High-T_c SQUID based on-scalp MEG

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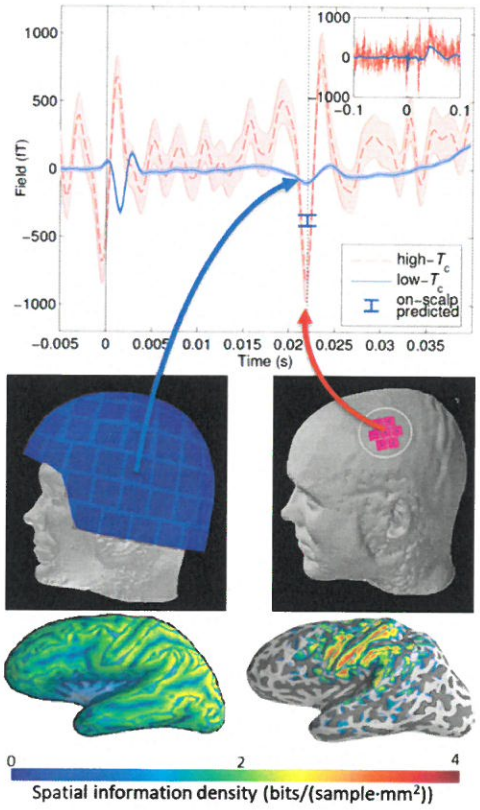
Accurate tracking of brain function in space and time with magnetoencephalography (MEG) has traditionally been performed with low critical-temperature superconducting quantum interference devices (low-T_c SQUIDs). While highly sensitive, the extreme cryogenic operating temperature of such SQUIDs necessitates rigid helmet dewars wherein the sensors are a few cm from the scalp surface. Our group is developing an approach for utilizing high-T_c SQUIDs for MEG because their less extreme operating temperature enables sampling at the scalp surface [1]. This is advantageous because improved proximity between the sensors and brain leads to stronger signal levels and higher spatial resolution. As such, we have shown how a full-head on-scalp MEG system can theoretically extract more information about brain activity—especially in children—than low-T_c SQUID-based systems despite the lower field sensitivity of high-T_c SQUIDs [2]. A newly developed seven-channel high-T_c SQUID based on-scalp MEG system reaches close scalp proximity and high sampling density. We have used it for a variety of neuroimaging investigations including somatosensory evoked fields, visual gamma-band neural oscillations, and epilepsy.

In this talk, I will provide an overview of our contributions to the field of on-scalp MEG. This includes theoretical motivation for this approach as well as experimental evidence for the advantages of on-scalp MEG via direct comparisons to a state-of-the-art (low-T_c SQUID-based) MEG system.



Experimental (top) and theoretical (bottom) demonstrations of the advantages of high-T_c SQUID-based on-scalp MEG (adapted from [2,3]).

References

[1] F. Öisjöen et al, *Applied Physics Letters* **100**(13), 132601 (2012)

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[3] M. Xie et al, *IEEE Trans. on Biomed. Eng.* **64**(6), 1270-1276 (2016).