Version Française

English version

INTEGRATED RESEARCH PROGRAM 3

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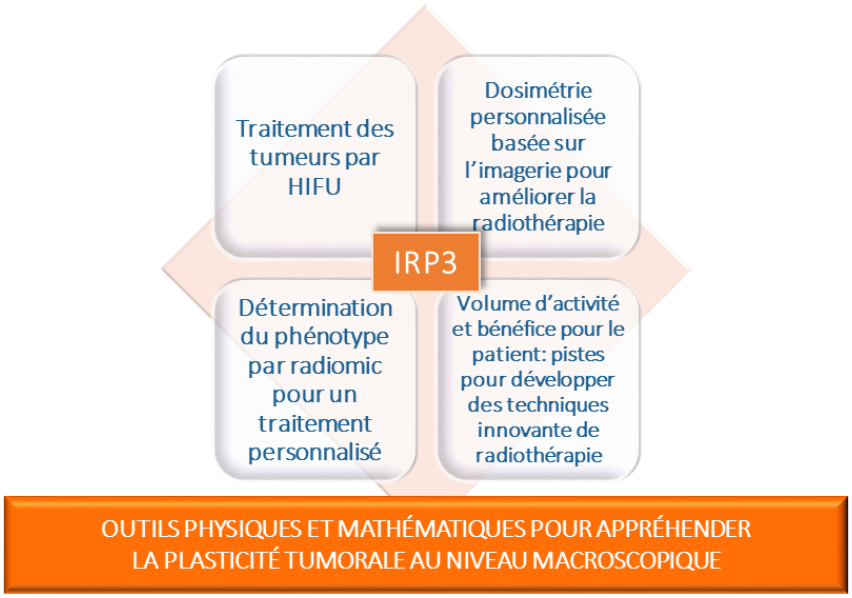
IRP3 : OUTILS PHYSIQUES ET MATHÉMATIQUES POUR APPRÉHENDER LA PLASTICITÉ TUMORALE AU NIVEAU MACROSCOPIQUE



L'IRP3 a pour objectif de développer des traitements personnalisés basés sur l'imagerie en utilisant des agents physiques pour appréhender l'hétérogénéité des tumeurs ainsi que la plasticité *in vivo*.

La destruction physique permet de détruire, en une étape et de façon précise, des masses tumorales difficilement opérables ou à un stade métastatique. La technique **d'HIFU** (High Intensity Focused Ultrasound) est utilisée pour provoquer la destruction de tumeurs du pancréas, des tumeurs primaires ou secondaires du foie. En parallèle de ces projets de destruction focalisée et dans le cadre d'essais cliniques, de nouvelles méthodes de modélisation de fusion dynamique des ultrasons basées sur l'imagerie seront appliquées afin d'évaluer l'impact des mouvements du foie par la respiration du patient.

Des projets de recherche sont développés dans le but de personnaliser au mieux les traitements ainsi que d'améliorer le guidage, l'efficacité et la sécurité de la radiothérapie dans les conditions d'escalade de dose ou de ré-irradiation. L'hétérogénéité intra et inter-patients est appréhendée par le développement d'outils de datamining, telle que la **radiomic**, permettent de combiner des données morphologiques à d'autres types de données (génomiques, sériques, biomarqueurs …).

Ces évolutions technologiques et techniques dans le domaine de la radiothérapie ont mené à s'interroger sur le lien qui peut exister entre le volume d'activité des hôpitaux et le bénéfice pour le patient dans le contexte de médecine personnalisée. Ce travail a pour objectif de mener à évaluer une technique innovante de radiothérapie sur la base de données au niveau national.

IRP3 : PHYSICAL AND MATHEMATICAL METHODS TO ANALYSE AND OVERCOME TUMOR PLASTICITY AT THE MACROSCOPIC LEVEL FOR PERSONALISED TREATMENTS

This axis is devided into 4 axis, as follows:

Axis 1. Ultrasound guided focal treatment of tumors with High Intensity Focused Ultrasound (HIFU)
Axis 2.Image-based personalized dosimetry in radiotherapy
Axis 3. Multiscale radiomic phenotype determination for personalized treatment
Axis 4. Exploring the Volume Outcome Relationship in the framework of innovative radiation therapy

This IRP3 is focusing on the development of image-based personalised treatments using physical agents to analyze tumor heterogeneity and plasticity *in vivo*. Physical destruction or removal of macroscopic tumor cell masses, in patients with localized inoperable disease, as well as in patients with metastatic disease, enables to treat in a single step a large number of tumor cells and cancer ecosystems. Tumors cells plasticity generates inter-patients as well as intra- and inter-lesions heterogeneity within a single patient, evolving spatially and over time. Personalized medicine must include an appraisal of this heterogenous behavior across tumor sites in a single patient. Imaging and computer simulations are keys elements to explore this heterogeneity and plasticity at the macroscopic level for this purpose. **The first axis** is devoted to the increasing development of High Intensity Focused Ultrasound (HIFU) as an image-guided tumor ablation technique alternative to surgical resection, with a specific program dedicated on the impact of this therapy on the immune system. **The second axis** focuses on image-based personalized dosimetry to customize radiation dose to be delivered according to imaging exams; the aim here is to boost targeting and personalized sparing of organs at risk, both for external and internal radiation therapy. **The third axis** is dedicated to multiscale radiomic phenotype determination based on mpMRI and nuclear imaging. Machine learning approaches (radiomic) will be used to link images and deformation characteristics to biological parameters. **A fourth axis** is devoted to the analysis of the volume outcome relationship (VOR) in a collaboration between Social and Human Sciences and economy researchers. The goal here is to demonstrate the impact of image-based adaptive methodologies on several treatments, but also provided insights through quantitative biomedical imaging for the others IRP.

Integrated social sciences and humanities projects

The volume outcome relationship (VOR) is a concept mainly investigated in health economics: higher volume hospitals provide better outcomes (e.g lower mortality rates). Studies can for example explain the VOR in the context of surgery, with surgical techniques linked to surgeons' volume. The goal here is to explore the VOR in the field of personalized medicine by developing a theoretical framework of the VOR and go further to propose an innovative radiation therapy. The ultimate goal is to provide significant and qualitative data to impact on policy implication and improve patients' care and health economy.