## DESCRIPTION FOR GENERAL PUBLIC

High Energy Physics (HEP) has rapidly developed in past decades thanks to particle accelerators providing higher and higher collision energies. Nowadays the most powerful particle accelerator is the Large Hadron Collider (LHC in operation since 2010) which allows to collide lead ions at the center of mass energy of nucleon-nucleon equal to 5.02 TeV (since 2015, before that time collision energy was 2.76 TeV). Obtained collision energy is about 25 times higher than the energy available for gold ions collisions at Relativistic Heavy Ion Collider (RHIC in operation since 2000). In ultra-relativistic HI collisions at sufficiently high energy densities quarks and gluons become deconfined which means that they behave like almost free particles. The state of matter created in this process is called Quark Gluon Plasma (QGP) which properties are a subject of intensive theoretical and experimental studies. It is believed that for a few millionths of a second, shortly after the Big Bang the universe was filled with extremely hot and dense *quark - gluon soup*. Nowadays it is expected that QGP is the main constituent of neutron stars or collapsing supernovae.

In a very short time after the collision, the QGP interaction region cools down. Free quarks and gluons combine into particles of ordinary matter that speeds away in all directions to be finally caught by enormous detectors located at their paths. Analysis of the detected energies and transverse momenta of created particles provides valuable information about the initial stage of the system.

One of the signatures of QGP is the azimuthal flow of particles produced in the heavy ion collision. QGP matter exhibits properties that are characteristic for an ideal fluid with a very low viscosity. Therefore, a good source of information about the plasma is the collective expansion of particles produced in such collisions. Measurement of azimuthal flow of charged particles allows to experimentally study the properties of QGP, its evolution over time and the dependence on initial conditions of a system. In addition, it creates the possibility of a better understanding of quantum chromodynamics - the theory of strong interactions.

It is widely believed that the initial asymmetry of the interaction region is the main source of final azimuthal anisotropy. The asymmetry of the shape of the impact area leads to huge pressure gradients inside the collision zone and consequently to increased particle production in the reaction plane directions. Depending on the azimuthal angle emission, partons traversing this system, on average, experience different path lengths and therefore different energy loss. It leads to i.a. azimuthal anisotropy in high-$p_{\mathrm{T}}$ particle production with respect to the reaction plane, commonly expressed via the Fourier series.

The main research objective is to determine the higher order Fourier harmonics - $v_n$. The $v_n$ coefficients will be measured over a wide region of transverse momentum up to a few hundred GeV, in broad pseudorapidity range ($|\eta| < 2.5$) and the collision centrality. The presented azimuthal flow measurement will be focused on two methods: the Scalar Product method (SP) and the Two Particle Correlation method (2PC). Obtained results will be compared with other experiments as well as with results at lower collision energy. The flow measurement will be based on data collected during lead-lead collisions at the center of mass energy of nucleon-nucleon equal to 5.02 TeV. By the measurement of the collective phenomena in Pb+Pb collisions, proposed project will significantly contribute to obtain the key information about the initial conditions of the QGP system and to understand its dynamic evolution. Furthermore, the project involves direct studies on jet quenching phenomenon, which is one of the main QGP signatures.