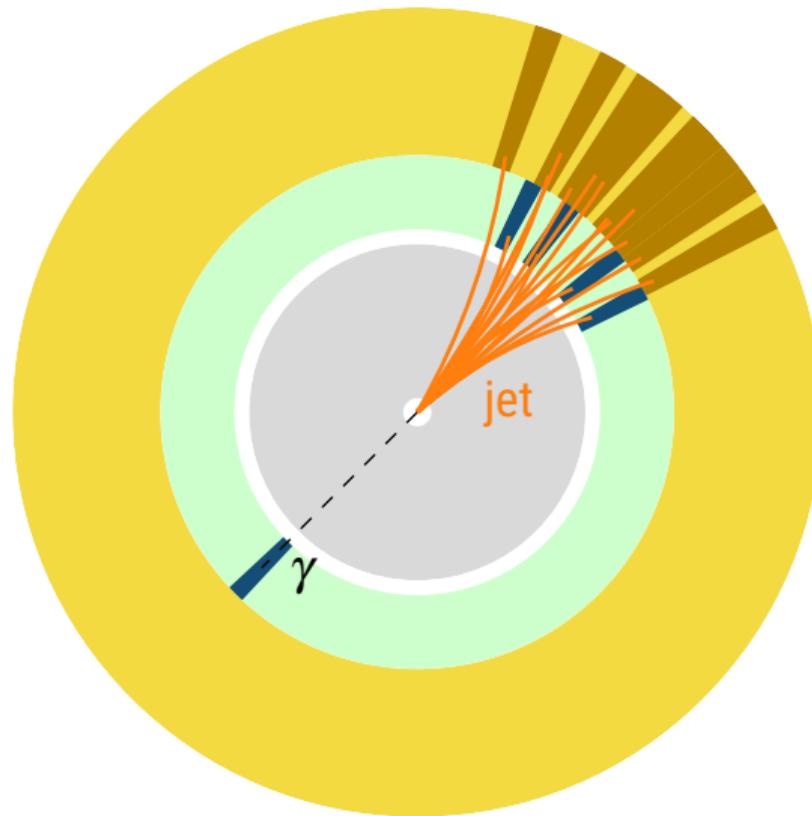


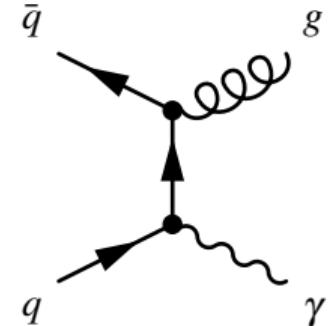
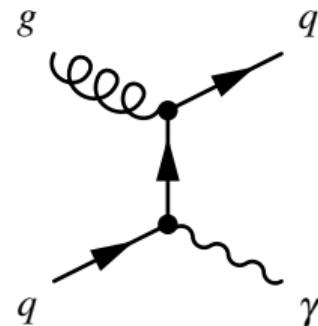
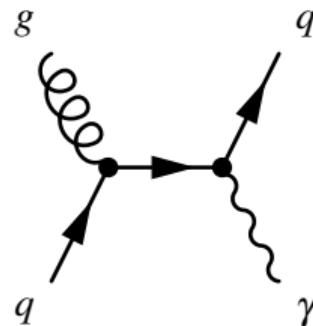
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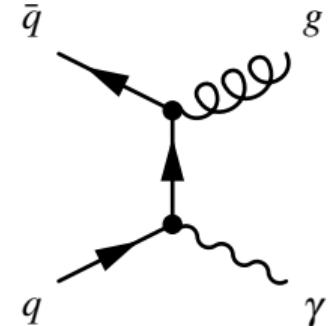
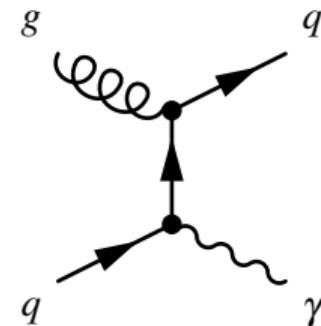
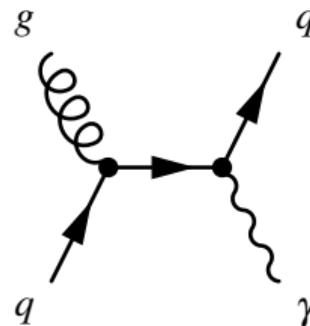


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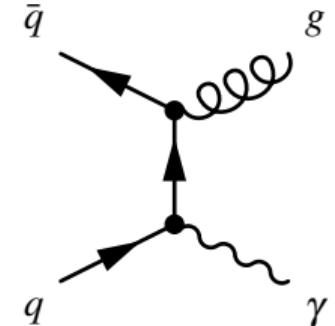
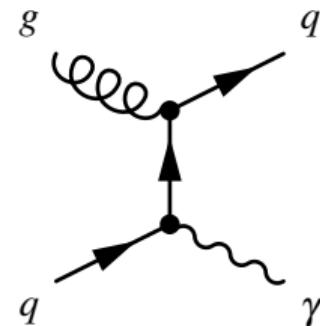
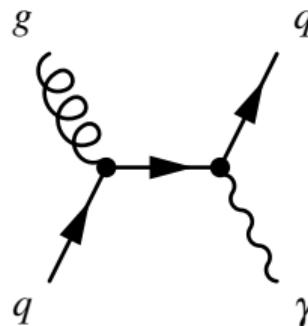






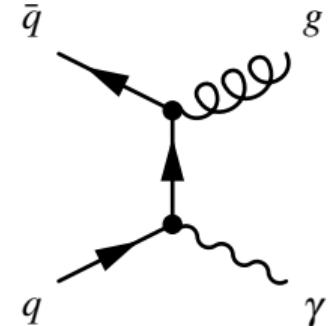
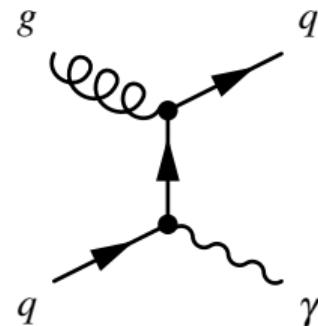
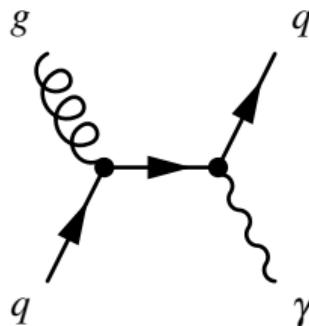


$$\vec{p}_{T,\text{ptcl}}^\gamma + \vec{p}_{T,\text{ptcl}}^{\text{jet}} = \vec{0} \Rightarrow p_{T,\text{ptcl}}^\gamma = p_{T,\text{ptcl}}^{\text{jet}}$$



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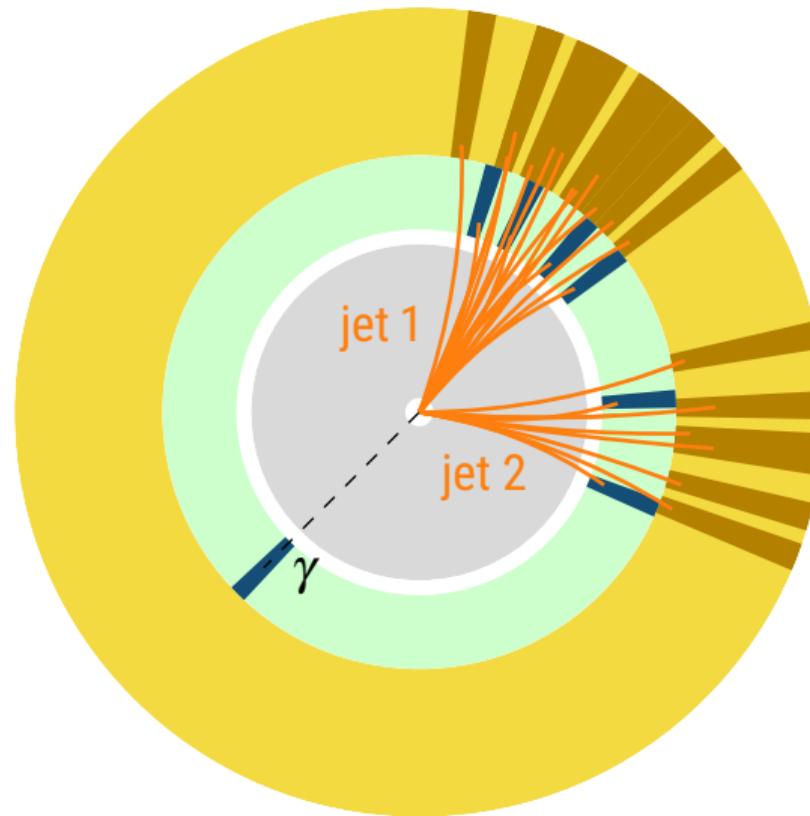
$$R = \frac{p_{\text{T reco}}^{\text{jet}}}{p_{\text{T ptcl}}^{\text{jet}}} = \frac{p_{\text{T reco}}^{\text{jet}}}{p_{\text{T ptcl}}^{\gamma}} \simeq \frac{p_{\text{T reco}}^{\text{jet}}}{p_{\text{T reco}}^{\gamma}}$$

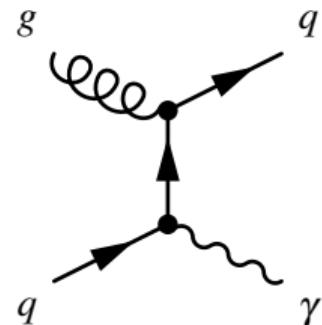


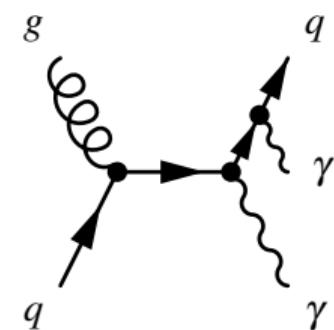
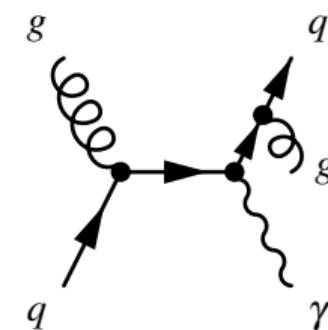
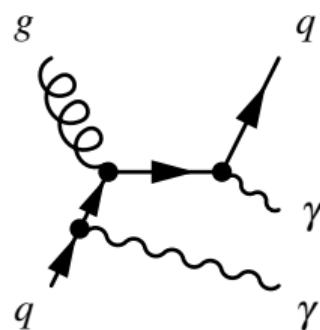
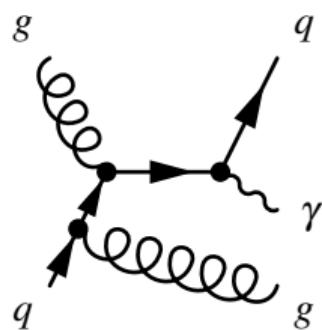
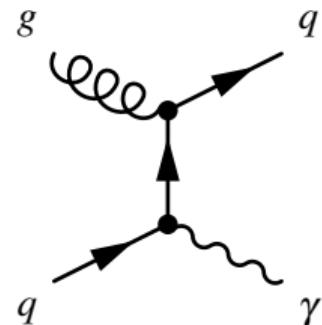
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$$R_{\text{bal}} = \frac{p_{\text{T reco}}^{\text{jet}}}{p_{\text{T}}^\gamma}$$







$$R_{bal} = \frac{p_T^{\text{jet 1}}}{p_T^\gamma}$$

$$\alpha = \frac{p_T^{\text{jet 2}}}{p_T^\gamma}$$

$$\vec{p}_{T\text{ptcl}}^{\gamma} + \vec{p}_{T\text{ptcl}}^{\text{recul}} = \vec{0}$$

$$\vec{p}_T^{\gamma} + \vec{p}_T^{\text{recul}} = \vec{0}$$

$$\underbrace{\vec{p}_T^{\gamma} + R_{MPF} \vec{p}_T^{\text{recul}}}_{\vec{p}_T^{\text{reco}}} = -\vec{E}_T^{\text{miss}} \Rightarrow R_{MPF} = 1 + \frac{\vec{p}_T^{\gamma} \cdot \vec{E}_T^{\text{miss}}}{|\vec{p}_T^{\gamma}|^2}$$

Jet Energy Resolution

- ▶ Remember R_{bal} definition,

$$R_{bal} = \frac{p_{\text{T}}^{\text{reco, 1st jet}}}{p_{\text{T}}^{\gamma, \text{reco}}}$$

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Then

$$R_{bal} = \underbrace{\frac{p_{T\text{reco}}^{\text{1st jet}}}{p_{T\text{ptcl}}^{\text{1st jet}}}}_{\sigma_{\text{jet}} = \text{JER}} \times \underbrace{\frac{p_{T\text{ptcl}}^{\text{1st jet}}}{p_{T\text{ptcl}}^\gamma}}_{\text{PLI}} \times \underbrace{\frac{p_{T\text{ptcl}}^\gamma}{p_{T\text{reco}}^\gamma}}_{\sigma_\gamma \equiv 1}$$

- ▶ PLI: Particle Level Imbalance (pile-up, radiations, neutrinos...), $\rightarrow 0$ when $\alpha \rightarrow 0$.

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$$\text{JER} = \sigma_{\text{jet}} = \sqrt{\sigma_{R_{bal}}^2 - \sigma_{\text{PLI}}^2}$$

Thank you for your attention!