Bob Eisenberg <bob.eisenberg@gmail.com>

Thermodynamics, Entropy and Field Theory

1 message

Bob Eisenberg <beisenbe@rush.edu> Mon, Nov 5, 2012 at 8:37 AM
Reply-To: beisenbe@rush.edu
To: Craig Evans <evans@math.berkeley.edu>
Cc: Chun Liu <liu@math.psu.edu>

Dear Craig and Chun,

It seems to me having read (superficially but completely)
Craig's notes on Entropy, that there is a clear path to follow.

I think we should take PNP (for point particles) and write it
as a function of the electrochemical potential for each particle
type. The only 'left over' variable is the concentration of each
species and that seems to be just a scaling factor for the flux,
although there may be hidden interactions Chun knows about
from his work on Stratonoich/Ito etc derivations that change
all this.

Then take PNP and evaulate the classical Clausius Duhem
inequality which he so beautifully presents in his notes and
see what happens. Are there cases in which PNP describes
things that are in conflict with Clausius Duhem? How do we
define 'system' best? Is the 'system' just the region inside
the boundary ? or does it include the (free) energy needed to maintain
the boundary conditions and dissipation in the boundary conditions?
and always lurking in the background How does one incorporate
Maxwell WITHOUT RADIATION (said to mean without acceleration
of charge movements in the books)?

Then take PNP EnVarA and do the same separately for UNcharged
systems (to evaluate a reasonably reaslistic model of uncharged
particles) to see how the interactions appear in classical language.
Finally, the same for charged systems.

Technical detail it is VITAL in these models that diffusion coefficients
of different ions NOT be set equal. Experimentally that is known to
be a highly singular case that removes many crucially important phenomena.

Does this make sense to you all?

I know it is not a classical math approach. I believe the classical abstractions need to arise from this bottom up approach. I think any
attempt to general without this approach will produce something too
vague to be useful. It is clear that there are a wide variety of nonequilibrium phenomena that must be solved case by case so any
attempt to over generalize will be futile. The question I am interested
in (along with all biologist and many chemists) is what can be done for
the bio ions in water which are so very important for all living and many chemical applications. In that case I think

there is a serious hope of a powerful abstract approach pivoting off the Clausius Duhem, but I think it must be sought by starting with specifics.

As ever
Bob

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