BIOLOGICAL RADIATION DOSE FROM ASTROPHYSICAL SOURCES. D. Atri[1], [1]Blue Marble Space Institute of Science, 1200 Westlake Ave N Suite 1006, Seattle, WA 98109, USA (dimitra@bmsis.org)

Introduction: From distant and infrequent gamma-ray bursts, to frequent solar particle events in our neighborhood, a variety of astrophysical sources emit high-energy particles, which strike the earth's atmosphere. Resulting particle interactions in the atmosphere produce a variety of secondary particles reaching the surface and could pose a threat to life [1][2][3]. Such particles contribute to a number of physical processes occurring in the Earth system. A large fraction of the energy of charged particles gets deposited in the atmosphere, ionizing the atmosphere, causing changes in its chemistry and affecting the global electric circuit. Remaining secondary particles contribute to the background dose of cosmic rays on the surface and parts of the subsurface region [1].

Life has evolved over the past ~ 3 billion years in the presence of this background radiation, which itself has varied considerably during the period . As demonstrated by the Miller-Urey experiment, lightning plays a very important role in the formation of complex organic molecules, which are the building blocks of more complex structures forming life. There is growing evidence of increase in the lightning rate with increasing flux of charged particles. Is there a connection between this enhanced rate of cosmic rays and the origin of life?

Computational Modeling: In order to model the interaction of GCR particles with the planetary atmosphere, we will use CORSIKA (COsmic Ray SImulations for KAscade), which is a widely used Monte Carlo tool to model cosmic ray induced air showers from primaries in a wide energy range [4]. The code is regarded as a gold standard in simulating the propagation of GCRs in the atmosphere. The model is continuously tested against data from a number of experiments around the globe and updated frequently with new physics results. Simulations were carried out using CORSIKA v6990, a stable version of the code with updated interaction models. The code has already been demonstrated to reproduce air shower data with high accuracy [1].

Radiation dose and habitability: Cosmic ray secondaries are also known to damage DNA and cause mutations, leading to cancer and other diseases. It is now possible to compute radiation doses from secondary particles, in particular muons and neutrons [1]. Have the variations in cosmic ray flux affected the evolution of life on earth?

We describe the mechanisms of cosmic rays affecting terrestrial life and review the potential implications of the variation of high-energy astrophysical radiation on the history of life on earth. We calculate the biological radiation dose from various such sources and discuss their implications on habitability [1][5].

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