

Selected centres (and experts):

- NeurATRIS Translational Neurosciences, Paris (Prof. LeBihan, Dr. Poupon)
- UMC Utrecht Center for Image Sciences (P. Luijten, D. Klomp, H. Hoogduin, C.A.T. van den Berg)
- LUMC Leiden C.J. Gorter center for High field MRI (A. Webb)
- MUMC Maastricht Brain Imaging Center (R. Goebel)
- The Danish Research Centre for Magnetic Resonance (DRCMR) Copenhagen (H. Siebner)
- IMINET, Sapienza University Rome (V. Panebianco), Palermo University (M. Midiri).

Literature

- **Trattinig S, et al.** Clinical applications at ultrahigh field (7T). Where does it make the difference? NMR Biomed (2015).
- **van der Kolk AG, et al.** Ultrahigh-field magnetic resonance imaging: the clinical potential for anatomy, pathogenesis, diagnosis, and treatment planning in brain disease. Neuroimaging Clin N Am (2012).
- **Kilsdonk ID, et al.** Multicontrast MR imaging at 7T in multiple sclerosis: highest lesion detection in cortical gray matter with 3D-FLAIR. AJNR Am J Neuroradiol (2013).
- **de Graaf WL, et al.** Clinical application of multi-contrast 7-T MR imaging in multiple sclerosis: increased lesion detection compared to 3T confined to grey matter. Eur Radiol (2013).
- **Kwon DH, et al.** Seven-Tesla magnetic resonance images of the substantia nigra in Parkinson disease. Ann Neurol (2012).
- **Cho ZH, et al.** Direct visualization of deep brain stimulation targets in Parkinson disease with the use of 7-tesla magnetic resonance imaging. J Neurosurg (2010).
- **Klomp DW, et al.** ³¹P MRSI and ¹H MRS at 7T: initial results in human breast cancer. NMR Biomed (2011).

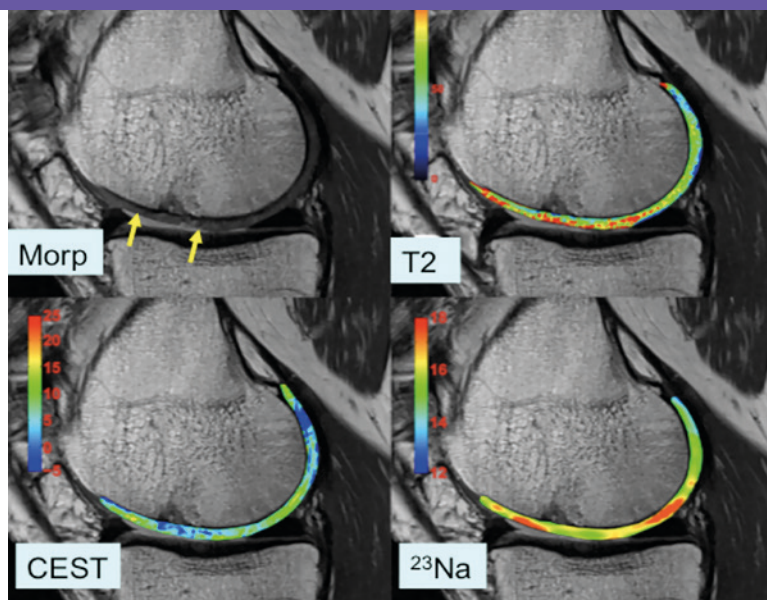
How can
UHF MRI help
your translational
development
program?

eatris

ULTRA-HIGH FIELD MRI:

IMAGING BIOMARKERS FOR HIGH PRECISION MEDICINE

DECREASE RISK, IMPROVE INSIGHTS, AND INCREASE VALUE



GagCEST imaging at 7T in a patient 9.4 years after autologous osteochondral transplantation (AOT) at the medial femoral condyle. Comparison to sodium imaging T2 mapping and PD-FSE sequence reveals cartilage degradation in the cartilage transplant (yellow arrows). Courtesy S. Trattnig et al., MR Centre of Excellence, Vienna, Austria.

Magnetic Resonance Imaging (MRI) and spectroscopy (MRS), with its non-ionizing radiation and unsurpassed endogenous soft-tissue contrast, is one of the most versatile imaging modalities capable of providing detailed morphological, functional, physiological and metabolic information. Recently several Ultra high field (UHF) MRI systems have been installed in EATRIS research institutions, operating at much higher magnetic field strengths (7T and above), to overcome the sensitivity and specificity limits of MRI platforms that are used for routine clinical diagnoses. While these systems are mostly used in the cognitive sciences, a number of them have been used for the development of (new) imaging biomarkers for early diagnosis, prognosis, prediction and surveillance of disease progression and treatment efficacy.

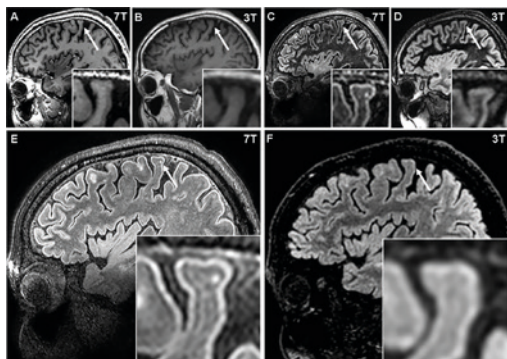
For example Multiple sclerosis (MS), a commonly encountered, progressive neurologic disease with a high morbidity, is generally associated with hyperintense white matter brain lesions. Such type of lesions are also characteristic of the normally ageing brain, but UHF MRI studies have revealed distinct features of MS associated lesions in cortical areas of the brain, allowing earlier treatment and monitoring of disease.

How can UHF MRI help your translational development program?

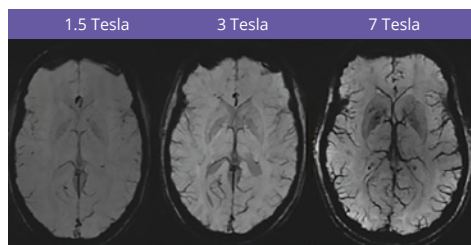
- Unprecedented spatial resolution combined with new contrast generation for the assessment of tissue morphology, function and metabolism.
- Detection of hallmarks of the early onset of degenerative diseases like Alzheimer and vascular dementia (e.g. micro-bleeds and micro-infarcts, intracranial atherosclerosis and sub-segmental hippocampal degeneration)
- Response monitoring, such as detection of molecular changes associated with chemotherapy (^1H , ^{31}P , ^{13}C , ^{19}F , ^{23}Na , ^{17}O spectroscopy), neurotransmission (glutamate, GABA), ischemia, tissue pH, phosphor mono- and di-ester metabolism)
- Detection of subtle changes in cartilage composition

Technical and Regulatory (QA/QC) aspects of UHF MRI

- Quantitative T_1 , T_2 , T_2^* , $T_1\rho$ and quantitative susceptibility (SQM) mapping (normal appearing white matter disease, vessel density, myelin loss and myocardial fibrosis)
- Fractional Anisotropy and Diffusion Tensor Imaging (neuro degeneration and ALS)
- Electrical Property Tomography (stroke and tumour imaging)
- Arterial Spin Labeling (stroke and small vessel disease)
- 3D Phase Contrast flow imaging (vessel shear stress and aneurysms)
- Chemical Exchange Saturation Transfer (cartilage imaging and tumor necrosis-recurrence differentiation)
- Front-running expertise in MR pulse sequences, MRI and MRS data analysis and interpretation
- Image quality control and support for the assessment of safety aspects of the applications of UHF MRI applications
- Quality assurance and vendor neutral standardization of procedures
- Access to 7T^1 , as well as 3T MRI platforms.
- Expertise for custom built UHF MR hardware (RF coils).



Clinical research: Lesion detection at seven Tesla in multiple sclerosis using magnetisation prepared 3D FLAIR and 3D-DIR. Courtesy P. Luyten, UMCU Utrecht, The Netherlands.



Improved T_2^* -weighted contrast using ultra-high field MRI. Courtesy M. Ladd, The German Cancer Research Center, DKFZ, Heidelberg

The EATRIS UHF MRI / MRS Imaging network

EATRIS offers pan-European access to cutting edge, unique in the world infrastructure, cost efficient use of shared facilities open for public-private collaboration. New therapy approaches are also evaluated in collaboration with industry.

¹ The Maastricht Brain Imaging Center and CEA Neurospin network have access to a human 7.0T and 9.4T MRI system