The main direction of our group is to study the NADH:quinone-oxidoreductase segment of respiratory chain of various prokaryotes. Unlike of animal mitochondria where only $\text{H}^+ \text{-translocating NADH:quinone-oxidoreductase (Complex I)}$ is operative, three different enzymes can function at this segment in bacterial respiratory chains. These are the $\text{H}^+ \text{-translocating (NDH-1, homologous to Complex I), Na}^+ \text{-translocating (NQR) and noncoupled (NDH-2) NADH:quinone-oxidoreductases.}$ All these enzymes are studied by our group. The main attention is given to the investigation of the coupling mechanism of $\text{Na}^+$-translocating NADH:quinone-oxidoreductase.

The major mechanism of energy conservation in living organisms is based on the conservation of redox energy released during oxidation of NADH by molecular oxygen into the transmembrane electrochemical gradient of hydrogen ions. This process is driven by molecular complexes of respiratory chain, the enzymes that work as molecular generators of electric current. The understanding of the mechanism of proton translocation by the respiratory chain complexes is a central objective of modern bioenergetics. Investigation of such mechanism has an inherent problem connected with the difficulty to distinguish between the protons required for redox chemistry and protons, which take part in proton translocation across the membrane (pumping). From that point of view the unique possibility to separate mechanism of ion translocation from proton dependent redox chemistry is provided by a redox driven primary sodium pump, which has the same function but pumps sodium ions instead of protons. For instance in this enzyme it is possible to study its catalytic cycle at low concentrations of $\text{Na}^+$ and to establish the stages, which are specifically activated by sodium ions. This technique lets to determine, which redox transitions in the studied protein are coupled with transmembrane $\text{Na}^+$ translocation. Also it is possible to investigate influence of sodium concentration on thermodynamic and conformational properties of the enzyme studied and thus to establish the mechanism of redox energy conversion into the transmembrane electrochemical gradient of sodium ions. In our group we use such an advantage to resolve mechanism of sodium translocation by the enzyme, the function of which is homologous to that of the mitochondrial Complex I – oxidation of NADH and reduction of ubiquinone – $\text{Na}^+$-motive NADH:quinone oxidoreductase.