Grenoble Alliance for Integrated Structural & Cell Biology

INTERNSHIP PROPOSAL

Institute and Group:

Laboratoire Interdisciplinaire de Physique (LiPhy) et Institut Laue Langevin (ILL)

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Research project title:

Quantum effects in biology

5 Keywords to describe the project:

Quantum tunnelling, protein's activity, isotope effect, transition rate, neutron scattering

Description of the project (aims, experimental techniques, recommended background):
The aim of the project is to investigate the influence quantum effects can have on biological systems. It is indeed known that tunnelling is sometimes important to explain the transition rates of enzymatic activity. Such effects can be tested experimentally by comparing protonated and deuterated samples and theoretically by describing the transition rates within a quantum model. Recent approaches to describe quantum effects in incoherent neutron scattering will be applied to data taken on such a set of samples. If we get beam time during the internship, corresponding neutron experiments will be conducted on spectrometers of the ILL. Otherwise the data will be analysed and different interaction descriptions will be tested against the data to identify the best approach to shed light on these quantum effects in biology.

Justification that the internship's subject fits with the general theme of GRAL:
The internship fits perfectly with the topics treated within the M2 "Complex Matter, Living Matter" and is in relation with molecular biology, biochemistry, biophysics, structural biology and biochemistry.

Relevant publications of the team:

The topic is very new, also within our group. So we do not yet have publications directly related to the subject.
1/ M. Trapp, M. Tehei, M. Trovaslet, F. Nachon, N. Martinez, M.M. Koza, M. Weik, P. Masson and J. Peters, Journal of the Royal Society Interface **11** (2014), 20140372. 2/ J. Marion, M. Trovaslet, N. Martinez, P. Masson, R. Schweins, F. Nachon, M. Trapp, J. Peters, Phys. Chem. Chem. Phys. 17 (2015), 3157 - 3163. 3/ C. D. Andersson, N. Martinez, D. Zeller, S. H. Rondahl, M. M. Koza, B. Frick, F. Ekström, J. Peters, and A. Linusson, Phys. Chem. Chem. Phys. 19 (2017), 25369 – 25379.

Otherwise, there is a good review article on the topic:

Brookes JC. 2017 Quantum effects in biology: golden rule in enzymes, olfaction, photosynthesis and magnetodetection. Proc. R. Soc. A 473: 20160822.