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Radiolysis of nucleobases under heavy ion irradiation: scaling laws for radio-resistance

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Complex organic molecules (COMs) have been detected in outer space [1]. The carbonaceous meteorites found on earth containing traces of nucleobases (i.e. adenine, guanine etc.) also indicate towards their presence in outer space. The later is permeated by ionizing radiations, therefore, COMs constantly suffer irradiation. Survival of COMs depends on their radio-resistance, and measurements of the corresponding destruction rates help to estimate their half-life-time in outer space [2].

We have studied the radiolysis of nucleobases in solid phase by swift heavy ions at very low temperatures (~20K). The experiments were performed at GANIL/France and GSI/Germany facilities. Samples were prepared by liquid evaporation and vapour deposition techniques. The IR absorption spectra of the samples were obtained in situ, before and after irradiation, with a FTIR spectrometer setup [3].

The evolution of IR bands with the ion-fluence allows to deduce apparent destruction cross sections (σ) by fitting with an exponential decay function. The samples were irradiated with several projectiles with different electronic stopping power (Se) to obtain the scaling law. Estimations of survival times in cold universe and comparison to UV radiation will be presented.

References:

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2. Muniz G. S. V. et al, Astrobiology 17 (2017):298-308.
3. Duarte E. S. et al, Astronomy and Astrophysics (2009) 502 (2): 599–603.

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