Nuclear ZPE Tapping

Horace Heffner May 2007

ENERGY FROM UNCERTAINTY

The uncertainty of momentum for a particle constrained by distance Δx is given, according to Heisenberg, by:

$$\Delta mv = h/(2 \pi \Delta x)$$

but since

$$KE = (1/2)\ m\ v^2 = (1/(2\ m)\ )\ (\Delta mv)^2$$

$$\Delta KE = (1/(2\ m))\ (h/(2 \pi \Delta x))^2$$

$$\Delta KE = h^2 /((8 \pi^2\ m) \quad (\Delta x)^2)$$

the more you can confine the *position* of a particle the more energy you can potentially observe when you sample that energy. If an electron can be confined to a 1 angstrom range then there is an uncertainty of 1.06×10^{-24} kg-m/s on the momentum and thus 6.1×10^{-19} J or 3.8 eV uncertainty on energy.

The position of an atom constrained in a lattice is perfectly known if it is at a temperature of 0 K. However, the Heisenberg uncertainty of its energy provides, on average, a nonzero kinetic energy upon sampling. This "zero point" energy (ZPE) is said to be supplied from the vacuum, i.e. from the zero point field (ZPF). Once sampled and removed, provided the certainty of location remains, the uncertainty energy is resupplied by the ZPF, thus the ZPF is a practically unbounded source of energy. [1 2 3 4 5 6]

HEISENBERG TRAPS

A construct for constraining the position of a particle for the purpose of increasing its energy uncertainty can be called a Heisenberg trap.[7] If a particle can be trapped into a sufficiently small location, its energy uncertainty can be driven well above ambient temperature. A naturally existing very small Heisenberg trap, and thus a powerful conduit to tap the zero point field, is the nucleus. Stable nuclei, like stable atoms, despite energetic constituent motions and accelerations, do not continuously radiate. However, nuclei, even unexcited nuclei, sustain within a large kinetic energy density. Nuclei are hot. For example, the temperature of the dysprosium (Dy) nucleus has been measured at 6 billion K by colliding nuclei and measuring the the spectrum of gammas emitted.[8 9]

The nucleus itself may be an endless repository of kinetic energy which can be tapped if a means to repetitively and frequently kinetically interact with it can be found. A means of tapping the energy might include photon stimulation, interaction with energetic electrons, or coupling and jiggling via a lattice. It seems reasonable to conjecture that the jiggle of rapidly diffusing Li, D or T nuclei might obtain some of the lattice nuclear heat energy via spin coupling or EM coupling with lattice nuclei. Once some energy is tapped from it, a lattice nucleus can subsequently replenish its heat from the zero point field.

Nuclear ZPE Tapping

Horace Heffner May 2007

ESTIMATING NUCLEAR HEAT

The radius of a Dy nucleus can be estimated by:

$$R_{Dy} = (1.4 \times 10^{-13} \text{ cm}) \ A^{(1/3)}$$

$$= (1.4 \times 10^{-13} \text{ cm}) \ (162)^{(1/3)}$$

$$= 7.6 \times 10^{-15} \text{ m.}$$

The atomic weight of Dy is 162.5 AMU, which, at 1.66×10^{-27} kg/AMU gives a mass m of 2.7×10^{-25} kg. Letting $\Delta x = 7.6 \times 10^{-15}$ m, the Dy radius, gives:

$$\Delta KE = h^2 /(8 \pi^2 \ (2.7 \times 10^{-25} \text{ kg}) \quad (\Delta x)^2)$$

$$= h^2 / ((8 \pi^2 \ (2.7 \times 10^{-25} \text{ kg})) \quad (7.6 \times 10^{-15} \text{ m})^2)$$

$$= 3.6 \times 10^{-16} \text{ J} = 2200 \text{ eV.}$$

The nucleus as a whole is not the agent of interaction with the zero point field.

Assuming the unit of mass involved in sustaining the heat is each of the 162 Dy nucleons, we have a mean mass of $(2.7 \times 10^{-25}$ kg$)/162 = 1.667 \times 10^{-27 \text{ kg}}$, and:

$$5.15 \times 10^5 \text{ eV} = h^2 /(8 \pi^2 \ (1.667 \times 10^{-27} \text{ kg}) \quad (\Delta x)^2)$$

$$\Delta x = 6.36 \times 10^{-15} \text{ m}$$

And this fits very nicely into the Dy radius of 7.6x10^$^{-15}$ m. However, there is a small discrepancy in that the nucleus is slightly hotter that it should be for its size. It is reasonable to expect there is a hierarchical sharing of zero point energy gathered energy between each level of existence. In other words the quarks share some of their zero point energy with their nucleons, the nucleons share some of their zero point energy between alpha-like nucleon substructures, etc.

Given the nucleons assume a temperature depending on the confining radius, we can predict, given the nucleon number A, the nuclear temperature T in kelvin for large nuclei by:

$$T = (11{,}600 \text{ degrees K/eV}) \ (h^2) / \\ (8 \pi^2 \ (1.667 \times 10^{-27} \text{ kg}) \quad ((1.4 \times 10^{-13} \text{ cm}) \ A^{(1/3)})^2)$$

We can see T is inversely proportional to $A^{(2/3)}$, thus using Dy as a baseline we have a rule of thumb:

$$T = K_{temp} \ A^{(-2/3)}$$

where:

$K_{temp} = 6x10^9/(162^{(-2/3)})$ deg. K = ($1.78x10^{11}$ deg. K)

and thus

T = ($1.78x10^{11}$ deg. K) $A^{(-2/3)}$

This rule of thumb then takes into account the ZPF interactions of quarks and other substructures of the nucleus. Converting the rule of thumb to KE in electron volts we have:

KE = ($1.53x10^7$ eV) $A^{(-2/3)}$

The rules of thumb were applied to create Table 1 below.

Nuclear ZPE Tapping

Horace Heffner May 2007

Atomic Number	Element Name	Nucleon Number	Nuclear Temperature (GigaK)	Nuclear Temperature (MeV)
2	He	4	70.6	6.07
3	Li	7	48.6	4.18
4	Be	9	41.1	3.53
5	B	11	35.9	3.09
6	C	12	33.9	2.91
7	N	14	30.6	2.63
8	O	16	28.0	2.40
9	F	19	24.9	2.14
10	Ne	20	24.1	2.07
11	Na	23	22.0	1.89
12	Mg	24	21.3	1.83
13	Al	27	19.7	1.70
14	Si	28	19.3	1.65
15	P	31	18.0	1.55
16	S	32	17.6	1.51
17	Cl	35	16.6	1.42
19	K	39	15.4	1.33
20	Ca	40	15.2	1.30
21	Sc	45	14.0	1.20
22	Ti	48	13.4	1.15
23	V	51	12.9	1.11
24	Cr	52	12.7	1.09
25	Mn	55	12.3	1.05
26	Fe	56	12.1	1.04
27	Co	59	11.7	1.00
28	Ni	58	11.8	1.02
29	Cu	63	11.2	0.96
20	Zn	64	11.1	0.95
31	Ga	69	10.5	0.90
32	Ge	74	10.0	0.86
33	As	75	10.0	0.86
34	Se	80	9.5	0.82
35	Br	79	9.6	0.83
36	Kr	84	9.2	0.79
37	Rb	85	9.2	0.79
38	SR	88	8.9	0.77
39	Y	89	8.9	0.76

Table 1 - Nuclear Temperature for Various Isotopes (Continued below)

Atomic Number	Element Name	Nucleon Number	Nuclear Temperature (GigaK)	Nuclear Temperature (MeV)
40	Zr	90	8.8	0.76
41	Nb	93	8.6	0.74
42	Mo	98	8.3	0.71
44	Ru	102	8.1	0.70
45	Rh	103	8.1	0.69
46	Pd	108	7.8	0.67
47	Ag	107	7.8	0.67
48	Cd	114	7.5	0.65
49	In	115	7.5	0.64
50	Sn	120	7.3	0.62
51	Sb	121	7.2	0.62
52	Te	130	6.9	0.59
53	I	127	7.0	0.60
54	Xe	132	6.8	0.59
55	Cs	133	6.8	0.58
56	Ba	138	6.6	0.57
66	Dy	162	6.0	0.51
73	Ta	181	5.5	0.47
74	W	184	5.5	0.47
78	Pt	195	5.2	0.45
79	Au	197	5.2	0.45
80	Hg	202	5.1	0.44
82	Pb	208	5.0	0.43
83	Bi	209	5.0	0.43
90	Th	232	4.7	0.40
92	U	238	4.6	0.39

Table 1 - Nuclear Temperature for Various Isotopes (Continued)

The temperatures toward the low mass number end of Table 1, are too high, in part because small nuclei are non-spherical. Still, their small size makes for an effective Heisenberg trap, and their more lumpy construction makes for more efficient transfer nuclear heat to impinging particles.

SPECULATIONS

It is notable that various cold fusion experiments which showed excess heat, some even without the use of deuterium, used lithium salt electrolytes. Some of the excess heat in those experiments may have been due to coupling to lithium nuclei by diffusing electrons and hydrogen nuclei in interstitial spaces around the trapped lithium, which also diffuses through the cathode, but at a lower rate. It may thus be of interest to codeposit lithium with the H and Pd in codeposition experiments.

Nuclear ZPE Tapping

Horace Heffner May 2007

Helium, ironically one of the most inert chemical or nuclear substances, is a very small trap, and thus may provide a powerful link to the zero point field. Tapping energy from helium involves creating high current density in a high density helium plasma. High current density is typical of pinch devices. Zero point energy may be involved in creating extra energy yield in the Sandia Z machines,[10] for example, or water-arc experiments,[11] even when the elements involved are not capable of producing nuclear energy via fusion or fission in that environment.

Helium, though small and tightly bound, and at a very high ZPF maintained temperature, may not be nearly as good an element for tapping the ZPF as boron. Boron, though a small nucleus, provides a much larger cross section than helium for particle interaction. It therefore may be a useful candidate for building practical ZPF tapping devices.

Best of all the nuclei for ZPE tapping may be the deuteron. Its ZPE fed nuclear heat may provide some explanation for the role of D in cold fusion, low energy nuclear reactions, and its surprising ability to shed a neutron when stimulated with less than its binding energy.

Plasma devices incorporating both D and B utilize a powerful combination. The neutron stripping reaction obtained at low collision energies provides:

$$D + {}^{11}B \rightarrow {}^{12}B + p + .957 \text{ MeV}$$

The energy balance for the above is: (2.0140 + 11.009305 - 12.014352 - 1.007947) AMU = 1.006E-3 AMU = .957 MeV.

The ${}^{12}B$ then predominately decays:

$${}^{12}B \rightarrow {}^{12}C + e- +13.369 \text{ MeV} \quad (0.202 \text{ s})$$

The carbon isotopes can then by cycled through:

$$D + {}^{n}C \rightarrow {}^{(n+1)}C + p + \text{energy}$$

Further, the ${}^{10}B$ present initially (natural abundance 19.9%) is consumed by the stripping reaction:

$$D + {}^{10}B \rightarrow {}^{11}B + p + 0.921 \text{ MeV}$$

The energy balance for the above is: (2.0140 + 10.012937 -11.009305 - 1.007947) AMU = 9.69E-3 AMU --> .921 MeV.

Boron fully ionizes at 340 eV, or about 4 million K. Carbon fully ionizes at 490 eV, or at about 5.7 million K, well under the 20 million K heating even a tokamak can achieve ohmically. One problem is obtaining a sufficient mass density to retain the majority of the neutrons. A z-pinch device of suffcient size, and which also includes a neutron reflector layer, may be able to achieve this.

[1] H. E. Puthoff,, “Everything for Nothing,” New. Sci. vol. 127 (28 July 1990): p. 52.

[2] H. E. Puthoff,, “Ground State of Hydrogen as a Zero-Point-Fluctuation-Determined State,” Phys. Rev. D vol. 35 (1987): p. 3266.

[3] D. C. Cole and H. E. Puthoff,, “Extracting Energy and Heat from the Vacuum,” Phys. Rev. E vol. 48 (1993): p. 1562.

[4] H. E. Puthoff, “The Energetic Vacuum: Implications for Energy Research,” Spec. in Sci. and Tech. vol. 13 (1990): p. 247.

[5] Timothy Boyer, “The Classical Vacuum,” Scientific American August 1985: p. 70.

[6] Walter Greiner and Joseph Hamilton, “Is the Vacuum Really Empty?,” American Scientist March-April 1980: p. 154.

[7] http://mtaonline.net/~hheffner/HeisenbergTraps.pdf

[8] http://www.aip.org/enews/physnews/1999/split/pnu443-1.htm

[9] E. Melby et al, “Observation of Thermodynamical Properties in the 162Dy, 166Er, and 172Yb Nuclei ,” Phys. Rev. Lett. 83/16 (October 1999): 3150 - p. 3153.

[10] http://zpinch.sandia.gov/

[11] Graneau et al, “Arc-liberated chemical energy exceeds electrical input energy,” Journal of Plasma Physics 63 (Feb. 1, 2000): p. 115-128.