Newly Defined Helicity

- Following the definition of the classical relative magnetic helicity.

- The field $\mathbf{B}_c$ can be further separated as $\mathbf{B}_{p1} + \mathbf{B}_{c1}$

  ,where $(\mathbf{B}_{\mathrm{p1}} - \mathbf{B}_{\mathrm{c}}) \cdot \hat{\mathbf{n}}|_{\partial\Omega} = 0$, and $\mathbf{B}_{c1} = \mathbf{B}_c - \mathbf{B}_{p1}$

Feature of the Newly Defined Helicity

- We can define a relative helicity for the field $\mathbf{B}_\mathrm{c}$ as

$$H_\mathrm{cr} = \int_\Omega (\mathbf{A}_\mathrm{c} + \mathbf{A}_\mathrm{p1}) \cdot (\mathbf{B}_\mathrm{c} - \mathbf{B}_\mathrm{p1}) \mathrm{d}^3\vec{x}$$

- From the field decomposition $\begin{aligned}\mathbf{B} &= \mathbf{B}_\mathrm{p} + \mathbf{B}_\mathrm{j} \\ &= \mathbf{B}_0 + \mathbf{B}_\mathrm{c} \\ &= \mathbf{B}_0 + \mathbf{B}_\mathrm{p1} + \mathbf{B}_\mathrm{c1}\end{aligned}$

- Clearly, $\mathbf{B}_\mathrm{p} = \mathbf{B}_0 + \mathbf{B}_\mathrm{p1}$ and $\mathbf{B}_\mathrm{j} = \mathbf{B}_\mathrm{c1}$, in most case, $\mathbf{B}_\mathrm{p1}$ is very small.