

Feixes de Partículas para terapia

Luis Peralta

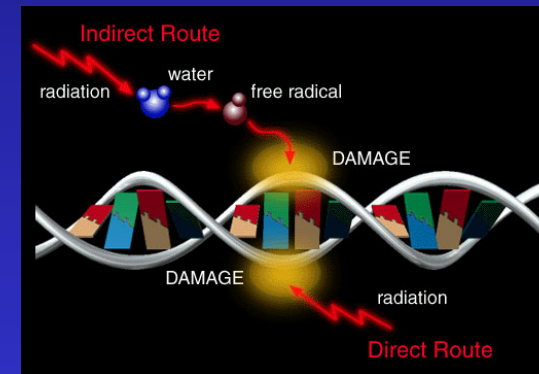
FCUL e LIP

Terapias para o cancro

30% da população irá provavelmente numa fase da sua vida estar submetida a tratamento a um tipo de cancro

Cirurgia: Remoção do tecido cancerígeno

Radioterapia: Destruição localizada do tumor

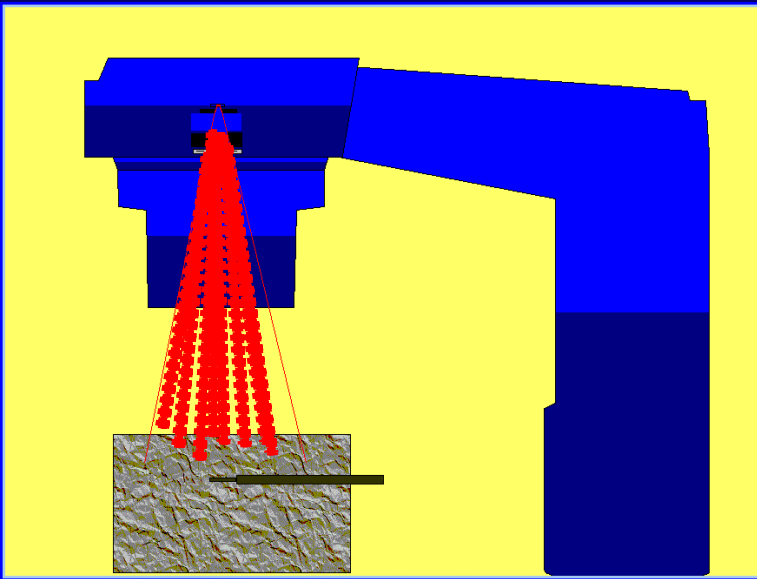


Quimioterapia: Terapia sistémica - eficaz em metástases

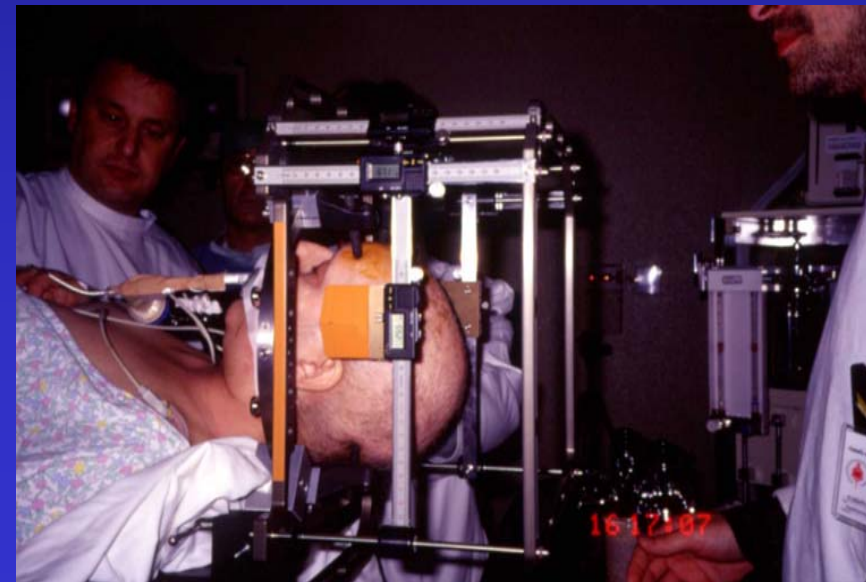
Radioterapia

Feixes Electrões

Feixes Fotões



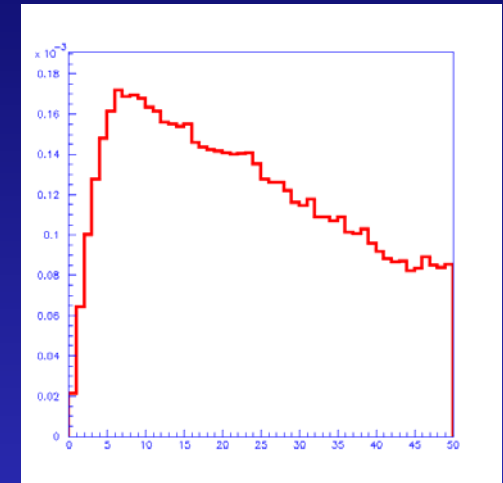
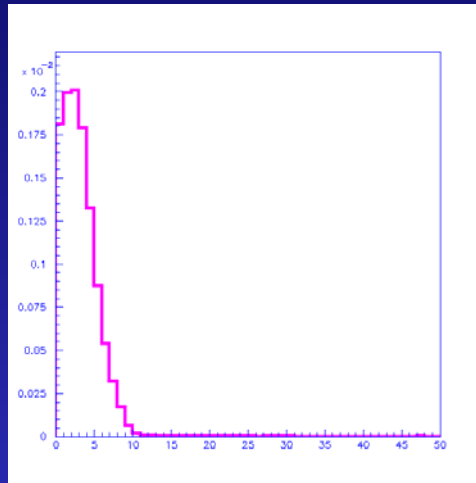
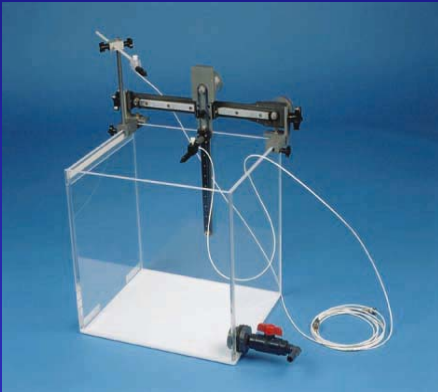
Radiocirurgia



Interacção de fótons e electrões com água

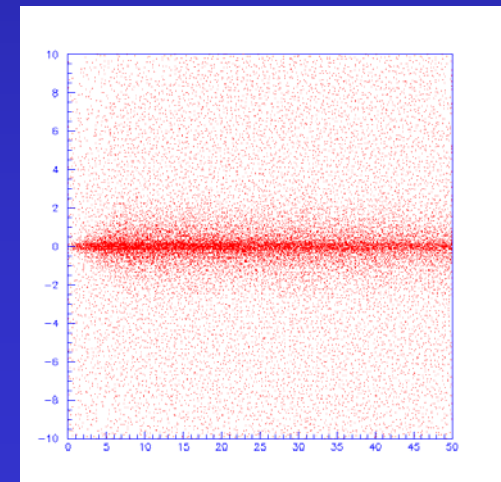
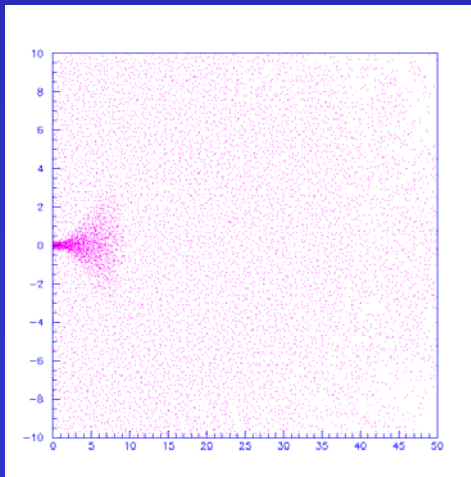
Electrões

Fótons



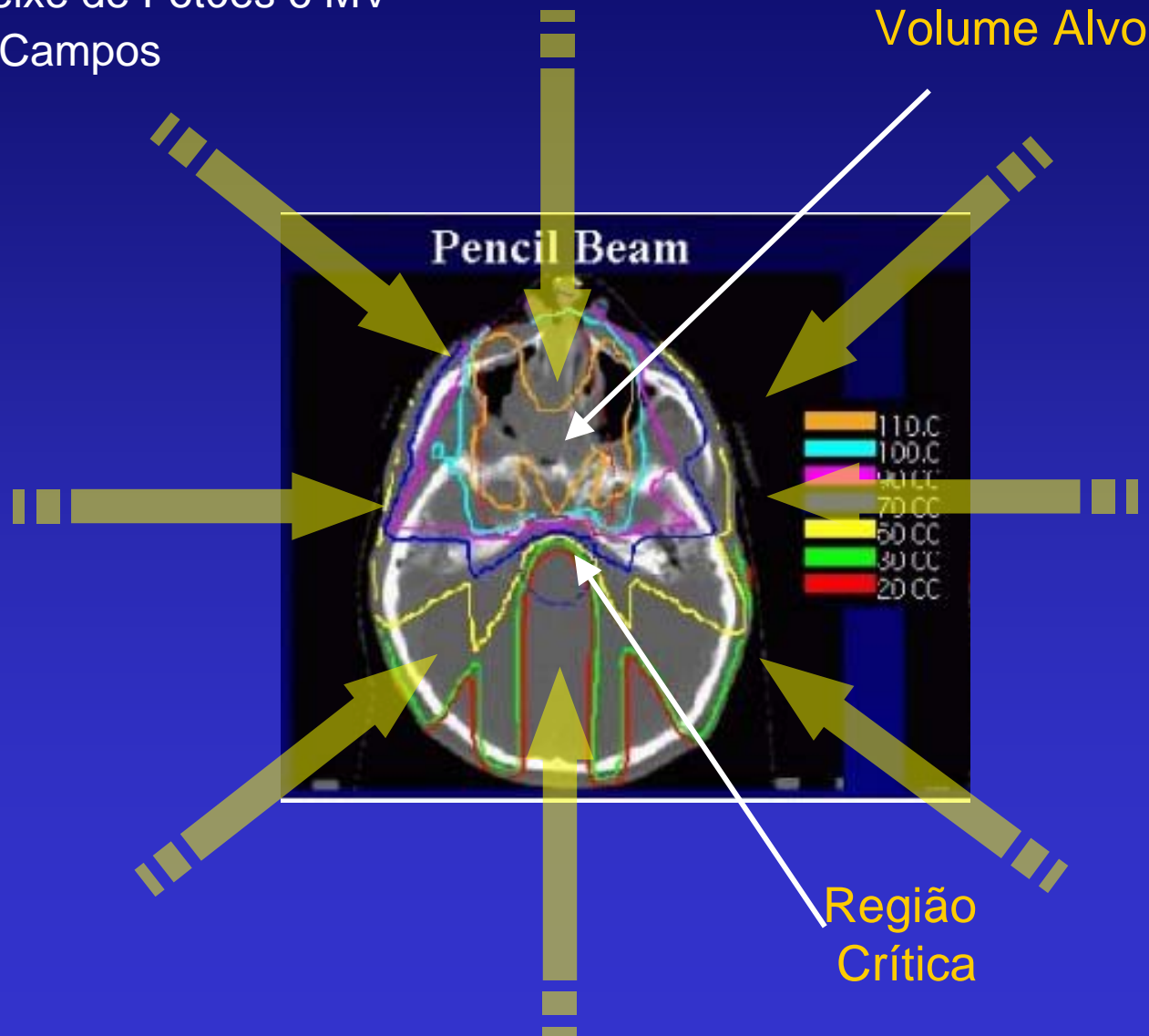
Profundidade (cm) →

$$Dose = \frac{Energia}{massa} \quad (Gy)$$



Terapia com várias incidências

- ❖ Feixe de Fótons 6 MV
- ❖ 8 Campos



Centro Regional de Oncologia de Coimbra

IPO-FG

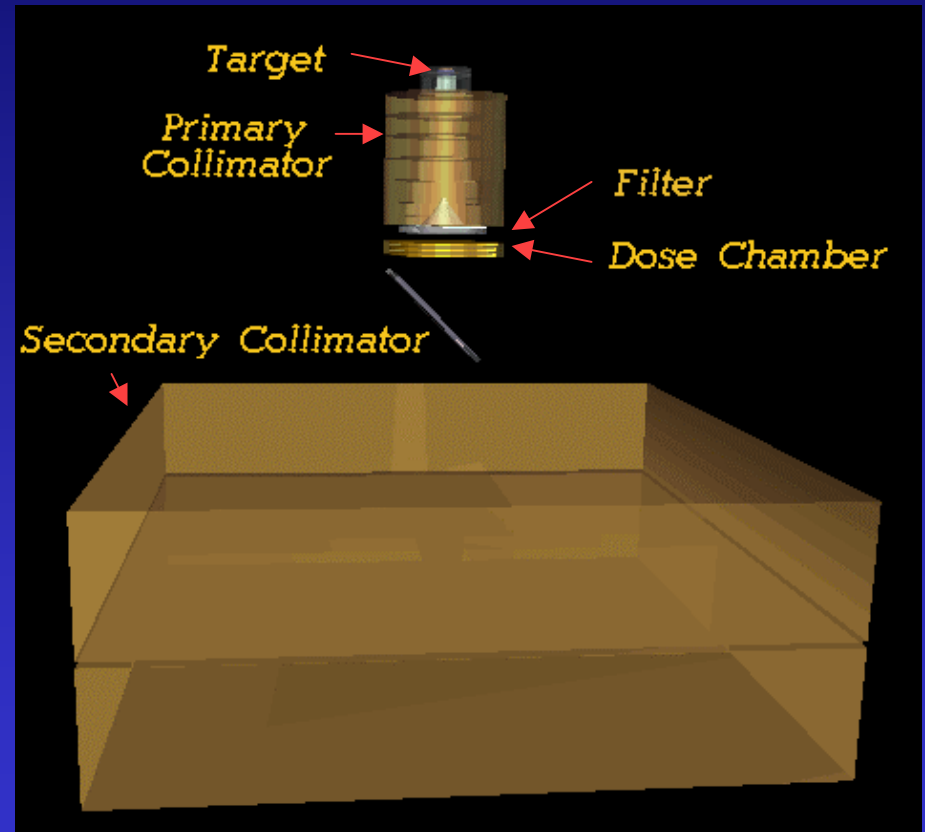


Hospital Universitario de Sevilla



Simulação do Acelerador Linear

Feixes 6 MV Siemens KD2



Descrição de feixes de fótons
em espaços de fases

Cálculo de Dose em Radioterapia

PEREGRINE

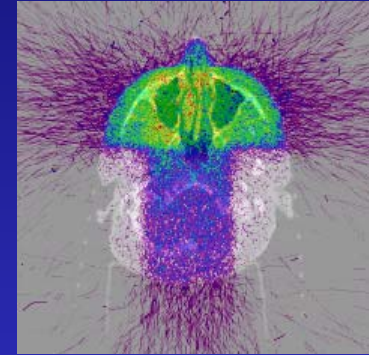
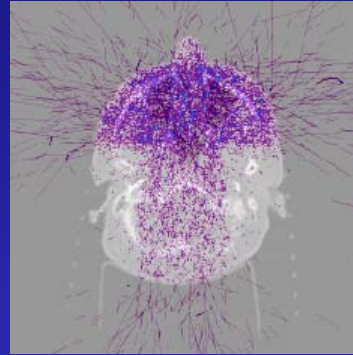
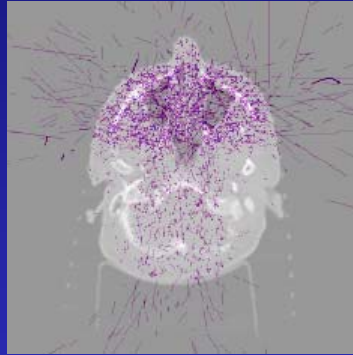
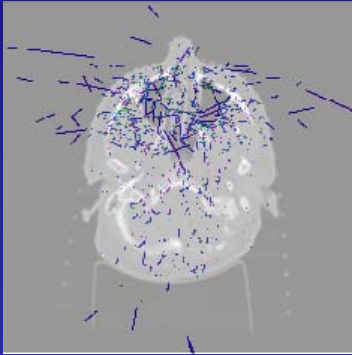
paranasal sinuses

1.1×10^4

6.6×10^4

1.7×10^5

1.2×10^6

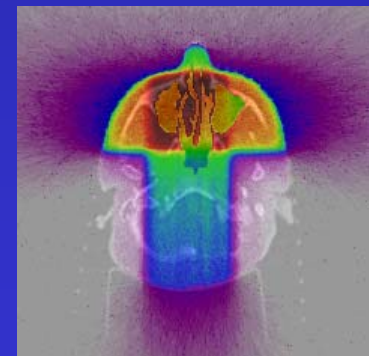
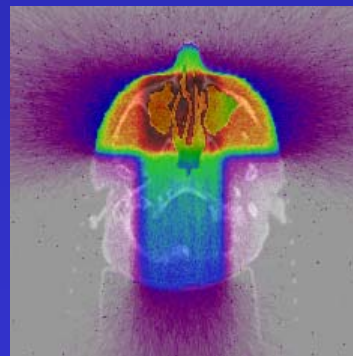
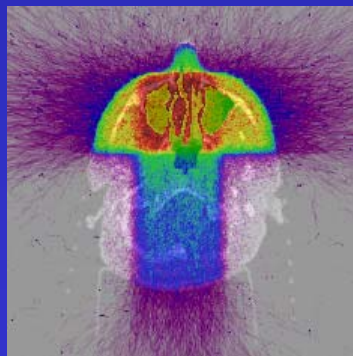
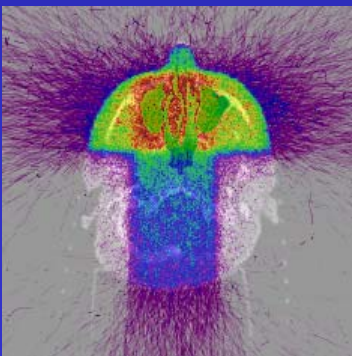


3.2×10^6

8.2×10^6

3.8×10^7

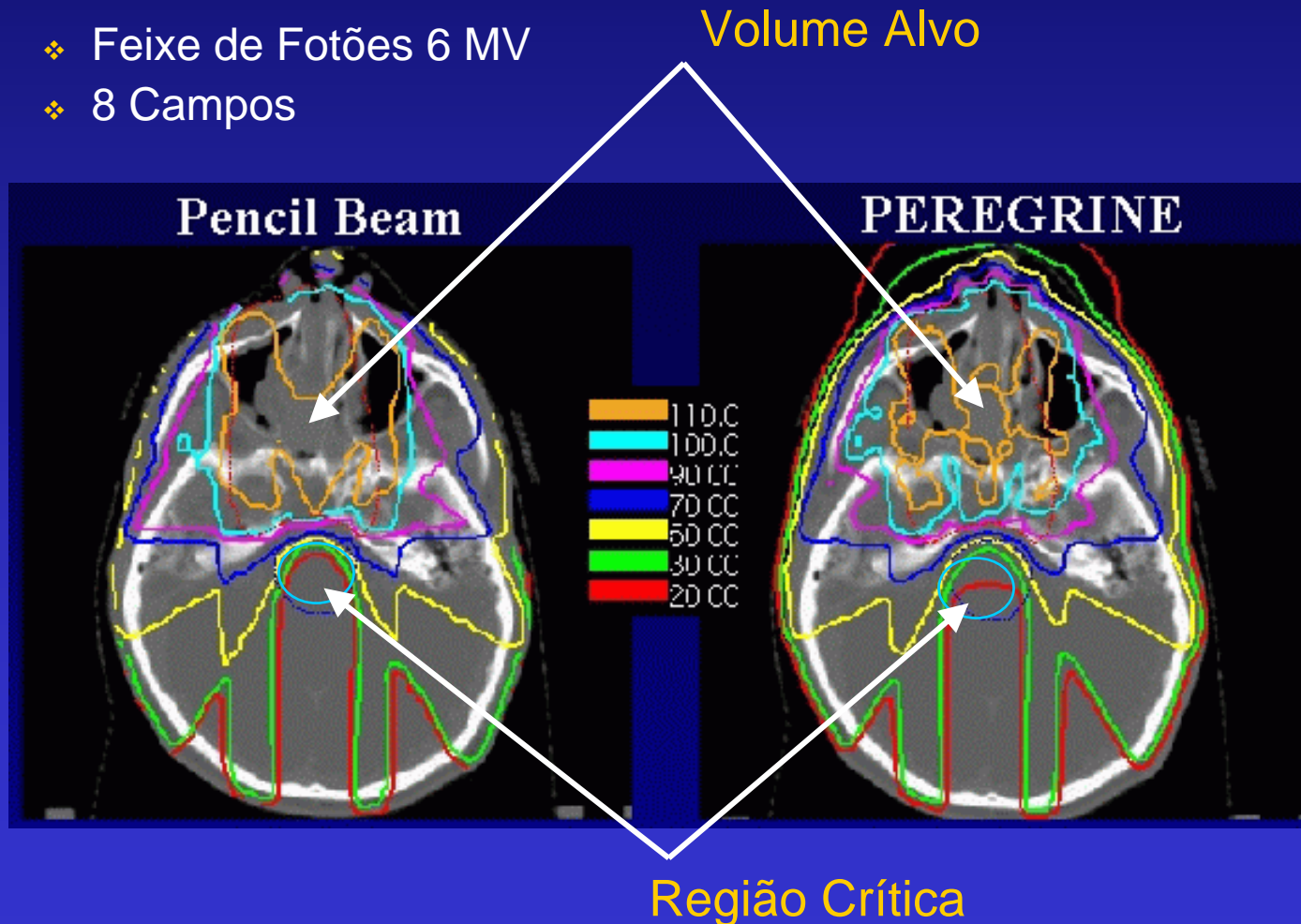
6.8×10^7



Cálculo de Dose em Radioterapia

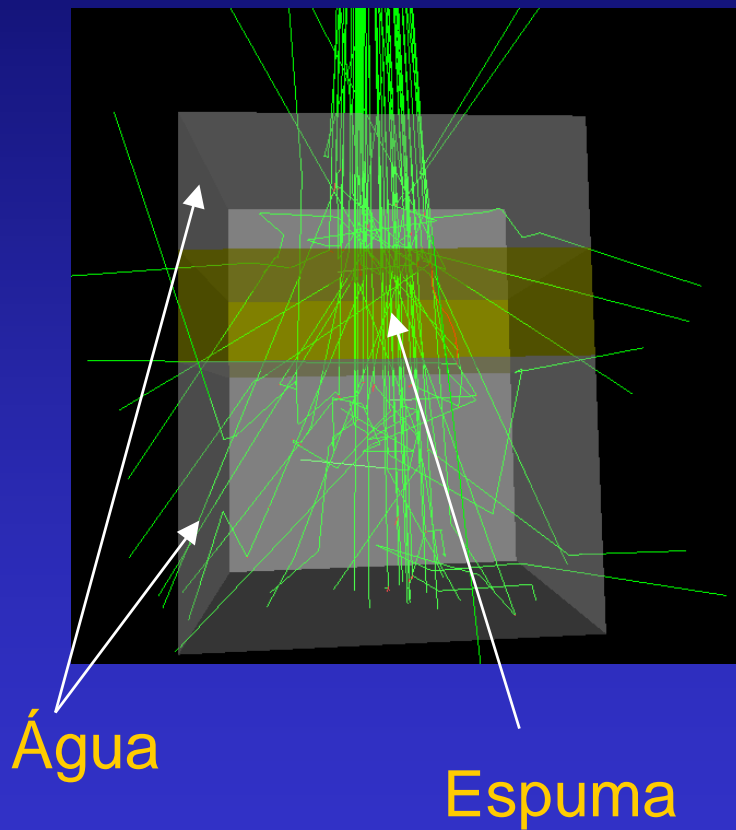
PEREGRINE

- ❖ Feixe de Fótons 6 MV
- ❖ 8 Campos

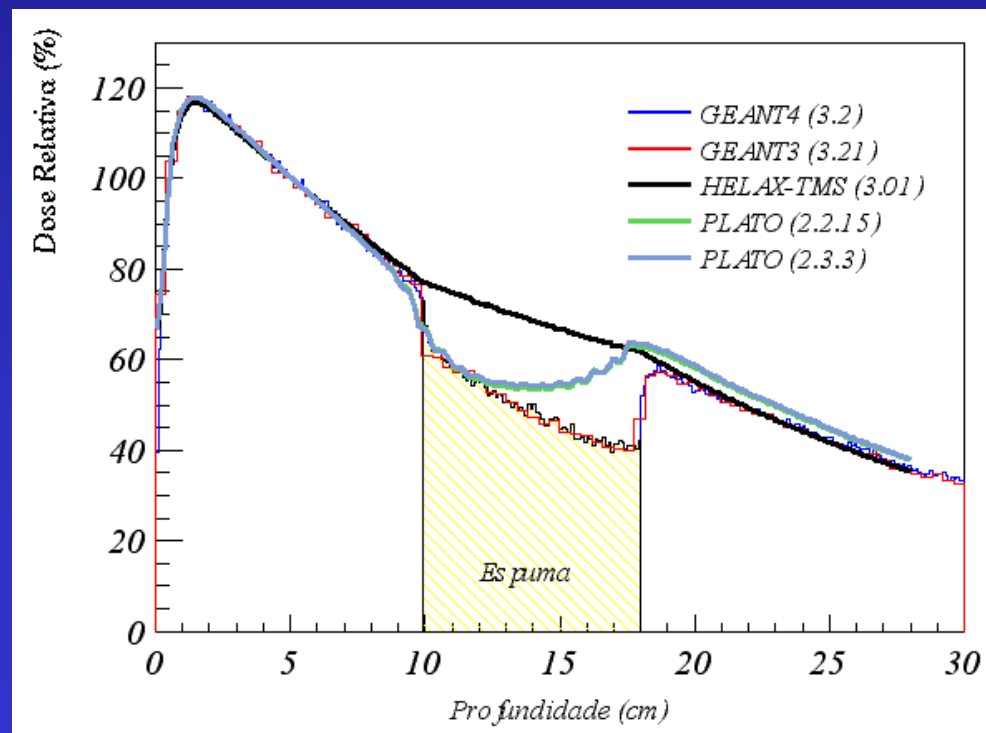


Sistemas comerciais de planeamento vs Monte Carlo

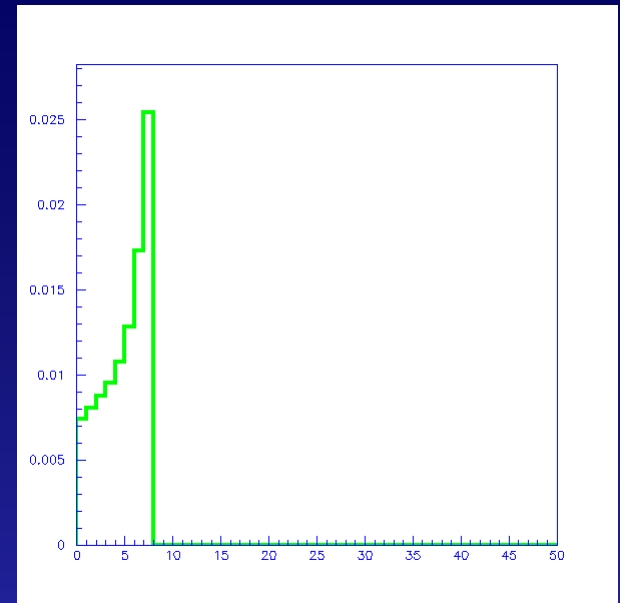
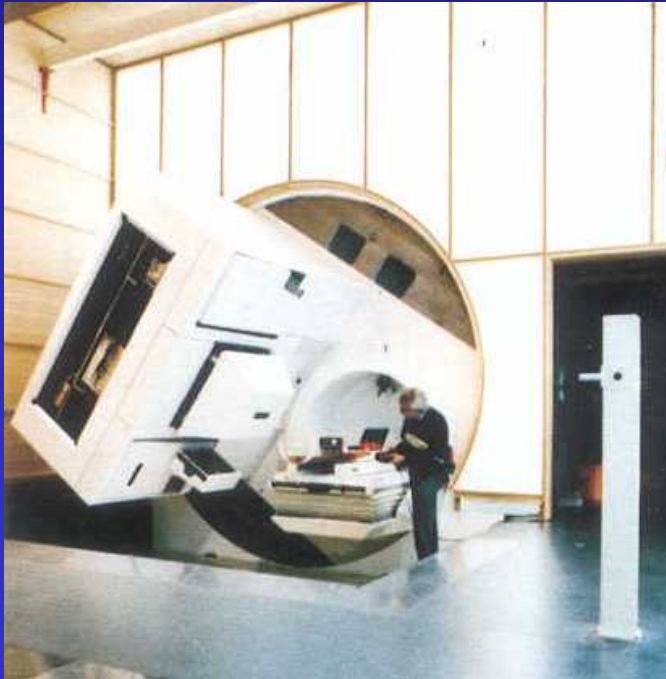
- ❖ Comparação GEANT4/ GEANT3 em *fantomas* heterogêneos
- ❖ Comparação com **PLATO** e **HELAX-TMS**



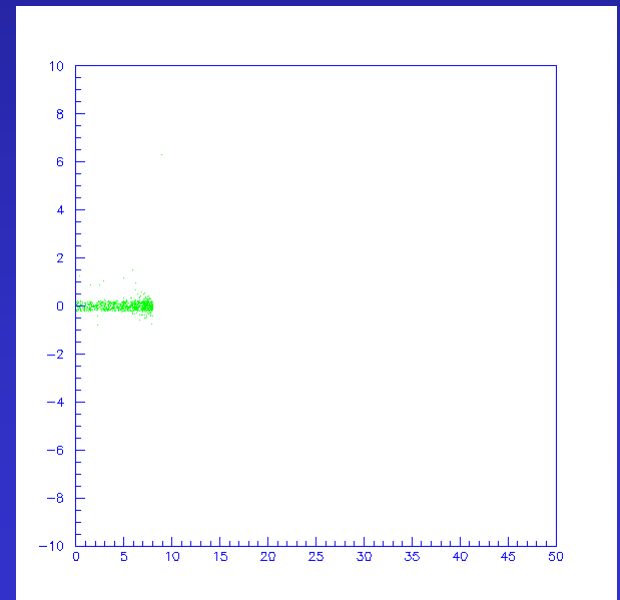
Campo 10 x 10 cm²



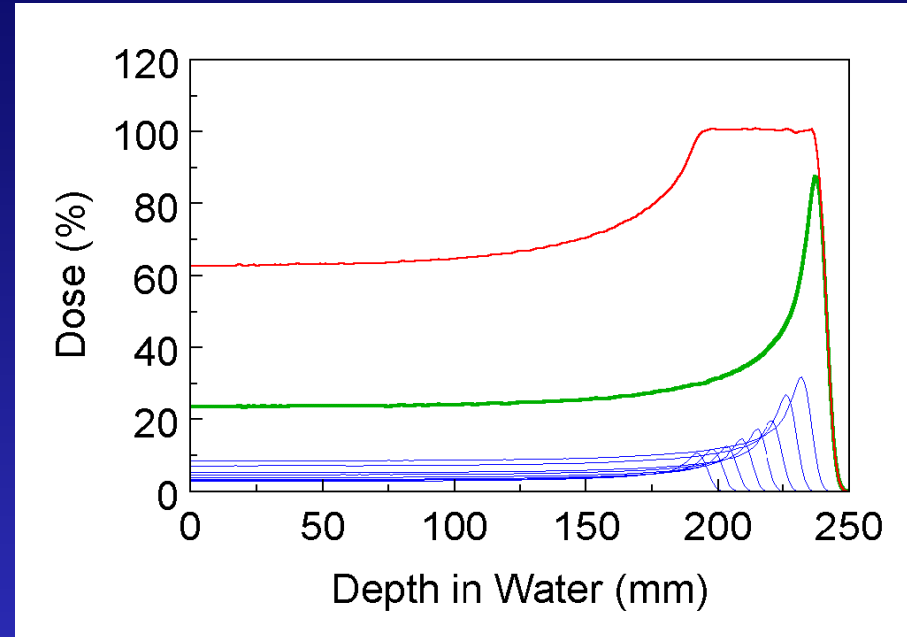
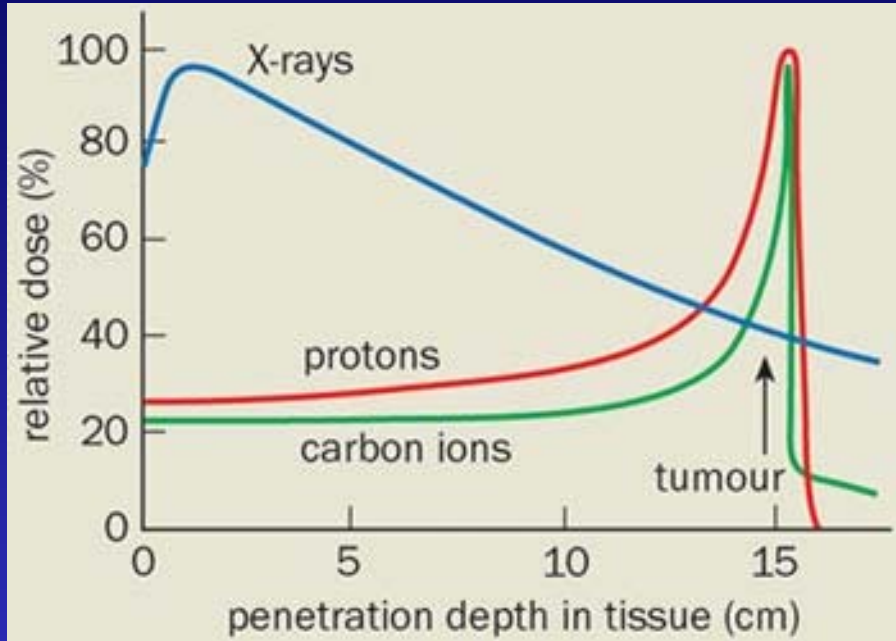
Interação de prótons com água



Profundidade (cm) →



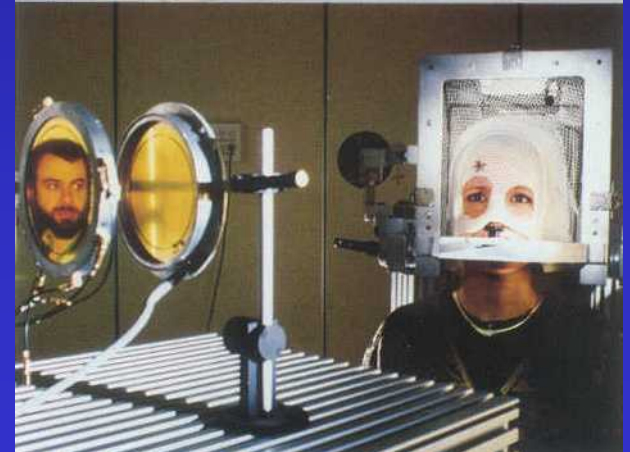
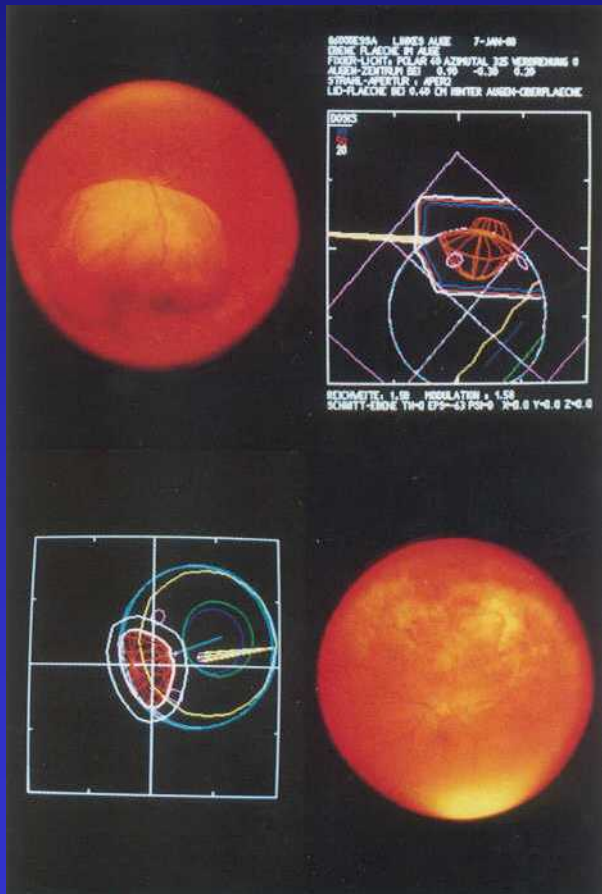
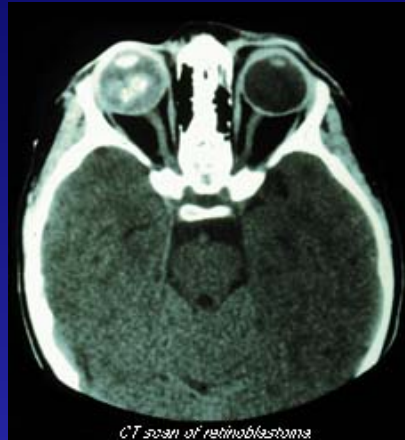
Terapia com feixes de prótons



O primeiro centro de terapia com prótons começou a funcionar em 1954 no acelerador Bevatron de Berkeley (California). Desde então foram tratados mais de 35000 pacientes em todo o mundo usando esta técnica.

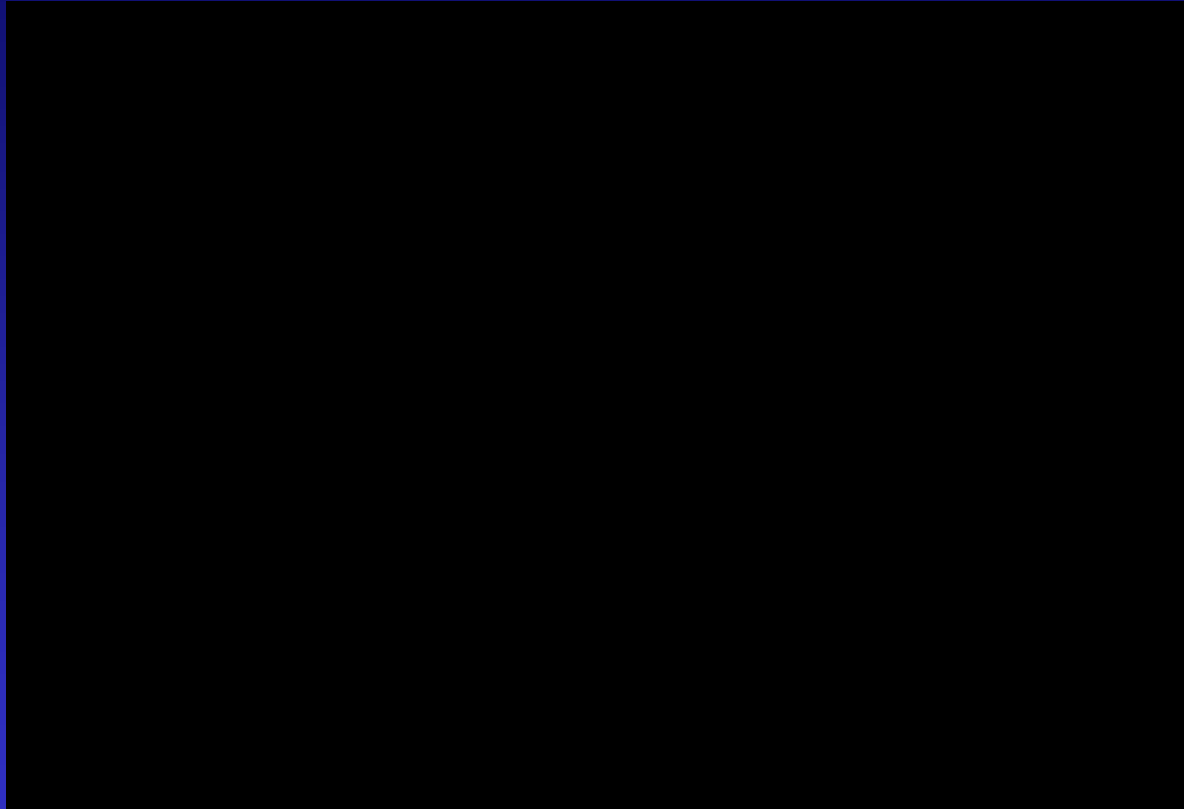
Radioterapia com feixe de prótons

Melanoma no globo ocular



Um ano depois do tratamento

Proton-Ion Medical Machine Study (PIMMS)



Radioterapia com feixes de iões

GSI - Darmstadt

Testes clínicos com ^{12}C em 1997
Sistema PET *on-line* (fragmentação ^{11}C , ^{10}C)

Até 2002, **160 doentes** com **tumores radio-resistentes** foram irradiados

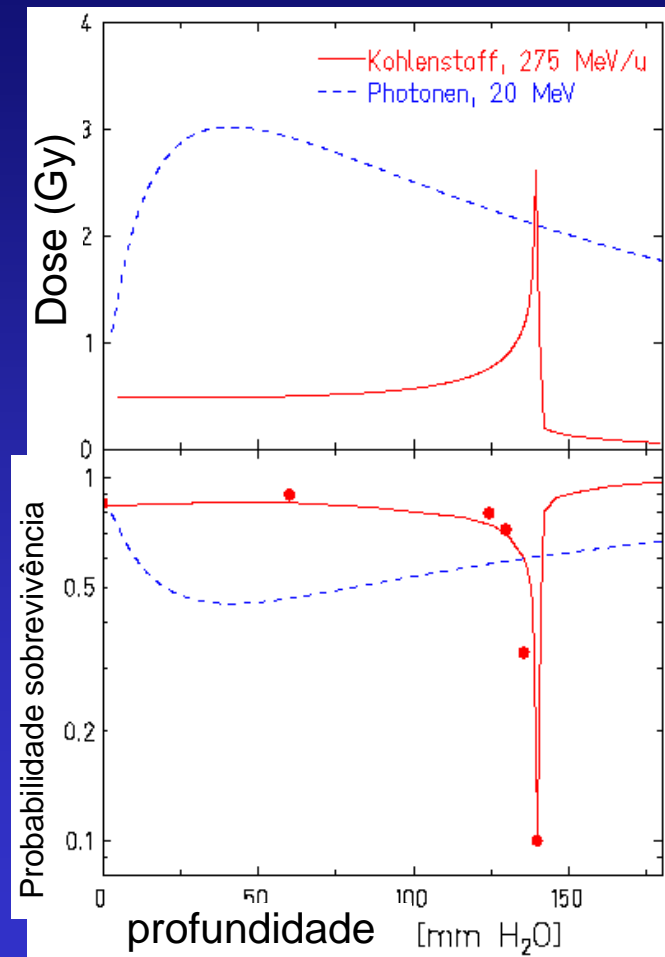
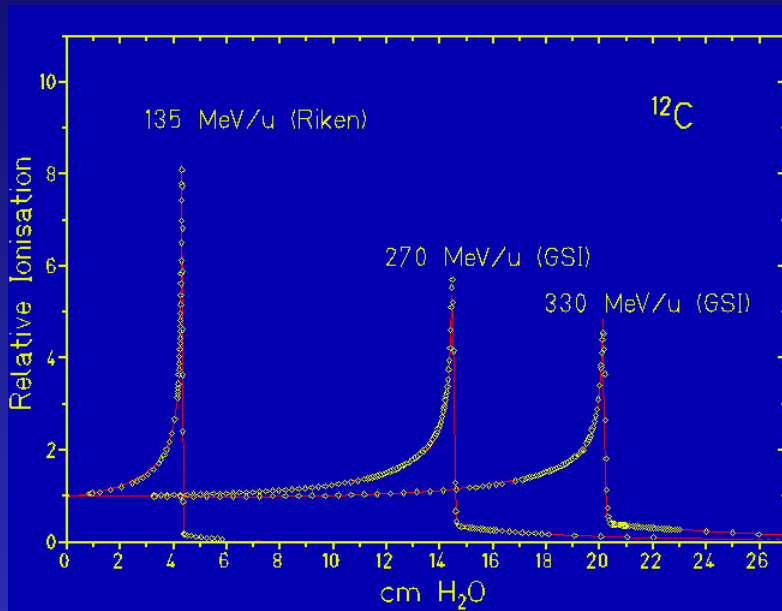
1997



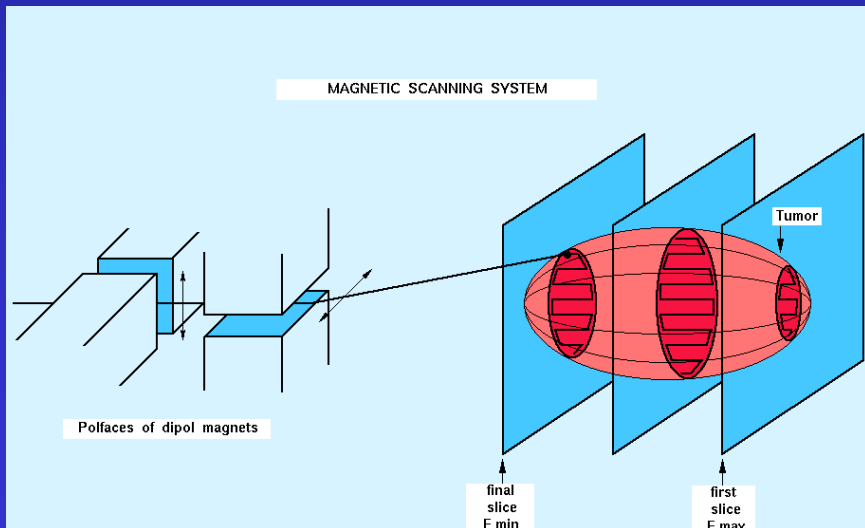
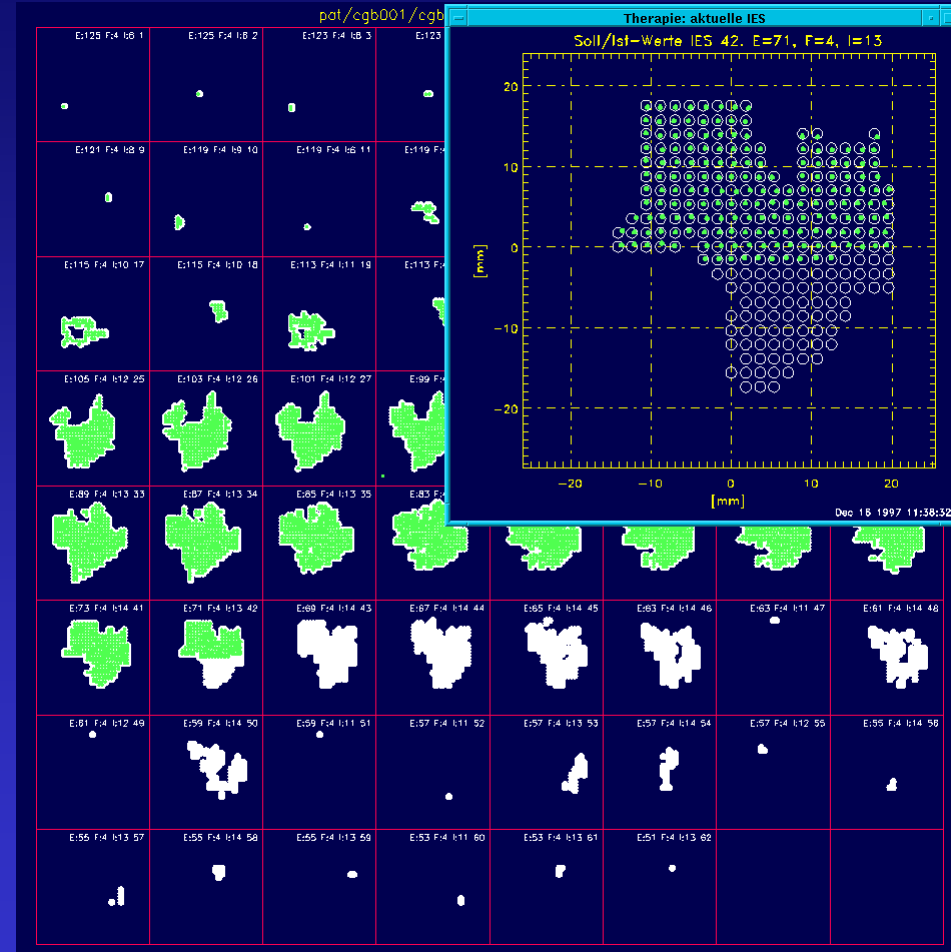
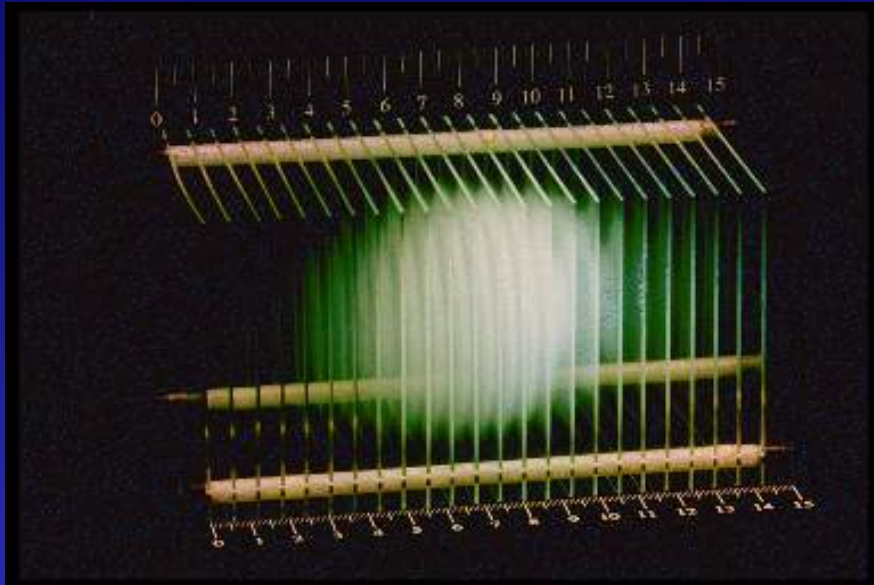
2000



Deposição de energia dos iões de carbono



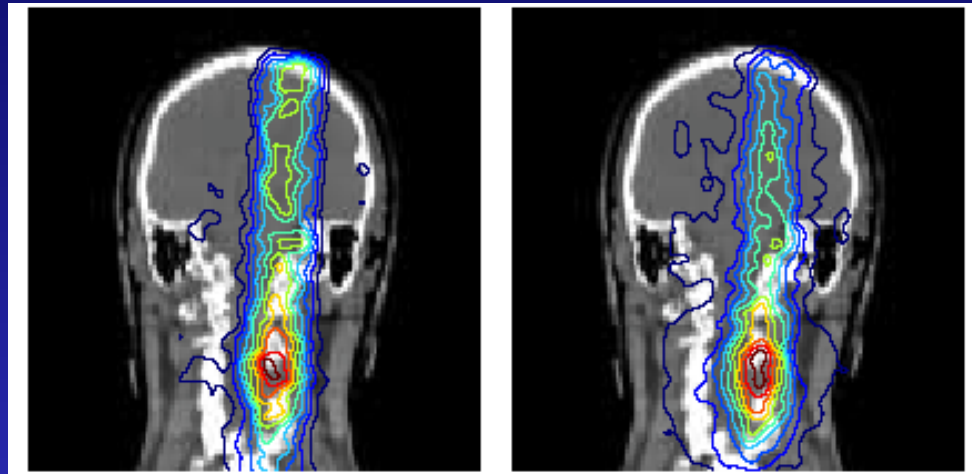
Sistema de controlo do feixe de iões



GSI - Darmstadt

β^+ prevista

β^+ medida



Tumor na base do
cérebro

6 semanas após
irradiação ^{12}C

