On the use of Timepix3 pixel detectors
in ATLAS and MoEDAL experiments at the LHC

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The aim of the lecture is to present the current state of use of Timepix3 pixel detectors in the ATLAS and MoEDAL experiments at the LHC at CERN, specifically within the ATLAS-TPX3 and MoEDAL-TPX3 detector networks, which were designed, installed and operated by the teams of the IIEAP CTU in Prague. Their ability to visualize individual particle tracks/trajectories in the semiconductor sensors, similar to those in nuclear emulsions or bubble chambers, will first be briefly demonstrated.

Specifically, the results of measurements of a composition and spectral characteristics of mixed radiation fields within the ATLAS and MoEDAL environments, based on track recognition of charged particles, gamma photons and neutrons interacting in silicon sensors of TPX3 detectors of the installed networks, will be presented. They will be supplemented by results of a long-time measurement of radiation in extraterrestrial conditions using Timepix detectors installed on Earth satellites.

The main part of the talk will summarize the experimental results obtained from the ATLAS-TPX3 and MoEDAL-TPX3 networks synchronized with the LHC beam collisions. Their ability to measure the Time of Arrival (ToA) of radiation quanta and/or particles interacting in their sensors with a resolution of about 1.6 ns allows determining their Time of Flight (ToF) in the environment of these experiments. Such ToF measurements, combined with precise particle tracking and recognition techniques, open the way to distinguish reliably particles born at the interaction point (IP) of the LHC beams from the radiation background in all its complexity. This will be demonstrated in the talk by the example of its use for real-time luminosity measurements in the ATLAS experiment.