Schwinger Pd-D Zeolite Quantum Fusion Process:

Sandia-UNM 147-atom Pd Clusters
Akito Takahashi TSC Pd-D Fusion
Peter Hagelstein F-W BreakDown for Nuclear Energy to Pd Structure
Iraj Parchamazad Transfer Pd Structure Energy to Zeolite
Klee Irwin Jitterbug Ejection of He and Reloading D

viXra 1502.0248 - Frank Dodd (Tony) Smith, Jr.

Julian Schwinger in 1990 lecture at Universite de Bourgogne said:
"... in the very low energy cold fusion, one deals essentially with a single state, described by a single wave function, all parts of which are coherent ...".

Current Science 108 (25 Feb 2015) LENR Special Section Preface says:
"... Analysts have described LENR as an emergent 'disruptive technology' and have predicted that it has the potential to upset the world economic order. ...
Arata ... demonstrated ... direct **deuterium gas loading of ... Pd black powder** ...[**with Pd cluster size on the order of 147-atom Sandia-UNM Pd Clusters**]... McKubre's group at SRI International ... demonstrated that unless and until the ... Pd-D ... loading ratio exceeds a threshold value of about 0.88, no excess heat is observed ... excess heat ... is due primarily to the occurrence of (d–d) fusion reaction forming He4 (inert helium gas). ... The 23.4 MeV energy released ... appears to be transmitted directly to the Pd lattice as phonons ...
Akito Takahashi ... propos[es] a ...[quantum]... structure ... that ... concentrates the electron population between the protons or deuterons. Thus, the Coulomb barrier is eliminated and ... four ... nuclei can simultaneously interact and fuse ...
Peter Hagelstein ... use[s] ... phonon models ...[for Relativistic Coupling Between Lattice Vibrations and Nuclear Excitation, enabled by Foldy-Wouthuysen transformation break-down due to 8-15 THz Lattice Vibration Modes, deuterons being responsible for fractionating the nuclear quanta in operation with excited optical phonon modes]...".

Iraj Parchamazad and Melvin Miles embedded Pd clusters in Sodium Zeolite Y and found that Deuterium gas produced heat in 10 out of 10 experimental runs with Heat Energy produced on the scale of kiloWatts of power per milligram of Palladium ...
the Zeolite Cages have large internal electrostatic fields, on the order of 3 V/nm, whereby the Energy of the Excited Optical Phonon Modes of the Pd Clusters is transferred to the Zeolite as stored Heat to be accessed by Zeolite-Water reaction.

Klee Irwin's Jitterbug Transformation studies show that
the stable Icosahedral phase of 147-atom Pd clusters enables TSC Pd-D Fusion
which thereby expands to its metastable cuboctahedral phase,
ejecting the 4He Fusion Product and reloading 2D Fusion Fuel, and
then goes back to its stable icosahedral phase for another round of TSC Fusion.

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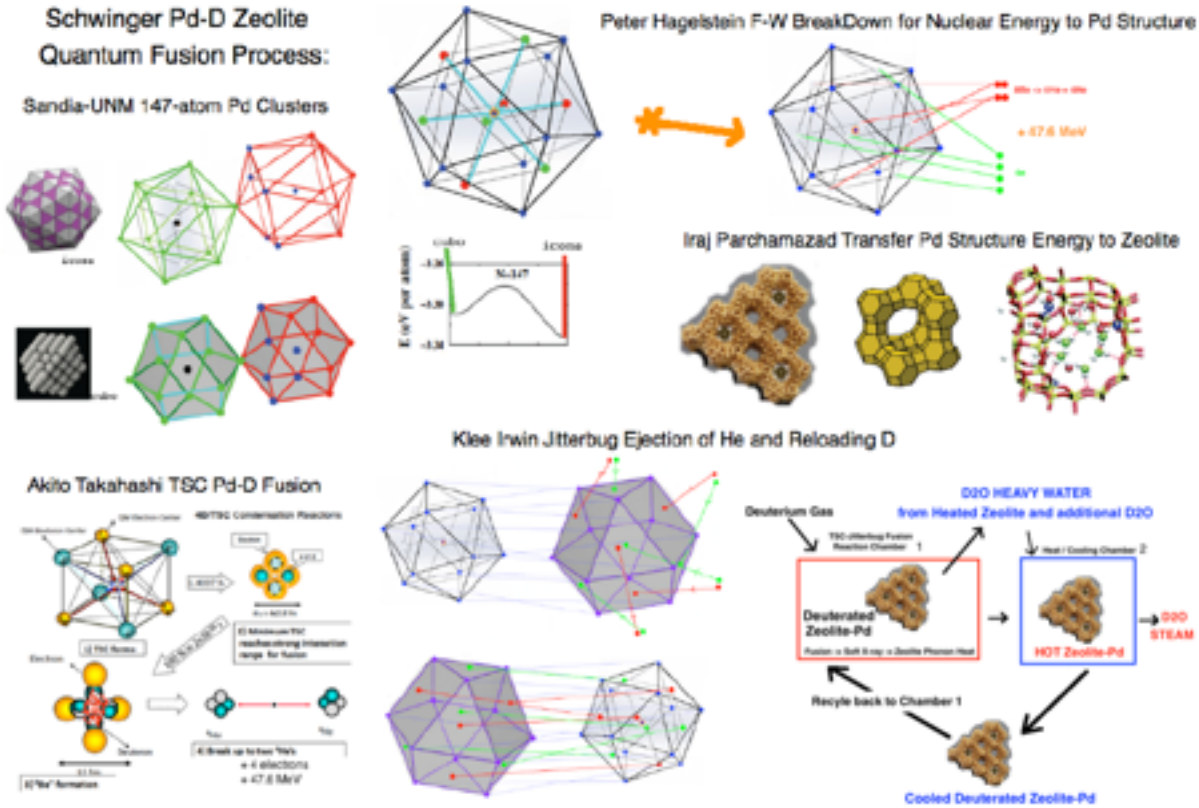
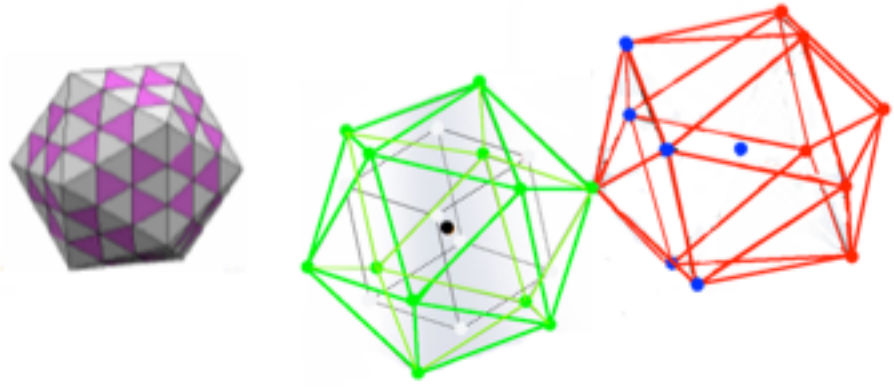


Sandia-UNM 147-atom Pd Clusters

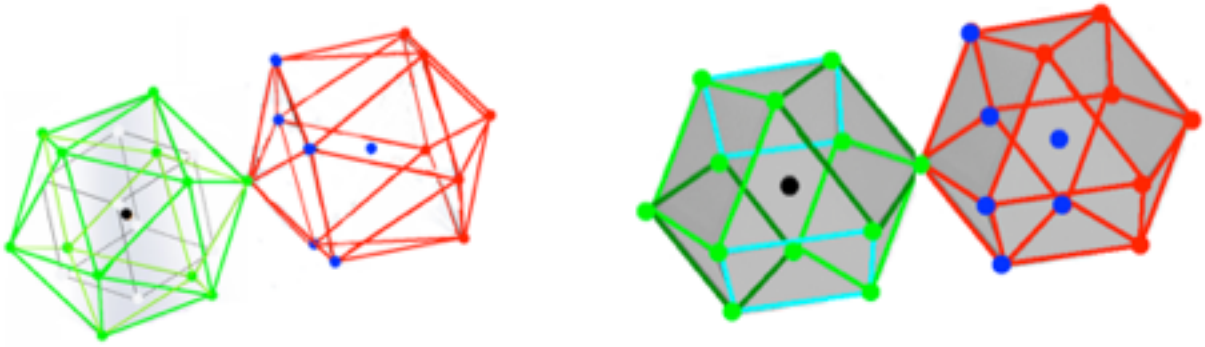
The icosahedral 147-atom state of Pd Clusters has 12 exterior vertices
and a central small icosahedron with 12 interior vertices
which are the innermost and outermost vertices of 12 small icosahedra



(see viXra 1502.0069)

The 13 small icosahedra have 13 x 12 = 156 vertices plus 13 centers for 169
but
the 12 vertices of the central one are each shared with one of the 12 outer ones
which reduces the total number by 12 to go from 169 to 157
and
5 surrounding the shared-with-central 12 of each of the 12 outer ones are shared with
an adjoining outer one reducing the total number by (1/2) 12 x 5 = 30 from 157 to 127
and
the large 147-atom icosahedron contains 20 vertices (at center of each face) that are
not in the 13 small icosahedra, giving the total of 127 + 20 = 147 atoms.

Two basic 147-atom structures are Jitterbug Transforms of each other:



Icosahedral and Cuboctahedral

n = number of shells; N = number of Pd atom vertices
d = diameter of icosahedral configuration in nm
C = number of cells in icosahedral phase
CT = number of tetrahedral cells in icosahedral phase
CO = number of octahedral cells in icosahedral phase

n	N	d	C =	CT +	CO
0	1	0.27	0 =	0 +	0


icosahedral

cuboctahedral

1	13	0.70	20 =	20 +	0



icosahedral

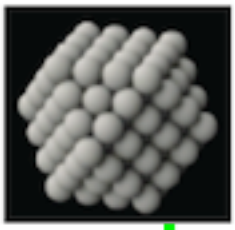
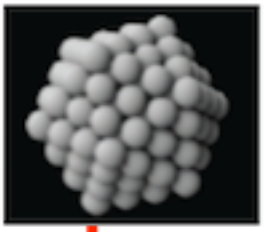
cuboctahedral

2	55	1.13	100 =	80 +	20


icosa


cubo

3	147	1.56	280 =	200 +	80

cubo


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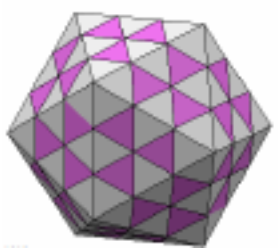
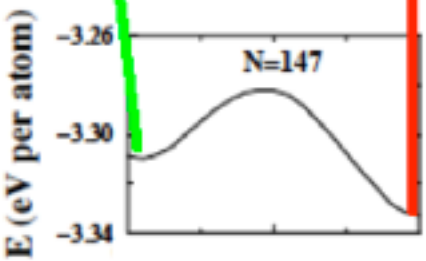
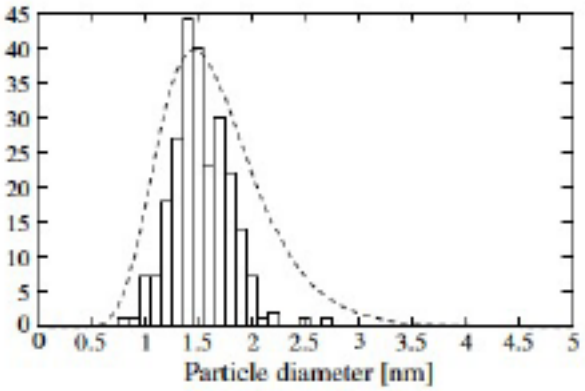



The 147-atom Ground State is Icosahedral. The Cuboctahedral State is Metastable.

(Images from: Polyhedral Clusters by Lord et al; Frank and Kasper in Acta Cryst. 11 (1958) 184-190; Mackay in Acta Cryst. 15 (1962) 1916-1918; vimeo.com/27662398 by Yan Liang (L2XY2) August 2011. Data for n, N, and d from Shtaya-Suleiman dissertation Gottingen 2003.)

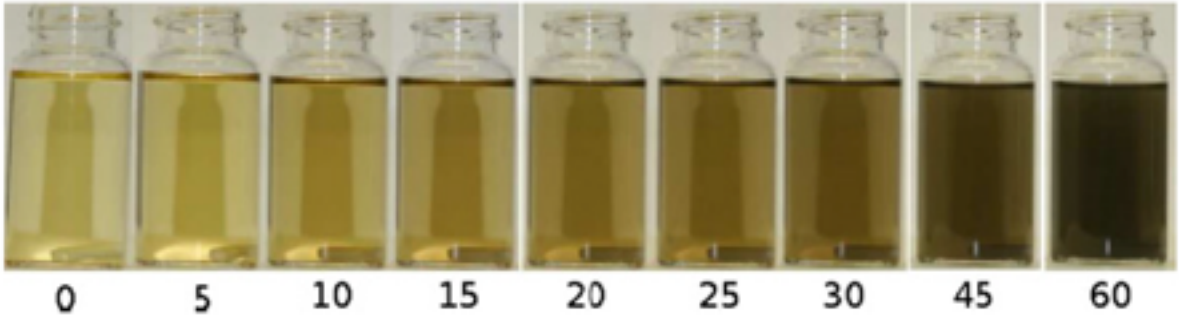
147-atom Pd clusters have diameter about 1.5 nanometers.

1.5 nm Pd Clusters have been produced
at Sandia National Laboratories
and University of New Mexico Center for Micro-Engineered Materials
according to a Journal of Catalysis article
"Facile, surfactant-free synthesis of Pd nanoparticles for heterogeneous catalysts"
at
http://www.flintbox.com/public/filedownload/2871/2011-038%20Science%20Direct%20Article
by Patrick D. Burton, Timothy J. Boyle, and Abhaya K. Datye showing



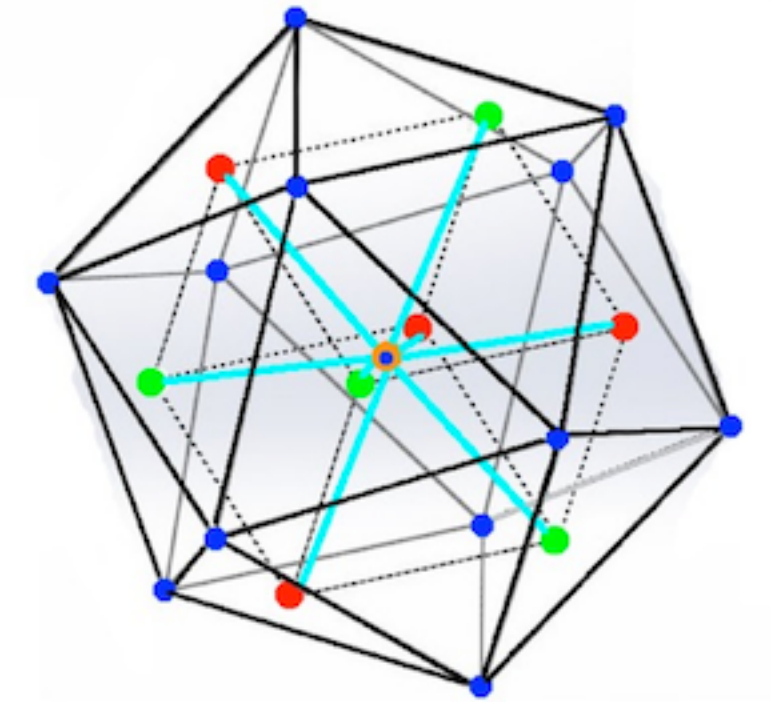
"... ...".

The Sandia-UNM recipe is
1 - 15 ml of methanol (MeOH) in a scintillation vial
2 - Add 5 mg palladium acetate (Pd(OAc)2) whose color is red-orange
3 - Reduce the Pd(OAc)2 by MeOH to Pd atoms
by stirring for 5 minutes with unobstructed exposure to room lighting.
4 - Place on elevated stir plate and allow to react undisturbed for 20 minutes.
During 20 minutes the Pd atoms form clusters that grow to size 1.5 nm (147 atoms)
Color of colloidal suspension changes from pale yellow to dark green over the 20 min



Akito Takahashi TSC Pd-D Fusion

From the point of view of 147-atom Palladium Clusters, each of their 13 small icosahedra constitutes one cell (TSC Fusion Cell) for Takahashi's TSC process



12 Palladium nuclei (blue dots) arranged in an icosahedral configuration
plus
a 13th Palladium nucleus at the center of the configuration that is the TSC fusion site (orange dot fusion site containing blue dot Palladium nucleus).

Within the icosahedral configuration
the 4 Deuterium nuclei (red dots) and their 4 electrons (green dots)
are at the vertices of a cube and are in a single coherent quantum state.

That state then contracts in a a symmetric way along the cyan lines
going down to the center of the cube at
the central Palladium nucleus (blue dot) which acts as a quantum attractor,
combining into the Deuterium TSC quantum state
to guide the condensation of the quantum state of Deuterium nuclei and electrons.

The D + D + D + D does Fusion at the orange dot to form 8Be* which decays
to 4He + 4He + 23.8 MeV + 23.8 MeV
which 47.6 MeV energy is carried to the Pd Cluster Structure
by the 4He+4He and the 4e electrons of the TSC coherent quantum state
according to the Hagelstein Coupling between Nuclear Excitation and Atomic Structure.

Peter Hagelstein F-W BreakDown for Nuclear Energy to Pd Structure:

Julian Schwinger in 1990 lecture at Universite de Bourgogne said:
"... in the very low energy cold fusion, one deals essentially with a single state, described by a single wave function, all parts of which are coherent ...".

Hagelstein and Chaudhary in ICCF 18 (Misssouri 2013) Poster:
Relativistic Coupling Between Lattice Vibrations and Nuclear Excitation say:
"... for **relativistic dynamics ... the fundamental theory includes a very strong coupling between the center of mass momentum operator, and internal nuclear transitions**.
This coupling is connected to changes in the internal structure of a composite when it moves (as a result of the Lorentz transform), compared to the rest frame wavefunction. **Under normal conditions a generalized Foldy-Wouthuysen transformation eliminates this strong coupling**, which results in a model in the rotated frame with no residual first-order interaction. As a result, one would expect generally not expect any significant coupling to survive.
The conditions under which any residual coupling would be expected are the same conditions where the generalized Foldy-Wouthuysen rotation "breaks down" ... in that it becomes very difficult to deal with the loss operator in the rotated picture.
**Under conditions where the Foldy-Wouthuysen transformation "breaks down" in this sense due to the presence of a strong Brillouin-Wigner loss operator, there exists no useful general nonrelativistic limit. In this case, the strong coupling between the center of mass momentum and
internal nuclear states remains, and can be used for coherent dynamical processes.** ...".

Hagelstein and Chaudhary in Current Science 108 (25 Feb 2015): Low Energy Nuclear Reactions : Phonon Models for Anomalies in Condensed Matter Nuclear Science say:
"... a... new physics model which addresses the fractionation of a large quantum; and a new fundamental Hamiltonian which describes the coupling between vibrations and internal nuclear degrees of freedom ...
the nuclear energy quantum is fractionated into much smaller quanta, which can go into vibrational modes. For this to work in the model,
**the vibrational modes first need to be highly excited ...
deuterons are responsible in fractionating the nuclear quanta in operation with excited optical phonon modes**, and the deuterons can accomplish this cleanly. However, THz acoustic mode excitation would also be expected to produce fractionation with participation of the host Pd nuclei, which do not fractionate cleanly (leading to disintegration of the Pd nuclei)
...
there is a strong coupling between the vibrational degree of freedom and internal nuclear degrees of freedom implicit in a relativistic model,
but this coupling is normally eliminated by a generalized Foldy–Wouthuysen transformation ...
The fundamental relativistic Hamiltonian under discussion is

$$\hat{H} = \sum_j (\mathbf{M}c^2 + \mathbf{a}\cdot c\hat{\mathbf{P}})_j + \sum_k \frac{|\hat{\mathbf{p}}_k|^2}{2m} + \sum_{j<j'} \frac{Z_j Z_{j'} e^2}{4\pi\varepsilon_0 |\mathbf{R}_{j'} - \mathbf{R}_j|} + \sum_{k<k'} \frac{e^2}{4\pi\varepsilon_0 |\mathbf{r}_{k'} - \mathbf{r}_k|} - \sum_{j,k} \frac{Z_j e^2}{4\pi\varepsilon_0 |\mathbf{R}_j - \mathbf{r}_k|}. \quad (5)$$

If we use a Born–Oppenheimer approximation, then the lattice nuclear problem that remains is

$$\hat{H} = \sum_j (\mathbf{M}c^2 + \mathbf{a}\cdot c\hat{\mathbf{P}})_j + \sum_{j<k} V(|\mathbf{R}_j - \mathbf{R}_k|) - \frac{i\hbar\hat{\Gamma}(E)}{\hbar}, \quad (6)$$

where we have augmented the normal Born–Oppenheimer model with a loss term due to coupling with the electrons.

... we have in this a starting place to analyse coherent energy exchange between nuclei and vibrations under conditions of fractionation ... phonon - nuclear coupling matrix element... in the case of the D2 / 4He transition ... is consistent in magnitude with what is needed to account for the rate at which excess heat is observed in experiments ... Fractionation is easier when fewer oscillator quanta are involved, so we would expect the highest frequency vibrational modes to be involved (THz frequency vibrations). There is only a weak coupling between vibrations and the D2 / 4He transition ... the D2 / 4He transition occurs with a single phonon exchange with the large nuclear energy quantum transferred to other more strongly coupled transitions and subdivided (many nuclear excitations for a single D2 / 4He de-excitation), and subsequently fractionated to optical phonons ...

excess heat is basically 'silent'
(in that there is nothing energetic emitted in the primary reaction)

...

The rate of fractionation without subdivision then has to match the energy release rate. For example, if the system produces excess heat at the 1 W level, then there are 2.6 x 10^11 reactions/sec and it must take 3.8 x 10^(-12) sec for each of the large 24 MeV quanta to be fractionated. If the optical phonon mode has an energy of 36 MeV, then the average time associated for the net transfer of a single phonon in connection with fractionation must be 5.7 x 10^(-21) sec. These numbers are consistent with the models we have studied over the years

...

If the nuclear system is treated relativistically, there is a very strong coupling present between the vibrational and internal nuclear degrees of freedom ... there exists a unitary transformation that eliminates this very strong first-order coupling. Under conditions where this unitary transformation is useful, the vibrational and nuclear degrees of freedom are nearly independent ... when the ... destructive interference ...[of]... the unitary transformation which eliminates the strong first-order coupling ... is spoiled ... there will be a[n]... enhanced rate for coherent energy exchange under conditions of fractionation ... a highly excited vibrational mode ... remove[s]... the destructive interference ...".

Letts in Current Science 108 (25 Feb 2015): Low Energy Nuclear Reactions : Dual Laser Stimulation says:
"... **PdD lattice vibrations might occur around 8 and 15 THz** ...
The peak thermal responses were off the flanks of the DOS ... Density of States ... plot, suggesting low group velocities typically located at the edge of an optical phonon mode.
In palladium deuteride, the band edges occur near 8 and 15 **-** 16 THz ...
These vibrations are known to involve phonons,
which might be implicated in coupling energy to the palladium lattice
...
Excess power was observed immediately at 8 and 15 THz.
As higher beat frequencies were tested,
a third trigger frequency appeared around 20 THz. ...
Three specific beat frequencies will trigger excess power in a deuterated cathode ...
Cathode fabrication, loading and laser application protocols enable excess power ...
An external magnetic field is required and its affect is linear ...
Polarization of the laser beams affects excess power ...
Plating gold on the cathode surface after loading is required to produce excess power ...
Higher cell temperature produces larger excess power and is exponential in effect ...
The dual laser effect is highly reproducible when protocols are followed ...".

The 8 - 15 THz Pd-D Fusion Frequency is interestingly coincident with:

Critical Temperature of BSCCO superconducting crystals

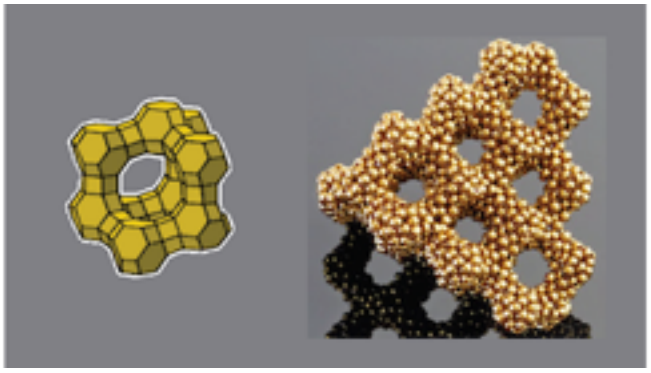
Beck - Mackey Dark Energy Josephson Junction Frequency

Energy of Neutrino Masses

Iraj Parchamazad Transfer Pd Structure Energy to Zeolite

Around 2012 at University of LaVerne, Iraj Parchamazad experimented

with Deuterium gas injected into a chamber containing Palladium embedded in Zeolites



producing heat **Energy in 10 out of 10** runs of the experiment
with Energy produced on the scale of **kiloWatts of power per milligram of Palladium**.

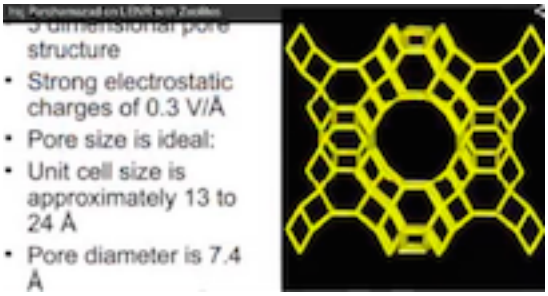
Each Zeolite Cage contains a Palladium atom cluster.

**In the Iraj Parchamazad experiments,
the Zeolite cage size is 1.3 to 2.4 nanometers and each Palladium Cluster contains on the order of the optimal 147 atom = 1.5 nanometer size**.

Iraj Parchamazad uses **Sodium Zeolite Y**
also known as faujasite. The Wikipedia page for faujasite says:
"... The faujasite framework consists of sodalite cages which
are connected through hexagonal prisms.
The pores are arranged perpendicular to each other.
The pore, which is formed by a 12-membered ring,
has a relatively large diameter of 7.4 Å [0.74 nm]

The inner cavity has a diameter of 12 Å [1.2 nm]
and is surrounded by 10 sodalite cages. ...".

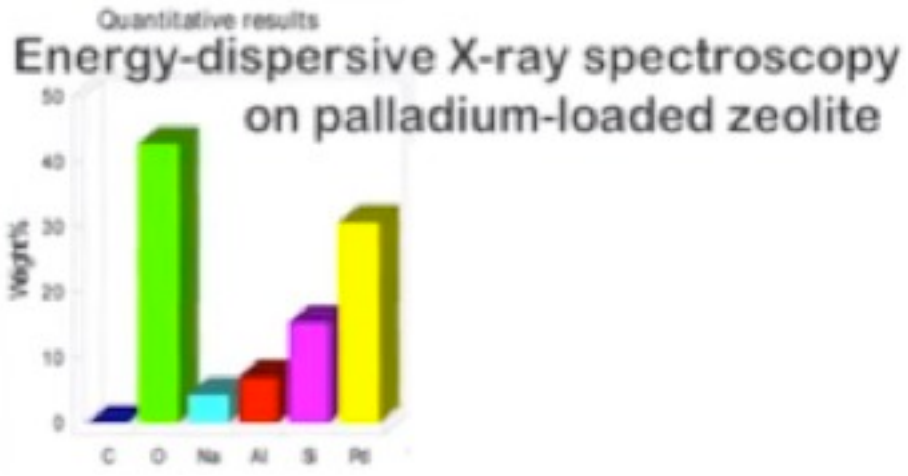
Ruby Carat and Melvin Miles interviewed Iraj Parchamazad of University of La Verne in 2012. In that video interview Iraj Parchamazad said that the Zeolite cavity size can oscillate and vary, enlarging up to about 2.4 nm.



A corresponding enlargement of pore size is to about 1.5 nm
which would permit a 3-shell 147-atom Palladium cluster to enter the Zeolite Cavity.

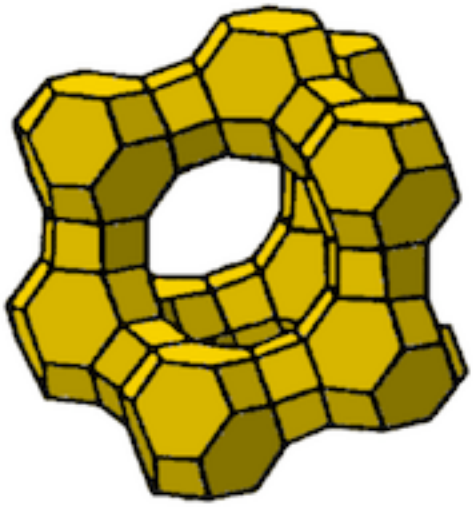
Iraj Parchamazad used an organometallic solution containing Palladium atoms.
After putting that into the Zeolite he heated the Zeolite
to burn off Carbon, Hydrogen, and Oxide
leaving a Zeolite and some Palladium.
Then he exposed the Zeolite/Palladium to Deuterium,
and got excess heat 10 out of 10 times, indicating fusion.

As to how much Palladium was put into the Zeolite, he found



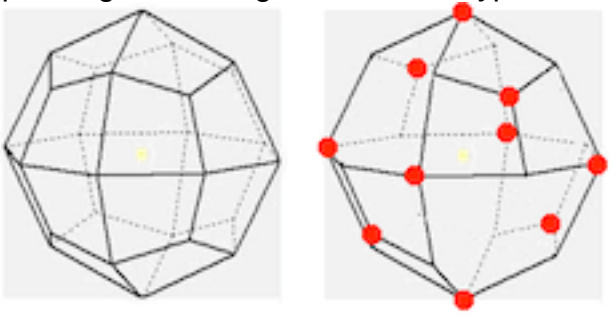
To use those results to see how many Palladium atoms were in each Zeolite Cavity,
look at the detailed structure of Sodium Zeolite Y.

Each Zeolite Cavity is surrounded by 10 sodalite cages which are arranged in a 3-dimensional Diamond network as shown in this image



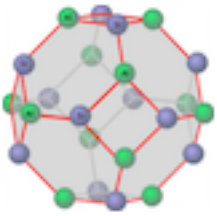
from
http://www.vurup.sk/sites/vurup.sk/archivedsite/www.vurup.sk/english/products/molek/slovsit1/english.html

The Zeolite Cavity has geometric symmetry related to an isometric trapezoid with the 4 holes corresponding to deleting 4 octahedral-type 3-face groups



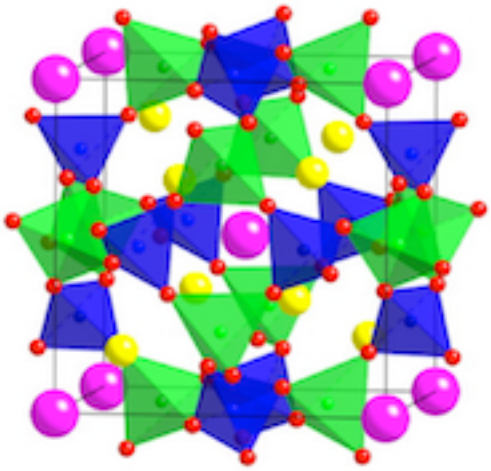
The 10 red dots correspond to the 10 sodalite cages.

Each sodalite cage is a 24-vertex truncated octahedron as in this image from Wikipedia



A more detailed view of a sodalite cage from
http://som.web.cmu.edu/structures/S099-sodalite.html

has red dots for Oxygen and pink spheres for OH and yellow spheres for Sodium
and blue tetrahedra for Silicon and green tetrahedra for Aluminum



It shows that of the 24 vertices of the sodalite cage,
12 are Aluminum and 12 are Silicon
so
each Zeolite Cavity has 10 x 12 = 120 Aluminum atoms.

To see the number of Aluminum atoms in each Zeolite Cavity
look at Iraj Parchamazad's graph of the weights of Aluminum and Palladium
and consider that their Atomic Weights are 27 for Aluminum and 106 for Palladium.
Looking at the graph,
it appears that the weights are about 7 for Aluminum and 32for Palladium
so **the number of Palladium atoms in each Zeolite Cavity** is about

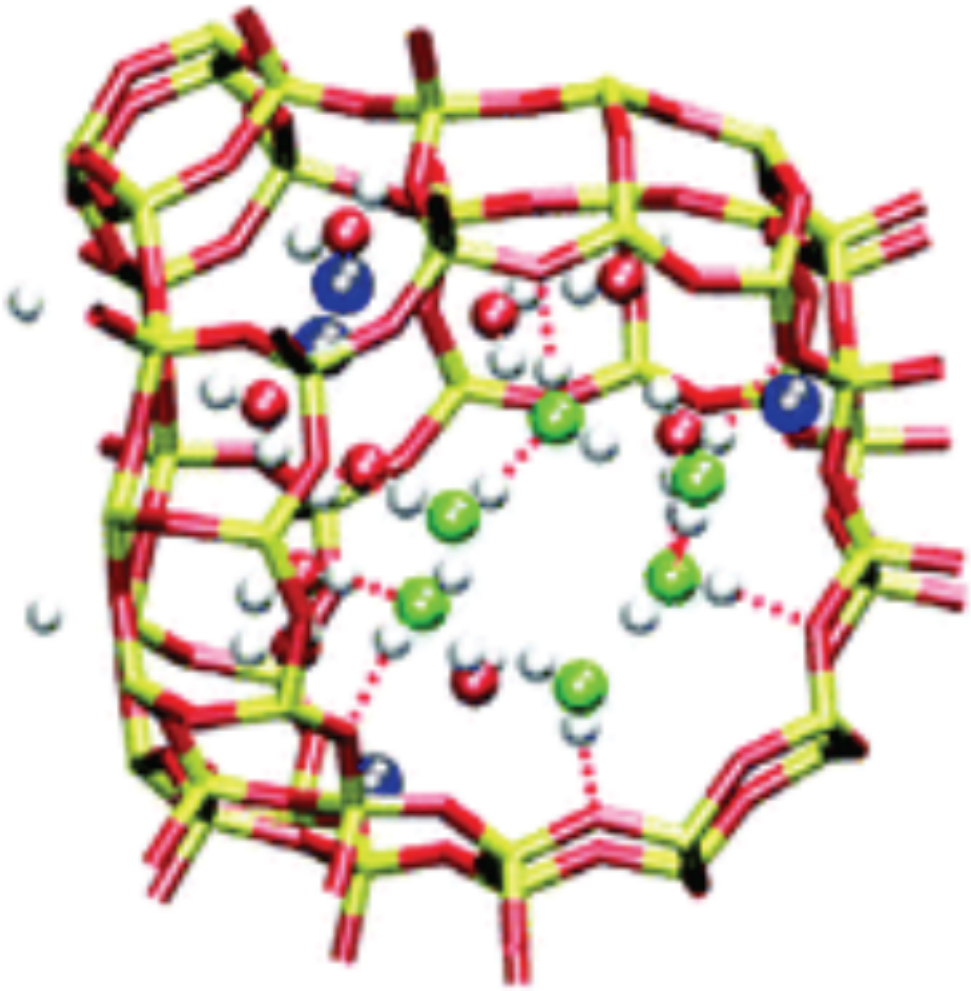
Npd/z = 120 x (32 / 7) x (27 / 106) = 140 atoms

which is roughly equal to the number of atoms (147) in a 3-shell Pd atomic cluster

TSC Fusion Energy is carried to the Pd Cluster Structure
by the 4He+4He and the 4e electrons of the TSC coherent quantum state
according to
the Hagelstein Coupling between Nuclear Excitation and Atomic Structure.

The Pd Structure Energy of Excited Optical Phonon Modes
is carried by the Zeolite Cage Electrostatic Field (on the order of 3 V/nm)
to be stored in the Zeolite as heat
which Heat can be accessed by Zeolite-Water reaction.

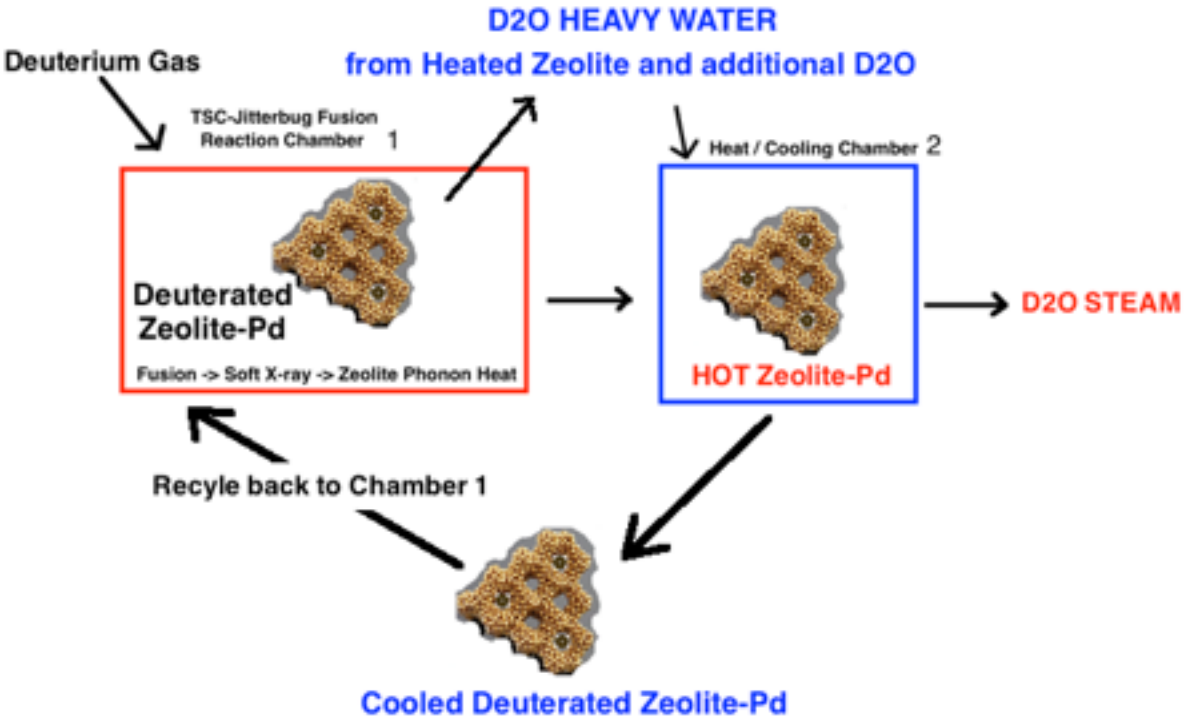
"... We report ... Monte Carlo simulations of water ... ... adsorption in [Zeolite] NaY ... faujasite ... The existence of cyclic water hexamers ... located in the 12-ring windows ...



... recently disclosed by neutron diffraction experiments ... were ... observed in the case of NaY ...". (Angela Di Lella, Nicolas Desbiens, Anne Boutin, Isabelle Demachy, Philippe Ungerer, Jean-Pierre Bellat, and Alain H. Fuchs, Phys. Chem. Chem. Phys. 8 (2006) 5396-5406)
(see viXra 1502.0096)

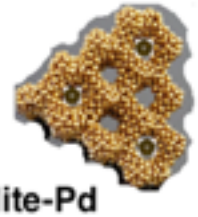
According to a 7 June 2012 techthefuture.com web article by Tessel Renzenbrink:
"... Zeolite is a mineral that can store up to four times more heat than water ...
zeolite retains a hundred percent of the heat for an unlimited amount of time ...
When water comes into contact with zeolite it is bound to its surface by means of a chemical reaction which generates heat. Reversely, when heat is applied the water is removed from the surface, generating large amounts of steam.
The transference of heat to the material does not cause its temperature to rise. Instead, the energy is stored as a potential to adsorb water. The ...[German Fraunhofer Institute]... scientists used these particular properties to turn zeolite into a thermal storage system. They created a storage device and filled it with zeolite pellets.
To charge the pellets, they exposed them to heat.
To retrieve the energy they simply added water. ...".

Here is my design for a TSC-Jitterbug Zeolite Pd-D fusion heat engine:



(Zeolite-Pd images adapted from
Calvo amd Carre in Nanotechnology 17 (2006) 1292-1299 and from
http://gwenbeads.blogspot.com/2014/04/infinite-skew-polyhedron-faujasite-4446.html)

D2O Heavy Water is used to take heat from the Zeolite to make steam so that Hydrogen from H2O does not poison the TSC-Jitterbug process by replacing Deuterium in the Palladium nanoclusters, a possible problem pointed out by Melvin Miles.



Preparation of
Sodium Zeolite Y has unit cell size about 2.5 nanometers
which corresponds to the edge-length per cavity of its overall tetrahedral structure.

According to http://www.google.com/patents/US20040047803
"... Synthesis and stabilization of nanoscale zeolite particles ...
Zeolite Y is of great interest … Zeolite crystals prepared under conventional synthesis conditions frequently have a mean particle size of between 1 and 5 μm. … it would ... be useful if the zeolite particles were sufficiently small to form a colloidal suspension … Mono- or di-saccharides can be used to keep the crystal size of faujasite (zeolite X and Y) small
… Sucrose, dextrose or other saccharides are added to a conventional aluminium silicate reaction mixture obtained by mixing aqueous alkali metal silicate and alkali metal aluminate solutions at low temperatures, followed by ageing and hydrothermal synthesis. Crystal sizes of between about 30 and 40 nm are claimed …".

According to a Journal of Catalysis article by Patrick D. Burton, Timothy J. Boyle, and Abhaya K. Datye "Facile, surfactant-free synthesis of Pd nanoparticles for heterogeneous catalysts"
"... room temperature reduction of Pd(OAc)2 in MeOH is slow enough to produce a suspension of ... metal-phase ... Pd NPs. ...
A Pd-NP/C catalyst was prepared by mixing the carbon support into the suspension of Pd NPs and evaporating the solvent. Aggregate formation was a concern, as there were no capping agents to prevent particle growth. Therefore, the nanoparticles were collected quickly before substantial aggregation could occur. ... this technique is general and can be extended to other powder supports. ...".

An "other powder support" that would be useful for TSC-Jitterbug fusion energy would be 30-40 nanometer Zeolite Y Crystals in colloidal suspension.

As the Pd nanoclusters "... grow for 20 ... min ..." up to size 1.56 nm for the 147 atom size that is optimal for TSC-Jitterbug fusion,
they are small enough to fit into the Exterior Cavities of the Zeolite Y Crystals
(which are have average pore opening 0.74 nm and cavity size 1.2 nm
but which sizes can oscillate to be up to about twice those sizes)
Due to the open structure of the Zeolite Y Crystals, growth up to the 147 atom size can continue inside the Exterior Cavities of the Zeolite Y Crystals.

As soon as the Pd nanoclusters have grown to the 147 atom size the solvent can be evaporated and the powder of 30-40 nm Zeolite Y Crystals loaded with Palladium can be collected and placed in the TSC-Jitterbug Fusion Reaction Chamber for exposure to Deuterium gas and heating the Zeolite Y Crystals by fusion energy.

As to how many of the 30 nanometer Zeolite Y Crystal Cavities are Exterior
(and therefore easily accessible to the Pd nanoclusters in colloidal suspension)
the Zeolite Y Crystal has tetrahedral structure and each unit cell with 1 Cavity is 2.5 nanometers so a 30 nm Zeolite Y Crystal would have 30 / 2.5 = 12 cavities per edge and its tetrahedral structure would have 12 triangular layers

and a total of 1+3+6+10+15+21+28+36+45+55+66+78 = 364 Cavities
of which 1+3+6+10+15+21+28+36 = 120 would be Interior Cavities (purple dots)
and 364 - 120 = 244 would be Exterior Cavities (orange dots)
so 244 / 364 = 67 % of the Cavities of the 30 nm Zeolite Y Crystals would be Exterior and therefore relatively easily accessible to the Pd nanoclusters in the colloidal suspension.

A 40 nm Zeolite Y Crystal would have 40 / 2.5 = 16 cavities per edge with 16 triangular layers
and 1+3+6+10+15+21+28+36+45+55+66+78+91+105+120+136 = 816 Cavities
of which 1+3+6+10+15+21+28+36+45+55+66+78 = 364 would be Interior Cavities
and 816 - 364 = 452 would be Exterior Cavities
so 452 / 816 = 55 % of the Cavities of the 40 nm Zeolite Y Crystals would be Exterior.

As to how much Zeolite Y Crystal should be mixed in colloidal suspension
with Palladium nanoclusters that grow to 147-atom size:

The atomic mass of a Zeolite Y unit cell is
(from nptel.ac.in Introduction to Catalysis Lecture 36 Zeolites)
(56x23 Na + 56x59 AlO2 + 136x60 SiO2 + 264x18 H2O) = 17,504
for actual mass = 17504 x 1.66 x 10^(-21) = 2.906 x 10^(-17) milligrams

The atomic mass of a 147-atom Pd nanocluster is
147x106 = 15,582
for actual mass = 15,582 x 1.66 x 10^(-21) = 2.587 x 10^(-17) milligrams

so if all the Cavities of Zeolite Y Crystal were External
equal masses of Palladium and Zeolite Y Crystal would be optimal
but
for 30-40 nm Zeolite Y Crystals only about 2/3 to 1/2 of their Cavities are External
so
it may be optimal to use Zeolite Y Crystal mass = 2 x Palladium mass in the colloid.

Klee Irwin Jitterbug Ejection of He and Reloading D

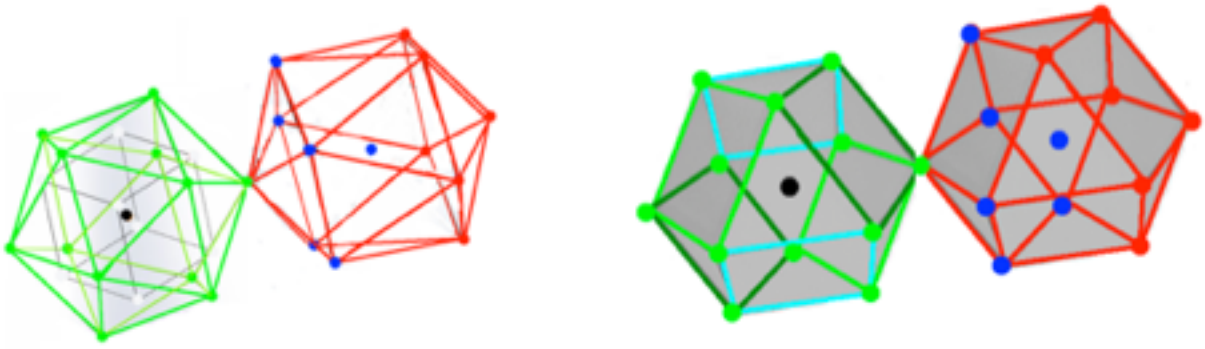
The size required for Jitterbug / TSC Fusion is a Palladium atomic cluster whose ground state is icosahedral and can easily Jitterbug Transform into a cuboctahedral state and whose size is large enough to contain several TSC Fusion Cluster sites, each of which is an icosahedron that can Jitterbug transform into a cuboctahedron.

The 13-atom Pd/Ni cluster (0.70 nm) is an icosahedron, for 1 TSC Fusion Cluster site.

The 2-shell 55-atom Pd/Ni cluster (1.13 nm) has two icosahedra that share a central vertex, for only TSC Fusion Cluster sites.

Clusters of between 56 and 147 atoms contain from 2 to 13 TSC Fusion Cluster sites by partially filing the 3rd shell of atoms.

The 3-shell 147-atom Pd/Ni cluster (1.56 nm) has 12 exterior TSC Fusion Cluster sites plus 1 central TSC Fusion Cluster sites, so it contains 13 TSC Fusion Cluster sites.



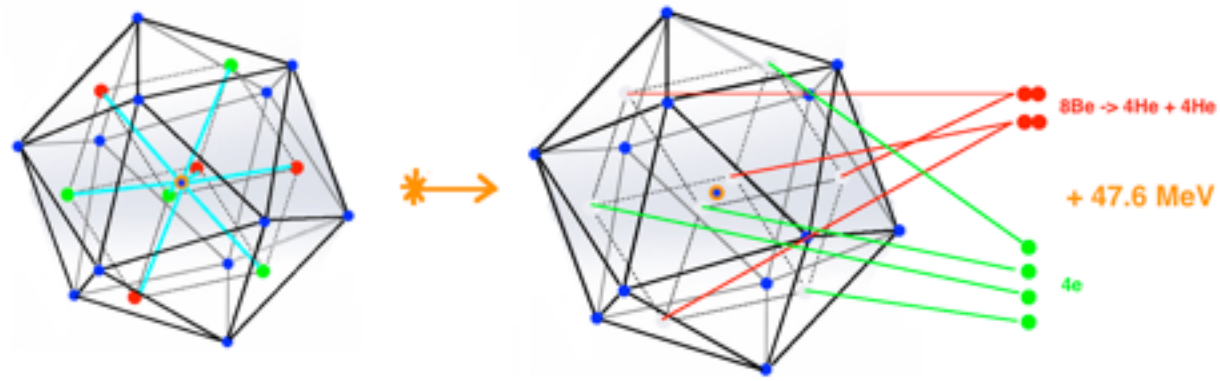
(see viXra 1502.0069)

Clusters of between147 and 309 atoms contain at least 13 TSC Fusion Cluster sites
The 4-shell 309-atom Pd/Ni cluster is 2.00 nm in size, so it is disfavored with respect to the 3-shell 147-atom cluster for use with Sodium Zeolite Y whose pore size is 0.74 nm expandable to 1.5 nm.

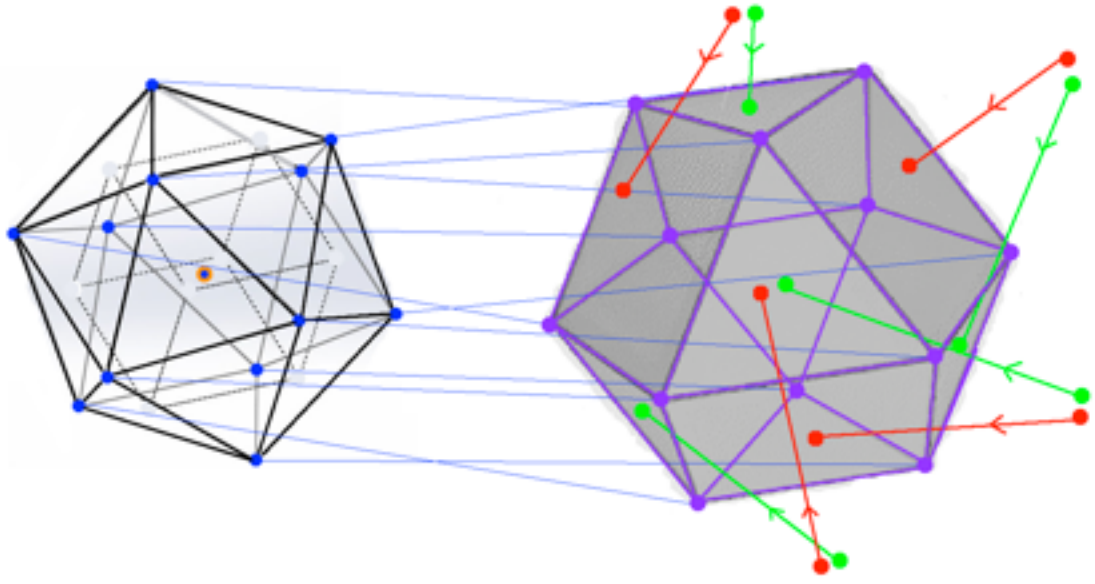
Most of the TSC Fusion Energy is carried to the Pd Cluster Structure
by the 4He+4He and the 4e electrons of the TSC coherent quantum state
according to
the Hagelstein Coupling between Nuclear Excitation and Atomic Structure.

The Pd Structure Energy of Excited Optical Phonon Modes
is carried by the Zeolite Cage Electrostatic Field (on the order of 3 V/nm)
to be stored in the Zeolite as heat
which Heat can be accessed by Zeolite-Water reaction.

Some of the TSC Fusion Energy goes to a Jitterbug transformation

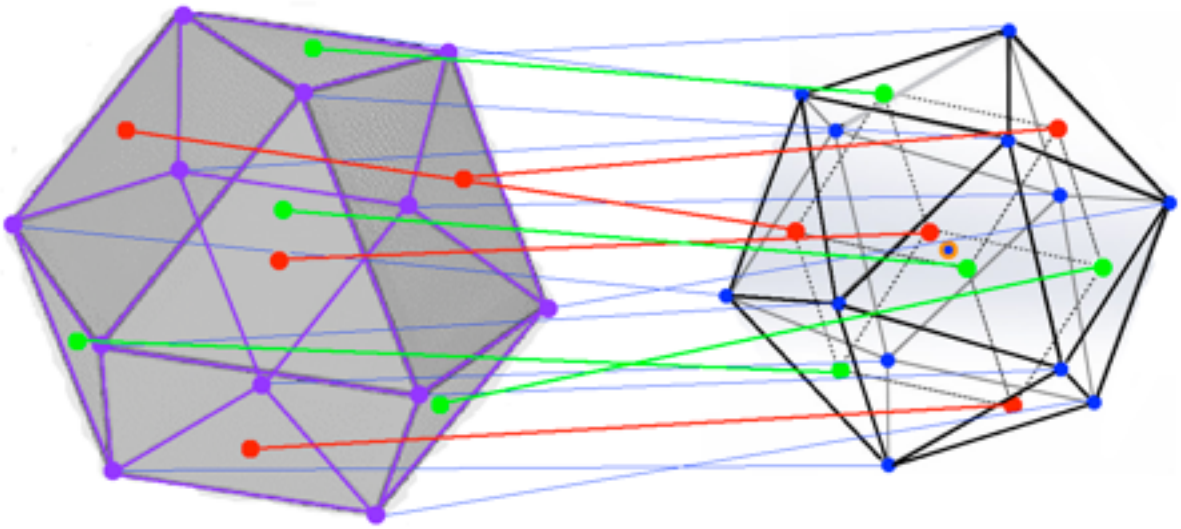


of the icosahedral Palladium, depleted of Deuterium fusion fuel,
to a cuboctahedral configuration



which has 6 large square openings through which
the 4He TSC Fusion Product Ash can leave the Pd cluster
and ambient Deuterium Fuel can enter to reload the Palladium cluster.

After entering the Palladium cluster the 4 Deuterium nuclei (red dots)
and 4 electrons (green dots) form a Tetrahedral Symmetric Coherent Quantum State
centered on the 8 triangular faces of the cuboctahedral configuration.
Then, since the icosahedral configuration is the Palladium cluster ground state,
another Jitterbug transformation



takes the Palladium cluster to an icosahedral configuration with the replenished
Deuterium nuclei and electrons ready for another round of TSC fusion