sc00aa

The covariant components of the tangential magnetic field are related to the singular currents at the interfaces.

[called by: xspech.]   [calls: coords.]

contents

1.1 covariant representation

1. The components of the vector potential, $\mathbf{A} = A_\theta \nabla + A_\zeta \nabla \zeta$, are

$$A_\theta(s,\theta,\zeta) = \sum_{i,l} A_{\theta,e,i,l}\, \overline{T}_{l,i}(s) \cos\alpha_i + \sum_{i,l} A_{\theta,o,i,l}\, \overline{T}_{l,i}(s) \sin\alpha_i, \tag{1}$$

$$A_\zeta(s,\theta,\zeta) = \sum_{i,l} A_{\zeta,e,i,l}\, \overline{T}_{l,i}(s) \cos\alpha_i + \sum_{i,l} A_{\zeta,o,i,l}\, \overline{T}_{l,i}(s) \sin\alpha_i, \tag{2}$$

where $\overline{T}_{l,i}(s) \equiv \bar{s}^{m_i/2}\, T_l(s)$, $T_l(s)$ is the Chebyshev polynomial, and $\alpha_j \equiv m_j\theta - n_j\zeta$. The regularity factor, $\bar{s}^{m_i/2}$, where $\bar{s} \equiv (1+s)/2$, is only included if there is a coordinate singularity in the domain (i.e. only in the innermost volume, and only in cylindrical and toroidal geometry.)

2. The magnetic field, $\sqrt{g}\,\mathbf{B} = \sqrt{g}B^s\mathbf{e}_s + \sqrt{g}B^\theta\mathbf{e}_\theta + \sqrt{g}B^\zeta\mathbf{e}_\zeta$, is

$$
\begin{aligned}
\sqrt{g}\,\mathbf{B} = \quad &\mathbf{e}_s \quad \sum_{i,l}[(\quad -m_i A_{\zeta,e,i,l} \quad - \quad n_i A_{\theta,e,i,l} \quad)\overline{T}_{l,i}\sin\alpha_i + (\quad +m_i A_{\zeta,o,i,l} \quad + \quad n_i A_{\theta,o,i,l} \quad)\overline{T}_{l,i}\cos\alpha_i] \\
+ \quad &\mathbf{e}_\theta \quad \sum_{i,l}[(\quad\quad\quad\quad\quad\quad\quad - \quad A_{\zeta,e,i,l} \quad)\overline{T}'_{l,i}\cos\alpha_i + (\quad\quad\quad\quad\quad\quad - \quad A_{\zeta,o,i,l} \quad)\overline{T}'_{l,i}\sin\alpha_i] \\
+ \quad &\mathbf{e}_\zeta \quad \sum_{i,l}[(\quad A_{\theta,e,i,l} \quad\quad\quad\quad)\overline{T}'_{l,i}\cos\alpha_i + (\quad A_{\theta,o,i,l} \quad\quad\quad\quad)\overline{T}'_{l,i}\sin\alpha_i]
\end{aligned}
\tag{3}
$$

3. The covariant representation for the field is $\mathbf{B} = B_s\nabla s + B_\theta\nabla\theta + B_\zeta\nabla\zeta$, where

$$
\begin{aligned}
B_s &= B^s g_{ss} + B^\theta g_{s\theta} + B^\zeta g_{s\zeta} \\
B_\theta &= B^s g_{s\theta} + B^\theta g_{\theta\theta} + B^\zeta g_{\theta\zeta} \\
B_\zeta &= B^s g_{s\zeta} + B^\theta g_{\theta\zeta} + B^\zeta g_{\zeta\zeta}
\end{aligned}
$$

where $g_{\alpha\beta}$ are the metric elements (computed by coords).

4. On the interfaces, $B^s = 0$ by construction.

1.2 output data

1. The Fourier harmonics of the even-and-odd, covariant components of the magnetic field, B_s, B_θ and B_ζ, are saved in

    `Btemn(1:mn,0:1,1:Mvol),`

    `Bzemn(1:mn,0:1,1:Mvol),`

    `Btomn(1:mn,0:1,1:Mvol),`

    `Bzomn(1:mn,0:1,1:Mvol);`

and these are written to `ext.sp.h5` by hdfint.