Energy from Electron Pair Condensates

Horace Heffner 7/11/97

OBJECTIVE

The objective here is to define and discuss some proposed means to create and utilize condensed charge to create energy. This paper is a collection of ideas proposed to and discussed with Hal Puthoff and Scott Little of Earthtech and was an outgrowth of a brief collaboration with them to study condensed charge.

One means proposed is use of a superconductor (SC) cathode as a Bose condensate factory, an assembly line. Electrons enter one at a time and move slowly through the SC until paired, then tunnel out of the anode facing surface, which is maintained at a high voltage, or a high gradient, as at a pointed tip. The pairs have already completed the first steps of condensate formation. They have net spin zero, and zero momentum. The coulomb barrier is potentially already overcome, provided the pairs can be made to have a tendency to be brought together. The pairs are catalysts waiting to react. The potential energy of their proximity alone may be sufficient to release over unity energy upon hitting an anode, ambient molecule or nucleus, or otherwise undergoing waveform collapse or energetic separation in space, provided the pair can be made to tunnel to any of these locations as a pair. To create energy. it is proposed such interactions can utilize both the coulomb potential of the electrons in proximity and the catalytic shielding effect produced when the waveforms of a tunneling pair collapses on a small locus, i.e. a nucleus.

It is subsequently proposed that cathode holes, not tips, are best for creating condensed charges.

Later, it will be speculated, based upon previously documented experimental results of others, that a SC cathode is not required for pair formation, that there is evidence that pair formation may be happening under the right conditions in high temperature environments,and that it is the electrode surface geometry that is key to the pair production.

CONDENSED CHARGE PRODUCTION WITH SUPERCONDUCTOR CATHODES

Beyond the expectation of electron pair ejections at a superconductor cathode tip, which seems to be far more more reasonable than various wild speculations in this field, is the more conjecture that as bosons, groups of electron pairs sufficiently overlapped by being ejected into an external extension of a conduction band at the cathode tip might easily superposition there like any normal non-composite boson. The fact that, under the right conditions, atoms, including their electrons, *can* superposition en mass is already proved via the Bose condensate work already achieved. [1a] However, in the work achieved to date, the condensates consist of mixed charge, and include large atomic nuclei. The Pauli exclusion principle seems to be not relevant to the large condensate. The question remains if the electron pairs alone can superposition with only each other, or if they require a seed, an atomic nucleus, to permit the tunneling and coalescing of the pairs into a charge cluster.

The ability to superposition en mass would provide a logical explanation for both the stability of ball lightning (BL) and the observations of massive energy releases upon BL bursting on contact with conductors like water.

The existence of zero point photon pressure provides an added measure of stability in addition to the Bose condensate mechanics.

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If initial results in using SC cathodes prove successful, there should be no difficulty in scaling up massively, nor large difficulties in doing so in a fairly compact way. The main difficulty is providing sufficient cooling.

The steps of a possible SC process:

(1) Electrons enter a vacuum enclosed superconductor via a metal conductor. This involves the cooling of the conductor and the incoming electrons.

(2) The electrons form pairs in the SC. Since in pairs the energy state is less than not, no cost.

(3) The electrons are ejected from the SC by tunneling across a vacuum gap.

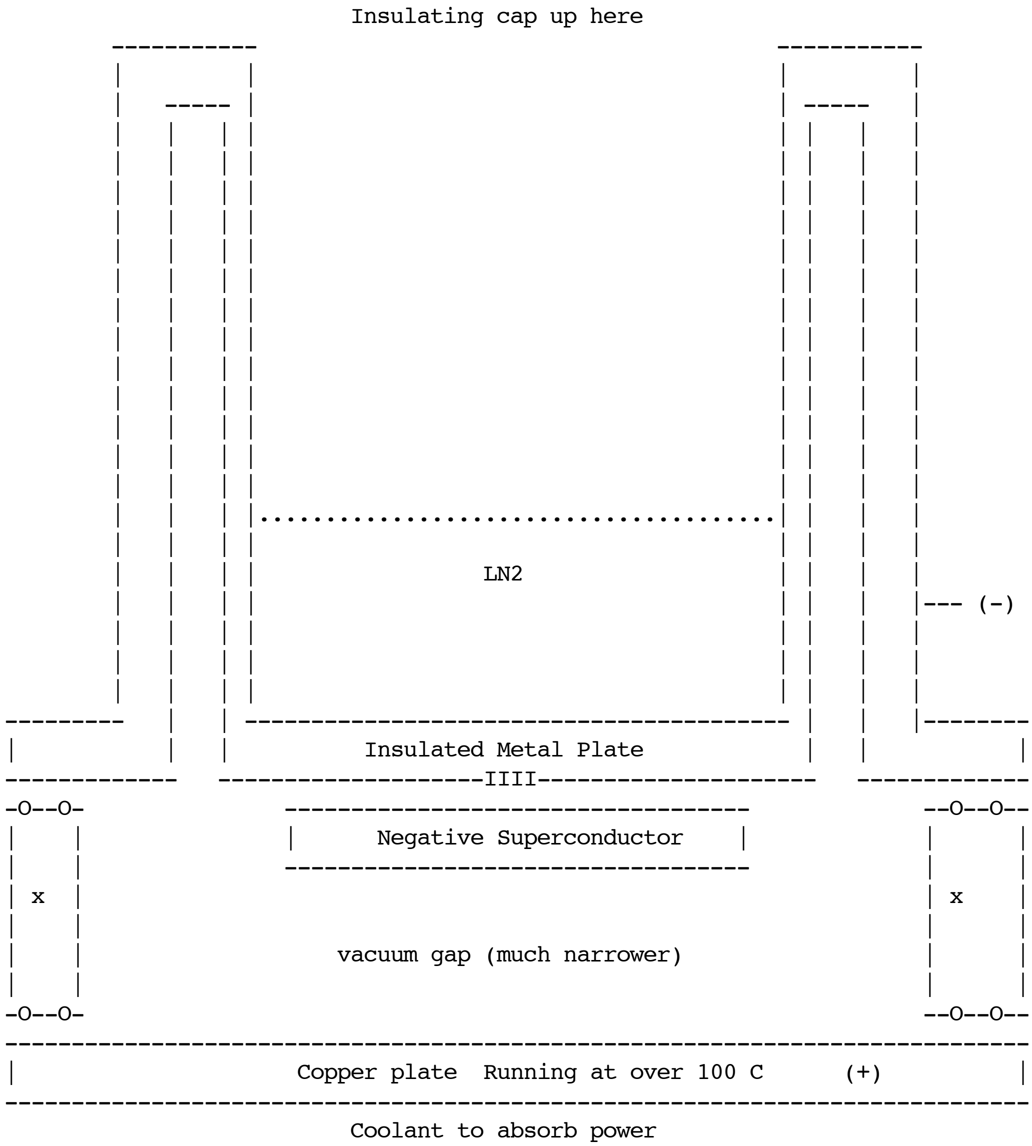
(4) Electrons tend to arrive on the other side of the gap in pairs in percentages approaching 50 %. Arriving in pairs means the electrons are in close proximity - only angstroms, thus having repulsive potential energy.

(5) It is a possibility, by using a point electrode, that massive condensates might be formed in space at the tip of a pointed cathode, thus greatly increasing the energy per cluster crossing.[1b]

(6) If the electrode (anode) on the other side of the gap is a SC, then, if the distance is short enough, pairs which tunnel across the gap can remain pairs in large percentages. Those that do not reform pairs.

(7) A premise for generating energy is that, if the anode is not a superconductor, but, say, the outside of a copper pipe carrying water, it will dislodge the pairs and gain the potential energy stored in the repulsive coulomb field. Large currents should produce large amounts of energy. A vacuum gap is therefore essential to insulate the SC cathode.

It is possible to scale up the device shown below in FIG. 1.



x - insulating vacuum holding ceramic walls
O - O-ring seals
III - Insulated contact between Superconductor and Insulated Metal Plate

FIG. 1

The electrons might only cross the gap in pairs, due to lack of a pointed cathode, but that should still produce a large COP. O-ring seals are for vacuum.

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Here is an interesting and relevant quote from "Superconductors, Conquering Technology's New Frontier", by Randy Simon and Andrew Smith, Plenum Press, 1988, about electron-phonon interaction: "The ground rules for this little game of pool require that the total momentum be conserved in the scattering process but *do not demand energy conservation* for the incoming and outgoing electrons. As long as the difference between the electrons is no more than the binding energy of the pair such scattering events will lower the energy of the system." Some more obvious info: "Of course accelerating the electrons adds some energy of motion. If too much energy is added, then the pairs must break apart. We call the amount of electric field required to break up pairs the *depairing field;* in practice, breaking pairs requires currents so large that the superconductor has long since surpassed the critical current associated with its magnetic field."

Considering the above, and the fact that the majority of electrons tunnel across a Josephson Junction in pairs, (There is no tug, they just tend to tunnel together - because tunneling is a zero resistance phenomenon, and the pairs are already bound, even if loosely. For once co-location is favorable!) it seems there might be some prospect that the pairs can remain paired right up to the tip of the needle and maybe some right on out into the extended conduction bands. For one thing, there is zero resistance inside the needle, so there can't be much of a field gradient. Some electrons will be broken apart, but some might make it to the edge, to the last few atomic layers of the SC, and then tunnel out beyond the tip before depairing. Further, it may not even be necessary to have a needle point. A plane might even work better if the gap is short enough. It ia only requied that enough close pairs tunnel out into the vacuum in order for the required energy to be gained. They aren't returning to the SC if there is a high gradient between the SC and the copper, because that is energetically denied. Actually, the paired electrons don't even have to be close to each other if enough other pairs are drawn out simultaneously due to macro level effects. They are all one waveform, and most important, as pairs, they are bosons. No Pauli exclusion principle to prevent a massive condensate, or numerous adjacent condensates, from forming. Further, a needle point, sharp to the angstrom level, forces the pairs into close proximity before tunneling out of the point tip. The main difficulty with a point tip is keeping the current level low enough that the tip is not destroyed.

In type II superconductors pairs are much closer together. It is this closeness that permits magnetic vortex formation. It appears that a strategy to bring pairs closer might be to place a type II needle point in a strong longitudinal magnetic field to nearly saturate the needle with magnetic vortices. However, that may not be necessary because it's already done by the tip current. The purpose of this is to further concentrate the pairs and thus increase their potential energy upon tunneling. Since pairs are bosons, the magnetic field should not affect them adversely.

There are lots of factors to try to balance. The magnetic field might be helpful (per above) and the current might not have to be very large, the tip not too pointed. I have done both spark and glow discharge experiments with xenon bulbs which were only at about a microamp. It would take some doing to balance needle geometry, field strength, voltage, gap size, etc. However, field emission has it's requirements - which don't seem too compatible; it might be unfeasible idea.

Type II SC's are very bad conductors. Maybe a thin coating on the SC would provide a barrier to stop the pairs before reaching the tip, and give them something to tunnel through like at a JJ. Such a coating might be provided and automatically regulated in size by the tip (1) going above Tc, or (2) too many pairs getting pulled apart, or (3) current density rising to high, or (4) electrostatic field gradient getting too high near tip. That's a lot of things that might be simultaneously and automatically regulated by the tip losing superconductivity.

CONDENSING ELECTRONS ON ATOMS - A BETTER IDEA

Suppose, in FIG. 1, the superconductor (SC) were covered with an thin (20 angstrom or so) insulating film, similar to a Josephson junction (JJ). This would provide two things (1) a uniform tunneling barrier to insure that all current is tunneling current and (2) a protection of the SC surface. The cathode conductor could be joined to a metal film deposited on the back side of the SC. A thick insulating covering deposited over the film and conductor.

Now, what is the difference between an electron or pair tunneling across the junction to an SC and across the junction to the vacuum, or maybe to a stray molecule or atom? The tunneling rate should be similar to a JJ if there is a favorable potential on the other side of the barrier, a sufficient gradient across the barrier. There is no need to actually have an anode there right up against the JJ barrier. Having a vacuum gap there provides the thermal insulation necessary to make the device work without excessive cooling costs. To get an energy gain it is only necessary that the pairs get to close proximity on the anode side of the barrier, not all the way to the anode itself.

Another interesting point or question is whether tunneling, i.e. waveform collapse at a new location, requires matter, a particle, as a target location. It appears there is evidence of this via photon collapse in the photoelectric effect. Photons travel for light years though space, continually expanding, only to collapse into an interaction with a single atom randomly selected at a destination surface. Pairs are bosons, so should be governed by a similar requirement of a matter target to collapse their combined waveform. In effect they need a seed to condense upon on the anode side of the barrier. A xenon atom, might provide just the kind of seed necessary to accumulate large numbers of pairs into a condensate. By being heavy, its momentum might let it hang around long enough to accumulate a good load. On the contrary side, a large accumulated negative potential should prevent the feasibility of more than a pair (or even a pair) from making the leap. However, even if only a pair can make the leap to condense on an atom, then massive energy is gained because they are forced into a location that is only about an angstrom in size. However, pairs are bosons, so their fields should overlap without interaction, so the jumps may be feasible if the boson nature is preserved.

CONDENSATION IN HOLES - THE BEST IDEA

The rule that maintains the electrons as a boson is that they keep equal but opposite momentum (not energy) at all times. So, to facilitate this, the surface of the SC (as shown in FIG. 1) should be filled with tiny holes or slits. If an atom drifts into a hole, or possibly even a singular electron, there is a seed to condense pairs upon. The pairs can approach the seed from opposite sides of the hole. Any pair equidistant from the seed but on opposite sides of the seed is a candidate for making the quantum leap to the seed yet remaining as a boson - thus not adding to the potential opposing the leap. The electrostatic gradient in a small hole should be small until reaching the hole opening. Thus acceleration of the seed to a point that would disrupt the condensate might be delayed until the condensate reaches the mouth of the hole. Then it is too late for energy to be conserved. The energy is gained and the condensate can explode in all directions, but most of the kinetic energy will tend to be carried away from the SC due to the strong electrostatic gradient and the pair momentum.

Though possibly not as effective as holes, slits or grooves might be easier to make. Separate superconductors sandwiched together to make a gap would not work well because coherence must be maintained between the two sides of the gap. Also, if any potential should be created across the gap a GHz EM emission will develop that will tend to shut things down as far as Bose condensate formation in the gap.

A maximum path through the SC of about 1 cm, maybe much less, depending on the SC, could be permitted around the slits to maintain coherence.

One problem with the above idea is that, for tunneling to be effective, the holes or grooves might have to be only about 40 microns across.

Because the condensate formation can occur in the holes or grooves at zero volts differential, it is not clear that a significant voltage would be required to generate the condensates in holes or slits. Also, a small voltage might facilitate a longer mean path outside the mouth of the hole or grating before the condensate exploded, or leaked electrons, thus reducing the SC cooling requirements. However, a larger voltage may increase the size of the structures that can generate condensates to something well above 40 angstroms.

An ionic pump could be used to circulate H2 or He or Xe, etc., at low pressure around a loop that includes the SC active surface, or moves though the surface. In this way, by maintaining a small pressure differential, a controllable flow of neutral seed material past the SC can be obtained. Possibly the neutral gas flow could facilitate cooling where it is needed most - at the mouth of the holes or grooves where the condensate would tend to explode.

CATHODE SPOTS - A MAYBE

The nature of cathode spots [1c] indicates a hole or gap size of up to 0.1 micron might work for the above proposed mechanisms. This is a typical size for a cathode spot. There is much not fully understood about cathode spots. As of 1980, there were at least 17 major explanations for them [2] There is also the continuing investigation of other emission anomalies, e.g. particle formations characteristic of higher energy processes, under the "Pseudospark" classification. [3a - 3c]

Of special interest about cathode spots is that metallic vapor jets issue from them with velocities of up to 1000 m/sec, with one atom of metal removed per about every 10 electrons emitted. [4] These spots can have high currents, estimated at up to 10^8 A/cm^2, and it is thought that the emission of high energy electrons is by thermal-field (T-F) emission as described by Schottky [5] and that the less energetic electrons are emitted by field emission (tunneling.) It is thought most of the emission is T-F emission, but, as of 1980, there was no experimental proof of this. [6]

A calculation using Childs space charge equation shows a vacuum arc 1 cm long varying a current density of 100 A/cm^2 would require about 100 KV voltage, and that if 99 percent of the electron space charge were balanced by a distribution of positive charge, then 4800 V would be required. [7] Actually only 28 V is required, indicating the space charge is neutralized to within a few parts per million, and that this neutralization occurs at the cathode spot. "Flows of [metal] ions away from cathode spots toward the anode (against the main electric field of discharge) have been detected by both optical and mass spectrographic data." [7]

Lafferty and Dillon state: "Honig [8] and Franzen and Schuy [9] found large amounts of multiply charged ions as well as singly charged ions. Plyutto et al. [10] showed in addition that the average ion energies correspond to voltages exceeding the total arc voltage, thus the average ion has sufficient energy to move anywhere within the discharge. Davis and Miller [11] confirmed, extended, and made more precise those earlier measurements: they showed that the energies of the neutral atoms emanating from the arc are much less than those of the ions, and apparently are confined to thermal energies, except for a few forming a high energy tail of the distribution. In copper arcs the energy gap (measured at anode potential) between the average singly charged ion and the average neutral exceeds 30 eV. There is very little overlap between neutral atom and ion energy distribution." [12]

Arc voltage characteristics are poorly understood, and no published theory explains the positive resistance characteristic or tells why the arc voltage for molybdenum is higher than for copper. [13] It appears to be especially true the voltages are poorly understood at arc extinguishing currents because of the extreme fluctuations, fluctuations many times arc voltage and at frequencies of 1 - 15 MHz, despite the addition of up to 2500 uH inductors in the circuit. [14] If such voltage fluctuations were the result of circuit parameters the addition of inductance would have changed the transient frequencies.

The combination of all these factors leads to the hypothesis here that pair formation may be going on to some degree in conductors at thermal levels. Due to thermal collisions, such pairs would have a very short half-life, and thus would not permit formation of any macro level coherence like that exhibited in superconductors. However, if such pair formation were frequent enough, it could account for some part of the above phenomena.

If there is pair availability in the cathode, then neutral atoms, boiled off the interior surface of the cathode spot hole, could be seeds for formation of doubly negative charged condensate formation, e.g. a CU-- condensate formation. It is even possible that the pair formation and tunneling to a co-centered location with the seed atom occurs at the same instant. The essential conditions would only be that the electrons have equal but opposite momentum, within the binding energy for a pair, and be equidistant from the seed. There would only be the possibility of tunneling to nearly exact co-centering on the seed. However, this co-centered configuration, even though having a high potential energy due to the tunneling of the electrons through their coulomb barrier, represents a lowest energy configuration for the electrons, thus has a high probability even though the volume involved is small.

The formation of double negative ions provides a couple explanations. One, it explains how the metal ions are accelerated out of the (cathode) hole. Another is that, when the ion reaches the boundary of the hole, it meets the full electrostatic field gradient of the plasma ball in front of the electrode hole. Acceleration here would destroy the condensate and a high energy explosion due to the mutual repulsion of the condensate electron pair would result. The energy of that explosion would quickly be dissipated in the plasma ball by collision. However, it has been experimentally observed that the plasma ball contains ions having kinetic energies well above the total potential drop across the vacuum arc. [15] Lastly, it explains why the energetic group of metal atoms are positively charged positive ions, or even multiply charged positive ions, and yet going the wrong direction, against the electrostatic gradient. That is because the energy of the electron pair repulsion at the moment of condensate breakdown is sufficient to knock one or two extra electrons off the metal atom, thus leaving it as a positive ion with higher momentum than the thermal neutrals. Perhaps these mechanisms can explain the very presence of the high energy plasma ball on the cathode right in front of the spot.

The current oscillations at near extinguishing voltages and currents could possibly be explained by the fact that when current is down the ion density is down and the electrons from the exploding condensates preserve their high kinetic energy longer. In fact, as current approaches zero, the mean free path can exceed the arc gap width. As heat in the spot drops a larger percentage of the current must be due to tunneling. This means a greater concentration of the explosive condensates should be formed, and upon reaching the surface of the spot hole their explosion could produce a strong negative pulse which (1) momentarily suppresses the potential in the spot hole, and (2) generates heating on the surface of the hole. These effects serve to reduce the current while shifting the mode more back to the lower voltage T-H type arc. Operating in that normal low voltage mode, however, the hole quickly cools and potential drops, repeating the cycle. This cycle uses overunity energy as the primary drive for the oscillation.

There are various devices which seem to gain energy from arc and abnormal glow current oscillations. If the hypothesis is true then perhaps the excess energy for these devices is coming from condensate explosion.

Some practical conclusions of the hypothesis are

(1) To see a maximum COP operate as close to the shutdown current, or with as many tunneling electrons, as possible.

(2) It may not be necessary to use a superconductor as a cathode to maximize the proportion of tunneled electrons, or the proportion of condensates formed. Copper or silver may be best.

(3) Possibly use a barrier surface on the cathode to guarantee that all electrons emitted from the cathode do tunnel.

(4) Prepare the cathode by creating holes or slits with rough interior surfaces.

(5) It is possible to use the gas flowing through the holes or slits as a coolant.

(6) Since, if a cold cathode is used, there is no source of thermal atoms to act as a seed source, provide them via flow through the holes or slits (created by a pressure differential.) This implies the need for a very thin cathode. If the process works as hypothesized, the cathode itself might work as an ion pump to maintain the differential. It is then simply a matter of directing the gas flow to obtain cooling before

returning to the back side of the cathode.

(7) If coherence over macro ranges, e.g. 1 cm., is not necessary, then the cathode could be made by sandwiching together separate pieces of metal, and these could have triangular cross sections to provide strength, narrow gaps, yet low gas flow resistance.

The major concern is the discrepancy between hole diameter and typical tunneling distances. It is possible the pair formation occurs in cathode spots at the moment the atom is dislodged from the metal crystal lattice. After the bonds are broken, the atom's brief continued presence in its own hole left in the crystal lattice then provides the condensate forming geometry suggested here. If the surface of the cathode slits are made sufficiently rough, probably by acid etching, and large neutral gas atoms, like xenon, are used, that may provide a similar situation, however.

This hypothesis of warm condition condensed pair formation seems a bit far fetched, much more so than the idea proposed earlier to use a superconductor cathode with holes. However, the facts and ideas taken as a whole lead to some interesting experimental possibilities and are consistent with descriptions of various ou devices.

There are further implications (of pair formation and simultaneous pair tunneling to form a condensate in warm conditions) to cold fusion and other devices where energy production has been reported. A condensate formed of H+ + e- + e- = H- should be more stable than a larger condensate, have a much higher probability of creation due to the low net energy condition, and has a clear potential to overcome the coulomb barrier so may act as a catalyst for low energy nuclear reactions.

FOOTNOTES:

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1b. Ken Shoulder, EV - A Tale of Discovery, 1987

1c. Lafferty and Dillon, "Vacuum Arcs", Wiley & Sons, 1980

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3a. See www URL: <http://www.ee.umd.edu/~rhee/pseudospark/geninfo.html>

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4. Lafferty and Dillon, "Vacuum Arcs", Wiley & Sons, 1980, p.9

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6. Lafferty and Dillon, "Vacuum Arcs", Wiley & Sons, 1980, p.122

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