**Boltzman Equation Viscosity**

So recall the general 2PI Boltzman equation solution process. Our goal overall is to calculate the steady-state distribution function f = fleq + δf, which obeys our two-particle Boltzman equation:



And recall from previous work that we proposed a solution:



Plugging this into the equation, and defining the operator, L, as:



which can be simplified somewhat to:



We can write our equation for χ as:



where the inhomogeneity Y is:



One approach to solving this equation was to use a variational approach. Χ = Φ would be the guy which minimizes the expection of the functional M, defined below:



**Viscosity Example**

Let’s specialize to a really simple case where there are no external fields or temperature gradients. Just velocity gradients. And we’ll presume no time-dependence – so we’re looking for the steady state. We’ll also presume no gas dilation, so there should be no density fluctuations, and so no chemical potential gradient. Then our equation is:



where (μ is chosen to normalize our f to 1),



and,



(going to Einstein summation notation in the last line, and remember **u** depends on **r**) We might presume a solution to be of the form found under the RTA.



But without the temperature gradient guy, and without the density dilation term ∇·u = ∂ui/∂ri because we left out the chemical potential guy in Y (I’m not really sure how what to do with the chemical potential guy anyway, if we decided to include gas dilation so this choice is convenient…). So we would go to:



which translates to, vis a vis our χ:



But which we’ll just say:



as we did in 1PI file, but this time hoping that τ is just a constant independent of everything. Then we would choose τ based on the variational condition:



So M is:



I have no desire to do these integrals. The last one is pretty easy. But the first…so let’s just say,



Then,



whose minimum is clearly at:



Okay well,



where we went to Einstein summation notation. Can refer to path integral thing to work out these integrals,



where we cancel out ∇·**u** because we presumed it was zero. As for the first guy, recall,



and so,



Pretty ugly. Now, change variables by adding m**u** to **k** and **k**1. So,



A little less ugly. Now it’d be nice if θ0(**k**1-**k**) were zero, which will be the case if align the z axis which defines our solid angle Ω with **k**1 – **k** direction. Then we’ll have:



and recall,



I guess I should change variables by adding **k**1 to **k** as well,



Ok yeah stopping now…