Theory of quantum groups is a far reaching generalization of the theory of groups and harmonic analysis. Groups play a very important role in mathematics and physics, as they are responsible for so called symmetries of the studied problems, models etc. Development of group theory began in the nineteenth century and to this day the subject evolved into many specialized branches one of which focuses on *locally compact groups*. These locally compact groups are objects which allow for the notion of integrations and thus studying them takes one onto the border between algebra (group theory) and analysis (real analysis, Hilbert and Banach space theory, operator algebras). The theory of locally compact *quantum* groups generalizes the latter branch of group theory within the framework of operator algebras.

Quantum groups are objects which, just like classical groups, describe symmetries of other mathematical objects, but these symmetries must be understood in a more general sense. An example of this may be the work [Soł] in which deals with the most general symmetries of the algebra of complex 2x2 matrices preserving the so called Powers states. Classical group of symmetries of matrices must necessarily preserve the trace of a matrix, but there are more general symmetries which form a quantum group and not a classical group.

The passage from classical groups to quantum groups is based on the bijective correspondence between locally compact spaces and commutative C*-algebras and an analogous correspondence between a wide class of measurable spaces and (an equally broad) class of commutative von Neumann algebras. Roughly speaking, a quantum group is described by a C*-algebra possessing structure analogous to that of the algebra corresponding to a classical group except for commutativity. The same principles apply to the passage from classical to *non-commutative* geometry in which quantum groups play a prominent role.

The proposed research project aims to study selected topics in the theory of locally compact quantum groups. This research will increase the potential for application of the theory of quantum groups in other fields of mathematics and in theoretical physics as well as provide deeper understanding of the theory of quantum group itself.

[Soł] P.M. Sołtan: Quantum SO(3) groups and quantum group actions on M_2. *J. Noncommut. Geom.* **4** (2010), 1–28.