**Ch 4 and App S** PhL 9.22.14

Two interesting items here.

1. I was trying out averaging C and 1/V and 1/K, but that did not turn out to be useful in the end, so the final Appendix S only contains something called $<\frac{1}{C'}>$ and then $G(\mathbf{x_1},\mathbf{x_2})$ and $C(\mathbf{x_1},\mathbf{x_2})$ are never mentioned and are not useful at all.

2. I noted that $L_e$ really ought to be complex, but in the end it is $K_L = K$ that forces it to be real, and this equality survives the averaging and now appears at the end of Appendix S.

Reviewed on 9/24/14 and stored in Appendix S.

Try this functional definition

$$C'(\mathbf{x_1},\mathbf{x_2}) \equiv q(z) / V(\mathbf{x_1},\mathbf{x_2}) = 4\pi\xi_d / K(\mathbf{x_1},\mathbf{x_2})$$

Decompose $C'(\mathbf{x_1},\mathbf{x_2})$ into its real and imaginary parts,

$$C'(\mathbf{x_1},\mathbf{x_2}) = G(\mathbf{x_1},\mathbf{x_2}) + j\omega C(\mathbf{x_1},\mathbf{x_2})$$

Double-averaging these equations gives

$$C' = q(z) * <\frac{1}{V}> = 4\pi\xi_d <\frac{1}{K}>$$

$$C' = G + j\omega C$$

How do I connect this with the main line progression leading to the new TL equations? There we obtain

$$\mathbf{y} \equiv j\beta_d^2/(\omega L_e)$$

which we could decompose into real and imaginary parts like so

$$\mathbf{y} = \mathcal{G} + j\omega\mathcal{C} \qquad \mathcal{G} \equiv \mathrm{Re}[\mathbf{y}] \quad \text{etc}$$

Question: In Chapter 4 when I do this

$$W(z) = L_e\ i(z)$$

do I know that $L_e$ is real?

Go back to

$$\varphi_1(\mathbf{x},\omega) = \frac{1}{4\pi\xi_d} \int_{C_1} \rho_1(x',y',z',\omega) \frac{e^{-j\beta_d R}}{R} dx'dy'dz' \quad . \qquad R = |\mathbf{x} - \mathbf{x}'| \qquad (4.1.1)$$

Now $\rho_1$ could have some complex phase, and then so could $\varphi_1$. And of course the expo is complex. You really must allow that everything *could* have a phase! How about

$$\rho_1(x,y,z) = \alpha_1(x,y)\ q_1(z) \quad . \qquad (4.1.2)$$

Is this physical real stuff or could things be complex?

$\rho_1(x,y,z,t) = \rho_1(x,y,z)\ e^{j\omega 1 t}$ $\rho_1(x,y,z)$ = physical at some instant in time = real ?

$\rho_1(x,y,z,\omega) = \rho_1(x,y,z)\ 2\pi\delta(\omega-\omega 1)$

But things often have phase depending on r.