# Ultra High Field Magnetic Resonance Imaging

Currently, the majority of clinical MRI systems operate at moderate field strengths of 1.5 Tesla and 3 Tesla. For small animal imaging, resolutions need to be significantly increased in order to visualize similar structures as in humans. Since the sensitivity increases with the field strength, field strengths of 7 Tesla and 9.4 Tesla are therefore standard in the preclinical field. Beyond this, preclinical UHF systems ranging from 11.7 Tesla to 21 Tesla address specific applications, which demand the highest sensitivity. Even the most demanding applications become feasible when ultra high field strengths are combined with optimal coil setups, such as receive-only arrays, the sensitivity of which increases super-linearly with magnetic field strength, or MRI CryoProbes, which provide an even additional sensitivity boost.

The advantages of UHF MRI go beyond the sensitivity gain itself. UHF MRI facilitates a range of imaging methods and applications. Increased chemical shift, increased Blood Oxygenation Level Dependent (BOLD) contrast, altered relaxation times, and increased susceptibility effects make it predestinated for several MRI methods such as MR Spectroscopy (MRS), BOLD Functional MRI (fMRI), Chemical Exchange Saturation Transfer (CEST), Susceptibility weighted Imaging (SWI), and Quantitative Susceptibility Mapping (QSM).

Taken together UHF MRI can open up completely new avenues in the understanding of biological processes.

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Implications of extracranial distortion in ultra-high-field MRI for image-guided cranial neurosurgery [1)].

1)
Voormolen EH, Diederen SJH, Woerdeman P, van der Sprenkel JWB, Noordmans HJ, Visser F, Viergever M, Luijten P, Hoogduin H, Robe PA. Implications of extracranial distortion in ultra-high-field MRI for image-guided cranial neurosurgery. World Neurosurg. 2019 Feb 21. pii: S1878-8750(19)30439-5. doi: 10.1016/j.wneu.2019.02.028. [Epub ahead of print] PubMed PMID: 30797931.