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Presenter: Daniel Pollak

Poster title: Magnetsearch: a collective science project to identify animal magnetoreceptors

Abstract: If biological cells could be controlled using magnetic fields, this would enable unprecedented approaches to basic biology and medicine. Ideally one wants a genetic tool that can render arbitrary cells magnetically sensitive, a goal now known as “magnetogenetics”. Several attempts to accomplish this by de novo bioengineering have failed, mainly because magnetic fields interact only weakly with biological molecules. At the same time we know that certain animal species have the remarkable ability to sense the Earth’s magnetic field and to use this information for orientation and navigation. Thus there must exist nerve cells with the mechanism to transduce even weak magnetic fields: the magnetoreceptors. If one could find those receptor neurons, they would reveal a cellular pathway that could be used for magnetic control. We have initiated a collective science project to find magnetoreceptors. The approach is to first search for neural signals anywhere in the brain that respond to magnetic stimuli. Based on such signals one can then pursue a magnetic scanning method to localize where the magnetic responses originate.

Many research groups today are engaged in high-throughput neuroscience pursuing a broad range of questions in diverse species, using revolutionary methods that record signals from hundreds to thousands of neurons at a time. The project transiently engages many of these groups in a broad unbiased search for magnetoreceptors. The Caltech team constructs electromagnetic stimulators that produce a defined magnetic field and ships these to each partner lab. The device can be added easily to an ongoing experiment, and a mere 20 minutes of recording will reveal whether any of the neurons under study carry magnetic signals.

Here we will report on the design of this project, and present data analysis methods designed to reveal a small sensory modulation with high sensitivity. We will also report preliminary results on recordings under magnetic stimuli from many thousands of neurons in diverse brain areas of mammals, fish, and birds.