A comparison of relative biological effectiveness for DNA double strand and mutation induction

J. Kiefer, Strahlenzentrum der Justus-Liebig-Universität, Giessen

We have collected over the years a large date base for heavy ion induced DNA double strand breaks in yeast [1, 2] as well as for the formation of HPRT-mutants in Chinese hamster cells (summarised in [3]). Contrary to findings in mammalian cells [4] DSB induction in yeast cells shows an increase in RBE with LET, displaying a maximum around 100 – 300 keV/µm. Mutation induction is characterised by a qualitatively similar behaviour but with distinctly greater RBE values. In this report both dependencies are compared, results are shown in fig. 1. It is seen that RBE values for both experimental endpoints increase with LET but they are always lower for DSB than for mutation induction.

The broken curves are semi-empirical approximations to the experimental points which are based on the assumption that induction cross sections can be described by a linear-quadratic dependence of the following form

$$\sigma_i = \sigma_0 \left[1 - \exp - (\alpha L + \beta L^2) \right]$$

with σ_I induction cross section, σ_0 "saturation" cross section, L LET and α, β fitting parameters.

The best fit was obtained with the following values:
Mutation:

$$\sigma_i = 11 \times 10^{-7} \; \mu m^2$$
$$\alpha = 3{,}35 \times 10^{-4} \; \mu m/keV$$
$$\beta = 7 \times 10^{-5} \; (\mu m/keV)^2$$

DSB per base pair:

$$\sigma_i = 6 \times 10^{-7} \; \mu m^2$$
$$\alpha = 1{,}54 \times 10^{-3} \; \mu m/keV$$
$$\beta = 2{,}85 \times 10^{-5} \; (\mu m/keV)^2$$

References

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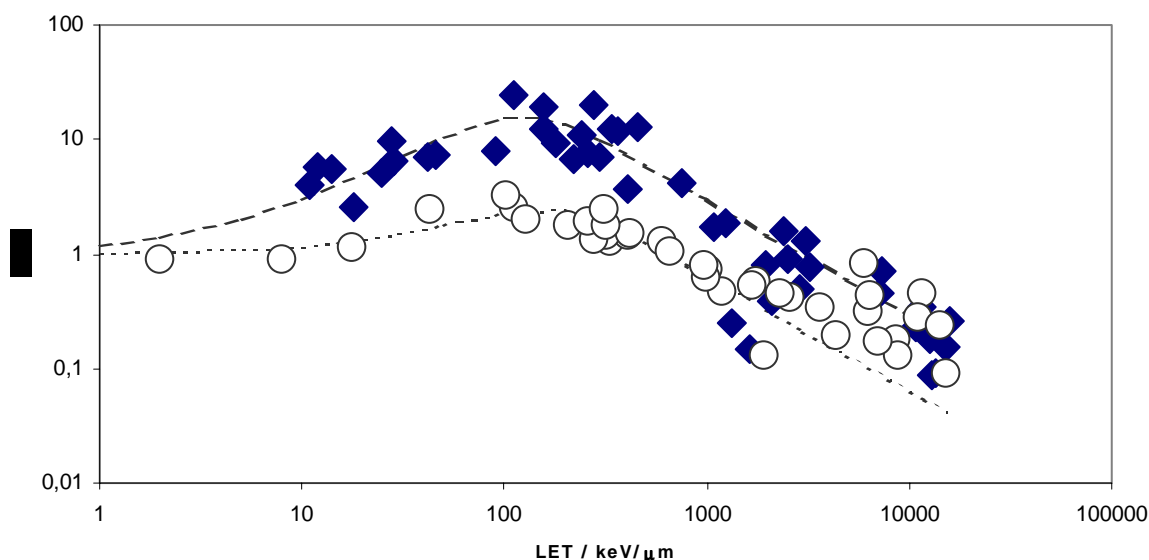
Fig.1: RBE in dependence of LET for DSB (open circles) and mutation induction (rhombi)