DESCRIPTION FOR THE GENERAL PUBLIC

The proposed research project aims at improving current understanding of dynamic structure and interactions of biopolymers on the level of single molecules. We will study proteins and mRNAs responsible for regulation of important cellular processes. In many such processes, proteins with significant proportion of structurally unordered fragments play important roles. Their structural dynamics is often directly connected with their biological function. The studies of structure and interactions of such proteins and their complexes are highly challenging due to their dynamic character. We want to focus on proteins engaged in two classes of fundamental biological processes. The first one is eukaryotic post-transcriptional regulation of gene expression via mRNA degradation, where (1) PARN (*poly(A)-specific ribonuclease*), and (2) GW182 protein (*glycine-tryptophan protein of 182 kDa*) engaged in miRNA-dependent gene silencing, are important players. The second one is biomineralization regulated by (3) coral acid-rich proteins that bind calcium in the skeletal organic matrix. In both cases, partial or complete lack of determined spatial structure is very important, because it allows flexible adjustment to interacting protein partners, RNAs or ligands. We want to investigate their dynamical properties and interactions in solution using methods of molecular biophysics, especially single molecule microscopic experiments. If we understand the nature of the proteins, it will bring us closer to understanding biophysical bases of fundamental biochemical processes governing normal development and functioning of eukaryotic organisms. Research on GW182 protein participating in miRNA-dependent gene silencing may (in further perspective) become an inspiration to search for new anti-cancer medications. In turn, PARN deadenylase is extremely important in e.g. telomere metabolism; lack of the PARN activity leads to the most severe congenital defects (*dyskeratosis congenita*). Research on the role of CARP proteins in biomineralization will help us explain the sudden, in geological time scale, massive occurrence of skeletons in organisms, e.g. in corals, which is a fundamental issue allowing interpretation of life history on Earth. Choosing these three different protein classes, we want to investigate a more general model of their functioning, which could have a more universal explanatory value.