Cosmic radiation is one of the most important hazards for man in long duration space missions. The assessment of the radiation risk to astronauts requires knowledge of the radiation environment and doses accumulated in the body. For flights reaching beyond the low Earth orbit, e.g. to the Moon orbit, such knowledge is very limited and insufficient. In the near future a space mission is planned – Orion vehicle (Artemis-1 mission) which will help to fill partly these gaps in our knowledge.

The aim of the present proposal is to enable the scientists from the Institute of Nuclear Physics Polish Academy of Sciences (IFJ PAN) to participate in the MARE project aboard Orion spacecraft – the first ever dedicated cosmic radiation dosimetric experiment to be performed at the lunar orbit.

The Artemis-1 flight of the Orion vehicle is planned to be carried near end of year 2021. The Orion will cross Van Allen radiation belts and spend some time in orbit around the Moon. The Orion vehicle is designed to carry four astronauts, but the Artemis-1 flight will be unmanned. This situation created an absolutely unique opportunity for conducting a large scale dosimetric experiment during this first flight. Such experiment, named Matroshka AstroRad Radiation Experiment (MARE), was proposed by the German Aerospace Center (DLR) in collaboration with the Israel Space Agency and accepted by NASA. The main idea of the project is to place in the crew compartment of the Orion two realistic models of a human body (so called "phantoms"). One phantom will be shielded with a specially designed protective vest, while the other one will be unprotected. The phantoms will be equipped with a large number of active and passive radiation detectors. They will be distributed throughout the phantom volumes, as well as on the phantom surface, what will allow to reconstruct a 3D distribution of radiation doses and other important parameters of the radiation field. The main research tool will be miniature thermoluminscent detectors (TLDs), nuclear track detectors will be also applied.

The main research goals can be summarized as follows:

– to determine experimentally radiation dose deposition profiles and organ doses inside the model of a human body, in conditions of Van Allen belt transit and at the Moon orbit
– to characterize radiation environment specific to Orion spacecraft
– to provide accurate radiation risk projections for deep space exploration
– to study possibility of reducing cosmic radiation exposure by using a personal shielding vest