DESCRIPTION FOR GENERAL PUBLIC

Numerous precision tests of the Standard Model (SM) and searches for any experimental discrepancies allow to test theory at the quantum level, as well as provide boundaries on various scenarios in the beyond Standard Model (BSM) physics sector. The anomalous moments of electron and muon are measured with extraordinary experimental precision, providing the opportunity to test the SM predictions. The tau anomalous magnetic moment is well predicted theoretically but, due to the very short lifetime of the τ lepton, strikingly evades measurement. The goal of the project is to conduct a novel measurement of the $\gamma\gamma \rightarrow \tau\tau$ process and its sensitivity on the anomalous magnetic and electric moments of τ lepton in ultraperipheral Pb+Pb collisions in the ATLAS experiment at the Large Hadron Collider (LHC) energies.

The ATLAS experiment is one of two general-purpose experiments at the Large Hadron Collider at CERN in Geneva. It was designed very precisely to search for the Higgs boson in proton-proton collisions, which according to the Standard Model predictions, decays into two photons. The Higgs boson was discovered in 2012. The ATLAS experiment also participates in the heavy-ion program of LHC and collects lead-lead collision data for about a month per year. Lead beams can serve as an intense source of high-energy photons flux. Such photons interact with each other in various ways, creating opportunities for the measurement of interesting physical processes. One of the phenomena recently studied using photons produced in ultra-peripheral heavy ion collisions is light-by-light scattering, in which two photons - light particles - interact with each other to scatter like particles of matter. The observation of this rare process paved the way for the experimental challenge of attempting to precisely measure the anomalous magnetic moment of the tau lepton. In quantum electrodynamics, the anomalous magnetic moment of a particle is a contribution of effects of quantum mechanics on the magnetic moment of that particle. According to the Dirac equation, the magnetic moment of a particle is expressed by the factor g = 2. For particles such as an electron, this classical result differs from the observed value by a small fraction of a percent. Any deviations from g = 2 pave the way for the search for the so-called new physics, i.e. for discovering phenomena that the Standard Model fails to describe. In particular, high values of anomalous magnetic moment can indicate the internal structure of a particle - such as in the case of a proton, which is composed of charged quarks.