

## Genotoxic and Cytotoxic Responses of Recombinant *Salmonella typhimurium* TA1535 Induced by Simulated Space Radiation Qualities

Christa Baumstark-Khan<sup>1</sup>, Ralf Moeler<sup>1</sup>, Isabelle Testard<sup>2</sup>, Yannick Saintigny<sup>3</sup>, and Christine E. Hellweg<sup>1</sup>,

<sup>1</sup> Division of Radiation Biology, Institute of Aerospace Medicine, German Aerospace Center (DLR), Linder Höhe, 51147 Köln, Germany, christine.hellweg@dlr.de

<sup>2</sup>CEA Grenoble, 17 rue des Martyrs, 38054 Grenoble Cedex 9, France, isabelle.testard@cea.fr

<sup>3</sup>LARIA, GANIL, Bd Henri Becquerel, 14076 Caen, France, saintigny@ganil.fr.

**Introduction:** For risk assessment, the mutagenic potential of the heavy ion component of the galactic cosmic radiation is of major concern for tumor induction as radiation late effects. The genetically modified TA1535 *Salmonella typhimurium* strain (SWITCH) reports on the presence of genotoxic conditions by dose dependent increase of bioluminescence induction and on the presence of cytotoxic conditions by dose dependent decrease in GFP fluorescence. By this, it is possible to analyze bacterial inactivation and mutation induction by ionizing radiation in parallel in the same cell within short time.

**Methods:** Experiments with heavy ions have been performed with the SWITCH test at GANIL with ion beams having a linear energy transfer (LET) from 37 up to 10238 keV/μm.

**Results:** The numbers of hits (particles per cm<sup>2</sup>) necessary to inactivate the bacteria (cytotoxicity) depend on LET. For genotoxicity induction, for very high LET radiation the number of hits required is much

less than for lower LET radiation. The power of the genotoxic response seems to be inversely related to LET. While 200 kV X-rays resulted in maximal induction (~99.6x), half-maximal induction of genotoxic potential is reached at LET of about 60 keV/μm. At LETs much greater than 100 keV/μm genotoxic potential decreases further to about 5 % for lead ion exposure (>10000 keV/μm).

**Conclusion:** The SWITCH test shows space relevant radiation qualities to peak for inactivation cross sections at LET between 100 and 300 keV/μm, while genotoxic potential is reduced when compared to sparsely ionizing radiation.

### References:

- Baumstark-Khan, C., Khan, R., et al. (2003) *Analytica Chimica Acta*, 487, 51-60.
- Stojcic, N., Baumstark-Khan, C. et al. (2010) *Toxicology*, 269, 35-40.
- Stojcic, N., Walrafen, D., et al. (2005), *Advances in Space Research*, 36, 1710-1717