**Master 2 internship project**

**Year 2024-2025**

**Laboratory/Institute:** INSERM **Director:** Sam Bayat

**Team:** UGA INSERM UA7 STROBE (Synchrotron Radiation for Biomedicine) **Head of the team:** Raphael Serduc

**Name and status of the scientist in charge of the project:** Laura Eling, PhD, post doc

**HDR: yes ☐ no x**

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**Program of the Master’s degree in Biology:**

**☐** Microbiology, Infectious Diseases and Immunology **☐** Structural Biology of Pathogens

**x** Physiology, Epigenetics, Differentiation, Cancer **x** Neurosciences and Neurobiology

**Title of the project: Microbeam Radiation Therapy for the treatment of brain tumors**

Objectives (up to 3 lines):

Our team works on the treatment of brain tumors with synchrotron-generated, spatially fractionated X-rays (microbeam radiation therapy; MRT). We aim at demonstrating that our novel method leads to an increased efficacy of brain tumor control and lower normal tissue damage, compared with conventional radiotherapy.

Abstract (up to 10 lines):

To date, brain cancers still have poor prognosis due to the normal brain tissue radiosensitivity limiting the efficacy of tumor control by radiation. Microbeam radiation therapy (MRT) has maximized the benefits of spatially fractionated radiotherapy: X-rays, collimated into an array of micron-wide beamlets, deliver very high doses in the microbeam path (peak dose), whereas a low dose diffuses between the beams (valley dose). This highly heterogeneous dose distribution results in an excellent normal brain tissue tolerance, while a preferential brain tumor-killing effect has been shown in preclinical studies. The proposed project aims at clarifying many yet unknown biologic, immunologic and radiation-induced changes in the brain tumor microenvironment. We assume that differential effects elicited by MRT on vascular networks in tumoral and normal tissue are also mediated by immunologic responses. This research will highlight new concepts for the treatment of brain tumors with microbeam radiation therapy. All of the information gathered from this project are highly relevant for the improvement of the still unsuccessful treatment of brain tumors.

Methods (up to 3 lines):

We have developed the following methods: *in-vivo* brain tumor models in rats, tumor growth measurements on MRI, radiotherapy by MRT or conventional homogeneous irradiation, brain tissue analysis by immunofluorescence, histopathology and microscopy, image analysis. We also correlate the *in-vivo* and *ex-vivo* findings to dosimetric parameters (dose-volume histograms).

Up to 3 relevant publications of the team:

L Eling, A Bouchet, A Ocadiz, J F Adam, S Kershmiri, H Elleaume, M Krisch, C Verry, J A Laissue, J Balosso, R Serduc. Unexpected Benefits of Multiport Synchrotron Microbeam Radiation Therapy for Brain Tumors. *Cancers* 13(5), 936, 2021. <DOI:10.3390/cancers13050936>

J F Adam, J Balosso, S Bayat, et al. Toward Neuro-Oncologic Clinical Trials of High-Dose-Rate Synchrotron Microbeam Radiation Therapy: First Treatment of a Spontaneous Canine Brain Tumor. *Int. J. Radiat. Oncol. Biol. Phys* 113(5), 967–973, 2022. <https://doi.org/10.1016/j.ijrobp.2022.04.022>

L Eling, C Verry, J Balosso, I Flandin, S Kefs, A Bouchet, J F Adam, J A Laissue, R Serduc. Neurologic changes induced by whole-brain synchrotron microbeam irradiation: 10 months behavioral and veterinary follow-up. *Int J Radiat Oncol Biol Phys*. Published online March 8, 2024. <https://doi.org/10.1016/j.ijrobp.2024.02.053>

Requested domains of expertise (up to 5 keywords):

Histology, Brain Anatomy and Oncology, Radiobiology