$$\overbrace{{}^{z}{}^{\zeta}\mathcal{E}^{\mu}_{\partial}\mathfrak{e}_{a}} = {}^{\zeta}\mathcal{E}^{\mu}_{a}\,{}^{z}\mathfrak{e}_{a}$$

$$= \overbrace{{}^{0}\mathfrak{t}_{z} \ltimes {}^{\zeta}\mathcal{E}^{\mu}_{\partial}\mathfrak{e}_{a}} = \overbrace{{}^{\zeta}\mathcal{E}^{\mu}_{\partial}\underbrace{\mathfrak{t}_{z} \ltimes \mathfrak{e}_{a}}} = \overbrace{{}^{\zeta}\mathcal{E}^{\mu}_{\partial}\underbrace{\mathfrak{e}_{a}\mathfrak{e}^{z\barwedge a}}} = \underbrace{\overbrace{{}^{\zeta}\mathcal{E}^{\mu}_{\partial}\mathfrak{e}_{a}} = \left(\mathcal{E}^{\mu}_{\zeta}\barwedge\mathfrak{e}_{a}\right) = \left(\mathfrak{e}_{a}\bar{\barwedge}\mathcal{E}^{\mu}_{\zeta}\right) = {}^{a}\bar{\mathcal{E}}^{\mu}_{\zeta}} \,{}^{z}\mathfrak{e}_{a} =$$

$$\underbrace{\mathcal{E}^{\alpha}_{-z}\mathcal{E}^{\gamma}_{i}}\barwedge\underbrace{\mathcal{E}^{\beta}_{-z}\mathcal{E}^{\gamma}_{i}} = \frac{(d/r)_{\mu}}{(d/r)_{\alpha}}\,{}^{e}\mathcal{E}^{\gamma}_{e}\,{}^{z}\mathcal{E}^{\alpha}_{z} = \frac{(d/r)_{\mu}}{\gamma!(d/r)_{\alpha}}\,{}^{z}\mathcal{E}^{\alpha}_{z}$$

$$\text{LHS} = (d/r)_{\mu}\underbrace{\mathcal{E}^{\alpha}_{-z}\mathcal{E}^{\gamma}_{i}}\underset{S}{\barwedge}\underbrace{\mathcal{E}^{\beta}_{-z}\mathcal{E}^{\gamma}_{i}} = (d/r)_{\mu}\int_{ds}^{S}{}^{s}\bar{\mathcal{E}}^{\alpha}_{-z}\,{}^{s}\bar{\mathcal{E}}^{\gamma}_{i}\,{}^{s}\mathcal{E}^{\beta}_{-z}\,{}^{s}\mathcal{E}^{\gamma}_{i} = (d/r)_{\mu}\int_{ds}^{S}{}^{s}\bar{\mathcal{E}}^{\alpha}_{-z}\,{}^{s}\mathcal{E}^{\beta}_{-z}\underbrace{{}^{s}\bar{\mathcal{E}}^{\gamma}_{i}\,{}^{s}\mathcal{E}^{\gamma}_{i}}$$

$$= (d/r)_{\mu}\int_{ds}^{S}{}^{s}\bar{\mathcal{E}}^{\alpha}_{-z}\,{}^{s}\mathcal{E}^{\beta}_{-z}\underbrace{{}^{s}\mathcal{E}^{\gamma}_{s}}_{=1/\gamma!} = \frac{(d/r)_{\mu}}{\gamma!}\int_{ds}^{S}{}^{s}\bar{\mathcal{E}}^{\alpha}_{-z}\,{}^{s}\mathcal{E}^{\beta}_{-z} = \frac{(d/r)_{\mu}}{\gamma!}\mathcal{E}^{\alpha}_{-z}\underset{S}{\barwedge}\mathcal{E}^{\beta}_{-z} = \frac{(d/r)_{\mu}}{\gamma!(d/r)_{\alpha}}\mathcal{E}^{\alpha}_{-z}\barwedge\mathcal{E}^{\beta}_{-z} = \text{RHS}$$

$$\bigwedge_{g}^{G}\bigwedge_{z:w}^{D}\bigwedge_{\xi}^{\mathbb{C}}{}^{z}\underline{g}^{\xi/p}\,{}^{zg}\Delta^{-\xi}_{wg}\,{}^{w}\underline{\overset{*}{g}}^{\xi/p} = {}^{z}\Delta^{-\xi}_{w}$$

$${}^{x\mathfrak{g}_{z}}\Delta^{\lambda}_{y\mathfrak{g}_{z}} = {}^{x}\Delta^{-\lambda}_{-z}\,{}^{x}\Delta^{\lambda}_{y}\,{}^{z}\Delta^{\lambda}_{z}\,{}^{-z}\Delta^{-\lambda}_{y}$$

$${}^{x\mathfrak{g}_{z}}\mathfrak{g}^{\lambda}_{y\mathfrak{g}_{z}} = {}^{x}\mathfrak{g}^{-\lambda}_{-z}\,{}^{x}\mathfrak{g}^{\lambda}_{y}\,{}^{z}\Delta^{\lambda}_{z}\,{}^{-z}\mathfrak{g}^{-\lambda}_{y}$$

$$ {}^{z}\Delta_{z}^{-\lambda}\,{}^{z\mathfrak{g}_z\partial}\mathcal{E}_{\partial}^{\mu}\,{}^{z}\Delta_{z}^{\lambda}={}^{z}\Delta_{z}^{-\lambda}\,{}^{\partial}\mathcal{E}_{\partial}^{\mu}|^{x\mathfrak{g}_z}\Delta_{y\mathfrak{g}_z}^{\lambda}=\lambda_{\alpha}\,\lambda_{\beta}\,(\text{-}\lambda)_{\gamma}\frac{(d/r)_{\mu}}{\gamma!(d/r)_{\alpha}}\,{}^{z}\mathcal{E}_{z}^{\alpha}=\lambda_{\alpha}^{2}\,(\text{-}\lambda)_{\gamma}C\,(\mu{:}\gamma{:}\alpha)\,{}^{z}\mathcal{E}_{z}^{\alpha} $$

$$ {}^{-z}\Delta_{y}^{-\lambda}\,{}^{x}\Delta_{-z}^{-\lambda}\,{}^{x}\Delta_{y}^{\lambda}=\lambda_{\alpha}\,\lambda_{\beta}\,(\text{-}\lambda)_{\gamma}\,{}^{-z}\mathcal{E}_{y}^{\alpha}\,{}^{x}\mathcal{E}_{-z}^{\beta}\,{}^{x}\mathcal{E}_{y}^{\gamma}=\lambda_{\alpha}\,\lambda_{\beta}\,(\text{-}\lambda)_{\gamma}\,{}^{-z}\mathcal{E}_{y}^{\alpha}\,{}^{x}\mathcal{E}_{-z}^{\beta}\,{}^{x}\mathcal{E}_{i}^{\gamma}\,{}^{i}\mathcal{E}_{y}^{\gamma} $$

$$ {}^{\partial}\mathcal{E}_{\partial}^{\mu}={}^{\partial}\mathcal{E}_{\ell}^{\mu}\,{}^{\ell}\mathcal{E}_{\partial}^{\mu} $$

$$ {}^{\partial}\mathcal{E}_{\partial}^{\mu}|\,{}^{-z}\Delta_{y}^{-\lambda}\,{}^{x}\Delta_{-z}^{-\lambda}\,{}^{x}\Delta_{y}^{\lambda}=\lambda_{\alpha}\,\lambda_{\beta}\,(\text{-}\lambda)_{\gamma}\,{}^{\partial}\mathcal{E}_{\ell}^{\mu}\,{}^{\ell}\mathcal{E}_{\partial}^{\mu}|\,{}^{-z}\mathcal{E}_{y}^{\alpha}\,{}^{x}\mathcal{E}_{-z}^{\beta}\,{}^{x}\mathcal{E}_{i}^{\gamma}\,{}^{i}\mathcal{E}_{y}^{\gamma}=\lambda_{\alpha}\,\lambda_{\beta}\,(\text{-}\lambda)_{\gamma}\underbrace{{}^{\partial}\mathcal{E}_{\ell}^{\mu}|^{x}\mathcal{E}_{-z}^{\beta}\,{}^{x}\mathcal{E}_{i}^{\gamma}}\underbrace{{}^{\ell}\mathcal{E}_{\partial}^{\mu}|^{-z}\mathcal{E}_{y}^{\alpha i}\mathcal{E}_{y}^{\gamma}} $$

$$ =\lambda_{\alpha}\,\lambda_{\beta}\,(\text{-}\lambda)_{\gamma}\overbrace{\underbrace{\mathcal{E}_{-z}^{\alpha}\mathcal{E}_{i}^{\gamma}}\mathbin{\barwedge}\mathcal{E}_{\ell}^{\mu}}\overbrace{\mathcal{E}_{\ell}^{\mu}\barwedge\underbrace{\mathcal{E}_{-z}^{\beta}\mathcal{E}_{i}^{\gamma}}}=\lambda_{\alpha}\,\lambda_{\beta}\,(\text{-}\lambda)_{\gamma}\underbrace{\mathcal{E}_{-z}^{\alpha}\mathcal{E}_{i}^{\gamma}}\barwedge\underbrace{P^{\mu}\overbrace{\mathcal{E}_{-z}^{\beta}\mathcal{E}_{i}^{\gamma}}}=\lambda_{\alpha}\,\lambda_{\beta}\,(\text{-}\lambda)_{\gamma}\,\mathcal{E}_{-z}^{\alpha}\overset{\mu}{\underset{\gamma}{\barwedge}}\mathcal{E}_{-z}^{\beta} $$

$$ =\lambda_{\alpha}^{2}\,(\text{-}\lambda)_{\gamma}\,\mathcal{E}_{-z}^{\alpha}\overset{\mu}{\underset{\gamma}{\barwedge}}\mathcal{E}_{-z}^{\alpha}=\lambda_{\alpha}^{2}\,(\text{-}\lambda)_{\gamma}\,\mathcal{E}_{z}^{\alpha}\overset{\mu}{\underset{\gamma}{\barwedge}}\mathcal{E}_{z}^{\alpha} $$

$$ \mathfrak{y}\overset{\mu}{\underset{\gamma}{\barwedge}}\mathfrak{h}=\underbrace{\mathfrak{y}\mathcal{E}_{i}^{\gamma}}\barwedge\underbrace{P^{\mu}\overbrace{\mathfrak{h}\mathcal{E}_{i}^{\gamma}}} $$

$$ \underbrace{\mathcal{E}_{-z}^{\alpha}\mathcal{E}_{i}^{\gamma}}\barwedge\underbrace{P^{\mu}\overbrace{\mathcal{E}_{-z}^{\beta}\mathcal{E}_{i}^{\gamma}}}={}_{\alpha}\delta^{\beta}\,C\,(\mu{:}\gamma{:}\alpha)\,{}^{z}\mathcal{E}_{z}^{\alpha} $$

$$ \int_{dz}^{D}{}^{z}\Delta_{z}^{\lambda}\,\overbrace{{}^{z\mathfrak{g}_z\partial}K_{\partial}^{\ell\cdot\cdot\ell}|\bar{\mathfrak{y}}^{\mu}\mathfrak{y}^{\mu}}=\int_{dz}^{D}\overbrace{{}^{z\mathfrak{g}_z\partial}K_{\partial}^{\ell\cdot\cdot\ell}|^{z}\Delta_{z}^{\lambda}}\,{}^{z}\bar{\mathfrak{y}}^{\mu}\,{}^{z}\mathfrak{y}^{\mu}=\lambda_{\alpha}^{2}\,(\text{-}\lambda)_{\gamma}\int_{dz}^{D}{}^{z}\Delta_{z}^{\lambda}\,\mathcal{E}_{z}^{\alpha}\overset{\ell}{\underset{\gamma}{\barwedge}}\mathcal{E}_{z}^{\alpha}\,{}^{z}\bar{\mathfrak{y}}^{\mu}\,{}^{z}\mathfrak{y}^{\mu} $$

$$ \mathfrak{s}_{\lambda}\barwedge\mathfrak{s}_{\mu}\,\mathfrak{s}_{\nu}\neq 0\Longrightarrow\mu\subset\lambda\supset\nu $$

$$ \mu\in\ell\ \text{coWallach}\ \Leftrightarrow\ \mu_{r}\geqslant\ell\Leftrightarrow\mu\supset\ell\cdot\cdot\ell $$

$$ \mathfrak{s}_{\ell\cdots\ell}\barwedge\mathfrak{s}_{\alpha}\,\mathfrak{s}_{\gamma}\neq 0\Longrightarrow\alpha\leqslant\ell\geqslant\gamma $$

$$ \mathfrak{y}^{\mu}\overset{\ell}{\underset{\gamma}{\barwedge}}\mathfrak{y}^{\mu}=\underbrace{\mathfrak{y}^{\mu}\mathcal{E}_{i}^{\gamma}}\barwedge\underbrace{P^{\ell\cdots\ell}\overbrace{\mathfrak{y}^{\mu}\mathcal{E}_{i}^{\gamma}}}\neq 0\Longrightarrow\mu\leqslant\ell\geqslant\gamma $$

$$\text{rank} \implies {}^{z}\Delta_{z}^{-\lambda\ z\mathfrak{g}_{z}\partial}\mathcal{E}_{\partial}^{\mu\ z}\Delta_{z}^{\lambda} = d_{\ell}\sum_{0\leqslant\beta\leqslant\ell}\frac{(\text{-}\nu)_{\ell\text{-}\beta}\nu_{\beta}^{2}}{(\ell\text{-}\beta)!d_{\beta}}{}^{-z}\mathcal{E}_{-z}^{\beta}$$

$$\sum_{0\leqslant\beta\leqslant\ell}(\text{-}\nu)_{\ell\text{-}\beta}\nu_{\beta}^{2}\underbrace{\mathcal{E}_{j}^{\ell\text{-}\beta}\mathcal{E}_{-z}^{\beta}}\overset{\blacktriangledown}{S}\underbrace{\mathcal{E}_{j}^{\ell\text{-}\beta}\mathcal{E}_{-z}^{\beta}} = d_{\ell}\sum_{0\leqslant\beta\leqslant\ell}(\text{-}\nu)_{\ell\text{-}\beta}\nu_{\beta}^{2}\int_{ds}^{S}{}^{s}\bar{\mathcal{E}}_{j}^{\ell\text{-}\beta}{}^{-z}\mathcal{E}_{s}^{\beta}\,{}^{s}\bar{\mathcal{E}}_{j}^{\ell\text{-}\beta}\,{}^{s}\mathcal{E}_{-z}^{\beta}$$

$$= d_{\ell}\sum_{0\leqslant\beta\leqslant\ell}(\text{-}\nu)_{\ell\text{-}\beta}\nu_{\beta}^{2}\int_{ds}^{S}{}^{s}\bar{\mathcal{E}}_{s}^{\ell\text{-}\beta}{}^{-z}\mathcal{E}_{s}^{\beta}\,{}^{s}\mathcal{E}_{-z}^{\beta} = d_{\ell}\sum_{0\leqslant\beta\leqslant\ell}\frac{(\text{-}\nu)_{\ell\text{-}\beta}\nu_{\beta}^{2}}{(\ell\text{-}\beta)!}\int_{ds}^{S}{}^{-z}\mathcal{E}_{s}^{\beta}\,{}^{s}\mathcal{E}_{-z}^{\beta}$$

$$= d_{\ell}\sum_{0\leqslant\beta\leqslant\ell}\frac{(\text{-}\nu)_{\ell\text{-}\beta}\nu_{\beta}^{2}}{(\ell\text{-}\beta)!}\underbrace{\mathcal{E}_{-z}^{\beta}}\overset{\blacktriangledown}{S}\underbrace{\mathcal{E}_{-z}^{\beta}} = d_{\ell}\sum_{0\leqslant\beta\leqslant\ell}\frac{(\text{-}\nu)_{\ell\text{-}\beta}\nu_{\beta}^{2}}{(\ell\text{-}\beta)!d_{\beta}}\underbrace{\mathcal{E}_{-z}^{\beta}}\overset{\blacktriangledown}{S}\underbrace{\mathcal{E}_{-z}^{\beta}} = d_{\ell}\sum_{0\leqslant\beta\leqslant\ell}\frac{(\text{-}\nu)_{\ell\text{-}\beta}\nu_{\beta}^{2}}{(\ell\text{-}\beta)!d_{\beta}}{}^{-z}\mathcal{E}_{-z}^{\beta}$$

$$\int^{D}{}^{z}\Delta_{z}^{\lambda}\,{}^{z}\mathcal{E}_{z}^{\beta}\,{}^{z}\bar{\mathfrak{q}}^{\mu}\,{}^{z}\mathfrak{q}^{\mu} = \int^{D}{}^{z}\Delta_{z}^{\lambda}\,{}^{z}\bar{\mathcal{E}}_{i}^{\beta}\,{}^{z}\mathcal{E}_{i}^{\beta}\,{}^{z}\bar{\mathfrak{q}}^{\mu}\,{}^{z}\mathfrak{q}^{\mu} = \int^{D}{}^{z}\Delta_{z}^{\lambda}\,{}^{z}\bar{\mathcal{E}}_{i}^{\beta}\,{}^{z}\mathcal{E}_{i}^{\beta}\,{}^{z}\bar{\mathfrak{q}}^{\mu}\,{}^{z}\mathfrak{q}^{\mu} = \underbrace{\mathcal{E}_{i}^{\beta z}\mathcal{E}_{i}^{\beta z}\bar{\mathfrak{q}}^{\mu}\,{}^{z}\mathfrak{q}^{\mu}}\overset{\blacktriangledown}{\lambda}\underbrace{{}^{z}\bar{\mathcal{E}}_{i}^{\beta z}\mathcal{E}_{i}^{\beta z}\bar{\mathfrak{q}}^{\mu}\,{}^{z}\mathfrak{q}^{\mu}}$$