The inner structure of atoms was explored for the first time at the beginning of twentieth century. Due to the revolutionary experiment which was performed by Rutherford the heaviest part of the atom, called nucleus, was discovered. This groundbreaking discovery can be considered as a birth of the new branch of physics, focused on the interactions between nuclei. After that discovery a plenty of experiments have revealed completely new nature of that mysterious ingredients of matter. Nowadays, the nuclear interactions are a very powerful source of energy used in nuclear power plants, and the nuclear methods are applied in other branches, like medicine and material research. In particular, the precise understanding of these interactions allows to design the appropriate radiation shields.

The progress in research of nuclei have led to a discovery of their components - nucleons. These are positively charged particles named protons, and particles with no charge called neutrons. Due to repulsive action of the electromagnetic force (so called Coulomb interactions) between identically charged particles it is impossible to describe the inner structure of nucleus only in the framework of electromagnetism. That is why a new force was postulated. This new force has been called a strong interaction since it had to overcome the Coulomb repulsion at very small scales and bound all nucleons in a very tiny atomic nucleus (more than a milliard times smaller than the thickness of a human hair).

Further studies have led to the conclusion that even nucleons themselves were not elementary particles but they form a system which is built of quarks. The nuclear interaction, despite of its strength, turned out to be just a tiny residual effect of the true strong interaction between quarks. Knowledge of the strong interaction between quarks is extremely difficult to "translate" into interaction between nucleons. Therefore a different way of modeling nuclear forces is used, based on exchange of massive particles - mesons - between nucleons. That approach has its drawback: since it neglects an inner structure of nucleons, the so-called three-nucleon force (3NF) has to be introduced for systems of three and more nucleons. Recently, the theoretical calculations for three nucleon systems are very advanced and the experimental accuracy is good enough to trace subtle effects of the 3NF. Some differences between experimental results and theoretical calculations are also observed and questions about the quality of current 3NF models arise. Calculations are very complex since including of long range Coulomb interaction as well as relativistic approach pose serious technical problems. On the other hand, a rich database is needed to test these calculations and to gain precise knowledge of nuclear interactions.

In practice such a system can be realized by a collision between a single proton and a deuteron (consisting of bound proton and neutron). In this nuclear process, the energy of proton beam is able to "break" the bounds between nucleons in deuteron and in the final state we obtain three interacting particles emitted at various angles and with various energies. Individual configurations of outgoing particles reveal different sensitivity to 3NF or other effects. Simultaneous measurement of all the configurations provides rich information about nuclear interactions. This project focuses on FSI configurations when the pair of nucleons moves close to each other, as well as on configurations sensitive to relativistic effects.