

# Institute for Translational Molecular Imaging

Emerging role of animal imaging in translational research



Osman Ratib MD, PhD

Department of Medical Imaging and Information Sciences  
Fac. of Medicine, University of Geneva

MEDICIS/Promed Lemanic School  
@ HUG / ITMI imaging lab  
Tuesday March 13 2018



## Healthcare economics

Shift of paradigm



Keynote Lecture  
Elias Zerhouni  
International Society  
for Strategic Studies  
in Radiology

### Transformation of medical paradigm

- Treat disease before it becomes symptomatic
- **Four P**
  - Predictive
  - Personalized
  - Preemptive
  - Participatory
- We should better understand how the molecules we are giving to the patients really work (how cancer mutate, response, environment etc..)
- Genomics, proteomics
- Molecular Imaging (quantitative...)



## New challenges in medicine

Accelerating research applications



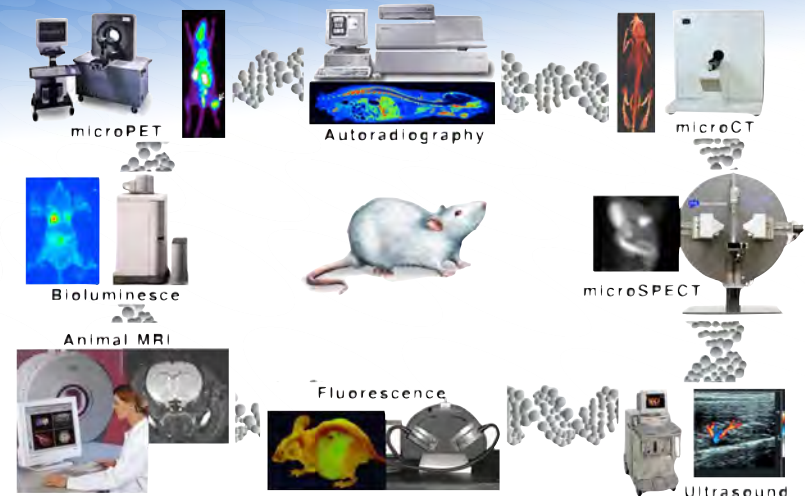
Fundamental Research

Clinical Research



## Translational research

Preclinical molecular imaging

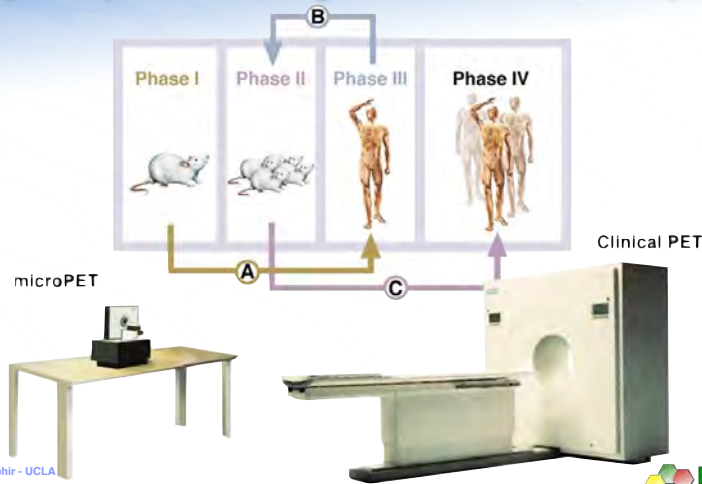




# Translational research

Preclinical molecular imaging

## Moving into preclinical drug and treatment development



Courtesy S. Gambhir - UCLA



# New challenges in medicine

Translational and pre-clinical research

This collage features several news items related to medical research and government policy. It includes a 'nature news' article titled 'The bridge between lab and clinic' about Francis Collins, a 'Money & Policy' article from 'The New York Times' about the Federal Research Center for drug development, and a photo of Barack Obama with the caption 'ANNOUNCING RECOVERY ACT RESEARCH GRANTS'.



# New challenges in medicine

Translational and pre-clinical research

The screenshot shows the website for the Center for Systems Biology (CSB) at MGH. It features a navigation menu, a search bar, and a main content area with the title 'Center for Systems Biology' and 'Ralph Weissleder's Lab'. The page includes images of imaging techniques and miniaturized chips, along with a list of research interests and a list of tools and platforms used in the lab.

New understanding of biology and diseases (systems biology)  
 New diagnostic tests (bringing it to patients)  
 New approaches for therapies



# Translational research

Biomedical Imaging

The diagram illustrates the CIBM network, showing its structure and the various institutions and departments involved. It lists 1 center, 3 sites, 5 institutions, 7 cores, and 9 professors. The network includes the University of Geneva, EPFL, UNIGE, HUG, CHUV, and the Fondation Leenaards. It also lists clinical departments such as Radiology, Neurology, Pediatrics, Psychiatry, Neurosurgery, and Medicine, along with specific imaging techniques like PET, IRM HUG, IRM CHUV, EEG, and Phase Contrast.




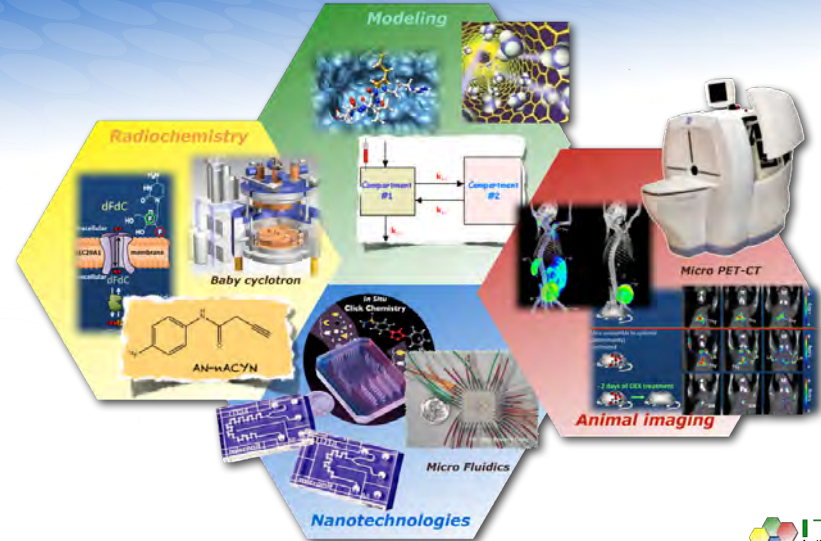
 **Translational research**  
*Preclinical molecular imaging*


**Translational Molecular Imaging Institute project**



 Institute of Translational Molecular Imaging

 **Translational research**  
*Preclinical molecular imaging*



 Institute of Translational Molecular Imaging


 **Translational Molecular Imaging Institute**  
*Infrastructure, labs, facilities*

**Visit to Stanford**





 **STANFORD BIO-X**



 **Translational Molecular Imaging Institute**  
*Infrastructure, labs, facilities*

**Visit to Stanford**

**Translational Molecular Imaging Institute**  
Infrastructure, labs, facilities

**EPFL**

**Preliminary phase in FOR SALE**  
5 Mio CHF

**Translational Molecular Imaging Institute**  
NEUROPOLIS project

**EPFL**

June 12, 2012

**LE TEMPS**

Subventions | Air du Temps | Economie & Finance

Nadal, la 7e dimension | Un écran pour faire rayonner les neurosciences sur l'Arc lémanique | Savoirs Dès 2013, le centre de recherche Neuropolis sera érigé sur le campus lémanique

**110 millions pour être No 1 de la recherche sur le cerveau**

Neuropolis Une capitale des neurosciences, d'envergure internationale, voit le jour sur le campus de l'EPFL. Un nouveau bâtiment sera construit avec le soutien de Roche

**L'Arc lémanique, futur pôle de simulation en biologie**

Etape de construction du centre de recherche Neuropolis sur l'Arc lémanique. Le projet, financé par le canton de Genève, l'Etat fédéral et la Roche, vise à créer un centre de recherche international de pointe en neurosciences. Le bâtiment sera construit sur le campus de l'EPFL. Un nouveau bâtiment sera construit avec le soutien de Roche.

A Genève l'université (UNIGE) et les hôpitaux (HUG) vont construire un Institut d'imagerie moléculaire translationnelle. Dans un premier temps, quelque 10 millions de francs seront avancés par des privés et des institutions publiques, a marqué le conseiller d'Etat genevois Charles Beer. Roche

**Translational Molecular Imaging Institute**  
Infrastructure, labs, facilities

**EPFL**

**Campus Biotech**  
Merck-Serono building

**EPFL**

**Tribune de Genève**  
Le quotidien genevois. Depuis 1879 | www.tdg.ch

**Biotech: Bertarelli rebâtit sur les cendres de Serono**

Merck cède son site genevois au duo Bertarelli-Wyss. Un centre de recherche en biotechnologie y verra le jour

**Campus Biotech remet Genève sur orbite**

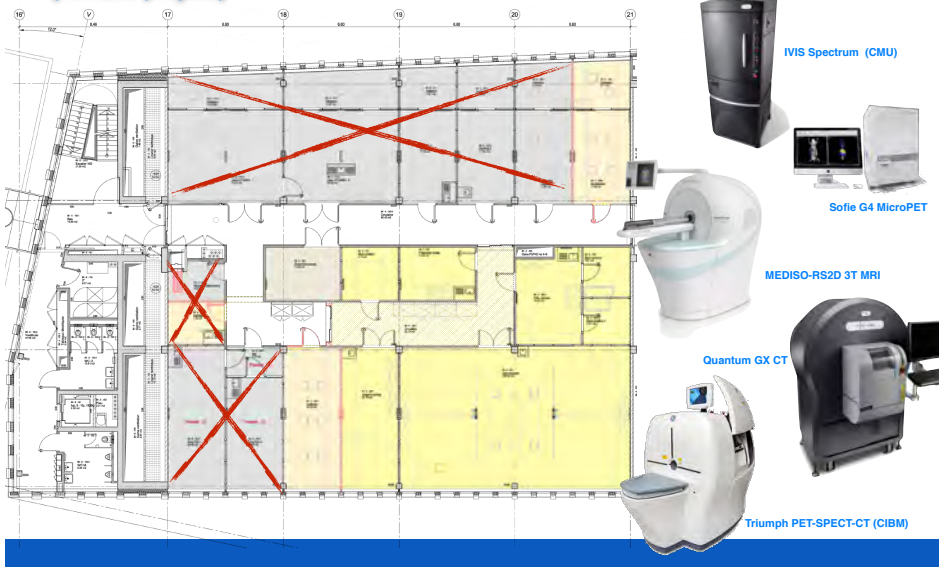
Bertarelli et Hansjörg Wyss veulent créer à Sâcheron un centre de compétences de niveau international. L'EPFL, l'Université de Genève et sont associés

«Un projet enthousiasmant»

Fermeture de Merck-Serono: autopsie d'un traumatisme régional

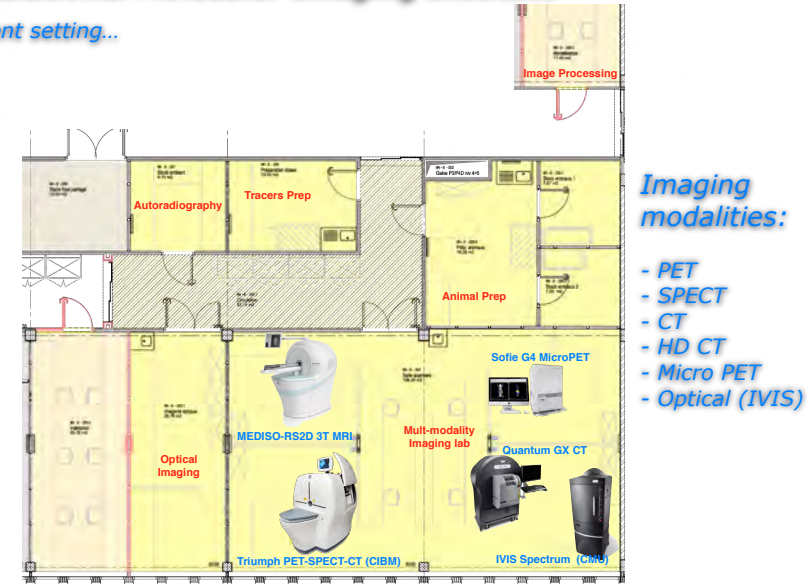
# Translational Molecular Imaging Institute

Infrastructure, labs, facilities  
(revised project)



# Translational Molecular Imaging Institute

Current setting...



Imaging modalities:

- PET
- SPECT
- CT
- HD CT
- Micro PET
- Optical (IVIS)

# Translational Molecular Imaging Institute

Support team



**Didier Colin, PhD**  
Maitre Assitant  
Responsable Laboratoire d'imagerie microPET/SPECT/CT  
Centre d'Imagerie BioMédicale: (C.I.B.M.)



**Laurent Vinet, PhD.**  
Maitre-Assistant  
Département de génétique et développement, C.M.U.,  
Prof X. Montet, Université de Genève (50%)  
Institute of Translational Molecular Imaging  
Geneva (50%)



**Stéphane Germain**  
Adjoint Scientifique,  
Laboratoire MicroPET/SPECT/CT (Plateforme Vétérinaire)  
Centre d'Imagerie BioMédicale: (C.I.B.M.)



**Yohan van de Looij, PhD.**  
Maitre-Assistant  
Division of Child Development & Growth  
Pro. P. Huppi Children's Hospital Geneva (50%)  
Functional and Metabolic Imaging Laboratory, EPFL  
--  
Institute of Translational Molecular Imaging  
Geneva (50%)



**Marie-Anais Petit**  
MRI Engineer  
Société RS2D / MEDISO  
Collaboration technique (50%)

# Translational Molecular Imaging Institute

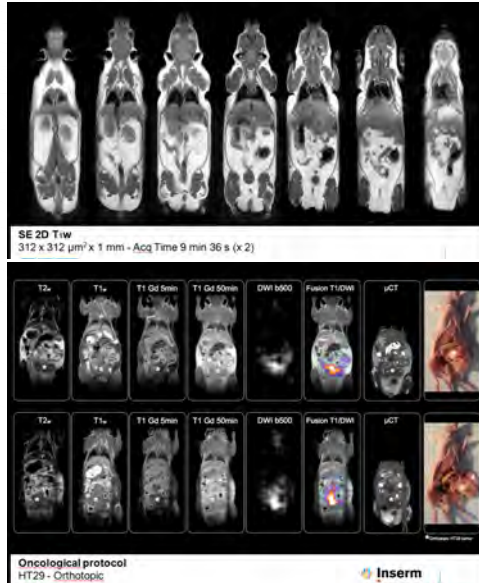
Progress of infrastructure implementation



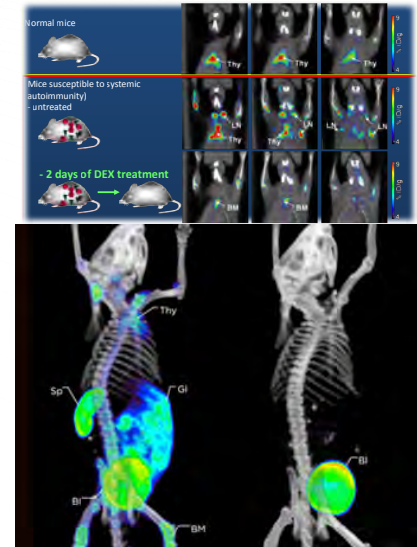
April-May 2016



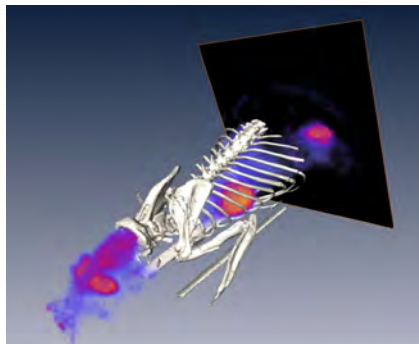
Nanoscan - 3T MRI



Hybrid PET-SPECT-CT



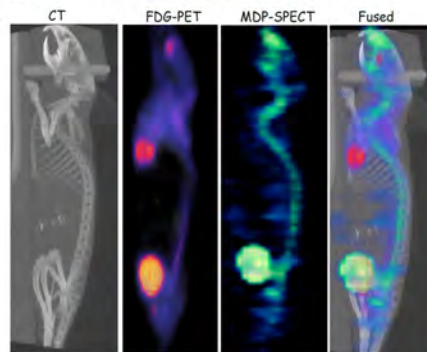
Hybrid PET-SPECT-CT



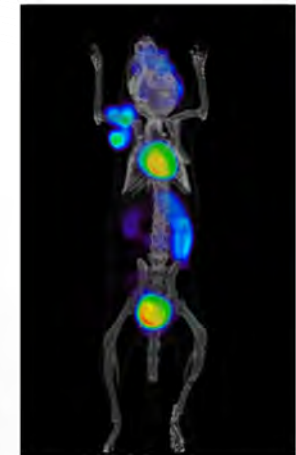
Bi-modality



Tri-modality



Desktop micro PET

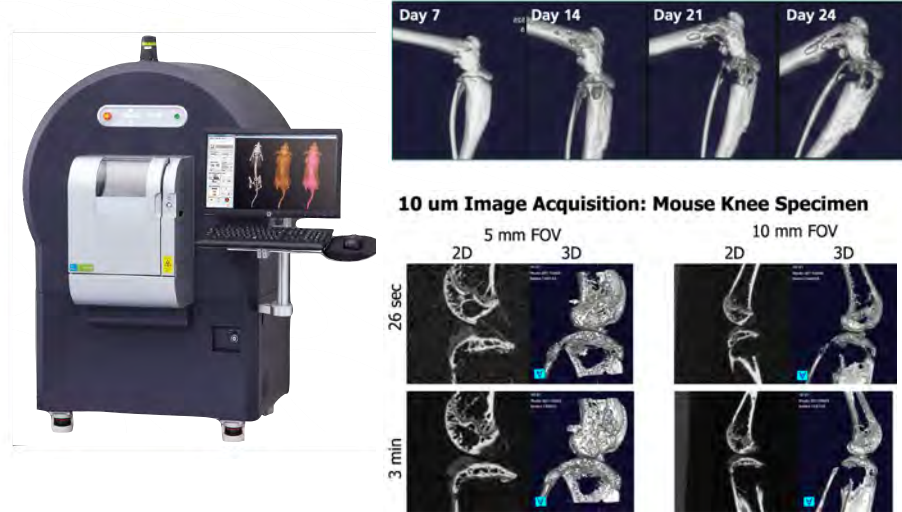


Fused FDG PET image with mouse registration system

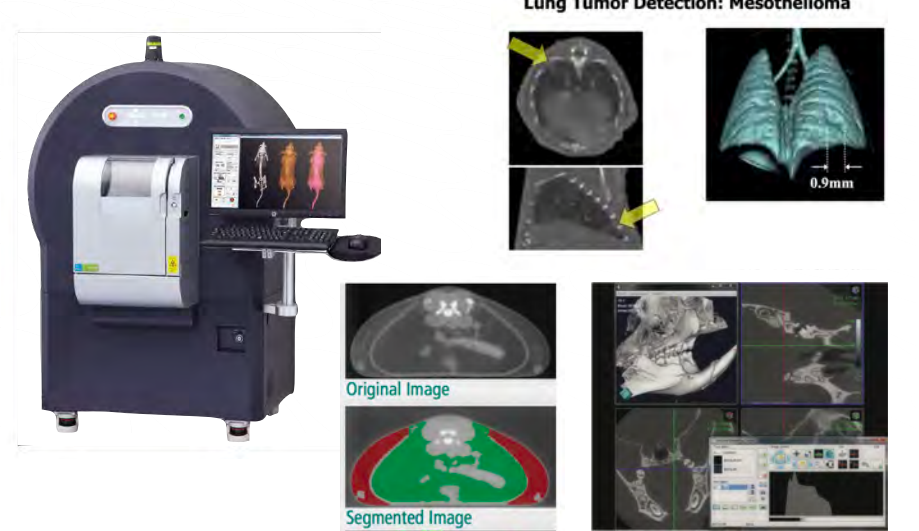


G4 PET/X-RAY

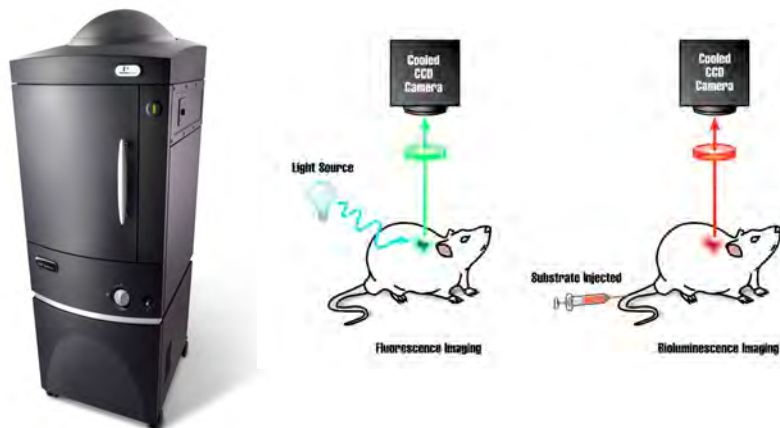
Low-dose high-resolution CT



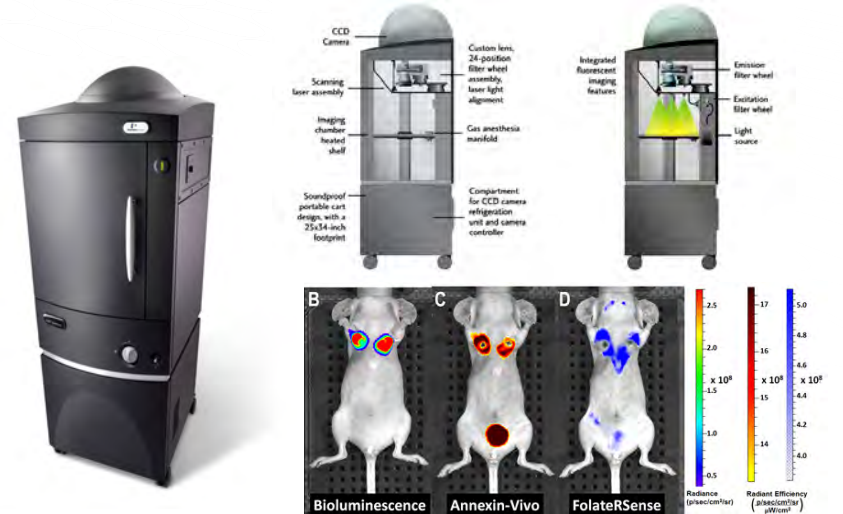
Low-dose high-resolution CT



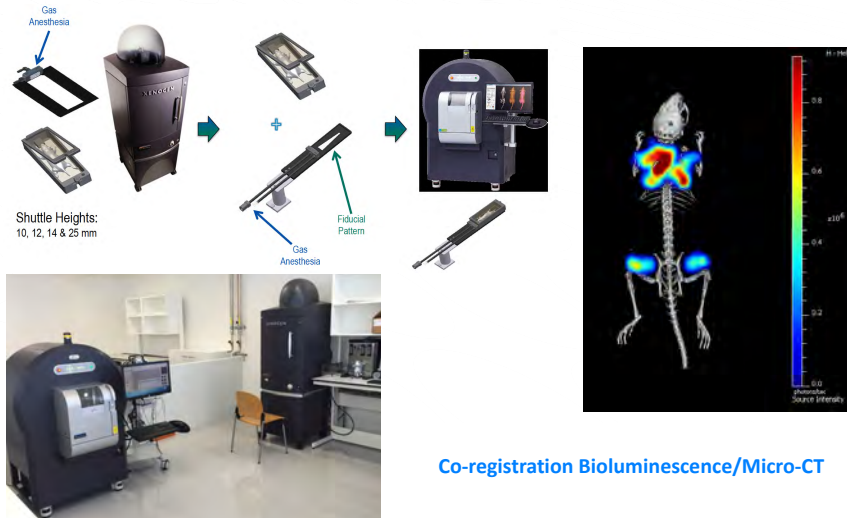
Optical imaging (Bioluminescence and Fluorescence)



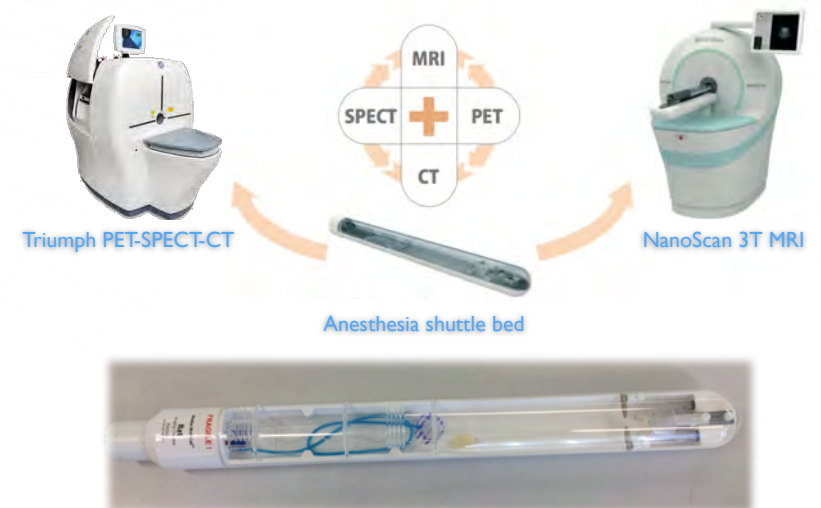
Optical imaging (Bioluminescence and Fluorescence)



*Multi-modality co-registration*



*Multi-modality co-registration (standard shuttles)*



*Controlled area for use of open radioactive sources*



*Sterile laminar flow animal prep cells*






- **Industry-driven projects**
  - Drug development programs
  - Development of new biomarkers
  - Long term partnerships
  - Multi-centric clinical trials
  
- **Public-Private partnership**
  - Validation and development of new imaging technologies
  - Joint development of new tracers and biomarkers
  - Private funding of spinoff companies
  
- **Public funding**
  - Competitive federal funding programs
  - Program projects grants
  - Enrollment in excellence programs
  
- **Donors and philanthropy**
  - Endowment of academic positions
  - Sponsoring of thematic programs

- **Neurodegenerative diseases**
  - MCI and Alzheimer disease
  - Multiple sclerosis
  - Parkinson disease
  
- **Advanced cancer treatment**
  - Neo-angiogenesis
  - Biomarkers
  - Radio-immunotreatment
  
- **Aging process Biomarkers**
  - Proteomic and genomic predictors of degenerative diseases
  - Molecular Imaging of aging process
  - Biological models of aging
  
- **Cardiovascular**
  - Pathophysiology of vascular plaques
  - Biomarkers of active arteriosclerosis
  - Linking arteriosclerosis and osteoporosis








## Translational Molecular Imaging Institute

Strength of Geneva pole

- Cyclotron and radiochemistry
- Proximity of CMU and HUG
- Collaboration with CERN
- Strong basic science (proteomic and genomic)
- Close link to pharmaceutical sciences
- Priority clinical research programs





## Geneva cyclotron unit

GMP certified production unit

<b>Radionuclides produced</b>	<ul style="list-style-type: none"> <li>● Standard positron emitters: <math>^{11}\text{C}</math>, <math>^{13}\text{N}</math>, <math>^{15}\text{O}</math> and <math>^{18}\text{F}</math></li> <li>● Radiometals: <math>^{64}\text{Cu}</math>, <math>^{86}\text{Y}</math>, <math>^{89}\text{Zr}</math></li> </ul>
<b>Approved radiopharmaceuticals</b>	<ul style="list-style-type: none"> <li>● Oncology: <math>^{18}\text{F}</math>FDG, <math>^{18}\text{F}</math>NaF, <math>^{11}\text{C}</math>acetate</li> <li>● CNS: <math>^{18}\text{F}</math>FDG, <math>^{18}\text{F}</math>F-A-85380, <math>^{18}\text{F}</math>Fallypride</li> <li>● Cardiac: <math>^{18}\text{F}</math>FDG, <math>^{13}\text{N}</math>ammonia</li> </ul>
<b>Clinical radiopharmaceuticals under development</b>	<ul style="list-style-type: none"> <li>● Oncology: <math>^{18}\text{F}</math>FCH, <math>^{18}\text{F}</math>FMISO, <math>^{18}\text{F}</math>FLT, <math>^{64}\text{Cu}</math>Cu-ATSM, <math>^{18}\text{F}</math>FDOPA</li> <li>● CNS: <math>^{15}\text{O}</math>H<sub>2</sub>O, <math>^{11}\text{C}</math>DASB, <math>^{18}\text{F}</math>FDOPA</li> </ul>
<b>Field of research</b>	<ul style="list-style-type: none"> <li>● Probe development: tyrosine kinase inhibitors, angiogenesis imaging, multimodality imaging probes, metabolism</li> <li>● Small animal imaging: therapy prediction, cardiac imaging</li> <li>● Technology: synthetic approach for labeling of biomolecules, microfluidic chip</li> </ul>

MEDICIS/Promed Leman School  
 @ HUG / ITMI imaging lab  
 Tuesday March 13 2018

### Final program

- 8:30-9:00 *Arrival and registration*
- 9:00-9:30 Emerging role of animal imaging in translational research (O. Ratib)
- 9:30-10:15 Molecular imaging as a tool to predict treatment outcomes (M. Walter)
- 10:15-10:30 Questions & discussion
- 10:30-11:00 *Coffee break*
- 11:00-11:30 Development of new radiopharmaceuticals (F. Bois)
- 11:30-12:00 Techniques of small animal imaging (S. Germain)
- 12:00-14:00 *Lunch*
- 14:00-17:00 Practical demonstrations and visits of:
- MRI imaging
  - High resolution CT imaging
  - PET-CT imaging
  - Optical Imaging
- Visit of the medical cyclotron unit (for ESR's only)

MEDICIS/Promed Leman School  
 @ HUG / ITMI imaging lab  
 Tuesday March 13 2018

Time	MRI	CT /OPTICAL	PET/SPECT	CYCLOTRON
14:00 - 14:30	Group 1	Group 2	Group 3	
14:30 - 15:00	Group 2	Group 3		Group 1
15:00 - 15:30	Group 3		Group 1	Group 2
15:30 - 16:00		Group 1	Group 2	Group 3

**Group 1** Annie Ringvall Moberg  
 Nhat-Tan Vuong  
 Johanna Pitters  
 Marina Nazarova  
 Vadim Gadelshin

**Group 2** Roberto Formento Cavaier  
 SANJIB CHOWDHURY  
 Alice D'Onofrio  
 Kyungdon Choi  
 Maddalena Maietta

**Group 3** Simon Thomas Stegemann  
 Alexandra Litvinenko  
 Francesco Cicone  
 IOANNA PRIONISTI  
 Grigory Karateev

## Institute of Translational Molecular Imaging



**Bridging between clinical  
 sciences and basic research**

