Telomeres contain repetitive DNA sequences and play a key role in cellular ageing and cancer. Human telomeric DNA contains guanine-rich sequences, such as $(GGGTTA)_n$, that are capable of four-stranded quadruplex structures assembling. Quadruplexes can adopt various topologies depending on the ionic environment, concentration, thermal treatment and other factors. Those topologies include parallel, anti-parallel and hybrid (3+1) types.

We explored the effect of dilution and annealing of two human telomere sequences (21 and 22 nucleotide long) in a potassium-containing solution by nuclear magnetic resonance (NMR) and Raman spectroscopies. We found that multimolecular complexes with parallel orientation of the DNA strands, which are formed at high DNA concentration ($\approx$ 10 mM), persist even after strong dilution. They are disrupted only by thermal annealing. Furthermore, annealing led to the creation of a unimolecular G-quadruplex that appeared to be in (3 + 1) conformation. The (3 + 1) conformation of G-quadruplex is the most populated monomeric quadruplex structure present in the solution, regardless of oligonucleotide concentration.

We examined the differences between quadruplex structures in crowded and diluted solutions, as well as, before and after annealing. The presented thesis brings new insights about dependence of the quadruplex type on ionic composition of the solvent and oligonucleotide concentration.