Listening to Nuclear Physics

Nuclear physics began with the discovery of radioactivity and with Marie Curie's proof that its source was a new element called radium. Nuclear physics as an experimental science began with Rutherford's alpha particle scattering experiments that showed that an atom's positive charge is concentrated in a tiny nucleus at the center of an atom. The growth of nuclear physics up until the discovery of neutrons and their use to create new elements was dominated by high energy scattering experiments, which are direct descendants of Rutherford's work. All of these involve an interaction at a central point. This highly successful tradition makes the concept of quasiparticle nuclei almost impossible for nuclear physicists to accept. Nonetheless, it is important for cold fusion scientists to listen to the nuclear physics community.

Nuclear physics has provided a deep understanding of the internal structure of the nucleus, its internal dynamics, and the mechanisms by which an unstable nucleus emits decay products. The geometry of alpha particles, neutrons, electrons, gamma rays, positrons, neutrinos, etc. must match onto the initial and final nuclei participating in any nuclear decay process. Nuclear physicists have classified various ground and excited states of nuclei much like atom chemists and physicists have done with atoms and molecules. Spin, angular momentum, and wave function (orbital) symmetry are used in their classification scheme. Reactions are labeled in terms of initial and final states (feedstock and product). The cold fusion reaction involves two quasiparticle deuterons combining to produce one quasiparticle helium-4. Nuclear physics call this type of reaction a 0+ to 0+ transition.

The 0+ to 0+ transitions are relatively slow transitions if the initial and final states are separated by a small difference in energy. The lifetime of the initial state becomes especially long if the energy difference is very small, which is the situation that exists when the reaction product is produced by a resonance scan. This relatively long lifetime suggests that momentum shock stimulation plays a role in the cold fusion process . McKubre's formula for fusion heat production shows that deuterium inflow and outflow are needed for production of detectable heat in his experiments. His empirical formula supports this view.

Nuclear physics scattering experiments have shown that reactions induced by charged particles striking a nucleus occur only when the incident particle has high energy. The studies show that reaction rate decreases rapidly with particle energy, falling close to zero by 1000 electron volts. At room temperature, reactions are clearly impossible. This conclusion is undeniable as long as the reaction geometry is the same as used in nuclear physics scattering studies. That is why deuterons must have a quasiparticle form if cold fusion reactions are to occur at normal metal densities and temperature.

The key characteristic of quasiparticle geometry is that the quantum-of-mass called a deuteron must occupy a many-lobe orbital. Ideally, each lobe is an equivalent potential well. In Rutherford scattering experiments there is a single identifiable location where an energetic particle recoil event has occurred. In Rutherford-type scattering experiments which result in a nuclear reaction event, there is a single identifiable location where the nuclear reaction has occurred. In contrast, in the cold fusion quasiparticle case there is no single location where the reaction takes place. Instead, the reaction takes place coherently and simultaneously at many locations. In the Rutherford scattering experiments one has a single-center target nucleus. In quasiparticle fusion one has an overlapping pair of many-centered deuterons which becomes a many-centered helium-4 nucleus. The Penrose interpretation of Schrodinger wave functions supports the reality of the quantum-of-mass picture in submicroscopic physics.

The cold fusion reaction is a catalytic reaction in which the physical form of the deuteron feedstock is converted from localized particle form to a lattice geometry form prior to reaction. In the lattice form, the deuterons are "coherently partitioned", which means that there is a fraction of each deuteron present in 1000 or more separate small volumes. These deuteron fractions are "entangled", which means that their mathematical sum is the mathematical original deuteron.

Cold fusion liberates nuclear energy in the form of heat by converting 2 deuterons into a helium-4 nucleus. The reaction liberates 23.8 MeV of energy per fusion event, which is about one tenth the energy liberated by splitting a uranium nucleus. Compared with uranium fission, cold fusion produces roughly 6 times more energy per pound of fuel.

Figure 3.6,1 illustrates the quasiparticle dd reaction. In the artist drawing, the initial state is the state which shows the paired deuteron quasiparticle located at an energy level 24 MeV above the helium-4 ground state. The 24-MeV level marks the energy of the quasiparticle deuteron pair both before and immediately after contraction to nuclear dimension, as described in Chapter 3.5. The amount of energy transferred during the resonance scan responsible for the contraction is too small to show on the chart. The stacks of small horizontal bars designate energy levels in a standard energy level diagram. The spacing between bars are the differences in excitation energy between adjacent vibration states inside the nucleus. The energy spacings within each of the vertical stacks are uneven and of the order of 100,000 electron volts. The adjacent stacks of horizontal bars are for the two internal geometries described in Chapter 3.4, namely a (d,d) pairing geometry and a (pp,nn) pairing geometry. A (dd) pairing is the same as a (pn,pn) pairing. These nucleon pairings are like the zero-spin electron pairings in atoms. The pairings create spin-zero pairs from half-spin fundamental particles, as discussed in Chapter 3.5.

The two stacks of energy levels on the left compare the excitation states for a normal single-center nucleus with the two stacks of energy levels on the right, which show the corresponding excitation states for a many-centers nucleus. Note that the 0+ ground states for the (d,d) nucleus are at different levels. This difference in ground state energies is due to the reduction in work energy required to contract two deuterons to nuclear dimension in a many-centers helium-4 geometry as compared with the work energy required to contract two deuterons to nuclear dimension in a single-center geometry. Note that the partitioning of a (pp,nn) nucleus does not alter nucleus energy, because the (nn) pair has zero charge. There is no coulomb repulsion force between a (pp) pair and a (nn) pair. As a result, the (pp,nn) helium-4 many-centers ground state has the same energy as the (pp,nn) helium-4 single-center ground state.

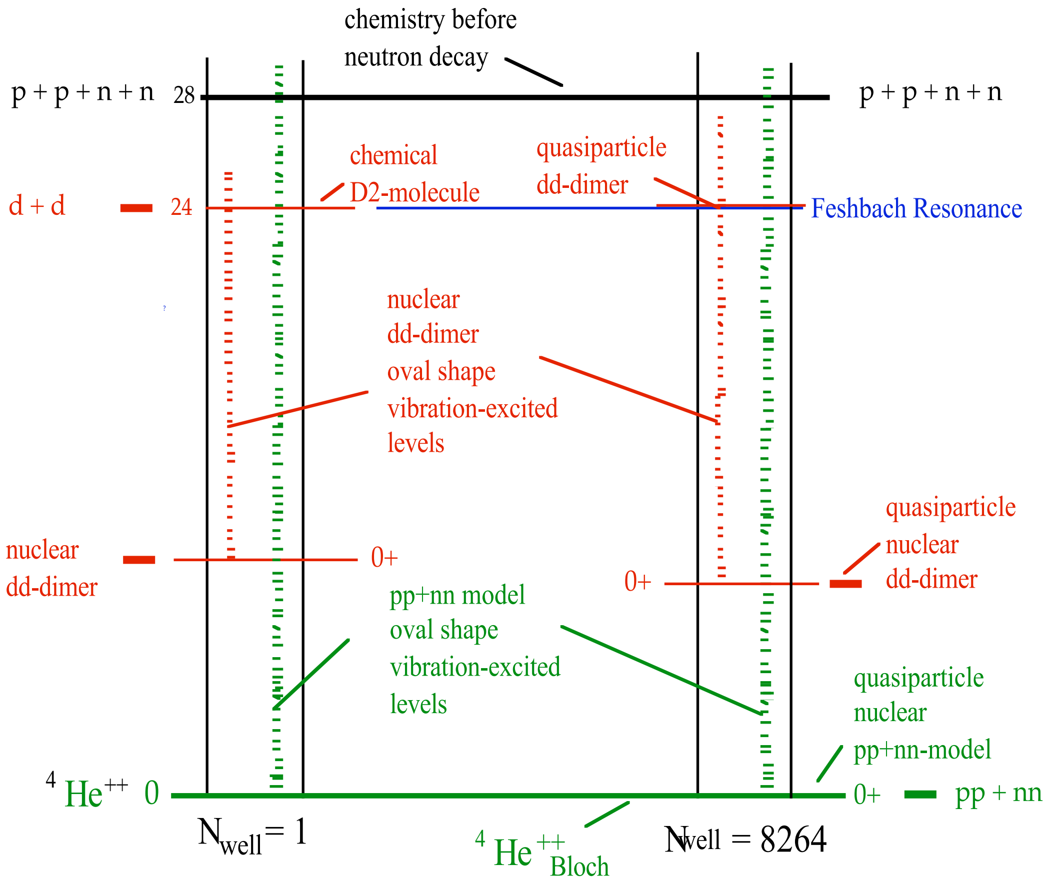

Fig. 3.6,1. Energy level chart for two internal structures of helium-4, and a comparison of energy levels for a single-center nucleus vs. a quasiparticle multi-center nucleus containing 8264 potential wells (orbital lobes). The initial paired deuterons before collapse to nuclear dimension is at 24 MeV above the ground state helium-4 nucleus. If one started with 2 free protons and 2 free neutrons, the starting state would have been 28 MeV above the helium-4 ground state.