



institut**Curie**  
Centre de **Protonthérapie** d'Orsay

# The 200 MeV proton beam for irradiation of electronics at ICPO-Orsay

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# 1. History of Centre de Protonthérapie d'Orsay (now rattaché to Institut Curie)

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## The nuclear physics era

- 1955: 1st synchro-cyclotron 156 MeV (Philips)
- 1978: 2nd synchro-cyclotron 200 MeV (CNRS/IN2P3/IPNO)

## The medical era

- 1990: facility fully devoted to protontherapy –joint venture of hospitals
  - 1991: first ophthalmological treatment
  - 1994: first deep-seated tumour treatment
  - 1997: second treatment room
  - 2004: CPO rattaché to Institut Curie
  - Now: more than 3000 patients treated (eye and head&neck)
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# Irradiation of electronics at ICPO (called « MAD »)

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- **From 1998: about 50 sessions achieved**
- sessions called M.A.D. « Mise A Disposition de l'installation »
- **Users: CNES, ONERA, TRAD, ASTRIUM, HIREX, IROC, CEA, CNRS, ...**
- **End of 2004: temporary stop of the MAD**
- **April 2005: restart of MAD**

## 2. Machine and beamline description

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### The machine and the beam

- synchro-cyclotron: protons of 200 MeV
- pulsed beam, structure: pulse width 20  $\mu$ s / period 2.2 ms

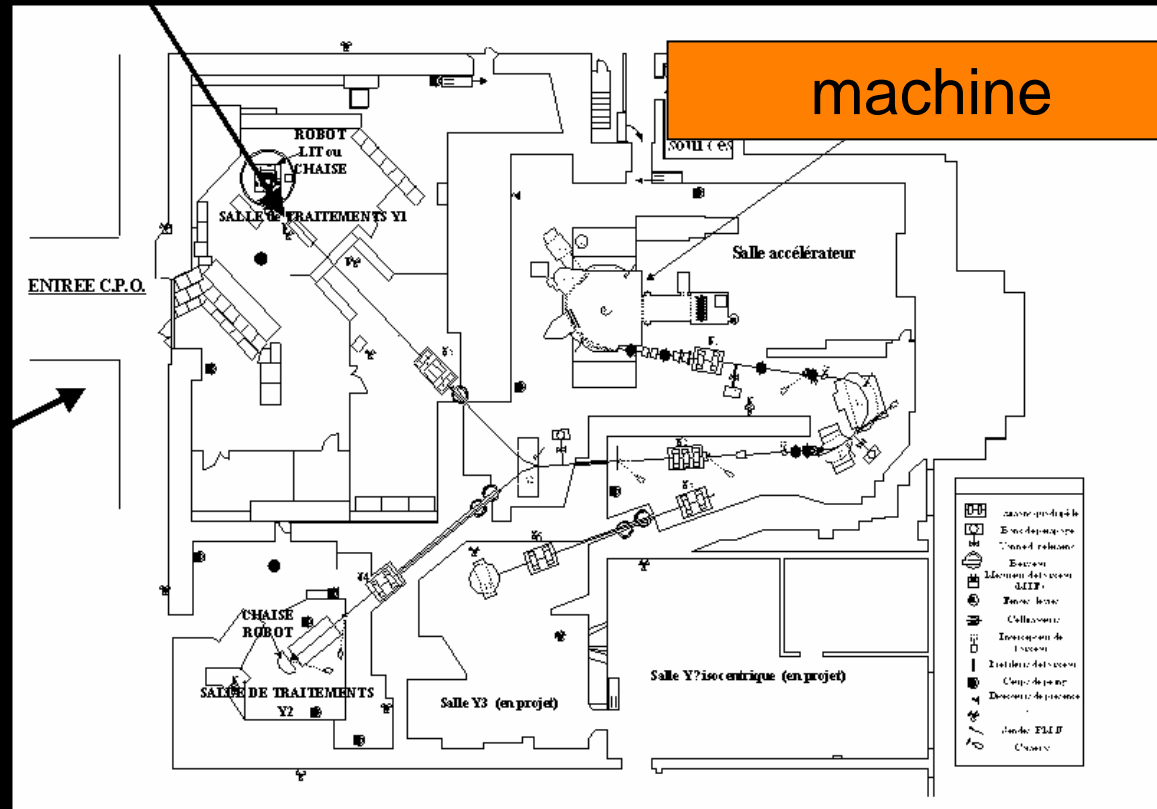
### The beam shaping

- Scatters, collimators (in order to obtain a flat and contoured field)
- Range shifter (selection of the energy from 30 MeV to 190 MeV by steps of 10 MeV) : lead/lexan degraders

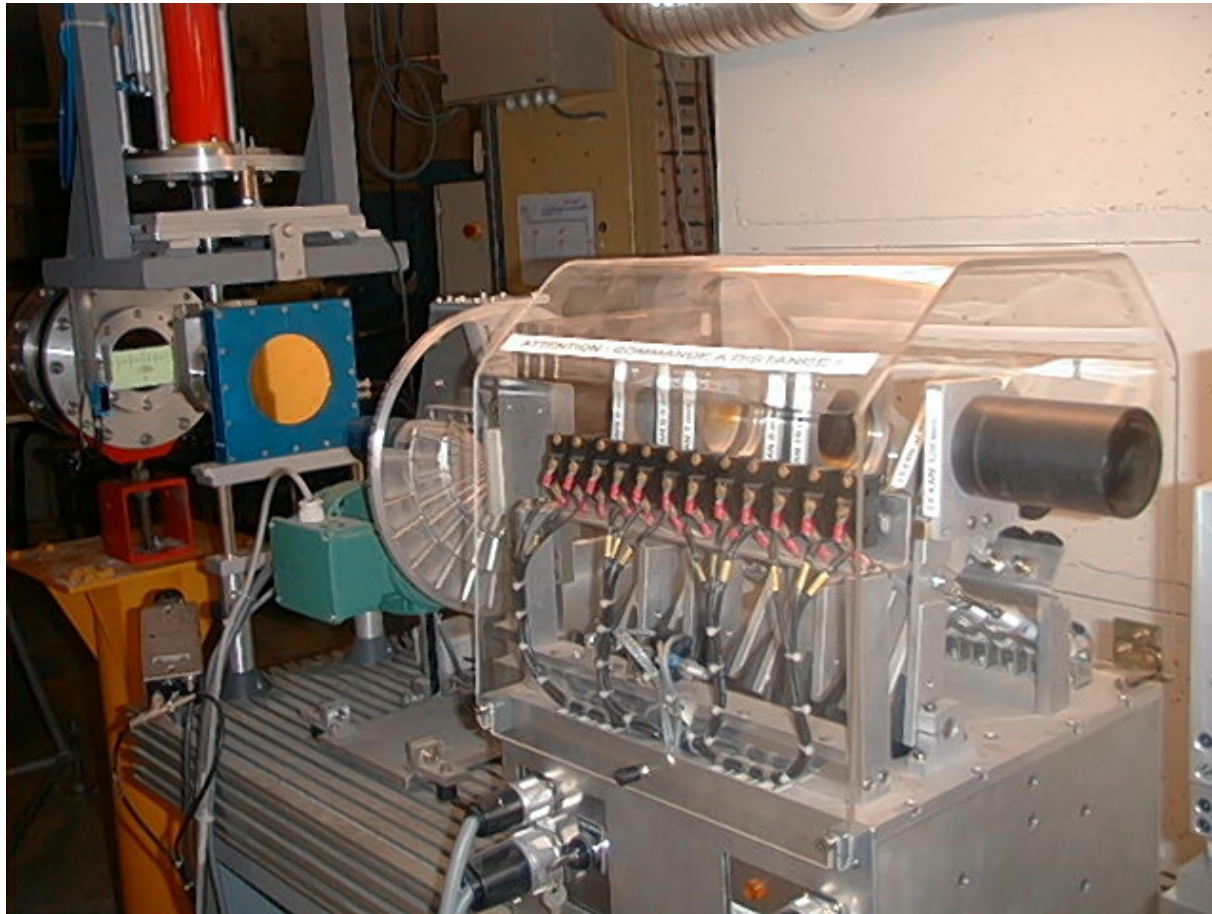
### 3. The facility

irradiation room

machine

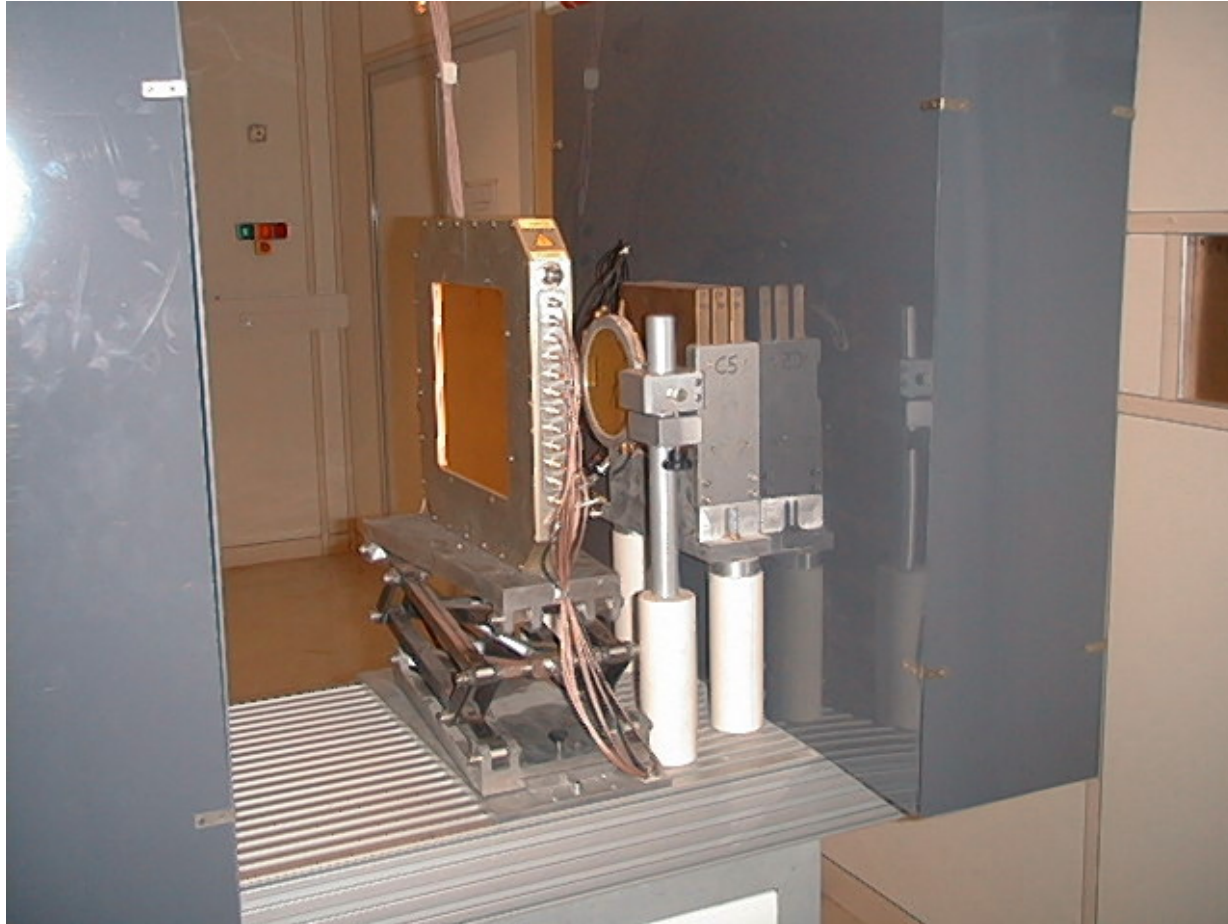


# Beam "binary absorber" for E selection



# Monitoring of the flux : parallel ionisation chamber

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# Measurement and calibration of the energy and flux with a radiotherapy phantom

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Ionization Chamber  
( $\mu\text{vol}$ )



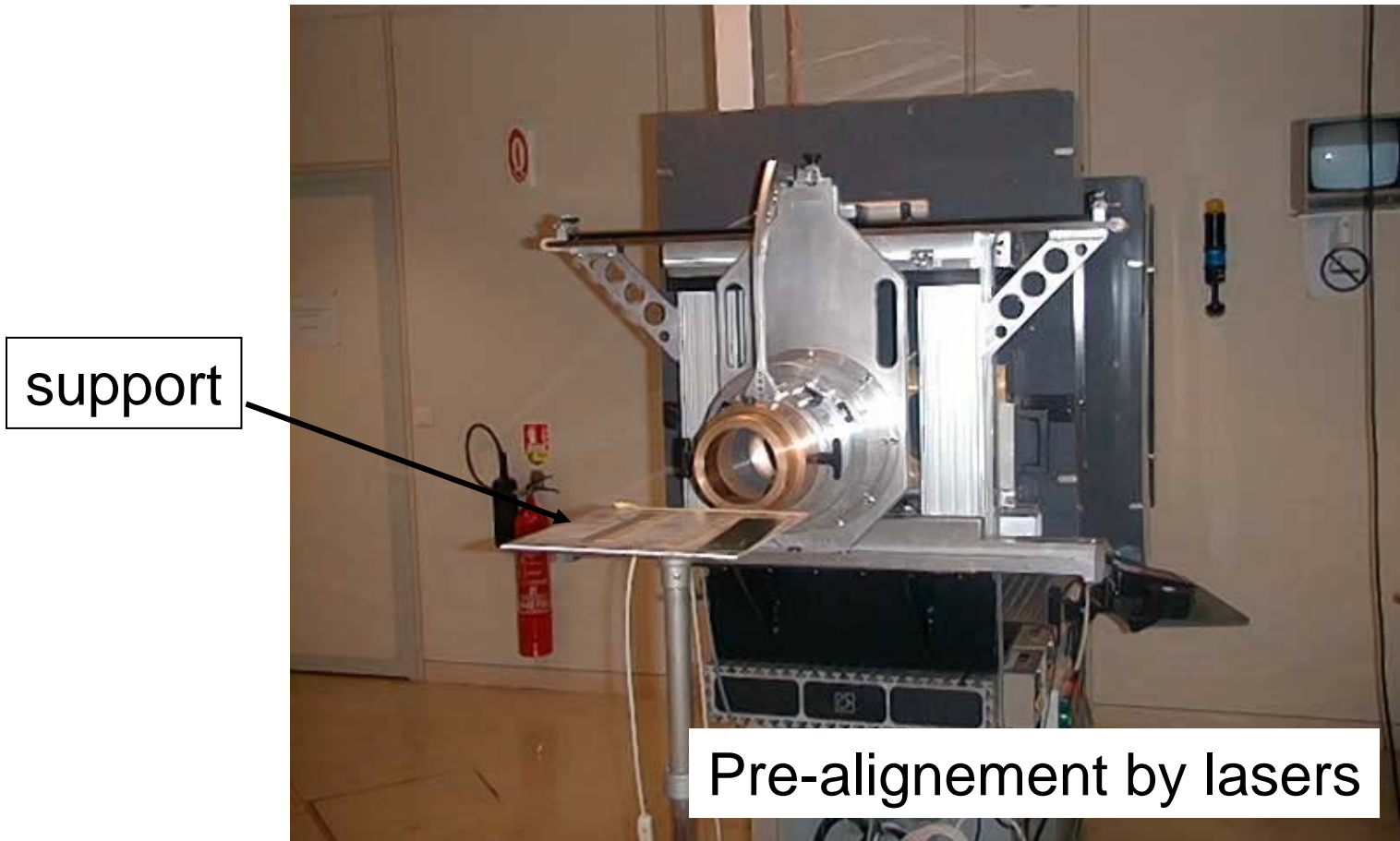
depth curve  $\Rightarrow$  Bragg peak  $\Rightarrow$  Energy, dose measurement  $\Rightarrow$  flux

*ICRU 49 report, 1993, Stopping powers and ranges for protons and alpha particles*



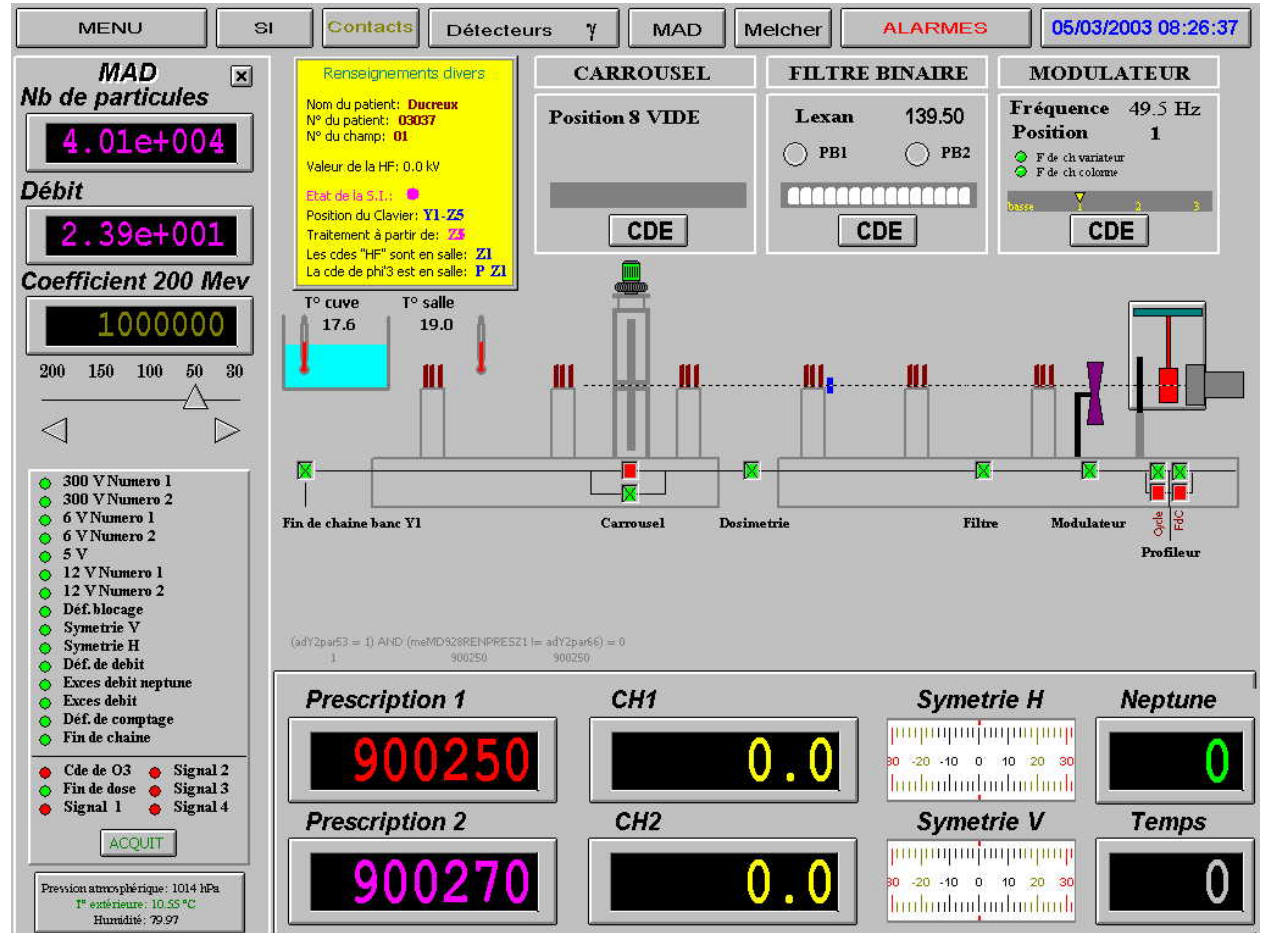
# Positioning of the device for irradiation (basic mechanical support or table driven by robot)

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# Dedicated interface from the control room

Total flux  
Rate  
Energy selected



## 4. Features of possible beams

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- Energy: from 30 MeV to 190 MeV (1 min to change)  
correlated dispersion (ex: 4 MeV for 100 MeV, *calculated*)
- beam structure: width 20 $\mu$ s, period 2.2 ms
- nominal flux for 200 MeV:  $1 \cdot 10^8$  protons.cm<sup>-2</sup>.s<sup>-1</sup>
- nominal flux for 50 MeV:  $3 \cdot 10^7$  protons.cm<sup>-2</sup>.s<sup>-1</sup>
- Flux tunable on line
  
- diameter of the field (collimator): 40-70-80-100 mm
- inhomogeneity: < 8%
- accuracy of the flux measurement: < 8 %

## 5. Administrative-scheduling

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**Slots (called MAD) available only on Friday evening / night (18:00 after last treatment session)**

**MAD of 6 hours (min) and 12 hours (max)  
Including 1 hour of beam calibration**

**2 MAD/month maximum (1 month closure in winter, no MAD in summer)  
Booking 3 weeks in advance minimum (depends on "booking queue")**

**2 ICPO persons devoted for MAD (technical support for machine operation and dosimetry )**

**Rate of MAD: 610 €/hour**

**If case of big breakdown (<5% of cases) : priority to recover for treatment**

## 6. Safety-radiation protection

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**Only persons registered in Cat A or Cat B (radiation protection) in the beam room**

**Electronic dosimeters provided**

**Waiting time if required (ICPO policy : no more than 50uSv per person per MAD)**

**Gamma-meter near the irradiation target. Readout at the entrance of the room**

**Classical survey of the Neutron rate for the facility**

**Active hardware kept until the end of over-activation (3 days-1 week) then shipped back**

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## 7. Future -contact

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**New (big) project approved (new accelerator + extension of the facility)**

- **New machine for 2008 (min 230 MeV protons)**
- **gantry room (3rd treatment room)**

**Dedicated room for experimentations?**

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