Simulation of Galactic Cosmic Rays (GCR) induced damage on DNA molecules

Objectivos

The student will simulate the early radiation-induced damage on a simplified model of the DNA molecule due to the most significant components of GCR.

The student shall learn:

• Learn the basis of radiobiology and related concepts: relative biological effectiveness (RBE), quality factors, and radiation weighting factors;
• Dosimetric and microdosimetric concepts and the relation between them;
• Implement Monte Carlo simulations with Geant4 including the recent extension Geant4-DNA for simulating the particle track structure in simple models of the DNA molecule;
• Compute microdosimetric quantities from simulated tracklengths and deposited energy distributions in a given volume;
• Simulate radiation-induced damage on DNA using the Geant4-DNA extension;
• Establish the relation between the yields of single- and double-strand breaks in the DNA (from energy deposition clustering criteria) and microdosimetric quantities.

Requisitos
Entrevista/Interview

Localização
LIP-Lisboa

Observações
The major source of uncertainties in radiological risk assessment for manned space missions is the insufficient knowledge of the effective biological response (RBE) of organs and tissues in the energy range and for the ions that make up the space radition environment. This difficulty arises from the complexity of the physical, chemical and biological processes resulting from the interaction of secondary radiation at the cellular and subcellular level that are still poorly understood.

Current RBE values result from a consensus based on a large number of radiobiology experiments (on cells, microorganisms and animals) performed for various radiation qualities (ie, particles and energies). However, despite the large number of experiments carried out in recent decades and even considering those planned for current and future particle accelerators, it is not and will not be possible to comprehensively cover the particle spectrum and range of energies in space radiation. In recent years, Monte Carlo applications are beeing developed for simulation of radiation-induced damage at the cellular and subcellular level, namely, at the level of the DNA molecule. These tools may play a very useful role in the evaluation of the risk of exposure to the radiation in space.

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This work will be performed with the LIP "Space Radiation Environment and Effects Group", in the context of its activities with the European Space Agency (ESA)

Cursos: MEFT