Possible models of ring current oscillations in DNA

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ABSTRACT

It is well established that ring currents are formed in pi electron clouds of DNA bases under the influence of external magnetic field. Recently, we hypothesized that Fe-containing enzymes can magnetize DNA in nature and create static and oscillating magnetic fields and suggested biological functions for these effects (Guschin, 2018). Here we suggest possible mechanisms for oscillations of ring currents in DNA.

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It is well established that ring currents are formed in pi electron clouds of DNA bases under the influence of external magnetic field. Recently, we hypothesized that Fe-containing enzymes can magnetize DNA in nature and create static and oscillating magnetic fields and suggested biological functions for these effects (Guschin, 2018) . Here we explore possible mechanisms for oscillations of ring currents in DNA.

We came up with two alternative models for ring current oscillations in DNA. In the first model, pi electron clouds of the base stack are unified and behave as a whole. In the second model, the pi electron clouds of individual bases are largely independent. We don't know which of the models (if any) is correct, but certain predictions can be made based on these models and verified experimentally.

In either model a hypothetical initial EM oscillation comes from a Fe-containing enzyme associated with DNA. There is a number of such enzymes including polymerases and helicases. The hypothetical enzyme is using ATP energy to produce alternating magnetic field, presumably by spinning magnetized Fe-S cluster in

proximity of the basepair stack.

MODEL 1 (united pi cloud).

The externally applied alternating magnetic field from the enzyme would spread over the pi-electron cloud of the base stack and cause magnetic oscillation in it as shown on Fig. [MODEL1].

According to the Faraday's law, the increase of the incident magnetic field applied to the pi-electron cloud will create a secondary field in the cloud in the direction opposing the incident field.

3. The ring current (spinning of the cloud around its axis) spreads through the base stack and this spinning creates the magnetic momentum in the affected bases. Ring current possesses certain inertia (inductance).

4. The enzyme reverses the polarity of the incident magnetic field, the first base reacts accordingly by reversing its ring current and the polarity of the secondary magnetic field, so the bases 1 and 2 will have the opposite ring currents and the opposite magnetic fields.

5. The new pattern spreads over the base stack, while the enzyme reverses again the polarity of the incident magnetic field. If the oscillation rate of the enzymatic magnetic field is right, a stable oscillation pattern may be established in the base stack.

Spreading of ring currents in DNA base stack

Fig. [model1]

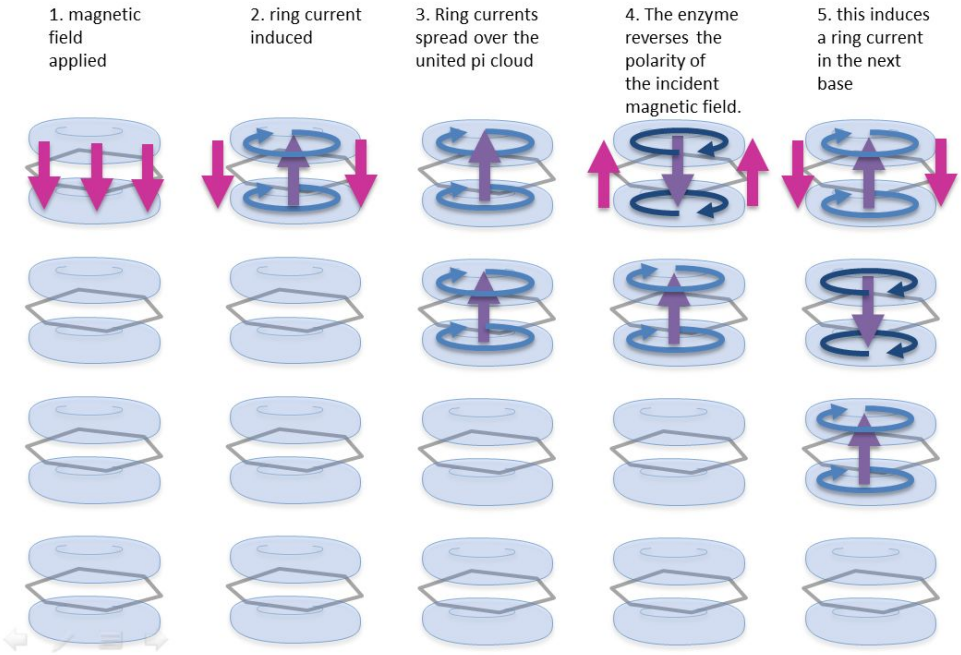

Fig. [model1]

MODEL 2 (independent pi rings).

While in model 1 the ring current was spreading through the united pi electron cloud of the base stack, in the model 2 it doesn't. Instead, there is an induction of pi-ring current in the next base by the magnetic moment of the previous base pi-ring current.

The magnetic field is applied by the enzyme.

The ring current is induced which creates the magnetic field opposite to the incident one.

This, second magnetic field spreads over to the next (and previous) bases and creates pi-ring currents in them, in such a way that both current direction and magnetic moment oppose the ones of the first base.

This spreads over to the next base, again causing the ring currents in the opposite way.

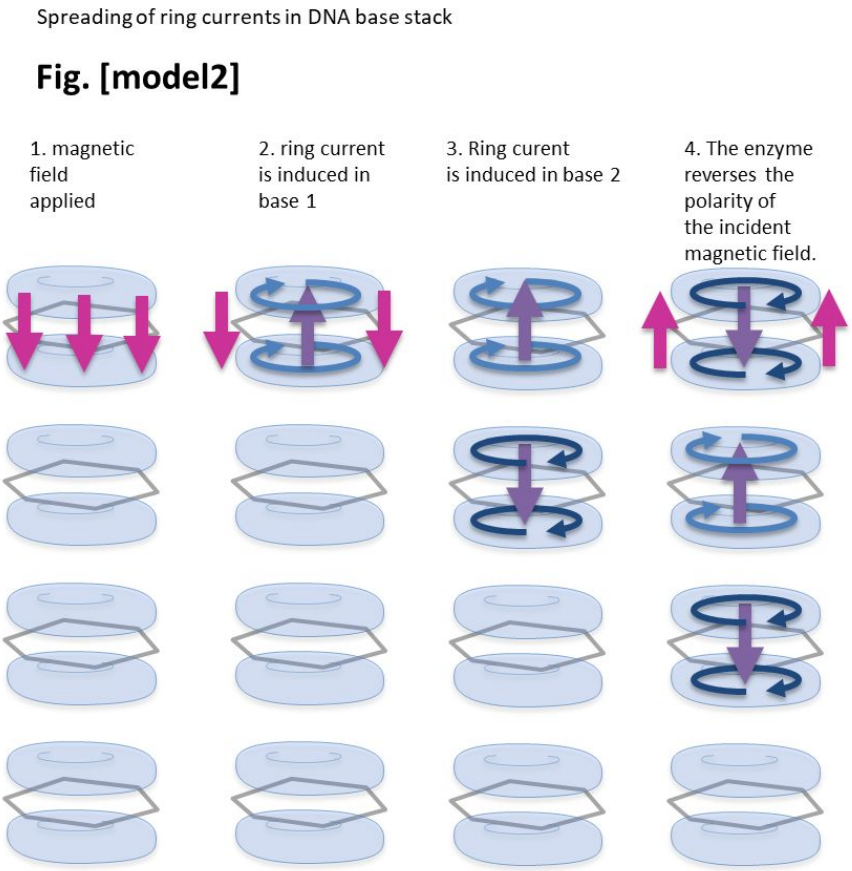

Fig.[model2]

Table: comparison of models

	Model 1	Model 2
What is transmitted to the next base:	Ring current directly because electrons are untied	Magnetic field (which in turn induces a ring current)
Directionality of the induced ring current, next base compared to the previous base	same	opposite

AUTHOR CONTRIBUTIONS

Main concept and writing - MMR. MMR, VG, OP, NZ, AM, AT - discussion of main ideas. EE - literature research.

REFERENCES

Guschin, V. V., Polesskaya, O., Zyryanova, N., Tovmash, A., & -B, M. M.-R. (2018). On the function of DNA magnetism. http://doi.org/10.13140/RG.2.2.24177.38248

Guschin, V. V., Polesskaya, O., Zyryanova, N., Tovmash, A., Mara, A., Erdyneeva, E., & Myakishev-Rempel, M. (2018). On the Function of DNA Magnetism. Retrieved from http://vixra.org/abs/1803.0075