Implementation of a Monte Carlo – GEANT4 Simulation for the dosimetric study of electron beams produced by a mobile accelerator for IORT

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#### Partnership



## Intra-Operative RadioTherapy

- Application of Radiotherapy (RT) directly on tumor or bed tumor
- In conjunction with External Beam RadioTherapy (EBRT) to increase amount of radiation delivered
- In selected case to exclude the EBRT

## Intra-Operative RadioTherapy

- Radioactive Sources
- Conventional Linac
- Focalized X-Ray Source
- Mobile dedicated Linac



- New-Novac7: • mobile and dedicated
- electron beam
- 4 energies ( 4, 6, 8, 10 ]
- very high dose per puls
- conventional surgery r
- 6 degree of freedom















## NOVAC 7

#### Collimators: 30, 40, 50, 60, 70, 80, 100 mm diameter Angles: 0°, 15°, 22,5°, 30°, 45°





#### **Breast Treatment**

- To spare the lung we use a beam stopper
- Disc of different dimensions
- Two layers: 4 mmAl + 2 mmPb





#### **Measurements** Setup

- Water Phantom
- IBA diode (insensible to high dose per pulse) [%] 120r

110

80

10

PDD





Depth: 6.6

Depth: 15.2 Depth: 17.4

## The research project

Simulate the NOVAC7 Linac

- Study the Dose distribution for the IORT Breast Treatment
  - Spare the Normal Tissue
  - Optimize the shape of collimators
  - Optimize the dimension and material of beam stopper

## Monte Carlo in IORT (1)

Simulation of the **Novac7 geometry**:

•the vacuum-air window

•the monitor chambers

•the fixed system of collimation

•the final collimator system (100 mm Ø at the moment)



## Monte Carlo in IORT (2)

The **sensitive detector** is a volume of 15 cm x 15 cm x 7 cm located inside a water phantom of 20 cm x 20 cm x 20 cm. We use a Read Out Geometry divided in voxel of 0.5 mm.

We use the **Physic List** chosen in collaboration with the LNS Geant<sub>4</sub> Group:

- Electromagnetic Standard
- (/physic/addPhysic/emstandard\_option3)

# Monte Carlo in IORT (3)

Beam characteristics at the exit point on air of the electron beam :

- Energy
- Energy Spread
- Spot dimension
- Momentum distribution

Specific of particular linac

No factory information

No licterature information

Configuration by the experimental PDD data

## Monte Carlo in IORT (4)

R100 [mm]	Rp [mm]	R50 [mm]	R90 [mm]	R30 [mm]	Rt [mm]	Ep0 [MeV]	E0(mean) [MeV]
15,08	45,24	34,80	24,32	39,07	26,17	9,23	8,11
16,01	44,24	34,81	25,38	38,72	27,01	9,03	8,11
15,00	43,95	34,05	24,14	38,17	25,94	8,97	7,93





## Monte Carlo in IORT (5)

Working in progress...

- •The validation of PDD in other energies
- •The profiles at different depths
- •The study of PDD with the Beam Stopper actually used in the Breast Treatment

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