

Abstract Submitted  
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**Vorticity equation for gyrokinetic formulations**<sup>1</sup> FELIX I. PARRA,  
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Traditionally, a gyrokinetic quasineutrality equation has been employed to calculate  
the electric field in delta-f gyrokinetic codes. The usual gyrokinetic quasineutrality  
is written to first order in an expansion in the ion Larmor radius over the tokamak  
minor radius, and it provides the correct result for short wavelengths, on the order  
of the ion Larmor radius. However, in tokamaks, this lowest order equation fails  
to give a self-consistent radial electric field for long wavelengths. To calculate the  
radial electric field, we need the toroidal rotation and hence we must keep the ra-  
dial transport of toroidal angular momentum. This effect is missing in traditional  
gyrokinetics. By studying the time derivative of quasineutrality, known as the vor-  
ticity equation, we make explicit the effect of momentum transport and we prove  
that gyrokinetics has to be solved to higher order if the radial electric field is to be  
calculated from quasineutrality. As an alternative approach, we propose to employ a  
vorticity equation where only the terms that transport toroidal angular momentum  
must be calculated to higher order.

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