

Referee report on: Research on the Biological Effect of Heavy Charged Particles with Different Energies - Theme 04 - 9-1077

As humankind prepares to embark on increasingly ambitious and potentially dangerous deep space missions, considerable detailed work is required to better characterize and mitigate, to an acceptable level, the risks associated with space radiation exposures. Report of research and of significance in the presented proposal of project is innovative of the soundness of the challenge in radiation risk for the interplanetary manned human flights. The concept of radiation for crew is dangerous under the action of heavy nuclei of the galactic cosmic rays on the central nervous systems structures. This damage is based on two established facts: (1) exposure cause changes in the higher integrative functions of the brain – leads to disorders in crew's operational performance; (2) in the simple fact is, that interplanetary flights will be under threat by cosmic radiation and will be not completed with success. The main fields of space radiobiology research calls for changes in all experimental systems. The working out new radiation safety standards for space flights is now the future of new experimental design in this research field. The presented theme is based on results from previous research theme, continues in these studies and wide- spreads them.

Appropriateness of the requested funding and of problems to solve:

The morbidity risk of radiation and unique toxicity profiles remain still poorly understood. This incomplete understanding persists, despite the existence of a significant body of literature describing the effects from anticipated absorbed dose ranges. Calculation of radiation exposures to astronauts in a detailed and realistic way is challenging because of the complexity of the radiation environment, the shielding effects of the vehicle and/or space suit and human anatomy and physiology. Uncertainties with respect to dose toxicity and the complex variation in self - protection system of organism likely to be encountered in future exploration missions underscore the need for biological models that are capable of identifying particle energy. The next problem is find out of the best species of cells – by - radiation interactions, which are caused damage of the living organism on its various levels. Additionally, integrating micro-dosimetry measurements together with radiobiological studies are essential to reducing the uncertainties in doses of the irradiation projections during mission planning, spaceflights and to inform post-flight research on astronaut health.

The project is based on the insights gained from molecular genetics and from applications of resolved problems during the risk estimation. Designed experimental advance requirements, of planned experiments, are real, clearly and are exactly explained in the application form of the funding of project.

Technical ability to implement the project within the stated periods:

Modern research of such problem requires a wide range of the main methods from molecular biology and the methods of condensed matter physics, as it does Laboratory of radiobiology in the JINR. Project takes into account of all planned participants, experiences of the represented group related to planned years is on good level and coordination by the JINR organization is the right choice for conducting and evaluation of proposed radiobiological studies among all participated institutions.

The methodology of the proposed project is convincing in showing main fields of research within the frameworks of the theme as of regularities and mechanisms of molecular, cell, tissue and system of the human organism damage.

The data collection strategy, potential sources of information, data accessibility and methods of methods of molecular biology, genetics, pharmacology, neurogenesis, morphology and radioprotection during the research of the heavy charged particles of the induction the damage in genetic structures of prokaryotic and eukaryotic cells (mammalian and human cells), to eye structures and in central nervous system planned in this project, are really clear and project depicts a developed strategy of meaningful results collection. Authors clearly list the expected results in next three years, which are well formulated and realistic based on the previous reached results.

Availability of the human resources of JINR and cooperating institutions:

The experimental evidence of the radiation damage is formed and contain has the required character and requested funding is realistic for the estimated budget. It includes clear overall responsibility of all staff resources for the activities, includes a problem-solving mechanism in the event of assignment experiments between partners including of JINR, from the other university and institution, which expressed their interest of the joint studies within the proposed project. The investigative model, tools and methods of the project, could resolve this part of problem and the scientific and technical impacts of this research will require future independent researches based on using JINR's basic facilities. The extent of the project realization is based on the practicable plan for basic and applicate research of all cooperating oragnizations.

STRENGTHS of the project:

- Project indicate the ability of humans to realize the potential by becoming a multi-planet species will hinge on, to a large extent, ability to appropriately understand, manage, mitigate and overcome the significant dangers and health effects caused by space radiation.
- The veracity of data obtained and the reliability of conclusions drawn from ground-based studies using model organisms will benefit substantially from accurately simulating combined exposures under heavy ions sources.
- These needs to be delivered in an acute dose regimen, reaching informations could be utilize in an integrated fashion to complement and more completely describing the physiological observations.
- Planned timetable, balance between the time frames and costs, description of the work plan, benefits for JINR arising from this activity, structure and planned procedures are clearly determined.
- The study of the radiation level risk is also meaningful for the using and application of institutional experimental facilities, as it regards obtaining the worldwide level of the research results at JINR.

- No factual errors were found, were no found discriminatory comments. Partners are capable to fulfil tasks from stated periods.

WEAKNESSES of the project:

- Actually, there are not found the weaknesses in submitted period of the project

Within the five usually limits (Excellent, Very good, Good, Fair, Poor and Proposal fails) the evaluation of the project is on excellent level. The continuation of the topic generally addresses the expected project criterion, addresses all relevant aspects and is recommended to continue with full financing of required amount, of this theme.

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In Bratislava, Slovak Republic: June 01, 2016