Usefulness of Quasiparticle Ion Band States in Modeling LENR Processes

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Initially Proposed Ion Band State Theory

- Reaction deuterons occupy energy band states analogous to the band states occupied by electrons in an ordered metal
- Initial Ion Band State theory was largely ignored

Factors Contributing to Non-Acceptance of Early Theory

- Misconceptions about what was taking place in the experiments
- Limitations imposed by building on conventional electron band state theory

Problems with Electron Quasiparticle Models

- Electron band state theory involves single-particle quasiparticle wave functions
- Collisions are treated in semi-classical fashion
- It was not obvious that band state deuterons had sufficient overlap at nuclear scale dimension to undergo fusion

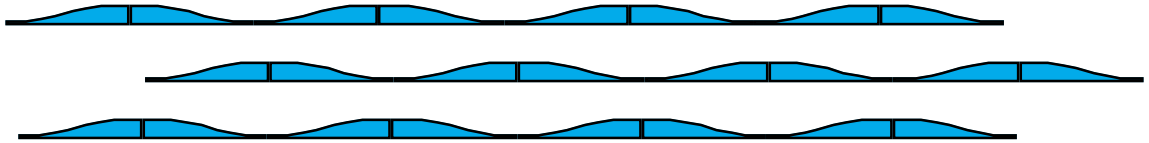
New 2-Particle Bloch Theory

- Uses 2-particle Bloch wave functions with deuteron-deuteron separation variables plus center-of mass variables
- The wave functions use the same dd exchange symmetry that Hylleraas used in his electron-electron helium atom wave function
- The Hylleraas electron wave function has large overlap at zero separation

Charge Density Distributions

D_2

D^+ Bloch state



Wave Function Cusps

- We call zero separation “separation at a point”
- We introduced cusps at zero separation to describe incomplete overlap
- Repeated cusps express Bloch symmetry
- Small or vanishing cusps mean fusion can take place

$g(\mathbf{r}_{12})$ vs. N_{cell} for non-Singlet Ground State

$N_{cell} = N_{cell,critical}$

$N_{cell} = 3\ N_{cell,critical}$

$N_{cell} = 10\ N_{cell,critical}$

Other Factors Blocking Acceptance

- Dynamic time-dependent explanations are commonly viewed as essential
- Argument involves a number of approximations
- Variational principles, time-independent quantum mechanics, and generalization of conventional band theory are obstacles to most Cold Fusion researchers

Broad LENR Application of Bloch Symmetry

- Initial application was to dd fusion in stoichiometric PdD
- Applied Bloch symmetry fusion is relevant to crystal-metal interface volumes such as occur in CaO/Pd systems studied by Iwamura

CR-39 Observations

- One of us (TC) argues that quasiparticle arguments apply to MeV alpha-particle showers observed by Oriani in CR-39 which is well separated from an active electrolysis cathode

TC's Modeling of dd fusion within an Interface Volume

- 2-dimensional symmetry model
- Assumes interface between gem quality ionic crystal and metal is location of reactive deuterium
- Modeling based on stationary state quantum mechanics
- Calculates reaction rate using Fermi time-dependent perturbation theory