



## **Dose and dose equivalent and related risk during a cruise to Mars**

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The radiation exposure in space can be estimated with numerical simulations applying different models for the galactic cosmic rays (GCR) irradiating a defined shielding geometry or by in situ measurements.

A comparison of commonly used GCR models, Badhwar-O'Neill2010, Burger-Usoskin, CREME2009/CREME96, and the recently released Badhwar-O'Neill 2011 with the newly developed DLR model show considerable differences in particle fluences. The differences arising in the calculated radiation exposure by applying these models were quantified in terms of absorbed dose and dose equivalent rates using the GEANT4 Monte-Carlo framework for different shielding thicknesses and the cumulative shielding distribution of the MSL transfer vehicle.

The calculations are compared with actual measurement of the Radiation Assessment detector (RAD) of the Mars Science Lab (MSL) on its cruise towards Mars and on the surface of Mars. From the dose equivalents measured and calculated estimates of the upper and lower limits for the risks for a human flight to Mars assuming the radiation environment experienced by MSL-RAD are given using the NASA risk model.