Preliminary evidence of fetal magnetoencephalography with optically pumped magnetometers

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The developing brain of the human fetus generates tiny magnetic signals that can be measured from the mother's abdomen. Fetal magnetoencephalography (MEG) gives insight into how the healthy fetal brain begins to function as well as potential abnormalities in high-risk pregnancies. However, the technique has been limited to only three labs in the world that have SQUID-based MEG systems appropriately shaped for pregnant women. Measurement of fetal MEG with OPMs would greatly expand the availability of fetal MEG.

Classic stimulation techniques involve delivery of light or sound onto the mother's abdomen. In this initial proof of concept, however, we instead relied on an acoustic signal intrinsic to the mother's body, the sound of her heartbeat. The QRS complex and T wave of the cardiogram coincide with the two major heartbeat sounds.

We recruited 2 women in the 36th week of pregnancy and placed 16 FieldLine OPMs covering their abdomens. Recordings were obtained while the mother relaxed or slept on an MEG-compatible bed. Maternal MCG and fetal MCG were both observed in the raw data, and the data were then processed with independent components analysis (ICA) to remove them and reveal potential fetal MEG signals. In both participants, this revealed waveforms consistent with two consecutive auditory evoked responses, each commencing 170 ms after the maternal QRS complex and T wave (Figure 1).

This corresponds well with known fetal auditory response latencies from SQUID-based fetal MEG studies, and may therefore represent the first fetal MEG recordings with OPMs to our knowledge.

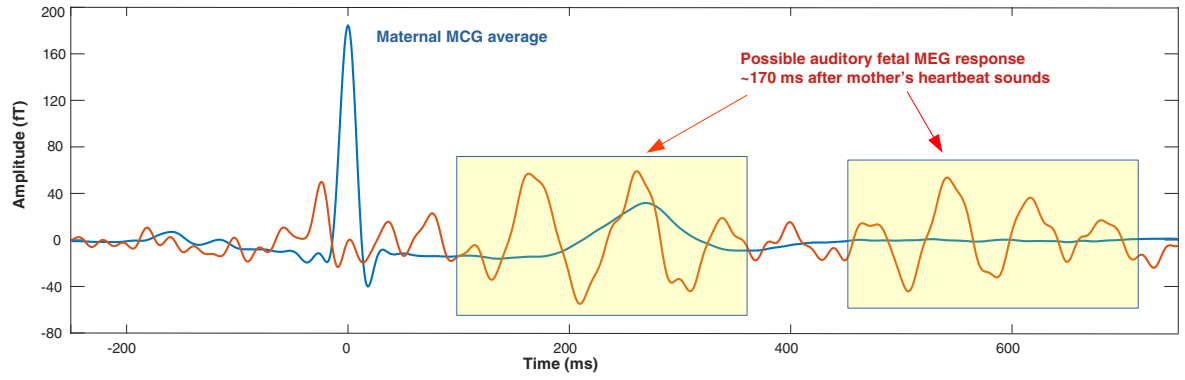

Figure 1: In blue, average of the maternal MCG component over 27 minutes (1519 heartbeats). In red, a component consistent with a fetal MEG response to the sound of the maternal heartbeat.