

Laboratory of Excellence Physic Radiobiology Medical Imaging and Simulation - PRIMES

Béatrice RAYET^{1*}, Denis DAUVERGNE² and Françoise PEYRIN³, on the behalf of the LabEx PRIMES members

¹ Chef de Projet LabEx PRIMES – *Contact: b.rayet@ipnl.in2p3.fr - + 33 (0)4 72 43 11 40 – <http://primes.universite-lyon.fr>

² CAS-PHABIO – Institut de Physique Nucléaire de Lyon, CNRS IN2P3, Villeurbanne

³ CREATIS Inserm U1044, CNRS UMR 5220, Villeurbanne et ESRF, Grenoble

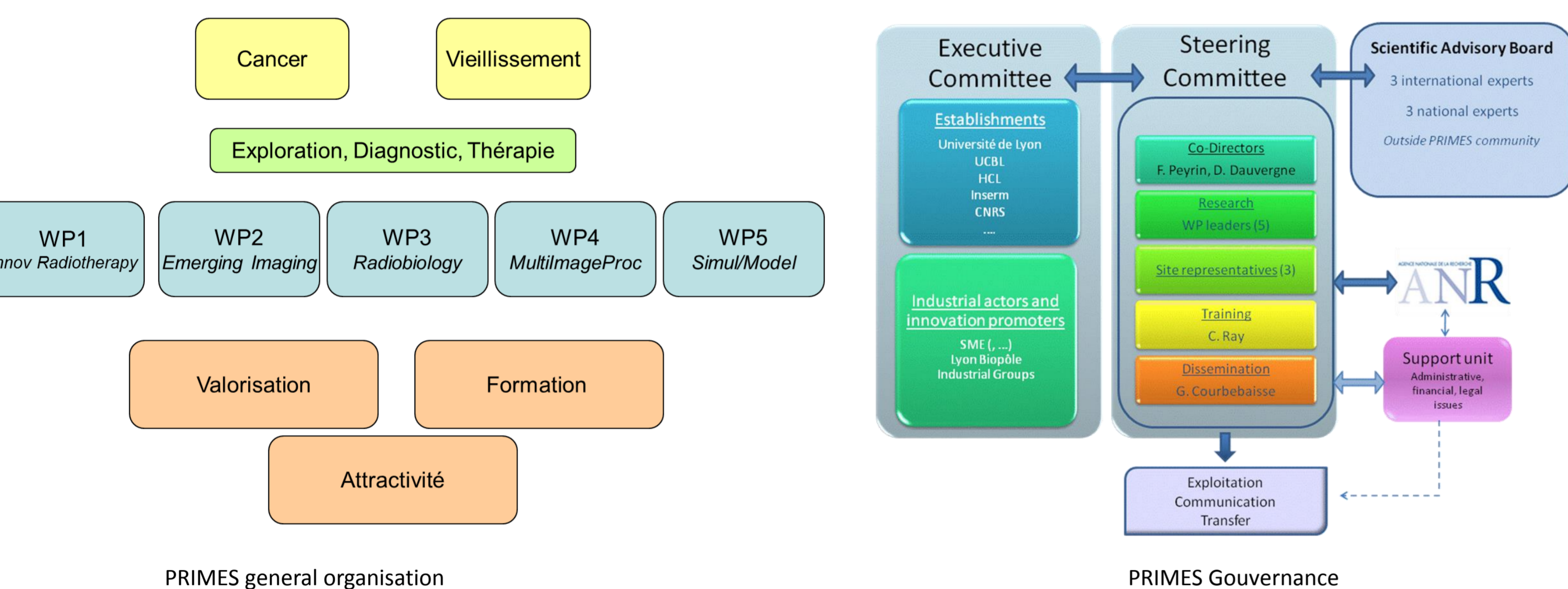
Acknowledgment: PRIMES is a LabEx 2 contract (Investissements d'Avenir - ANR)

BACKGROUND

At the National level, the questions of **cancer** and **ageing** are given highest priority in the domain of health research, providing strong societal impact for the quality of life and for the economy.

The fundamental questions that are addressed in this project are how to provide new imaging tools for exploring living tissues at different scales with new contrasts and how to build optimized, controlled and safe strategies for irradiation-based cancer therapy.

This field of research is by nature interdisciplinary and the LabEx members have expertise in **physics, radiobiology, acquisition, images reconstruction and treatment, simulation and modeling**.

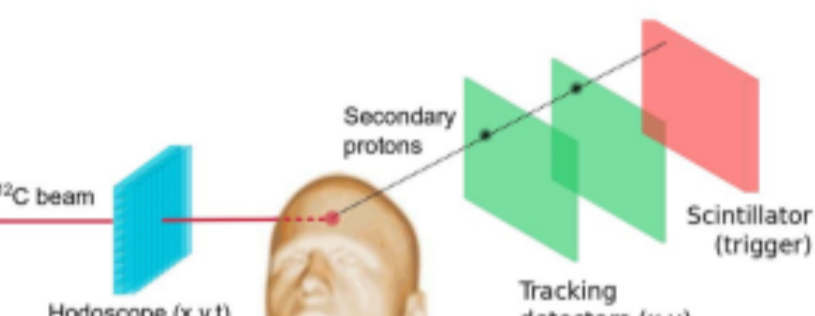


LabEx Partners

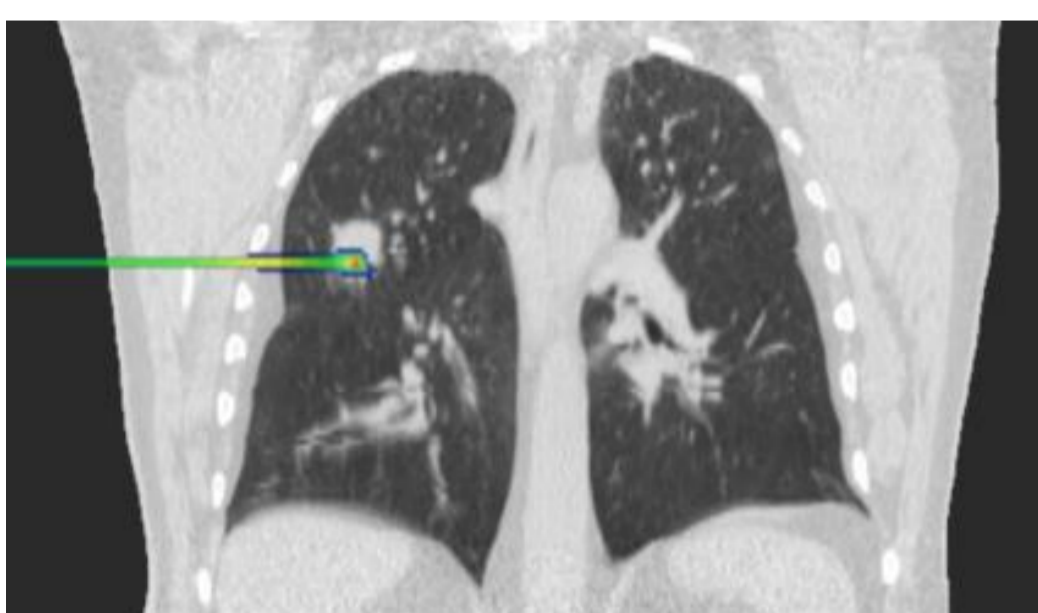
- Centre de Recherche en Acquisition et Traitement de l'Image pour la Santé (CREATIS - Villeurbanne)
- Institut de Physique Nucléaire de Lyon (IPNL - Villeurbanne)
- Laboratoire d'Informatique en Image et Systèmes d'information (LIRIS - Villeurbanne)
- Laboratoire Hubert Curien (LHC - Saint-Etienne)
- Laboratoire de Physique Corpusculaire (LPC - Clermont-Ferrand)
- Laboratoire de l'Informatique du Parallélisme (LIP - Lyon)
- Laboratoire de Radiobiologie Cellulaire et Moléculaire (LRCM - Lyon)
- Grenoble Institut des Neurosciences (GIN - Grenoble)
- Lésions des Acides Nucléiques (LAN - Grenoble)
- Laboratoire de BioMécanique des Chocs (LBMC - Lyon)
- Laboratoire de Physique Subatomique et de Cosmologie (LPSC - Grenoble)
- CEA Leti (Grenoble)
- Ampère (Lyon)
- Laboratoire de Physico-Chimie des Matériaux Luminescents (LPCML - Villeurbanne)
- Centre de Recherche en Neurosciences de Lyon (CRNL - Lyon)
- Neurodis (Lyon)

RESEARCH: RADIOTHERAPY (WP1; 3; 5)

Interaction Vertex Imaging (secondary protons)



Principe du contrôle en ligne par imagerie de vertex protons en carbone-thérapie © Cédric RAY, IPNL et al.



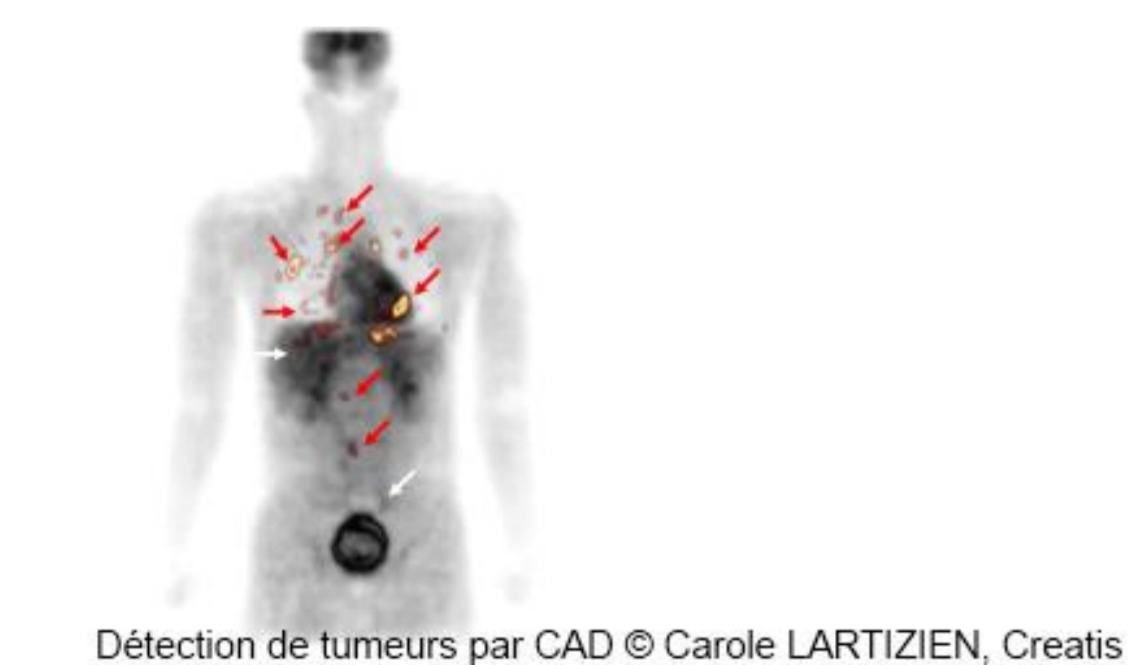
Distribution de dose obtenue par un faisceau de protons ciblant la tumeur pulmonaire, simulée avec GATE © David SARRUT, Loïc GREVILLOT, Nicolas FREUD, CREATIS & CLB

WP1: Development of Innovative Methods and Instruments in Radiotherapy: innovative radiotherapies, will include **hadrontherapy** and hard X-rays at ESRF. A key issue will be **on-line dose monitoring**.

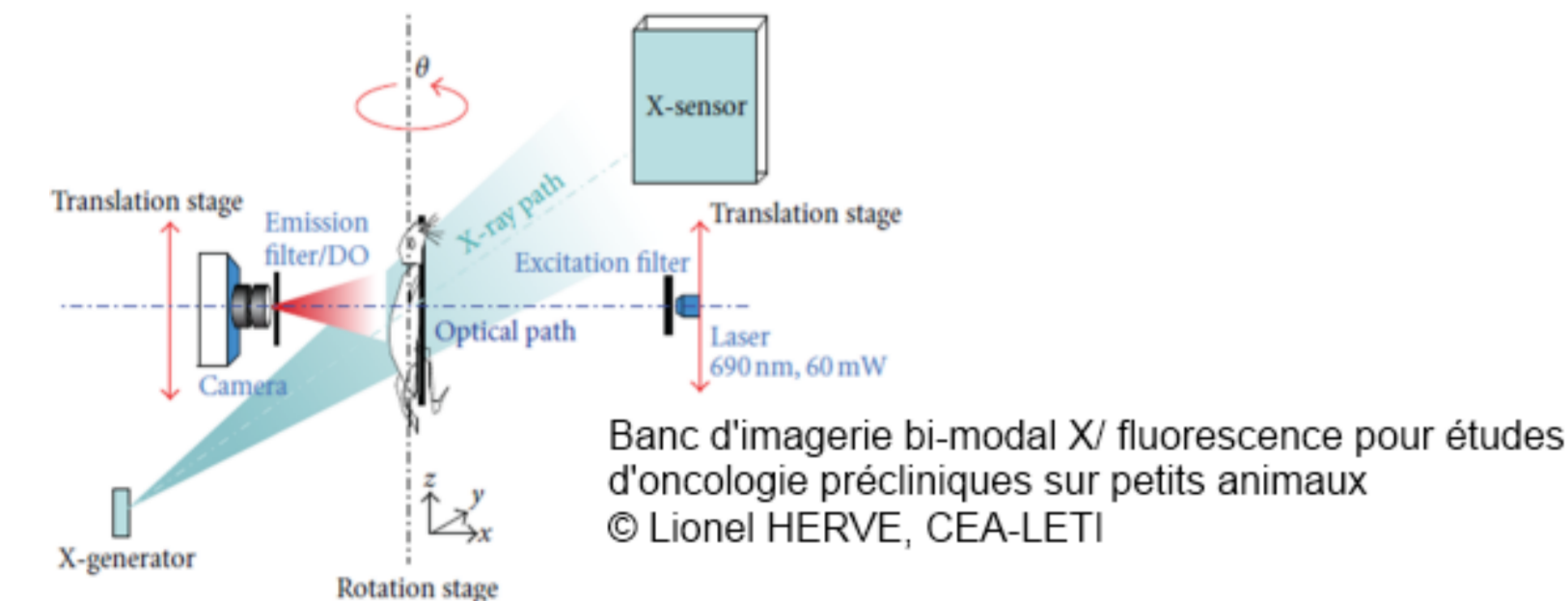
WP3: Radiobiology: including development of instruments, methods, models and simulations for the acquisition, the analysis and prediction of radiobiological data, and the improvement of **innovative radiotherapy treatments** based on high energy carbon ions, PAT-Z and MRT.

WP5: Image-based models and simulations will develop tools for modeling of a virtual patient and treatment room environment.

RESEARCH: MEDICAL IMAGING AND SIMULATION (WP2; 4; 5)



Détection de tumeurs par CAD © Carole LARTIZIEN, CREATIS



Banc d'imagerie bi-modal X/ fluorescence pour études d'oncologie précliniques sur petits animaux © Lionel HERVE, CEA-LETI

WP2: Emerging Imaging Techniques will cover new instruments for improved diagnosis **with new hybrid imaging techniques**, with combinations of PET, MR, US, Optical Imaging as well as **challenging techniques** such as cardiac DTI, novel X-ray based methods (Spectral CT, Phase-Contrast Imaging), or Fluorescent Diffuse Optical tomography.

WP4: Multidimensional Image Processing spanning new developments in **inverse problems** for emerging imaging modalities and **extraction of image biomarkers** involving denoising, segmentation, motion estimation, image registration and quantification.

WP5: Image-based models and simulations will develop tools for virtual multimodality imaging and modeling of a virtual patient.

VALORIZATION AND SOCIO-ECONOMIC IMPACTS

Cancers represent a multitude of diseases and is one of the most important cause of death and morbidity in Europe. Age related diseases including cardiovascular diseases, stroke, brain degenerative diseases, osteoarticular diseases are the first cause of acquired disability.

At the National level, the questions of cancer and ageing are given highest priority in the domain of health research, providing strong societal impact for the quality of life and for the economy.

The new achievements anticipated from the LabEx are expected to improve the early diagnosis of targeted diseases, improve the treatment of cancers and thus participate to a better quality of life. Early screening and stratification of risk through imaging may improve our knowledge and may have a significant socioeconomic impact.

Our socio-economic partners are: Fondation Neurodis; Canceropole CLARA; Lyon -Biopôle (IRT); AQUILAB, CIRMA, VOXCAN, Bioclinica, Kitware, Eriksolution, Digsens, Guerbet, Bruker, IBA, Dosisoft...

CONCLUSION

The expectations from this LabEx initiative are to strengthen the local and regional synergies also with medical actors; to create a pole in medical imaging and physic applied to health; to increase the visibility on these thematic (publications, diffusion, animation); to strengthen international collaborations; to gain recognition in initial and continuous training, to develop valorization through industrial partnership, ...

TRAINING



The LabEx will create a new practical and classes platform combining in a unique place: A material platform (MRI, ultrasounds and X scanner) and a simulation platform (GEANT 4, GATE and Images reconstructions).

Students will be encouraged to choose several credits from a LabEx-labeled set of classes. This hub will cover four main topics: Instrumentation and data acquisition, Signal, data and image processing, Radiotherapy and particles interactions, Simulations