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Bob Eisenberg <bob.eisenberg@gmail.com>

Re: Phone Conversation

Bob Eisenberg <beisenbe@rush.edu> Thu, May 9, 2013 at 1:00 PM
Reply-To: beisenbe@rush.edu
To: Ken Weiss <kenweiss@psu.edu>, Bob Eisenberg <beisenbe@rush.edu>
Cc: Chun Liu <liu@math.psu.edu>, Anne Buchanan <avbuchanan@gmail.com>

Dear Ken and Anne,

This email may be interrupted at any moment by arrival of daughter for tourist activities.....but it will then be continued.

The Brownian motion story is one of the more fantastic sagas in intellectual history in my view. See if you agree.

Fundamental facts: charge is the source of the electric field. When the density of charge changes the electric field changes. This is fundamental in Maxwell's equations, Gauss' law or whatever formulation of electromagnetism one uses. Charge is an abstract quantity and CRUCIAL the chemical and physical nature of charge does not appear in Maxwell's equations (i.e., charge on a nuclear particle whatever the are, charge on a hole in a semiconductor, charge on a sodium ion behave nearly the same way. I say "nearly" because each kind of charge may have physical properties that slightly differ but their electrical properties are in fact identical.). These equations are in fact easy to check to something like 1 part in 10^{20} because the electric field is so strong and because such small electric fields can be measured.

Fundamental fact: nearly everything that dissolves in water has substantial electrical charge. The bio-ions Na, K, Ca, and Cl have permanent electric charge that never varies in biological or even chemical conditions. Water itself is nothing like electrically uniform in charge, even though its integrated (average) charge is zero. It is approximately a quadrupole with 'partial' charges of around 0.25.

Any Brownian motion theory will produce fluctuating number densities of charged particles when applied to water or to a biological solution.

Thus, any Brownian motion theory will produce a fluctuating electric field.

Classical Brownian motion theory either does not include an electric field at all (Einstein) or has a mean (time independent that is) field (Langevin equation).

The fluctuations in electric field are likely to produce flows LARGER than the diffusive flows of the classical Brownian motion theory of uncharged particles.

Thus, classical Brownian motion theory cannot be sensibly applied to the motion Brown studied or the motion of sucrose that Einstein said he was measuring. (I do not have the paper in my hands but I have check and he specifically refers to sucrose.) Sucrose has highly charged regions in its molecule.

The correct way to deal with this problem is to compute the electrical forces from the fluctuating number densities of charge.

That can be done using Poisson's equation and is done that way in the field of computational electronics with substantial success. IT IS NOT AN EXAGGERATION

TO SAY that our semiconductor technology would not exist if computational electroncis made the same mistake that Brownian motion theory has made.

I personally believe (but this view is NOT shared by many other people) that Maxwell's equations need to be used not Poisson because the displacement currents should be large on the time scales of Brownian motion (in my view). In my view, displacement currents need to be handled by Maxwell's equations. Others think they can fool with Poisson and get it good enough. They may be right. I am just starting a collaboration with engineers who actually solve Maxwell everyday to see who is right. There is a specific calculation that will tell us, but it will take a year or so to do.

Computational electronics deals with these issues by very clever EXTENSIVELY TESTED computational tricks that work well for some but not all things. (they get the noise of transistors all wrong for example).

Chun's mathematics gets all of this exactly right (which is why it is so fantastically important) but he has not applied it to these problems in detail yet.

Daughter has arrived....
I attach publications but the discussion above is meant to be much better than the publications. PLEASE UNDERSTAND any obscurities in what I wrote are my fault and it will be a joy for me to correct those obscurities. But I cannot do that unless you speak up vigorously!

As ever
Bob

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On Thu, May 9, 2013 at 5:29 AM, Ken Weiss <kenweiss@psu.edu> wrote:

> Everyone's agenda is of course wholly legitimate, but our conversation yesterday revealed the gaps (or chasms) between views. After the call, we don't feel that the idea of a workshop aimed at finding new cross-scale or integrative approaches to this kind of causation would work. More importantly, the rest of you have a much more shared universe, that could be highly focused and could involve others in Steve's group or whom he knows at Penn State, as well as you (Bob) and other persons you et al. know. So, even though meeting with you this winter, along with our personal interest in channelopathies, triggered our suggestion for a workshop, it isn't the kind of thing we'd be appropriate to organize--though we would want to sit in on it!

As Anne noted, it's Steve's Center that would host any such workshop, and he needs to use his resources for things that could catalyze not just interesting or important research, but research that, in today's climate, is actually fundable. We're too senior to worry about that at this stage!

In any case, we certainly want to meet with you and Chun this summer.

And can you send me a copy of your letter on Brownian motion?

Ken

On Thu, May 9, 2013 at 10:56 AM, Bob Eisenberg <beisenbe@rush.edu> wrote:

> Dear Ken, Anne, and Chun,
>
> I enjoyed our chat but felt that Steve had
> quite a different agenda from the rest of us.
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> I have had a long standing but somewhat peripheral
> interest in the community he represents and perhaps
> was drawn into his discussions too much.
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> Let me assure you that his interest in a very
> different line of work (e.g., status of and modifications
> to Hodgkin Huxley equations) does NOT NOT decrease
> my interest in what you all want to do.
>
> as ever
> Bob
>
> Robert Eisenberg
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"There is nothing more deceptive than an obvious fact."
The Boscombe Valley mystery (Sherlock Holmes,1891)

"I do so wish I knew what life meant and what we really are....if only I had someone to explain them to me."

The Documents in the Case (Dorothy Sayers, 1930)

My co-author Anne Buchanan and I have a blog on evolution, genetics, and understanding science, called The Mermaid's Tale, at: EcoDevoEvo.blogspot.com

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2 attachments

Einstein's mistakes Physics Today November 28 2007 with cover.pdf
277K

Proofs of forthcoming letter Physics Today.pdf
128K