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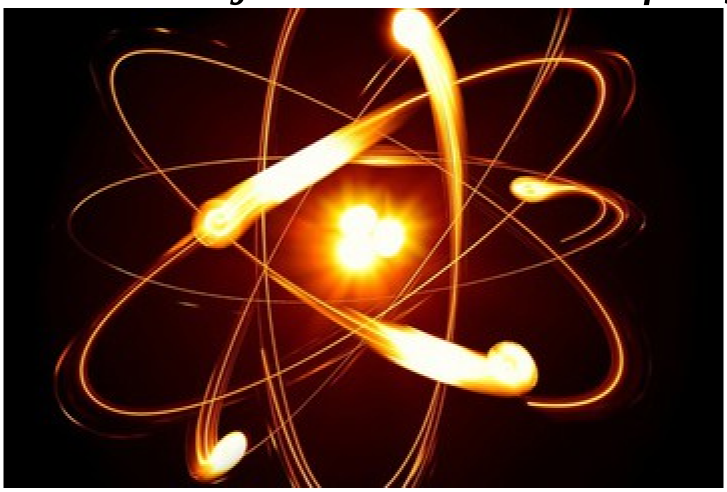
The Specific Heat Problem of Electrons

another major mainstream fudge



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This problem—also listed as Electron Heat Capacity—is another one the mainstream has been hiding for decades, one I wish to pull out of the closet and exhibit on the front lawn. The gatekeepers have hired hoards of people to try to waste my time in various ways to prevent me from writing any more of these papers, but their gambits are failing. Here I am again.

As we have seen in previous papers, almost as soon as the electron was discovered it was used as the field particle for nearly everything, including of course heat transfer and heat capacity. The Drude-Lorentz Model of 1900 tapped the electron as the basic field particle, and that has not changed in the 115 years since then. Although the mainstream now has ubiquitous evidence the electron is *not* the field particle, it keeps fudging the old equations over and over to convince students it is. The Drude-Sommerfeld model is now such a huge pile of finesses it should be an eternal embarrassment to any real scientist and to the fields of physics and chemistry, but rather than admit that they just keep finessing it. New finesses are added each year to answer new experiments, as we have seen.*

We have looked at many later indications that the electron was not the field particle in those previous papers, but here we will look at the first indication—one that should have been (and almost *was*) fatal to electron theory. This was the fact that electrons did not add to specific heat. Using the theory of the time, it was expected that electrons should add appreciably to specific heat; but experiments could not show even 1% of that expectation. This was an early "catastrophe," on a par with the later vacuum catastrophes and dark matter meltdowns. They tell you this problem was solved, but it wasn't. To prove that, we will look at some of the solutions posted by the mainstream on the internet.

Hyperphysics.edu is the top listed answer to a search on this subject. Here is that answer:

The electrons in the metal which contribute to conduction are very close to the Fermi level, "ripples on the Fermi sea". But to contribute to bulk specific heat, all the valence electrons would have to receive energy from the nominal thermal energy kT. But The Fermi energy is much greater than kT and the ovewhelming majority of the electrons cannnot receive such energy since there are no available energy levels within kT of their energy.

Apparently Hyperphysics operates without Spell-check. It also apparently operates without Logic-check. That entire paragraph is just back-engineered speculation and we have no evidence to support it. In fact, we have about a century of evidence to refute it. To start with, the Fermi level is simply a level of energy in a given substance, also called chemical potential. That potential is then assigned by the mainstream to electrons arbitrarily, but if that assignment had been true, the theory shouldn't have needed a continuous pile of magical pushes over the decades. The magical pushes are precisely what should have indicated to honest physicists and chemists that the initial assignment was mistaken.

As it turns out, the Fermi energy (and Fermi level) can just as easily be assigned to charge photons, and if that assignment is made we no longer need all the magical pushes like quantum tunneling, band structures, electron holes, ideal crystals, and so on. Assigning the Fermi energy to photons instead of electrons immediately simplifies all solid state theory, conduction theory, and heat theory by many orders of magnitude.

It also solves the electron problem of specific heat. If the electron isn't the field particle of either conduction or heat, then the original expectations vanish. This also ties into the problem of heat capacity, which I have already solved in a previous paper. See below where I gloss it again for good measure.

Also notice how the explanation at Hyperphysics elides from conducted electrons to valence electrons. But conducted electrons must be free: how else are they *conducted* from place to place? Valence electrons aren't free. The definition of a valence electron is "one that is associated with an atom." Heat can't be transferred by electrons associated with atoms, unless they are proposing the atoms are dragged along in conduction as well. So whether or not valence electrons are responding to kT is beside the point. The original problem concerned the fact that *conducted* electrons were not adding to the heat, and that is even admitted at Hyperphysics. Where? In their statement of the original problem:

One of the great mysteries in physics in the early part of the 20th century was why electrons didn't appear to contribute to specific heat. How could they contribute to electrical conduction and heat conduction and not to specific heat?

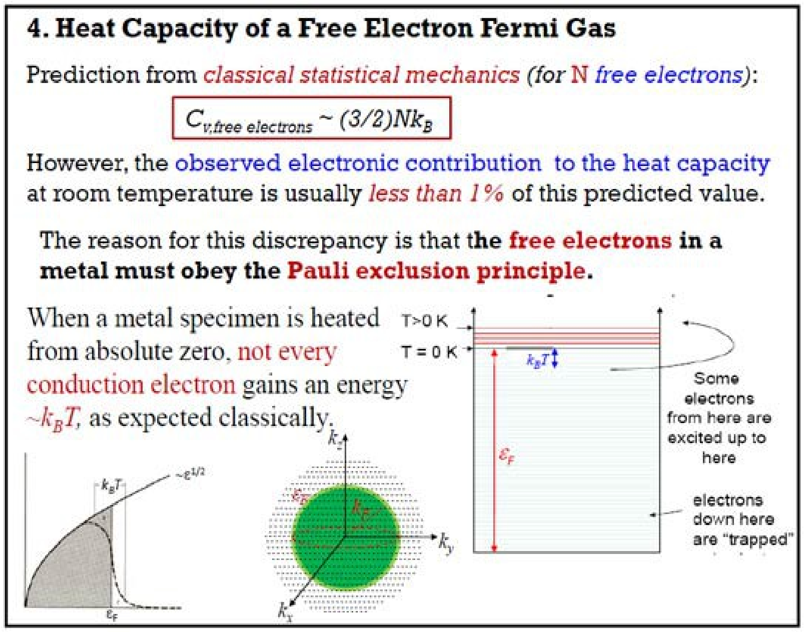
If they are contributing to electrical conduction or heat conduction, they aren't valence electrons. So the entire Hyperphysics explanation is just misdirection. As more proof of that, we can compare the Hyperphysics explanation to the explanation at the number two site that comes up on a search. This is the site at Drexel University. There, it says this in the first box:

When a metal specimen is heated from absolute zero, not every conduction electron gains an energy ~*k T* as expected classically.

See, they say "conduction electron." That would be "free electron," not "valence electron." These major sites can't even fudge you in the same way on the same longstanding question.

Beyond that, you can't have valence electrons in a Fermi gas, since a valence is a type of charge interaction. When talking of Fermi models, the fermions are non-interacting, which precludes charge interaction.

Here is the entire first box at Drexel:

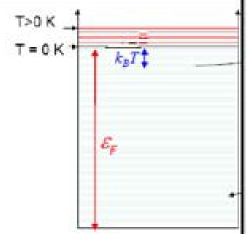


First, they tell you the cause of the discrepancy is the Pauli exclusion principle. But then if you look at all the other stuff in the box, you find nothing to do with the Pauli exclusion principle. Like Hyperphysics, they try to trap 99% of the electrons "down here," but that trapping isn't a function of the PEP. To start with, the PEP applies to electrons in orbitals or shells, not to free electrons. There is no reason free electrons can't have the same or very similar energies, since they aren't trying to occupy the same place. If they are the field particle of heat or conduction, then they must be conducted, which means that aren't in those orbitals. So the electrons "down there" are just a fiction created to fudge an answer here. Nothing in the old theory would indicate conducted electrons should be trapped in lower energy levels, and in fact they should occupy higher energy levels, simply because they are both "free" and electrons. Being the smallest fermions, the electrons should have the highest kinetic energies.

To see the continuation of this fudge, let us look at the second box at Drexel:

For a simple, *qualitative* argument:

If there are N free electrons in the metal, only a *fraction* (in the order of $k_B T/\varepsilon_F$) can be excited thermally, the energy of each electron is increases by $\sim k_B T$ upon thermal excitation.



The total ***thermal*** energy of the electrons

$$\Delta U = N\left(\frac{k_B T}{\varepsilon_F}\right)k_B T = N\left(\frac{T}{T_F}\right)k_B T$$

The electronic heat capacity: $C_{ele} = \dfrac{\Delta U}{\Delta T} \cong Nk_B\left(\dfrac{T}{T_F}\right)$

C_{ele} is *proportional to T, agreeing with experimental measurements.*

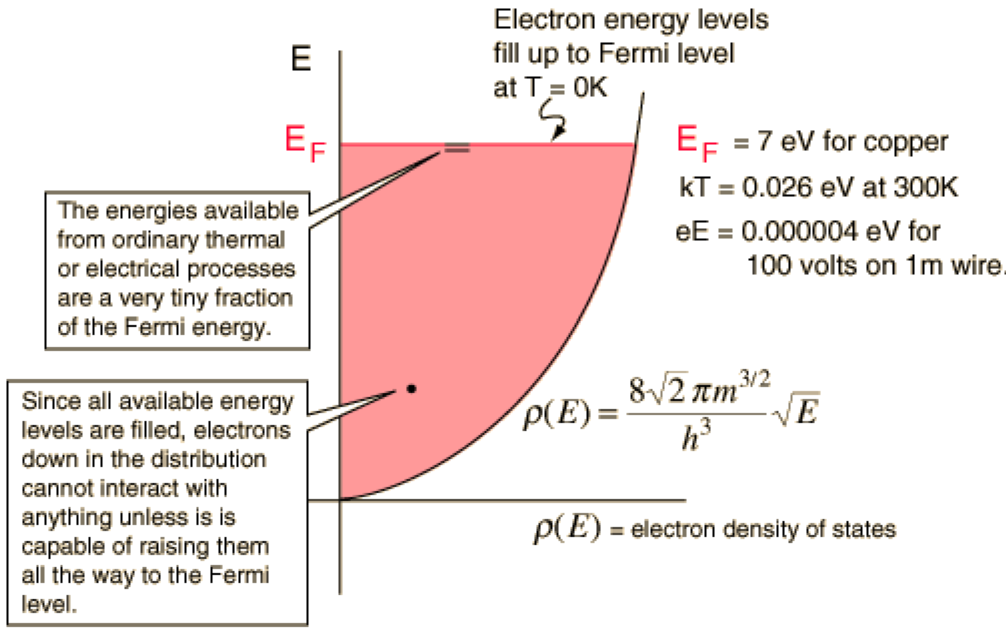
At room temperature C_{ele} *is smaller than the classical value* ($3Nk_B/2$) *by a factor ~0.01.* Clearly, electrons cannot be treated as classical particles.

We are supposed to be getting a "qualitative argument," but as you see we are just getting pushed math. Pushed math isn't a qualitative argument. Math is *quantitative*, last time I looked. The authors are just assuming what they are trying to prove, then writing equations for it. Not only is that not qualitative, it isn't an argument. Look closely: they say: "only a fraction can be excited thermally." But we have no experimental evidence for that. They are just *assuming* that is the cause. They are assuming what they are expected to argue for. There is no argument or theory here, just a push to a conclusion. No mechanics is offered, just unsupported diagrams.

This reminds us that all this talk about the Fermi energy and Fermi level doesn't even apply to real substances. Both

refer to the energy difference between the highest and lowest occupied single-particle states in a quantum system of non-interacting fermions at absolute zero temperature. In a Fermi gas the lowest occupied state is taken to have zero kinetic energy, whereas in a metal the lowest occupied state is typically taken to mean the bottom of the conduction band.

In real life, there are no such things as non-interacting fermions, and this is due to a little thing called charge. Fermions are charged, and the charge defines the interactions. For the same reason, there is no such thing as a "single-particle state." Real particles don't create Fermi gases, or anything like them, not even near absolute zero. Just as they later fudged solid-state physics with ideal crystals, here they are fudging you with manufactured quantum systems which do not and cannot exist. Ask yourself why they would define these problems in terms of fake systems of fake particles? Why would you theorize about non-interacting fermions, when part of the definition of fermion was that they interacted strongly via charge? Isn't such theory simply perverse?



But back to Hyperphysics. Let's look at their first diagram. Note the lower box, which continues the misdirection. It says that all available energy levels are filled. But are they? Is there any indication substances have to be filled in order to conduct? No, just the opposite. We know that ionized substances actually conduct *better*, which means an electron has been ejected. That is what ionization is, remember? If an electron has been ejected from an atom, that level is no longer filled.

This is why talking about this problem in terms of Fermi models is complete misdirection: real systems don't fill like Fermi systems, so modeling fake systems to answer questions about real systems should always have been seen as absurd. If you aren't going to try to answer the question by modeling and discussing the systems we know we have, you shouldn't even bother posting an answer.

By talking of Fermi energies and Fermi levels, they are misdirecting you into old Fermi models based on a Fermi gas. But in a Fermi gas, the fermions don't even coalesce into nuclei, much less atoms. So not only are these models ignoring charge and nuclear structure, they are also ignoring *atomic* structure. I beg you to remember that most solid-state solutions now ditch atoms, as we are seeing here. They can't model them, so they just drive you around them.

We also have no indication that electrons "down in the distribution" cannot interact with anything and lots of proof they can. This whole idea hinges on the definition of "interact with anything." If the mainstream means they cannot be ionized, that is true. But if they mean the electron cannot be heated, that is not true. If the entire substance has been heated, why would electrons down in the distribution be shielded from that? They could not possibly be shielded from that heat, because that would indicate they were shielded from charge. As I have shown, heat is charge and charge is heat, and no place in any molecule (or even nucleus) is shielded from charge. Charge runs through every nucleus, and it is these charge channels that carry the heat. So no electrons can possibly hide from this charge. Not even my electrons, which I have shown are actually inside the nucleus. But especially not the mainstream's electrons, which are supposed to be outside the nucleus in very vulnerable orbitals. Defining this problem in terms of Fermi models is the dastardly attempt to skirt all questions of charge.

The mainstream claim is illogical in yet another way, in that it is proposed that electrons down in the distribution are non-reacting with kT until they are raised all the way to the Fermi level. But that contradicts the entire definition of Fermi level, which is (in part)

In a band structure picture, the Fermi level can be considered to be a hypothetical energy level of an electron, such that at thermodynamic equilibrium this energy level would have a 50% probability of being occupied at any given time, if it does not lie in the forbidden gap.

But now they are telling you electrons below the Fermi level can't interact with kT. That is a logical contradiction, because it begs the question how any electron ever reached the Fermi level in the first place. While appearing to answer this question of a specific heat deficit, it fails to answer the broader question of higher energy levels. If the Fermi energy is "much greater than kT," then how does any electron ever reach the Fermi level? This pseudo-mechanism they have proposed would permanently trap most electrons in an non-interactive state, you see.

The whole idea of Fermi energy is a muck-up from the first word, like all the rest of solid-state physics. Just go to the Wikipedia page on that concept to find this:

What this means is that even if we have extracted all possible energy from a Fermi gas by cooling it to near absolute zero temperature, the fermions are still moving around at a high speed. The fastest ones are moving at a velocity corresponding to a kinetic energy equal to the Fermi energy. This is the **Fermi velocity**. Only when the temperature exceeds the **Fermi temperature** do the electrons begin to move significantly faster than at absolute zero.

So the Fermi energy is the kinetic energy of the fastest fermions at absolute zero. Since fermions are particles like protons, neutrons, and electrons, it is the electrons that would be at the Fermi energy. It is the baryons that would be moving more slowly, and which would therefore be "down in the distribution." If we are talking about ideal substances like a Fermi gas instead of real substances, electrons would never be down in the distribution. Electrons could only be down in the distribution in some way if we were talking about real substances, and only if the electrons were bound in the atom somehow (as I showed above). But even then they could not possibly be bound away from the charge field. No charged particle could possibly be bound away from interaction with the charge field, by definition.

But the greater problem with all Fermi analysis is its total ignorance of the charge field. Notice that when they create this Fermi gas at absolute zero, they never mention the presence of either charge or photons. They tell you that even at absolute zero, they know these energies are there. They tell you we have motion. But they do not bother to tell you why, or what is causing that motion. It can only be the presence of charge, which does not go away at absolute zero. Since you cannot shield any experiment from photons, the charge field will always have some density. It is these photons that cause any residual motion at the lowest temperature. Photons cannot be slowed below c, as we know, so even one photon in a substance will cause motion of the substance, and because c is so great, that motion will not be slight.

We can more easily forgive Fermi and Drude and the old guys because they didn't know what we know now. The photon was little better than a myth back then, and Einstein's photoelectric effect paper hadn't even been published in 1900. But starting with Sommerfeld and his additions to theory, we can no longer give anyone such a pass. They should have known by then all this was no better than a gigantic cheat. And current physicists and chemists no longer have any excuses at all. Teaching these tricks in 2015 is pathetic. More pathetic still is their attacks on new theory and theorists such as me.

The hostility to new ideas over the past century has been incredible to witness, especially in a time that is sold to us as more open and free. Protecting such awful theory doesn't resemble science in any conceivable way. It is no more than job protection and suppression of science, and that is pretty obvious to any honest person who studies this problem—or any of the thousands of other problems propped up with wicker sticks to this day.

The fundamental problem with all these theories from the very beginning was that they were trying to explain effects without the first cause. It would be like trying to explain ocean waves without water. Trying to solve these problems while ignoring the charge field structures and nuclear structures is not even remotely possible, as the mainstream has proven and continues to prove on a daily basis.

We see more evidence of this if we return to the theory of heat capacity. In the section titled "Theory of Heat Capacity" at Wikipedia, we find this:

For any given substance, the heat capacity of a body is directly proportional to the amount of substance it contains (measured in terms of mass or moles or volume). Doubling the amount of substance in a body doubles its heat capacity, etc.

However, when this effect has been corrected for, by dividing the heat capacity by the quantity of substance in a body, the resulting specific heat capacity is a function of the structure of the substance itself. In particular, it depends on the number of degrees of freedom that are available to the particles in the substance; each independent degree of freedom allows the particles to store thermal energy. The translational kinetic energy of substance particles is only one of the many possible degrees of freedom which manifests as *temperature change*, and thus the larger the number of degrees of freedom available to the particles of a substance *other* than translational kinetic energy, the larger will be the specific heat capacity for the substance. For example, rotational kinetic energy of gas molecules stores heat energy in a way that increases heat capacity, since this energy does not contribute to temperature.

There is nothing said about either charge or nuclear structure. They are still trying to solve these problems with naïve degrees of freedom they got from early Fermi models—models that don't even mention charge interactions or field structures. Yes, they say that heat capacity "is a function of the structure of the substance itself," but they then define that structure not from experiment but from ridiculous models that ignore charge channels. Notice, for instance, that they claim the degrees of freedom are *independent*. But that only applies to the old models, which just assert something and go from there. In reality, the degrees of freedom are *not* independent. All the energy levels are dependent, as we see when we study the cause of spin. Spin is one degree of freedom in the field, as they admit. But once you understand that charge is causing everything here, you see that spin is a function of linear motion. All magnetism is a function of linear motion, since the linear motion of charge photons create the E field and the spin of the photons creates the B field. In other words, photons have to collide to maintain the spins, and these collisions are functions of the linear motions. So nothing is independent.

Because they don't know that—or are choosing to ignore it—they can make these ridiculous claims like the last one, that spin doesn't contribute to temperature. In order to fudge their failed equations and models and theories, they have to do things like this, but it makes no sense on any level. Spin could be stored only if particles were never colliding or influencing one another in any way. But that isn't reasonable and we know it isn't true regardless. Spin has to contribute to temperature and heat, and we know that from things like magnetic reconnection. Magnetic reconnection causes extremely high temperatures, in places like the Solar corona or even in the upper atmosphere of Uranus, so saying that spins do not contribute to heat is counterintuitive as well as counter-empirical.

As I have shown before, the only way to solve these problems sensibly is to include the charge field, making it your fundamental field. In this way, the real charge photon becomes the field particle, not the electron. But you also have to know the nuclear structure of any element in your substance, since that is the architecture that is actually determining your charge streams. Without knowing that, there is absolutely no way you can ever model any solid-state problem, or any other molecular or atomic or subatomic problem. It is because I have both these things that I have made such quick progress on these old stalled problems, solving them much more simply and logically and mechanically than the mainstream has been able to.

Addendum, July 28, 2015: To prove that once again, I will tell them where their numbers were coming from in one line of math. My readers have seen me do this again and again: solve on a post-it note what the mainstream has not been able to solve on supercomputers. Remember above, where they told us that electrons were only adding about 1% to specific heat? Since they claim to have solved this, can they tell you where that original 1% number was coming from? No, of course not. But I can. Here is the math:

19/1822 = .01

Yep, that's all of it. The number 19 comes from the strength of the charge field relative to fermionic matter. See my paper on the Galactic Rotation Problem, where I find that number with three lines of high school algebra, given nothing but the current value for *e* and the definition of the Ampere. That proof shows that the proton is recycling about 19 times its own mass every second as charge. I show that this also tells us that Dark Matter is charge. The numbers match again: if charge is 19 times more energetic than the matter field, it is 95% of the total field. I am the only person to calculate the Dark Matter percentage from *e*.

The electron is also recycling the charge field, but because it is smaller, it cannot recycle the same amount as the proton. The proton and electron actually *do not* have equal and opposite charges. They have opposite reactions to charge in some cases, but they do not recycle the same *amount* of charge per second. The electron recycles about 1/1822 the amount of charge of proton, that number coming from what I call the Dalton. The number is known by the mainstream, it is just mis-assigned, like everything else.

And that is why they found about 1% of their expectation as specific heat.

*See recent tweaks to Anderson localization, for instance.