This is the Title PhL 3.26.05

SEPTEMBER 2013

9/3 [p1 of edit log] Initial mechanical assembly of document. Greek letter font replacement. Subscripts and superscripts. Cosmetic repairs. Numbering of sections and equations. Replace double spaces.

9/8/13 [5]. Rename appendices as follows:

1.1	→	A	gauge invariance
1.2	→	B temp	complex dielectric constant (later went away)
2.1	→	C	DC properties of a wire
2.2	→	D	electric fields inside a round wire
3.1	→	E	surface charge on a conductor
3.2	→	F	waveguides
4.1	→	nada	erroneous evaluation of some Helm integrals

9/9 [6] Ch 1. Pondering my "applied" J_a and ρ_a stuff. Later this went away. Writing overviews of chapters in attempt to grok. Then Ch 2, then Ch 3, then Ch 4.

9/12 [11] Kent visits for 5 days ending 9/17/13.

9/17 [11] Decide SI units like blue Jackson. Decide μ and ε usage. Rewriting Ch 1. Relativity note and upgrade App A.

9/21 [16] Problem with ε_0 in a metal. Working on Ch 2 (fields in round wire). Kelvin functions.

9/25 [20] Cherie visits and Jim Memorial, 4 days no work.

9/30 [20] Working on Ch 1 section 1.7 on complex fields

OCTOBER 2013

10/1 [21] Working on Ch 2 and App B which goes away later. Jackson stuff on wire inductance, App C. Work in App D. Work on App E. Work on App F. Back to tables in Ch 3. Confusion with magnitudes of entries in these tables.

10/10 [26] Loss tangent. New loop picture for B_z estimate for Ch 3 tables. Confusion about displacement current. Working on Ch 3. Delete third table. Shape of fields stays constant. Install App D which was in a separate file for development.

10/13 [31] Facing up to the J_a and ρ_a issue, rooting it out. Reviewing App A again. Confusion about the King gauge. Library trip. Found King gauge in Vago book. Working in Ch 4.

10/17 [35] did AARP review, no work done.

10/18 [35] King gauge confusion continues. Parsing King's book section. King died 2006 at age 100. List of his 12 books. I am facing up to the "regions" issue for the King gauge and Helm equations. Pondering the notion of E refracting at a boundary in "the Jackson problem" of electrostatics. I am confused now about two King Problems: what is the source j for Helm equation? Why is ξ in the φ King expression?

10/29 [39] Major rewrite of Section 1.1. Other work in Ch 1. I solve the King ξ mystery by considering a conducting capacitor. This was a major breakthrough for me. Transport surface charge $n_{\mathtt{c}}$. Still I don't have the 3 regions yet, worrying about propagator refracting at boundaries. Working on Ch 1.

NOVEMBER 2013

11/1 [40]. I am getting closer to my "regions approach" where King gauge is the dielectric King gauge in all 3 regions, but not fully there yet. This then gets rid of $J_{\mathtt{a}}$ and $\rho_{\mathtt{a}}$ in a clean matter, another major breakthrough. Writing now Ch 1 sections 1.5 and above which deal with the 3 regions. Reject Fourier Cosine Transform to clean things up in complex notation world.

11/5 [45]. Getting ready to dump App B on ξ. Working in Ch 3. Working in Ch 2.

11/6 [47]. First pondering of $\mu_{\mathtt{c}} \neq \mu_{\mathtt{d}}$ and how King does not handle that. Panofsky book helps. Confusion about μ in simple round wire case, is it inside or outside μ?

11/7 [50]. Electrostatic spheres work now in App L. I think I should include $J_{\mathtt{m}}$ everywhere to get things to work. App C work.

11/8 [51] Torrey trip with Dave Blair for 3 days.

11/11 [52] Name for B field? Write App I and H on propagator stuff. Had some old App H before installing new ones.

11/15 [55] Writing new App B on $J_{\mathtt{m}}$ magnetization stuff, but have not yet realized that $J_{\mathtt{m}}$ should not be in the Maxwell equation source for this section. Explanation of how my two "King problems" were resolved. More work on App B.

11/16 [56] "The Nov 16 disaster". " I had been making hay by saying "you must include $\mathbf{J}_{\mathtt{m}}$ when computing **A**", but now it seems that you should *not* include $\mathbf{J}_{\mathtt{m}}$ and that means lots of stuff is going to collapse which depended on this idea. " " Since **B** = curl **A** and since **B** "sees" $\mathbf{J}_{\mathtt{m}}$, I would think that **A** also ought to "see" $\mathbf{J}_{\mathtt{m}}$. " While ongoing, I add boundary condition stuff for A including $K_{\mathtt{free}}$.

11/22 [58] At this point I am convinced that you should include surface and bulk $J_{\mathtt{m}}$ in full J. More work in Ch 1 to implement this. Some Ch 2 work. I realize that the Helm particular integral gives the whole solution with no homo adder when μ are all the same. Wrote App M (later became App G) on A for a round wire obtained from Helm integral with adder homo solutions, BC on $A_{\mathtt{z}}$ etc etc.

11/26 [62] New stuff at start of Ch 2. Wave on wire in Ch 2? Run into a Sisyphus paradox. Writing Meaning of Chap 2 doc. In App D show fields satisfy Maxwell's so must be right. Worrying about a_m and K_m. How to meld internal and exterior solutions for Ch 2? Major work on App D.

DECEMBER 2013

12/4 [72]. I throw out low ω limits in App D. Attempt at exterior solution for round wire. The two App D boundary conditions continually wobble! Where does n(θ) come from? How does it move? Did my little work on electron elliptical paths and how they go nowhere. Problem with the $E_\varphi = 0$ BC justification. Torsion wave idea. More App D work. Section D.7 is about fields outside the wire. Big Appendix D review. Last subsection at this time is D.8 but not sure what that was. Have just spent 19 days in Appendix D!

12/15 [80] Edits in Ch 2 to adjust for new App D. Review of Ch 2, and now 2 and D in sync. Review of App C and App E gets upgraded on Debye stuff. Review App F waveguides. Review A, H and I. I claim that Appendices A,C,D,E,F,H,I are all stable, but others are not.

Cod Cod trip 12/18 thru 1/2/14, effective 12 days

JANUARY 2014

1/2 [84] Reread all appendices to get back up to speed. Then review Ch 1,2,3. Start into 4.6, more on homo solutions. Wrote up W(z) section. Worrying again about the μ problem. Show $K = K_L$ in certain general example. Why does W(z) not depend on x,y I ask? Review App D. Write early Ch 5 sections 1,2,3. Clarify meaning of the μ,ε,σ type symbols. Idea of a new boundary condition which would then outlaw $2 \ln(s_2/s_1)$. Until that, I had no way to explain the scale of the Perga solution.

1/11 [91] Ch 5 seems stable. I write my general "capacitor problem" solution with Smythe help. Work in Ch 6. Clean up App F on waveguides, new drawing there. Review App M (becomes B later). I note that I have never proved the J_m business.

1/16 [95]. I prove the J_m theorem with Stakgold help, this is in App B. I am amazed. Overhaul of App B. Then Kuester and more work in App C. Appendix M is installed as App G. Write App J showing how 3D becomes 2D. Play with Kuester rectangular wire calculation. General review of Ch 1- Ch 6. Then review of appendices A through G only. Then H,I,J installed.

1/22 [98] Install new App K on network model. Doc is now 300 pages. Then write up App L on dielectric spheres and cylinders. Decide not to include the Jackson Problem. Add 2D section to App L. Write Overview and Summary. Start long round of proofing

1/26 [102]. Problems with $\mathbf{E} \bullet \mathbf{B} = 0$ at low ω. More App C on Holloway thing, various ways to do the calculation. Plots. More on $\mathbf{E} \bullet \mathbf{B}$. Email from Kuester helps out.

FEBRUARY 2014

2/2 [105] Review App C on the rect bar analysis. Wrote up C.5 showing Kuester point. then C.6 on hollow tube which later turns out to be very helpful for skin effect stuff. Add 3D and 2D Biot Savart laws. Back to review of Ch 3. Proofing of Ch 4,5,6. Paper is now 172+158 = 322 pages. Proof App A and App B. Then App C. How does J_m theorem alter Chapter 4? Wrote this up as last Ch 4 section, a breakthrough after many months and years of confusion on that particular μ issue. Proof App D and App G. Then proof App E,F,H,I,J,L. Start pagination. Make PDF. Create Visio index and then Maple index. Getting ready for release.

2/12 [120] Did 2/10 then 2/12 **releases**, fixing some bugs. Adding k(ω) stuff I guess to release. Then I did the big release! I thought I was done and fini!

2/15 [122] I realized that I have a big internal contradiction. In Ch 4 I have Z_{s1} = constant, but I know from elsewhere that $Z_s(\theta)$ varies and is not constant at least for round wires. This ruins my derivation of the TL equations. I ponder how this all works in Ch 4. I know there is $Z_s(\theta)$ θ dependence because I know that I have explicit η_m moments.

2/25 [127] I digress for 10 full days to write Bipolar Doc. I need that so I can make sure of n(θ) and then the η_m for the two cylinder TL. Due to the fact that Ch 4 is then totally inconsistent, I pull my PDF off the internet. I now have to start a long list of repairs.

MARCH 2014

3/6 [128] Clean up θ and φ usage. Write brand new App M about why A_t is small. (the previous App M became App B, and the original App B was thrown out as not needed). Small A_t is tied in with my repair effort and the sizes of V and W relative to E_z and all that stuff.

3/10 [128]. I decide to test ω→0 of the theory and find that I don't get the expected uniform J_z result. This is the biggest disaster so far! This spawns the "low freq" folder of docs and work. I am honestly wondering whether J_z is uniform at DC, very unsure. Library trip to look at the Paul book. In that low freq folder I compute limits of f_m and related functions. I try the reflection idea to repair things. I review that Paul book. Many files creation dates 3/9 thru 3/20 in low freq folder. Web claims that non-uniformity is caused by eddy currents, something I know nothing about, but they should go away at ω = 0.

3/28 [128]. I have now done all those low freq folder files. As part of my questioning of uniform J_z at DC, I ponder the simple isolated round wire! I realizes there is a Hall effect there with some radial E_r fields and I find that J_z really is uniform there after all. Could find no web reference to a radial Hall effect. So this led to my writing App N on Drude and Hall and radial Hall.

APRIL 2014

4/7 [129] Reading about eddy currents, can find no analytic examples.

Cod Lee trip takes maybe 14 days from 4/14 to 4/28.

4/30 [129] Writing App P on eddy currents. Did the circular plate.

MAY 2014

5/5 [129] Third version of App P written, then proofed it and installed it. Again, eddy currents of interest because they imply that $\omega \rightarrow 0$ should have uniform J_z, whereas my model does not give this! Separate Visio and Maple index for App P. Install App N on radial Hall. Review App M on A_t smallness.

"Project Status. All appendices are now in place. I can now "pop the stack" to get back to the various problems that I was concerned with in the **"lines overhaul Feb 2014"** folder. Notice that it took me 3 full months to deal with the distractions of (1) small A_t; (2) Hall Effect; (3) Eddy Currents and Proximity Effect. These subjects were all triggered by my considering the $\omega = 0$ limit of my theory which gave me an unexpected result and kept me wondering about a DC proximity effect! So again, I have very many miles to go before I sleep. A related topic is that Chapter 4 has to be redone so it only applies in the skin effect regime where A_z and W can be constant on the conductor surfaces. "

5/8 [131]. Paradox #1 ($\omega \rightarrow 0$ non-uniform) and #2 (King gauge says $A_z = (\varphi/v_d)$ but how can φ be constant while A_z is not constant on conductor surface?). Doc on this in repairs folder. Whiteboard picture is drawn and photographed. Have to rewrite Chapter 3 to explain these paradoxes.

5/11 [132] Rewrite Ch 2 with idea that not valid at small ω. Did the "averaging repair" to get new transmission line equation derivations and to resolve the $Z_s(\theta)$ problem. Questioning φ = constant even. Ch 6 work, plotting proximity effect. Added detail showing how $n(\theta)$ and J_z really are tied together. Doc is now 428 pages long. Doing ongoing small repairs, such as voltmeter voltage. Retry reflection idea. Ongoing review of doc files.

5/16 [138] Spend a whole day again on the $\omega=0$ asymmetry anomaly, I just cannot make it go away. Reflection does not work. Here is where I added the how to plot field lines App O. Update App D to use symbols like f_m. Fix $\delta << 16a$ bug in Ch 2. Find simpler forms for h_m and g_m, so more App D updates.

5/19 [139] Another "disaster" : (1) the charge pump BC wobbles again. I am worried once again about Debye surface currents. (2) The $E_\theta = 0$ BC also wobbles. (3) Asym of J_z still painful. At least this is only an "inside the conductors" disaster. I recover, and address the surface currents in D.9.

Torrey Mem Day weekend, no work 5/23 thru 6/1, about 10 days

JUNE 2014

6/2 [141] Working on D.9 and D.8 and other App D sections. I guess by this time I do the extension to non-conducting dielectrics worked in the D.9 (d) Added the symbol index. Finished and installed Appendix O on mag field line plotting. I ponder still more the asymmetry anomaly. Consider reflection idea yet again. Comments on my "loss theory" which is at this point in D.11. I think this might solve the anomaly by breaking connection between $n(\theta)$ and J_z.

Colorado Trip consumes June 6-9, call it 4 days including prep and recover.

6/9 [145] . Conclude that loss theory does NOT fix the J_z anomaly. I try again on reflection in separate doc. I give up on resolving the anomaly, and write a summary "conclusions". I try the audio lamp cord TL example but dismiss it.

6/10 [149] Proof App P and add its overview. Same for App O. Same for App N and App M.

6/13 [152] Another stab at the reflection solution. Give up again. App K proof. Then H,I,J,G,E. Then C, then B, then A. Then comes a proofing of the big App D. All appendices are stable. Proof Ch 3. Then Ch 4 proofing. Install Z_s averaging repair, did it better this time. Proof Ch 5 then Ch 6. Added telegapher's section. Chap 2 proofing.

6/17 [160] Have some Z_s repair problem, on hold. Meanwhile, proof Ch 1. I am thinking about a June 18 release. Spell check. Headers. Pagination. Build a PDF. Then back again to the reflection business for about the 6th time. Made small changes involving N_0. DC ladder resistance problem.

6/21 [167] I am suddenly unhappy about my loss model in D.12. The model is wrong. I see loss model equation in Pozer which is different. I then realize that k(ω) really contains the loss model! Update of App K to derive its own Z_0 and TL equations, independently of my main Maxwell text. Then I do a repair on the use of the β symbol, document wide, a major thing. Then I am doing a loss update everywhere. Start with 5.4 and low loss concept.

6/24 [173] I then write App Q to get the k(ω) stuff clearly stated with limits, since this is really my new "loss model". Then clean up D.11 a bit. Try again on the anomaly, it cannot go away at low ω ! I prove this rather conclusively, given my model. I try to use radial Hall to fix anomaly, no go! Deal with some issues of $G = 0$ versus $G \neq 0$. Replace β_d by k in Appendix D. Update App Q.

6/29 [178] I start thinking about Belden cable as example.

JULY 2014

7/1 [180] Update 6.5 including how I acknowledge the anomaly with J_z non-uniformity. I then look into the transverse equations of Chapter 4/5. Are they Helm or are they Laplace, and when? More updates to App Q on limits. Added Z_0 and not just k(ω). Then write Appendix R for Belden, but start over after it becomes a mess. Suddenly coax doc rears its ugly head! I am trying to "explain" all the Belden numbers, and this turns into a major effort. I get the DC L OK. But attenuation comes our wrong.

Cape Cod Lee trip 7/15 thru 7/25 in effect, call it 12 days total.

7/26 [188] Back from Cod. Found problem with attenuation. Rewrite App R once again. Then proof it. Maple artifact problem with straight line segments. Final proofing. Installed App R. Proof 4.11. Proof Chap 5, deal with red text. Handle the Way Back problem in Chap 1. Add energy conservation section 5.3 (c) which is sort of a loss model thing and appears in Haus.

7/30 [192] Did lots of doc reviewing. Proof App K. Proof D.9,10,11. Getting ready for a release again. Header checks, TOC check, proof overview stuff. Proof some of Ch 1 and Ch 2, new stuff only. Pagination of the whole doc.

AUGUST 2014

8/1 [194] Update Visio index. Update Maple index. Make PDF and check bookmarks. No blank pages. It is 500 pages at this point, down from 505 somehow. Proof overview stuff. Scan R and P. Examine typesetting in general. Decide sums in App D are OK as is, even though a bit large. **Release**!

8/2 [194] Wrote up this little history.

8/20 [198] **But** I started soon started *worrying* again about the $\omega \rightarrow 0$ J_z anomaly and wrote a whole new set of docs which is now in the "Low-Freq Aug-Sept" folder, where I stayed away from the main edit log for a while. I did the third whiteboard picture, and found that B fields were infinite as $\omega \rightarrow 0$, another major failure in the $\omega \rightarrow 0$ limit. Now I know it is not just some "math error" somewhere. This was related to my curl E problem, so called. Also, I know the problem is not related to my Ch 4 averaging. Debye reconsidered. This forced me to look very hard at every possible source the $\omega = 0$ problems.

SEPT 2014

9/3 [200] Had to **rewrite App Q** to allow for RLCG to vary with ω! Had to get rid of my ω_c loss model and **rewrite App M**.

9/20 [202], Decided to face the ω=0 problem directly and wrote new **Chapter 7**. Got cleaner expressions for the App D B fields and now have E and B in various clean forms. Cleanup in D.11. Cleanups involving forms for N_0.

9/23 [215] Moved 4.11 to be 4.12 and created new 4.11 about $G = C(\sigma_d/\varepsilon_d)$ because this was all mixed into the other TL equations logic. While redoing the new 4.12, decided to write **App S** showing full details of the "averaging process" and managed to recover $K_L = K$ there. More D.11 work and 6.5 work. Add Line Strength section near 1.6. Rewrote small things. Now at 574 pages.

OCT 2014

10/6 [222] More work in 6.5, cleanup in new Ch 7. Did a review of docs. Updated Maple and Visio indices.

10/9 [225] . Started a very long 11 day proofing pass of lines doc! Did this in linear order, and repaginated after proofing each section. More bugs fixed, added reflection picture back into waveguide App F. This was a very thorough review, found lots of bad x ref eq links and such things. Always editing.

10/19 [241] Final checks and did a release!