Life beyond Earth: the antarctic black fungus in planetary simulations

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Abstract:
The cryptoendolithic black fungus Cryomyces antarcticus inhabits the ice-free area of the Antarctic McMurdo Dry Valleys, one of the best terrestrial analogue environment for Mars. There, conditions on rock surface are often incompatible with life; hence, microbes develop within porous rocks as last chance for survival. The almost complete isolation over a timescale of evolutionary significance led to the evolution of unique, extremely adapted and resistant, genotypes. C. antarcticus is particularly skilled in stress tolerance being able to tolerate injuries well beyond the harsh conditions of its natural environment. Because of its uncommon resistance, the fungus has been chosen as eukaryotic model for astrobiological studies to test the endurance of eukaryotic cells to space conditions. In the experiment here reported, the fungus C. antarcticus was exposed, in the frame of the STARLIFE irradiation campaign, to different types and qualities of ionizing radiation with different linear energy transfer values (0.2 to 200 keV/µm). Irradiation with up to 1 kGy of accelerated He, Ar and Fe ions, and 55.57 kGy of gamma rays (60Cobalt). Single gene PCR, RAPD fingerprinting, qPCR and PMA coupled with qPCR analyses reveal minimal damage to DNA or plasma membranes induced by the treatments. This experiments further confirm the stunning stress tolerance of the fungus and its high relevance in astrobiological investigations, including the search for life on Mars, the reliability of the Lithopanspermia theory, and the estimation of planetary contamination risks.