Neoclassical Physics

Let

$$\vec{B} = I(\psi)\,\vec{\nabla}\zeta + \vec{\nabla}\zeta \times \vec{\nabla}\psi. \tag{1}$$

where $\vec{b} = \vec{B}/B$. Expect $n_a = n_a(\psi)$, $p_a = p_a(\psi)$, and $T_a = T_a(\psi)$.

Let

$$\vec{u}_0^{\,a} = \vec{V}_a, \tag{2}$$

$$\vec{u}_1^{\,a} = -\frac{2}{5}\,\frac{\vec{q}_a}{p_a}, \tag{3}$$

and

$$u_{\theta\,j}^{a} = \frac{\vec{u}_j^{\,a}\cdot\vec{\nabla}\theta}{\vec{B}\cdot\vec{\nabla}\theta}. \tag{4}$$

Let

$$(u_\theta^a) = \begin{pmatrix} \langle u_{\theta\,0}^a\, B^2\rangle \\ \langle u_{\theta\,1}^a\, B^2\rangle \end{pmatrix}, \tag{5}$$

$$(V_*^{\,a}) = \begin{pmatrix} V_{*\,0}^{\,a} \\ V_{*\,1}^{\,a} \end{pmatrix}, \tag{6}$$

where

$$V_{*\,0}^{\,a}(\psi) = -\frac{I\,T_a}{e_a}\,\frac{d\ln p_a}{d\psi}, \tag{7}$$

$$V_{*\,1}^{\,a}(\psi) = \frac{I\,T_a}{e_a}\,\frac{d\ln T_a}{d\psi}. \tag{8}$$

Let

$$(u_\theta^i) = -[L^{\,ii}]\,(V_*^{\,i}) - [L^{\,iI}]\,(V_*^{\,I}). \tag{9}$$

Require elements of $[L^{\,ii}](\psi)$ and $[L^{iI}](\psi)$ matrices. Here, i denotes the majority ion species, whereas I denotes the impurity ion species.