Theoretical landscape in condensed matter nuclear science consistent with phonon theory

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Since the initial report of anomalies in PdD by Fleischmann and Pons back in 1989, a variety of anomalies have been seen in experiments of all kinds over the years. Although there is not agreement within our field as to precisely which anomalies should be accepted as real, in our view there is evidence for excess heat production in PdD with associated ^{4}He emission; slow tritium production; light water excess heat in the NiH system; low-level neutron and charged particle emission; weak gamma emission; collimated x-ray emission; and different kinds of transmutation effects. None of these effects are predicted from conventional nuclear or solid state physics.

Over the years we have pursued theories that describe coherent dynamics in nuclear states, in which coherent energy exchange with a highly-excited phonon mode occurs. More than a decade ago a toy mathematical model (the lossy spin-boson model) was found that was capable of demonstrating substantial coherent energy exchange rates under conditions where a large two-level system quantum is fractionated into a very large number of oscillator quanta. Later, we proposed and studied a generalization of the model (which we called the donor and receiver model) which in our view implemented essentially all of the mechanisms that would be needed to account for excess heat in the Fleischmann-Pons experiment.

More recently we have developed a new physics-based version of the model which allow us to extend the theory to describe coherent dynamics in physical systems. The simplest example of one of the new processes in the new theory is energy transfer from a highly-excited vibrational mode to couple to nuclear transitions, leading to nuclear excitation. We interpreted collimated x-ray emission in the Karabut experiment as an example of this mechanism. Gamma emission in the Gozzi experiment, and in Piantelli's experiment, in our view seems consistent with this mechanism.

In our view, the panoply of anomalies in CMNS experiments which our community focuses on must involve a single underlying mechanism, which expresses itself in different ways under different conditions. If we suppose that the phonon-nuclear coupling and coherent dynamics that we have studied is this underlying mechanism, then we might take a step back and see what collection of physical effects we might expect if we take a systematic approach to the associated theory. What results from this exercise might be considered to be a theoretical landscape.

In this presentation we provide an overview of this new theoretical landscape. The simplest class of mechanisms include lattice-induced nuclear excitation generally; subsequent radiative decay can lead to x-ray emission or gamma emission; and subsequent alpha-decay or other disintegration would produce transmutation (which we might consider overall to be a "cold fission" effect). In essence, we might expect to observe energy production under conditions where no hydrogen or deuterium is present (as claimed in experiments at Proton-21). Fusion reactions between two deuterons, or hydrogen and deuterium, combined with coherent energy exchange could account for excess heat, helium, and tritium production. In this case a generalized donor and receiver model seems relevant, and whether the vibrational modes are acoustic or optical impacts which receiver transitions are relevant. The model suggests that ^{3}He should be seen in NiH experiments. A number of reaction pathways within the picture lead to low-level nuclear emission. The most problematic anomaly is transmutation with an associated mass increase (as claimed in the Iwamura experiment), which if real requires a neutron exchange effect combined with coherent energy exchange with the lattice.