Do Conjectures/Concepts of Schwinger, Turner, Chubb, R. Bush, Lamb & Parmenter, *et al* Resolve the Chief Challenge to Cold Fusion Theory?

Robert W. Bass

Innoventech Inc.
P.O. Box 1238, Pahrump, NV 89041
email: donquixote@innoventek.com

Cold Fusion:
experimental "facts" assumed herein:

- **Deuterons** in **Palladium** and **Nickel** lattices can fuse to create **Helium** nuclei and **heat** in the form of lattice vibrations

- **Protons** in **Nickel** lattices can fuse to create **Deuterium** nuclei and **heat** in the form of lattice vibrations

Initial theoretical "implausibility:" Problem of the COULOMB BARRIER

•Princeton University's Albert Einstein Professor of Science, P. J. E. Peebles, in his book on *Quantum Mechanics* (Princeton University Press, 1992, pp. 52-60), presents the mainstream argument and calculation:"…the 'tunneling rate' through the [repulsive] coulomb barrier [is] very slow. … That is why, despite the fact that there are many unresolved problems in condensed matter physics, people are confident that, if conventional quantum mechanics is valid, the deuterium fusion reaction rate in solids at room temperature is exceedingly slow." But Peebles earlier had wondered if he were "overlooking" any significant points in his calculations (which presumably echo Koonin, Baym *et al*, though he gives no specific citations). As a mathematician trained in nonlinear mechanics it was plain to me that Peebles *was* overlooking the periodicity of the lattice and presenting a local two-body analysis of what requires a global and many-body treatment.

Rabinowitz ACID TEST

- After co-authoring a survey of 173 published Cold Fusion theories [*Int. J. Theor. Phys.,* vol. 33 (1994), pp. 617-670], **Mario Rabinowitz** [private communication] **stated that no CF theory of which he was aware, or could foresee based upon the survey, could explain why heavy water works in a Fleischmann-Pons type of electrolysis experiment with a palladium cathode, whereas ordinary water does not. Specifically, he predicted that if one divided by two the mass of the deuteron in the theory presently advocated herein , to study replacement of deuterons in a Pd lattice by protons, then it would predict an enhanced CF reaction, exactly contrary to empirical reality.**

- **Nevertheless, the presently advocated QRT theory passes the Rabinowitz Acid Test not only in the cited case, but in a total of 7 different particle/host-lattice pairs, 4 of which had not been published when this criterion was made public by Bass in June 1991.**

A new (albeit simplified) model

Contribution of Turner (September 1989):

Periodic array of potential barriers can be *resonantly transparent*

Contribution of Schwinger (1990):

A certain *dimensionless ratio* of lengths "sums up, albeit crudely,

<u>all</u> of the forces at work in the lattice"

Contribution of Chubb (1990):

Bloch's Theorem is fundamental principle of solid-state physics

Contribution of R. Bush (1989):

Duane's Rule enables quantization of linear momentum in lattices, a key step in determining the spectrum of Resonantly Transparent energy levels

Contribution of Lamb & Parmenter (1989):

Coulomb-Madelung potential augmented by Fermi-Thomas-Mott enables inclusion of electron screening

Use these five concepts as inputs for new model

Basic model

Would like to calculate dynamics of deuterons, host metal atoms and electrons in 3-D as route to completely understand phenomena …

But need simplifying approximations to make progress!

Some important approximations:

- **1-D approximation for 3-D physical system**
- **Host metal atom potentials neglected**
- **Neglect nuclear potentials**
- **Coulomb potentials adapted to 1-D problem**

What about the electrons?

fixed deuterons   dynamic deuteron

electron cloud

fixed discrete electrons
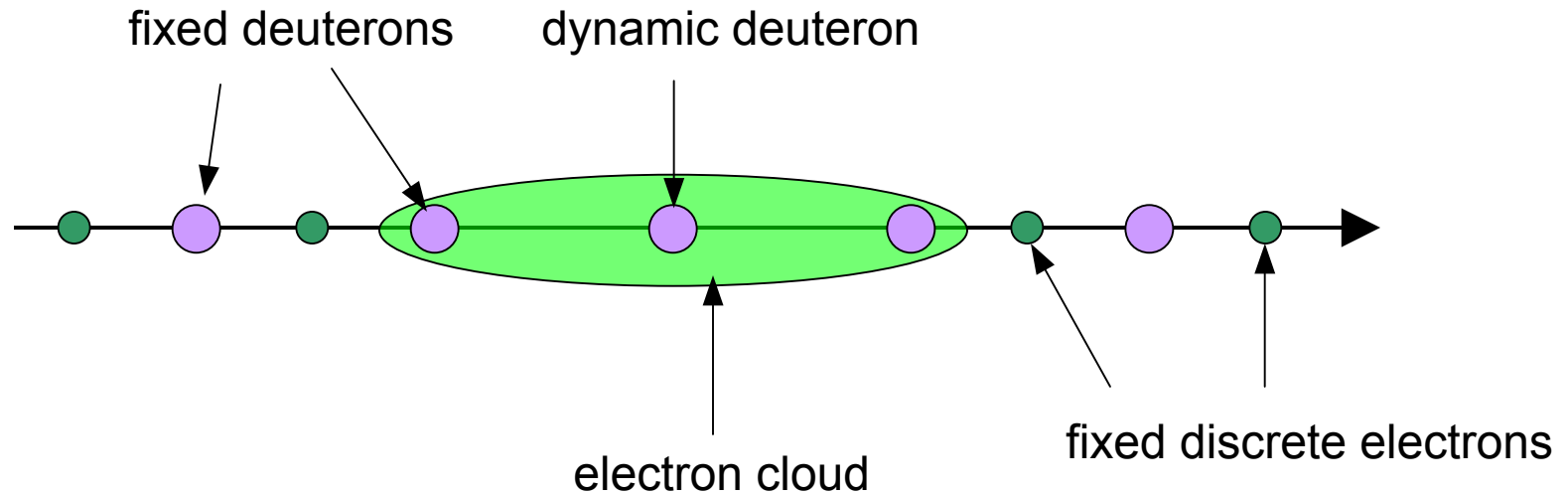
Hybrid description:

Fixed point charge model away from area of interest
Quantum distribution near area of interest

Schwinger Ratio σ = *L*/Λ

Potential $V(r) \equiv V(-r) \equiv V(r + 2.L)$ for $-\infty < r < +\infty$.

Bound deuterons at $r = \pm k.L$, ($k = 1, 2, 3, \ldots$) and an excited deuteron near $r = 0$.

"Averaged" electrons fixed between every pair of bound deuterons that are a distance L apart.
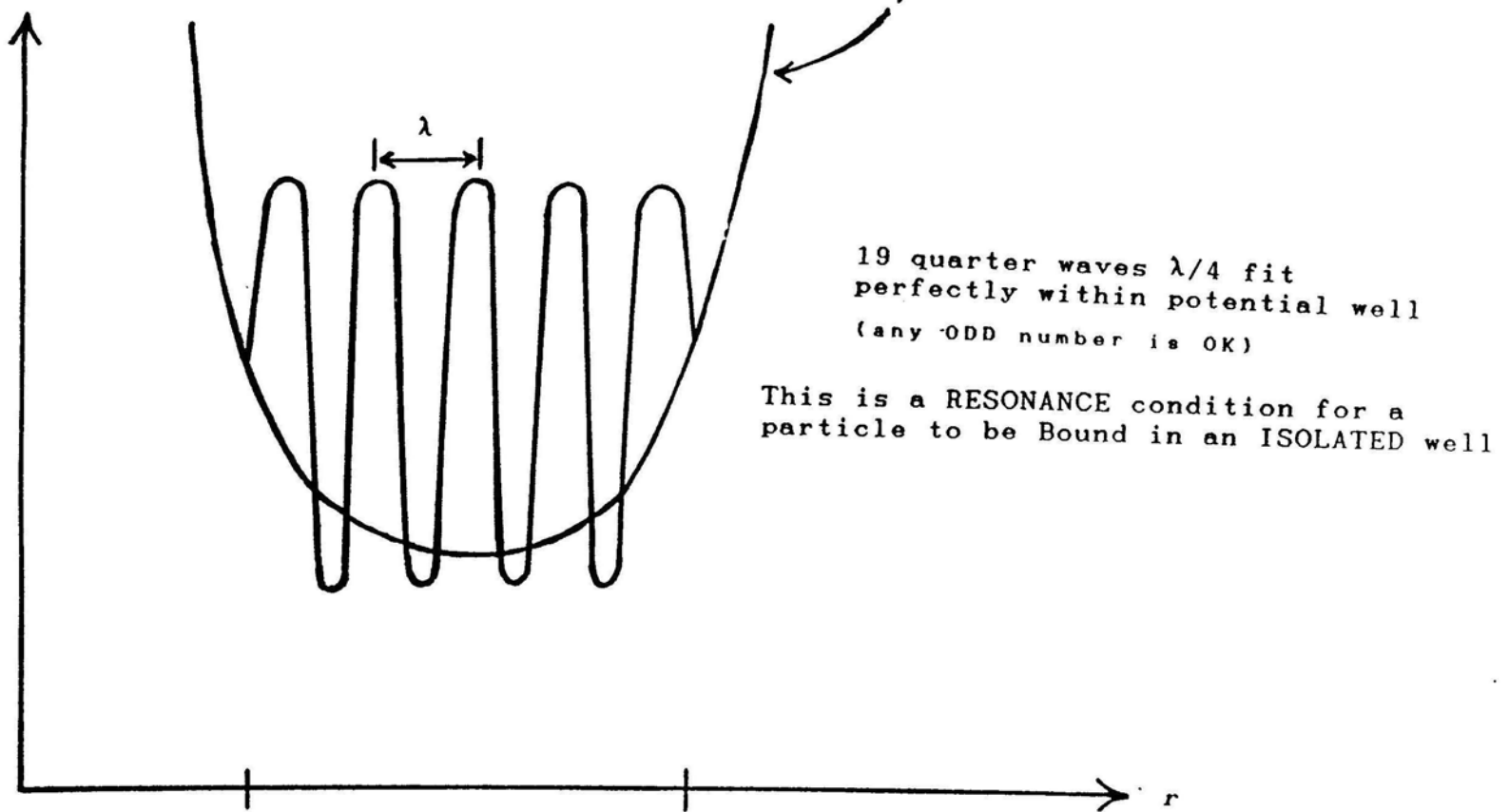
THREE electron charges in a uniform cloud smeared out between $-L$ and $+L$.

[Required for linear Lattice to be electrically neutral.]

Λ = *rms amplitude* of Zero Point Fluctuations (ZPF) of bound deuterons.

QRT Criterion for Resonant Transparency of the Coulomb Barrier

- following Turner in using standard QM (as in Bohm's classic book) Bass proved that the YES/NO answer is equivalent to whether or not $\sigma_{\mathbf{QRT}} \equiv \sigma/\pi$ is closer to an **ODD** integer than to an **EVEN** one, whose physical interpretation is whether the de Broglie wave of an excited particle fits into the potential well between two adjacent bound particles.

λ

19 quarter waves λ/4 fit
perfectly within potential well

(any ODD number is OK)

This is a RESONANCE condition for a
particle to be Bound in an ISOLATED well

r

WAVE-MECHANICAL TRAPPED PARTICLE

Free particle is Bound (in an Excited State) when the well-width
is an ODD multiple of one-quarter of the particle's
de Broglie wavelength

FIG. 3B

$$L_w \;=\; 2L \;=\; 20 \cdot (\lambda/4) \qquad\qquad (20 \text{ is EVEN})$$
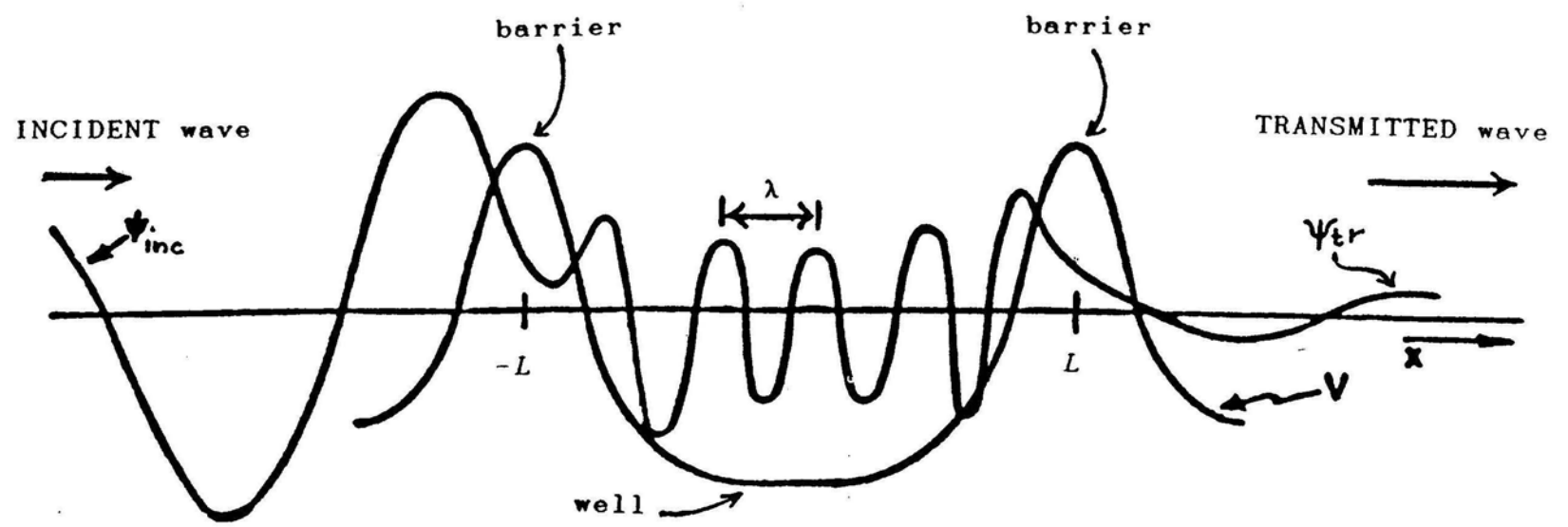

FIG. 5

[after BOHM]

Potential 'BARRIER-WELL-BARRIER' Configuration

WELL-WIDTH $L_w = 2L$ is <u>EVEN</u> multiple of Quarter-Wavelength $(\lambda/4)$:

NO RESONANCE!

Intensity of Transmitted Wave LESS than Intensity of Incident Wave
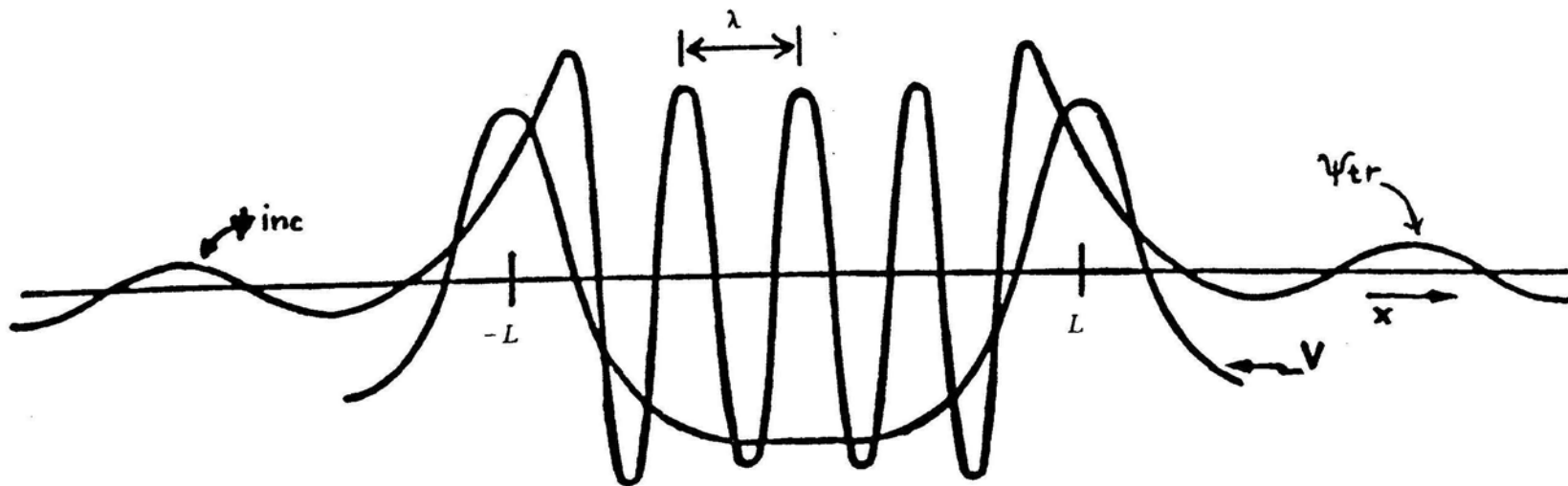(after many transmissions, wave is completely attenuated)

FIG. 6

[after BOHM]

Potential 'BARRIER-WELL-BARRIER' Configuration

WELL-WIDTH L_w = 2L is <u>ODD</u> multiple of Quarter-Wavelength ($\lambda/4$):

PERFECT RESONANCE!

Intensity of Transmitted Wave EQUALS Intensity of Incident Wave

Perfect Resonant Transmission = Resonant <u>TRANSPARENCY</u>

(note similarities & differences with FIG. 3B)

Analytical Proof of Schwinger's Conjecture

- Robert T. Bush's conjectured **spectrum of resonant transparency** of the Coulomb Barrier on either side of an excited particle is a function of basic constants of physics & mathematics, and of NOTHING ELSE but the dimensionless Schwinger ratio σ

Additional Confirmation

- using empirical data from Chubb & Chubb and Bockris, Bass successfully applied the preceding σ_{QRT} test not only to the above 3 pairs, but to 4 new pairs which had not been published in 1991, thereby showing the presciently predictive power of Schwinger's Conjecture, with a Confidence Limit of $100.(\ 1\ -\ (1/2)^7\ ) =$ **99.2%** that this is NOT a coincidence!

Schwinger/Turner/Bush/Chubb/Lamb-Parmenter/Bass theory, which is related to work of Kim & Zubarev, and Li *et al*) of Resonant Transparency of Coulomb Barrier in Periodic Lattices

Quantum Resonance Triggering (QRT principle)

Coulomb/Madelung/Fermi-Thomas/Mott Potential $V = V(r) \equiv V(r + 2.L)$, $-\infty < r < +\infty$.
Bound Positively-Charged Particles at $r = \pm k.L$, $k = 1,2,3, \dots$

Averaged electrons at mid-points between bound particles,
except for $-L < r < L$, where three unit-charges are smeared out as an electron cloud.

Schwinger Ratio $\sigma = L/\Lambda$, Λ = rms amplitude of **Zero Point Fluctuations (ZPF)**

Potential validated by predicting Schwinger Ratio σ within one-third of one percent of measured reality, i.e. **predicted accuracy 99.7%**!

QRT Principle: A host-lattice pair is suitable for Cold Fusion (in the sense that the so-called "Coulomb Barrier" is actually a resonantly transparent mirror), if and only if the Schwinger Ratio divided by π, namely σ/π, is closer to an **ODD** than an Even **integer.**

DECISIVE TEST: Consider 4 possibilities, wherein host lattice is either Palladium or Nickel, and embedded positive particles are either Protons or Deuterons. Then host-particle **pair** is suitable for Cold Fusion if and only if it satisfies the QRT Principle, which turns out to be the case for Deuterons in Palladium or Nickel and for Protons in Nickel but NOT to be the case for Protons in Palladium! Thus the QRT Principle predicts **non-obvious** truth in 4 out of 4 cases!