Unified Field Theory and Occam's Razor

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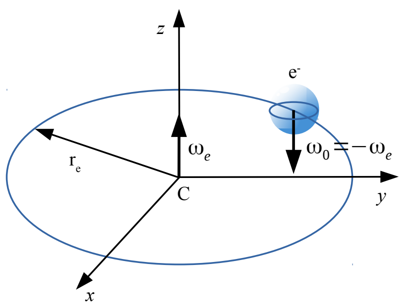
Unified Field Theory was an expression first used by Einstein in his attempt to unify general relativity with electromagnetism. Our book titled "Unified Field Theory and Occam's Razor" [1] attempts to provide real answers to foundational questions related to this unification and should be of high interest to innovative scientists. In the hope of a fruitful dialogue with all who are interested in this subject, our online poster presents some key ideas from the book, which are relevant to low-energy nuclear reactions:

- **Compton-scale Electron-Proton or Electron-Deuteron composites catalyze nuclear FUSION**. Light-matter scattering experiments yield two distinct electron sizes. On the one hand, Compton scattering measurements indicate the r_{charge}=2.82 fm classical electron charge radius. On the other hand, Thomson scattering measurements indicate an r_e=386.16 fm value of the so-called reduced Compton radius. The proper physical understanding of these electron sizes has been clarified in our book [1]: it describes in detail the electron's internal structure. This structure is sketched below. The r_e=386.16 fm reduced Compton radius is recognized as the electron's Zitterbewegung radius, and the r_{charge}/r_e ratio is exactly the fine structure constant. The electron spin is generated by the circular Zitterbewegung of its charge.



Entanglement type	Where is it observed?
Spin entanglement	Two electrons sharing the same orbital
Angular momentum entanglement	Electron-nucleus system (for example H atom)
Momentum entanglement	Bose-Einstein Condensate material
Position entanglement	Compton-scale composite ($e-p$ or $e-D$)

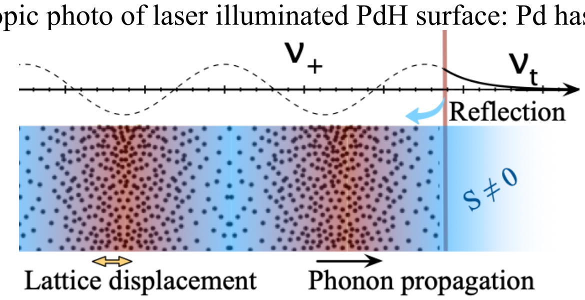
It follows from the electron's physical size that the shortest possible electron-nucleus distance is r_e. This shortest distance is realized in the position entangled state (see table above). I.e. the "Compton scale composite" state is complementary to other well-know QM entanglement modes. A close proximity e-p or e-D configuration implies small inter-nuclear distance between such quasi-neutron and some other nucleus, thereby enabling catalyzed fusion reactions.

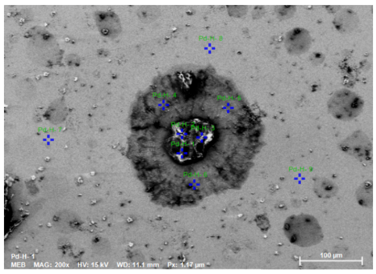
Our theory explains electron-mediated nuclear fusions, including: electron-mediated fusions (M. Lipoglavsek's group) where the mediating electron sometimes carries away the entire fusion energy, the analogous observation >7 MeV particle energy in D-D fusions (P.A. Mosier-Boss' group), the appearance of Cu in hydrated Ni at elevated temperature (J. P. Biberian), as well as the 2.3 pm inter-nuclear distance measurements (L. Holmlid's and S. Olafsson's groups).

- **Phonon-induced nuclear FISSION at phonon-reflecting surfaces**. In our book [1], we explore the simplest form of Maxwell's equation: $\partial\mathbf{G}=\partial^2\mathbf{A}=0$, where **A** is the electromagnetic 4-vector, and **G** is the electromagnetic field. There is no need to insert charges "by hand" into Maxwell's equation, i.e. it explains what charges are made of. However, **G** now has three components: electric, magnetic, and scalar.

We explain why an electromagnetic scalar field arises at phonon-reflecting surfaces, as illustrated in the bottom left figure. This phenomenon is analogous to the appearance of an evanescent field at light-reflecting surfaces. A sufficiently strong electromagnetic scalar field appears to induce nuclear fissions. From experimenters' perspective, these appear as phonon-induced fissions.

Our theory explains surface transmutations, including: fissions on fracture surfaces (A. Carpinteri's group), fissions on sonicated metal surfaces (F. Cardone's group), fissions on nickel surfaces (Y. Iwamura's group), fissions on laser-illuminated surfaces (J. P. Biberian, U. Mastromatteo). The bottom right figure is a microscopic photo of laser illuminated PdH surface: Pd has almost completely fissioned, mainly into O and N.





[1] A. Kovacs, G. Vassallo, P. O'Hara, F. Celani, A. O. Di Tommaso "Unified Field Theory and Occam's Razor", World Scientific, 2022.

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