Behavioural studies over more than 50 years have shown that many animals are able to sense steady magnetic fields even weaker than the earth field and exploit this extraordinary capacity for orientation, navigation and homing. The intriguing question how magnetoreception works, both physically and neuro-physiologically, is still a matter of debate. Major candidate mechanisms are magnetic nano-particles somehow coupled to the nervous system and field dependent chemical reactions involving photoinduced spin-correlated free radicals. In this project a new non-invasive optical technique, Near Infrared Diffusing Wave Spectroscopy (DWS), will be used to monitor and possibly image magneto-reception-related brain activity in different animals, primarily homing pigeons, under controlled laboratory conditions. DWS detects mechanical motions down to the nm range at time-scales below μsec and thus has potential to complement other techniques - such as functional Magnetic Resonance Imaging which is comparably slow – by accessing short times (msec) after stimulus were evoked nervous activity and metabolic changes can be distinguished. Various stimuli such as magnetic field strength, gradient and direction, strong field pulses, modulated fields, light intensity and polarization and odours will be used either separately or in combinations. This should allow critical tests of the features of both mechanisms of magnetoreception and quantify their significance and eventual interplay.