

# Préparation au TP "sur les traces du bosons de Higgs avec le détecteur ATLAS"

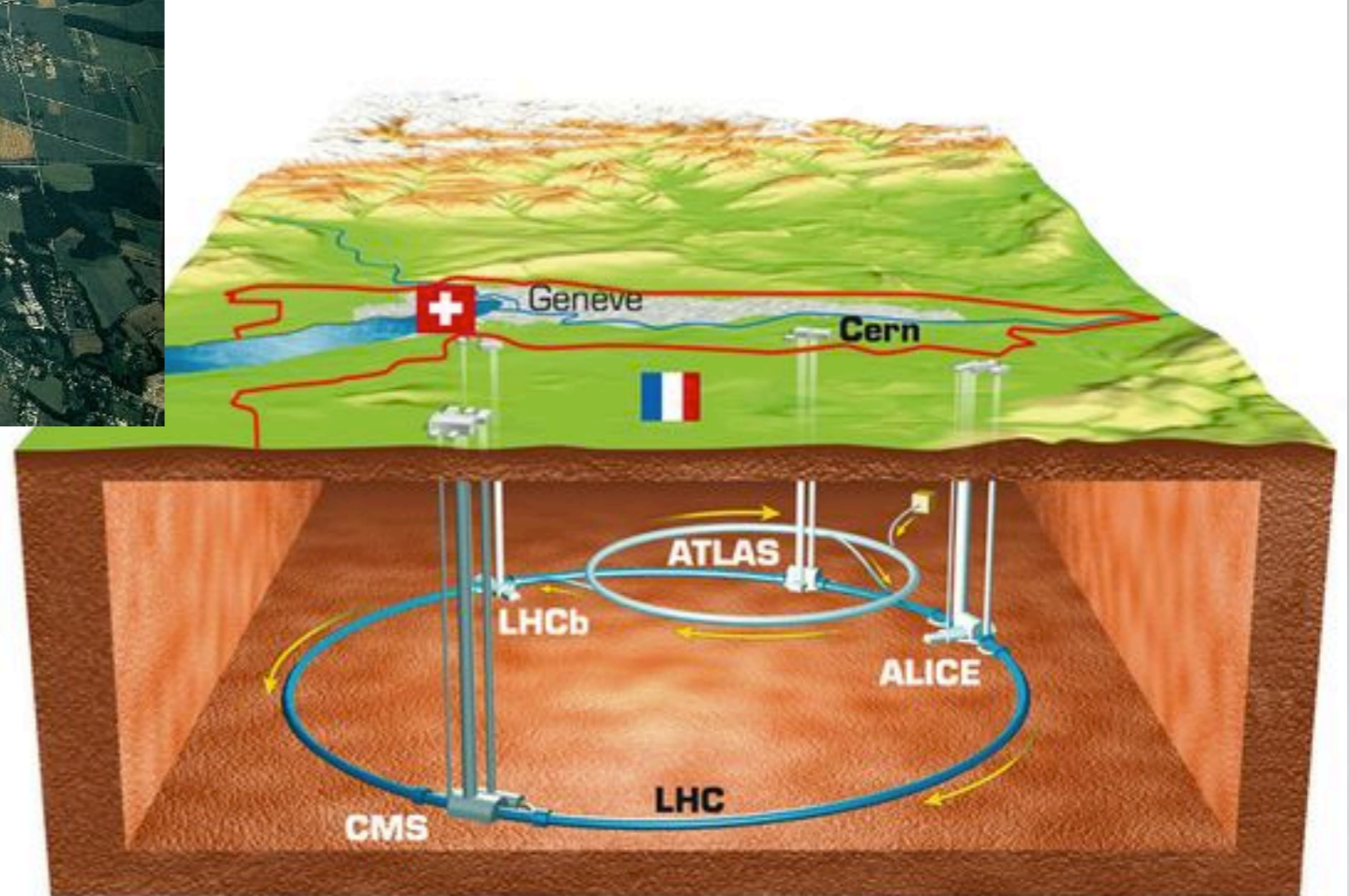
**Frédéric Déliot**

masterclass, 8 avril 2016

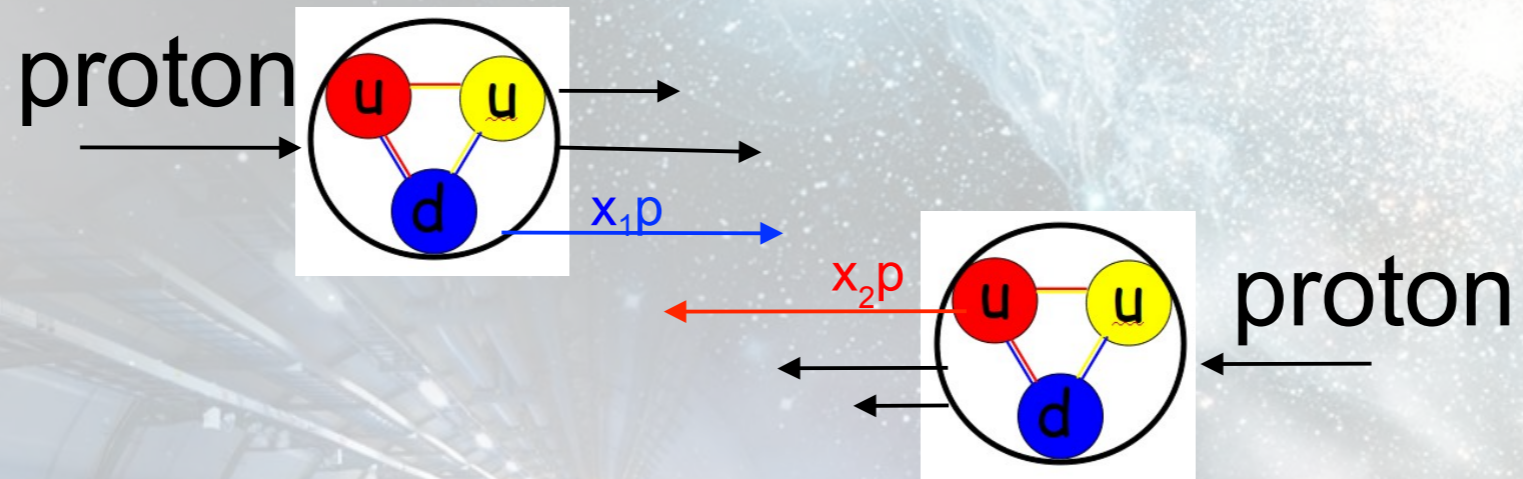
largement inspiré des transparents de Laurent Chevalier



# ATLAS au CERN

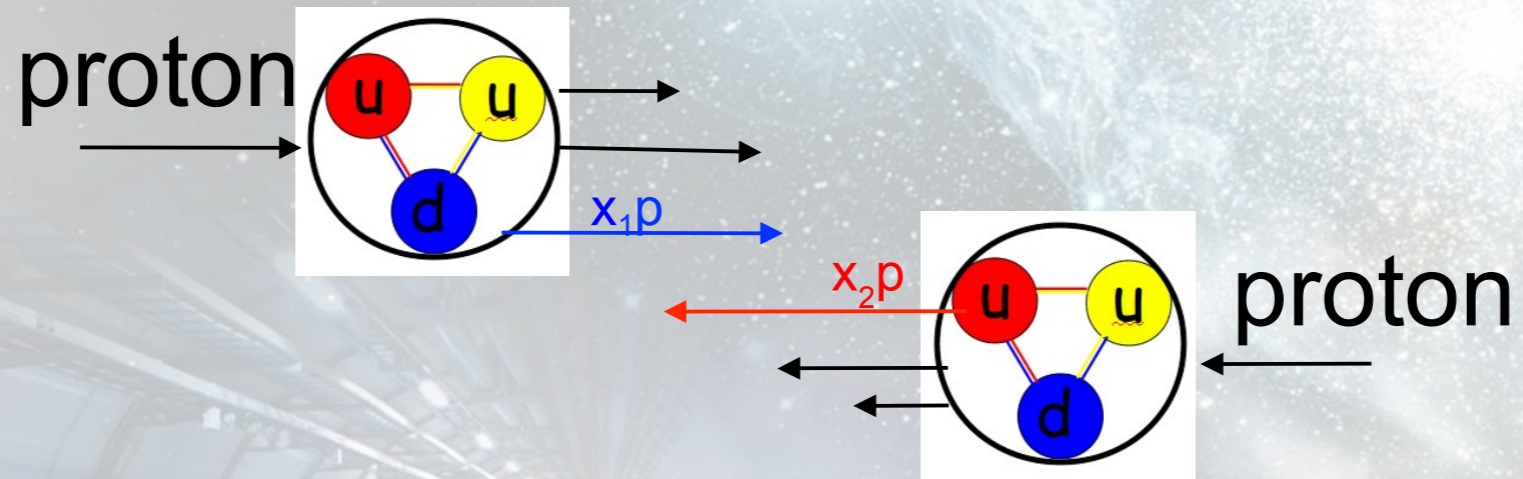


# Collisions au LHC

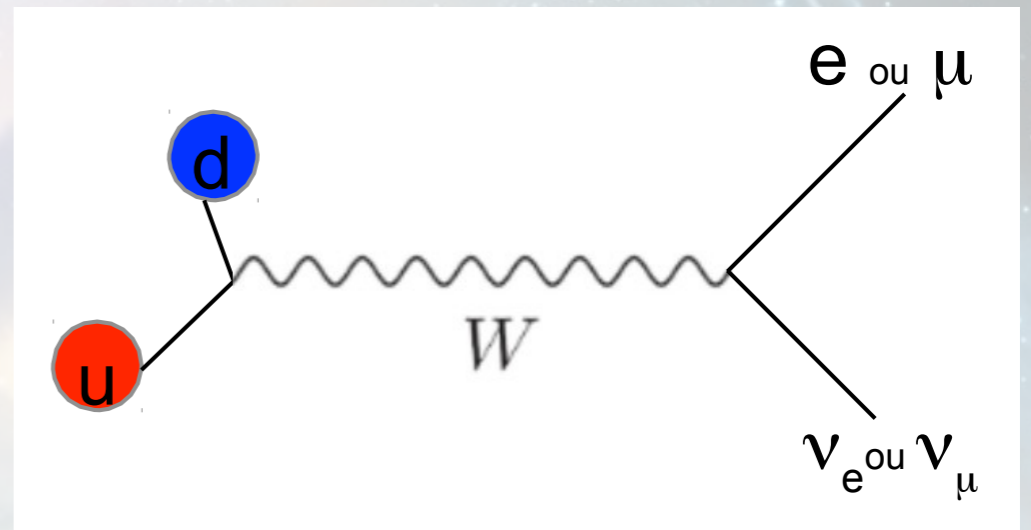
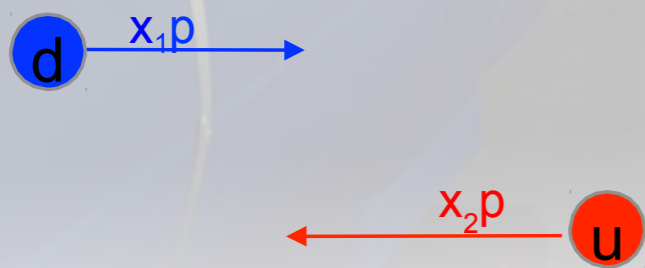


matière (proton)  $\longrightarrow$   $E=mc^2$  énergie  $\longrightarrow$  matière (boson W)

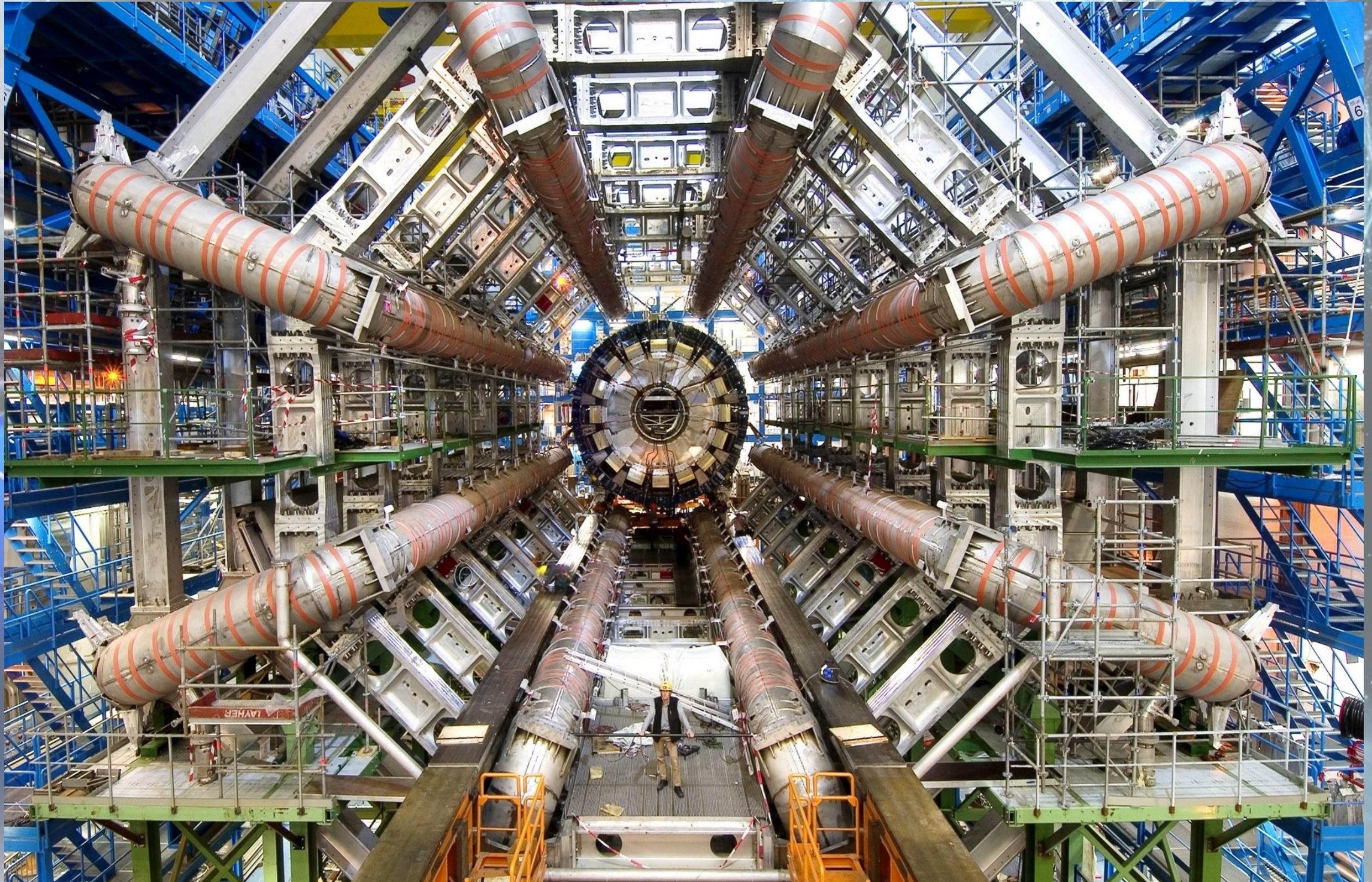
# Collisions au LHC



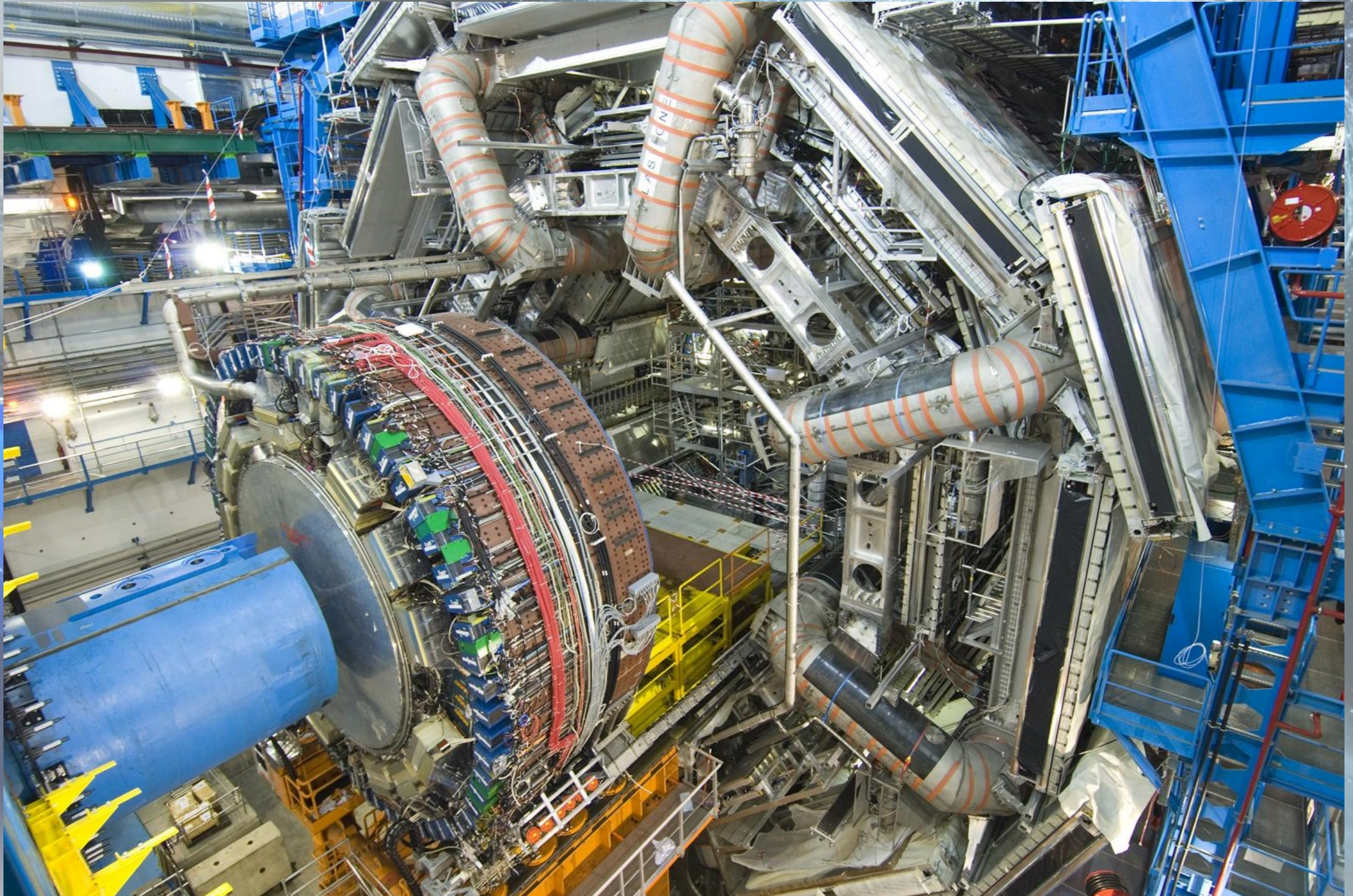
matière (proton)  $\longrightarrow$   $E=mc^2$  énergie  $\longrightarrow$  matière (boson W)



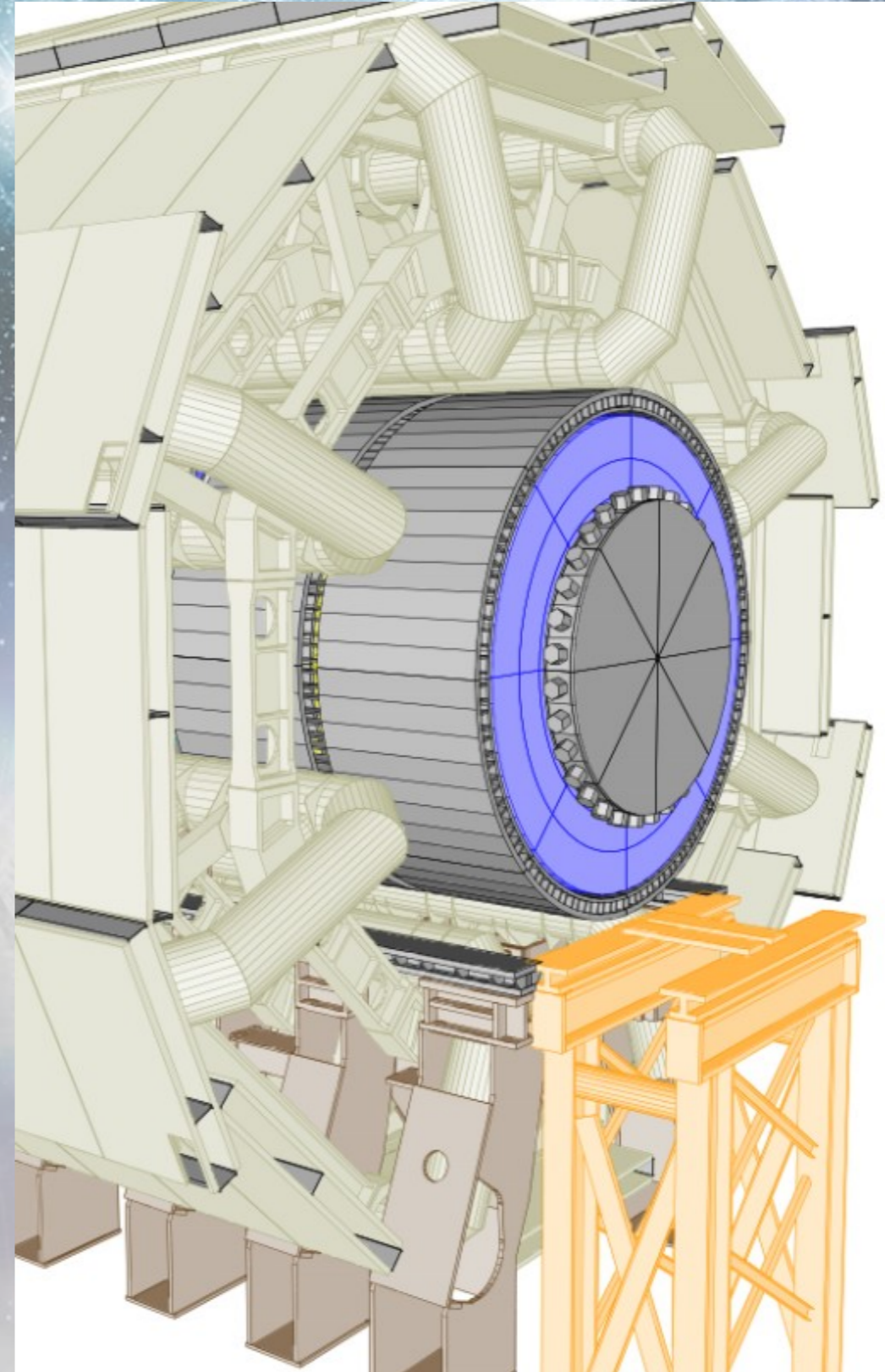
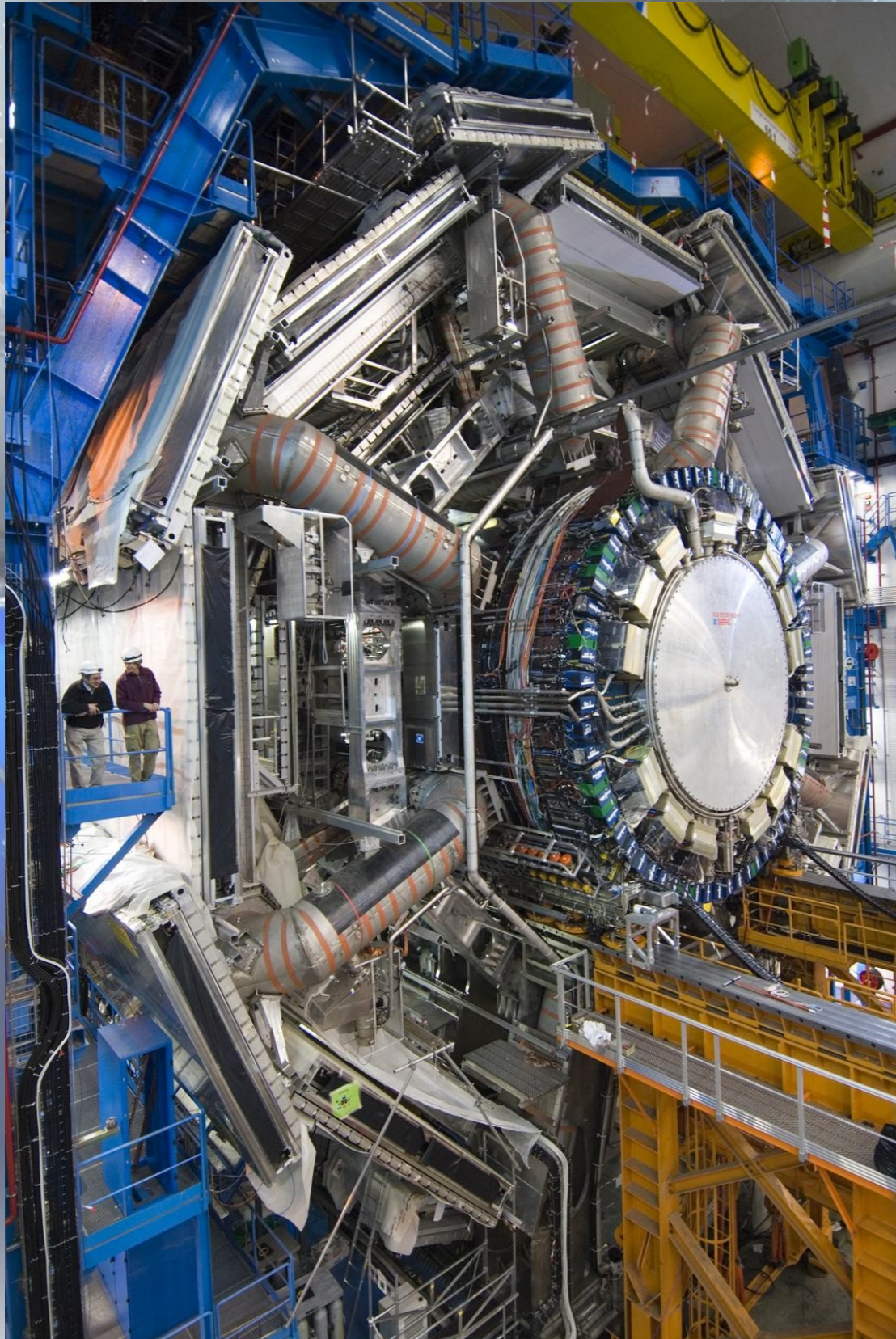
# Le détecteur ATLAS



# Le détecteur ATLAS



# Simulation



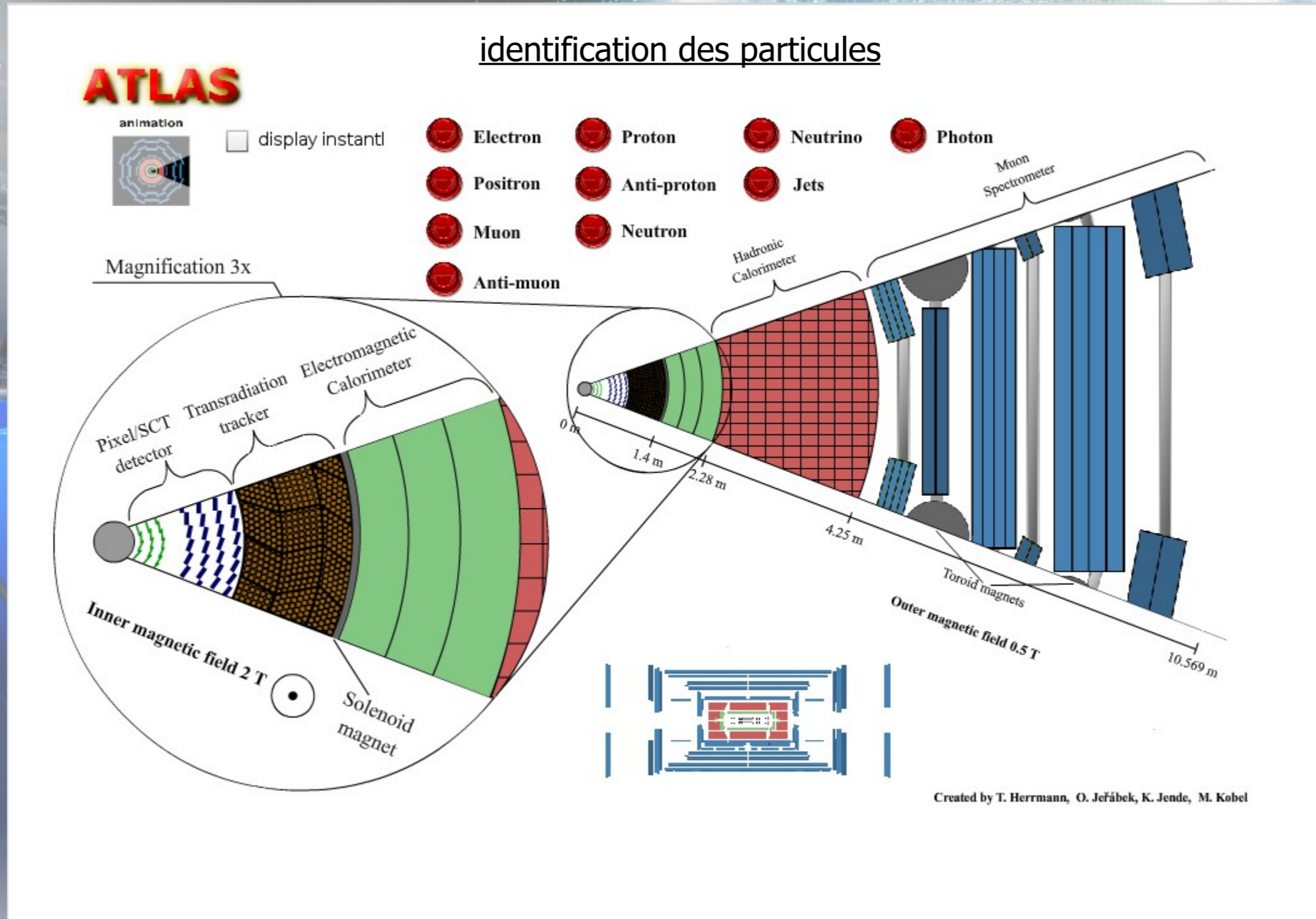
# Principe d'un détecteur



collision proton-proton dans ATLAS

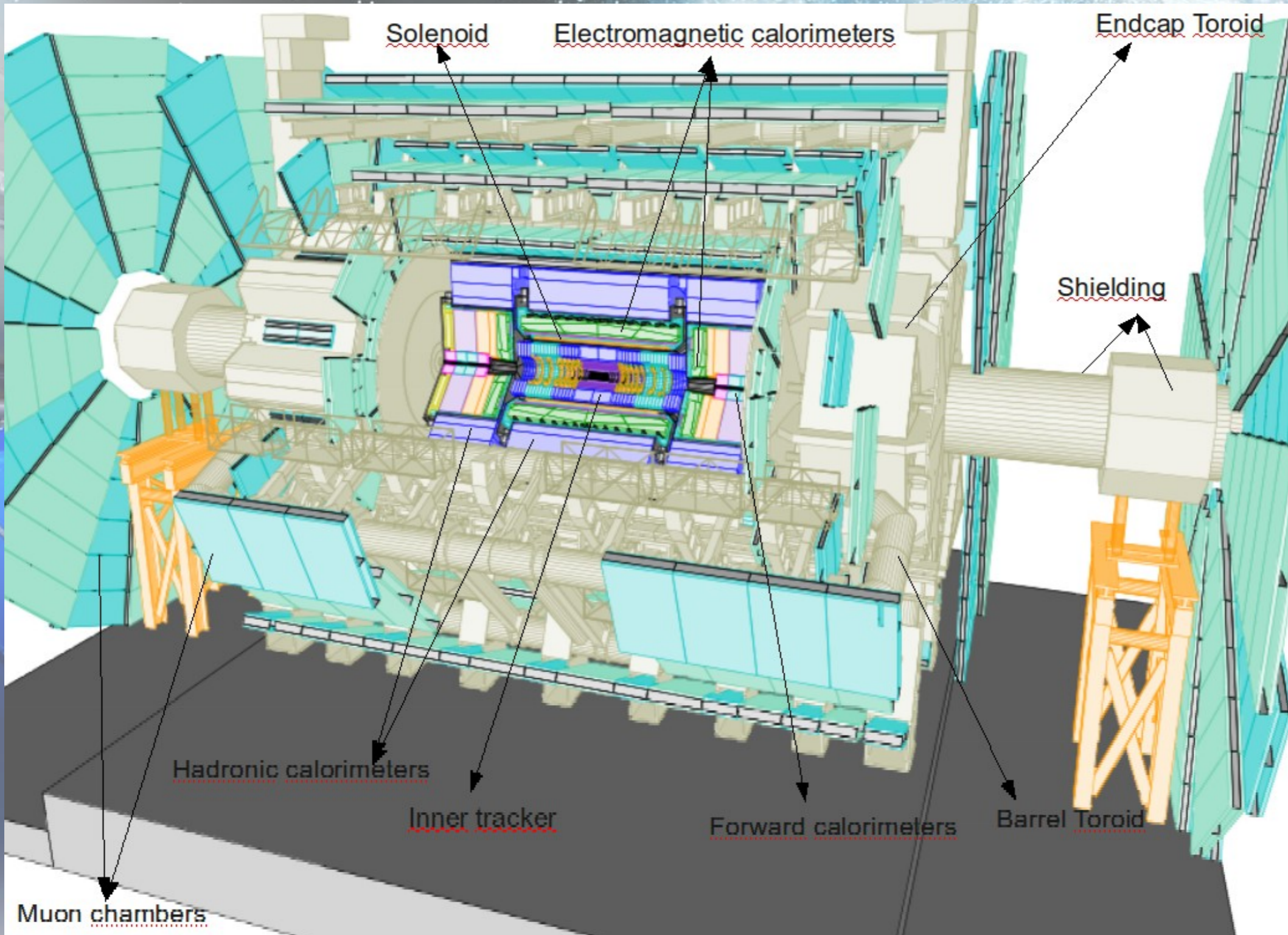


# Différents sous systèmes



# ATLAS: ~ 90 000 000 pixels

45 m

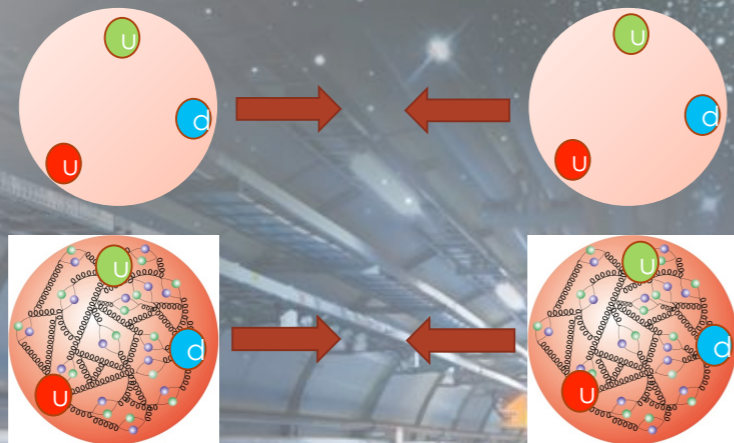


24 m

# But du TP

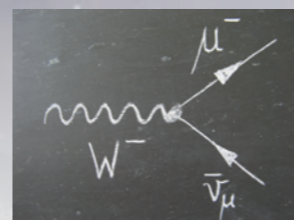
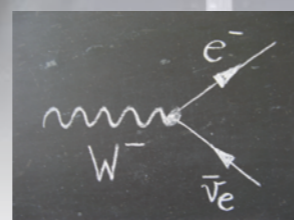
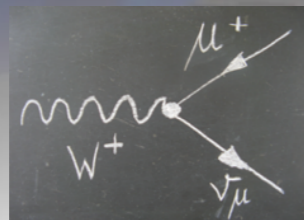
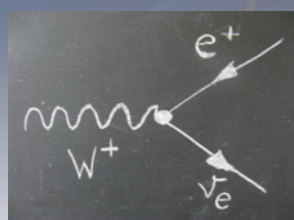
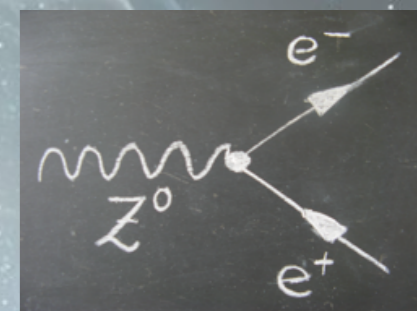
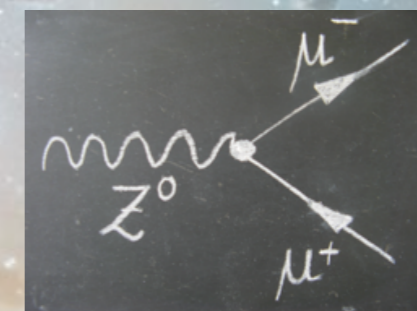
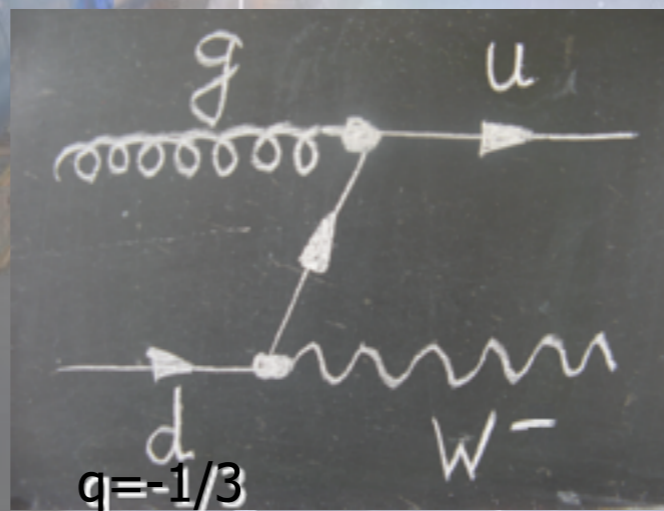
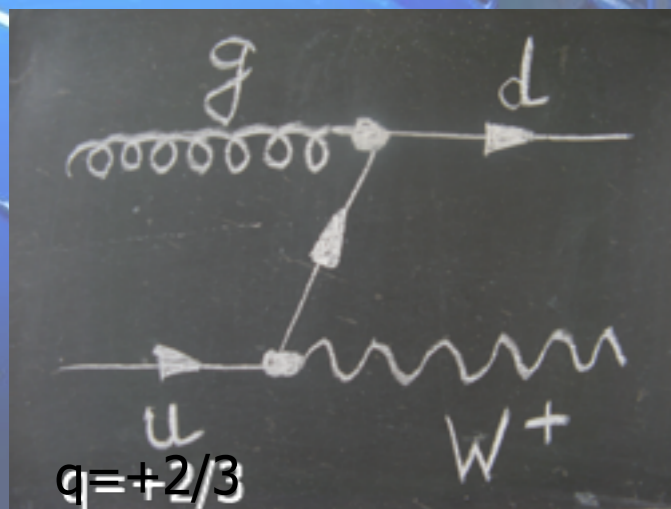
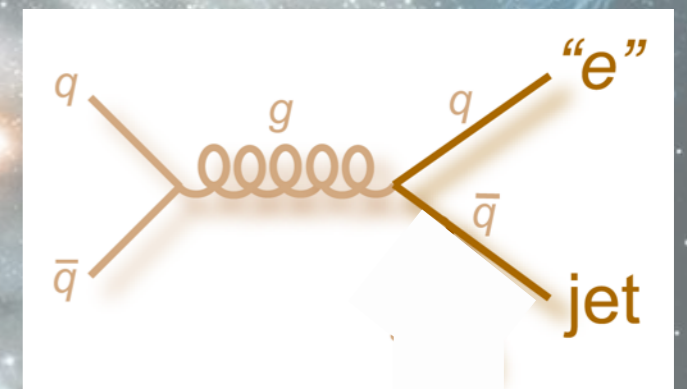
identifier et compter les événements avec un boson  $W^+$ ,  $W^-$  ou 2  $W$ 's

1) test de la structure du proton:



signal

bruit de fond

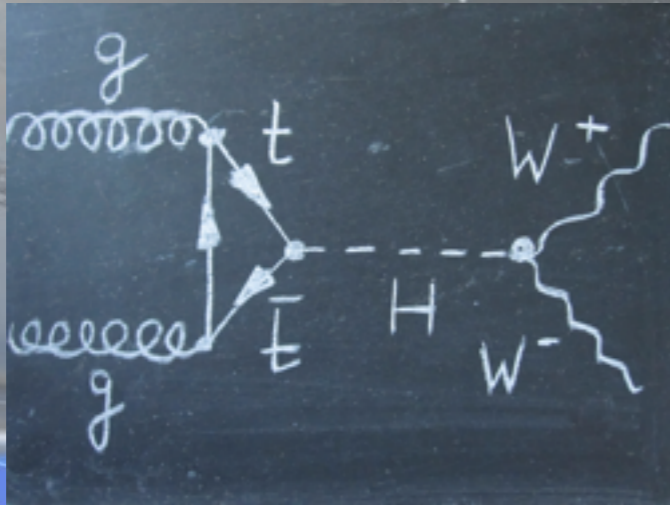


# But du TP (2)

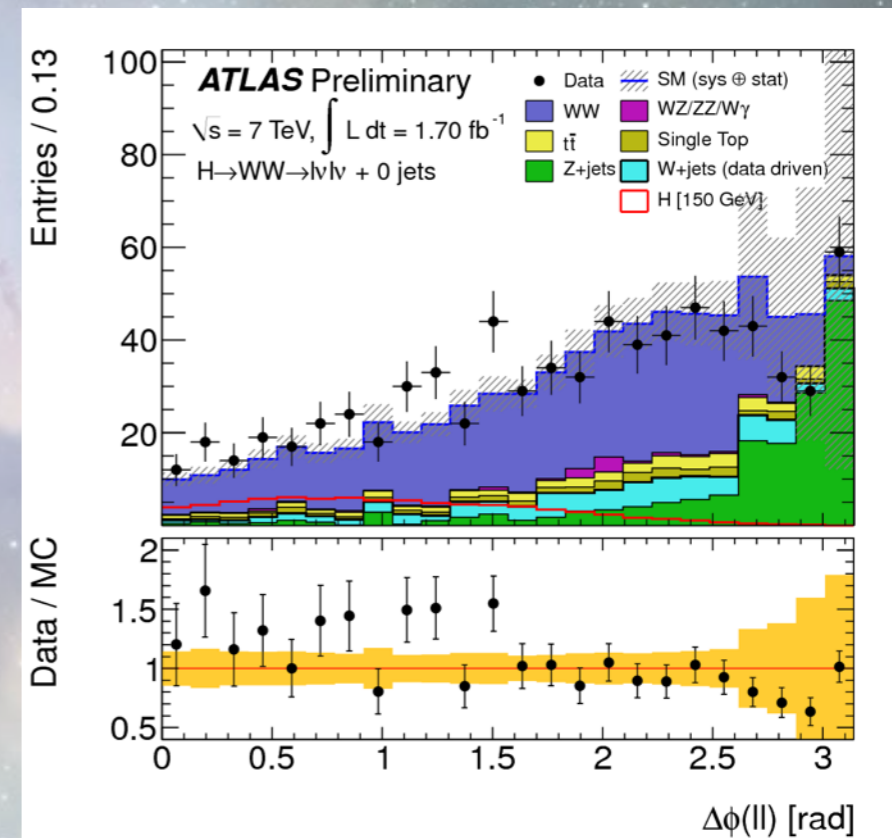
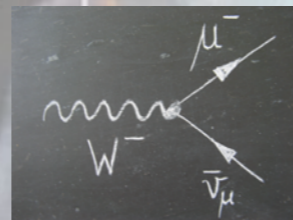
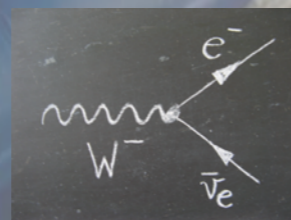
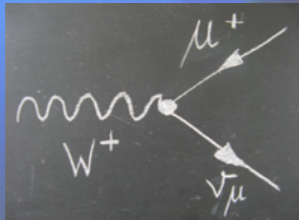
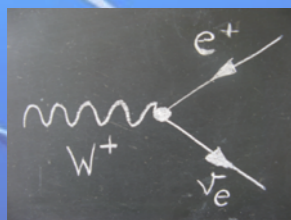
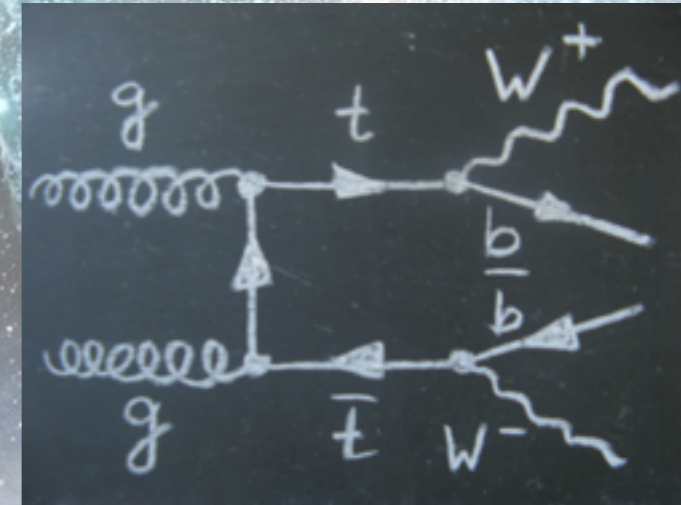
identifier et compter les événements avec un boson  $W^+$ ,  $W^-$  ou 2  $W$ 's

2) recherche du boson de Higgs:

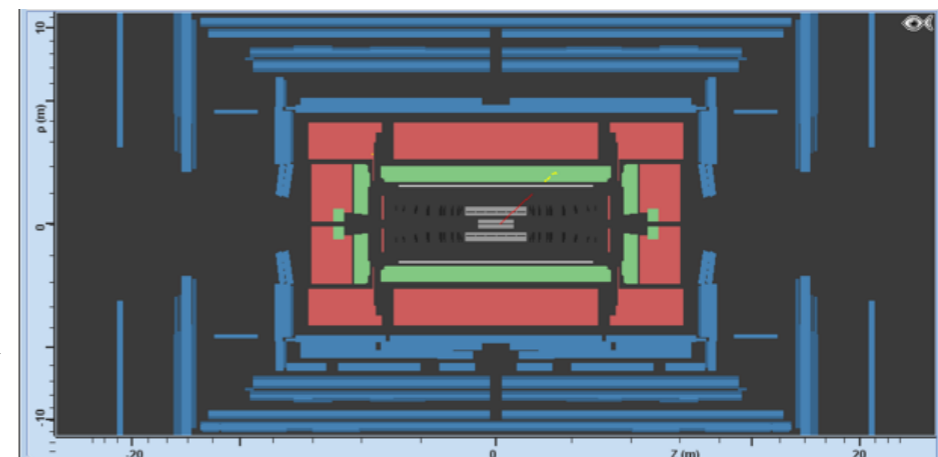
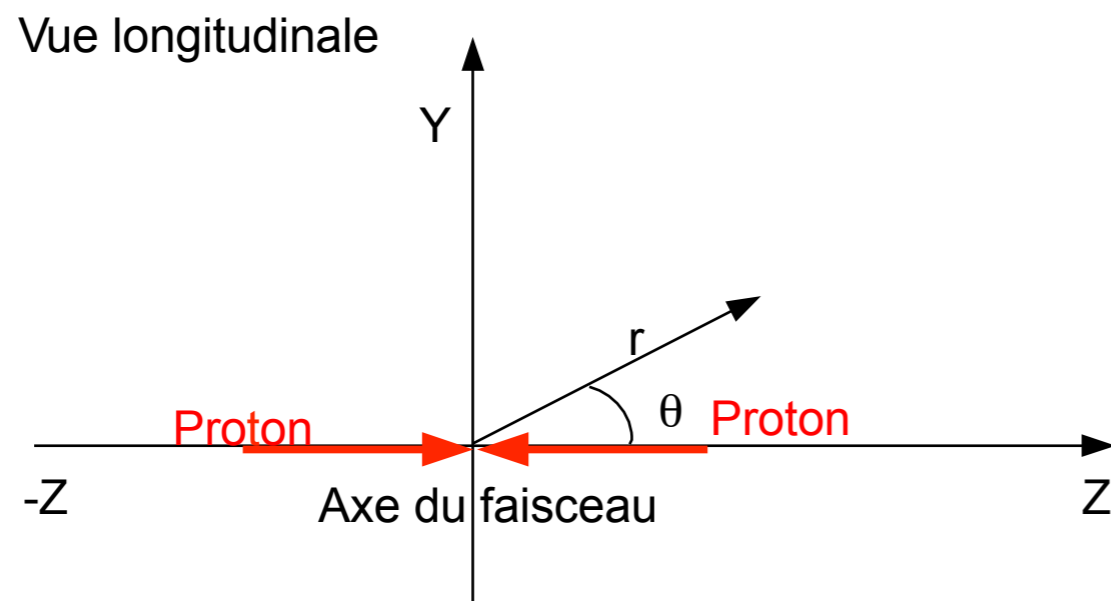
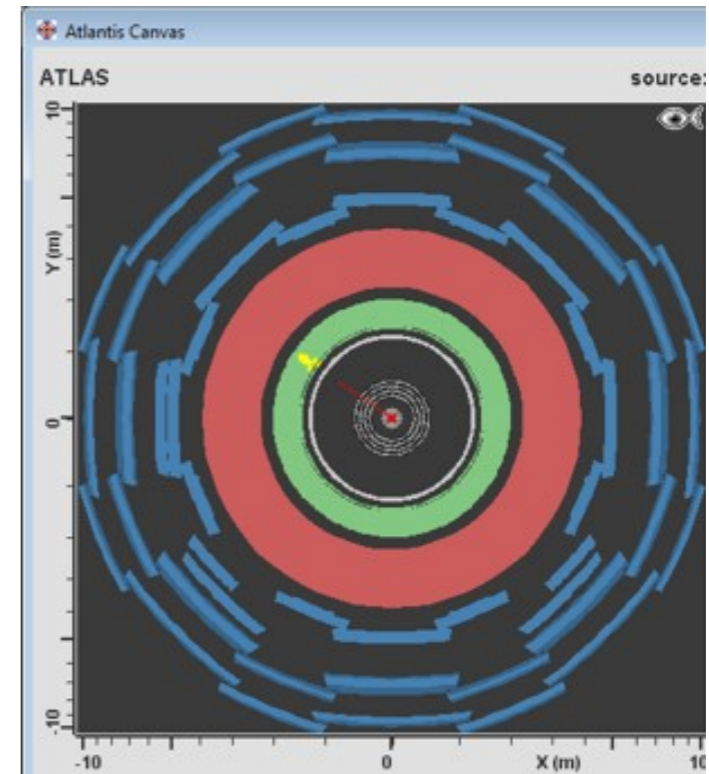
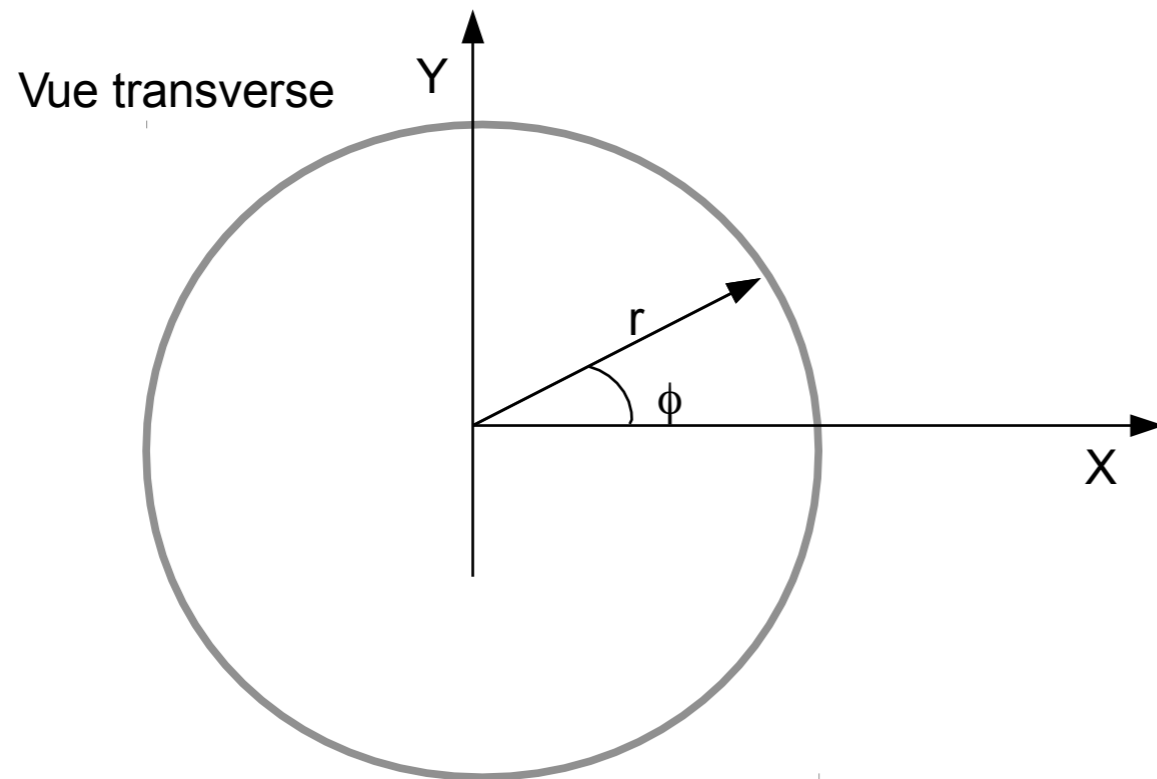
signal



bruit de fond

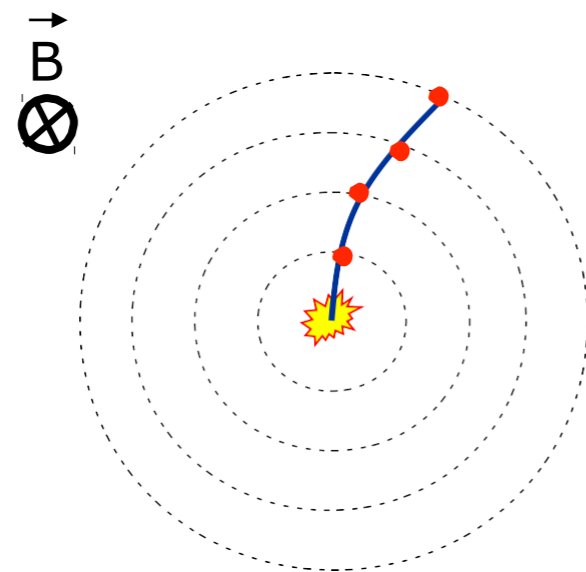


# Visualisation



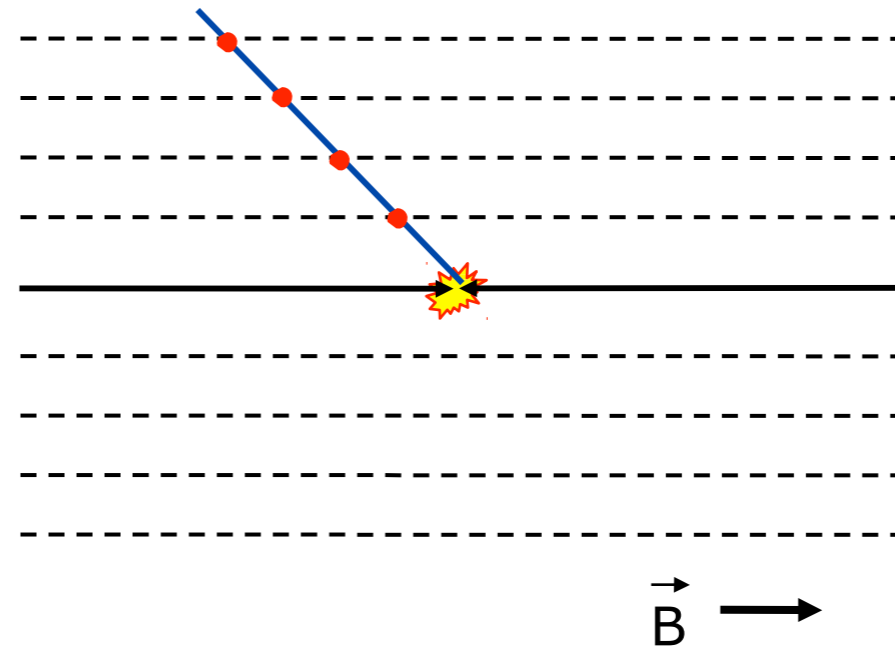
# Visualisation

Vue transverse



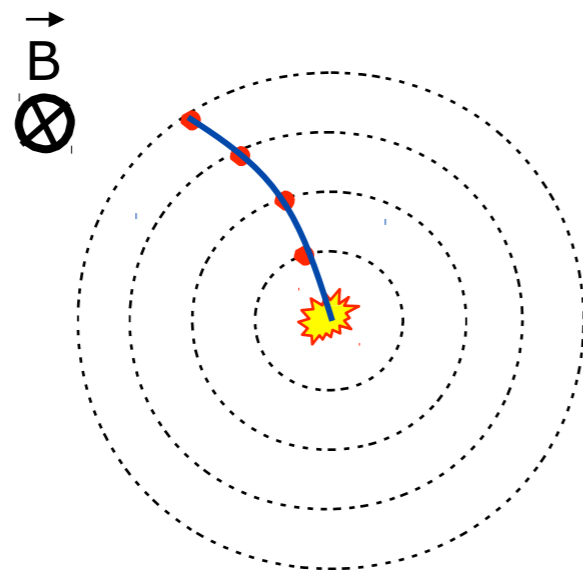
Un électron

Vue longitudinale



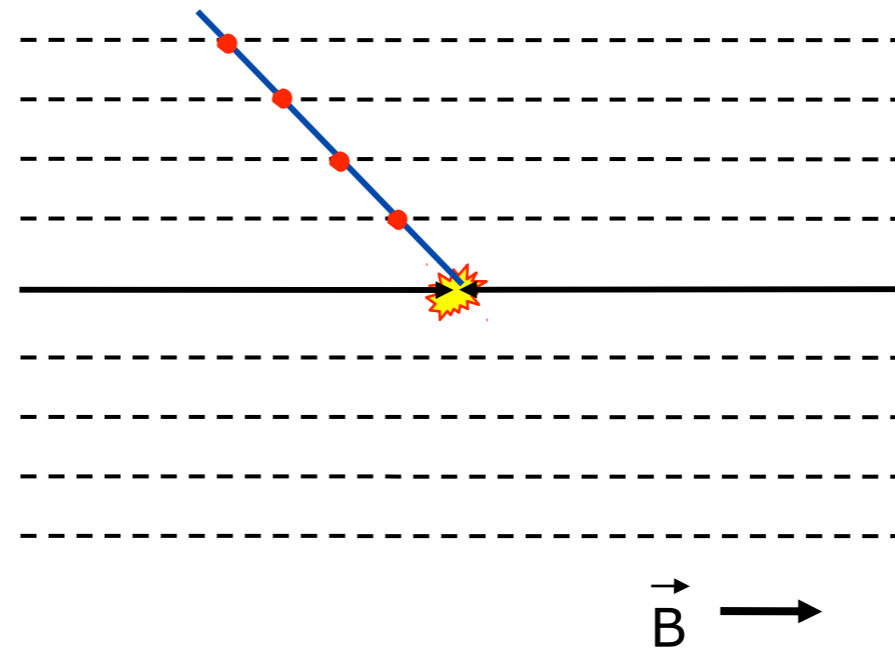
# Visualisation

Vue transverse

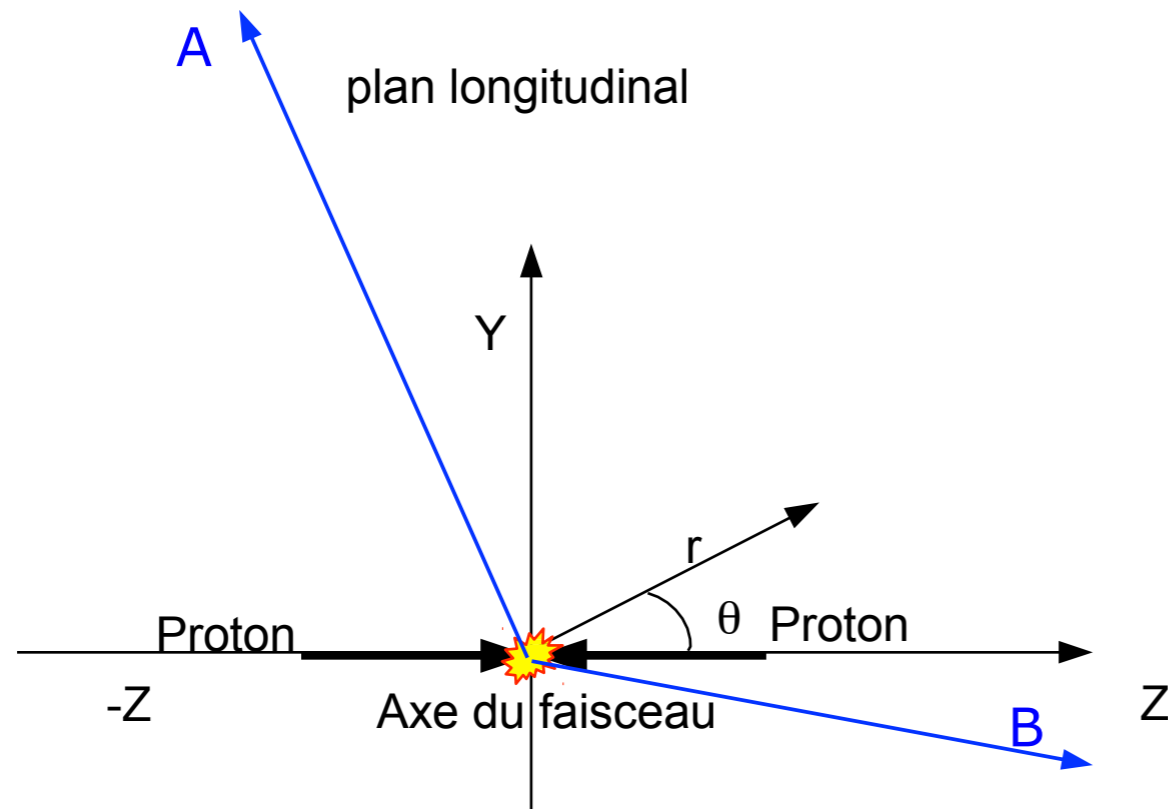


Un positon

Vue longitudinale

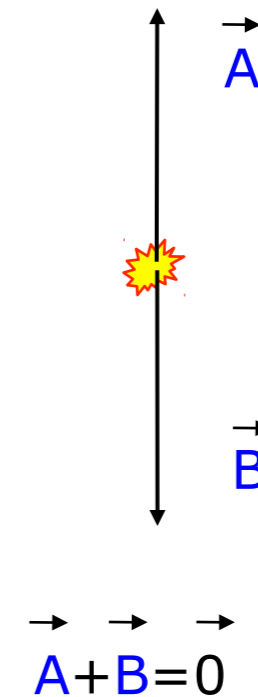


# Conservation de la quantité de mouvement



Quantité de mouvement ( $p=mv$ ) = **impulsion**

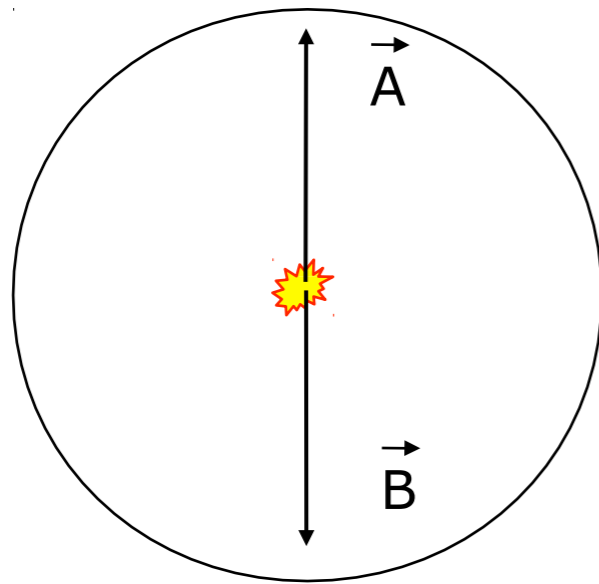
plan transverse



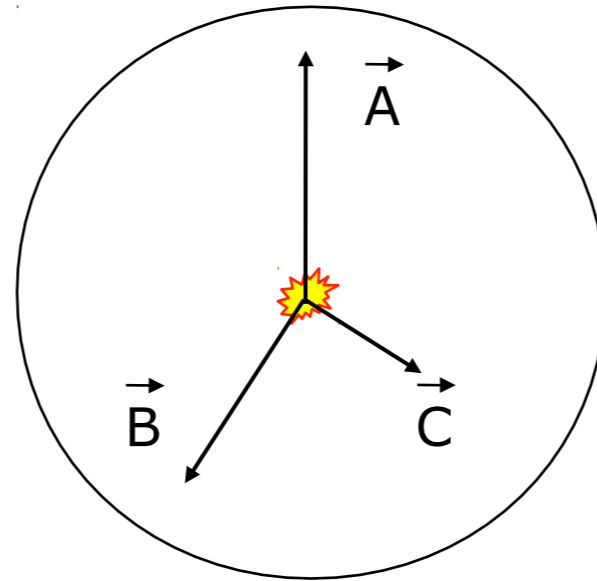
**Conservation de l'impulsion dans le plan transverse au faisceau**



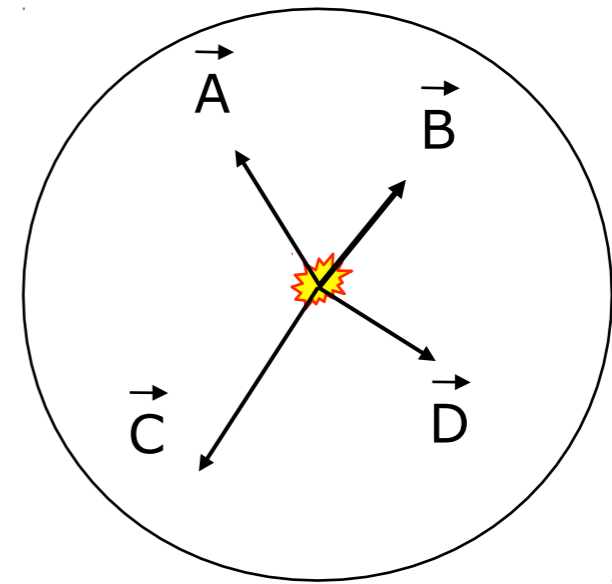
# Conservation de la quantité de mouvement



$$\vec{A} + \vec{B} = \vec{0}$$

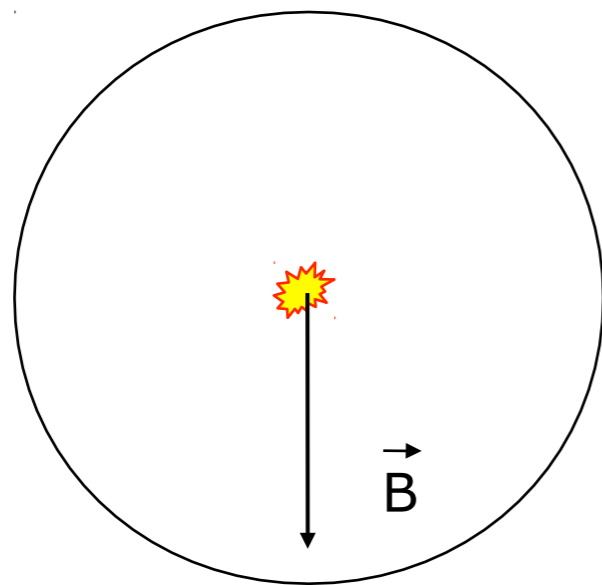


$$\vec{A} + \vec{B} + \vec{C} = \vec{0}$$

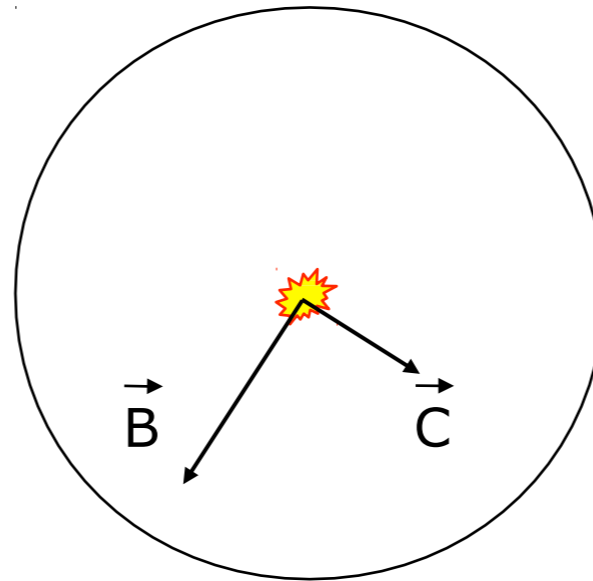


$$\vec{A} + \vec{B} + \vec{C} + \vec{D} = \vec{0}$$

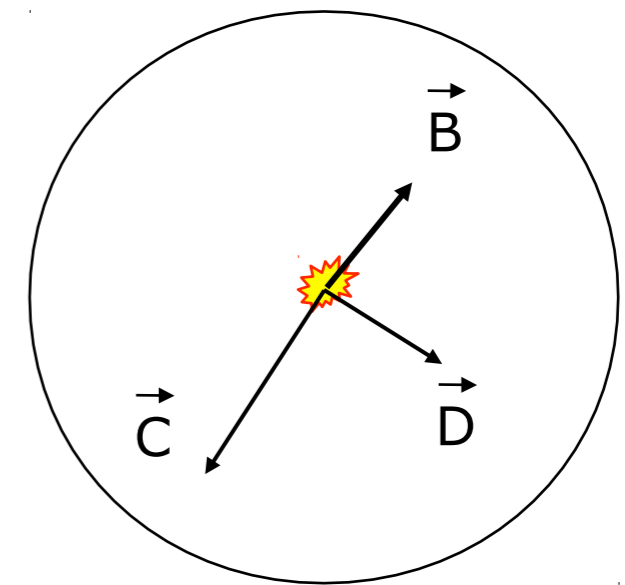
# Energie manquante (MET)



$$\vec{B} \neq 0$$



$$\vec{B} + \vec{C} \neq 0$$

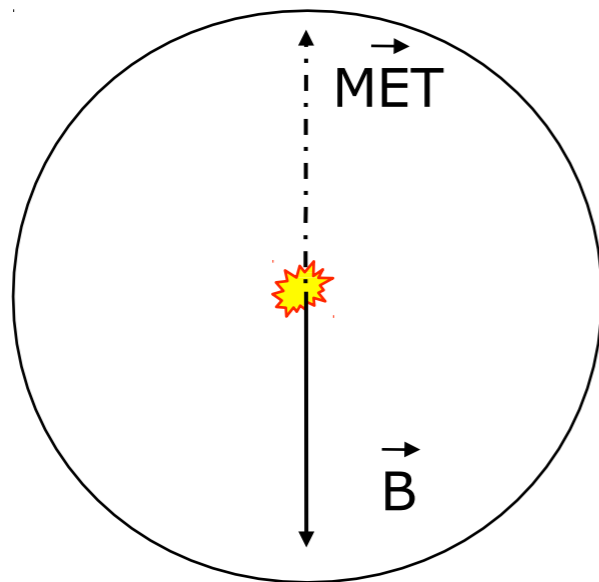


$$\vec{B} + \vec{C} + \vec{D} \neq 0$$

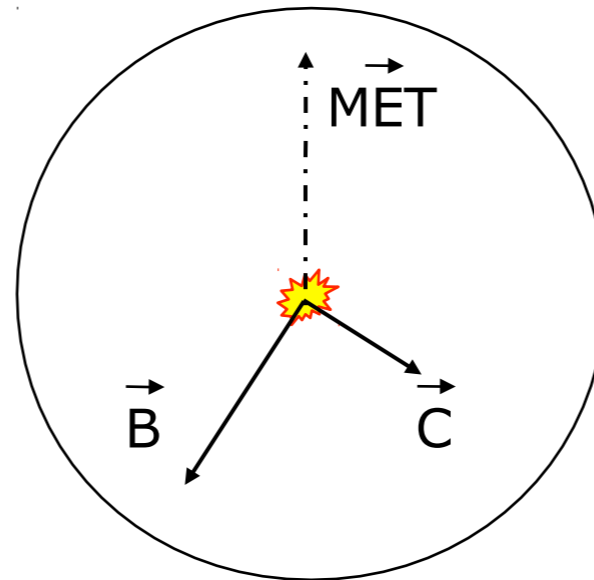
Le neutrino ne laisse pas de trace dans le détecteur interne (neutre) et ne dépose pas d'énergie dans le calorimètre (interagit très faiblement).

Si la particule A est un neutrino, l'impulsion dans le plan transverse semble ne plus être conservée.

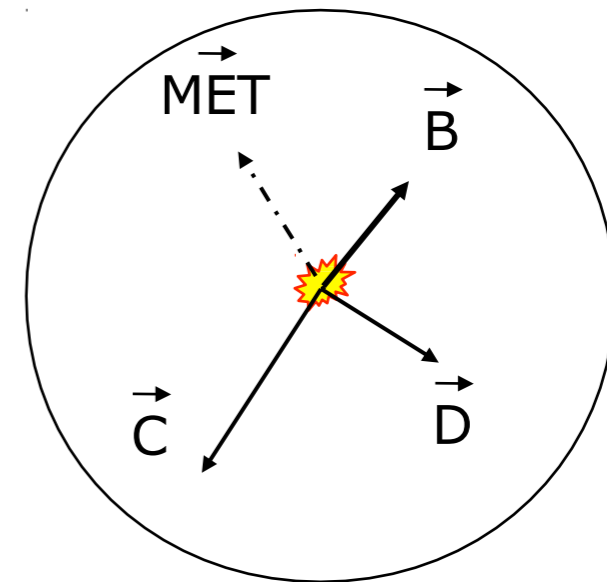
# Energie manquante (MET)



$$\vec{B} = -\vec{MET}$$



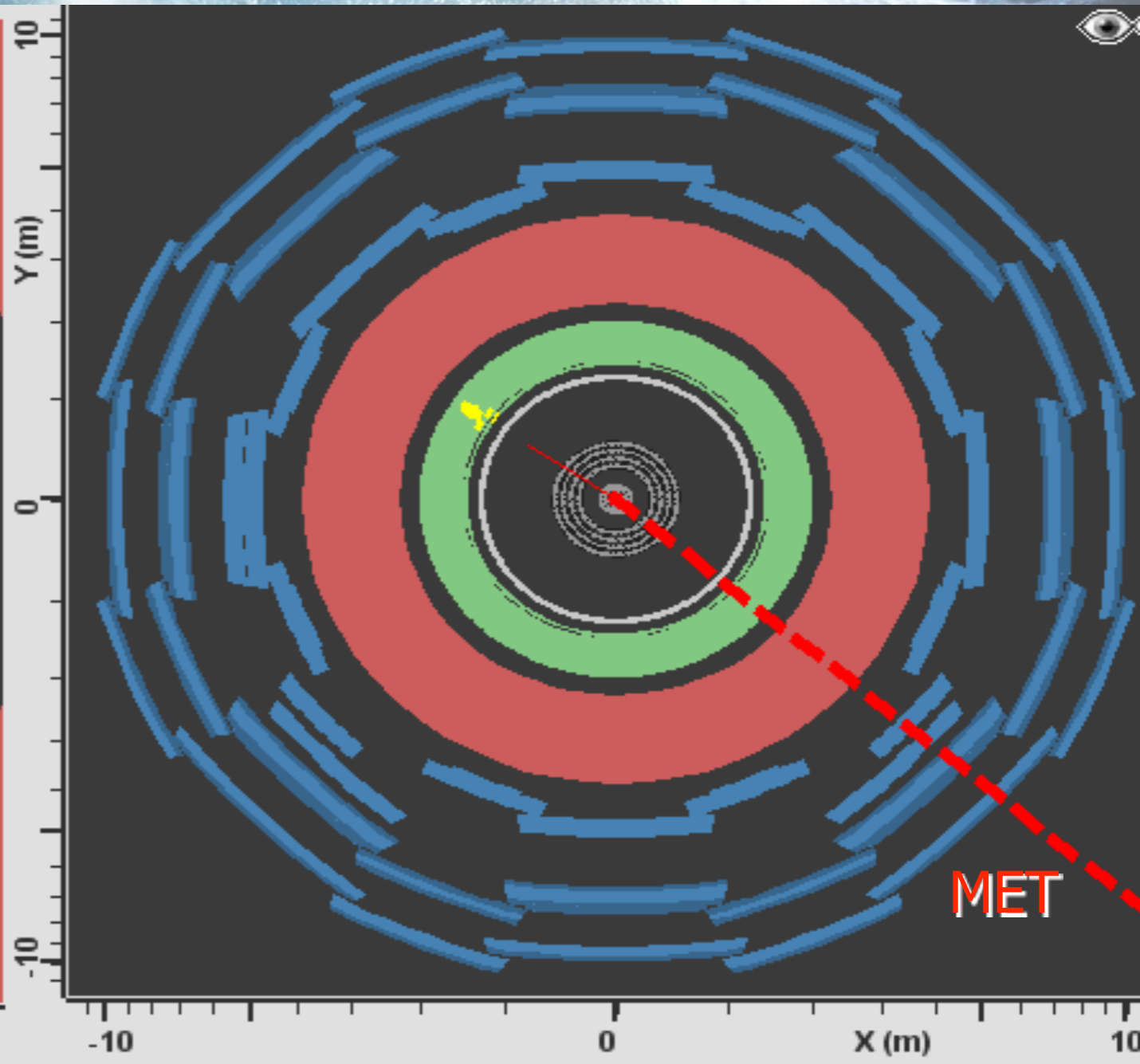
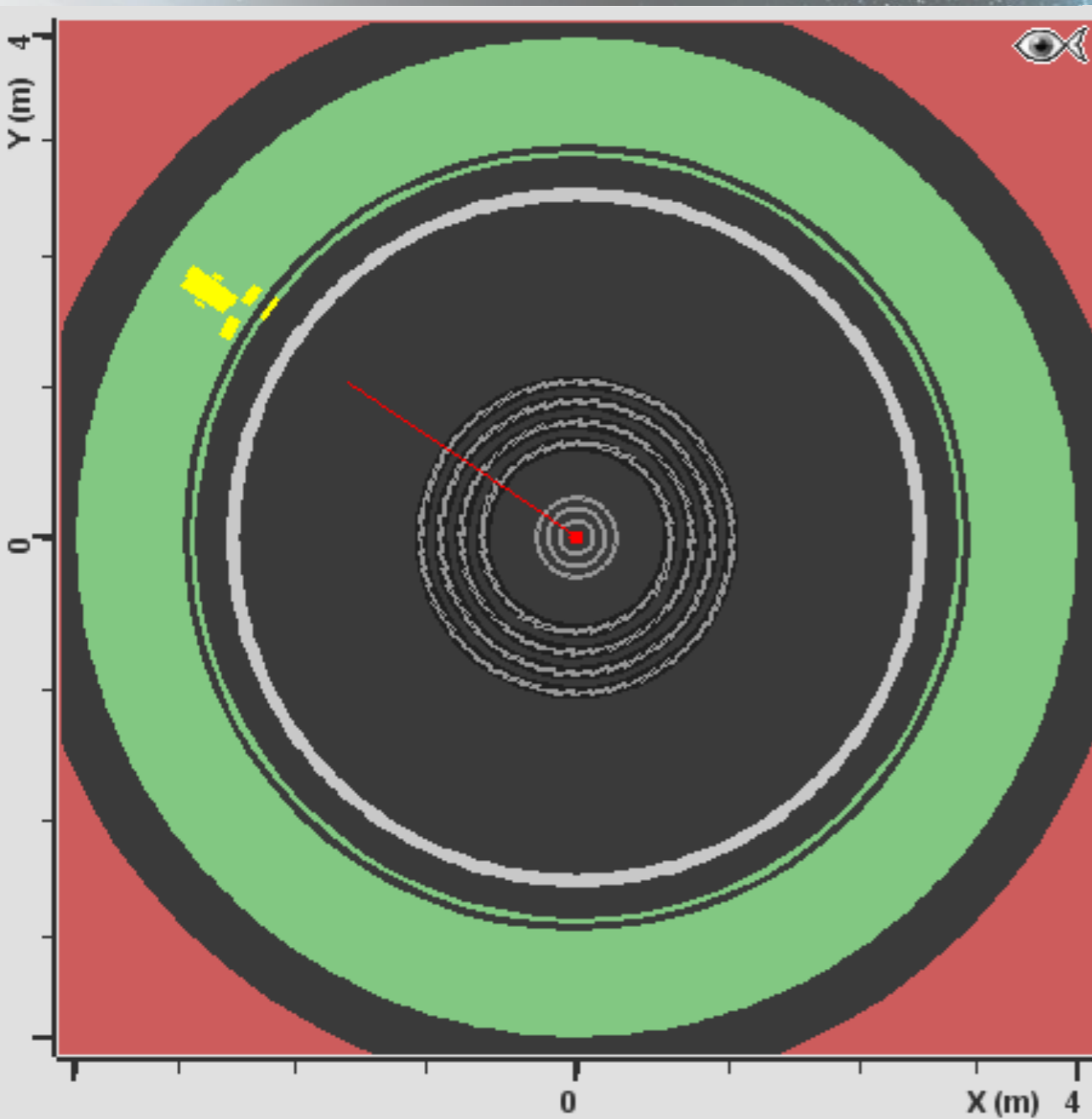
$$\vec{B} + \vec{C} = -\vec{MET}$$



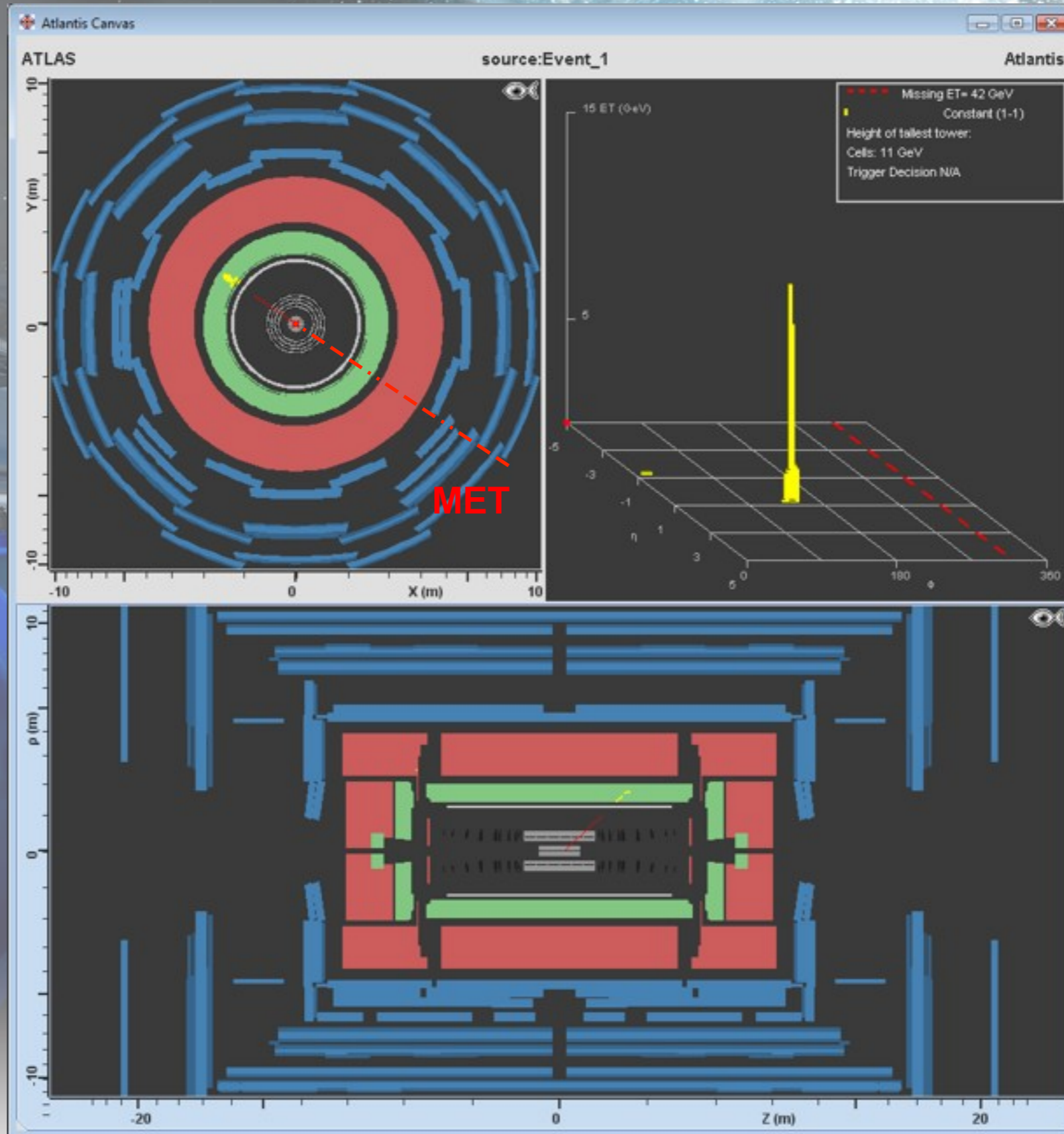
$$\vec{B} + \vec{C} + \vec{D} = -\vec{MET}$$

$\vec{MET} \neq 0 \Rightarrow$  Presence d'un neutrino

# Energie manquante (MET)

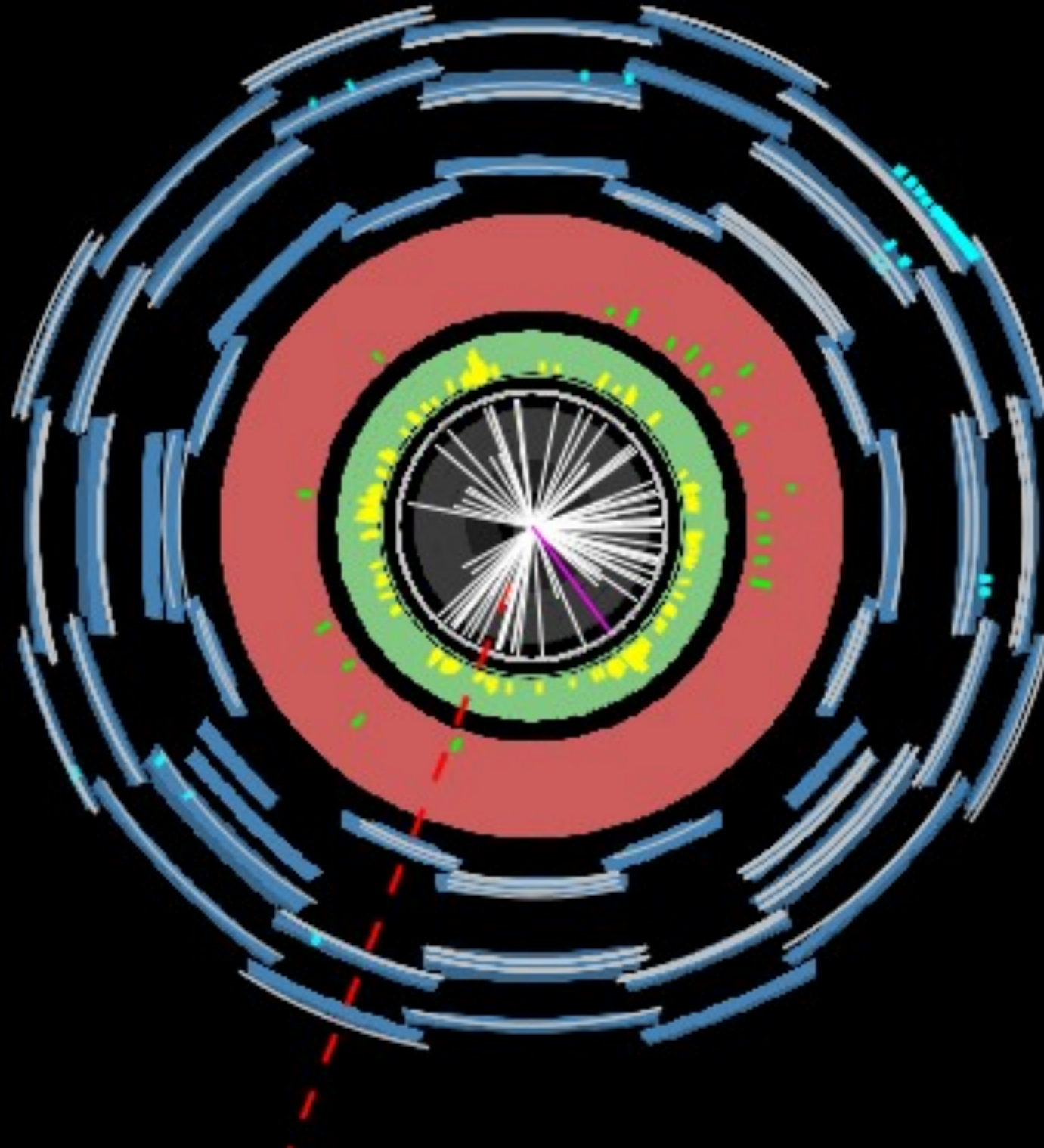


# Energie manquante (MET)



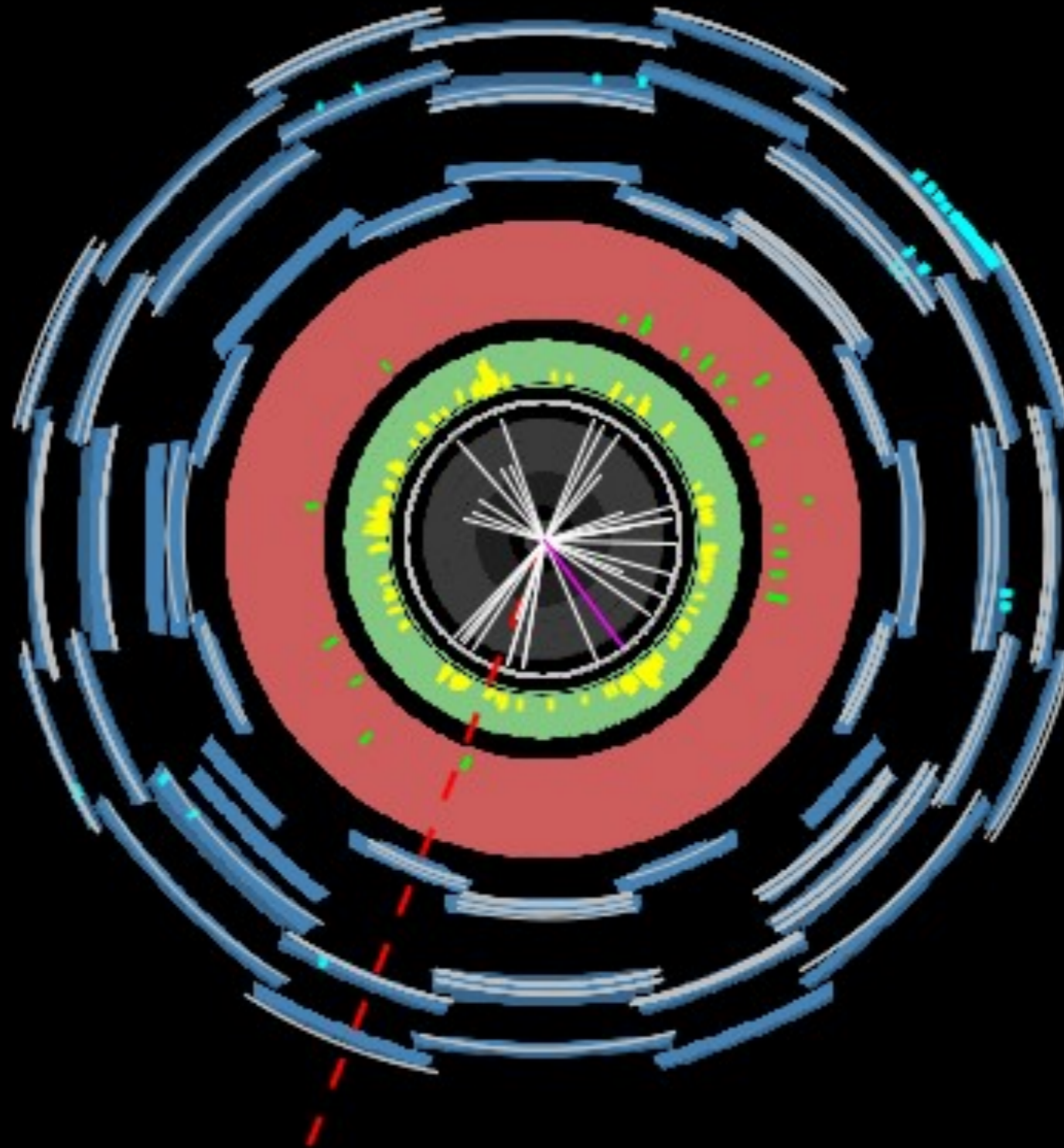
# Isolation dans le détecteur interne

$pt > 1 \text{ GeV}$



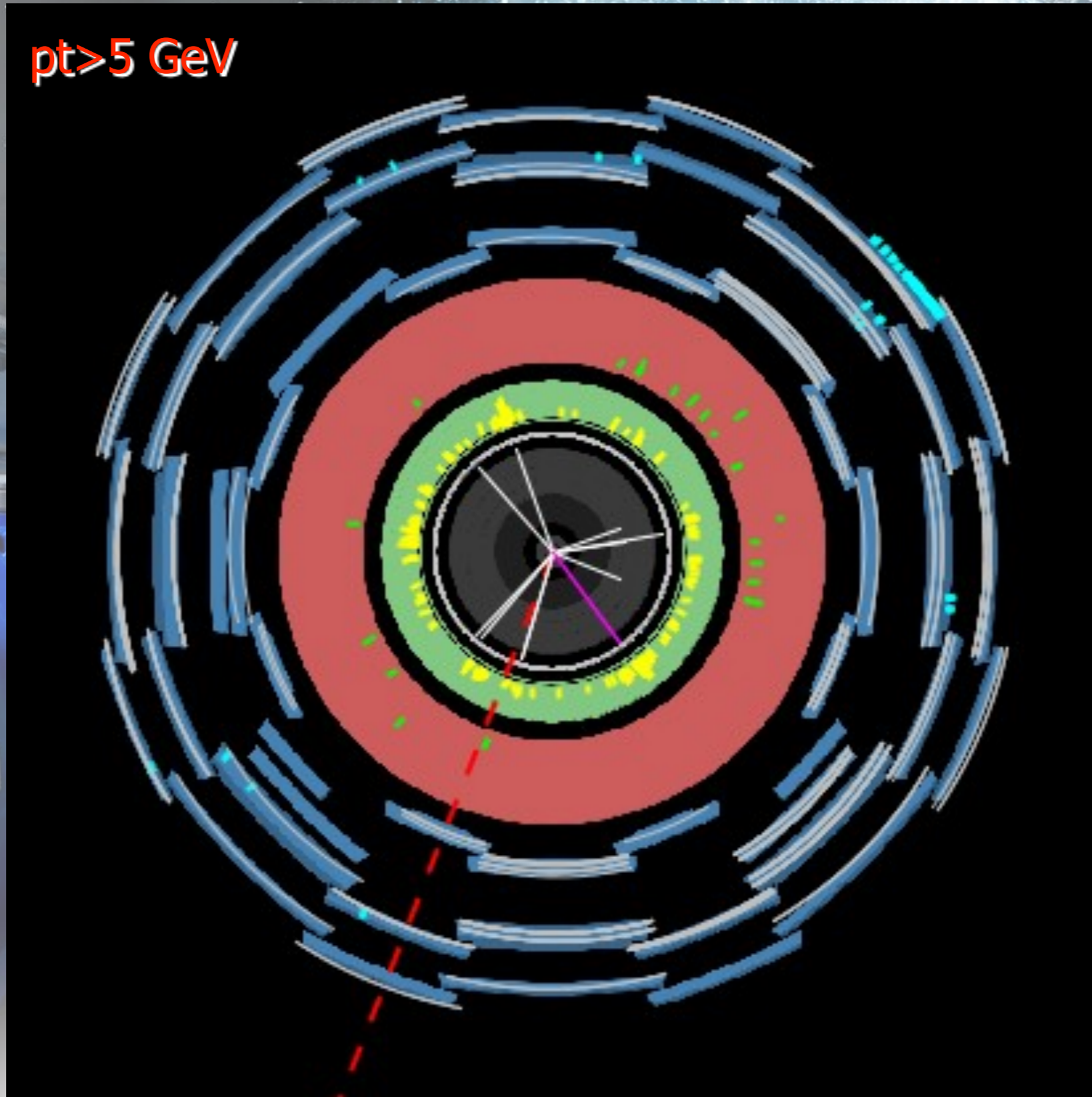
# Isolation dans le détecteur interne

$pt > 2 \text{ GeV}$



# Isolation dans le détecteur interne

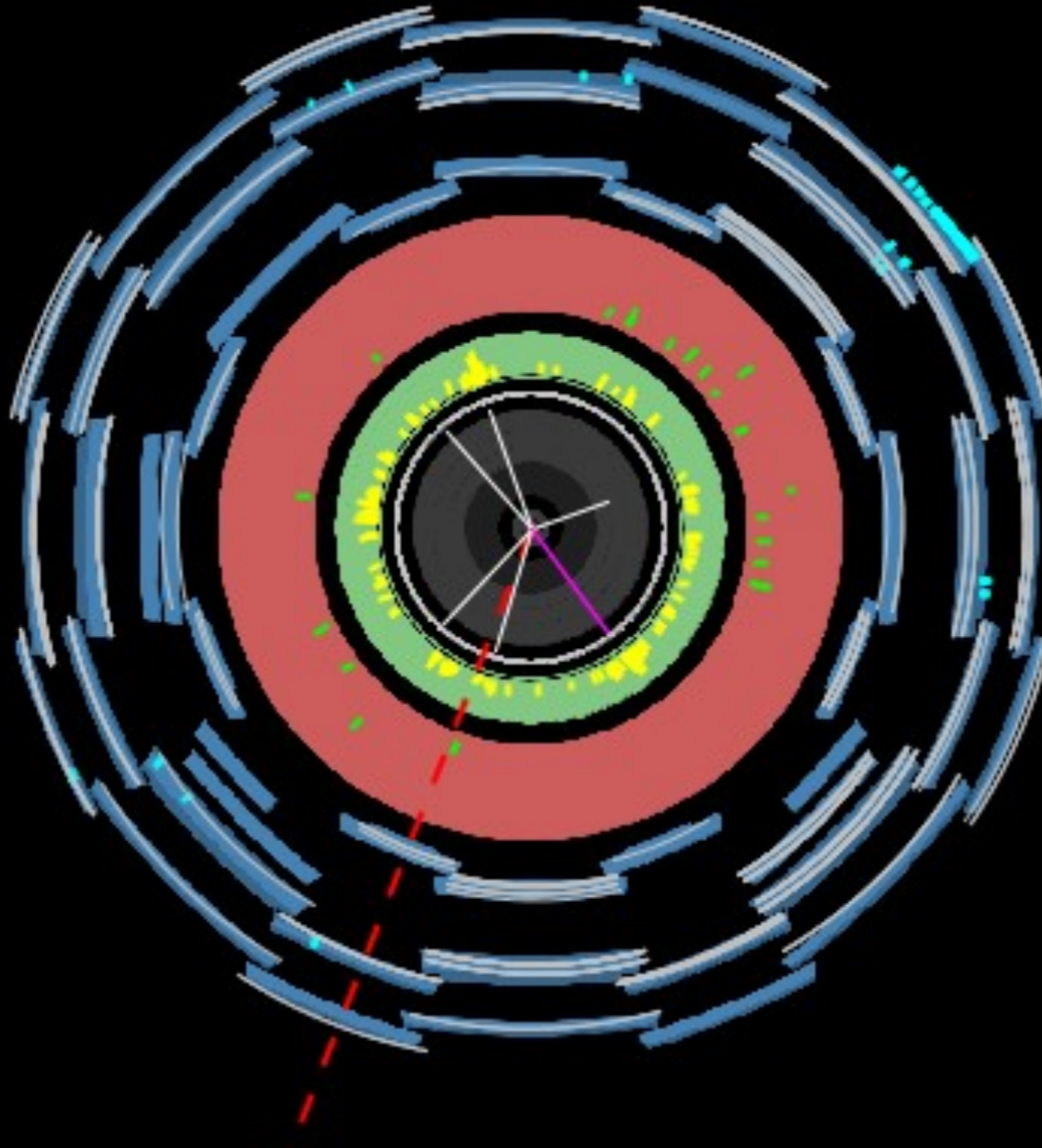
$pt > 5 \text{ GeV}$





# Isolation dans le détecteur interne

$pt > 10 \text{ GeV}$



# Entraînement

exercice

