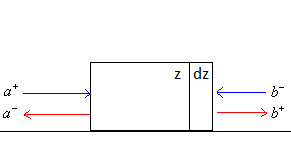
**Mello Summary**

The first attempt to generalize the DMPK equation was undertaken by Mello, et. all in 1992. Again we consider a transfer matrix of length z, and, going straight to the continuum limit, what happens when we add a slice of length dz.



Making reference to that Appendix, we have the evolution with length of any statistic F(**M**) to be given by the following PDE:



where **M**(z) is the transfer matrix of the length z, **Mʹ** is the transfer matrix of the slice dz, and d**M**(z) is the transfer matrix accrued to **M**(z) by the addition of the slice, i.e. d**M**(z) = **M**ʹ·**M** – **M**. At this starting point, **M** is a completely general matrix, and no constraints such as current conservation have been imposed. This would seem disconcerting, then, as the evolution equations may seem to allow for unphysical behavior. However, one could suppose that if both the specified initial condition **M**(0) and matrix model **M**ʹ that serves as the driving evolutionary ‘force’ are consistent with symmetry conditions, then **M**(z) will be as well. Furthermore, the probability distribution P(**M**) will depend on **M** solely through the reduced set of variables θk(**M**) = gk(**M**) which automatically satisfy the constraints. As such, we may say that the probability distribution P(**M**) will be related to the probability distribution P(**θ**) via:



This gives us two different possible ways to determine P(**θ**), if desired. One is to apply the ‘**M**-space’ evolution operator, H**M**, to this expression, use the delta function to transfer derivatives to the **θ** variable, and thereby construct the analogous ‘**θ**-space’ operator, H**θ**. With H**θ** in hand, one may attempt to solve for P(**θ**). Another possibility is to solve the equation in ‘**M**-space’, and then construct P(**θ**) using the above equation. Either way, to proceed we have to specify Pdz(**M**ʹ), with a particular aim to go beyond the isosotropy assumption implicit in the maximum entropy analysis. To gain some insight, we consider a particular representation of any transfer matrix **M**ʹ:



where θ, η are anti-Hermitian, symmetric respectively. Their model makes θ and η effectively independent Brownian complex variables in the small dL limit, with the following postulated correlations:



So then out to O(dz), we have:



which, due to the expectations given above, effectively reduces to:



The parameters σab, σʹab allow for current anisotropy. And is either modeled as:



There are ancillary results associated with the vaguely defined σ terms: namely Σbσab = Σbσʹab = 1/ℓa, and where ℓa is the mean free path of channel a. And Σaσa = Σaσʹa = N/ℓ, where N is the total number of channels, and ℓ is the system mean free path. From this, using the machinary of Appendix B, the general evolution equation follows. The evolution operator H is given by:



where **M**mn refers to the subblocks:



and the s/sʹ index refers to the real/imaginary parts of the matrix element, or alternatively the complex/conjugate parts of the matrix element. These are interchangeable because the **M**ʹ statistical model is real. As discussed in the Appendix, one can now write down the Fokker-Plank equation for the probability distribution of the matrix elements Pz(**M**), but solving this equation would be intractable. However the advantage of writing the evolution equation in terms of the individual matrix elements is that the Fokker-Plank equation is closed, and while there seems to be little hope of solving it itself, we can use it to work out the exact evolution of certain quantity averages. To wit, it turns out the evolution equations for <tij>, <rij> are self-consistent and can be solved. <tij> is exponentially damped at the rate of ℓab while <rij> is identically zero [does this show any signature of a transition?]. In contrast, the isotropy model predicts both <tij> and <rij> to be identically zero at all lengths. More revealing are the equations for the evolution of <tijt\*iʹjʹ> and <rijr\*iʹjʹ> since from these, the transmission and reflection coefficients, T and R, can be deduced. Unfortunately, the equations for these turn out to depend on higher powers of t and r. And the evolution equations for the higher powers of t and r turn out to depend on even higher powers, generating an infinite regress of equations. But while <T> cannot be calculated exactly, it turns out <Trλ> = <ΣT/(1-T)> can be. Defining y = uλu† = M12M12†, and calculating the evolution of the quantities <yaa>, one finds a set of self-consistent equations which can be solved to reveal straightforward exponential growth at a rate(s) given by the 1/(eigenvalues of σab). Unfortunately <Trλ> reveals nothing concerning the phase transition since it is dominated by the largest λn’s, while only the smallest λn’s have a meaninful impact on the conductance. Additionally, the index dependence of the eigenvector |uaN|2 can be extracted from the solution to yNN, and in the product σab model reveals signficant anisotropric behavior:



For all the progress on this front, it is unclear whether the model is capable of straddling the transition.

Ideally, we’d like to use the model to work out a self-consistent equation for the evolution of the N eigenvalues λ. But there seems to be no way to directly connect **M** to the matrix **λ** without invoking one or both of u and υ. But interestingly, one can relate **M** to a different set of quantities, N generalized traces of λ, designated ρk, defined below:



[note that only the first N traces are independent; any higher order traces ρk>N can be related back to some combination of the traces ρk<N]. According to the Appendix, we will be able to write a self-consistent Fokker-Plank equation for the probability distribution of these traces if both H[ρk] and H2[ρk] map back onto some function of these traces themselves. Unfortunately, it appears this happens only under the equivalent channel model of σab. But in this case, we have:



[where the ξ = (N+1)ℓ/2 is the localization length] And it is shown that the DMPK equation is equivalent to this same equation, thus putting the DMPK equation on a more substantial footing. It is worth considering whether there exists some other set of λ-related quanties for which a self-consistent equation can be written.