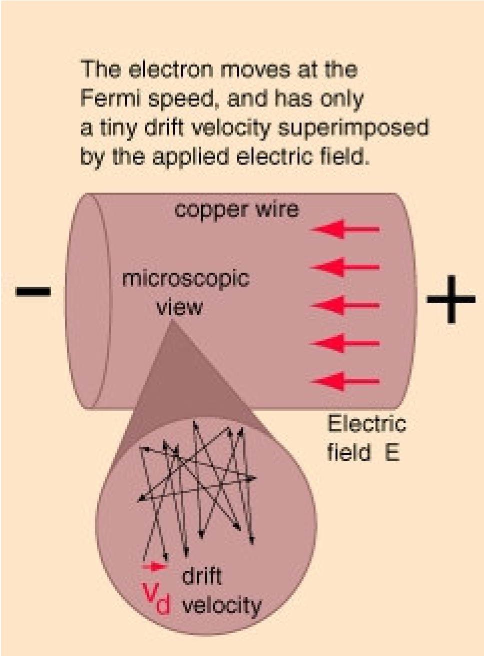
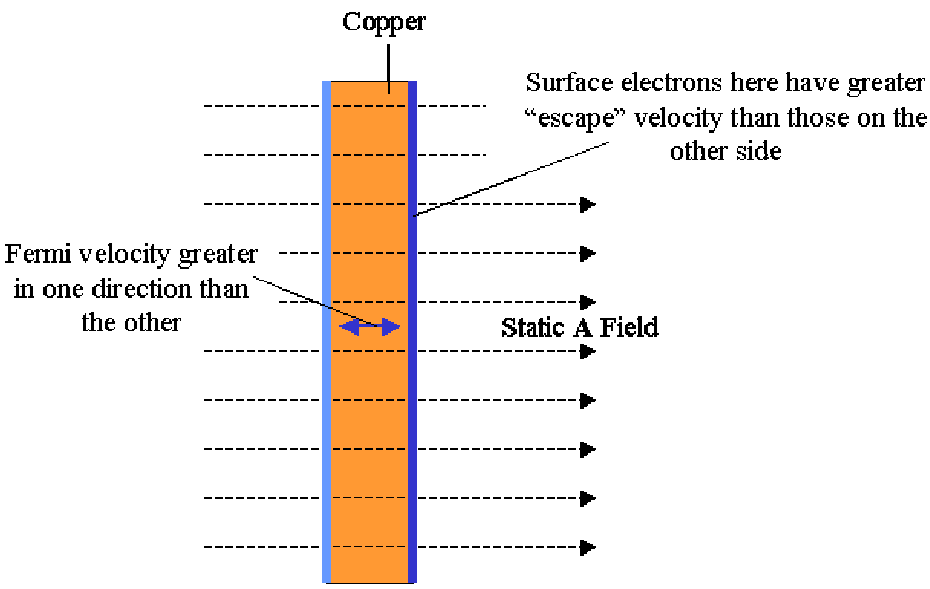
Some Thoughts on using Magnetism to produce Amplified Thermal Noise

Consider the free electrons responsible for conduction in copper. They are jiggling about at Fermi velocity as shown in this image taken from http://hyperphysics.phy-astr.gsu.edu/hbase/electric/ohmmic.html.



That same site gives the Fermi velocity as 1.57×10^6 meters per second, which may be compared to the typical drift velocity that is fractions of a mm per second. Clearly the electrons endure positive and negative accelerations and if the electro-kinetic potential **v.A** has any validity its gradient represents an electric field. That gradient could come from those changes in velocity, so we can expect electrons accelerating in one direction along an **A** field to gain more speed than would otherwise be the case, while accelerating in the other direction (decelerating) will lose more speed. This would seem to imply that a thin copper sheet having a static **A** field normal to its surface would produce surface electrons on one side that achieve greater Fermi velocity than those on the other side. Also the thermal noise waveform would be expected to be asymmetrical.



For the case where a PM has one pole placed against the copper sheet the **A** field will form concentric circles within the sheet while the **B** field will pass through the sheet normal to its surface. Electrons moving in the plane of the sheet will obtain a sideways force from **E**=-(**v**×**B**) so that Fermi jiggling will produce a noisy alternating radial **E** field amplified by the presence of the **B** field. Add to that the **A** field velocity pumping effect and you get an even greater noise amplification. All these considerations should be easy to verify by simple experiments.