Our grant concerns detailed analysis of production of different microscopic objects, such as mesons, pairs of leptons and mesons, pairs of quark-antiquark etc. We consider processes understanding of which requires both perturbative as well as so-called nonperturbative methods. We intentionally consider a pletora of processes, including proton-proton, proton-nucleus and ultraperipheral nucleus-nucleus collisions where there is no direct contact between nuclei and the objects are created by photons from clouds sourranding the ultrarelativistic heavy ions. A big part of considered processes is related to a small number of produced particles, so called small multiplicities.

We consider inclusive processes, i.e. such where we are interested in one kind of particles and not interested in many others. The example is production of charmed mesons containing charm quarks or antiquarks. Such mesons are unstable and decay producing electrons (or muons) as well as neutrinos (particles weakly interacting with the matter). Such processes occur also in the Earth's atmosphere when cosmic rays, mostly protons, interact with nuclei of the atmosphere. Such neutrinos are measured in the experiment IceCube on the South Pole. The technical methods worked out by us allow to calculate the flux of neutrinos. We proposed a new mechanism of D meson production, which may lead to increased production of neutrinos. We wish to explore more such consequences.

We will consider also production of pairs of mesons in central exclusive processes ($pp \to ppM\bar{M}$). One hopes that such processes are usefull in searches for glueballs – objects built dominantly of gluons. They were predicted but not yet unambigously identified. We have worked out formalism how to calculate such processes, called diffractive. Our predictions combined with confrontation with experimental data will certainly bring new aspects.

Another type of processes we will consider are collisions of photons. They can be sudied for proton-proton, proton-nucleus and nucleus-nucleus collisions. Different objects can be created. Particularly interesting is so-called light-by-light scattering "measured" recently by the ATLAS and CMS collaborations and being in agreement with our predictions. Such processes were never studied before. The ATLAS and CMS analyses allowed to study the $\gamma\gamma \to \gamma\gamma$ scattering at energies larger than 5-6 GeV. In the present grant we will study in detail a possibility to investigate it at lower energies. This will be done together with the members of ALICE and LHCb collaborations. Can we expect a surprise ?

Part of our plans is related to the nature of so-called pomeron - theoretical object responsible for high-energy scattering. Its partner with opposite C-parity – odderon, stays still not discovered, although new results from the LHC suggest its possible presence. We plan a detailed and critical analysis in this context. Those object may be also tested in CEP of mesonic or baryonic pairs.

Our grant intentionally comprises quite many processes, but as we show in the more expanded description of the grant, the processes are interrelated and often compete together so-disentagling them requires different attempts and consistency in different processes. Our study aims also at providing new ideas for future experiments. We will also suggest new analyses of the collected already data.