**LABORATORY OF RADIATION BIOLOGY**

**Theme: 1112**

**Project: “Research on cosmic matter on Earth and in nearby space; research on the biological and geochemical specifics of the early Earth”**

**Period: 2013-2022**

**Year of last approval: 2019**

 **PART A: Achievements**

1.   Contributions of the JINR group:

LRB: preparation and irradiation of meteorite matter and organic samples with hadron beams; clean room for prebiotic chemistry research, handling collection of meteorites and cosmic matter samples; study of microfossils with electron scanning microscopy; data analysis, systematization and interpretation;

FLNP: determination of the elemental composition using multi-element neutron activation analysis at the IBR-2 reactor; evaluation of the proportion of heavy isotopes in cosmic matter samples using the IREN pulsed neutron source; identification of heavy isotopes with the IREN neutron spectrograph; determination of the structure of samples by X-ray and neutron tomography methods.

2.   Publications:

1) Bizzarri B.M., Šponer J.E., Šponer J., Cassone G., Kapralov M.K., Timoshenko G.N., Krasavin E.A., Fanelli G., Timperio A.M., Di Mauro E., Saladino R., Meteorite assisted phosphorylation of adenosine under proton irradiation conditions // Chem.Systems.Chem. 2020, V.2, No.3, P. e1900039. doi: 10.1002/syst.201900039

 Performing the experiment, irradiation, data acquisition and interpretation.

2) Bizzarri B.M., Manini P., Lino V., Ischia M., Kapralov M.I., Krasavin E.A., Mrazikova K., Sponer J., Sponer E., Di Mauro E., Saladino S., High-Energy Proton Beam-Induced Polymerization/Oxygenation of Hydroxynaphthalenes on Meteorites and Nitrogen Transfer from Urea: Modeling Insoluble Organic Matter? // Chem. Eur. J., 2020. V.26, P.14919 – 14928. doi: 10.1002/chem.202002318

 Performing the experiment, irradiation, data acquisition and interpretation.

3) Rozanov A.Yu., Hoover R., Ryumin A.K., Saprykin E.A., Kapralov M.I., Afanasyeva A.N. New finds of microfossils in the Orgueil meteorite. // Paleontologicheskiy zhurnal (Paleontological Journal), 2021, No. 1, pp. 1–3 doi: 10.31857/S0031031X21010116 (in Russian).

 Key equipment, data analysis, systematization and interpretation.

4) Rozanov A.Yu., Hoover R.B., Krasavin E.A., Samylina O.S., Ryumin A.K., Kapralov M.I., Saprykin E.A., Afanasyeva A.N. An atlas of microfossils in the Orgueil meteorite. // Rozanov A.Yu., ed. in chief. Moscow: Paleontological Institute, Russian Academy of Sciences, 2020. 130 pp., 5 figs., 40 photo tables. In Russian and English. ISBN 978-5-903825-42-4.

 Key equipment, data analysis, systematization and interpretation, book publishing. First world systematization of microfossils data.

3.   PhD theses:

4.   Talks:

Hoover R.B., Rozanov A.Yu. Evidence for indigenous microfossils in carbonaceous chondrites // The Tenth Moscow Solar System Symposium. (Space Research Institute. October 7-11, 2019).

Ryumin A.K., Kapralov M.I. Astrobiological studies in Dubna // The Tenth Moscow Solar System Symposium. (Space Research Institute. October 7-11, 2019).

**PART B: Plans and requests**

5.   Plans

* Obtaining new data on the amount of cosmic matter falling on the whole Earth's surface. Obtaining data on the dynamics of cosmic dust fallout on large territories.
* Evaluation of the following parameters of particles of extraterrestrial origin: morphology, structure, size distribution, and elemental, isotopic, and mineralogical composition. Assessment of changes in these characteristics in different plates in different time intervals.
* Creation of a cosmic dust collection, where dust microparticles will be characterized by quantity (concentration) and the size distribution.
* Obtaining new information on the role of microorganisms in the formation and evolution of life on Earth and processes of weathering, precipitation growth, etc.
* Research on the synthesis of complex prebiotic compounds from formamide under exposure to ionizing radiations of different qualities with meteorite samples as catalysts.
* Generalization of the obtained data on the forms of ancient terrestrial and, possibly, extraterrestrial life.

6.   Group size, composition and budget

Project leader: E.A. Krasavin

Researcher leaders: A.Yu. Rozanov, V.N. Shvetsov (FLNP), M.V. Frontasyeva (FLNP)

Researchers: A.K. Rymin, M.I. Kapralov, E.А. Saprykin, I. Zinicovscaia (FLNP)

Engineers: А.N. Afanasyeva

FTE – 5.8

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|  | Expenditure items | Full cost, k$ | 1st year | 2nd year | 3rd year |
| 1.2.3.4. | MaterialsEquipmentPayments for agreement-based researchTravel allowance | 15100-15 | 540-5 | 530-5 | 530-5 |
|  | Total direct expenses | 130 | 50 | 40 | 40 |