**Random Matrix Ensembles**

So going to explore the different random matrix ensembles out there, having in mind specifically electron transport. So the Hamiltonian which governs the behavior of the electrons in a metal will have different symmetries, depending on the presence (or not) of magnetic fields, magnetic impurities, spin-interactions, etc. Thus in each instance, the Hamiltonian will possess certain symmetries. And the eigenvectors of the Hamiltonian will posses certain commensurate symmetries. Looks like the ensemble of Hamiltonians is named after the properties of its corresponding ensemble of eigenvectors.

**Orthogonal Ensemble (β = 1)**

This corresponds to the presence of Time Reversal Symmetry as well as Spin Rotation Symmetry – I suppose the latter occurs when [S,H] = 0 and spin is a conserved quantity, or spectator, basically. In this case the eigenvectors of H are real and so U would be an orthogonal matrix. We can formally demonstrate this. Let Θ = UK be the time-reversal operator, where U is (any) unitary matrix, and K is the complex conjugation operator. Then we have:



Now apply Θ()Θ-1 again,



Evidently he takes this as evidence that:



Perhaps we can conclude this, as opposed to that Θ = ±1 because ΘHΘ-1 = H, because UU\* does lie entirely within the HS, unlike Θ? Well, if we take +1, then that means



So the **eigenvectors** form an **orthogonal symmetric** matrix. Furthermore, **H** will be **symmetric** since:

