Low LET protons focused to submicrometer shows enhanced radiobiological effectiveness.

This study shows that enhanced radiobiological effectiveness (RBE) values can be generated focusing low linear energy transfer (LET) radiation and thus changing the microdose distribution. 20 MeV protons (LET = 2.65 keV µm(-1)) are focused to submicrometer diameter at the ion microprobe superconducting nanoprobe for applied nuclear (Kern) physics experiments of the Munich tandem accelerator. The RBE values, as determined by measuring micronuclei (RBE(MN) = 1.48 ± 0.07) and dicentrics (RBE(D) = 1.92 ± 0.15), in human-hamster hybrid (A(L)) cells are significantly higher when 117 protons were focused to a submicrometer irradiation field within a 5.4 × 5.4 µm(2) matrix compared to quasi homogeneous in a 1 × 1 µm(2) matrix applied protons (RBE(MN) = 1.28 ± 0.07; RBE(D) = 1.41 ± 0.14) at the same average dose of 1.7 Gy. The RBE values are normalized to standard 70 kV (dicentrics) or 200 kV (micronuclei) x-ray irradiation. The 117 protons applied per point deposit the same amount of energy like a (12)C ion with 55 MeV total energy (4.48 MeV u(-1)). The enhancements are about half of that obtained for (12)C ions (RBE(MN) = 2.20 ± 0.06 and RBE(D) = 3.21 ± 0.10) and they are attributed to intertrack interactions of the induced damages. The measured RBE values show differences from predictions of the local effect model (LEM III) that is used to calculate RBE.
values for irradiation plans to treat tumors with high LET particles.