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Space radiation risk advancements through neutron radiobiology and in-orbit ion monitoring

In space, astronauts are exposed to a complex radiation field with charged particles and secondary neutrons causing detrimental biological effects through heterogeneous energy deposition.
Within the ASI-funded n-SPACE project, neutron effects are investigated through in-vitro cell culture irradiations at CNAO, where high-energy protons striking an aluminum block, representative of space-vehicle walls, generate a neutron field characterized through Monte Carlo simulations. DNA damages are quantified measuring double-strand breaks (γ-H2AX) and pyrimidine dimers (CPDs) following neutron exposures. Additional radiobiological analyses include cell viability, clonogenic survival, cytokine release.
In parallel, within the ASI-funded OBP project, the LIDAL light-ion detector, integrated into the ALTEA system and deployed on the ISS in 2019, provides real-time monitoring of heavy and light ions.
In both cases, theoretical Relative Biological Effectiveness modelling, coupling radiation transport and track-structure simulations, can be applied, finally enhancing mechanistic understanding of radiation-induced DNA damage and strengthening risk assessment for terrestrial and space-flight environments.

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