

## Abstract

Author: Dr. Jürg Fröhlich  
Institution: ETH Zürich

### **Title: Thermosensor protein GrpE of the heat shock protein Hsp70 system as target for high-frequency electromagnetic fields**

In previous studies on the potential effects of electromagnetic fields on different cell types after exposure, alterations in complex cellular features and processes, such as genetic damage, proliferation, differentiation, apoptosis or gene expression were examined. The electromagnetic fields applied were mostly narrow-band signals such as emitted by mobile phones in the GSM bands. Some studies included UMTS-like signals. However, results remained controversial and relevant mechanisms are still unclear.

Other studies using single proteins have already reported effects on the structure (de Pomerai et al., 2003) and on the folding kinetics (Bohr and Bohr, 2000). Effects of microwaves below power levels that increase temperature have also been reported with myoglobin (Mancinelli et al., 2004).

These studies have not remained undisputed and, in one case, have even been retracted by the authors because re-investigation showed that at least part of the observed effect was thermal (Dawe et al., 2006). The differentiation between thermal and non-thermal effects is indeed the general crux in examining possible effects of high-frequency electromagnetic fields on biological matter.

In this project, a mechanism-oriented approach will be taken. The complexity of the investigated object will be reduced from the cellular to the molecular level as the most likely primary targets for electromagnetic effects are expected to be biological macromolecules and membranes. The molecular system GrpE chosen for the study also exists in the human organism (Moro & Muga, 2006) and its thermal behaviour within the physiological temperature range is well characterized (Grimshaw et al., 2001, 2003). The conformational equilibrium that will be measured is strictly defined by temperature and thus may be expected to allow a clear differentiation between thermal and non-thermal effects. By integrating the exposure unit into the spectropolarimeter for the detection of potential changes, the point of observation becomes identical with the potential interaction site in space and time. This situation allows the detection of even small effects that otherwise might vanish in biological noise. If an effect can be detected, the interaction mechanism may be explored by genetic engineering of GrpE, e.g. by deleting or introducing positively or negatively charged residues or segments of the polypeptide chain.