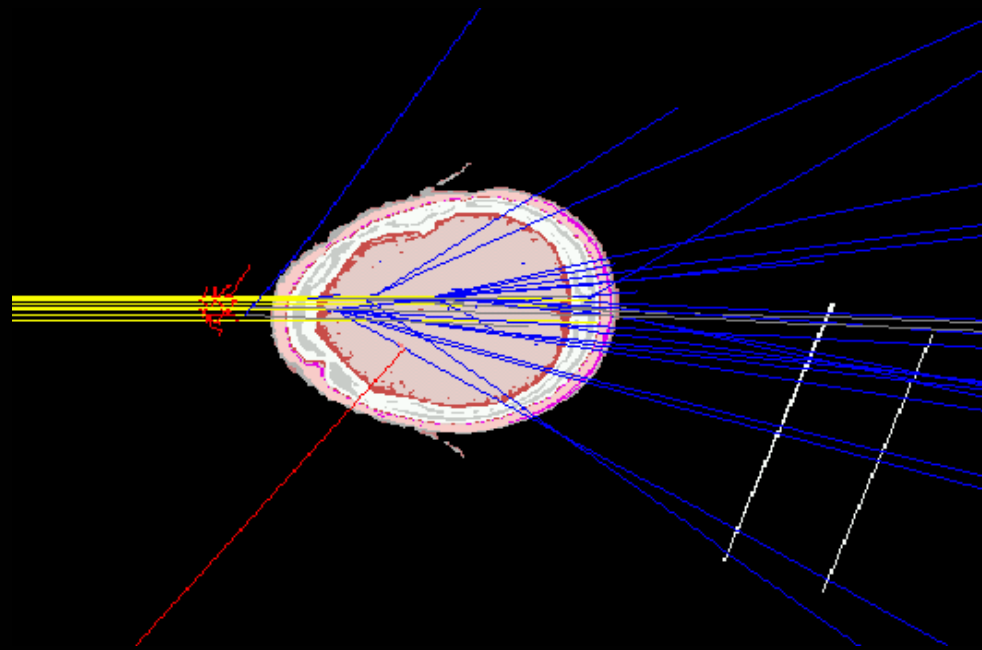


# Contrôle qualité d'un faisceau d'hadronthérapie par détection de fragments chargés secondaires



## I) Introduction :

-L'hadronthérapie :

Définition

Propriétés balistiques

-Principe du contrôle qualité par détection de fragments chargés

## II) Travail effectué :

-Validation des simulations

-Technique de reconstruction de vertex : 1ers résultats théoriques

## III) Perspectives et conclusion

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## II) Travail effectué :

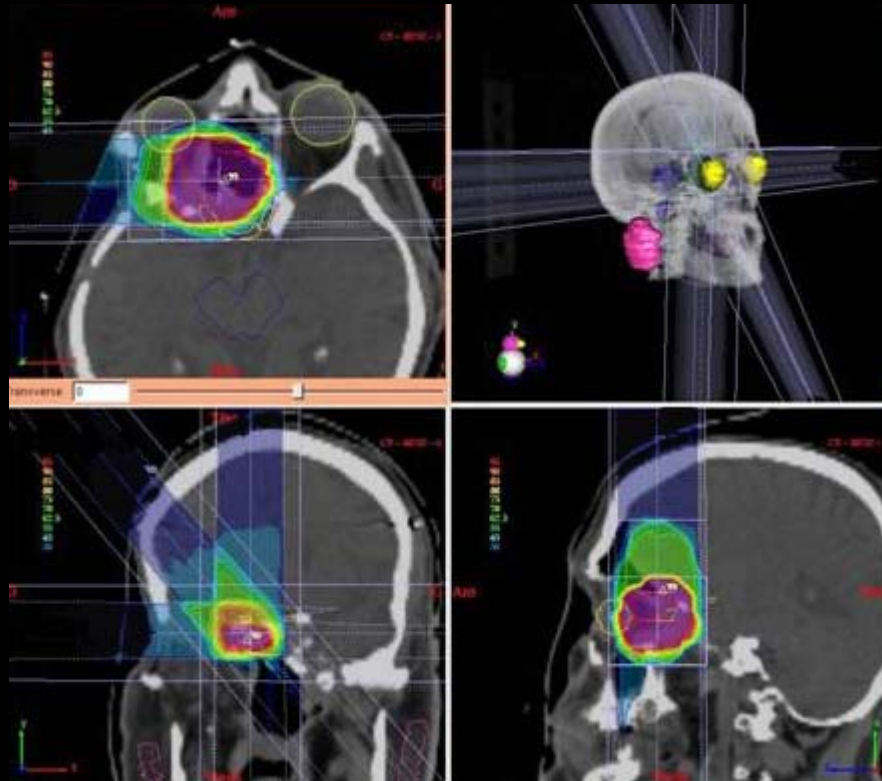
-Validation des simulations

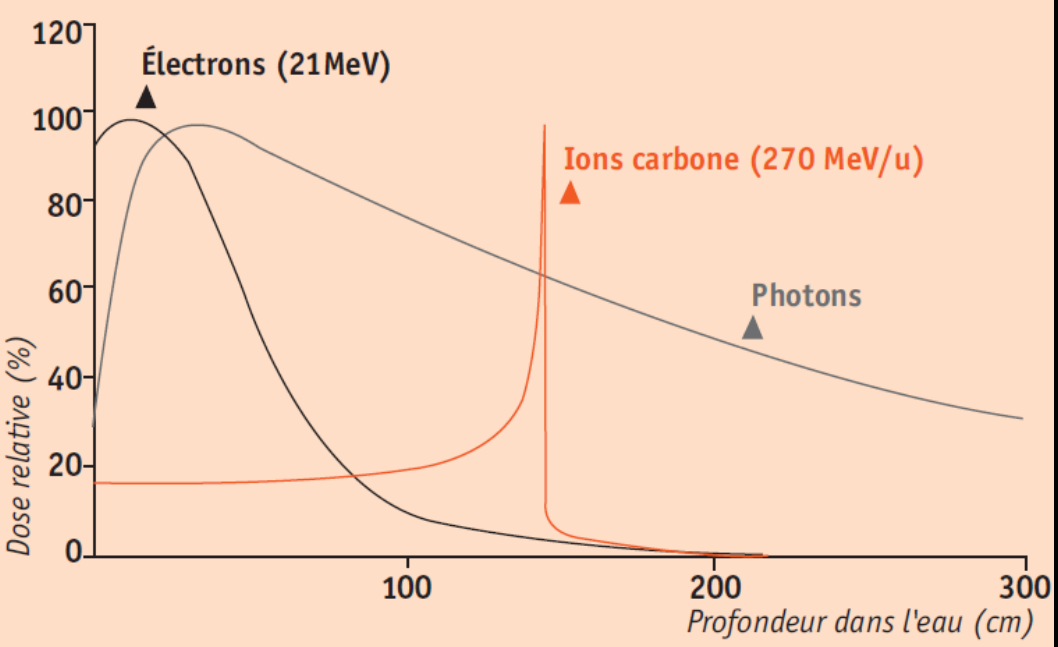
-Technique de reconstruction de vertex : 1ers résultats théoriques

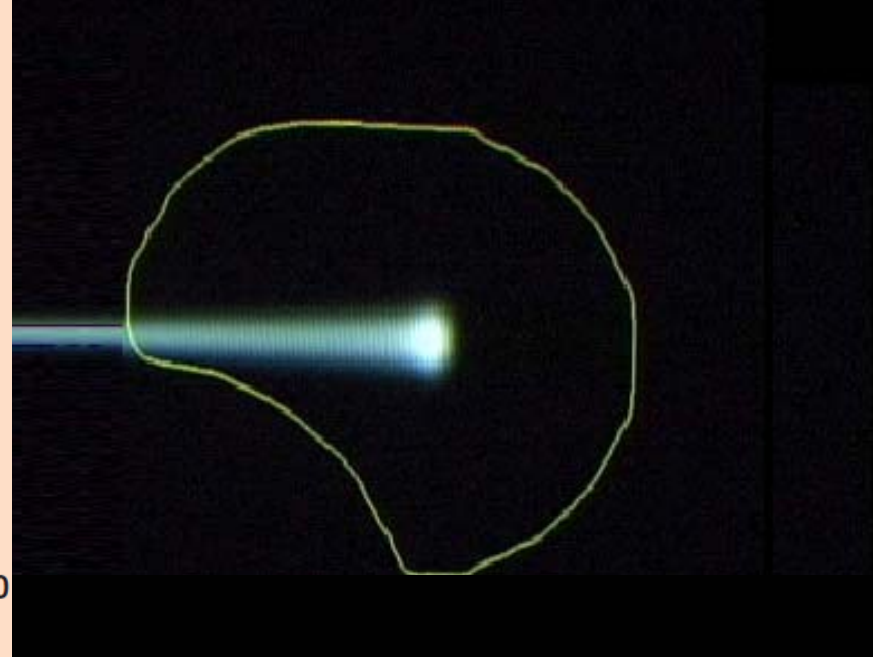
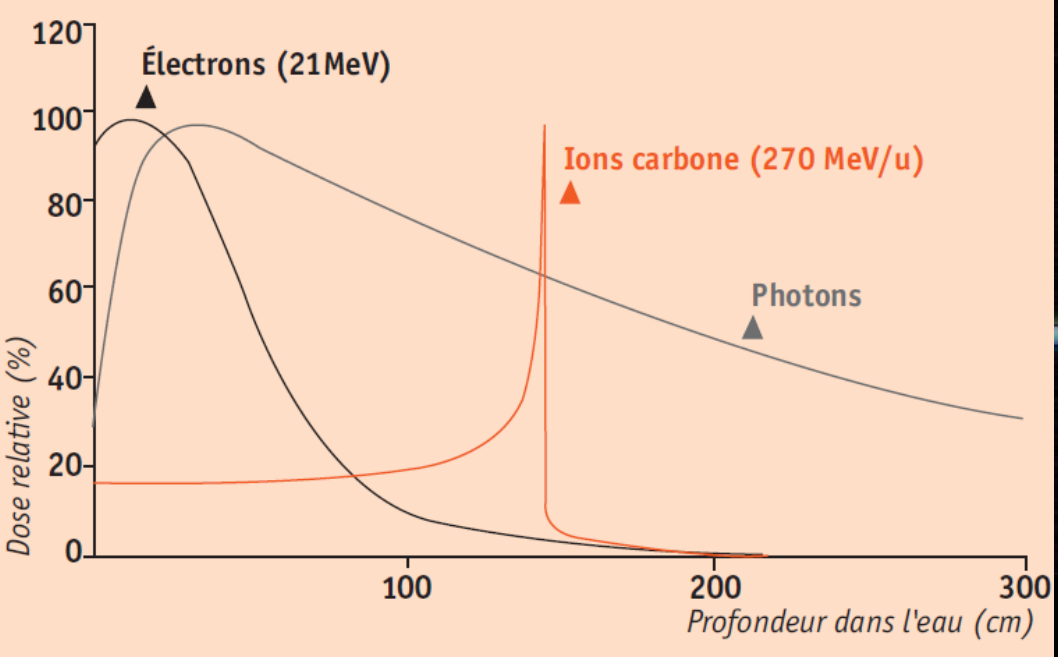
## III) Perspectives et conclusion

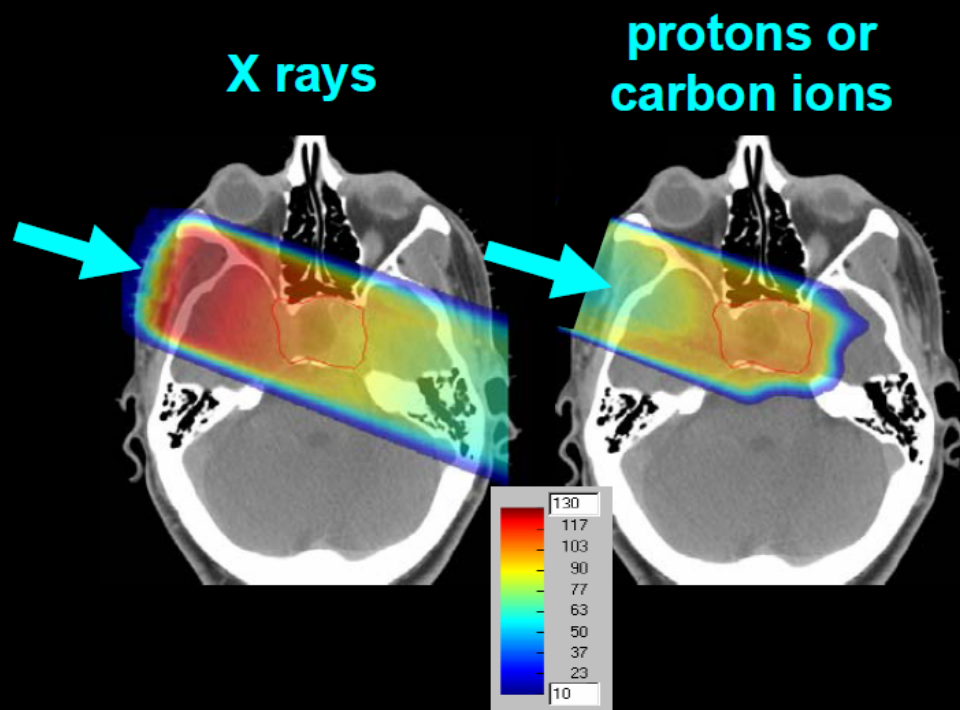
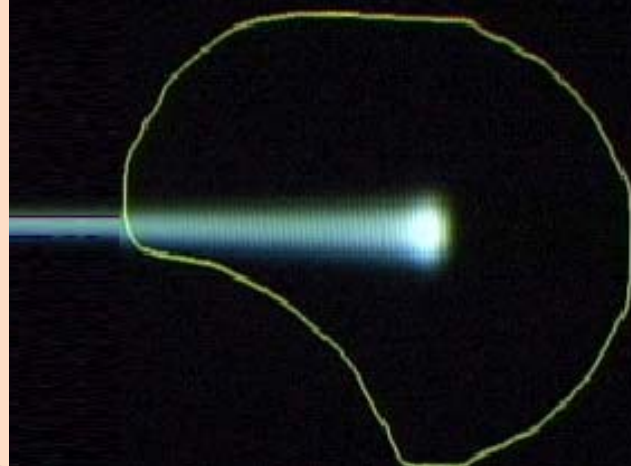
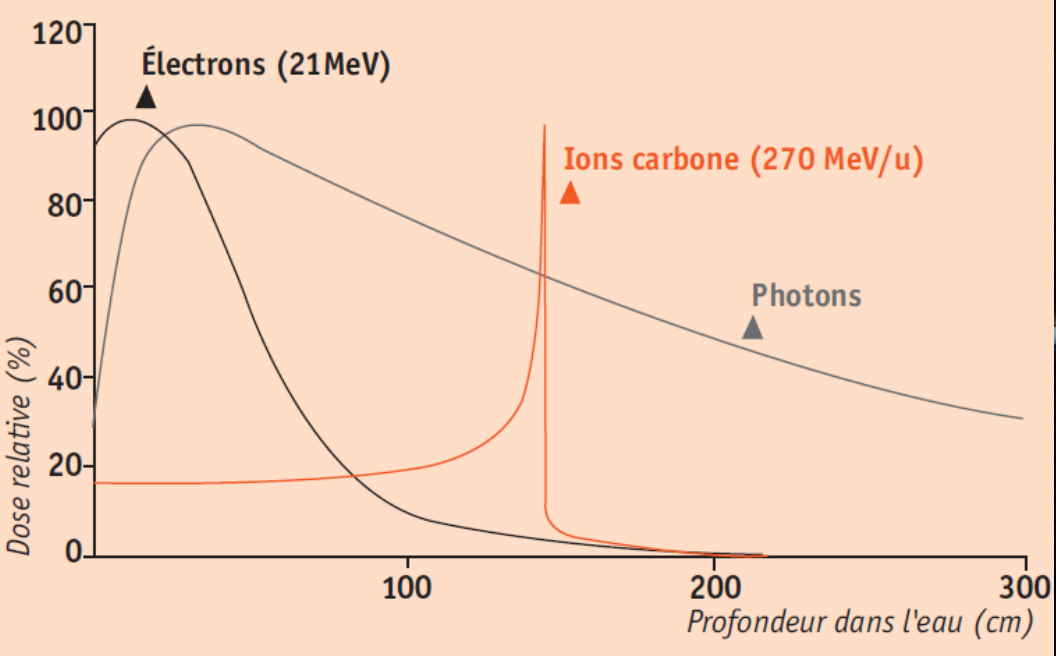
HADRONTHERAPIE :

**HADRONTHERAPIE** : technique de traitement contre le cancer consistant à irradier des tumeurs avec un faisceau d'ions légers (protons, carbone)

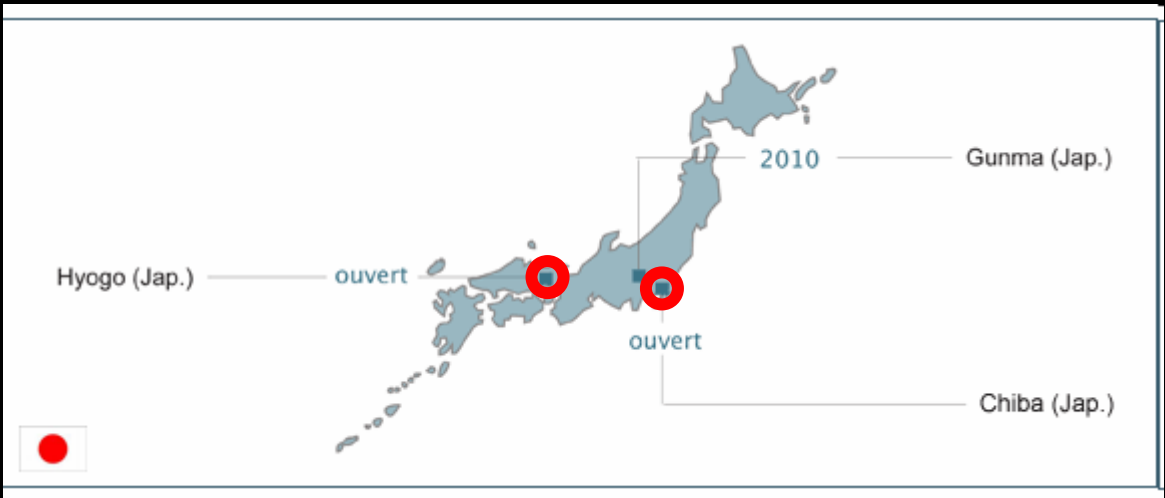
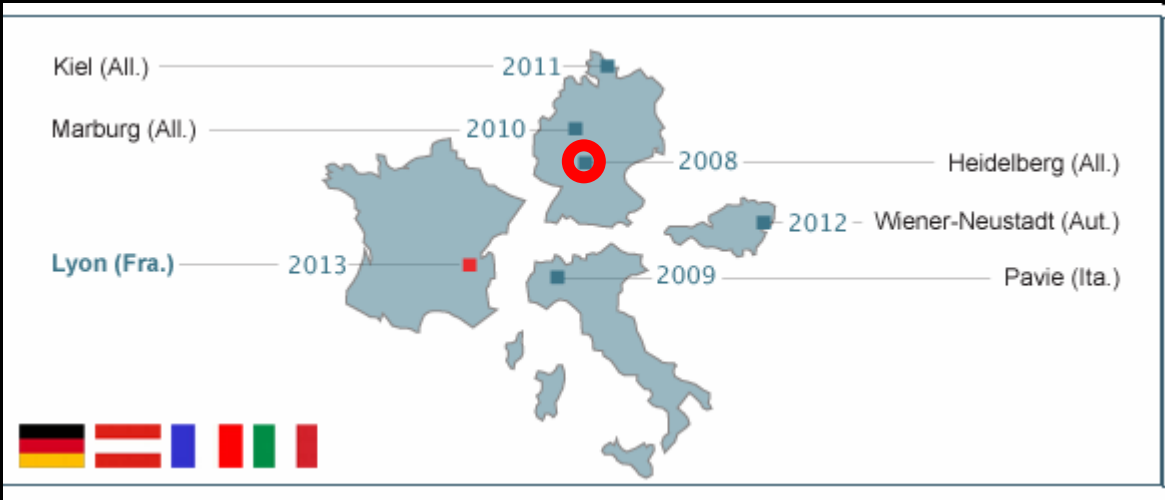


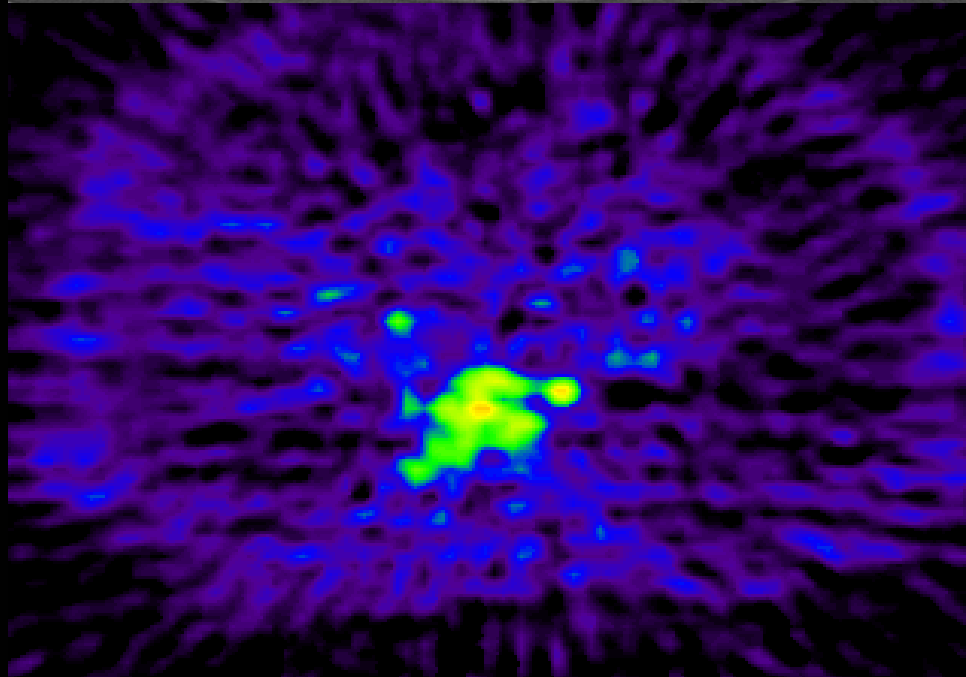
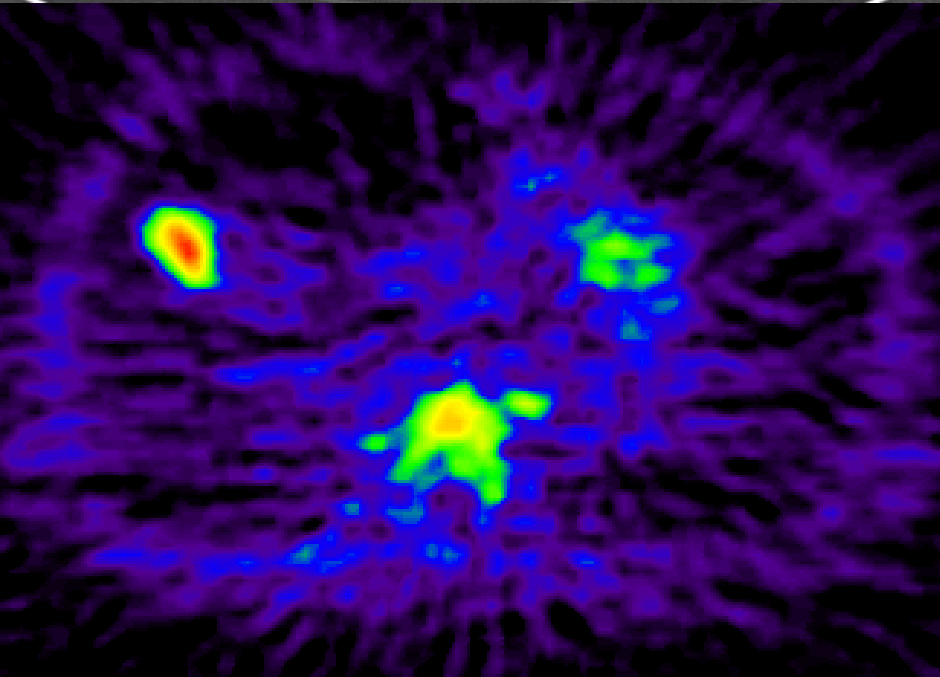
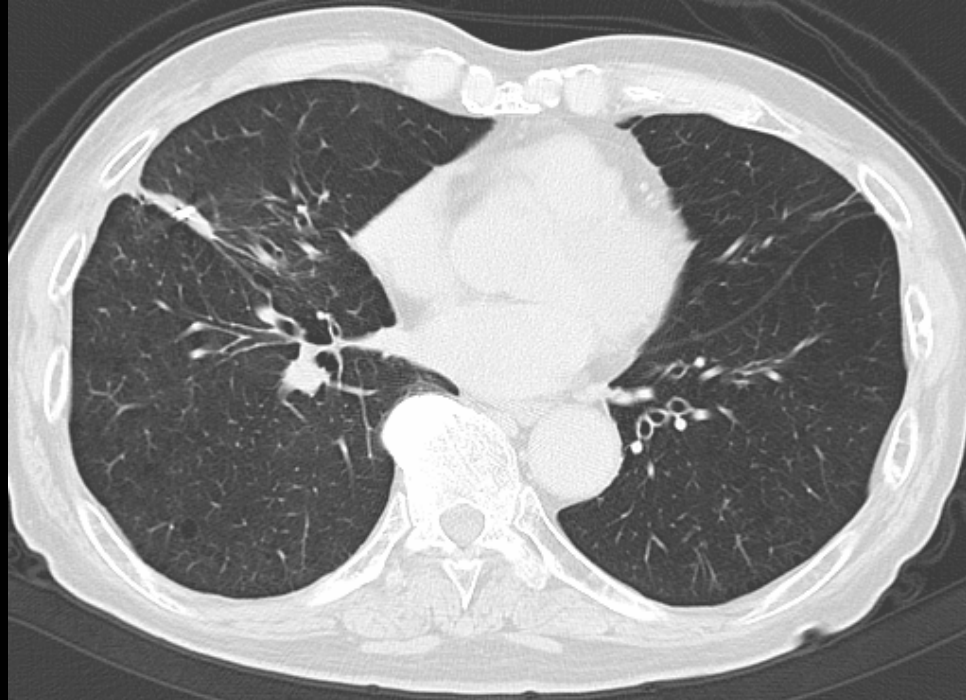
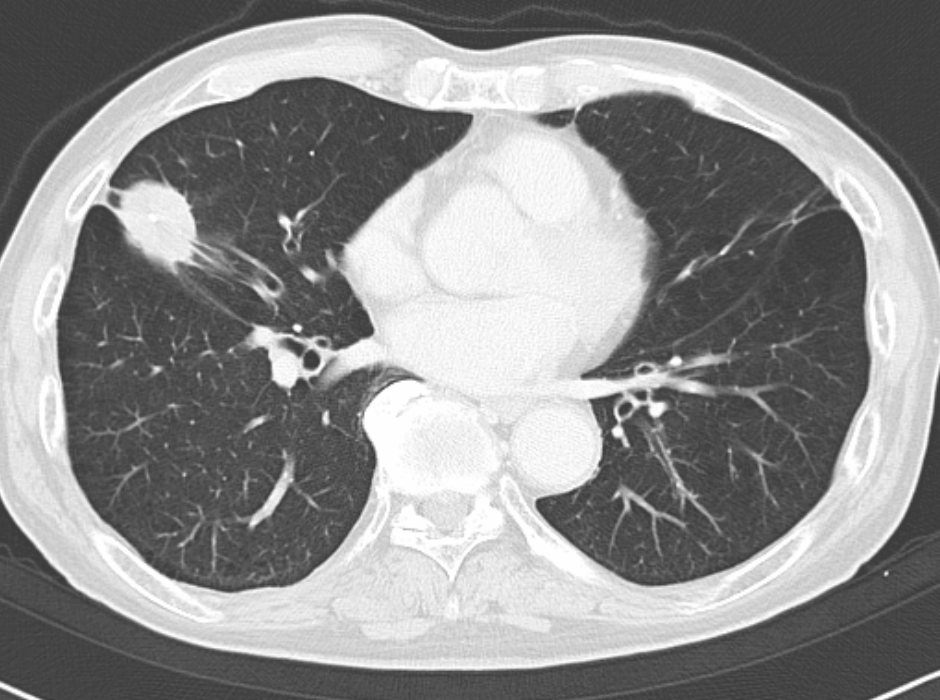




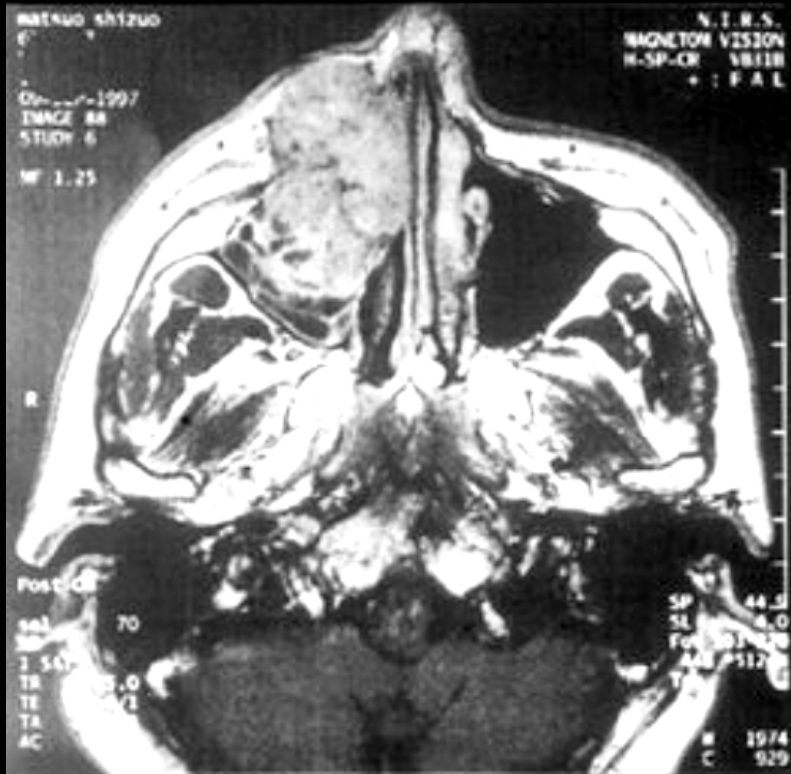




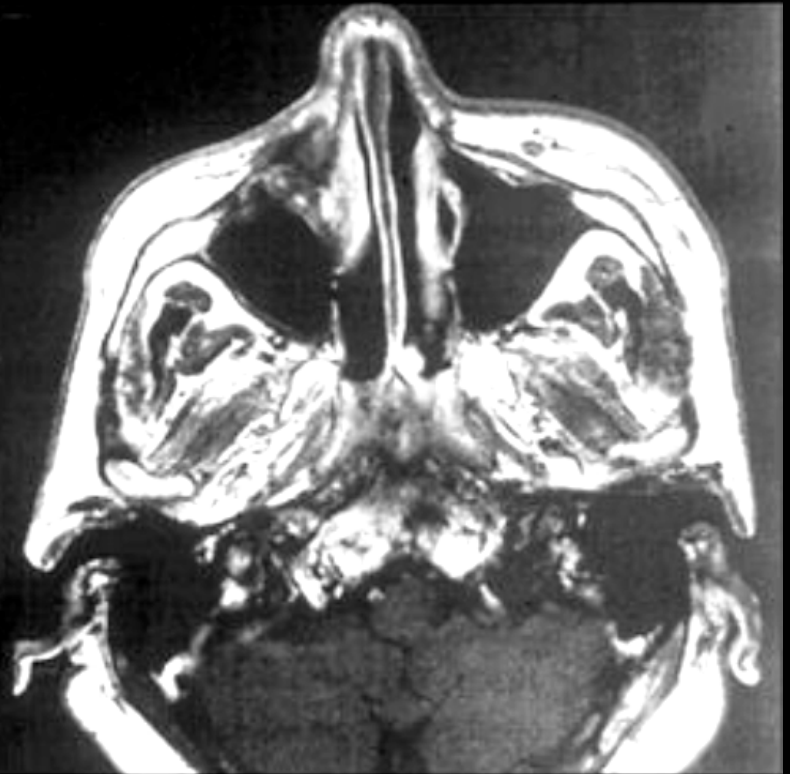




## Carcinome adénoïde kystique du sinus droit



Avant traitement



20 mois plus tard

I) Introduction :

-L'hadronthérapie : Définition  
Propriétés balistiques

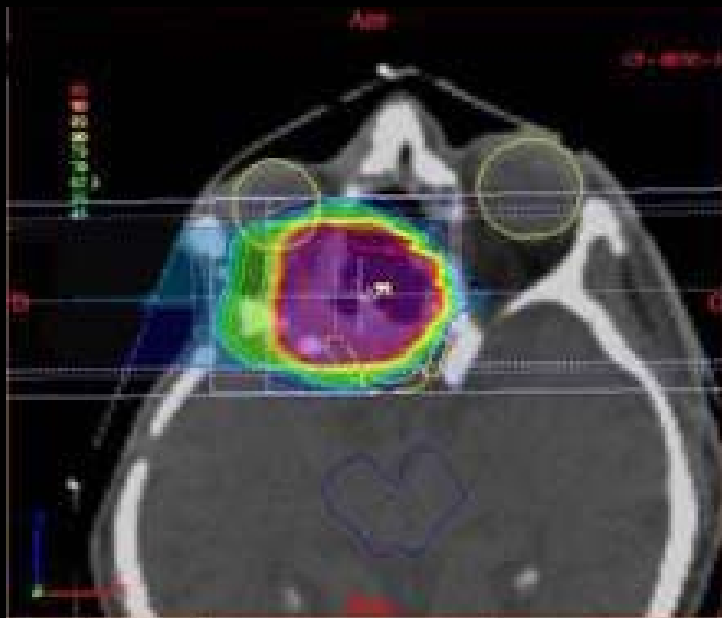
**-Principe du contrôle qualité par détection de fragments chargés**

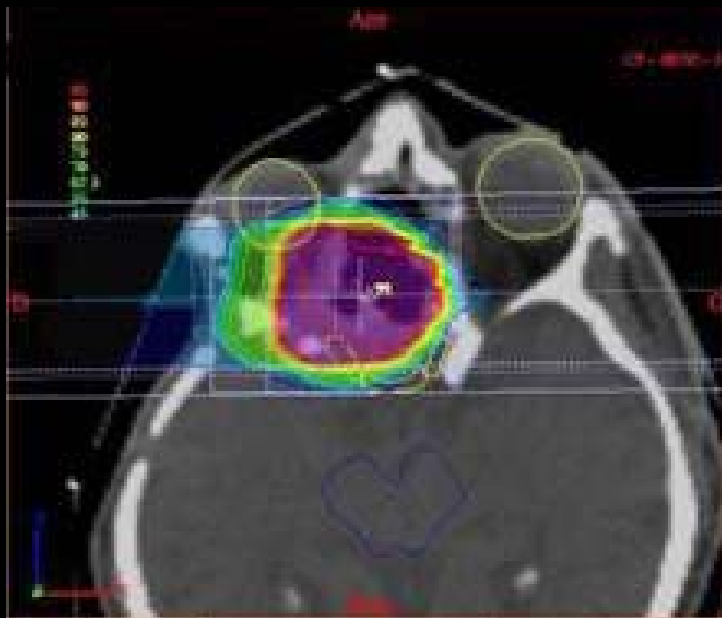
II) Travail effectué :

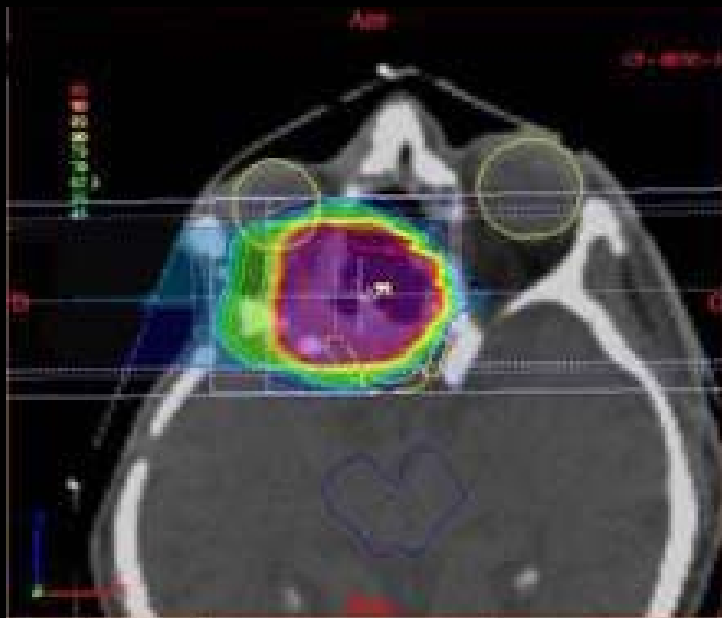
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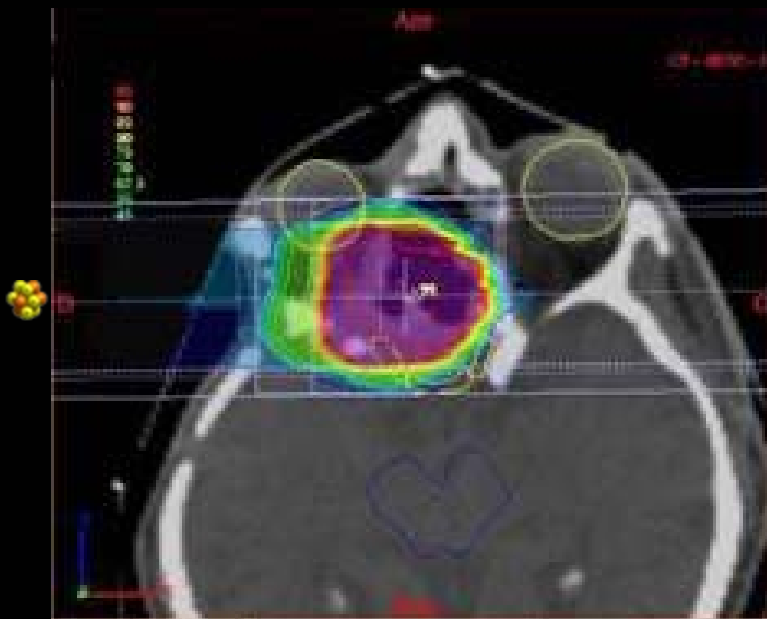
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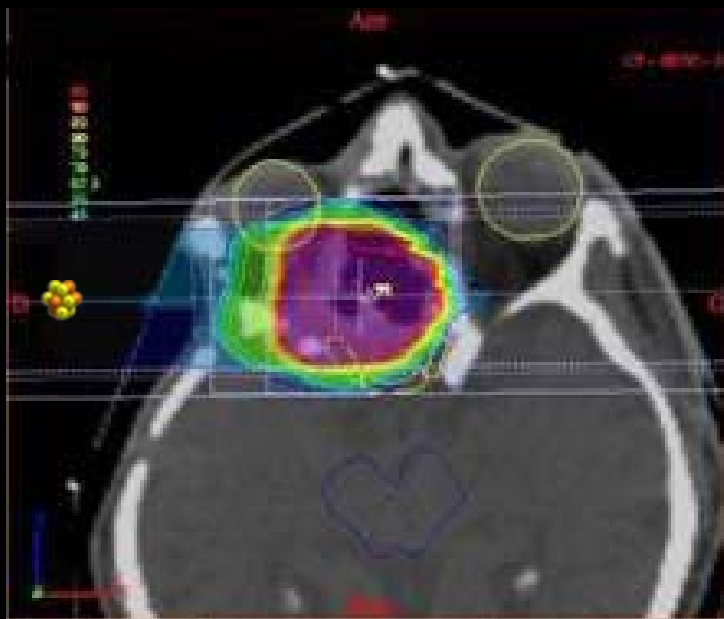


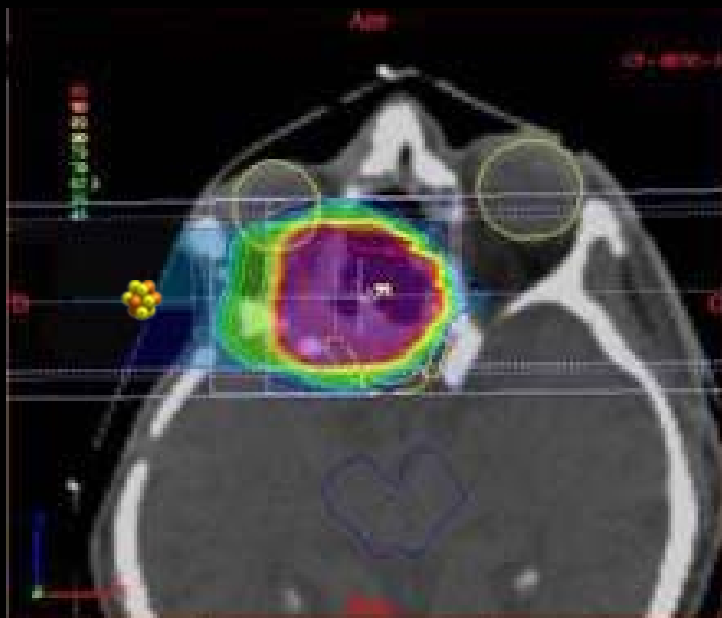


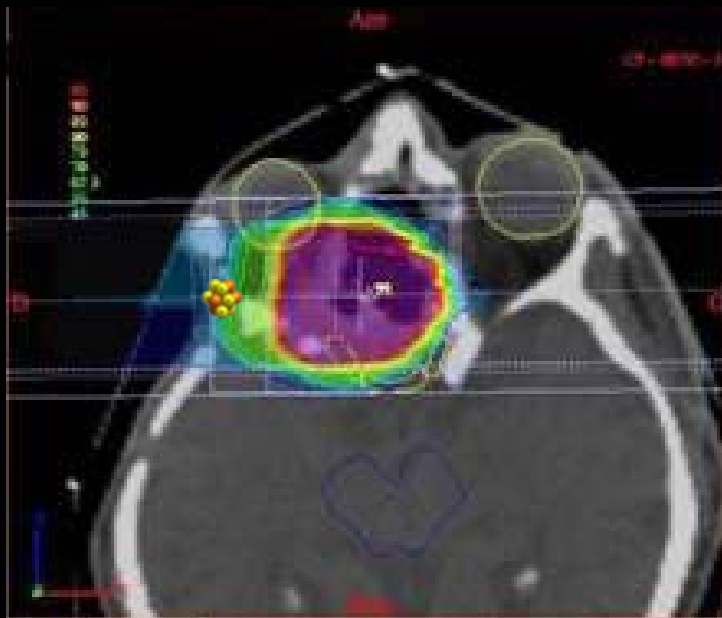


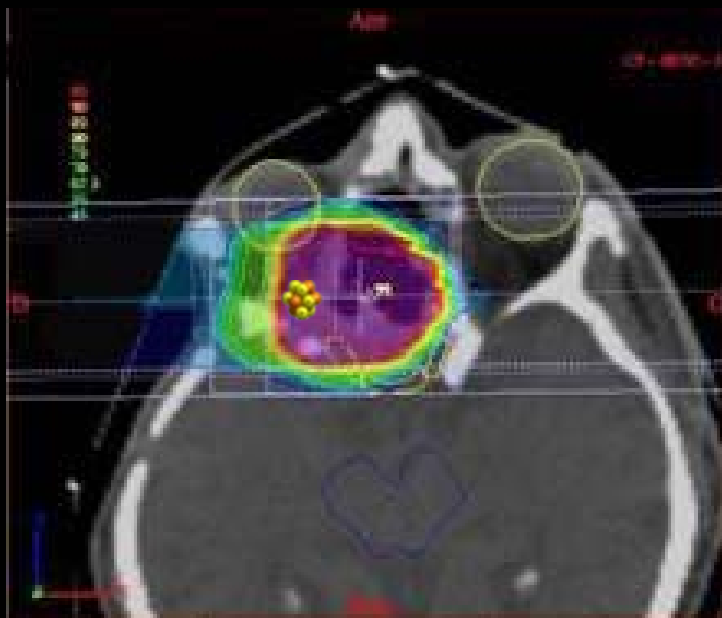


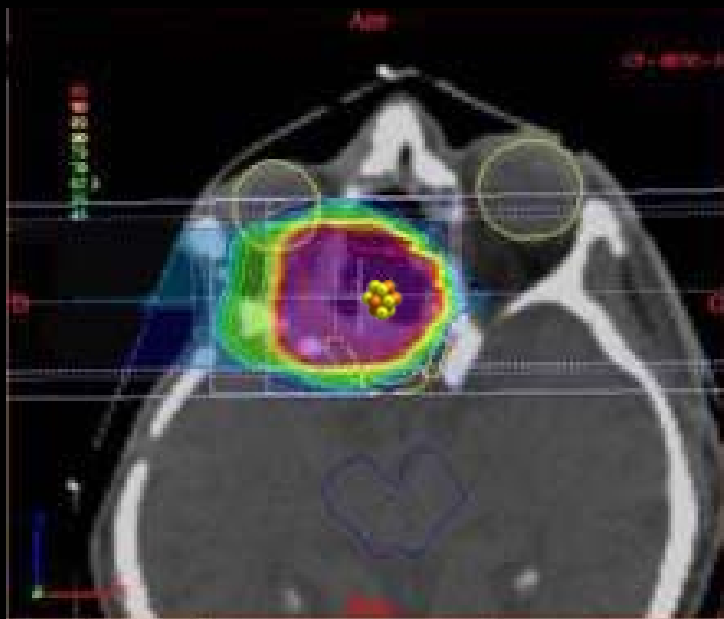


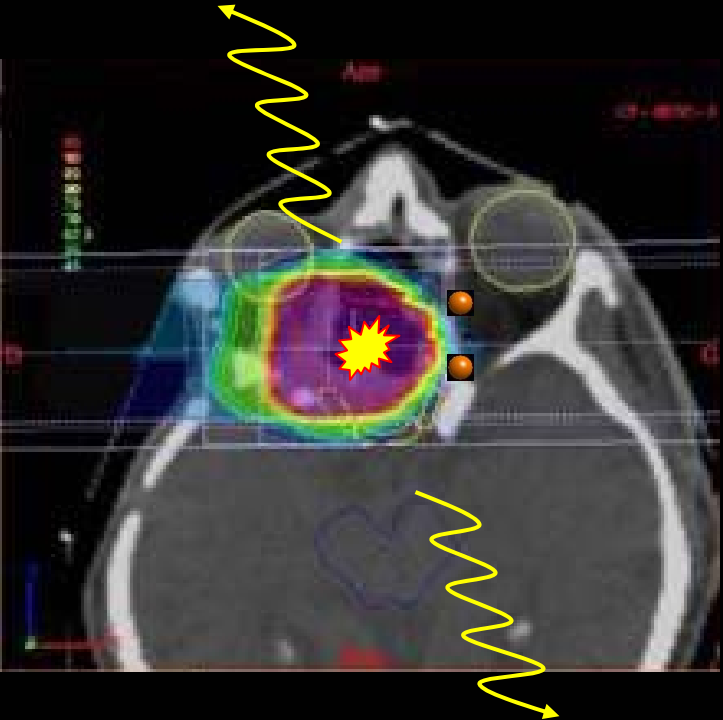


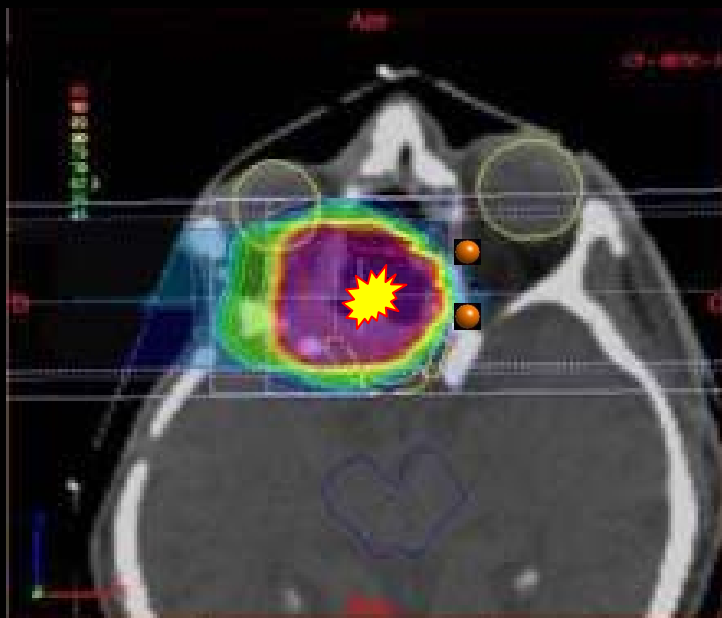


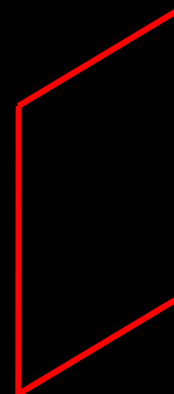
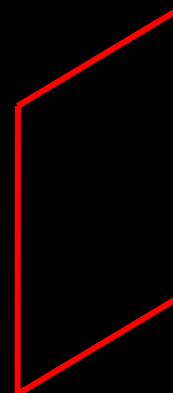
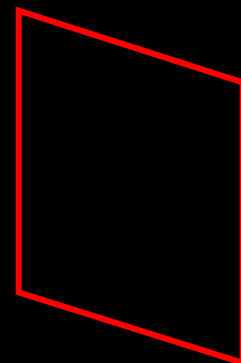
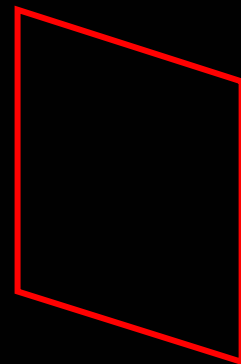
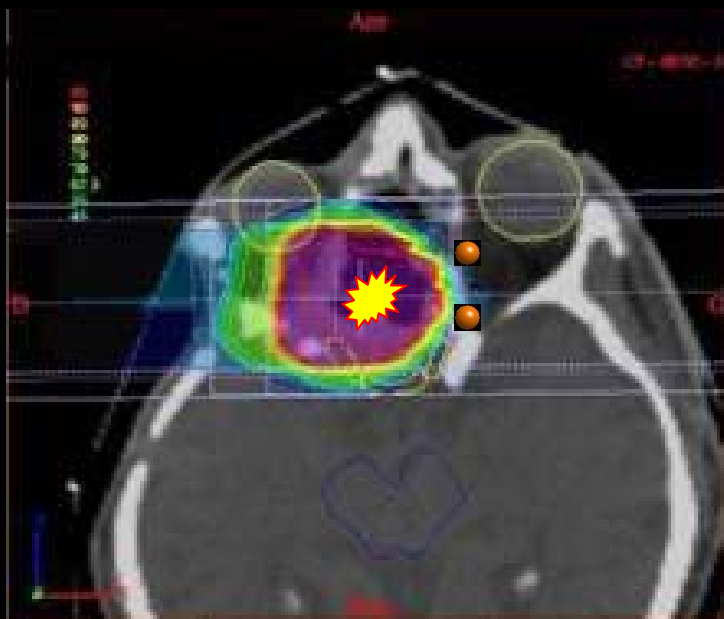




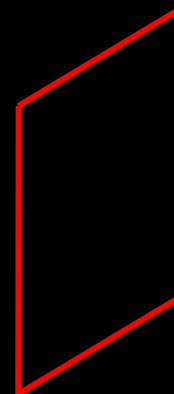
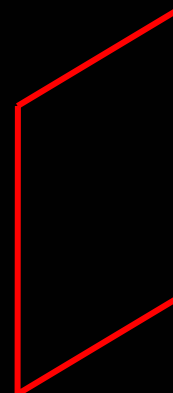
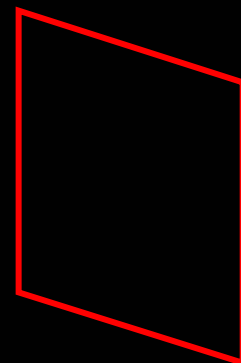
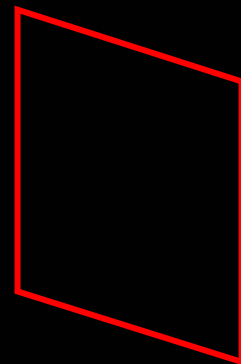
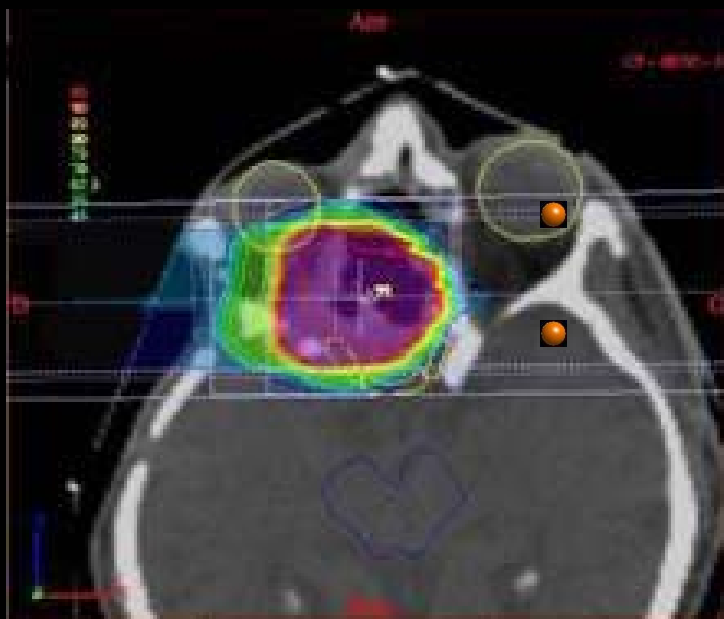


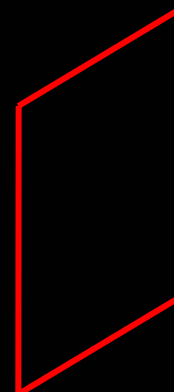
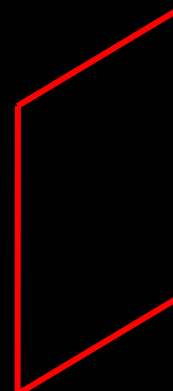
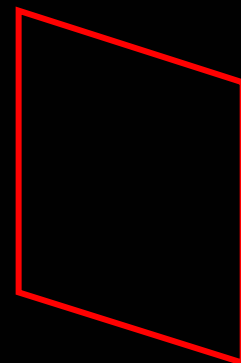
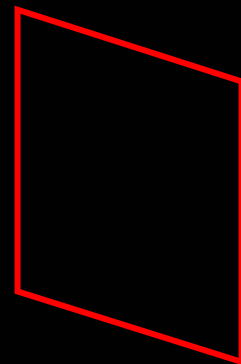
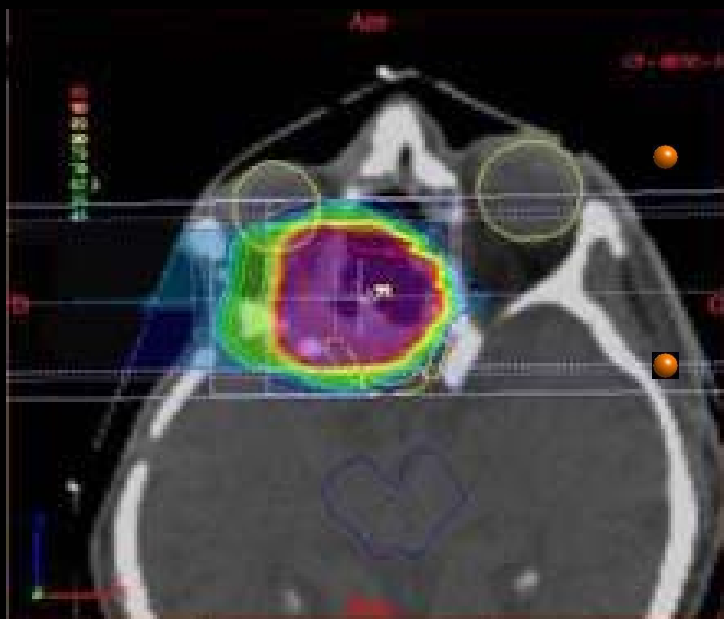


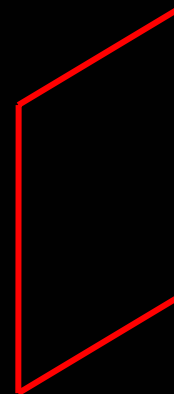
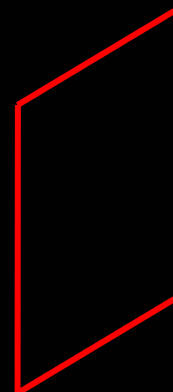
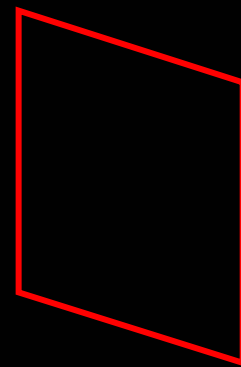
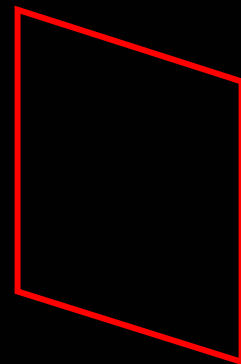
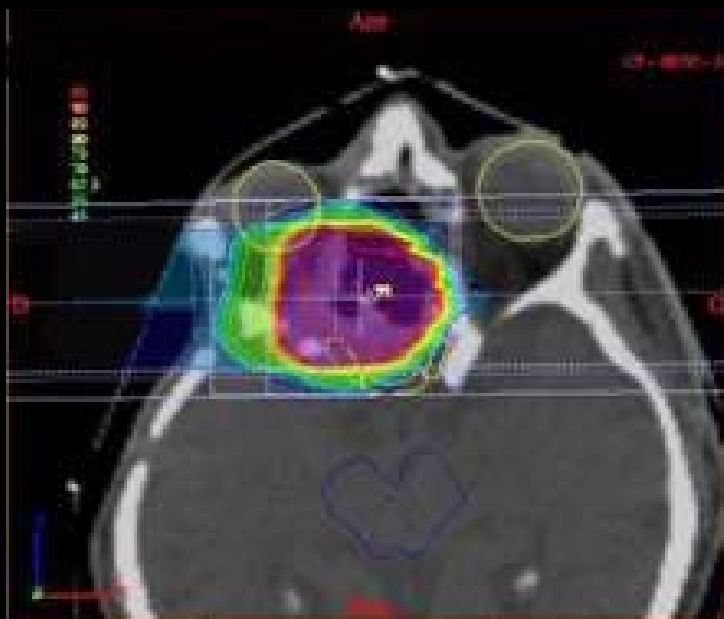


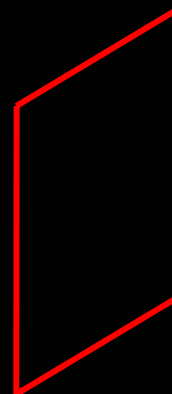
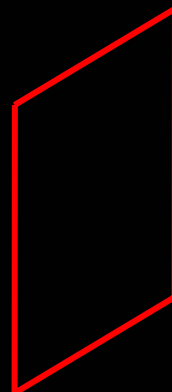
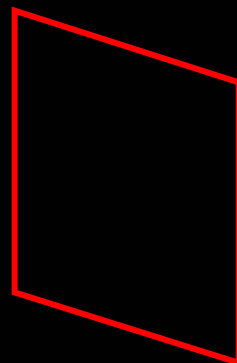
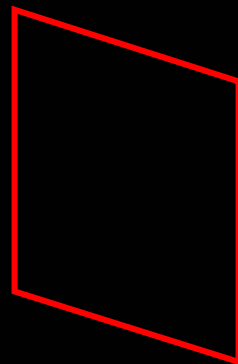
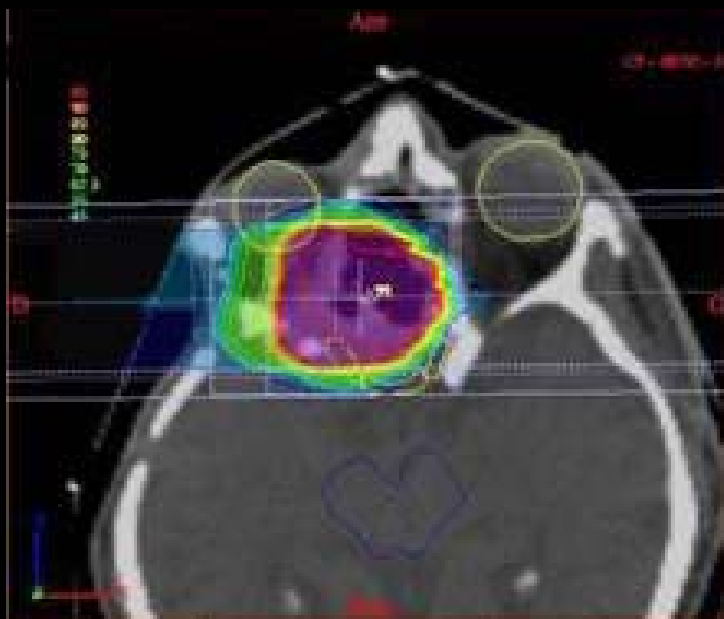


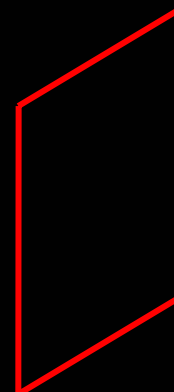
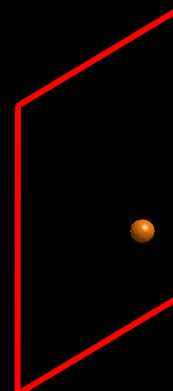
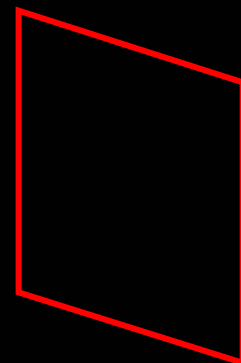
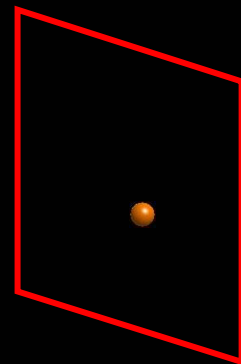
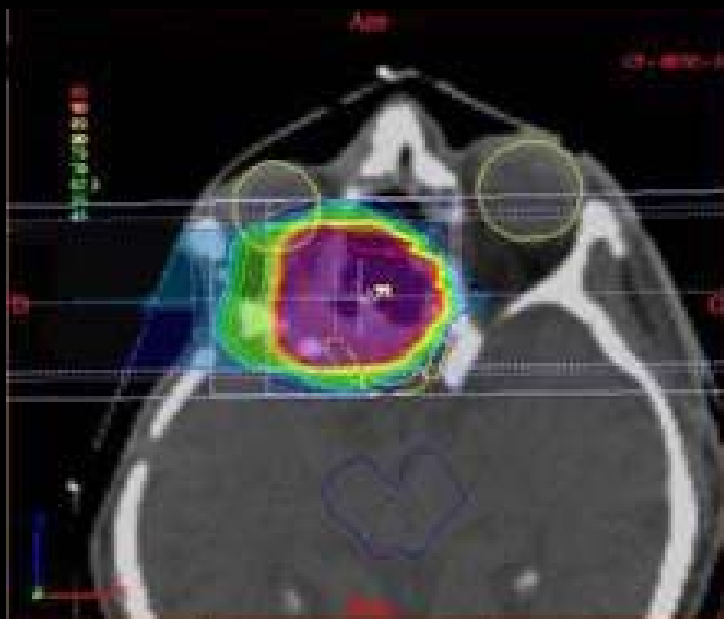


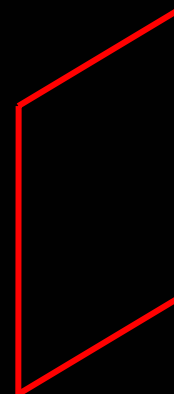
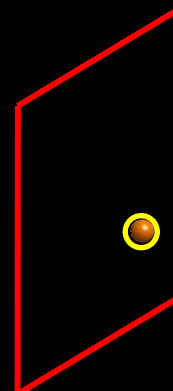
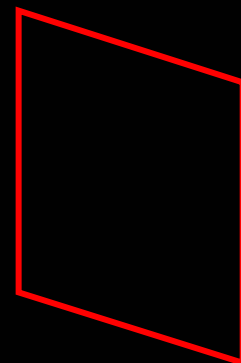
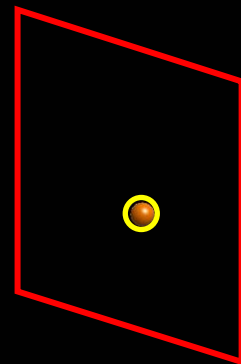
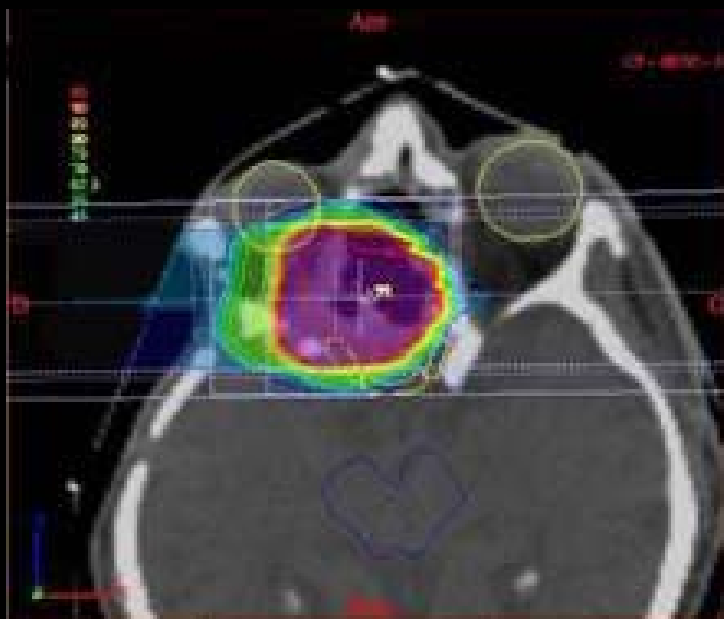


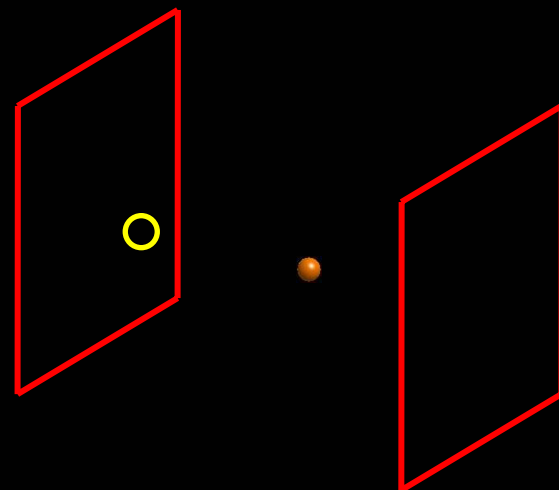
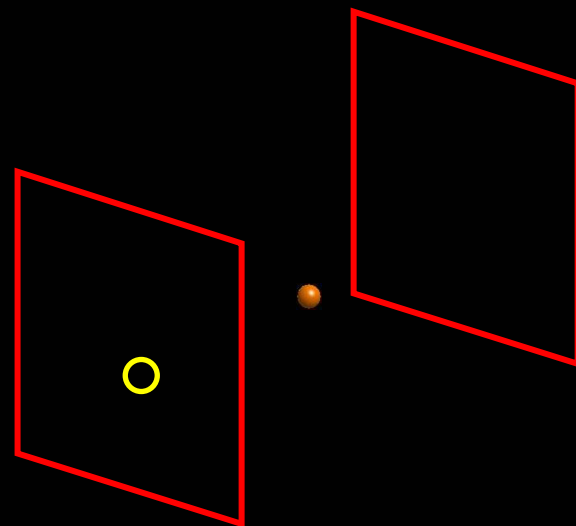
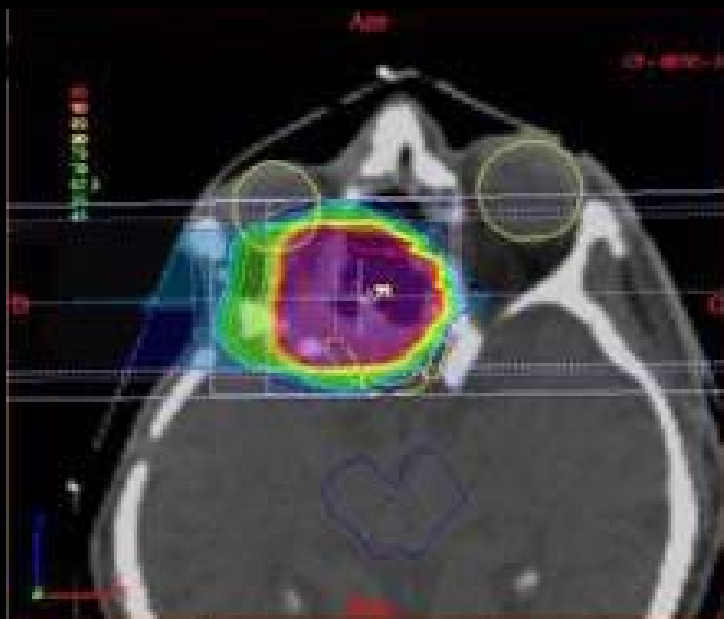


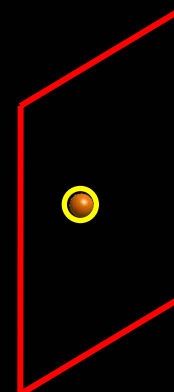
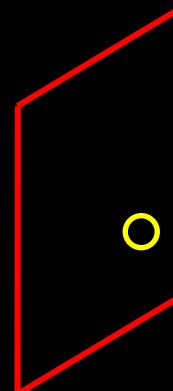
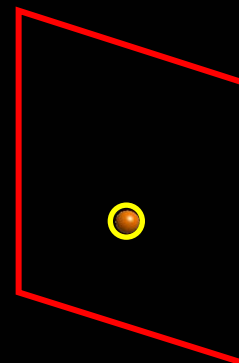
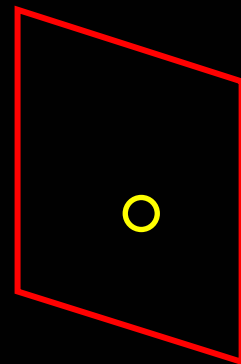
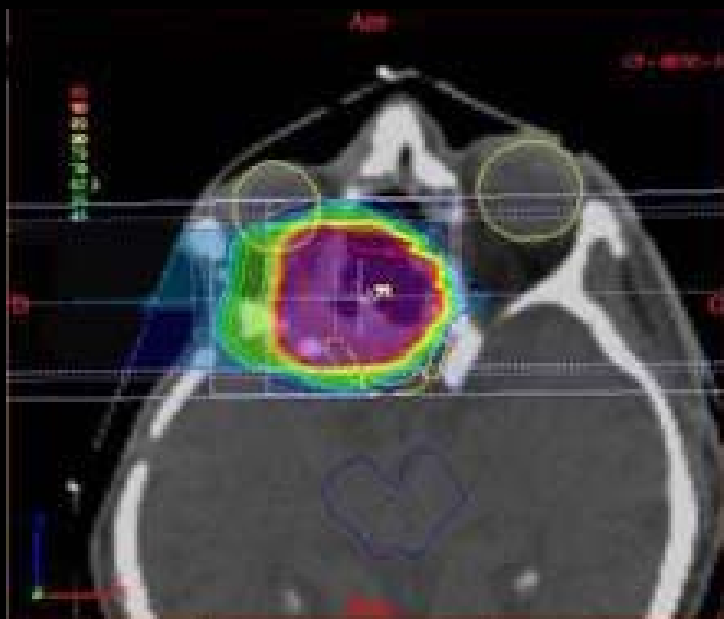




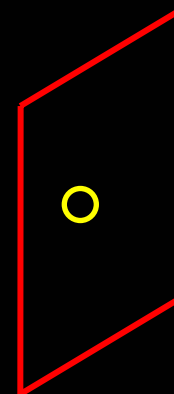
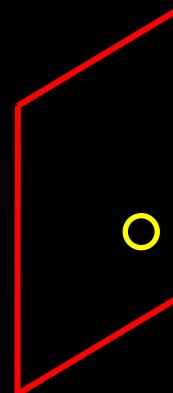
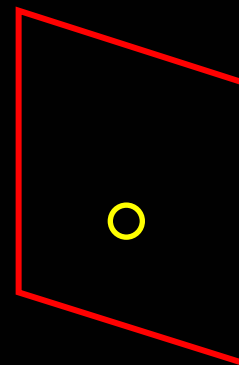
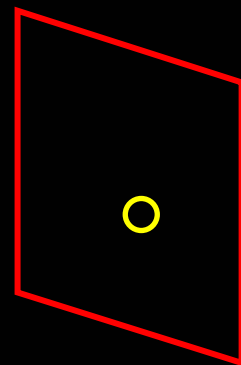
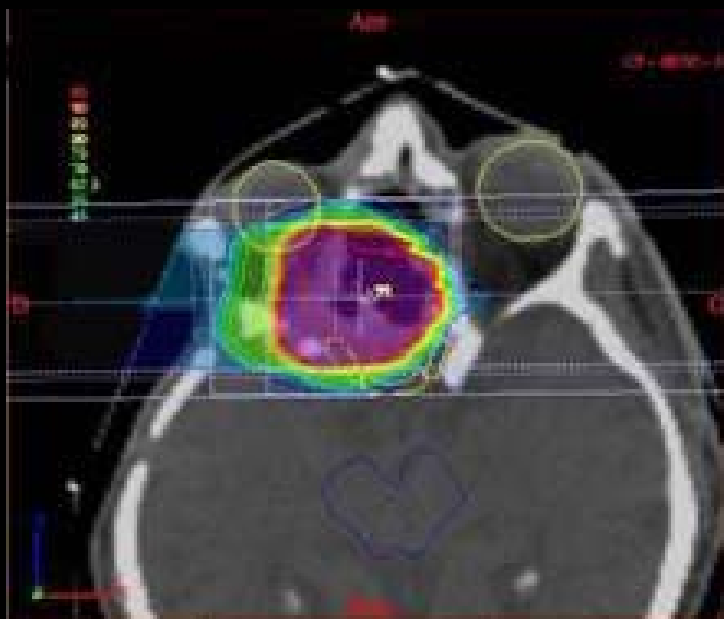


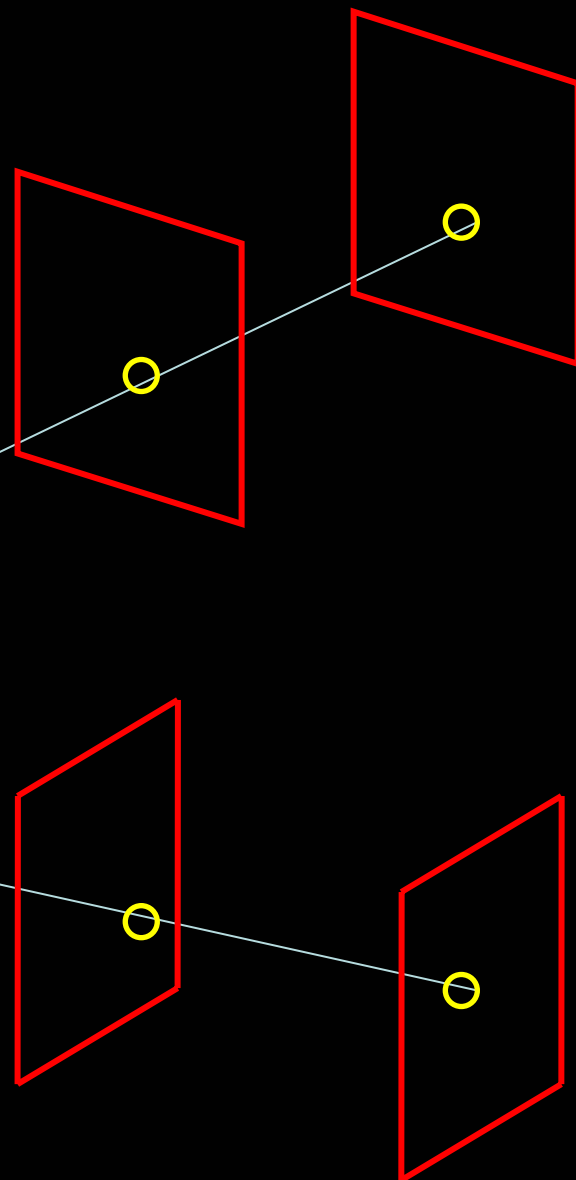
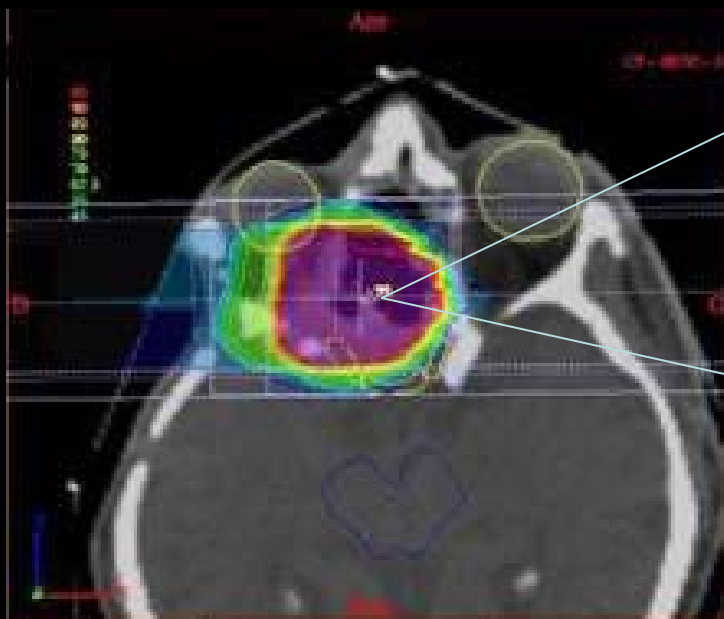


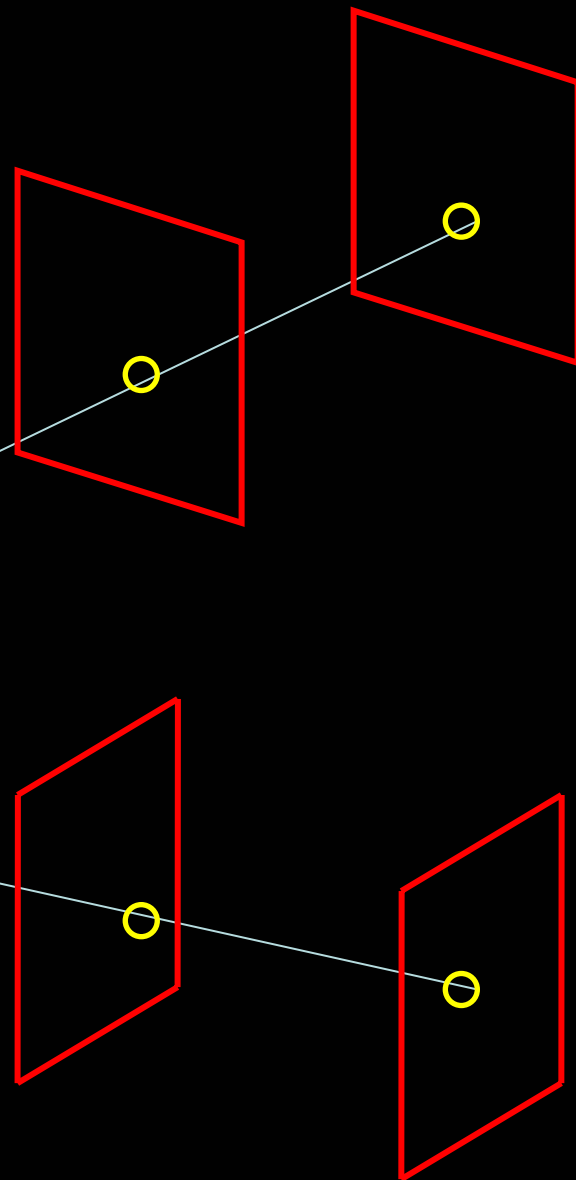
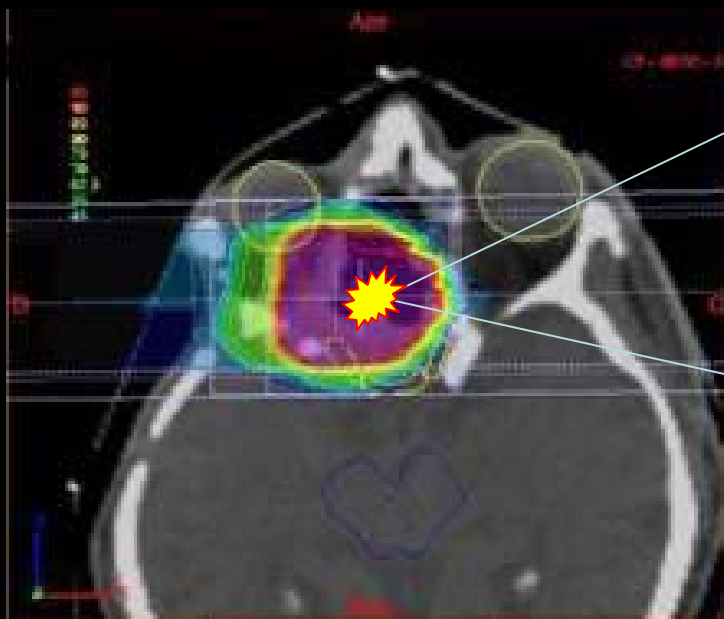


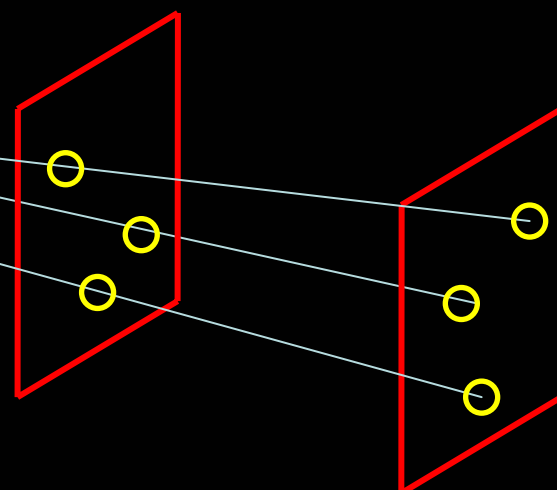
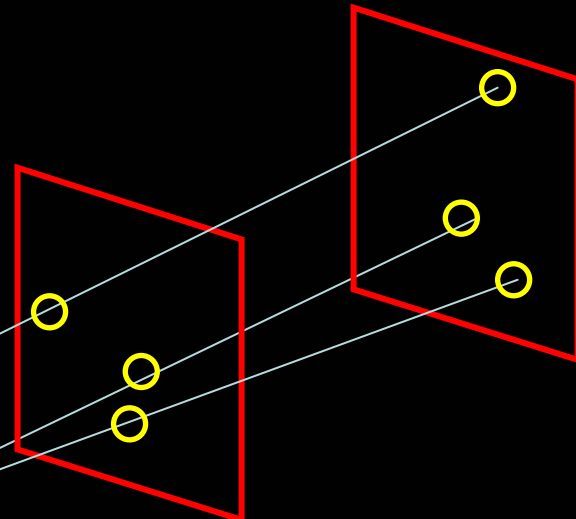
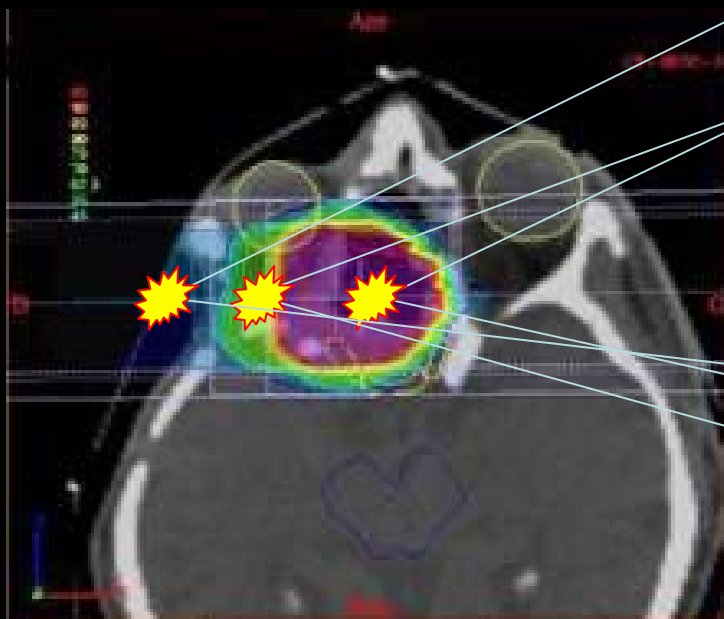


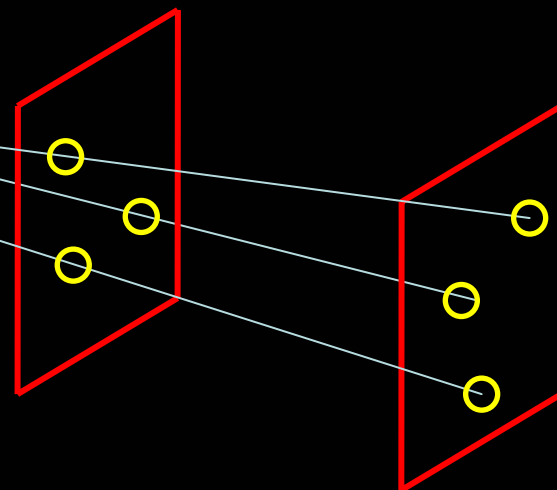
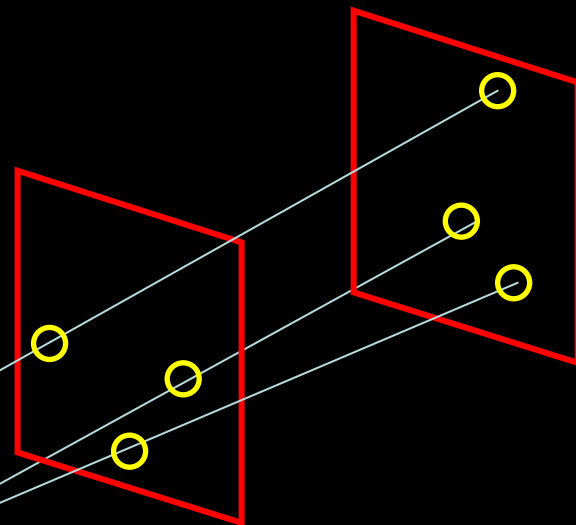
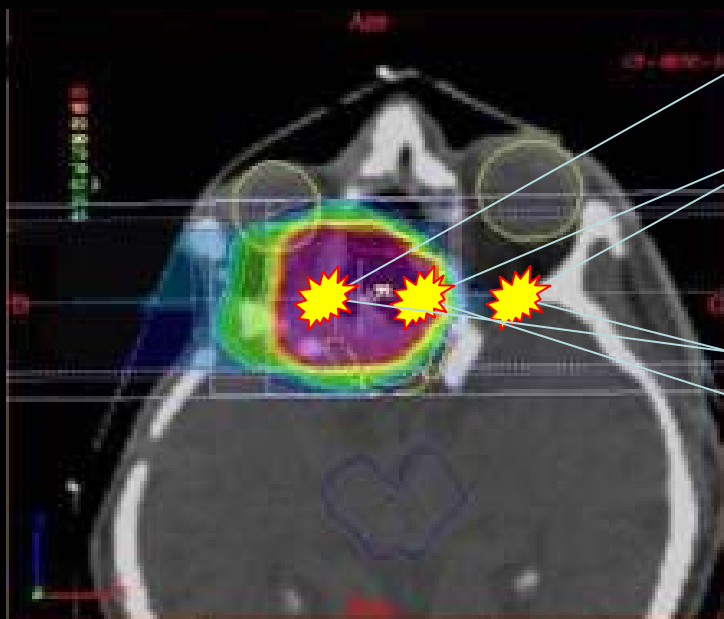




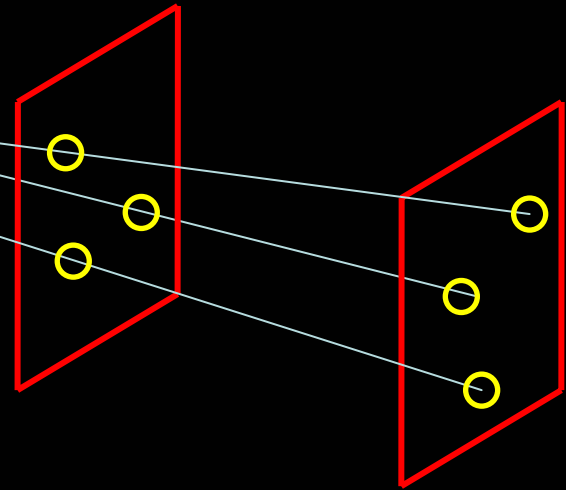
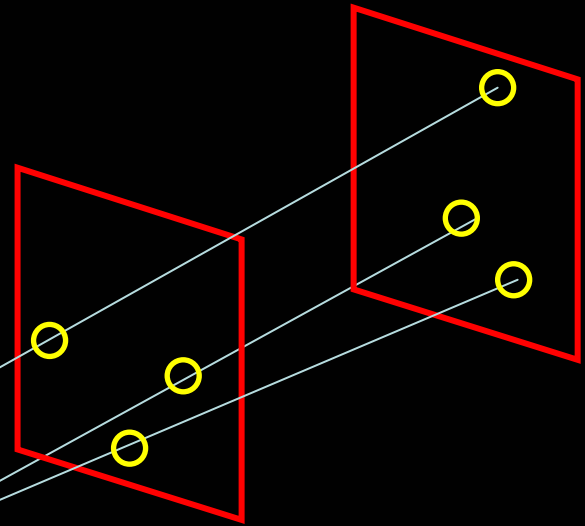
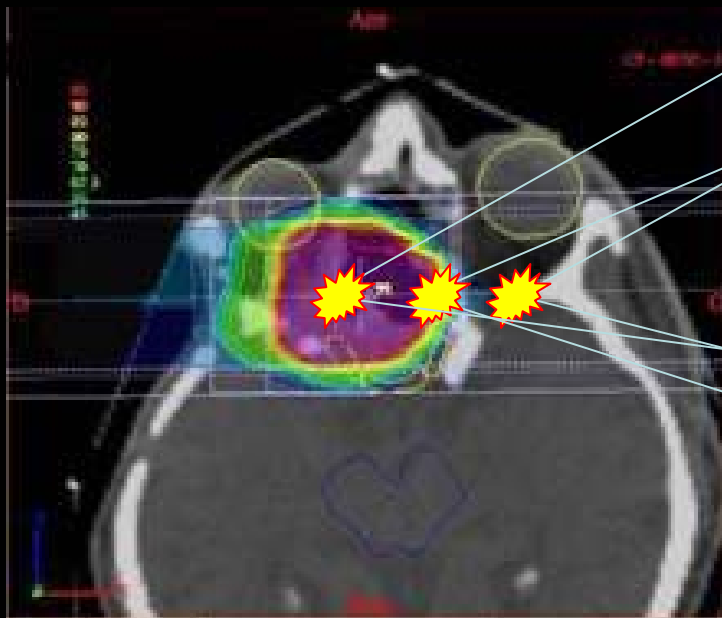








# STOP



## I) Introduction :

-L'hadronthérapie :

Définition

Propriétés balistiques

-Principe du contrôle qualité par détection de fragments chargés

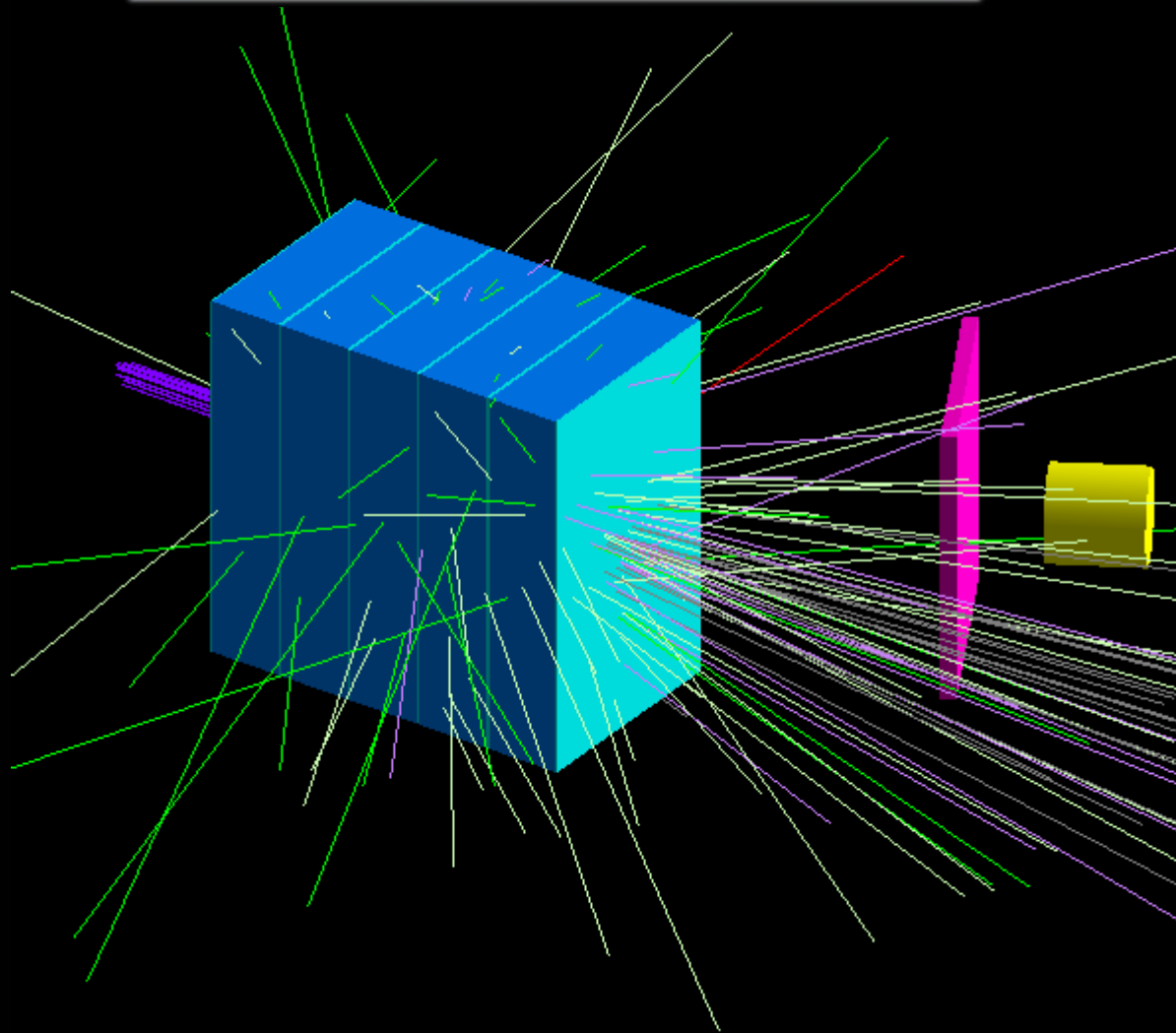
## II) Travail effectué :

-Validation des simulations

-Technique de reconstruction de vertex : 1ers résultats théoriques

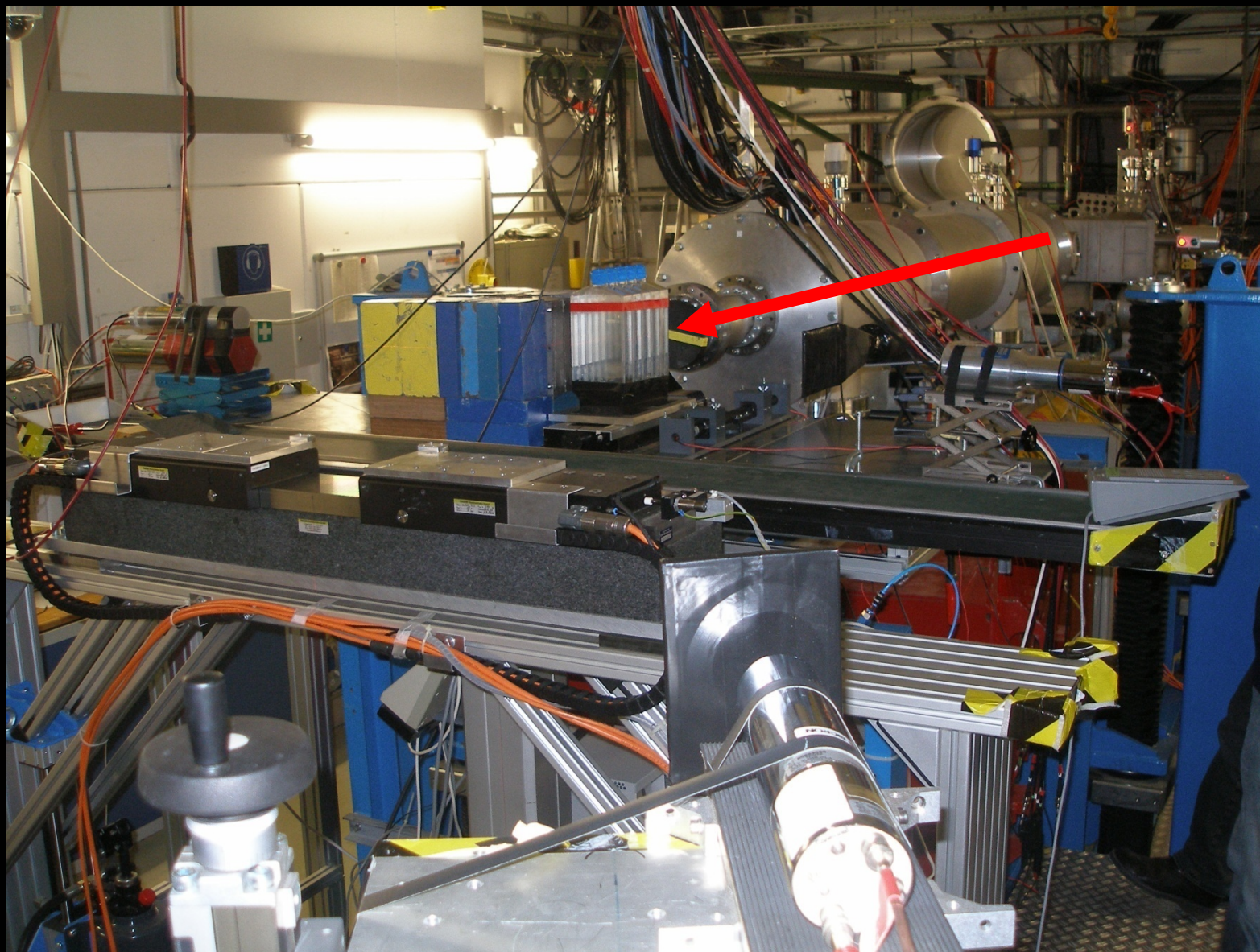
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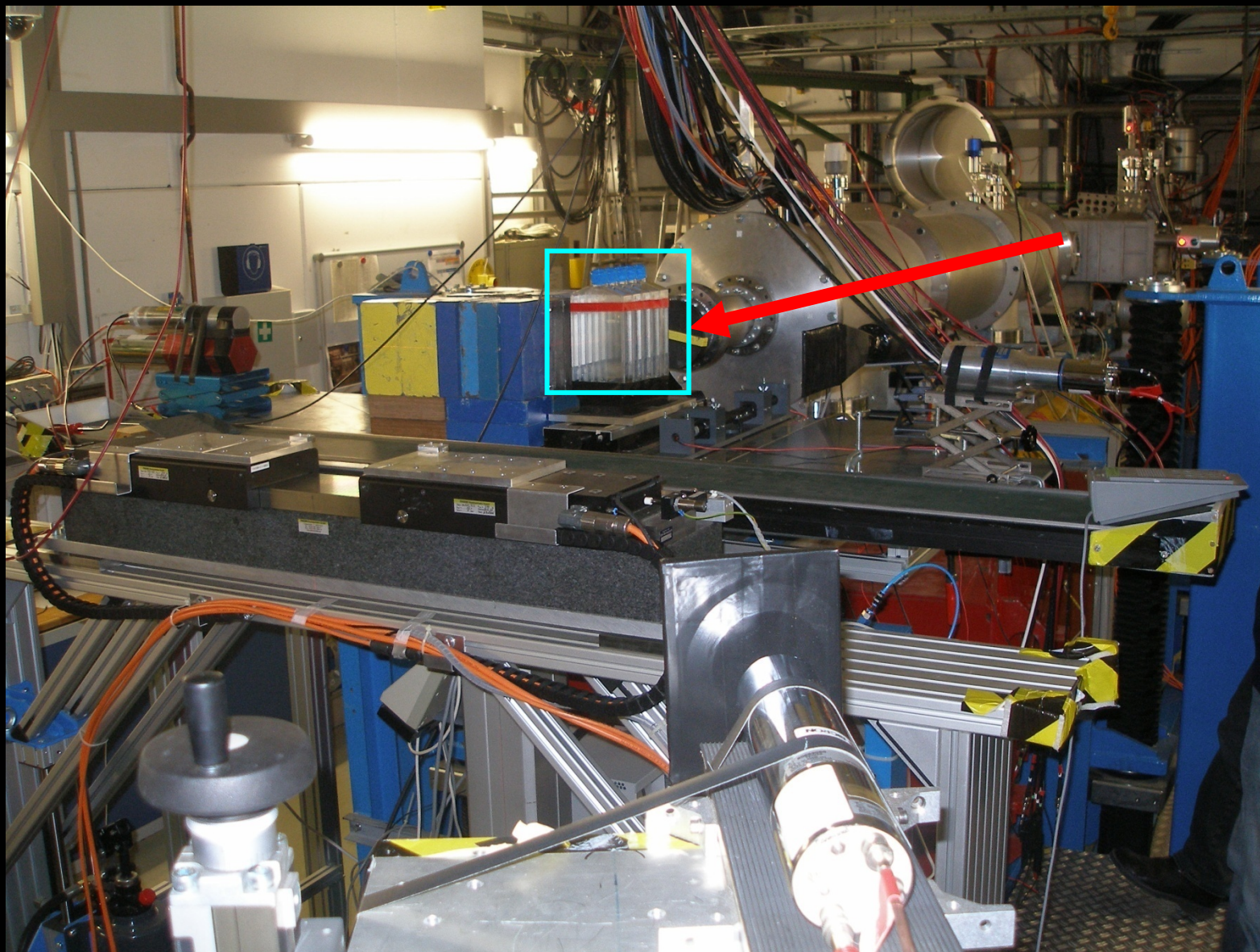
# GEANT4

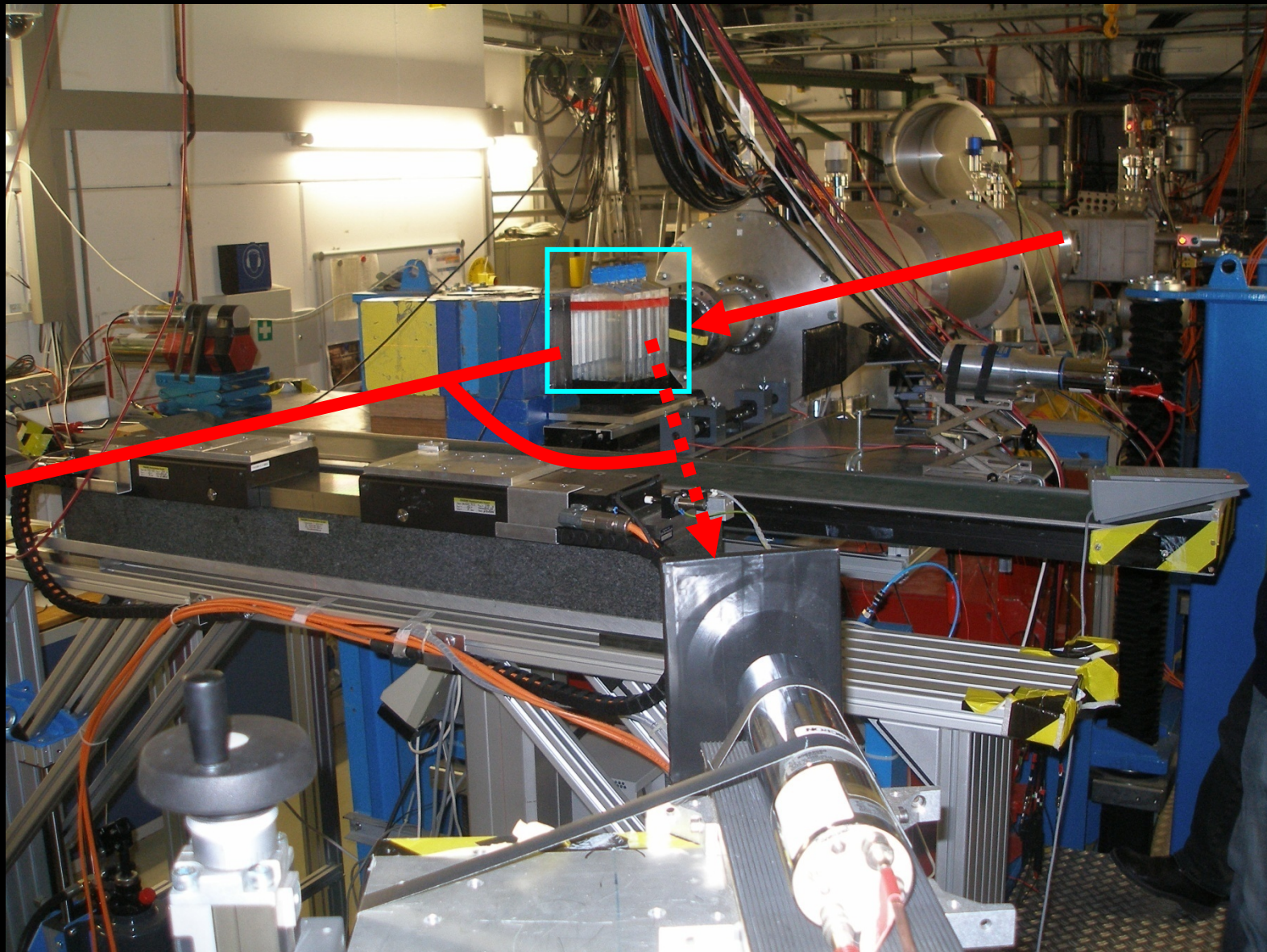


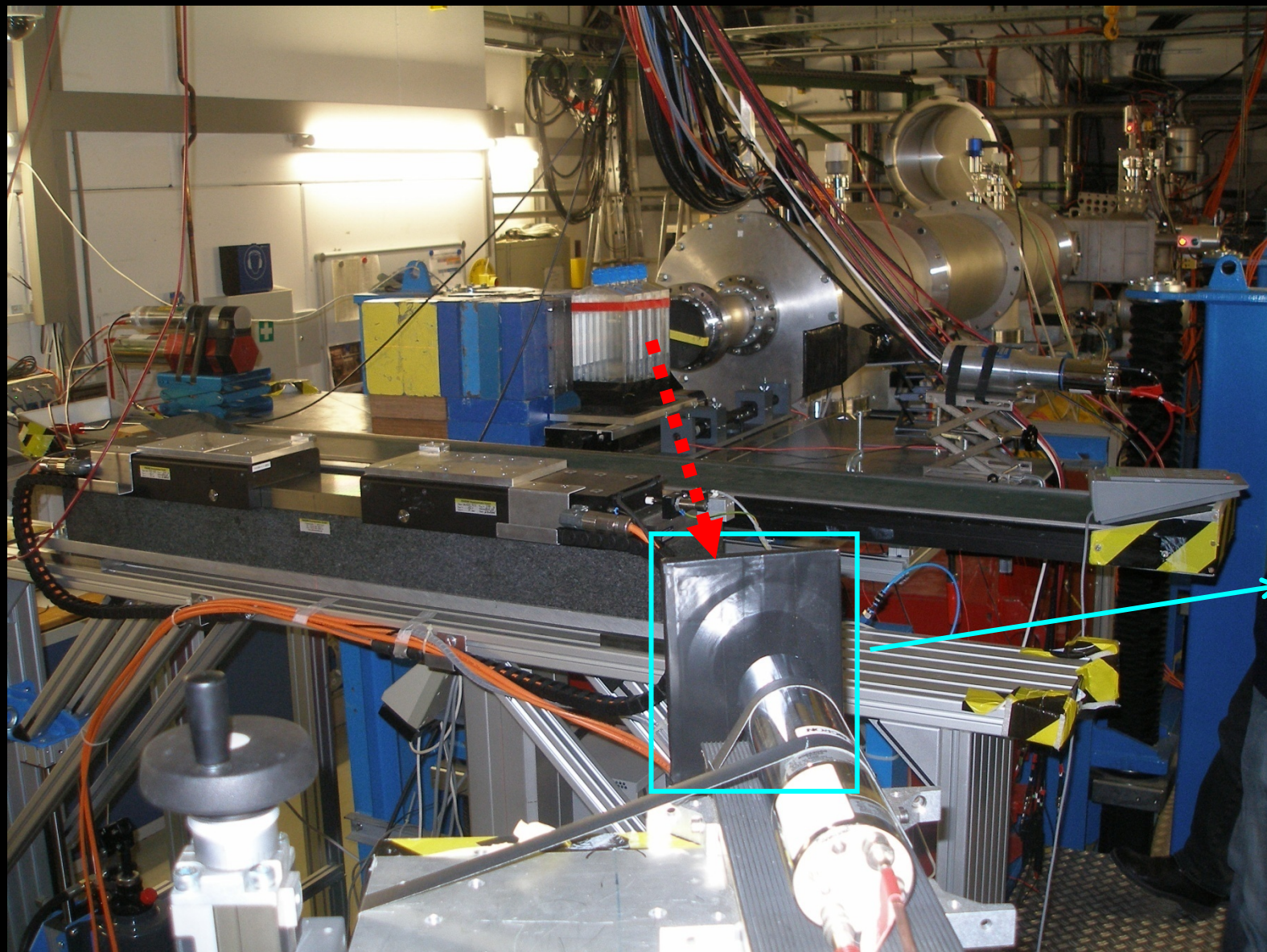




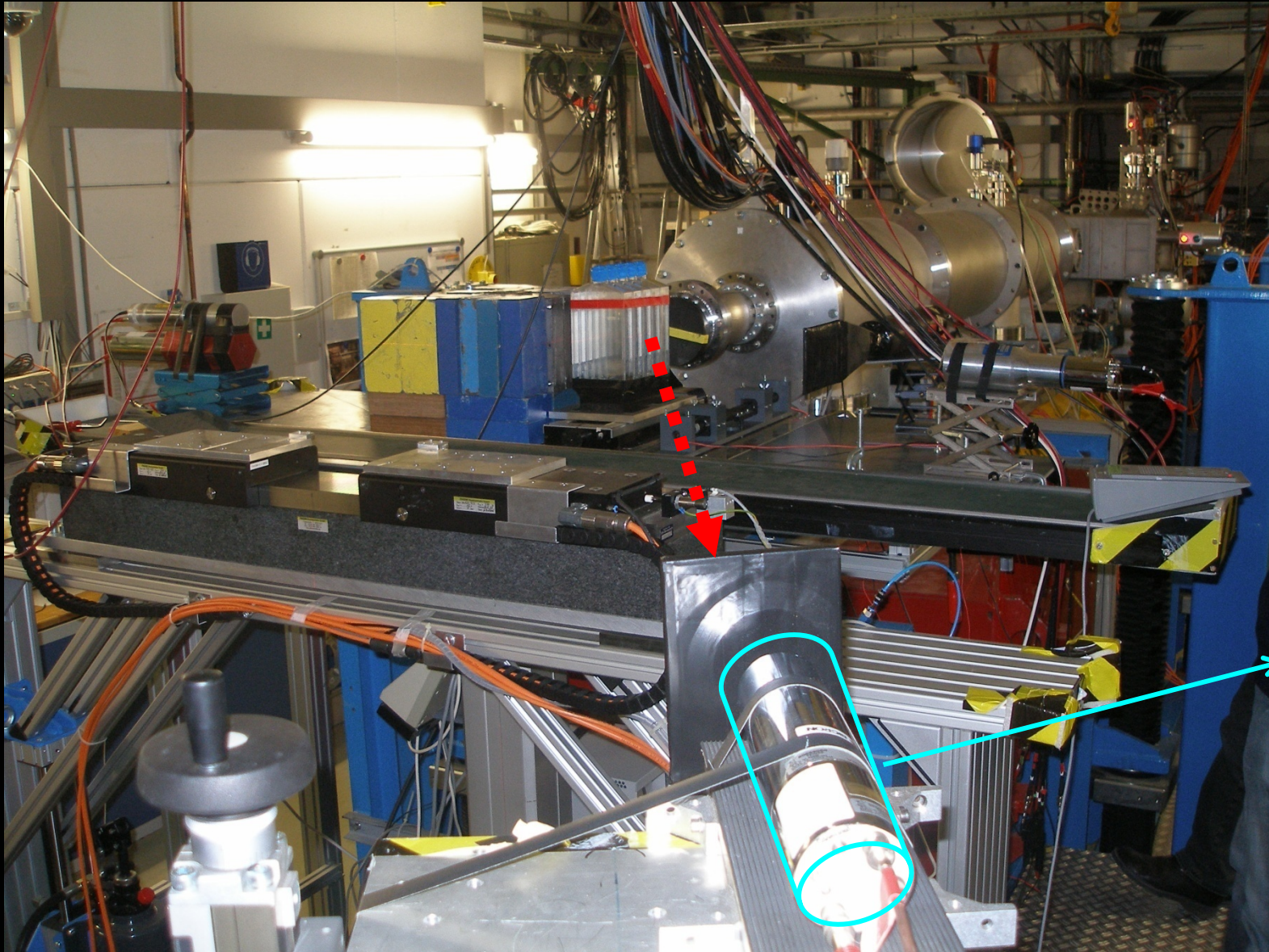








temps

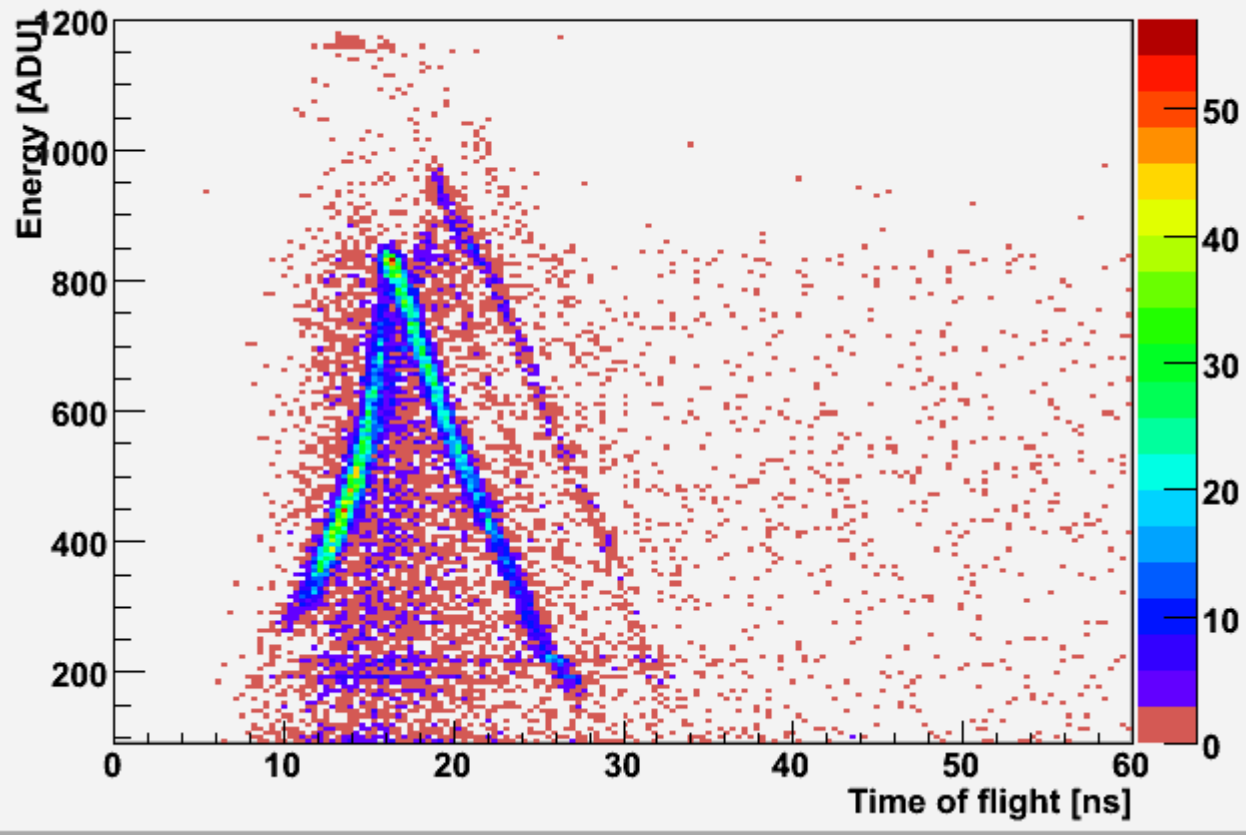


temps

énergie

ETOF\_total

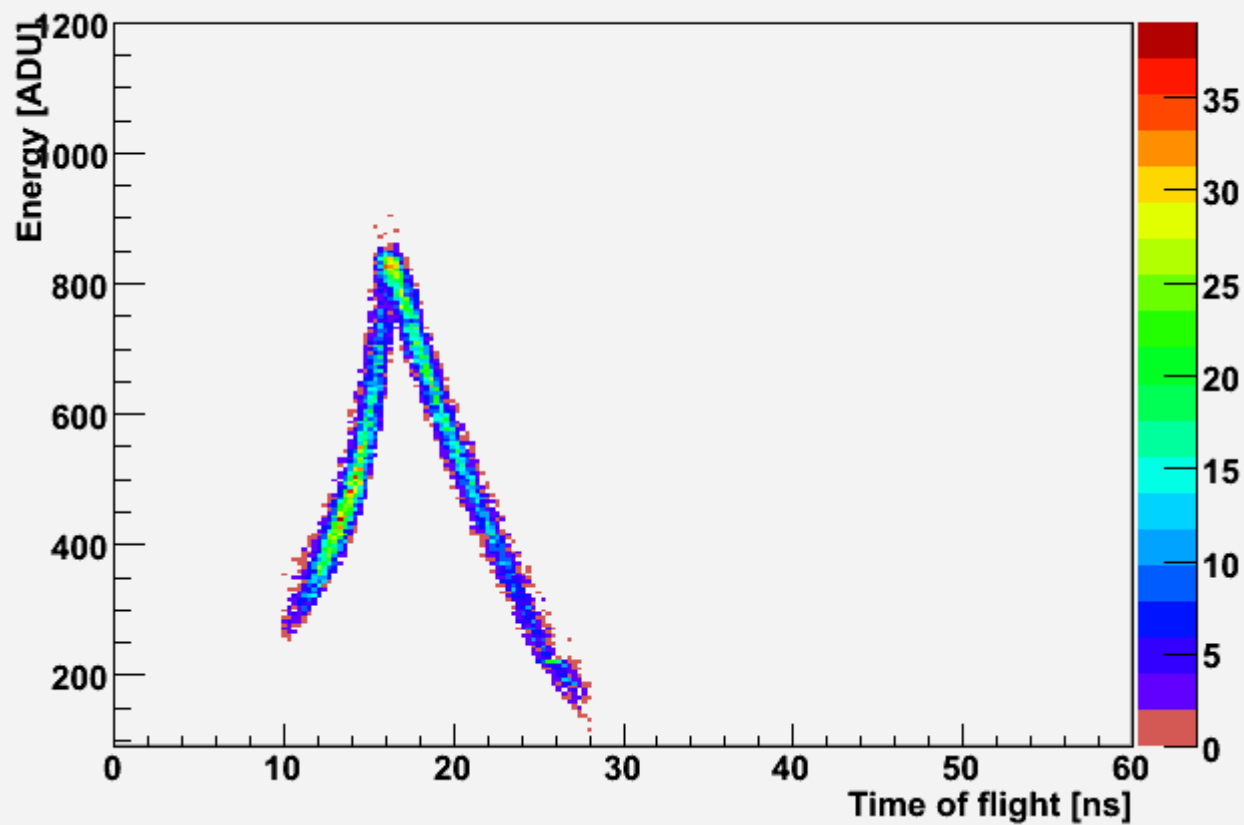
Entries 401950



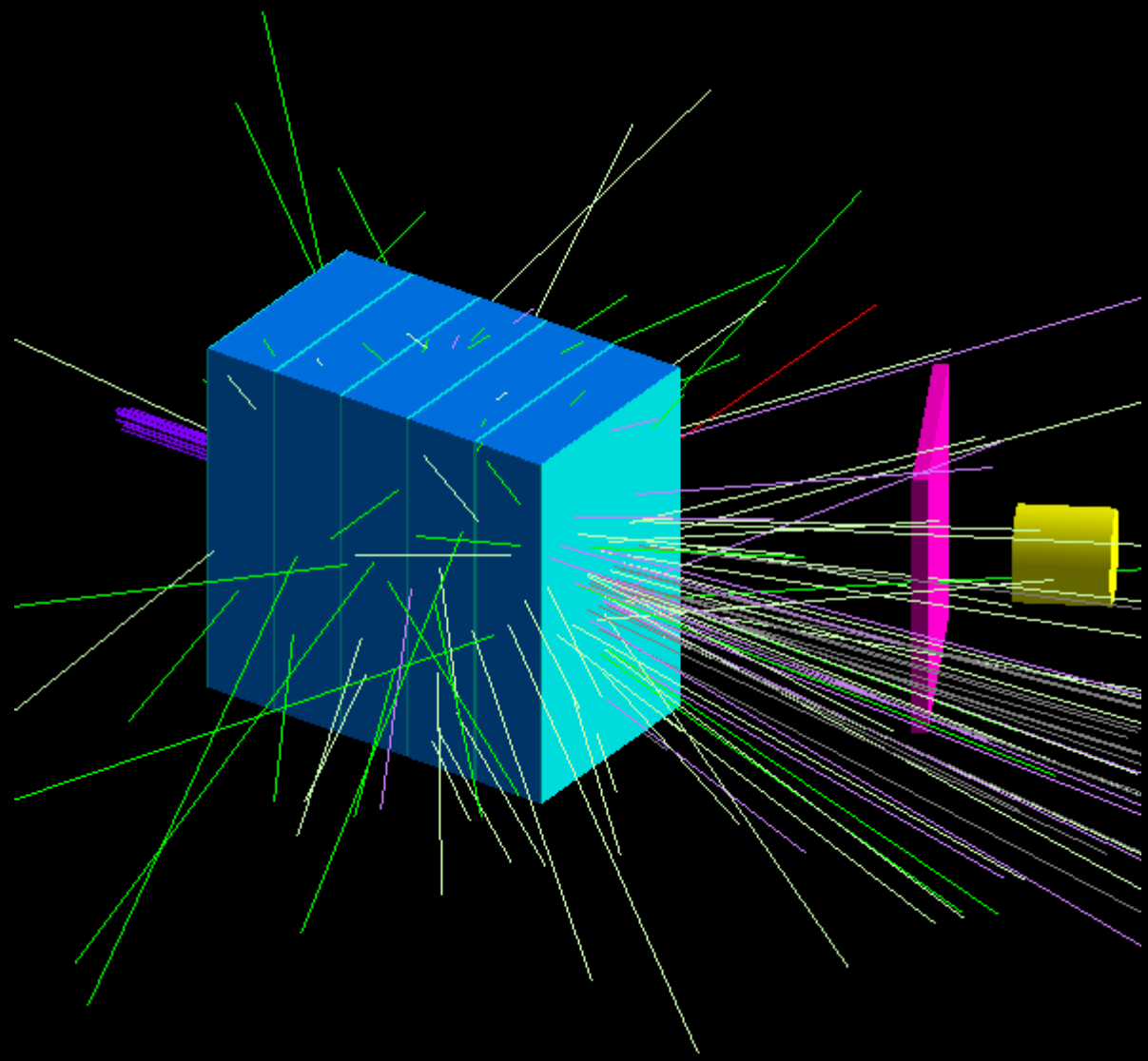
temps  
énergie

E-TOF Protons

Entries 10467

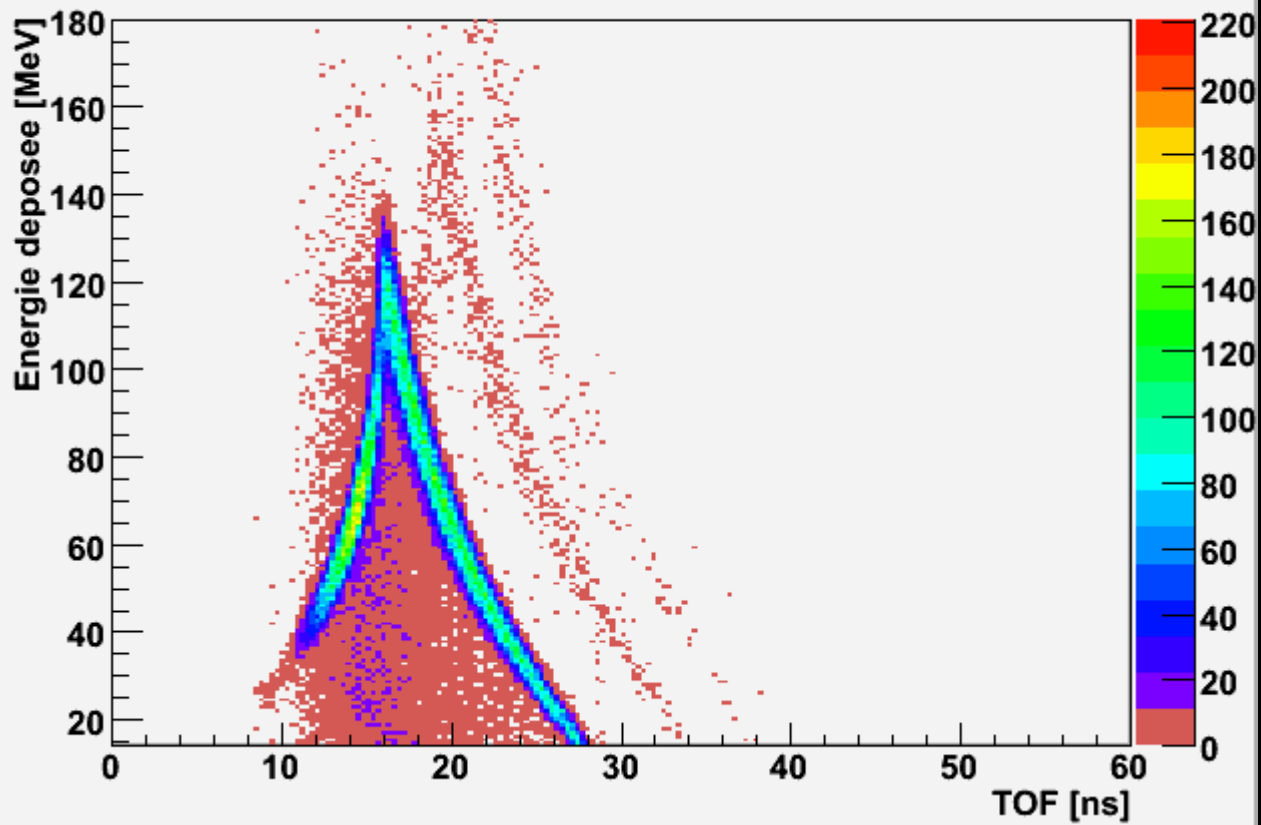






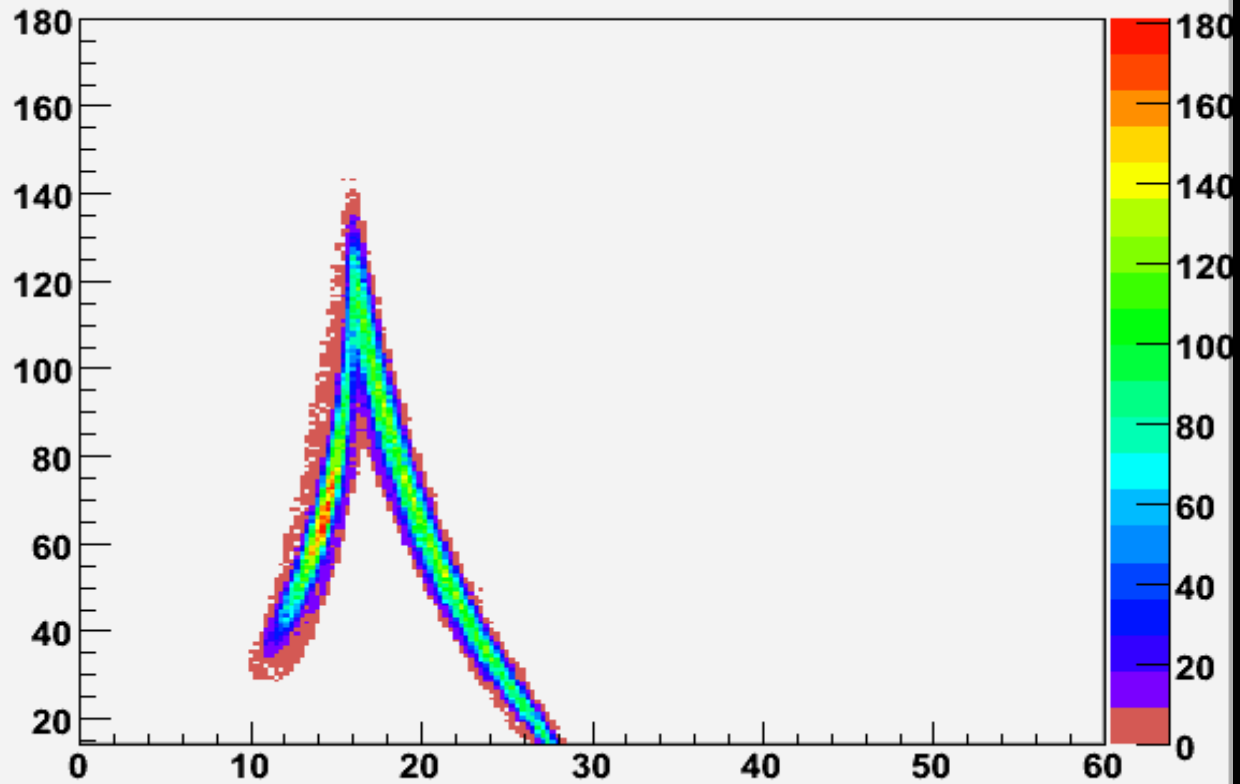
E\_TOF NaI

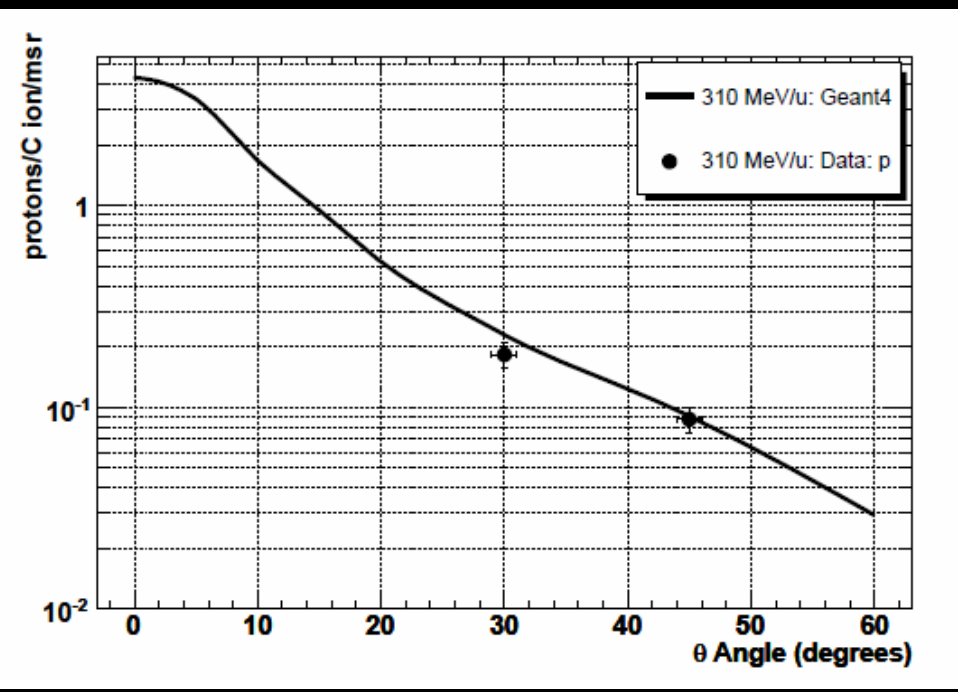
Entries 106561

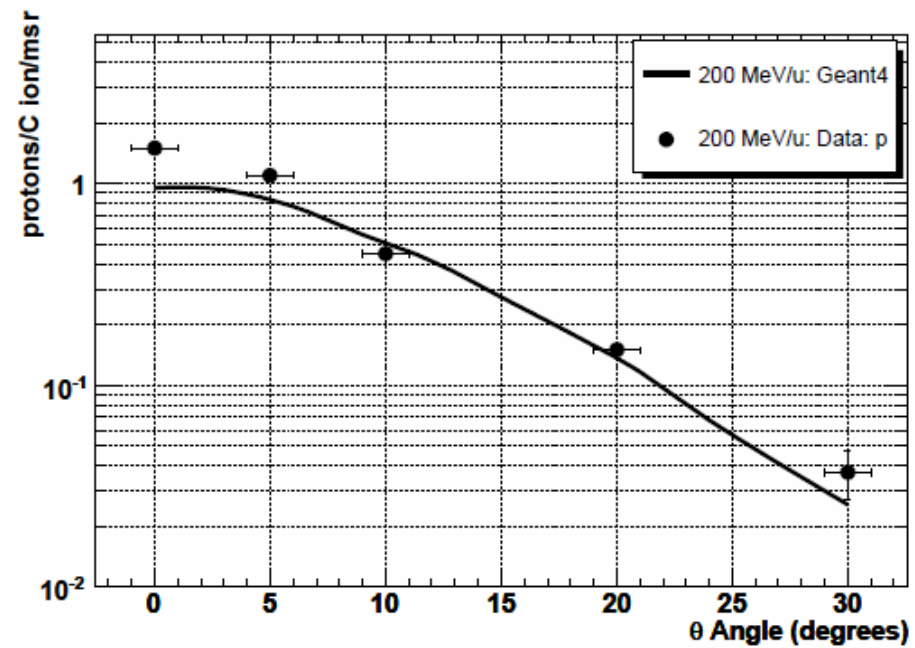
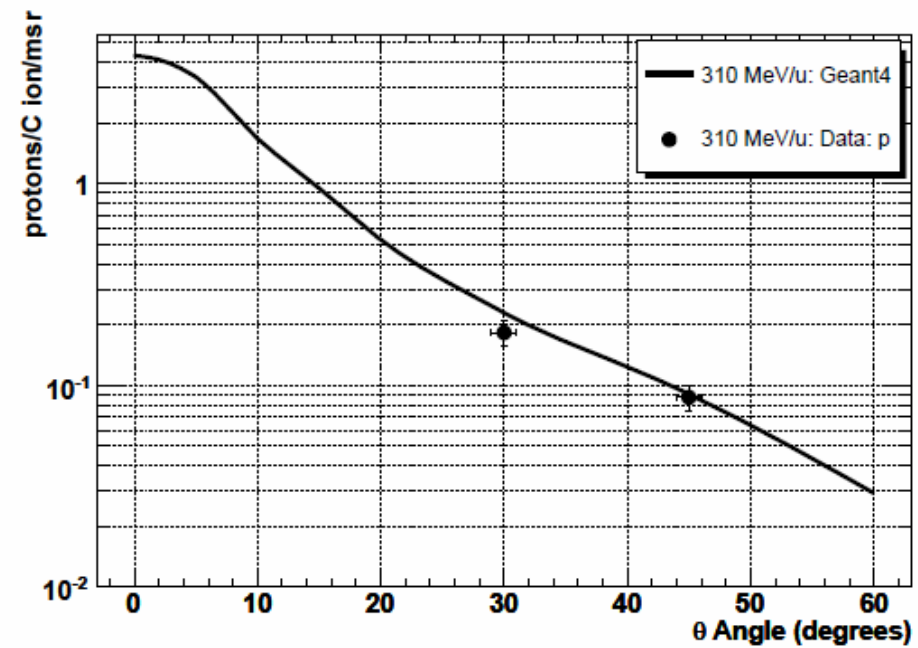


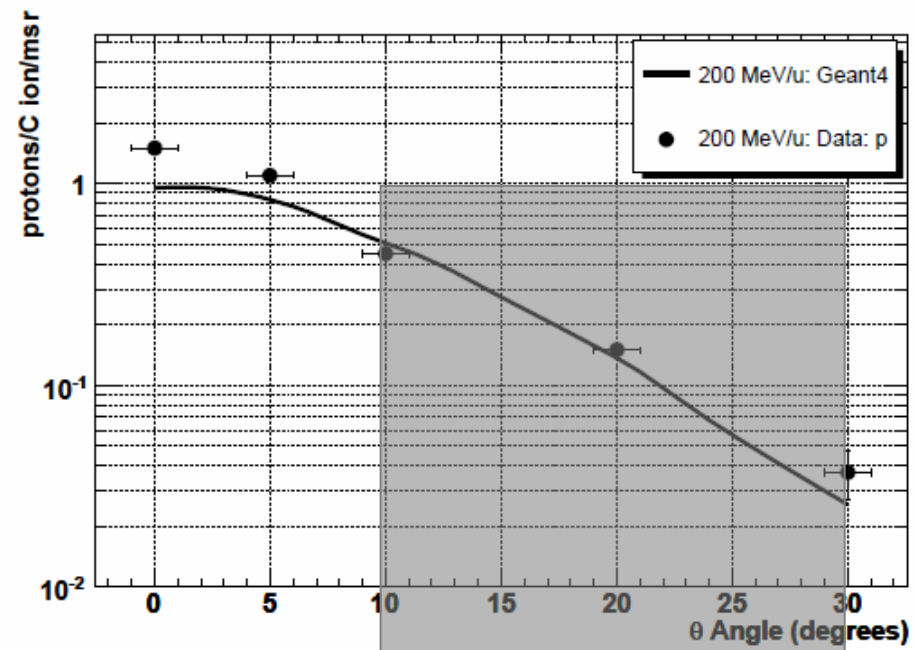
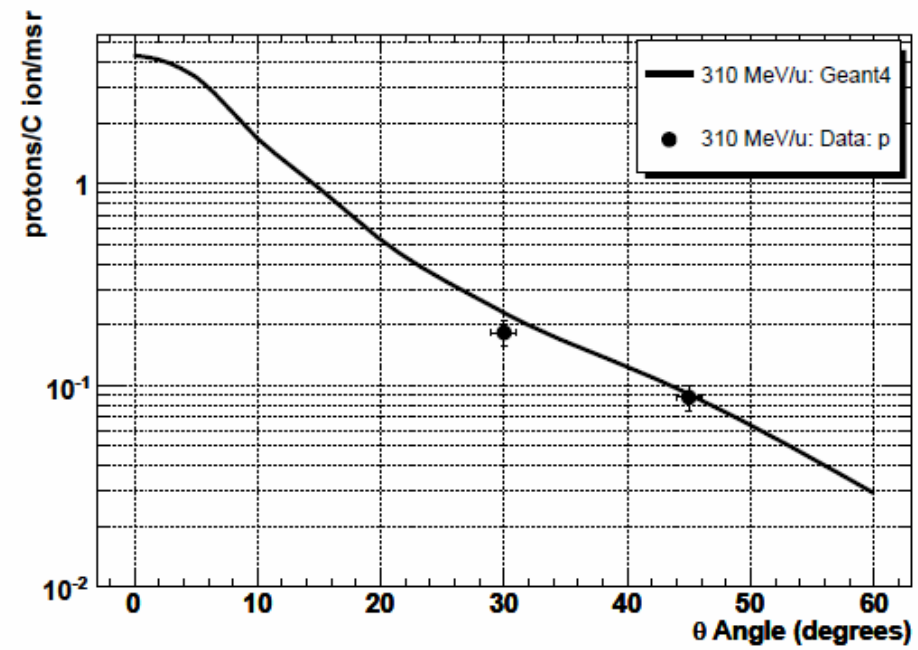
E-TOFprotons

Entries 90780









## Validation des simulations :

- Spectre énergétique
- Taux de production
- Dépendance en angle

## I) Introduction :

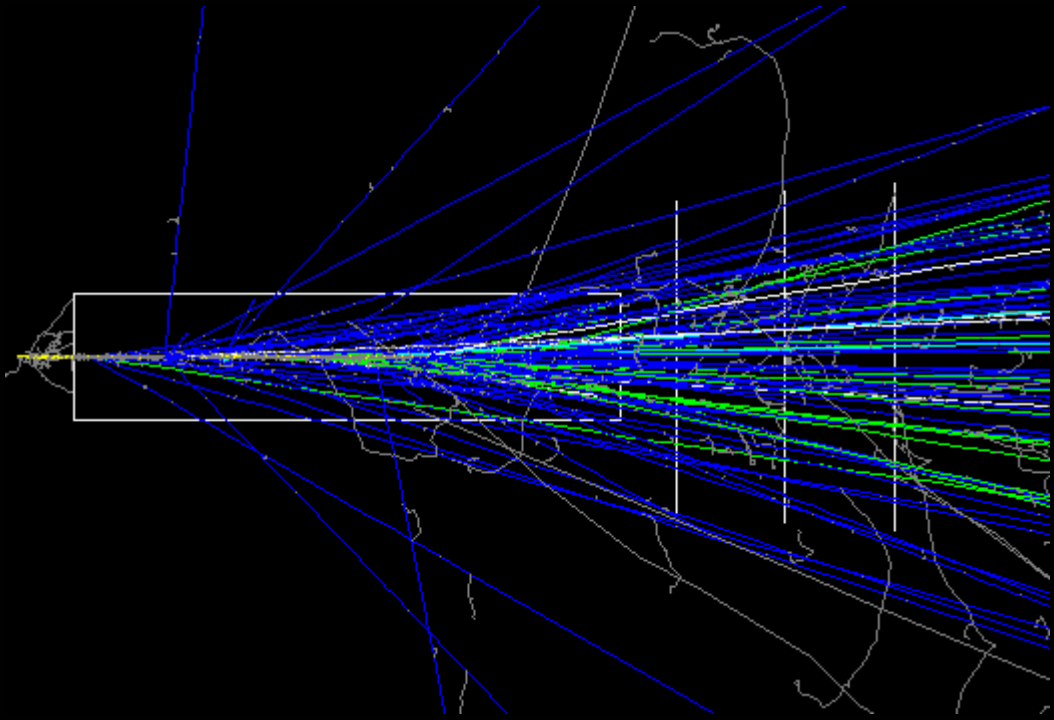
- L'hadronthérapie : Définition  
Propriétés balistiques, biologiques
- Principe du contrôle qualité par détection de fragments chargés

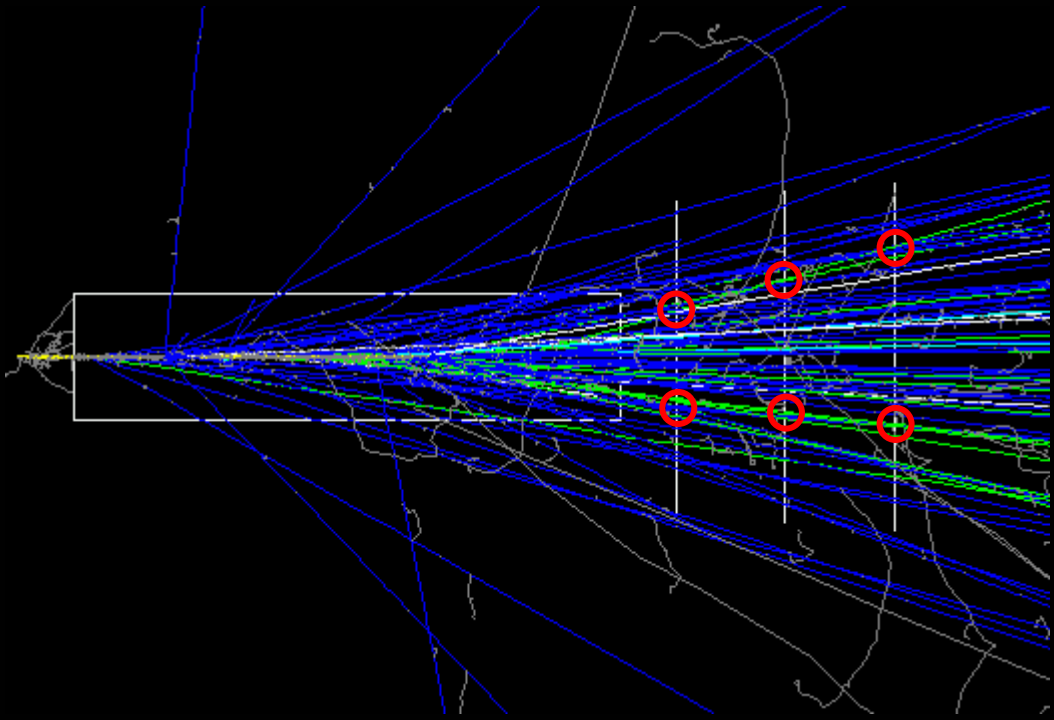
## II) Travail effectué :

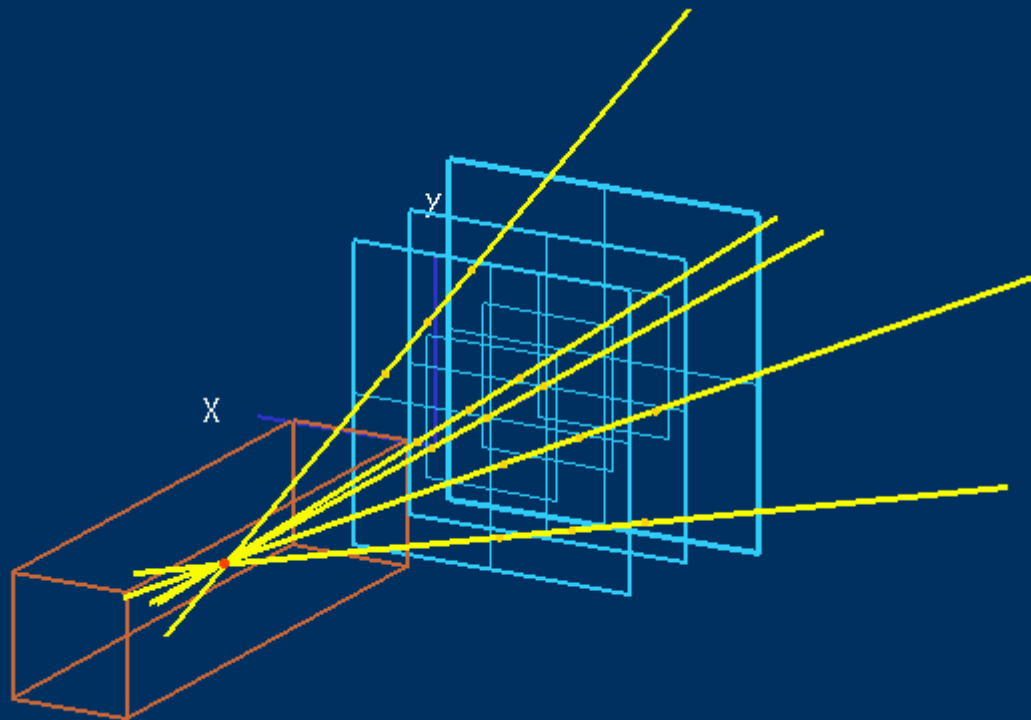
- Choix d'un outil de modélisation
- Validation des simulations
- Technique de reconstruction de vertex : 1ers résultats théoriques**

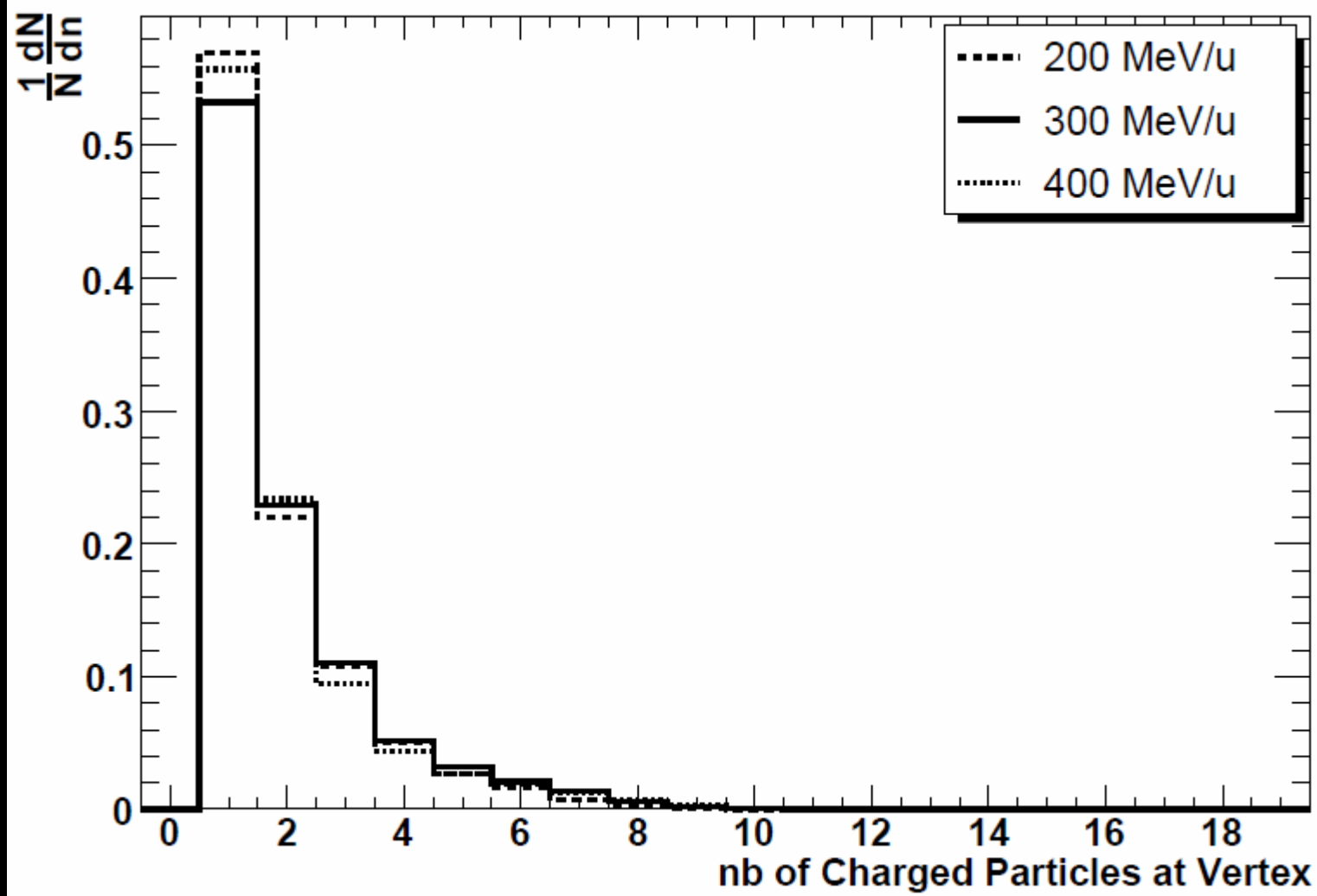
## III) Perspectives et conclusion

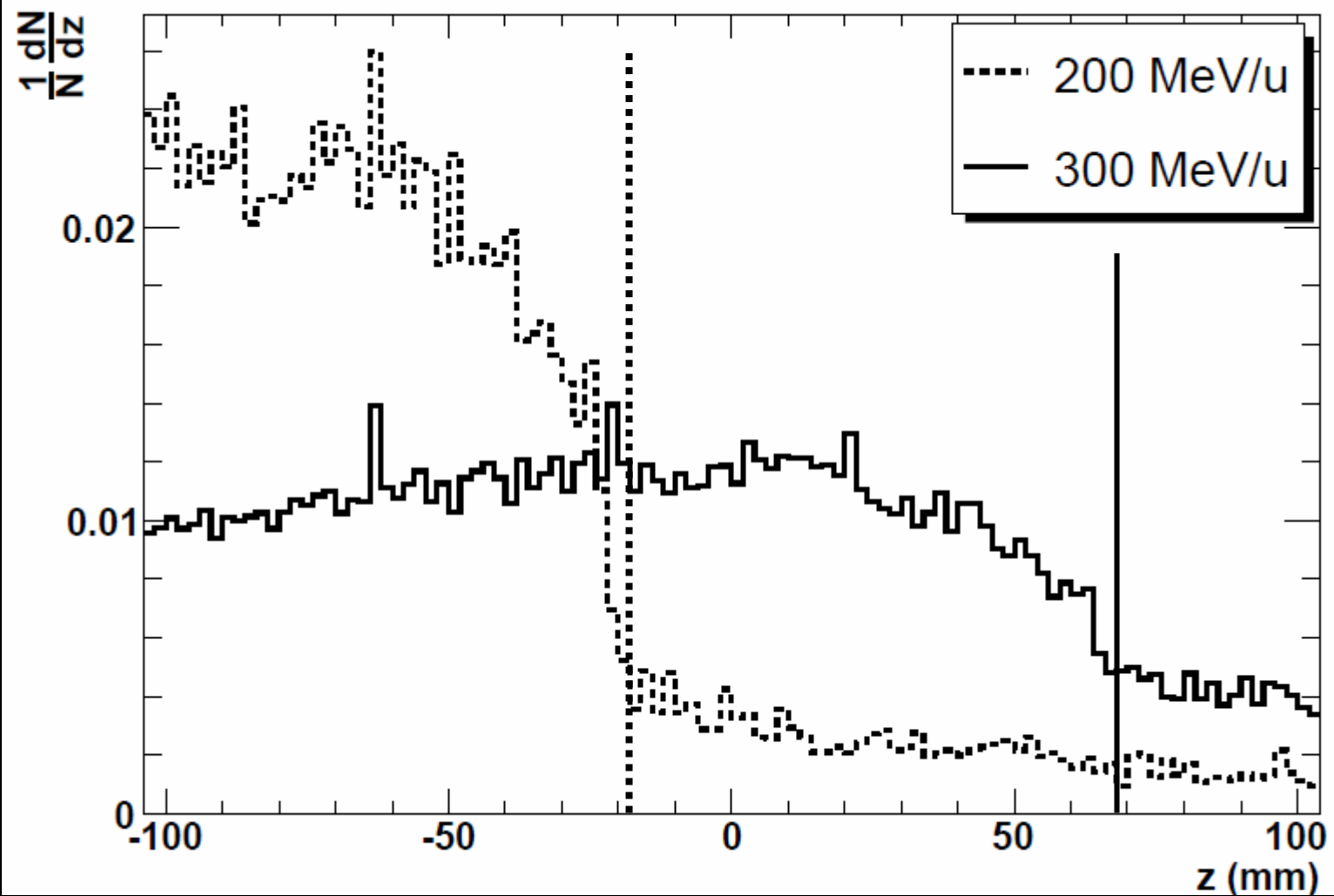


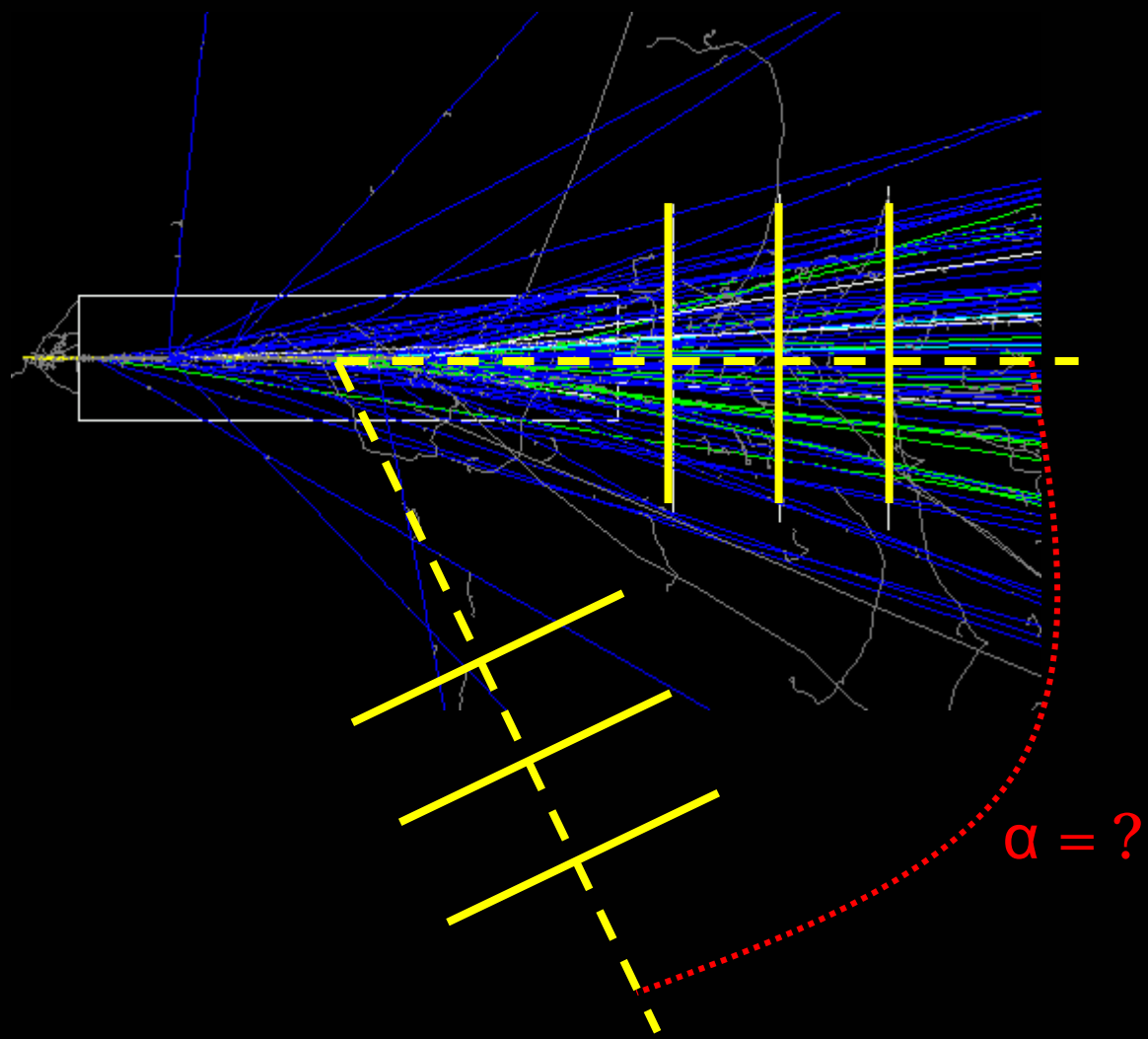


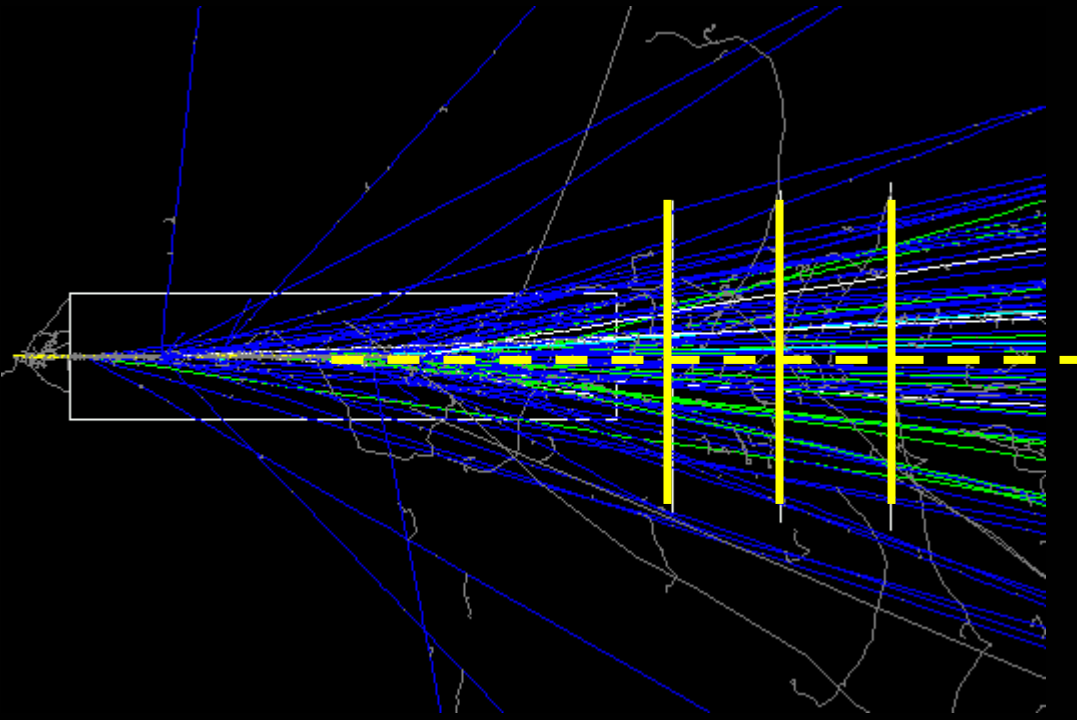






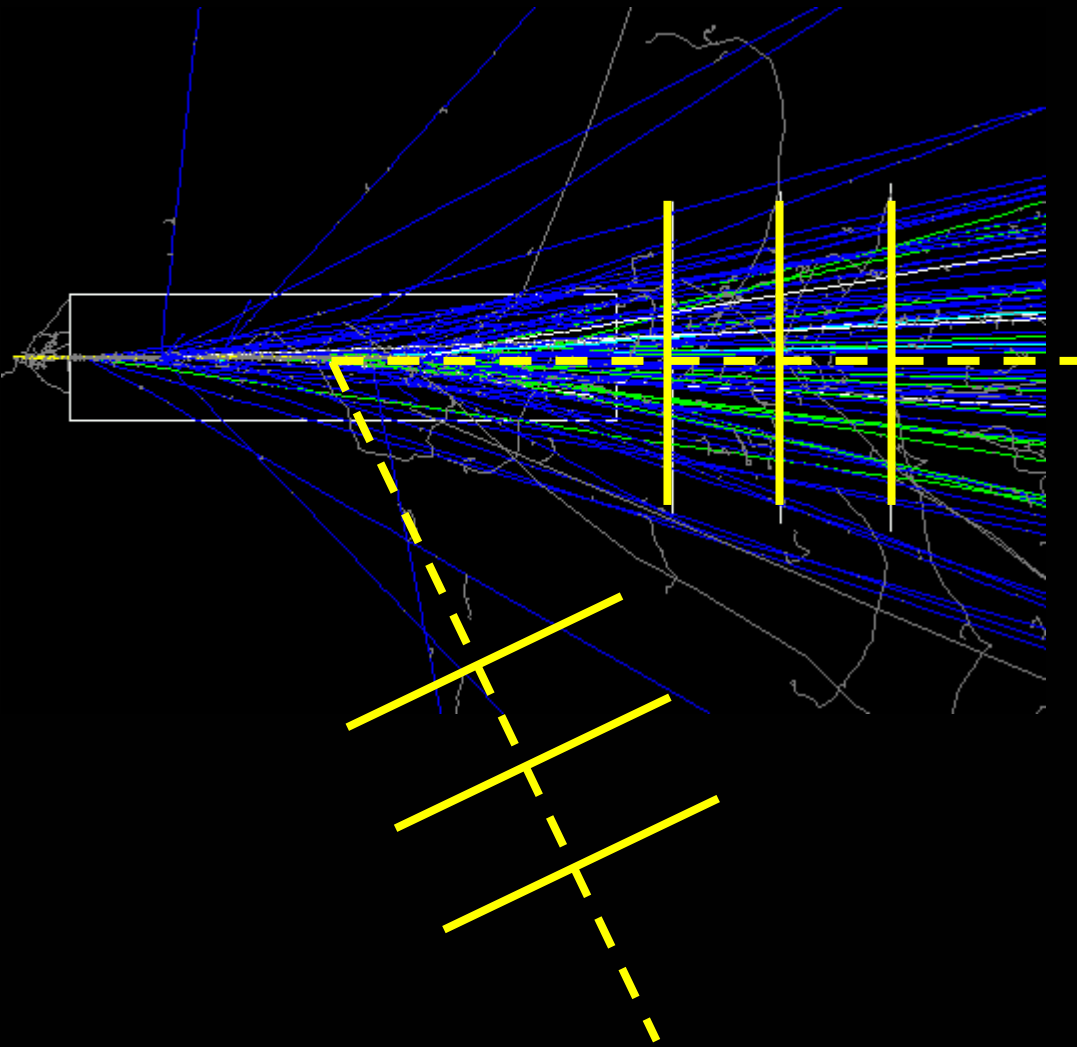






Angles faibles :

- Particules plus énergétiques donc moins de multiple scattering. Trajectoires plus rectilignes
- Statistique élevée
- Mais moins grande précision géométrique sur la reconstruction de la position du vertex

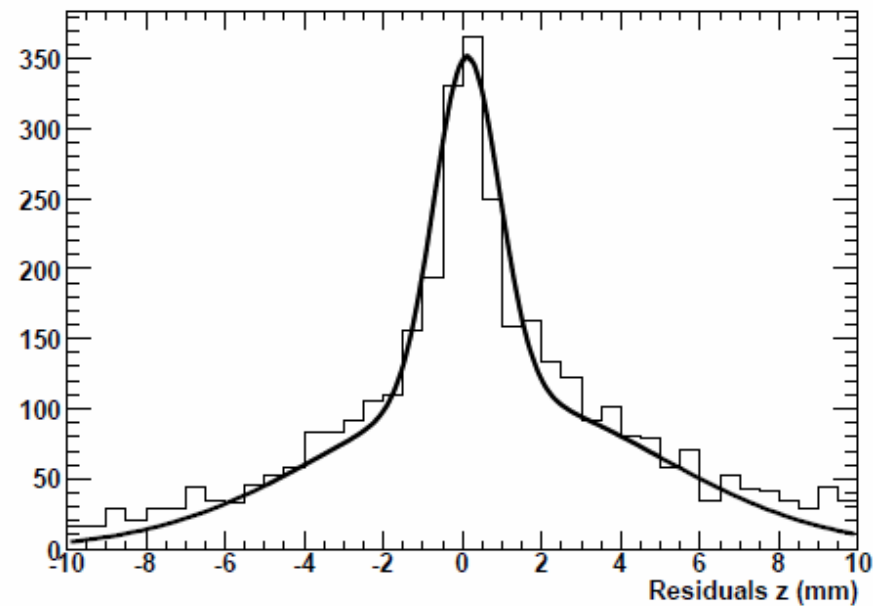
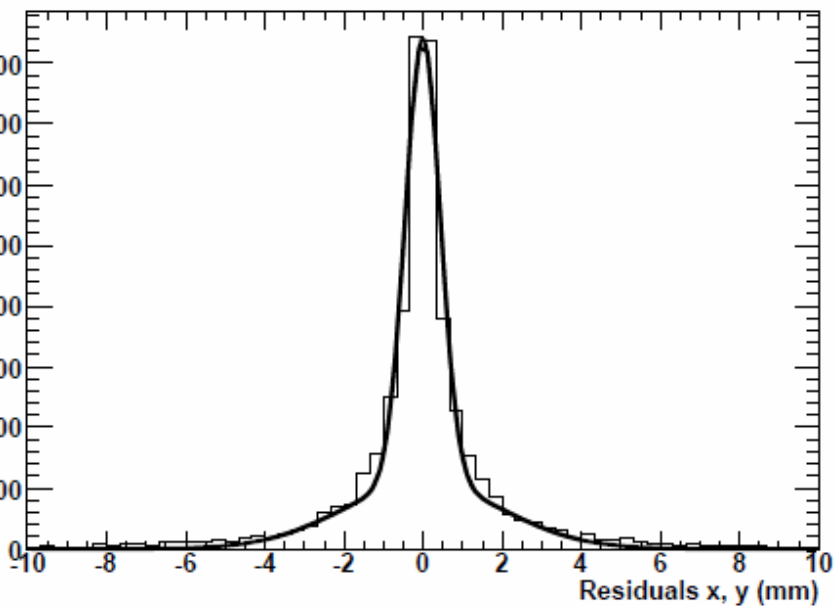


Angles élevés :

- Plus grande précision géométrique sur la reconstruction de la position du vertex
- Mais particules moins énergétiques. Plus de multiple scattering. Trajectoires moins rectilignes
- Statistique plus faible



Angle ( $^{\circ}$ )	Vertexes/ $^{12}\text{C}$ ion	$z$ Resolution $\sigma_{75}$ (mm)	$y$ Resolution $\sigma_{75}$ (mm)
0	0.094	$1.14 \pm 0.06$	$0.67 \pm 0.02$
20	0.045	$0.81 \pm 0.06$	$0.43 \pm 0.02$
45	0.002	$2.0 \pm 0.7$	$1.7 \pm 0.8$



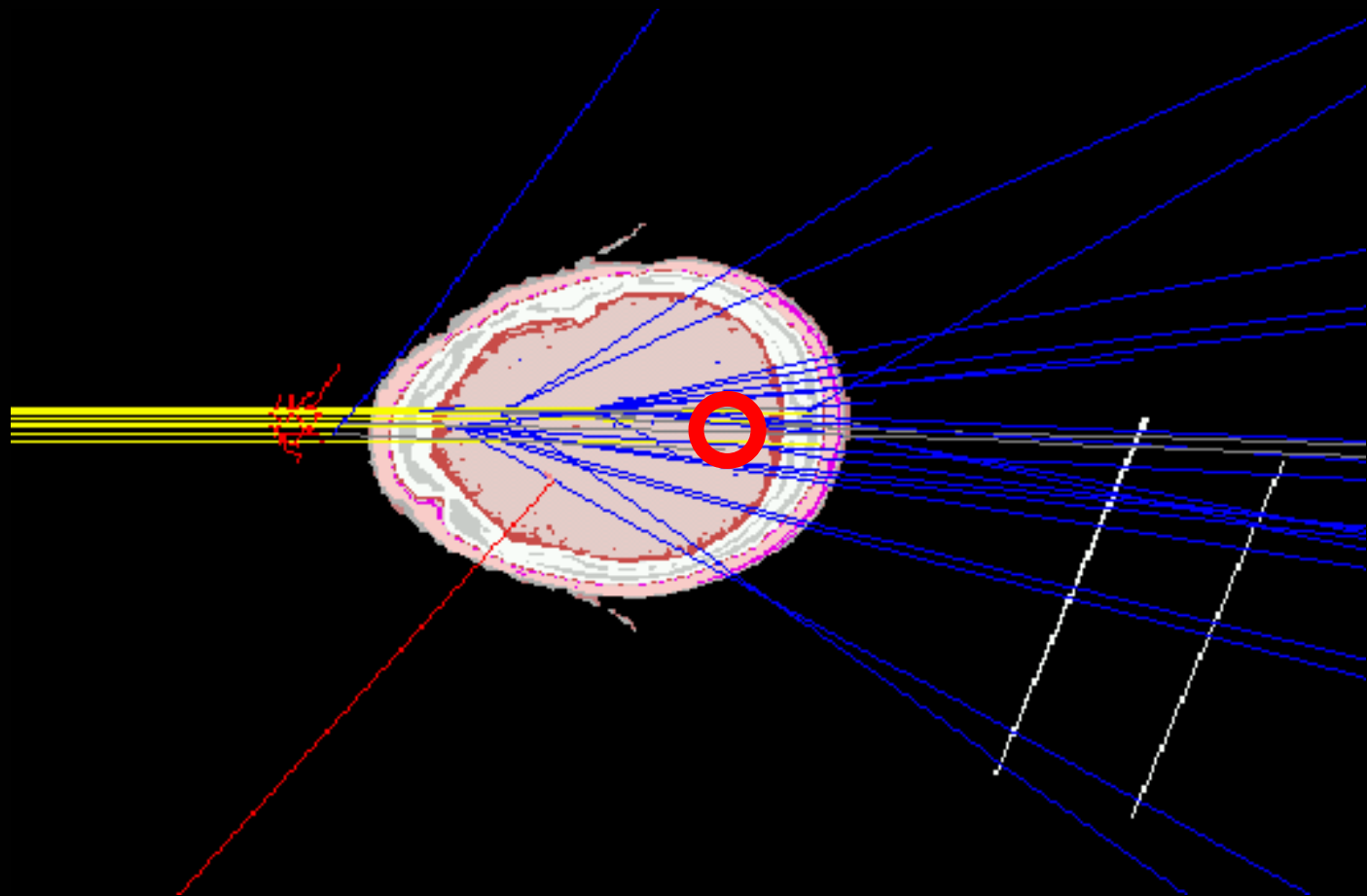
$^{12}\text{C}$  335 Mev/u

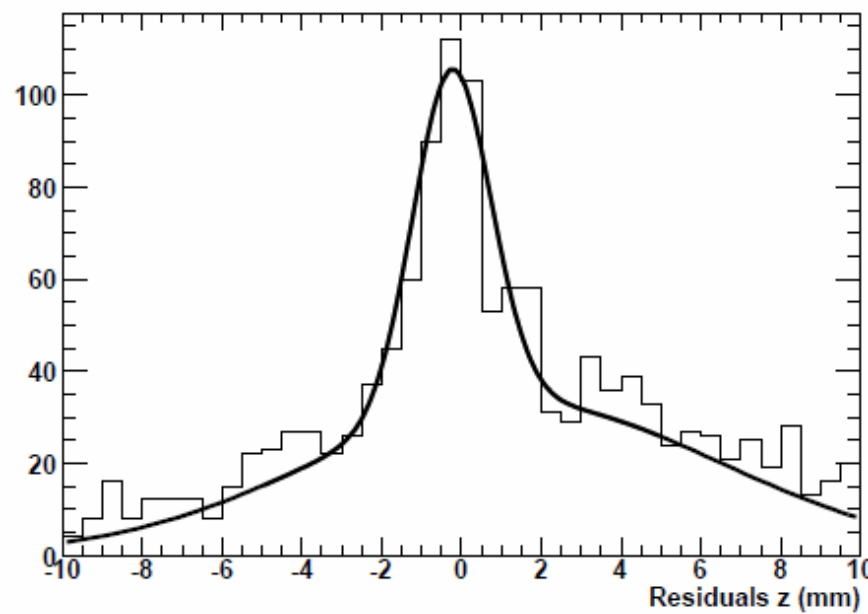
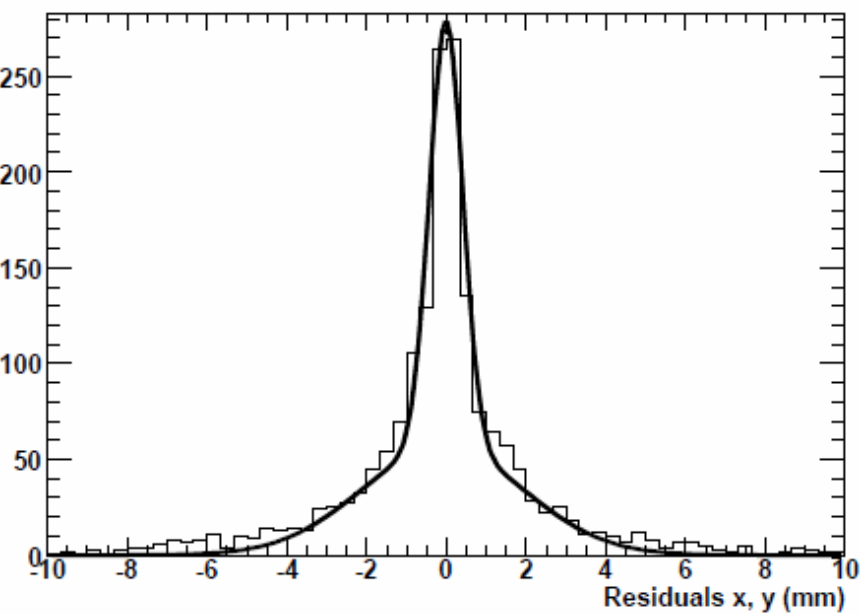
Cible : Bloc d'eau

Sigma de la gaussienne centrale :

X,Y : 0.44 mm

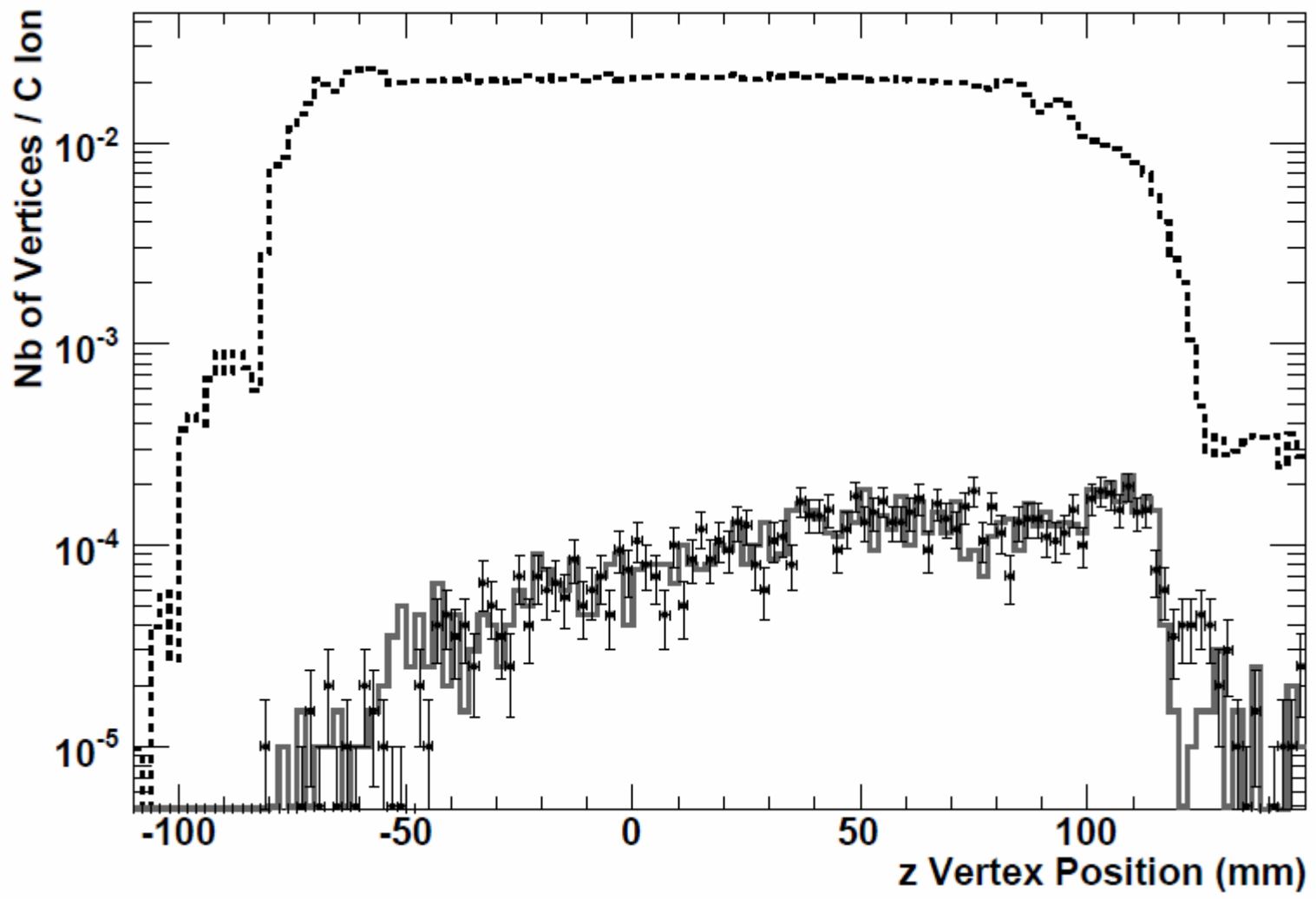
Z : 0.82 mm

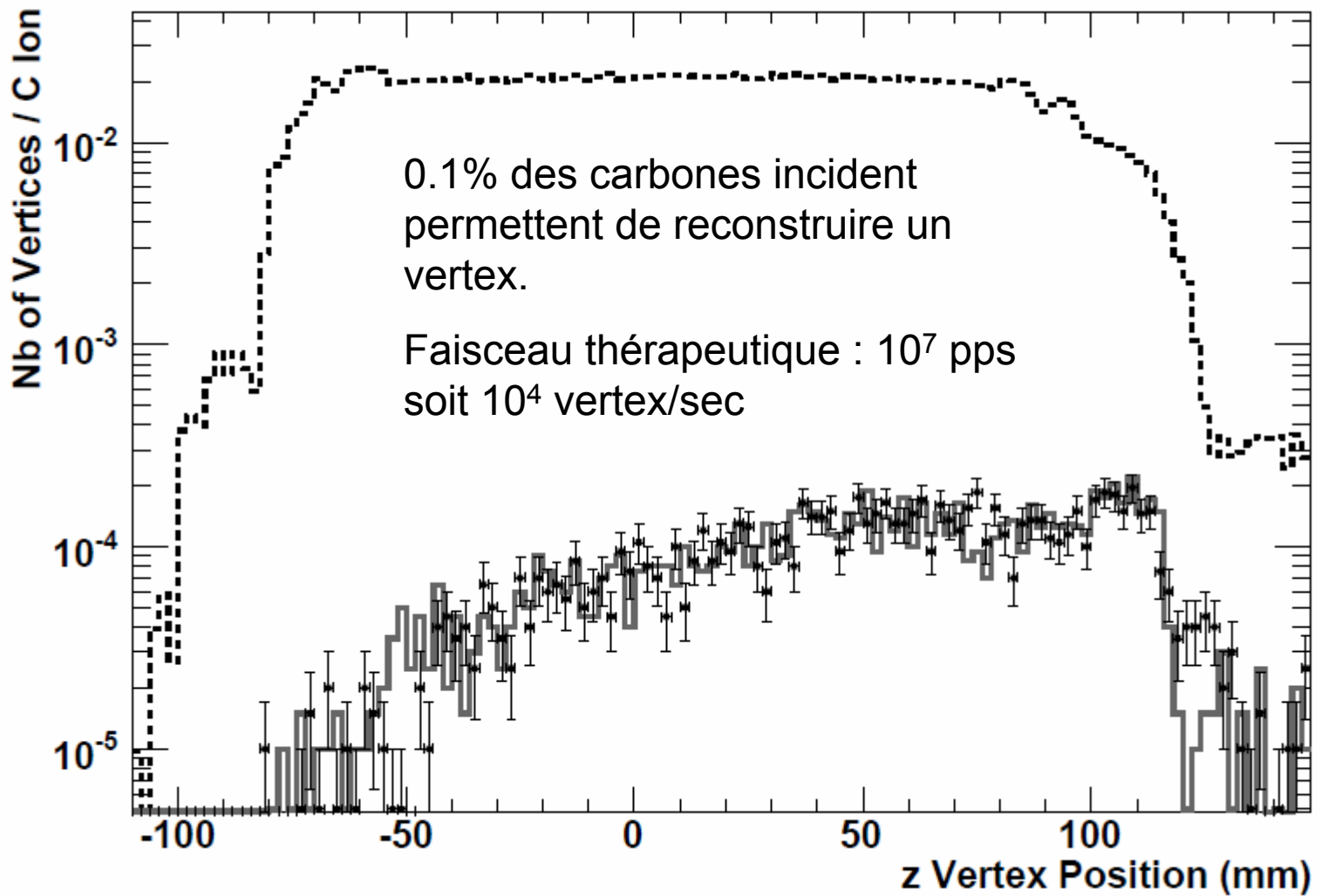




$^{12}\text{C}$  325 Mev/u  
Cible : crâne humain

Sigma de la gaussienne centrale :  
X,Y : 0.63 mm  
Z : 0.97 mm





## I) Introduction :

- L'hadronthérapie : Définition  
Propriétés balistiques, biologiques
- Principe du contrôle qualité par détection de fragments chargés

## II) Travail effectué :

- Choix d'un outil de modélisation
- Validation des simulations
- Technique de reconstruction de vertex : 1ers résultats théoriques

## III) Perspectives et conclusion

Les particules chargées produites par l'interaction d'ions carbonés avec la matière semble bien permettre de déterminer le profil des positions d'interaction du faisceau avec le patient.



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La technique d'Interaction Vertex Imaging (IVI) qui consiste à extrapoler la trajectoire des particules secondaires pour retrouver leur point d'émission permet de le faire avec une résolution de l'ordre du millimètre, ce qui est inférieur aux marges de sécurité couramment utilisées dans ce domaine médical (PTV).

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Le modèle physique développé lors de cette étude a été validé mais continue d'être modifié afin d'améliorer sa valeur prédictive.

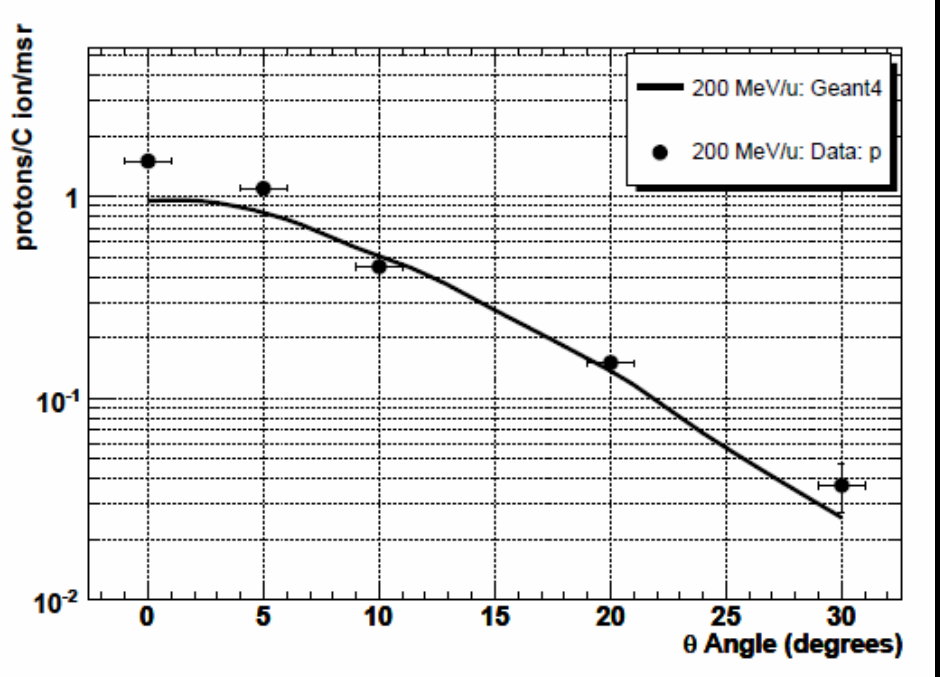
Les particules chargées produites par l'interaction d'ions carbonés avec la matière semble bien **permettre de déterminer le profil** des positions d'interaction du faisceau avec le patient.

La technique d'Interaction Vertex Imaging (IVI) qui consiste à extrapoler la trajectoire des particules secondaires pour retrouver leur point d'émission permet de le faire avec une **résolution de l'ordre du millimètre**, ce qui est inférieur aux marges de sécurité couramment utilisées dans ce domaine médical (PTV).

Le modèle physique développé lors de cette étude a été validé mais continue d'être modifié afin d'améliorer sa valeur prédictive.

Des campagnes de mesures utilisant la technique de l'IVI doivent maintenant être effectuées, afin de comparer simulation et données expérimentales.





EnergieTAC

Entries 10424

