

# Radiation Coupling: Nuclear protons to deep-orbit-electrons, then to the lattice

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The deep-Dirac level (DDL) electron orbits have been proposed, and rejected, for over 50 years. The rejections have been based on mathematical considerations resulting from the singular Coulomb potential used in the Dirac equations and on lack of observation of such levels. Nevertheless, these orbits explain many things experimentally observed in CF [1] and may be a unique explanation for the low-radiation or nearly radiation-free transmutation measured in both PdD and NiH CF systems [2]. It is important to develop the characteristics of these very deep-orbit, relativistic, electrons and their formation of femto-atoms and molecules in more detail.

Important DDL-electron characteristics include:

1. relativistic velocities ( $>1$  MeV) and extremely high EM-radiation fields
2. high binding energy (up to 507 keV)
3. close proximity (within Fermis) to radiating protons in  $d^{\wedge}$  or  $4He^{\wedge}$  (near-field EM coupling)
4. charge neutralization of protons, deuterons, and helium nuclei is source of transmutation [3]
5. near frequency matching of excited DDL electrons with many-MeV nuclear protons (allows primary pathway for de-excitation of  $D-D \Rightarrow 4He^{*\wedge}$  nuclei)
6. deep, bi-modal, potential well permits DDL electron interaction with both photons and neutrinos and direct resonant energy transfer from nuclear protons (non-photonic coupling)
7. ability to interact with EM fields of nuclear protons within several lattice spacings
8. interaction with protons of radioactive nuclei provides attractive force between femto-atoms or -molecules and radio-isotopes (provides basis for reducing radioactivity in lattice)
9. non-photonic (strong, longitudinal, EM field) coupling to atomic and lattice electrons (strong EM field permits single-pulse energy transfer via non-linear interactions with atom electrons)
10. DDL electrons about radio-nuclides provide ready decay paths and permit radiative discharge of nuclear energy rather than normal energetic-particle/gamma-production pathways

The process of energy transfer involves the near-field electromagnetic coupling of energy of energetic charged nuclear dipoles to tightly co-confined electron dipoles (DDL orbits). From there, the energetic electrons can near-field-couple energy into the adjacent Pd-bound electrons causing intense local ionization, but no energetic radiation beyond the keV x-ray level. The steady loss of nucleon energy to the DDL electron(s) and their disturbing presence in the nuclear region prevent the semi-stable nuclear orbits required for the formation of gamma rays. This paper seeks to qualify the decay processes and identify the conditions and limits required to permit stable and efficient conversion from nuclear energy to thermal energy in the lattice. In particular, it will describe the near-field EM coupling that will take place within the nuclear region. While nuclear-dipole coupling has been studied, the EM coupling of nucleons to tightly bound electrons and thence to nearby bound electrons may be new.

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[1] A. Meulenberg, "From the Naught Orbit to He4 Ground State" 16th International Conference on Condensed Matter Nuclear Science, Chennai, February 6 -11, 2011, JCMNS-10 p 1-15 (2012)

[2] A. Meulenberg and K. P. Sinha, "Deep-orbit-electron radiation emission in the decay from  $4H^{*\wedge}$  to  $4He$ ," 17th Int. Conf. on Condensed Matter Nuclear Science, Daejeon, Korea, 12-17 Aug., 2012

[3] A. Meulenberg, "Femto-molecules and transmutation," 17th International Conference on Condensed Matter Nuclear Science, Daejeon, Korea, Proceedings, 12-17 Aug., 2012