

Scientific Formation

Doctoral School : ED352

Intitulé de la formation	MRI Physics
Mots-clés	MRI, biophysical models, biomarkers
Public Prioritaire	PhD students, Master Students
Adresse http de la formation	https://crmbm.univ-amu.fr/teaching/
Lieu où se déroulera la formation	CEMEREM, Hopital la Timone, Bat F. 264 rue St Pierre – 13385 Marseille https://crmbm.univ-amu.fr/public/pdf/crmbm_access.pdf
Durée de la formation	2.5 days/15 HETD
Dates de la formation	20-21-22/01/2025
Objectifs	Introduction to MRI: <i>quantum basis, macroscopic magnetization, localization principle, signal processing and image reconstruction, instrumentation</i> To understand the different types of MRI contrasts and their association with biophysical models for <i>in vivo</i> applications
Programme	<ul style="list-style-type: none">- Basics: from the spin to the image- MR contrasts- Parametric imaging- Hands on
Pré-requis éventuels	Quantum Physics, Modelling, numerical physics, signal processing
Compétences visées à l'issue de la formation	<ul style="list-style-type: none">- Theoretical basis of Nuclear Magnetic Resonance & Magnetic Resonance Imaging- Advanced parametric MRI- Relationship between biophysical models and MR contrasts
Observations particulières	
Méthode pédagogique	Powerpoint presentations & hands on in CRMBM lab https://crmbm.univ-amu.fr
Equipe ou intervenant(e)	L. de Rochefort, O. Girard, S.Rapacchi, L. Soustelle, G. Duhamel - groupe « <i>Physics and digital technologies for quantitative imaging of the central nervous system</i> » https://crmbm.univ-amu.fr/topic/pheniqs/
Nombre min de participants	>5
Nombre max de participants	<40

Heures de formation en vacation

Heures dispensées dans le cadre de l'Institut : Institut Marseille Imaging

MRI Physics

- **Basics: from the spin to the image** – (Ludovic de Rochefort)
 - Quantum basis: spin $\frac{1}{2}$, Larmor Resonance, Thermal equilibrium, Magnetization
 - Macroscopic Magnetization: Spin Echo, Gradient Echo
 - NMR Relaxation T1, T2, T2*
 - Instrumentation (B0, gradient, RF coil)
 - Spatial coding / Localization principle / parallel imaging
 - Contrasts and basis for image interpretation
- **MRI Contrast Mechanisms** - (Guillaume Duhamel, Olivier Girard)
 - Diffusion
 - Perfusion (DSC, DCE, ASL, BOLD)
 - Relaxation (multicomponent)
 - Magnetization Transfer (MT, CEST)
 - Magnetic Susceptibility
- **Parametric imaging** - (Lucas Soustelle, Aurélien Destruel)
 - Analytic and matrix formalism
 - Direct model / inverse model (fitting)
 - Regularization
 - Advanced MR techniques (MR Fingerprinting, Compressed sensing, Artificial Intelligence)
- **Hands on** -
 - In vivo MRI experiment: Parametric image acquisition on the (pre)clinical MRI scanner of CRMBM / Image processing