Popular scientific summary of the project:

The project's scientific aim is to create a new team from the Faculty of Physics, Warsaw University of Technology (WUT), in close collaboration of two experiments conducted at GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt / FAIR: Facility for Antiproton and Ion Research: HADES and CBM.

The results of nearly three decades of studying the relativistic heavy-ion collisions, and in particular, the decade associated with the use of the largest collectors: LHC at CERN and RHIC at BNL, led to the creation of a new state of matter in which the so-called quark degrees of freedom, or the smallest, yet indivisible components of matter. However, the results obtained so far concerned the conditions for high temperature and low values of baryon density, when the proportions of baryons and anti-baryons are almost identical. By using smaller collision energies of elementary particles and heavy ions, it is possible to explore the properties of matter with lower temperature and higher baryon density values describing neutron stars and neutron star mergers. The physics goal would be to explore the QCD phase diagram in so far unexplored regions relevant to one of the hottest recent topics of astrophysics by the analysis of particle correlations. The CBM experiment at FAIR will play a unique role in the exploration of the QCD phase diagram due to its unprecedented interaction rates, which will perform measurements with extremely high precision. Understanding the QCD phase diagram is one of the most important goals of relativistic heavy-ion physics. Several methods are proposed to study baryon densities of a neutron star, here we focus on particle correlations, which is our original contribution and is the subject of this project. Femtoscopy is related to the Femto scale (1 fm), which can not be accessed by any other experimental technique.

As part of two experiments: already operating HADES and CBM, which is in the construction phase. The effects sought are an essential element of our knowledge about the structure and properties of matter. If the results show unexpected phenomena, new research directions will be open in the physics of relativistic nuclear reactions. This research also has a direct reference to understanding the first moments of the universe's evolution.