Appendix 1: Electromagnetic pulse generation

The DNA conductance C for the coherent regime is given by [14].

$$C = C_0 \exp\left[-\beta \bar{v} \left(b - b_0 \right) \right]. \quad (1)$$

For the purpose of the present study, the replacement of the variable b by t is necessary. We note in this regard that the total time (t) the electron takes to move along its path is the sum of the time intervals it expends to jump between individual GC base pairs (t_i), that is, $t = \sum_i t_i$. In order to simplify the approach, while maintaining the essential ingredients of the observed effect, we define an average hoping velocity as

$$\bar{v} = \frac{\sum_i b_i}{\sum_i t_i} = \frac{b}{t} \quad (2)$$

where b_i is the distance between adjacent GC base pairs. Therefore,

$$b = b(t) = \bar{v}\, t \quad (3)$$

Then, a pulse (details below) of electric current is generated, and its intensity is proportional to the conductance, that is (see eq.1),

$$I(t) = A \cdot C(t) \equiv I_0 \exp\left[-\beta \bar{v} \left(t - t_0 \right) \right] \quad (4)$$

Where A is a proportionality factor, and $t_0 = \frac{b_0}{\bar{v}}$ is the time elapsed between the radiation hit and the beginning of the exponential decay. An electric current generates a magnetic field. According to the Ampere's law,

$$\oint_\Gamma \vec{B} \cdot d\vec{s} = B \left(2 \pi r \right) = \frac{I}{\varepsilon_0 c^2} \; ; \quad (5)$$

therefore,

$$B(\mathrm{t}) = \frac{I(\mathrm{t})}{2\pi\varepsilon_0 c^2} \frac{1}{\mathrm{r}} , \quad (6)$$

Where Γ is a circle with radius r and centered at the DNA persistent length (see figure 1) .

A time varying magnetic field induces an electric field, and according to Faraday's law

$$\oint_{\Gamma'} \vec{E} \cdot d\vec{s} = -\frac{\partial}{\partial t} \Phi_B(t) = -\frac{\partial}{\partial t} \int \vec{B}(t) \cdot d\vec{a} \quad (7)$$

Where Φ_B is the magnetic flux calculated as

$$\Phi_B = \int B \, dr \, dl = \int B(r) dr \int_0^l dl \; ; \; (8)$$

See Figure 1 for notation. Also,

$$\oint_{\Gamma'} \vec{E} \cdot d\vec{s} = (2l + 2r) E \cdot \; (9)$$

Finally, after some algebra we obtain

$$E(t) = E_0 \exp\left[-\beta \,\overline{\mathrm{v}} \, (t - t_0) \right], \; (10)$$

Where

$$E_0(r) = \frac{\beta \,\overline{\mathrm{v}}\, I_0}{4\pi\varepsilon_0 c^2} \; \frac{l}{(l+r)} \; \ln\left(\frac{r}{r_0} \right), \text{ and } (11)$$

$$B(t) = B_0 \exp\left[-\beta \,\overline{\mathrm{v}} \, (t - t_0) \right], \; (12)$$

where

$$B_0(r) = \frac{I_0}{2\pi\varepsilon_0 c^2} \; \frac{1}{r} \; . \; (13)$$

In Figure 2 the results of the present calculations for E and B are shown. The message conveyed by these results is: an electromagnetic field could be generated all over the region surrounding the DSB site, having a maximum at r = 3 nm and with sizeable intensities (relatively to the maximum) extending over significantly far distances from the damage, but quickly extinguishing with the elapse of time. Typical electron drift velocities are of the order of 10^5 cm/s in semiconductors and for a low-field region [33]. This is perhaps a too high drift velocity for DNA. For instance, Hall and collaborators [34] demonstrated photo induced oxidation by a rhodium metallointercalator in DNA over 4nm within 100 ps, meaning a velocity in the range of 10^3 to 10^4 cm/s. If 10^4 cm/s is adopted as a working figure, the resulting electromagnetic time-pulse spans up to 50ps in the coherent regime region, giving rise to the transient depicted in Figure 2 insert, where it was assumed that the radiation hits DNA damaged at t = 0.

The intensity of the electric field is strongly dependent on the electric current intensity, which in turn is determined by both the density and velocity of the charge carriers [35]. Our estimates, therefore, span two orders of magnitude; that is, average electric field intensities at r = 50-200 nm see Figure 2 are likely to assume values between 10mV/m and 1V/m.