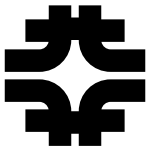

Fermi National Accelerator Laboratory

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Comment on "Biological Effects of Stellar Collapse Neutrinos"

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Comment on "Biological Effects of Stellar Collapse Neutrinos"

Recently, Collar has presented important conclusions on this subject [1]. We find that important research in the field of radiobiology has been overlooked and that certain results taken from the literature appear to be cited out of context.

Several of the cited references report on results from *in vitro* studies involving tissue specimens. While *in vitro* studies are useful, it is generally acknowledged that the connection of specific results of such studies to *in vivo* results applicable to whole, living organisms is quite difficult as there exist biological repair mechanisms which correct damage done by such "insults" as ionizing radiation.

Taking the mixture $C_4H_{40}O_{17}N_1$ as "representative" of all biological tissue is not always a valid assumption. It neglects consideration of important heavier elements which are present in significant quantities. For example, nucleotides, the components of DNA molecules, are approximately 9-10 % phosphorus by mass. Yet the presence of phosphorus and the effects of recoil phosphorus ions on DNA were not discussed.

Both Brackenbush and Braby [2] and Goodhead [3] express conclusions that unique and important biological effects may result from high linear-energy-transfer (LET) radiation. Neither, however, expresses these conclusions without also suggesting caution based upon the limited set of existent

experimental results. Serious reservations about drawing definitive conclusions appear in Ref. [3] where it is expressed that this whole field is in early development and much more experimental work is needed before complete understanding of these effects is reached. Ref. [3] states, "Further understanding of these questions could lead, in future (*sic*), to substantial increases or decreases in estimations of risk."

Issues of cell specialization and replication rate which may have important effects on repair mechanisms are not considered. Further, the assertion that 3.6 nucleosomes (out of a total of approximately 3 X 10^7 nucleosomes per cell) damaged per cell nucleus corresponds to a 97 % certainty that the damage is "important" is not substantiated. Likewise the assertion that a malignancy rate of $\approx$ 4 kg^{-1} is sufficient to kill a "vast percentage of larger animals leading to extinction" is not supported.

The calculated absorbed dose of 9.88 X 10^{-9} Gray (Gy) due to a stellar collapse at 1 parsec from Earth is very small. A recognized measure of risk which takes into account recent work in radiobiology is given as 5 X 10^{-2} latent fatal cancers Gy^{-1} of photons [4]. Thus, if this absorbed dose of $\approx$ 1 X 10^{-8} Gy were due to photons, the expected fatal cancer production is 5 X 10^{-10} per exposed organism. For comparison, individuals of *Homo sapiens* are subject to a lifetime cancer mortality rate from all natural sources of about 20 % per individual [5]. Given this "background" lifetime cancer risk, it is unlikely a value of 1 % increased lifetime cancer risk is sufficiently

large to result in the extinction of species. For 1 X 10^{-8} Gy due to recoils from neutrino elastic scattering to result in a fatal cancer production of even 1 % per exposed organism, the value of relative biological effectiveness (RBE) for this radiation must be approximately 2 X 10^{7}. Currently accepted RBE values assigned for all types of damage, not limited to cancer induction, do not exceed approximately 200 [6,7].

Finally, a stellar collapse within 1 to 10 parsecs of the Earth is likely to have multiple effects on the environment that could also produce extinction of species. A comparison of these effects with those due to the neutrino-induced radiation is not provided.

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