MA 34: Invited Talks Winklhofer / Zabow

Time: Thursday 14:00–15:00 Location: HSZ 04

Invited Talk MA 34.1 Thu 14:00 HSZ 04

The biophysics of geomagnetic-field reception in animals — •Michael Winklhofer — LMU Munich, Germany

I will give an overview of the recent progress towards understanding the physical basis of the magnetic sense of animals. Research into magnetic field reception is currently driven by two hypotheses. One proposal relies on the presence of molecules that undergo magnetically anisotropic chemical reactions due to transient formation of a spin-correlated radical pair. Lately, the proposed chemical compass mechanism has been corroborated in principle by in-vitro experiments on artificial radical-pair systems. Specifically designed behavioral experiments suggest the involvement of radical-pair molecules in the compass sense of birds, but the biological structures hosting such molecules remain elusive. The second hypothesis builds on specialized sensory structures that contain ferrimagnetic particles and assumes that the magnetic input energy is converted into mechanical output energy to be transduced into a nerve signal by means of strain-sensitive ion channels. Magnetite has indeed been identified in sensory nerve structures, with stable magnetic single-domain particles in fish and micrometer-scale clusters of superparamagnetic nanocrystals in birds. While it is straightforward to explain the basic compass sense with the magnetite-based transduction mechanism, it is still a challenge to explain its sensitivity, which in some animals has been reported to be lower than 100 nT. Funding by the German Science Foundation (DFG Wi1828/4-1) and HFSP (RGP 45/2008) is gratefully acknowledged.

Invited Talk MA 34.2 Thu 14:30 HSZ 04

Micromagnets for multispectral magnetic resonance imaging — •Gary Zabow[1,2], Stephen Dodd[1], John Moreland[2], and Alan Koretsky[1] — [1]National Institutes of Health, Bethesda, MD, USA — [2]National Institute of Standards and Technology, Boulder, CO, USA

New optical bio-imaging techniques are behind much of the recent growth in molecular and cellular biology research. Many of these imaging advances are due to the introduction of new coloured fluorophores such as fluorescent proteins and quantum dots. Used as biological tags / labels, their distinct colours enable simultaneous tracking of multiple biological indicators. Unfortunately, equivalent multiplexing capabilities are largely absent in magnetic resonance imaging (MRI). Corresponding MRI labels have generally been limited to chemically synthesized paramagnetic molecules and superparamagnetic nano- and microparticles that are substantially indistinguishable from one another.

This talk introduces a top-down microfabrication approach to MRI contrast agent engineering that enables encoding of distinct spectral signatures into the geometry of magnetic microstructures. Although based on different principles to those of optically-probed nanoparticles, these new magnetic microstructures permit a multiplexing functionality in the magnetic resonance radio-frequency (RF) spectrum that is in many ways analogous to that permitted by quantum dots in the optical spectrum. Additionally, in situ modification of particle geometries may facilitate RF probing of various local physiological variables.

The talk will be aimed at an introductory level and will not assume any prior biology or MRI knowledge.