

Spécial  
Festival d'Avignon

La 66<sup>e</sup> fête du théâtre  
démarre le 7 juillet

Supplément

# Le Monde

Jeudi 5 juillet 2012 - 11<sup>e</sup> année - N° 3091 - 1,60 € - France métropolitaine - www.lemonde.fr

## Science : la matière dévoilée

- Le boson de Higgs, particule manquante pour expliquer l'Univers, vient d'être découvert
- Les physiciens du CERN de Genève ont prouvé son existence à 99,9999 %

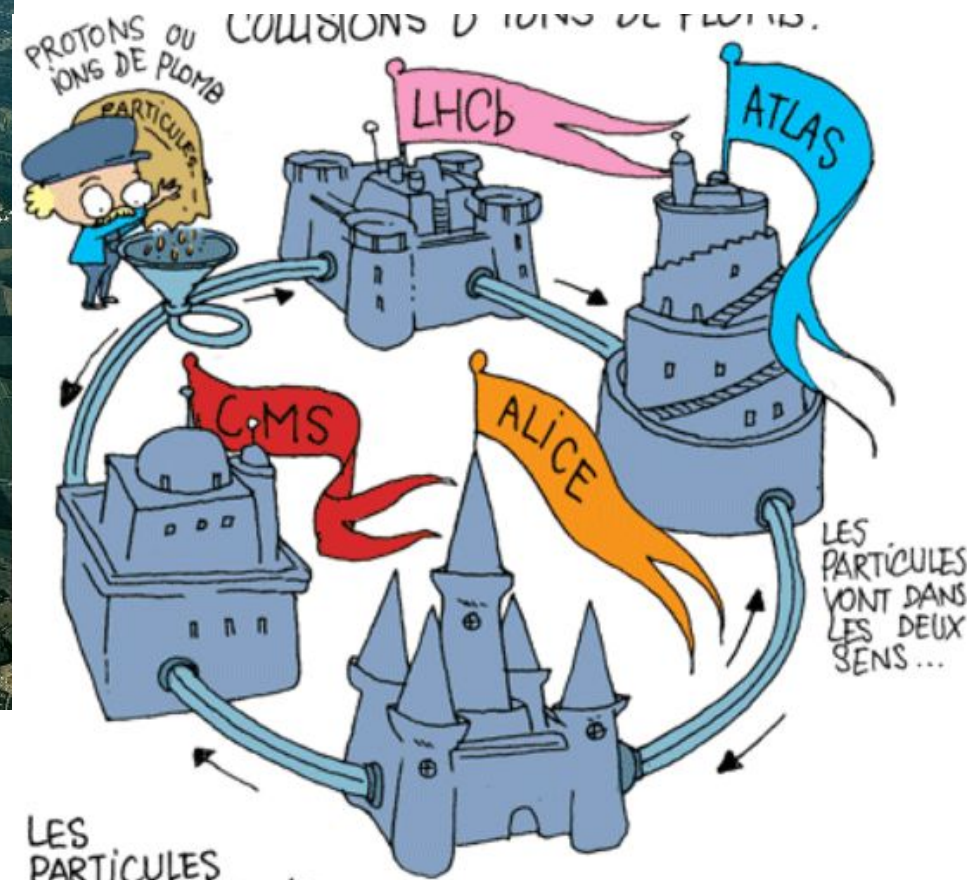


STP - ABBEY

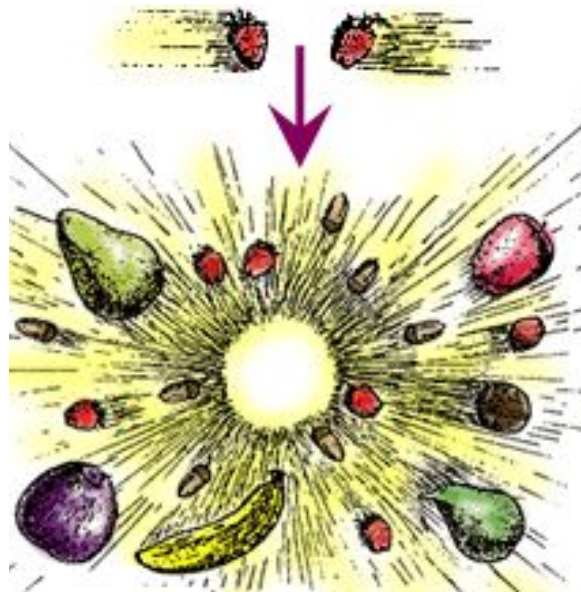
Le boson de Higgs  
est la clé pour expliquer  
l'existence de la matière  
ordinaire de l'univers.  
www.lemonde.fr



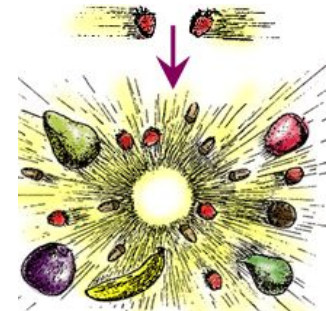
# Large Hadron Collider LHC, CERN



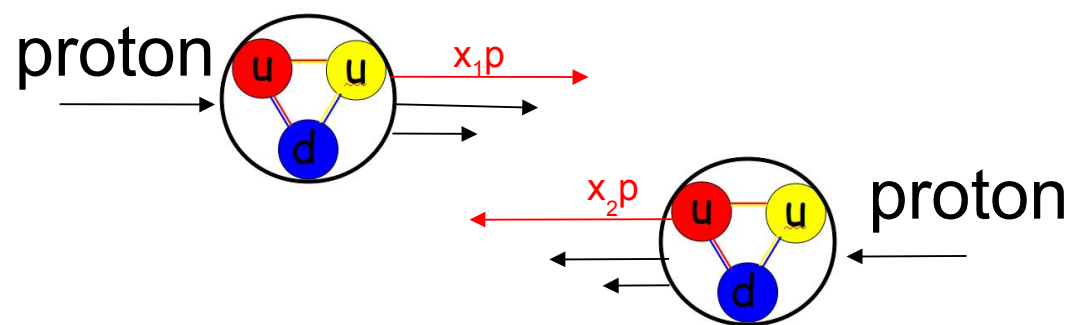
LES PARTICULES SONT ACCÉLÉRÉES ET ENTRENT EN COLLISION DANS LES DÉTECTEURS: ATLAS ALICE, CMS ET LHCb\* (\*LHCb NE...







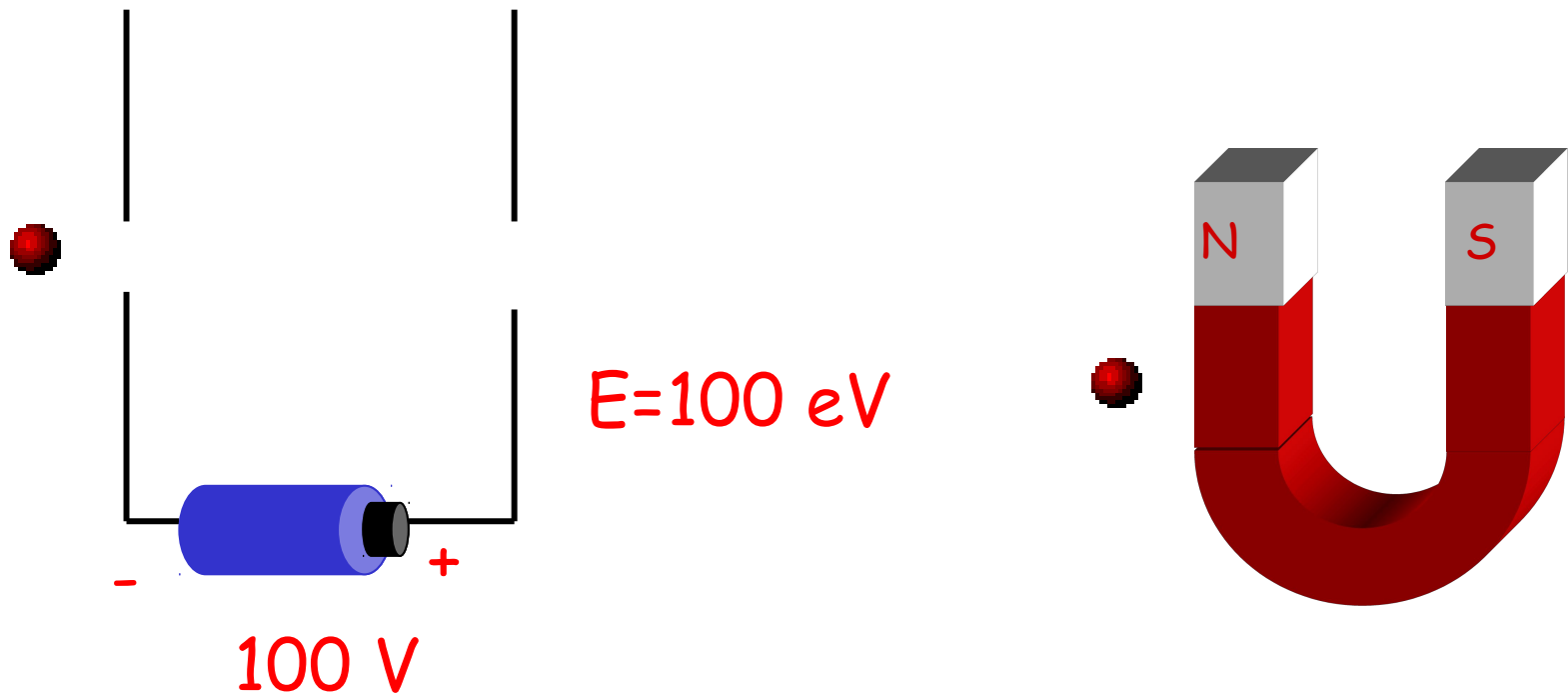
# *Large Hadron Collider (LHC)* CERN



$$E=mc^2$$

matière (proton) → Énergie → matière (Higgs)

# Accélérateur

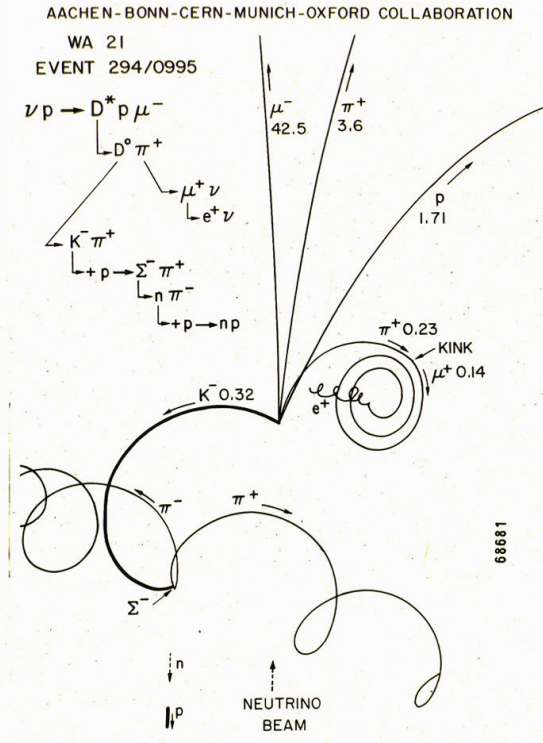
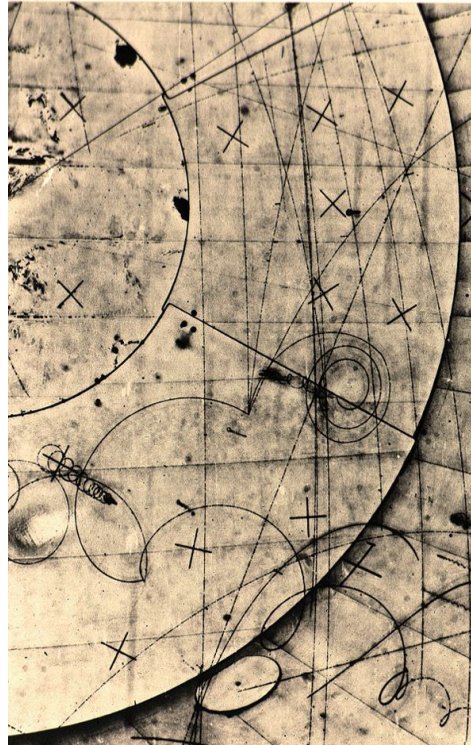


$$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}$$

# Détecteur

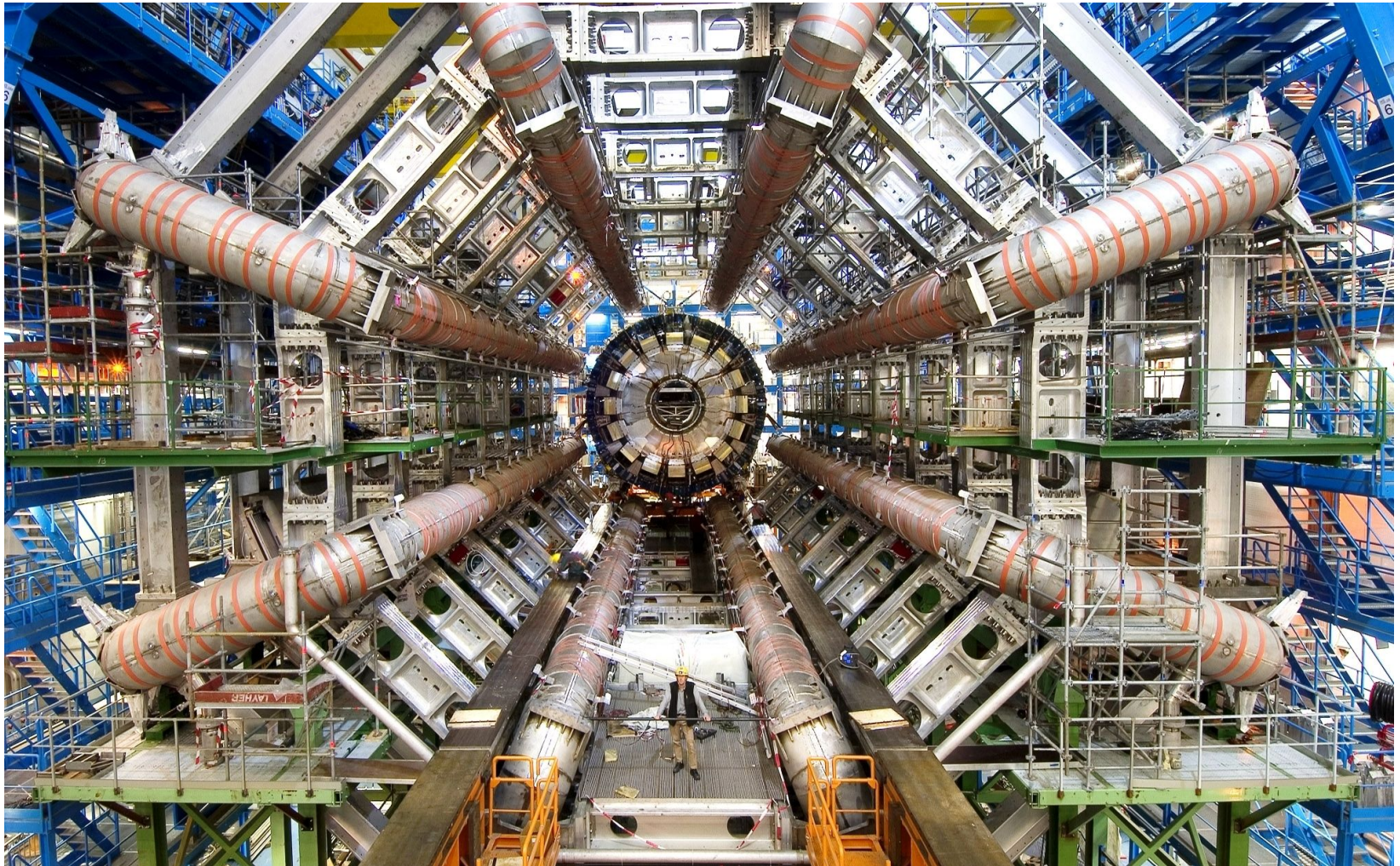


Argentique



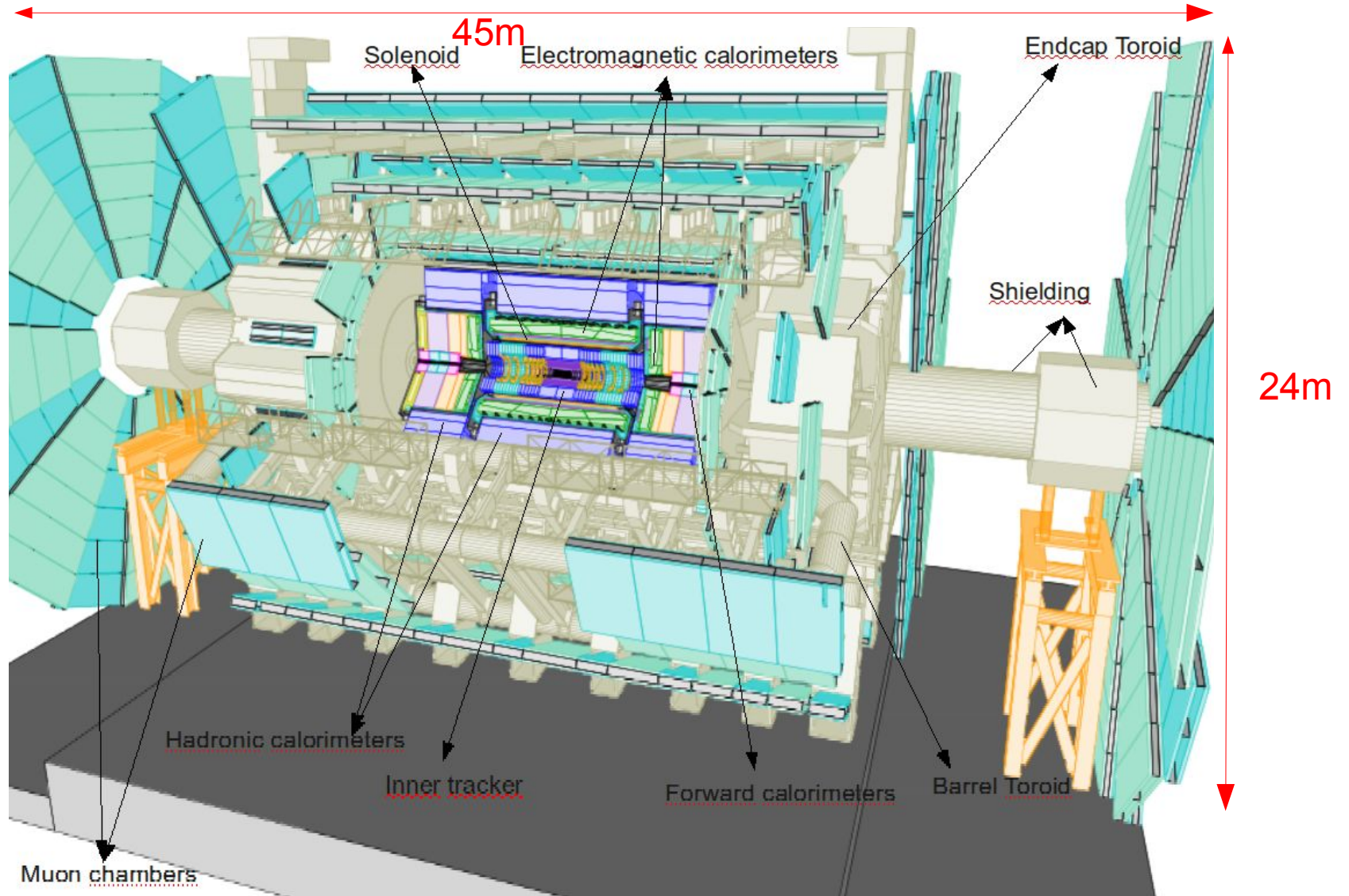


# détecteur



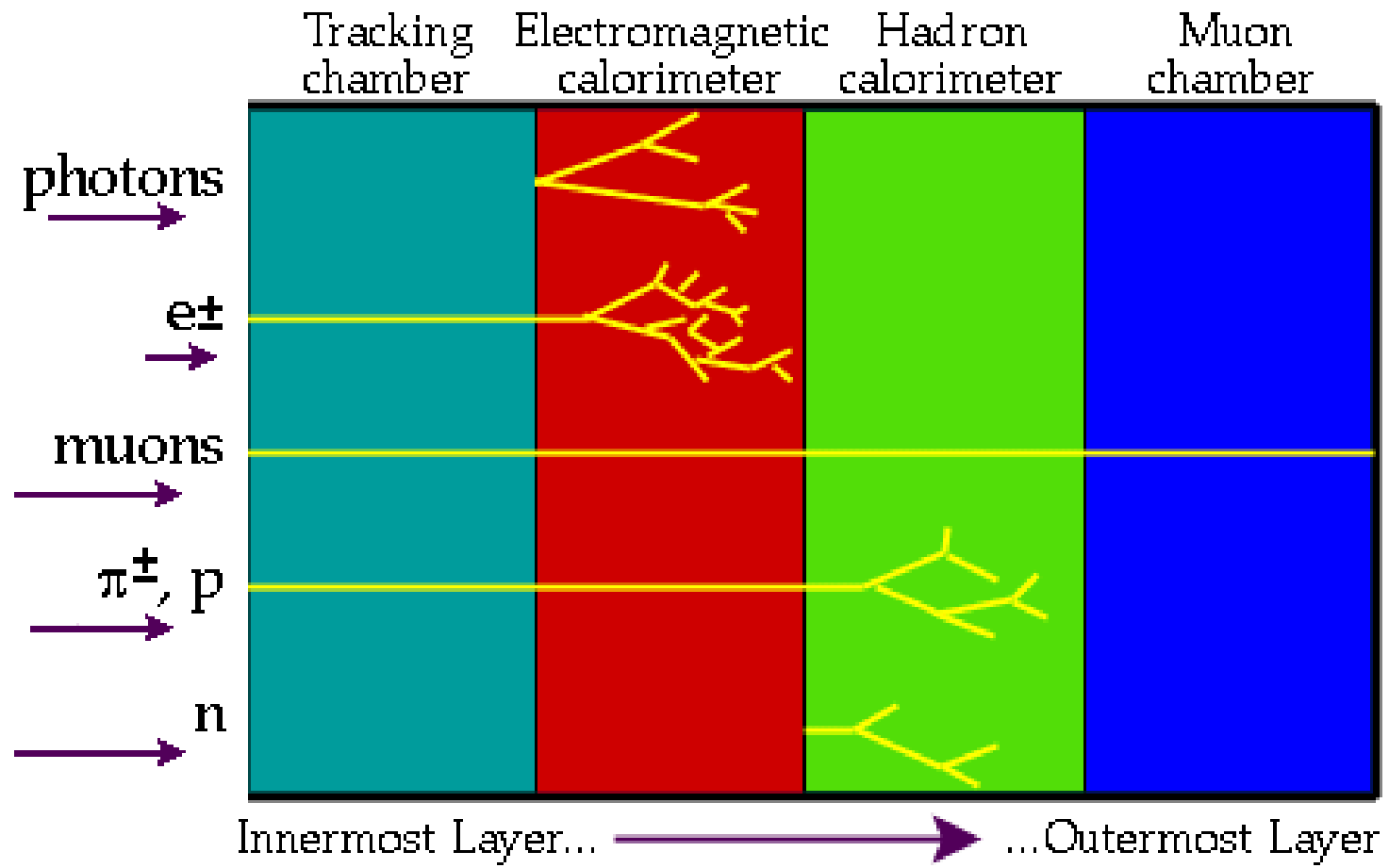


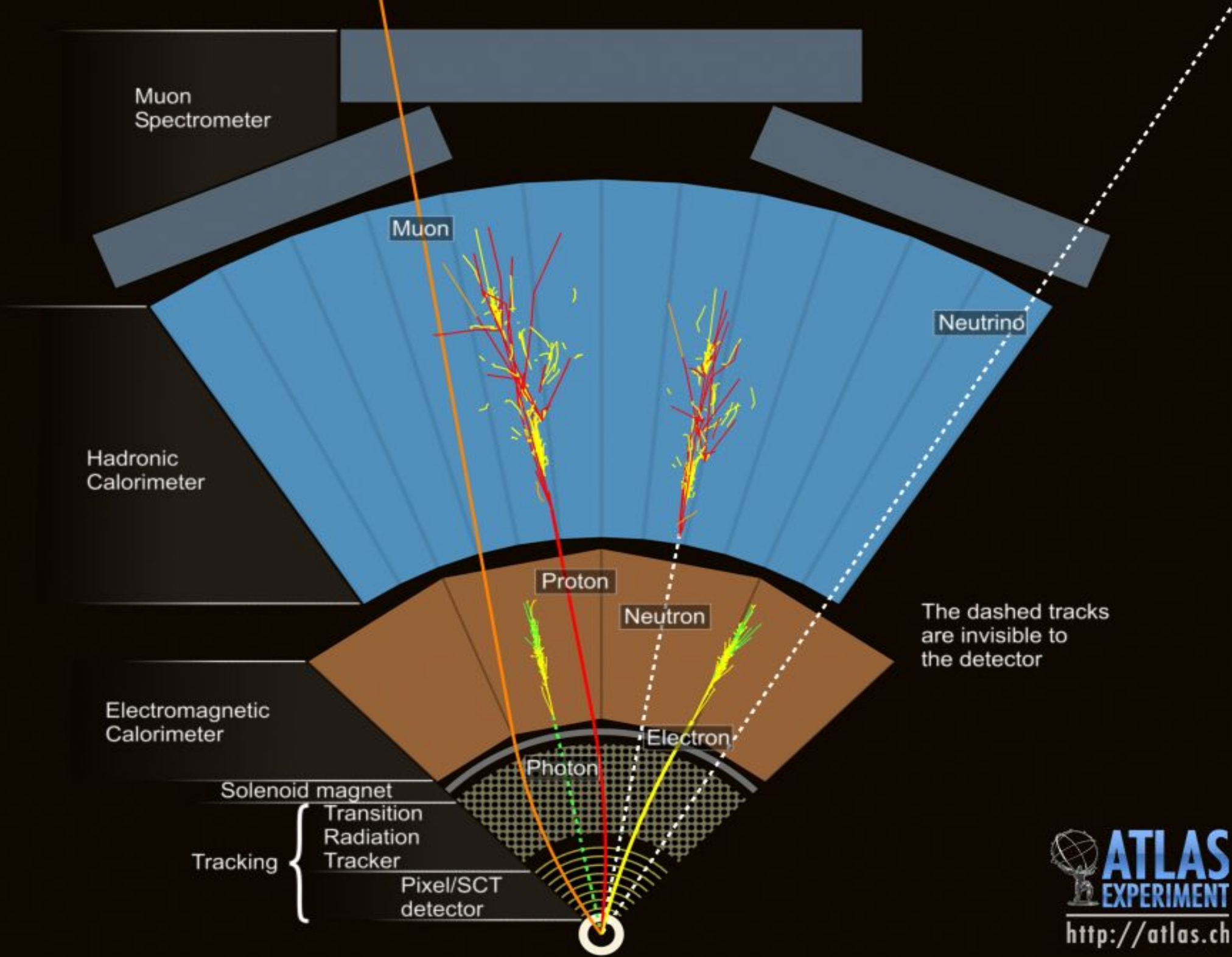
~90 000 000 pixels



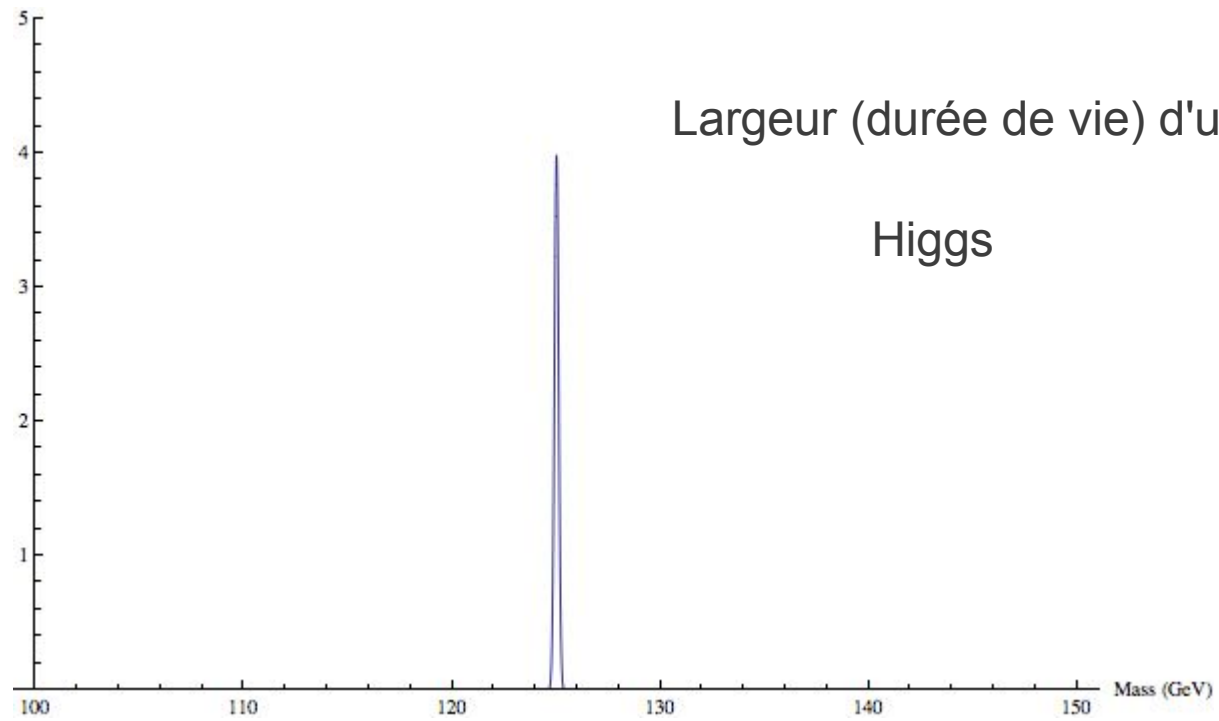






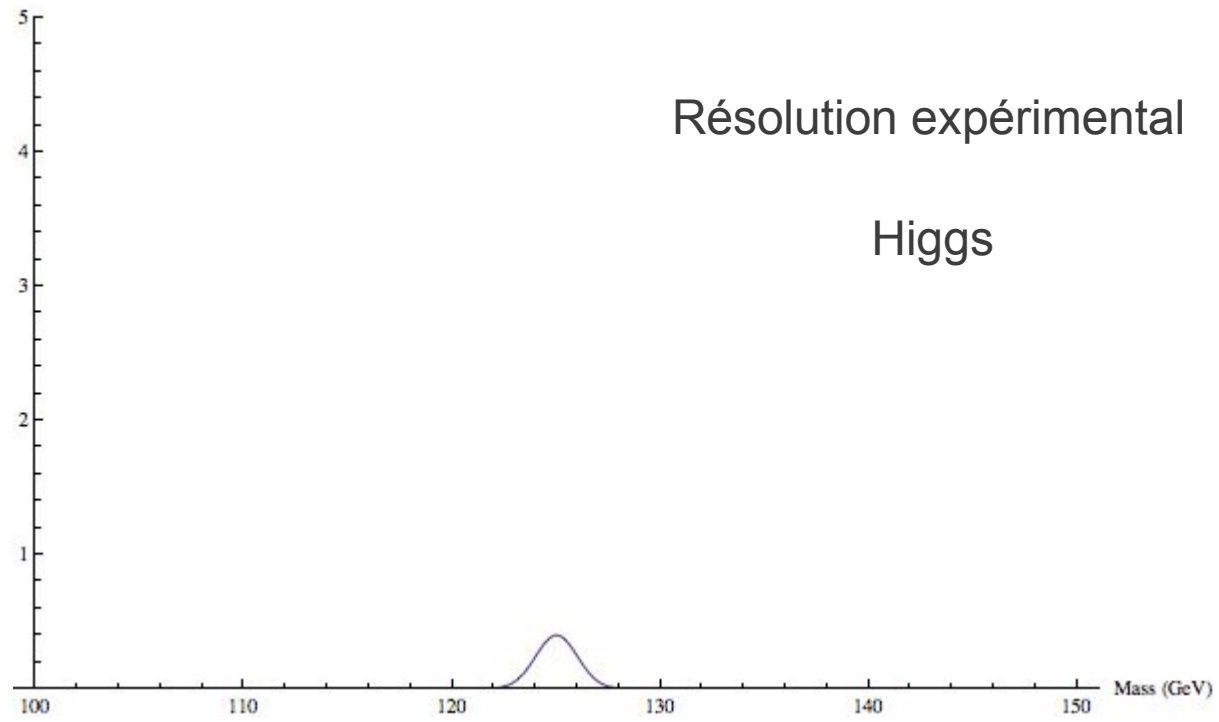






Résolution expérimental

Higgs







$$\vec{F} = q\vec{v} \times \vec{B}$$

q=+1

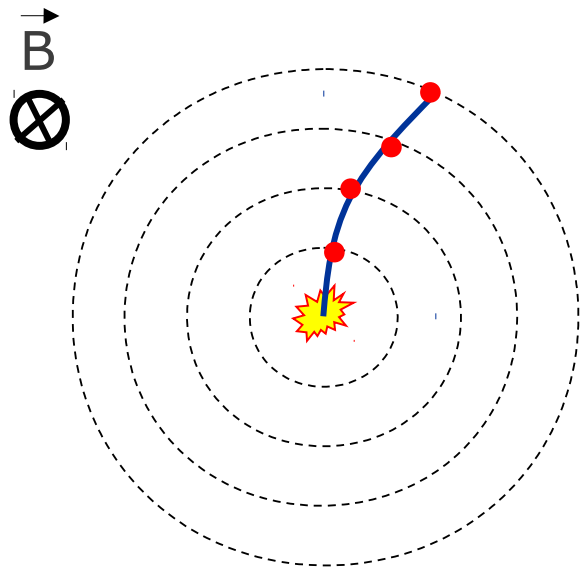
q=-1



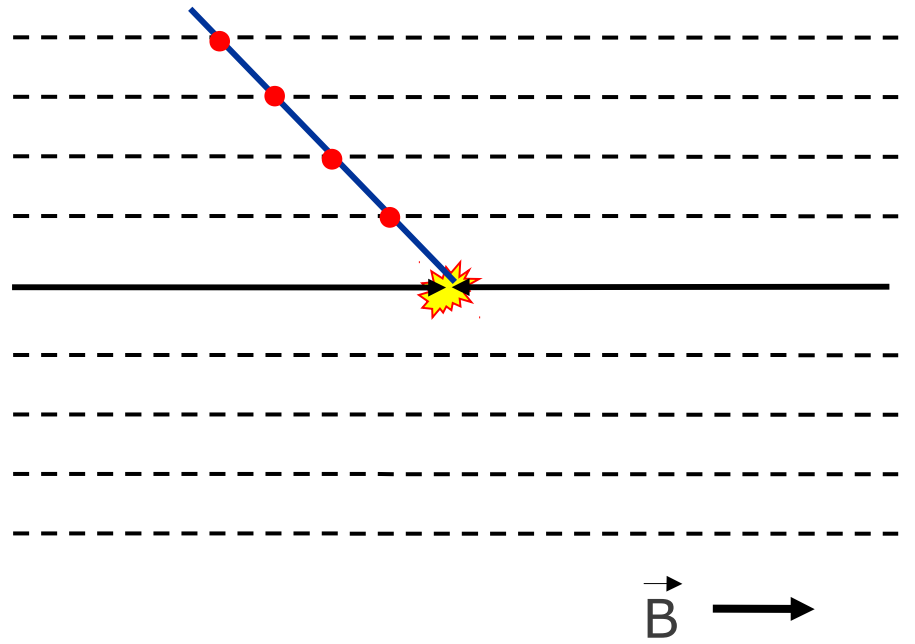
Conservation de la charge électrique

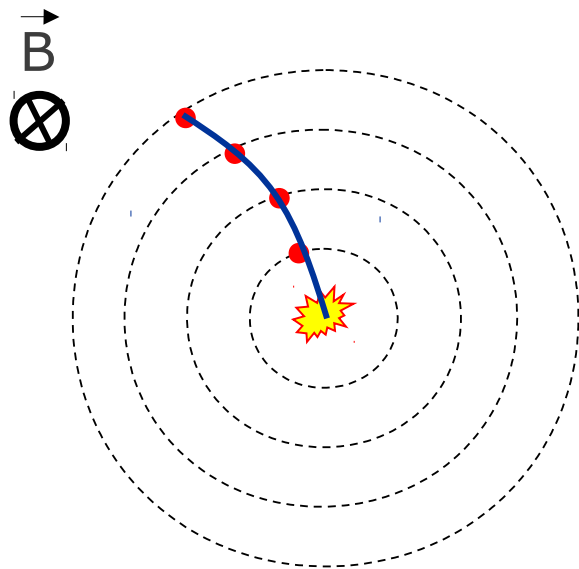




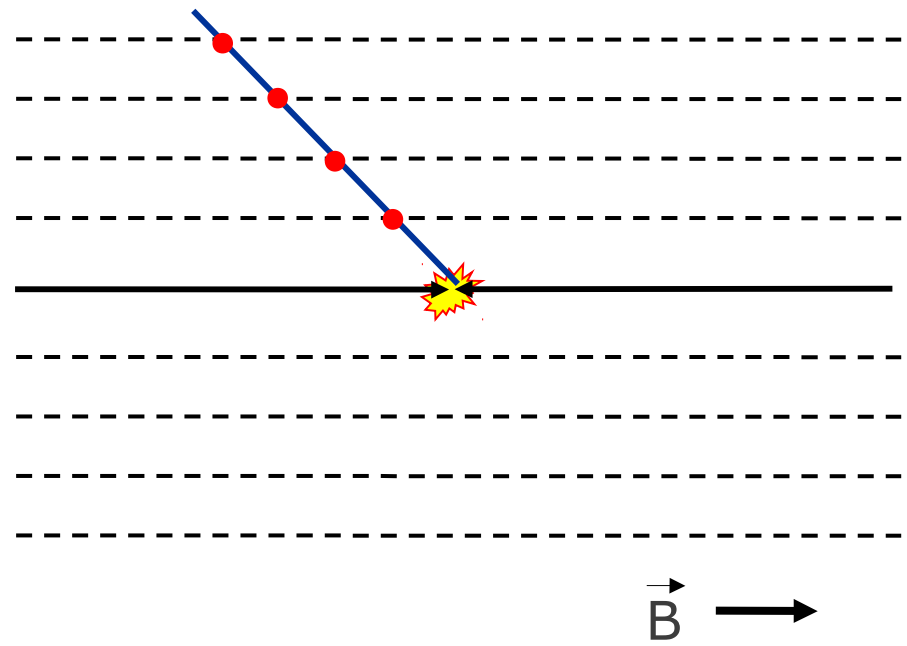


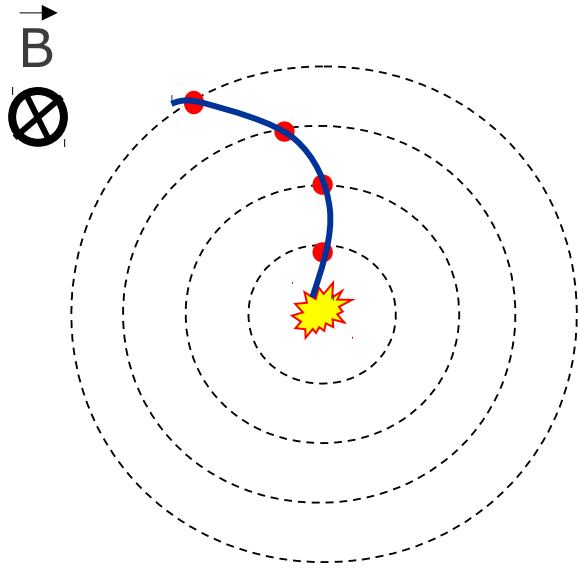
Un électron



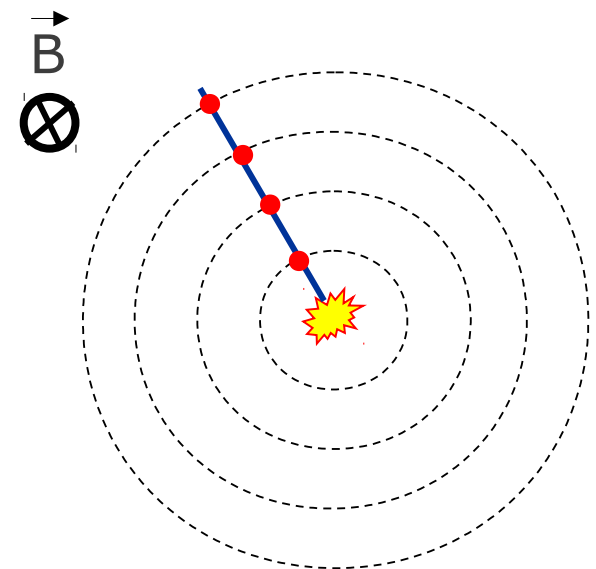
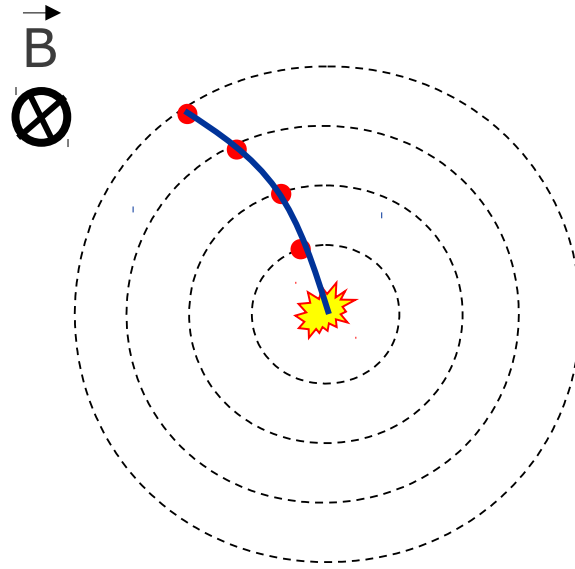


Un positon

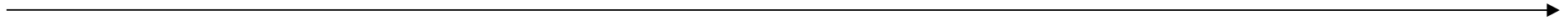




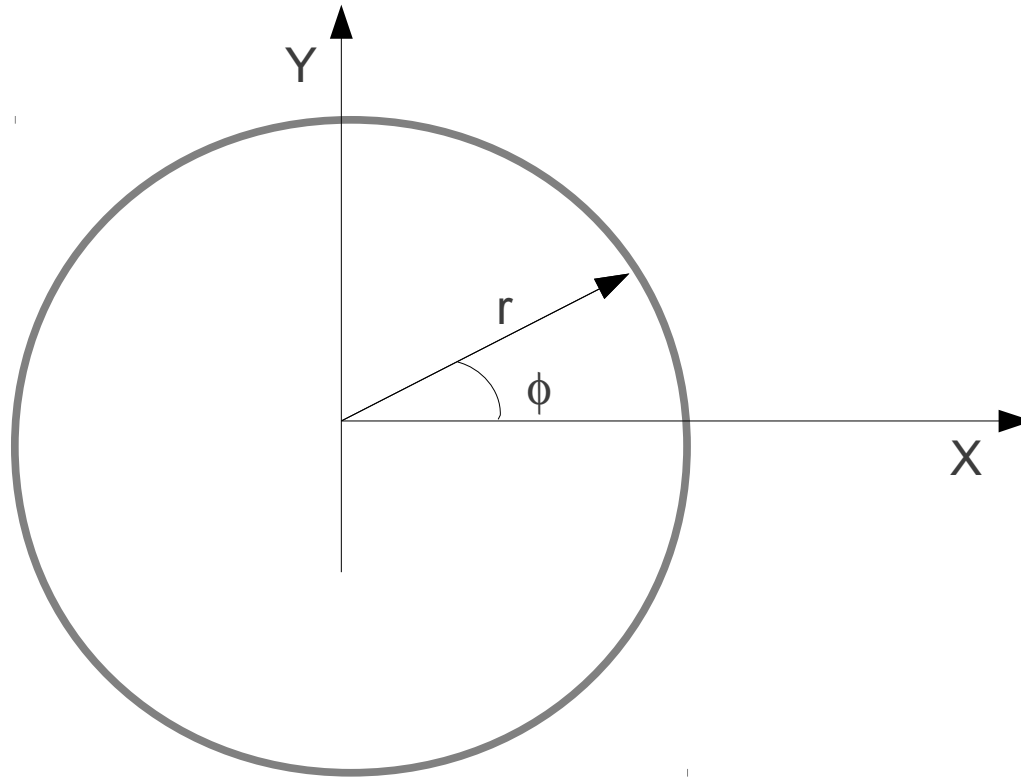
Plus lent



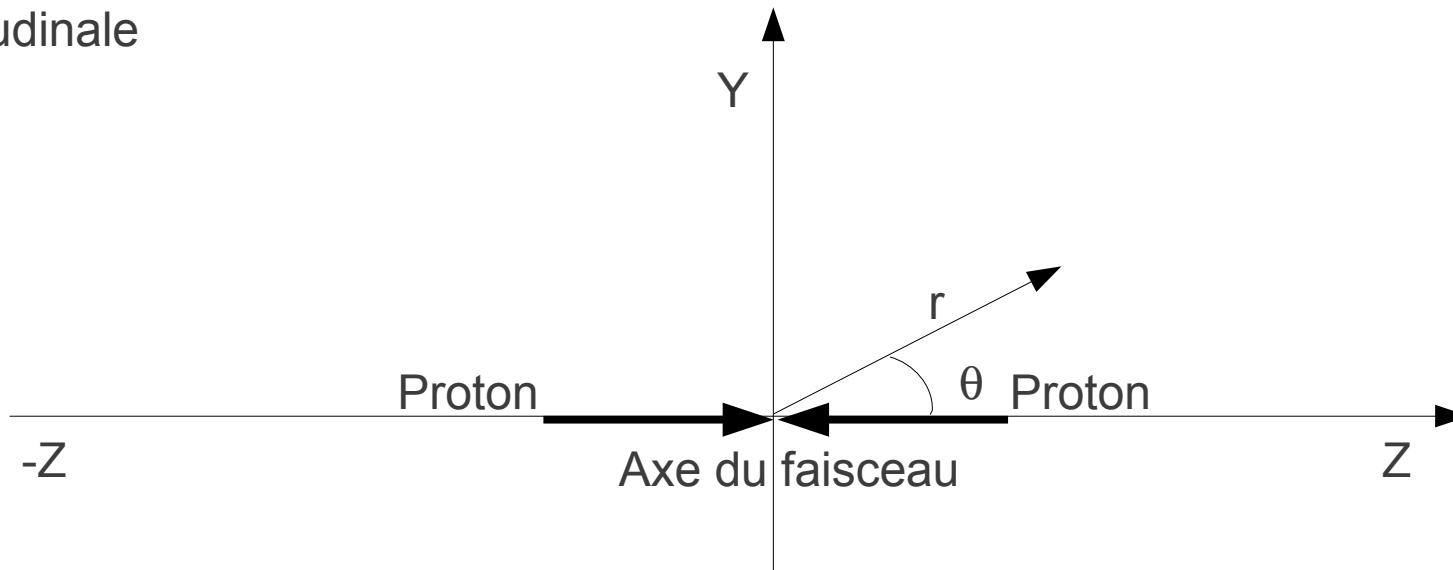
plus rapide



Vue transverse



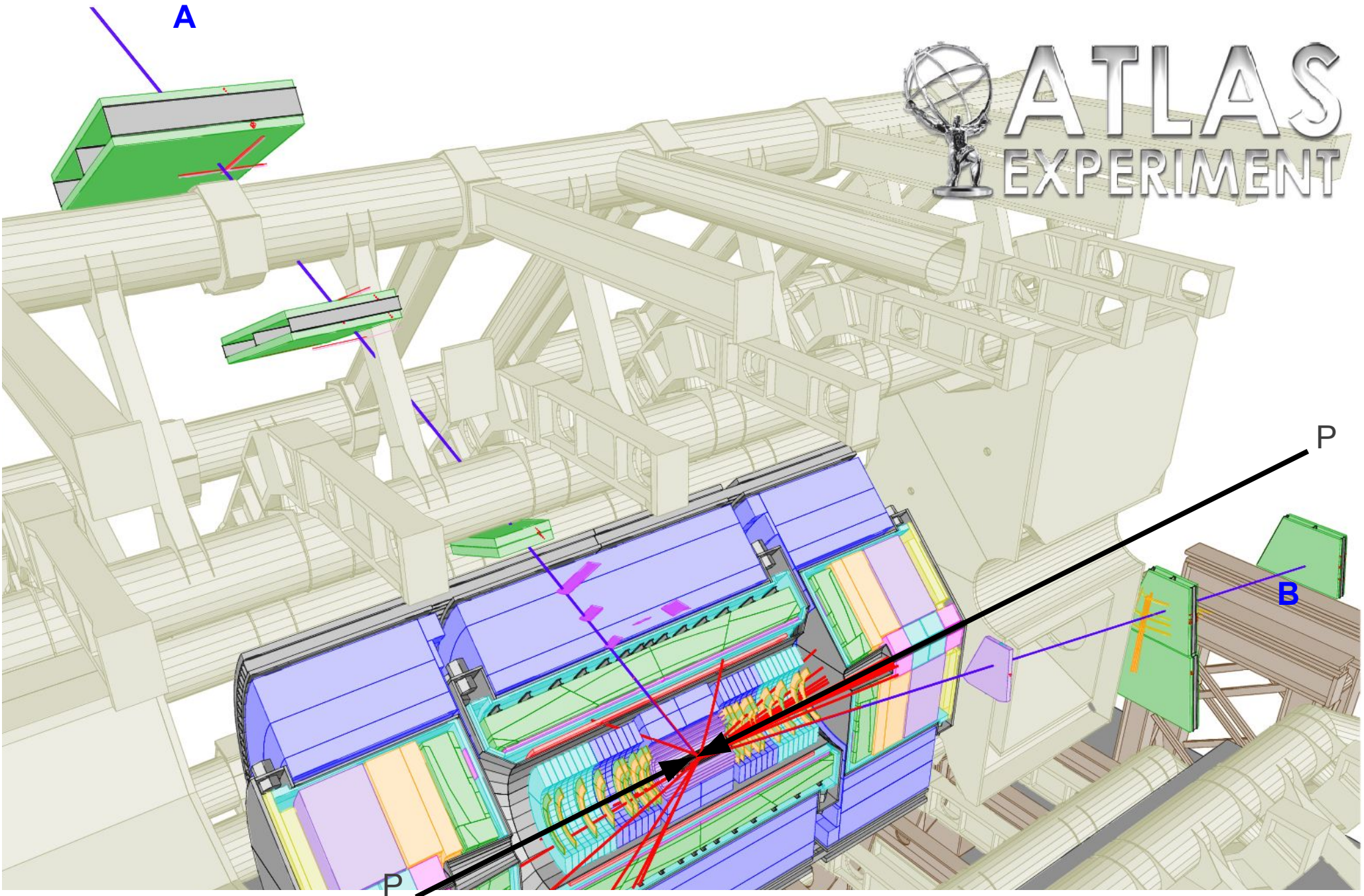
Vue longitudinale



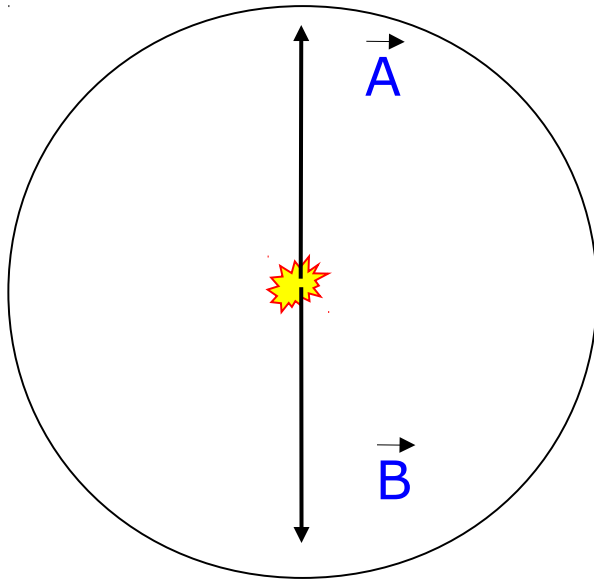




# ATLAS EXPERIMENT



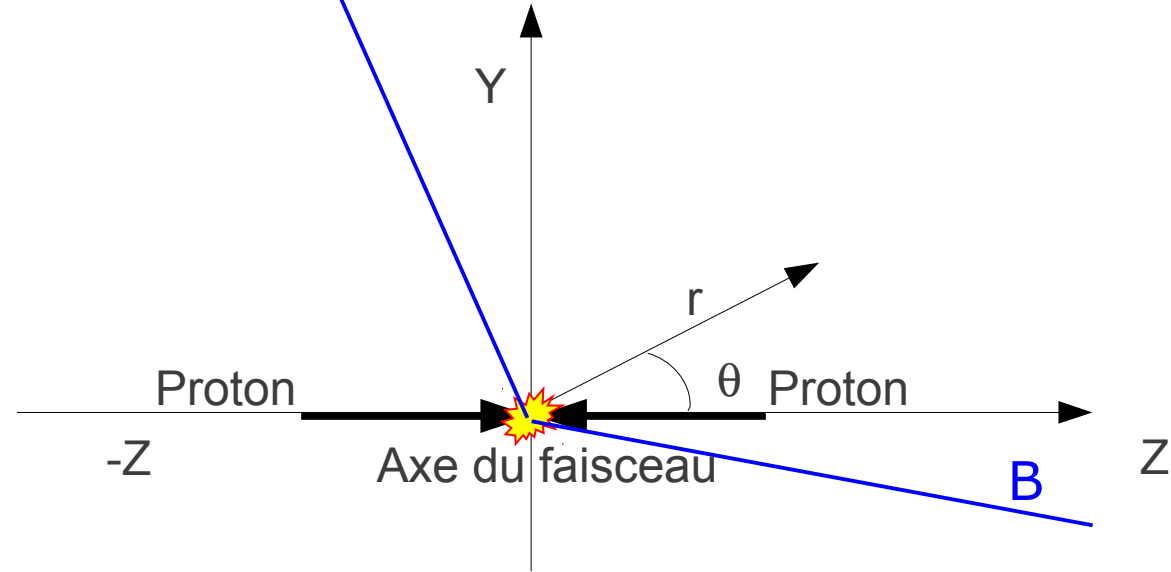
plan transverse

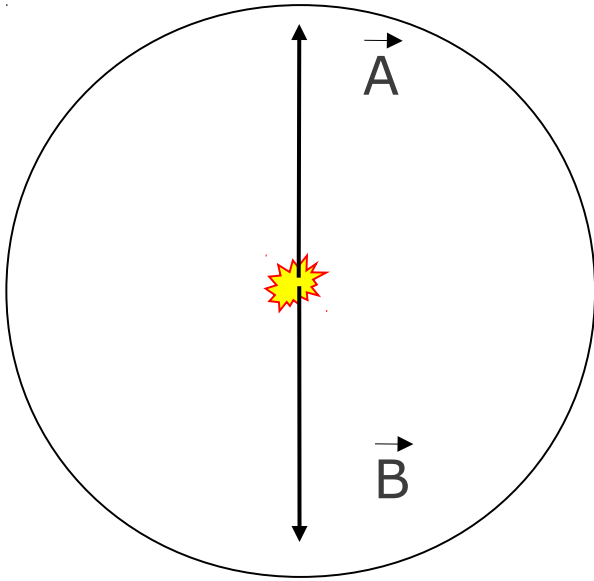


$$\vec{A} + \vec{B} = 0$$

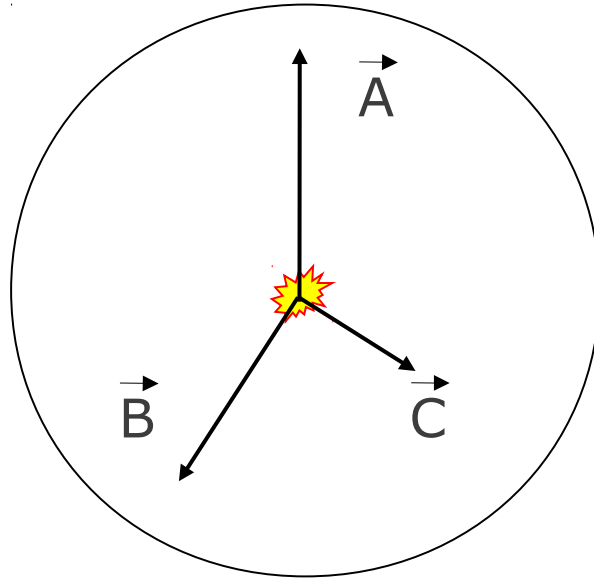
Conservation de l'impulsion dans le plan transverse au faisceau

plan longitudinal

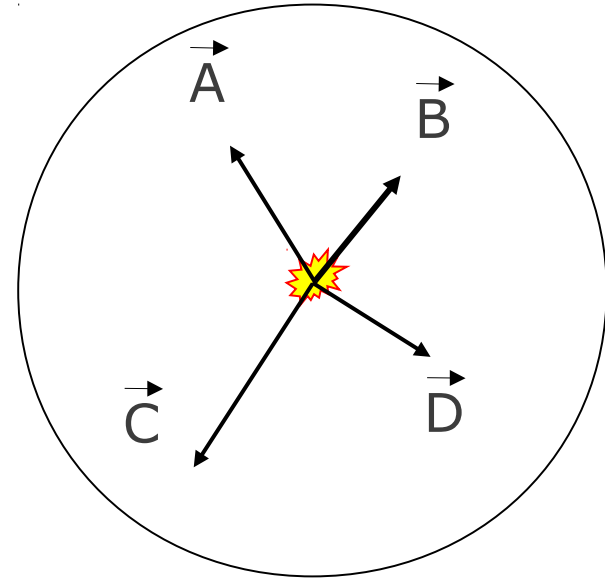




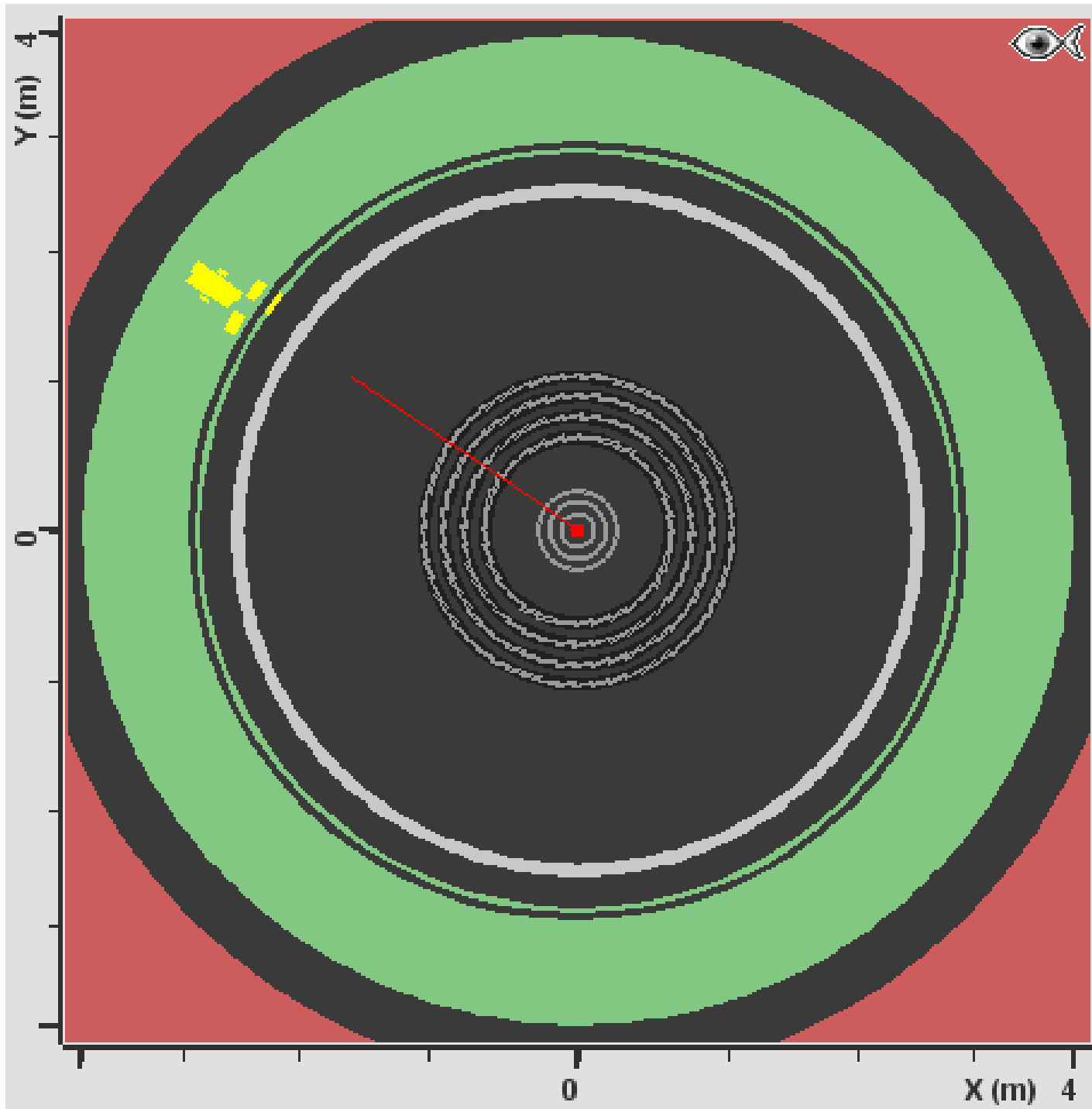
$$\vec{A} + \vec{B} = 0$$



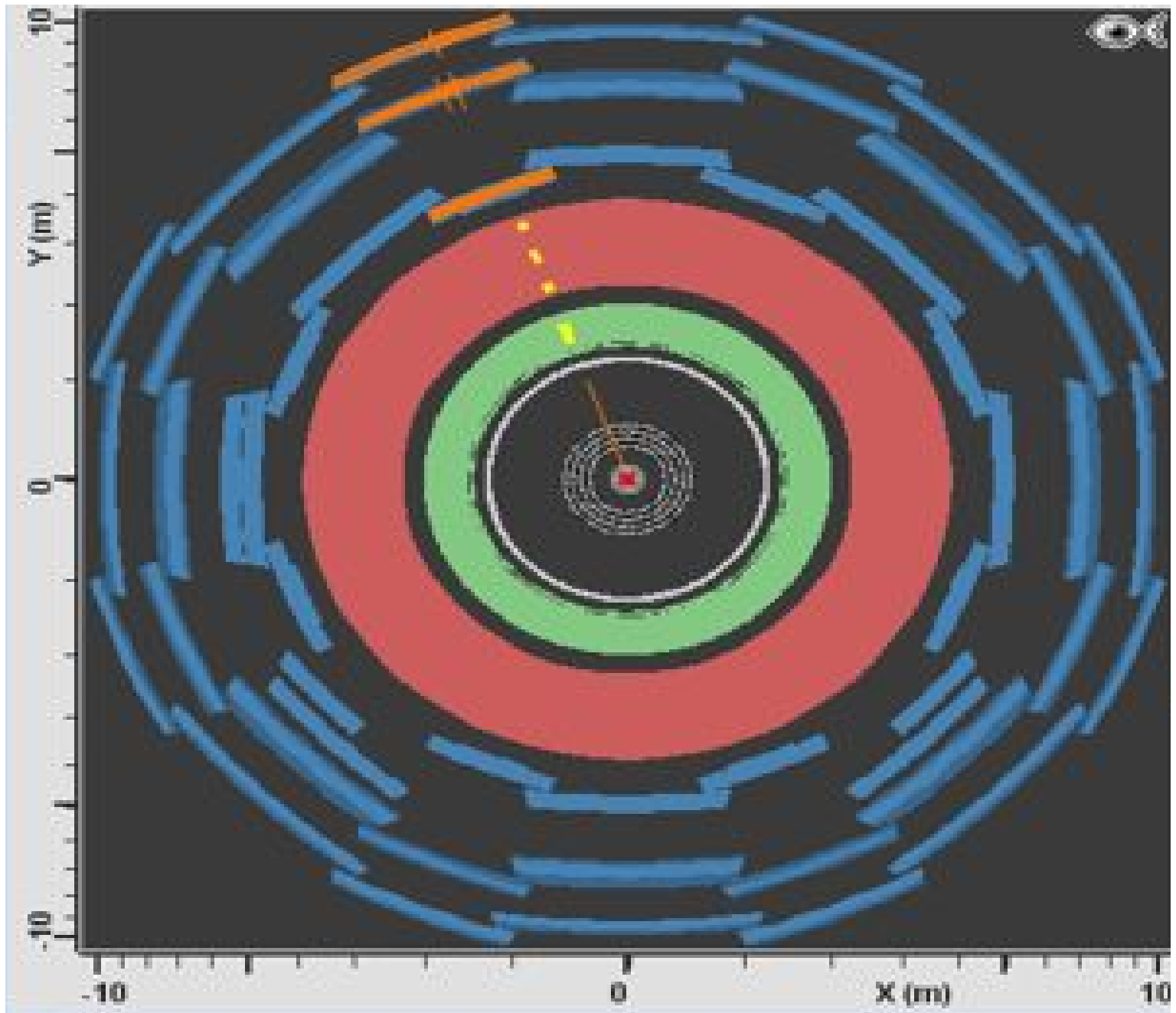
$$\vec{A} + \vec{B} + \vec{C} = 0$$

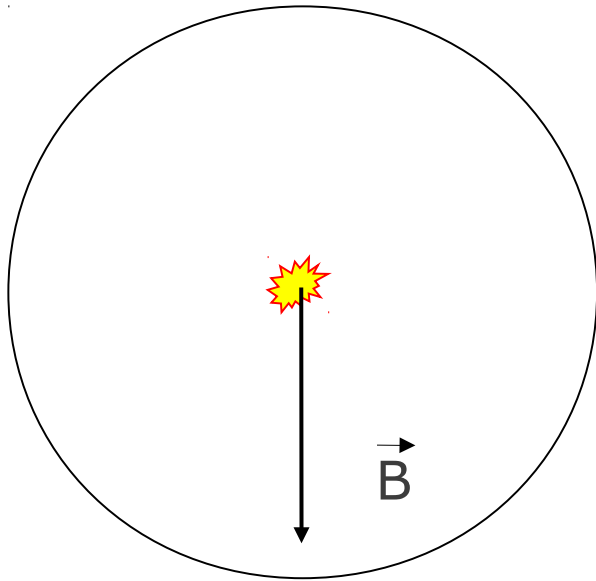


$$\vec{A} + \vec{B} + \vec{C} + \vec{D} = 0$$

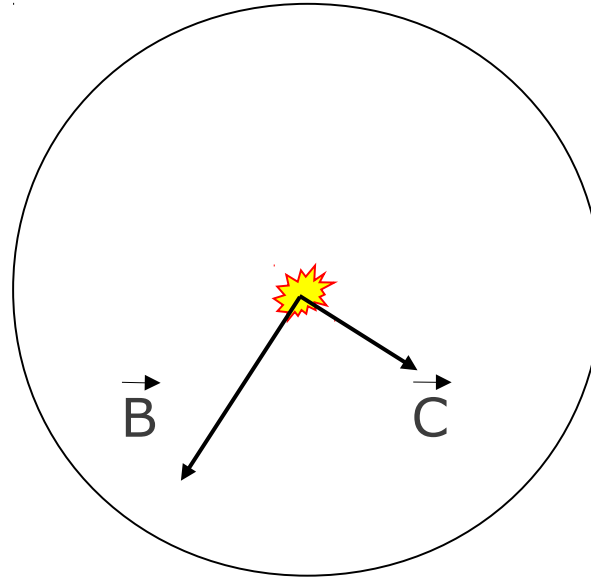




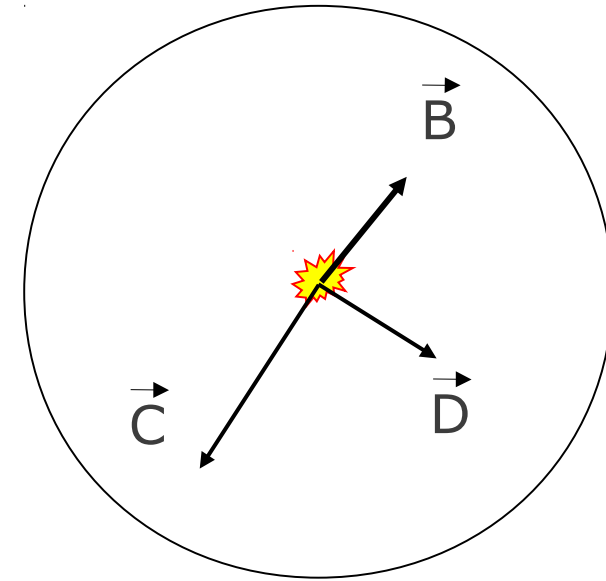




$$\vec{B} \neq 0$$



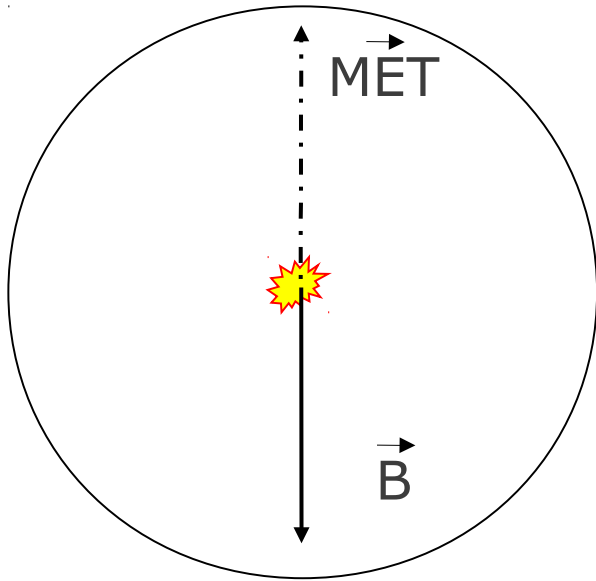
$$\vec{B} + \vec{C} \neq 0$$



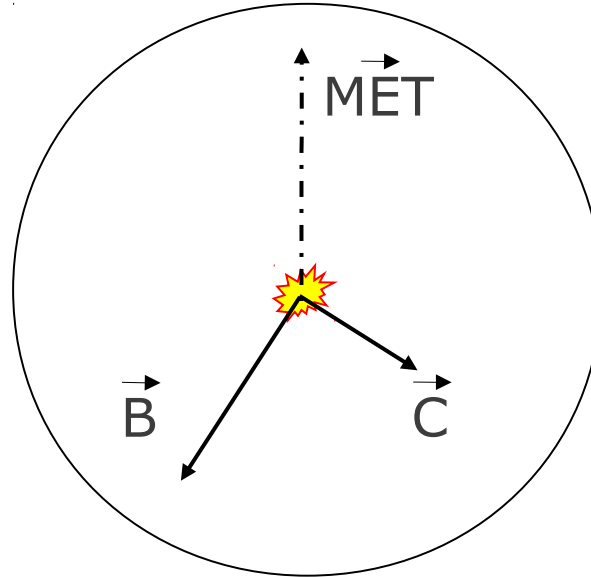
$$\vec{B} + \vec{C} + \vec{D} \neq 0$$

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

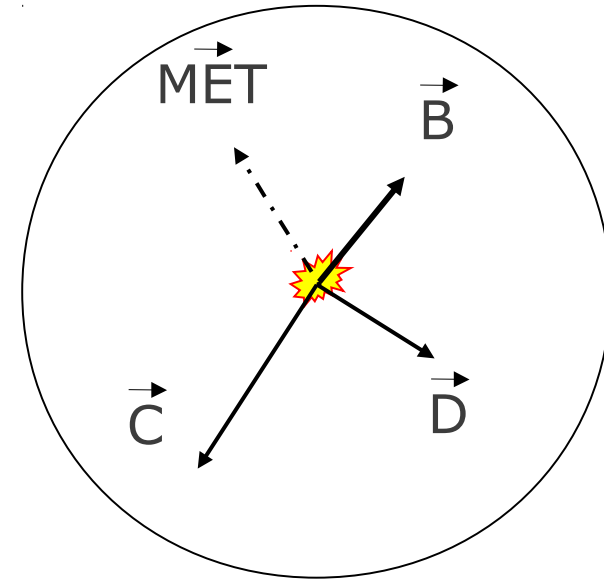
Si la particule A est un neutrino l'impulsion dans le plan transverse au faisceau ne semble plus être conservée



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



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



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

La non-conservation de l'impulsion dans le plan transverse au faisceau est une indication de la présence d'un neutrino

$$|\vec{MET}| \neq 0 \quad \Rightarrow \quad \text{Présence d'un neutrino}$$

