CDs as negentropic engines in the frame of geomagnetic and geoelectromagnetic fields.

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According to the theory of Del Giudice-Preparata-Vitiello (1988, PhysRevLett), CDs are clusters of millions of water molecules that oscillate mainly between the ground state and the first excited state, with the same phase, i.e. in a coherent way. Thus, they are named "coherent domains". According to our experimental results, CDs become stable only near surfaces (Comisso N *et al*. 2006, Bioelectrom), in agreement with the observations of Pollack and coll. (Zheng JM *et al*. 2006, Adv Colloid Interf Sc 2006). Furthermore, we observed that CDs capture ions and zwitterions in aqueous solutions under stimulation of an alternate magnetic fields, coupled with the geomagnetic field (Zhadin MN and L Giuliani, 2006, EBM; Giuliani L *et al*. 2009 IJBS). We attempted explaining the mechanism (Del Giudice E and L Giuliani, 2010, EJOO Library v. 5), based on the role of the ponderomotive force. This force is caused by the elevated squared gradient of the electromagnetic potential vector through the boundary of CDs and is countered by the squared difference of frequencies between the captured ion and the frequency of the attracting water CD. It has been seen that in the IR spectrum of water, the vibrational peak at 3200 cm-1 (0.4 eV) is the peak due to the coherent fraction of water (De Ninno A *et al.*, 2014, Water J). Thus ions that can be captured by CDs waters are only the ones having a spectrum line in the neighborhood of 3200 cm^{-1}. These ions seem to be undistinguishable from ordinary water molecules while they are kept captive in the boundary of CDs. In such condition, they are belonging to the more ordered phase of CDs rather than to the unordered phase of bulk water. The entropy of the system -CD and captured ions together- decreases while the Gibbs energy increases. In the presence of a weak magnetic field, tuned with the ion cyclotron resonance (ICR), the free energy is transferred to the ion and the ion escapes from the CD with enough energy to overcome the averaged energy in the bulk, kT. If there is an electric field in order to give a direction to the motion of such ions, a current arises, as happened in the well-known Liboff-Zhadin effect. This is the main mechanism through which CD works as a negentropic engine. In this report we present a second auxiliary mechanism: Schumann's frequencies match the cyclotron frequencies of several hydrates of hydronium. Thus they can protonate the bulk water thanks to the Liboff-Zhadin effect of hydronium, modifying again the properties of water (D'Emilia E *et al.*, 2015, EBM, and 2016, EBM). This phenomenon allows ion currents -present in bulk water- to be amplified, thanks to the increased conductivity in water. Also iIn this way, the energy of ion currents exceeds kT.