Can Cold Fusion be real ?

The decision of Martin Fleischmann to embark in 1983 on Cold Fusion research was based on the belief that Quantum Mechanics alone was not able to explain some experimental facts, which require some new approach.

The Fleischmann intuition implied that nuclear transformations of D^+ compressed into Pd lattice would differ substantially from the reactions observed in dilute plasmas.

The question about the reality of CF is usually asked in the context of Quantum Mechanics which shows that “Cold Fusion” should not be possible:

the nuclear physics of deuterons in the lattice (with a space-time scale some six orders of magnitude smaller than the space-time scales of the lattice) should not differ from the nuclear physics in the vacuum (that is the principle of Asymptotic Freedom).

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However Asymptotic Freedom is <u>not</u> a general property of the coherent ground state of QED in condensed matter !

QED is the relativistic quantum field describing interaction of electrically charged particles via photons and it is therefore a good candidate to describe the interactions among particles and fields inside condensed matter.

In 1989 Emilio Del Giudice together with Giuliano Preparata and Tullio Bressani investigated the system in the context of QED. The ground state in condensed matter involves the atoms/molecules of a macroscopic piece of matter in an intricate dynamical interplay mediated by large amplitude (classical) e.m. field. In such a scenario the Asymptotic Freedom is not a general property of such a coherent ground state because the e.m field fills the vacuum among the particles inside the matter and interacts strongly with the charges.

This intuition was substantially shared by Julian Swinger, one of the fathers of QED.

Suppose that a fusion be a physical event localized at a definite site of the lattice. The compound nucleus D+D must release its exceeding energy (in order to relax to a stationary state) in the time allowed by the Heisenberg uncertainty principle DEDt ~ ħ. In order to reach the nearest atom at a distance of about 3 Å (i.e. about the distance between first neighbour in Pd lattice) the velocity of the energy transfer should be orders of magnitudes larger than the light speed, then the only possibility for the nucleus is to fission in fragments as expected in vacuum!

Even if we are able to find in condensed matter quantum electrodynamic a mechanism able to justify weak interactions such as the capture of “heavy” electrons by proton as suggested recently by Larsen and Widom it is still hard to imagine a mechanism able to dissipate the energy produced locally different from a coherent electromagnetic field.

According to the universally accepted principle of physics it is impossible to dissipate energies of MeV simply “heating” the lattice without emission of very energetic fragments that have not been observed in these phenomena.

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Cold fusion cannot be a localized event but implies the revision of some of our implicitly assumed facts about condensed matter.

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