



HAL
open science

Upgrade of the flash beam monitoring system at ARRONAX cyclotron

Quentin Mouchard, Noël Servagent, Charbel Koumeir, Guillaume Blain, A. Bongrand, Sophie Chiavassa, Sylvain Deffet, Grégory Delpon, Manon Evin, Arnaud Guertin, et al.

► To cite this version:

Quentin Mouchard, Noël Servagent, Charbel Koumeir, Guillaume Blain, A. Bongrand, et al.. Upgrade of the flash beam monitoring system at ARRONAX cyclotron. 2nd Flash Radiotherapy and Particle Therapy Conference (FRPT 2022), Nov 2022, Barcelona, Spain. . hal-03885576

HAL Id: hal-03885576

<https://imt-atlantique.hal.science/hal-03885576>

Submitted on 5 Dec 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

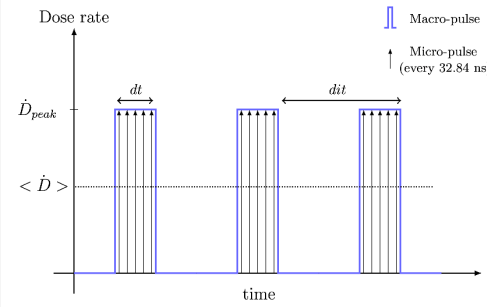
L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

UPGRADE OF THE FLASH BEAM MONITORING SYSTEM AT ARRONAX CYCLOTRON

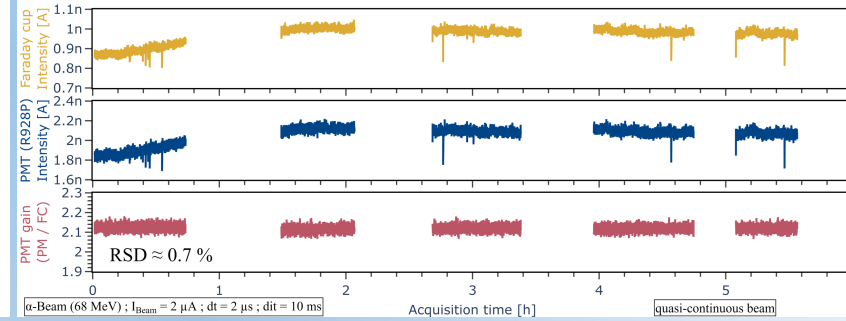
Q. Mouchard, N. Servagent, C. Koumeir, G. Blain, A. Bongrand, S. Chiavassa, S. Deffet, G. Delpon, M. Evin, A. Guertin, R. Lubarbe, S. Lucas, V. Métivier, F. Poirier, V. Potiron, F. Ralite, S. Rossomme, L. Schoenauen, E. Sterpin and F. Haddad

Previous results

The radiobiological platform at ARRONAX offers different types of particles (protons, deuterons, alpha) in an energy range of up to 68 MeV, with two delivery modes: **continuous** and **pulsed beams**. In addition, beam monitoring (intensity and profile), based on the detection of air fluorescence, with a PMT is in progress for an **ultra-high pulsed dose rate up to an order of magnitude (\mathcal{O}) of 100 kGy/s**.

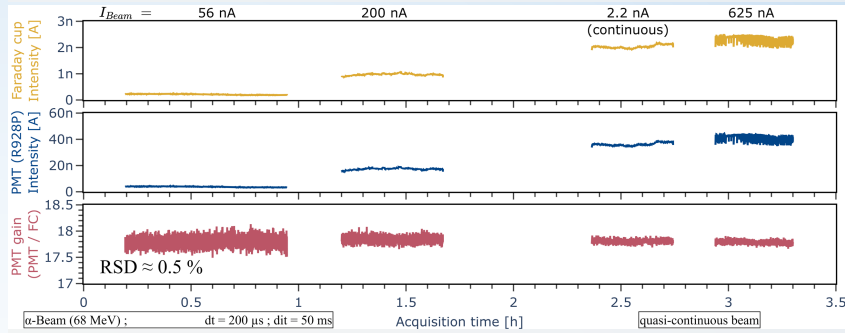


PMT gain stability as a function of time



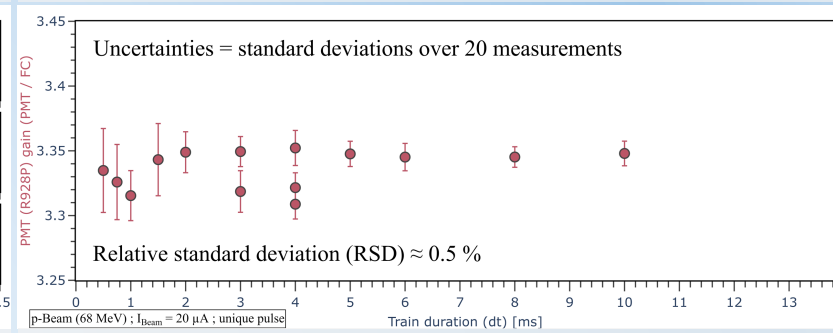
- ✓ Correlation of the PMT intensity: $I_{PM} \propto I_{FC}$
- ✓ PMT gain constant over time for continuous beam

PMT gain stability as a function of beam intensity



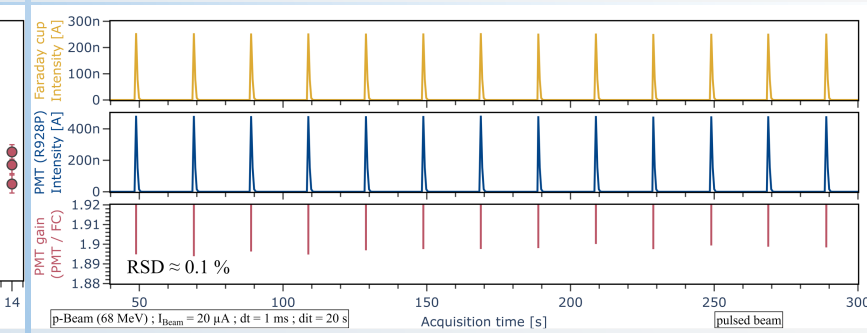
- ✓ PMT gain constant over beam intensity I_{Beam} $\mathcal{O}(10)$ nA to $\mathcal{O}(1)$ μ A

PMT gain stability as a function of pulse width



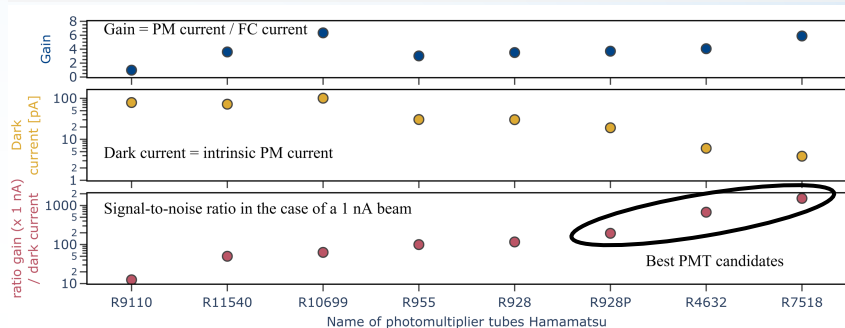
- ✓ PMT gain constant over width pulse

PMT gain stability with a pulsed beam



- ✓ PMT gain constant over time for pulsed beam

Selection of photomultiplier tubes (PMT)



To increase the sensitivity of the device for the beam profile (low light intensities), we made a selection of PMTs offering the **best signal-to-noise ratio, low dark current, high gain and reasonable cost**.

Conclusions / Outlook

- ✓ **Stable gain over time**, in the case of a **quasi-continuous and pulsed beam** → **robustness** of PMT
- ✓ **Stable gain for different pulse widths (dt) and beam intensity** → **adaptability** of PMT
 - The **PMT allows continuous and pulsed beam monitoring at conventional and ultra-high dose rates**. The **same dosimetric protocol** can be used regardless of the beam structure and dose rate.
 - ☐ The development of a new beam profiler based on PMTs is in progress, thanks to the choice and characterisation of a suitable PMT (best gain/dark current ratio).