

Advanced neutron scattering and complementary techniques to study biological systems

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The deep understanding of the way by which fundamental biomolecules, such as proteins, perform their tasks in living beings is critical in many fields, ranging from biology to medicine, passing through pharmaceuticals, food science and biochemistry. Indeed, the possibility to describe in detail, and eventually control, all the steps involved in biological activity of proteins would have a huge scientific and technological impact. In analogy with what happens in complicated engines or electronic devices, the correct and optimised functioning of biomolecules requires the activation of elementary processes, which take place in localised special regions over timescales much faster than the relevant duty cycle. Neutron scattering technique offers the unique opportunity of time- and spatial-zooming into such elementary processes, i.e. to discover the details of biomolecule motions and conformational changes occurring at the atomic level, in pico- and nano-second time-window. Actually, present-day neutron scattering experiments are performed either on diluted protein solutions, or on hydrated protein powders, while data on biomolecules in their physiological working state are scarce. With this respect, the aim of the “Proteins At Work” workshop was to highlight the most recent results obtained via small angle (SANS), quasi-elastic (QENS) and inelastic (INS) neutron scattering investigations on structure and dynamics of biomolecules near or, better, at the real working conditions, thanks to the

improvements on instrumentation, data analysis methods and modelling techniques. The structural information gathered from SANS experiments is also particularly important given the challenge of the “post-genomic” era, in which a large number of protein sequences-structures become available. On the other hand, QENS and INS provide crucial insights on the dynamical changes in response to variations of external conditions (temperature, pressure, pH, presence of co-solvents). It is crucial to underline that such kind of investigations on biomolecules at working conditions require an integrated multidisciplinary and multitechnique approach, where novel collaborations bring together physicists with biologists and, in general, scientists from other disciplines (e.g. from chemistry, mathematics, computer science, engineering, bioinformatics, nanosciences).

In this EBJ Special Issue, significant results are reported showing to which extent SANS, QENS and INS, coupled with other numerical and experimental techniques, may provide details that are essential to understand the intimate triangular relationship between structure, dynamics and biological function of proteins *near* or *at* their physiological conditions.

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