METEORITE PATROL SERVICE FOR STUDYING TEMPORAL AND SPATIAL VARIATIONS OF GALACTIC COSMIC RAYS IN THE INTERNAL HELIOSPHERE.

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Introduction: The meteorites having fallen to the Earth are unique cosmic objects, which supply us with invaluable information about the early stage of the Solar system. A possibility of study of their matter in modern laboratories has led to the development of a specific science, meteoritics, devoted to the study of origin and evolution of meteorites themselves, as well as the Solar system on the whole. We would like to pay attention to the unique possibility of using meteorites, in particular, chondrites, to study contemporary processes in the heliosphere too.

Cosmogenic Radionuclides in Chondrites as Natural Detectors of Cosmic Radiation: Chondrites on their orbits are isotropically (4π) irradiated by galactic cosmic rays (GCR), which leads to the development of cascade nuclear-active particles and production of cosmogenic radionuclides of different half-lifes ($T_{½}$) inside the chondrites, both being in direct dependence on the primary GCR intensity. Studying cosmogenic radionuclides of different $T_{½}$ in the fresh-fallen chondrites of different orbits allows us to record GCR intensity on the temporal and spatial scales. Some adequate approaches have been elaborated – including the analytical method, in which the entire problem of the GCR cascade depth distribution in meteoritic bodies is expressed in an analytical form, so that it might be used for quantitative determination of the depth distribution of any radionuclide in any meteorite of any size and composition [1]. The method was verified experimentally due to isotropic irradiation of a rotating thick iron sphere by the extended proton beam of the Dubna synchrocyclotron [2]. Practically, in the book [1] and in numerous further works, e.g. [3,4], the whole problem of using cosmogenic radionuclides in chondrites as natural detectors of cosmic radiation is elaborated in detail. A lot of full texts of the works on the question are available on the website https://www.google.com/search?q=Lavrukhina+and+Ustinova+Meteorites+as+probes+of+cosmic+ray+variations&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwHypmSr9_aAhVEWSwKHfRiDNgQsAQITQ&biw=1024&bih=686#imgdii=UMWvQzi-TQCLOM:&imgrc=4cE6__KsyljiyM:

Solar Modulation of GCRs in the Internal Heliosphere: The region of orbits of the meteorites, which could fall to the Earth (1- 5 AU), is the most turbulent range of magneto-hydrodynamic processes, which are conditioned by the solar activity of 11-year periodicity. The point is that, due to the sun rotation, the solar radial magnetic fields become Archimedes cocklings up to 5 AU, i.e. practically azimuthal ones [5]. This creates the most dynamical region of accumulation of the solar wind irregularities on the way of the GCR penetration into the internal Solar system, and their additional effective modulation, apart from that conditioned by the whole volume of the solar wind. The 11-year variations of GCRs (> 100 MeV) at 1 AU are demonstrated well by the balloon stratospheric measurements since 1957 [6]. Which tendency do they exhibit at the other heliocentric distances in the region? Just the first analyses of cosmogenic radionuclides in the chondrites Pribram and Lost City, which fell at the stages of high solar activity, have educed large GCR gradients along their orbits, but the similar analysis in the Innisfree chondrite, which fell at the solar activity minimum, has shown the small GCR gradients [7] being similar to those registered during the flights of Mariner 4,5, Pioneer 10,11 and Voager 1,2, all the spacecrafts being launched at the solar actity minima.The enhancement of the GCR gradients at the high solar activity was registered only ~20 years later, when in 1990 maximum Ulysses was launched [8,9]. It is clear that permanently falling chondrites have an advantage over rare and expensive spacecrafts. Besides, the long-lived cosmogenic radionuclides supply us with information on some average properties of the GCRs over a long-time scale, which is not accessible via the measurements in space.

A Possible International Meteorite Patrol Service for Studying Processes in the Heliosphere: Due to 1) the increasing number of fireball camera networks installed world-wide [10] (which provide exact calculation of the chondrite orbits), 2) the high-precision low-level equipment of many laboratories in the world for measurement of cosmogenic radionuclide contents in the fresh-fallen chondrites, and 3) the development of adequate quantitative methods of analysis of cosmogenic radionuclide distribution in chondrites of any size and composition (e.g., the analytical and the Monte Carlo methods), a possible international meteorite patrol service in the heliosphere looks practicable and, in addition to direct experiments in the interplanetary space, it would greatly enlarge our possibility of comprehension of the magneto-hydrodynamic processes in the internal heliosphere.

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