

$${}^x\widehat{\underline{\pi}_g \gamma} = {}^x\widehat{\delta_g}^{1/2} \widehat{g}(x) \gamma; \quad \widehat{\underline{\pi}_g \gamma} = \widehat{\delta_g}^{1/2} \underbrace{\widehat{\underline{\varrho}_g} \gamma}_{\widehat{\underline{\varrho}}_g}$$

$$\widehat{\underline{\pi}_\gamma} \gamma = \frac{1}{2} \widehat{\underline{\delta}_\gamma} \gamma + \widehat{\underline{\varrho}_\gamma} \gamma$$

$$\widehat{\underline{\pi}_w} \gamma = 2 \partial_{w \dot{u} x} \gamma + \underline{w \star u + u \star w} \left( 1 + \frac{\alpha - p}{2} + \alpha \partial_x \right) \gamma + \frac{1 + \alpha}{2} \underline{w \star x + x \star w} \frac{\underline{\varrho}}{\varrho} \gamma$$

$$\begin{aligned} \widehat{\underline{\pi}_w} \gamma &= \frac{1}{2} \widehat{\underline{\delta}_w} \gamma + \widehat{\underline{\varrho}_w} \gamma = \underbrace{1 + \frac{\alpha - p}{2} + t \frac{1 + \alpha}{2} \underline{\varrho} / t \varrho}_{\underline{w \dot{u} x}} \underline{w \star u + u \star w} \gamma + \overbrace{2 \partial_{w \dot{u} x} + \alpha \underline{w \star u + u \star w} \partial_x}^{\underline{\varrho}} \gamma \\ &= 2 \partial_{w \dot{u} x} \gamma + \underline{w \star u + u \star w} \left( 1 + \frac{\alpha - p}{2} + t \frac{1 + \alpha}{2} \underline{\varrho} / t \varrho + \alpha \partial_x \right) \gamma = \text{ RHS} \end{aligned}$$

$$\begin{aligned} \phi \star \widehat{\underline{\pi}_w \psi} &= 2 \phi \star \widehat{\partial_{w \dot{u} x} \psi} + \phi \star \overbrace{\underline{w \star u} \left( 1 + \frac{\alpha - p}{2} + \alpha \partial_x \right) \psi}^{\widehat{\underline{\varrho}} \psi} + \frac{1 + \alpha}{2} \phi \star \overbrace{\underline{w \star x} \frac{\underline{\varrho}}{\varrho} \psi}^{\widehat{\underline{\varrho}} \psi} \\ &\quad + \overbrace{\underline{w \star u} \phi \star \overbrace{1 + \frac{\alpha - p}{2} + \alpha \partial_x}^{\widehat{\underline{\varrho}}} \psi}^{\widehat{\underline{\varrho}} \psi} + \frac{1 + \alpha}{2} \overbrace{\underline{w \star x} \frac{\underline{\varrho}}{\varrho} \phi \star \psi}^{\widehat{\underline{\varrho}} \psi} \end{aligned}$$

$$\text{LHS} = 2 \phi \star \widehat{\partial_{w \dot{u} x} \psi} + \phi \star \overbrace{\underline{w \star u + u \star w} \left( 1 + \frac{\alpha - p}{2} + \alpha \partial_x \right) \psi}^{\widehat{\underline{\varrho}} \psi} + \frac{1 + \alpha}{2} \phi \star \overbrace{\underline{w \star x + x \star w} \frac{\underline{\varrho}}{\varrho} \psi}^{\widehat{\underline{\varrho}} \psi} = \text{ RHS}$$

$$2\phi \overline{\partial}_{w\ddot{u}x} \widehat{\psi} + \phi \overline{\star} \overbrace{w \star u \left( 2 + \alpha - p + t(1+\alpha)^t \underline{\varrho}/^t \varrho \right) \psi} + \alpha \phi \overline{\star} \overbrace{w \star u \partial_x \psi} + \alpha \widehat{\partial_x \phi} \overline{\star} \overbrace{w \star u \psi} = 0$$

$$\begin{aligned} 0 &= \phi \overline{\star} \overbrace{\underline{\pi}_w \psi} + \overbrace{\underline{\pi}_w \phi \overline{\star} \psi} = \phi \overline{\star} 2\partial_{w\ddot{u}x} \psi + \overbrace{w \star u + u \star w \left( 1 + \frac{\alpha - p}{2} + t \frac{1 + \alpha}{2} {}^t \underline{\varrho}/^t \varrho + \alpha \partial_x \right) \psi} \\ &\quad + \overbrace{2\partial_{w\ddot{u}x} \phi + w \star u + u \star w \left( 1 + \frac{\alpha - p}{2} + t \frac{1 + \alpha}{2} {}^t \underline{\varrho}/^t \varrho + \alpha \partial_x \right) \phi \overline{\star} \psi} \\ 0 &= 2\phi \overline{\star} \overbrace{\partial_{w\ddot{u}x} \widehat{\psi}} + \phi \overline{\star} \overbrace{w \star u \left( 1 + \frac{\alpha - p}{2} + t \frac{1 + \alpha}{2} {}^t \underline{\varrho}/^t \varrho + \alpha \partial_x \right) \psi} \\ &\quad + \overbrace{u \star w \left( 1 + \frac{\alpha - p}{2} + t \frac{1 + \alpha}{2} {}^t \underline{\varrho}/^t \varrho + \alpha \partial_x \right) \phi \overline{\star} \psi} = \text{LHS} \end{aligned}$$

$$\partial_{w\ddot{u}x} \varphi + w \star u \left( 1 - \frac{p}{2} + \alpha \partial_x \right) \varphi + \frac{1 + \alpha}{2} w \star x \left( {}^t \underline{\varrho}/^t \varrho \right) \varphi \in \mathcal{H}^\perp$$

$$2\partial_{w\ddot{u}x} \mathcal{E}_b^{m+} + w \star u \left( 2 - p + 2\alpha(m+1) + t(1+\alpha)^t \underline{\varrho}/^t \varrho \right) \mathcal{E}_b^{m+} \in \mathcal{H}^\perp$$

$$\begin{aligned} 0 &= 2\mathcal{E}_a^m \overline{\star} \overbrace{\partial_{w\ddot{u}x} \mathcal{E}_b^{m+}} + \mathcal{E}_a^m \overline{\star} \overbrace{w \star u \left( 2 + \alpha - p + t(1+\alpha)^t \underline{\varrho}/^t \varrho \right) \mathcal{E}_b^{m+}} \\ &\quad + \alpha \mathcal{E}_a^m \overline{\star} \overbrace{w \star u \partial_x \mathcal{E}_b^{m+}} + \alpha \widehat{\partial_x \mathcal{E}_a^m} \overline{\star} \overbrace{w \star u \mathcal{E}_b^{m+}} \\ &= 2\mathcal{E}_a^m \overline{\star} \overbrace{\partial_{w\ddot{u}x} \mathcal{E}_b^{m+}} + \mathcal{E}_a^m \overline{\star} \overbrace{w \star u \left( 2 + \alpha - p + t(1+\alpha)^t \underline{\varrho}/^t \varrho \right) \mathcal{E}_b^{m+}} + \alpha(2m+1) \mathcal{E}_a^m \overline{\star} \overbrace{w \star u \mathcal{E}_b^{m+}} \\ &\quad c_{m+} \varrho_{2m+1} {}^a \mathcal{E}_b^m w \star b (2m+p+2+\alpha-p+\alpha(2m+1)-(1+\alpha)(2m+2)) = 0 \end{aligned}$$

$$\begin{aligned} \underline{\pi}_w \mathcal{E}_b^{m+} &= 2\partial_{w\ddot{u}x} \mathcal{E}_b^{m+} + w \star u + u \star w \left( 1 + \frac{\alpha - p}{2} + t \frac{1 + \alpha}{2} {}^t \underline{\varrho}/^t \varrho + \alpha \partial_x \right) \mathcal{E}_b^{m+} \\ &= 2\partial_{w\ddot{u}x} \mathcal{E}_b^{m+} + w \star u + u \star w \left( 1 + \frac{\alpha - p}{2} + t \frac{1 + \alpha}{2} {}^t \underline{\varrho}/^t \varrho \right) \mathcal{E}_b^{m+} + \alpha(m+1) w \star u + u \star w \mathcal{E}_b^{m+} \\ &= 2\partial_{w\ddot{u}x} \mathcal{E}_b^{m+} + w \star u + u \star w \left( 1 + \frac{\alpha - p}{2} + \alpha(m+1) + t \frac{1 + \alpha}{2} {}^t \underline{\varrho}/^t \varrho \right) \mathcal{E}_b^{m+} \\ &\quad 2w \dot{u} x + \alpha w \star u x = \overbrace{\widehat{e_i} \star u} 2w \dot{e_i} x + \underbrace{\alpha w \star e_i x}_{\text{underbrace}} \end{aligned}$$

$$-\pi'_w \mathcal{E}_b^n = \underbrace{\beta_t + \alpha n}_{\text{underbrace}} \underline{w} \star u + u \star \underline{w} \mathcal{E}_b^n + 2 \underline{w} \hat{u} x \mathcal{E}_b^n$$

$$x \mathcal{E}_b^n = \underline{x} \star b \mathcal{E}_b^{n-} = n \mathcal{E}_b^n$$

$$\underbrace{2\beta_t + \alpha(2m+1)}_{\text{underbrace}} \underline{w} \star u \mathcal{E}_b^{m+} + 2 \underline{w} \hat{u} x \mathcal{E}_b^{m+} \in \mathcal{H}^\perp$$

$$\begin{aligned} & \mathcal{E}_a^m \star \overbrace{\beta_t + \alpha n}^{\text{underbrace}} \underline{w} \star u + u \star \underline{w} \mathcal{E}_b^n + 2 \underline{w} \hat{u} x \mathcal{E}_b^n + \overbrace{\beta_t + \alpha m}^{\text{underbrace}} \underline{w} \star u + u \star \underline{w} \mathcal{E}_a^m + 2 \underline{w} \hat{u} x \mathcal{E}_a^m \star \mathcal{E}_b^n \\ &= - \mathcal{E}_a^m \star \underline{\pi'_w \mathcal{E}_b^n} - \underline{\pi'_w \mathcal{E}_a^m} \star \mathcal{E}_b^n = 0 \end{aligned}$$

$$\begin{aligned} 0 &= \mathcal{E}_a^m \star \overbrace{\beta_t + \alpha(m+1)}^{\text{underbrace}} \underline{w} \star u \mathcal{E}_b^{m+} + 2 \underline{w} \hat{u} x \mathcal{E}_b^{m+} + \overbrace{\beta_t + \alpha m}^{\text{underbrace}} \underline{u} \star \underline{w} \mathcal{E}_a^m \star \mathcal{E}_b^{m+} \\ &= \underbrace{2\beta_t + \alpha(2m+1)}_{\text{underbrace}} \mathcal{E}_a^m \star \overbrace{\underline{w} \star u \mathcal{E}_b^{m+}}^{\text{underbrace}} + 2 \mathcal{E}_a^m \star \overbrace{\underline{w} \hat{u} x \mathcal{E}_b^{m+}}^{\text{underbrace}} \\ &= \mathcal{E}_a^m \star \overbrace{2\beta_t + \alpha(2m+1)}^{\text{underbrace}} \underline{w} \star u \mathcal{E}_b^{m+} + 2 \underline{w} \hat{u} x \mathcal{E}_b^{m+} \end{aligned}$$

$$\begin{aligned} & -\pi'_w \mathcal{E}_b^{m+} = \underbrace{\beta_t + \alpha(m+1)}_{\text{underbrace}} \underline{w} \star u + u \star \underline{w} \mathcal{E}_b^{m+} + 2 \underline{w} \hat{u} x \mathcal{E}_b^{m+} \\ &= \underbrace{2\beta_t + \alpha(2m+1)}_{\text{underbrace}} \underline{w} \star u \mathcal{E}_b^{m+} + 2 \underline{w} \hat{u} x \mathcal{E}_b^{m+} + \underbrace{\beta_t + \alpha m}_{\text{underbrace}} \underline{u} \star \underline{w} - \underline{w} \star \underline{u} \mathcal{E}_b^{m+} + \alpha \underline{u} \star \underline{w} \mathcal{E}_b^{m+} \end{aligned}$$

$$\frac{2}{p} \underbrace{e_i^* e_i x}_{\text{underbrace}} \mathfrak{I} = n \mathfrak{I} = E \mathfrak{I} \text{ Euler}$$

$$\underbrace{e_i^* e_i x}_{\text{underbrace}} \mathcal{E}_b^n = \overbrace{\underbrace{e_i^* e_i x}_{\text{underbrace}} \star b}^{\text{underbrace}} \mathcal{E}_b^{n-} = \frac{p}{2} x \star b \mathcal{E}_b^{n-} = n \frac{p}{2} \mathcal{E}_b^n$$

$$\pi'_w \varphi = \underbrace{\alpha_w + \bar{\alpha}_w}_{\text{underbrace}} \varphi + \gamma_w \underline{\varphi}$$

$$\begin{aligned} 0 &= \underline{\pi'_w \varphi} \star \psi + \varphi \star \underline{\pi'_w \psi} = \overbrace{\alpha_w + \bar{\alpha}_w}^{\text{underbrace}} \varphi + \gamma_w \underline{\varphi} \star \overbrace{\alpha_w + \bar{\alpha}_w \psi + \gamma_w \underline{\psi}}^{\text{underbrace}} = \varphi \star \overbrace{2\alpha_w \psi + \gamma_w \underline{\psi}}^{\text{underbrace}} + \overbrace{2\alpha_w \varphi + \gamma_w \underline{\varphi}}^{\text{underbrace}} \star \psi \\ &\Rightarrow \varphi \star \overbrace{2\alpha_w \psi + \gamma_w \underline{\psi}}^{\text{underbrace}} = 0 = \overbrace{2\alpha_w \varphi + \gamma_w \underline{\varphi}}^{\text{underbrace}} \star \psi \Rightarrow 2\alpha_w \varphi + \gamma_w \underline{\varphi} \in \mathcal{H}^\perp \end{aligned}$$

$$\pi'_w \mathfrak{I} = \underbrace{\alpha_w + \bar{\alpha}_w}_{\text{underbrace}} \mathfrak{I} + \gamma_w \underline{\mathfrak{I}} = \pi'_w \mathfrak{I} = \overbrace{2\alpha_w + \gamma_w \underline{\mathfrak{I}}}^{\text{underbrace}} + \underbrace{\bar{\alpha}_w - \alpha_w}_{\text{underbrace}} \mathfrak{I}$$

$$P(\pi'_w \gamma) = P\left(\underbrace{\bar{\alpha}_w - \alpha_w}_{\bar{\alpha}_w - \alpha_w} \gamma\right) = T_{\bar{\alpha}_w - \alpha_w} \gamma$$

$$0 = \underline{\pi'_w \mathcal{E}_a^m} \star \mathcal{E}_b^n + \mathcal{E}_a^m \star \underline{\pi'_w \mathcal{E}_b^n} = \overbrace{\underline{\alpha_w + \bar{\alpha}_w} \mathcal{E}_a^m + \hat{\gamma}_w \mathcal{E}_a^m} \star \mathcal{E}_b^n + \mathcal{E}_a^m \star \overbrace{\underline{\alpha_w + \bar{\alpha}_w} \mathcal{E}_b^n + \hat{\gamma}_w \mathcal{E}_b^n}$$

$$= \overbrace{\underline{\alpha_w + \bar{\alpha}_w} \mathcal{E}_a^m + \underline{w \dot{u} x} \mathcal{E}_a^m + \alpha m \underline{w \star u} + u \star \underline{w} \mathcal{E}_a^m} \star \mathcal{E}_b^n + \mathcal{E}_a^m \star \overbrace{\underline{\alpha_w + \bar{\alpha}_w} \mathcal{E}_b^n + \underline{w \dot{u} x} \mathcal{E}_b^n + \alpha n \underline{w \star u} + u \star \underline{w} \mathcal{E}_b^n}$$

$$0 = \overbrace{\bar{\alpha}_w \mathcal{E}_a^m + \alpha \underline{u \star w} m \mathcal{E}_a^m} \star \mathcal{E}_b^n + \mathcal{E}_a^m \star \overbrace{\underline{\alpha_w \mathcal{E}_b^n} + \underline{w \dot{u} x} \mathcal{E}_b^n + \alpha \underline{w \star u} n \mathcal{E}_b^n}$$

$$= \mathcal{E}_a^m \star \overbrace{\underline{2\alpha_w + \alpha(m+n)} \underline{w \star u} \mathcal{E}_b^n + \underline{w \dot{u} x} \mathcal{E}_b^n} = \mathcal{E}_a^m \star \overbrace{\underline{2\alpha_w + \alpha(2n-1)} \underline{w \star u} \mathcal{E}_b^n + \underline{w \dot{u} x} \mathcal{E}_b^n}$$

$$\underline{2\alpha_w + \alpha(2n-1)} \underline{w \star u} \mathcal{E}_b^n + \underline{w \dot{u} x} \mathcal{E}_b^n \in \mathcal{H}^\perp$$

$$\pi'_w \mathcal{E}_b^n = \underline{\alpha_w + \bar{\alpha}_w} \mathcal{E}_b^n + \underline{w \dot{u} x} \mathcal{E}_b^n + \alpha \underline{w \star u} + u \star \underline{w} n \mathcal{E}_b^n$$

$$= \underline{2\alpha_w + \alpha(2n-1)} \underline{w \star u} \mathcal{E}_b^n + \underline{w \dot{u} x} \mathcal{E}_b^n + \underline{\bar{\alpha}_w - \alpha_w + \alpha w \star u} + \alpha (u \star \underline{w} - \underline{w \star u}) n \mathcal{E}_b^n$$

$$P(\pi'_w \mathcal{E}_b^n) = P\left(\underline{\bar{\alpha}_w - \alpha_w + \alpha w \star u} \mathcal{E}_b^n + \alpha \underline{u \star w - w \star u} n \mathcal{E}_b^n\right)$$