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1.

F is any flux label $\rightarrow F(r)$

$$dF = \frac{\partial F}{\partial r} dr = |\nabla F| dr \rightarrow dr = \frac{dF}{|\nabla F|} \tag{1-1}$$

$$\begin{aligned} \langle A \rangle &= \frac{1}{V'} \oint \sqrt{g}\, d\theta d\zeta A(\boldsymbol{x}) \\ &= \frac{1}{V'} \oint \sqrt{g} |\nabla r| d\theta d\zeta \frac{A}{|\nabla r|} \\ &= \frac{1}{V'} \oint dS \frac{A}{|\nabla r|} \end{aligned} \tag{1-2}$$

If we can set r as V similar with Hamada Coordinate,

$$\langle A \rangle = \oint dS \frac{A}{|\nabla V|} \tag{1-3}$$

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2.

By definition, flux surface average can be described as

$$\begin{aligned} \langle \nabla\chi \cdot \nabla\theta \times \nabla\zeta \rangle &= \frac{1}{V'} \int \sqrt{g}\, d\theta d\zeta \nabla\chi \cdot \nabla\theta \times \nabla\zeta \\ &= \frac{\chi'}{V'} \int \sqrt{g} \frac{1}{\sqrt{g}} d\theta d\zeta = \frac{d\chi}{dV} (2\pi)^2 \end{aligned} \tag{2-1}$$

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