

## Microtesla MRI of the Human Brain Combined with MEG

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**Abstract** - Detailed understanding of human brain function requires the ability to non-invasively image brain activity with both high temporal and high spatial resolution. Presently, this can only be achieved through integration of complementary imaging modalities, such as magnetoencephalography (MEG) and magnetic resonance imaging (MRI or functional MRI (fMRI)). MEG, which uses highly sensitive superconducting quantum interference devices (SQUIDS) to directly measure magnetic fields of neuronal currents, cannot be combined with conventional high-field MRI in a single instrument. MEG and MRI data, acquired by two different systems, can only be matched indirectly, by means of an elaborate and error-prone co-registration. A new imaging method – SQUID-based microtesla MRI – can be naturally combined with MEG in the same system to provide an anatomical map for MEG-localized neural sources. Here we report the first MR images of the human brain acquired at a microtesla-range measurement field, together with auditory MEG (functional) data, recorded using the same seven-channel SQUID system during the same imaging session. This result demonstrates feasibility and potential of human brain imaging by microtesla MRI. It also shows that two new types of imaging equipment – systems for anatomical MRI of the human brain at microtesla fields, and more advanced instruments for combined functional (MEG) and structural (microtesla MRI) brain imaging – are practical. Information provided by such combined instruments can be easily integrated with data from other imaging modalities, including fMRI, to utilize advantages of different methods and enable high-resolution spatiotemporal imaging of brain function.

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### Editor's Comment to Paper ST31

(February 8, 2008) Although European News Forum publishes mainly papers originating from Europe, we gladly accept papers from overseas if these are especially timely and important. In the Editor's opinion this is the case of the paper ST31 by Zotev et al.

Readers of that paper might wonder why in discussing the speed of MRI data acquisition the authors did not mention the seemingly obvious possibility of further increasing the number of SQUID channels? While it is so in principle, this possibility is subject to some limitations and deserves a detailed discussion. Interested readers can find pertinent arguments in another, earlier paper by the same authors ("Parallel MRI at Ultra-low Fields" by V.S. Zotev, P.L. Volegov, A.N. Matlashov, M.A. Espy, J.C. Mosher and R.H. Kraus Jr), which is accessible at: <http://arxiv.org/abs/physics/0701188>.