$$\begin{array}{ccc} \mathcal{H}_0 & \xleftarrow{\;[\gamma_w^{-1}\gamma_z]\;} & \mathcal{H}_0 \\ \Big\downarrow \hat{\gamma}_w & & \Big\downarrow \hat{\gamma}_z \\ \mathcal{H}_w & \xleftarrow[\;{}^{w}\mathcal{B}_z\;]{} & \mathcal{H}_z \end{array}$$

$$\overset{\circ}{\left(\begin{array}{c|c} 1 & z \\ \hline \overset{*}{z} & 1 \end{array}\right)} = \left(\begin{array}{c|c} \overset{\circ}{\overbrace{1-z\overset{*}{z}}} & -\overset{\circ}{\overbrace{1-z\overset{*}{z}}}\,z \\ \hline -\overset{\circ}{\overbrace{1-\overset{*}{z}z}}\,\overset{*}{z} & \overset{\circ}{\overbrace{1-\overset{*}{z}z}} \end{array}\right)$$

$$\gamma_z = \left(\begin{array}{c|c} 1 & z \\ \hline \overset{*}{z} & 1 \end{array}\right) \left(\begin{array}{c|c} \overset{\circ}{\sqrt{1-z\overset{*}{z}}} & 0 \\ \hline 0 & \overset{\circ}{\sqrt{1-\overset{*}{z}z}} \end{array}\right) = \left(\begin{array}{c|c} \overset{\circ}{\sqrt{1-z\overset{*}{z}}} & 0 \\ \hline 0 & \overset{\circ}{\sqrt{1-\overset{*}{z}z}} \end{array}\right) \left(\begin{array}{c|c} 1 & z \\ \hline \overset{*}{z} & 1 \end{array}\right)$$

$$\text{LHS} = \mathfrak{t}_z\,{}^{z}B_z^{1/2}\,\mathfrak{t}_z^{*} = \left(\begin{array}{c|c} 1 & z \\ \hline 0 & 1 \end{array}\right) \left(\begin{array}{c|c} \sqrt{1-z\overset{*}{z}} & 0 \\ \hline 0 & \overset{\circ}{\sqrt{1-\overset{*}{z}z}} \end{array}\right) \left(\begin{array}{c|c} 1 & 0 \\ \hline \overset{*}{z} & 1 \end{array}\right) = \left(\begin{array}{c|c} \overset{\circ}{\sqrt{1-z\overset{*}{z}}} & \overset{\circ}{\sqrt{1-z\overset{*}{z}}}\,z \\ \hline \overset{\circ}{\sqrt{1-\overset{*}{z}z}}\,\overset{*}{z} & \overset{\circ}{\sqrt{1-\overset{*}{z}z}} \end{array}\right) = \text{RHS}$$

$$\gamma_w^{-1}\gamma_z = \left(\begin{array}{c|c} \overset{\circ}{\sqrt{1-w\overset{*}{w}}}\,\underbrace{1-w\overset{*}{z}}\,\overset{\circ}{\sqrt{1-z\overset{*}{z}}} & \overset{\circ}{\sqrt{1-w\overset{*}{w}}}\,\underbrace{z-w}\,\overset{\circ}{\sqrt{1-\overset{*}{z}z}} \\ \hline \overset{\circ}{\sqrt{1-\overset{*}{w}w}}\,\underbrace{\overset{*}{z}-\overset{*}{w}}\,\overset{\circ}{\sqrt{1-z\overset{*}{z}}} & \overset{\circ}{\sqrt{1-\overset{*}{w}w}}\,\underbrace{1-\overset{*}{w}z}\,\overset{\circ}{\sqrt{1-\overset{*}{z}z}} \end{array}\right)$$

$$\text{LHS} = \gamma_{-w}\,\gamma_z = \left(\begin{array}{c|c} \overset{\circ}{\sqrt{1-w\overset{*}{w}}} & 0 \\ \hline 0 & \overset{\circ}{\sqrt{1-\overset{*}{w}w}} \end{array}\right) \left(\begin{array}{c|c} 1 & -w \\ \hline -\overset{*}{w} & 1 \end{array}\right) \left(\begin{array}{c|c} 1 & z \\ \hline \overset{*}{z} & 1 \end{array}\right) \left(\begin{array}{c|c} \overset{\circ}{\sqrt{1-z\overset{*}{z}}} & 0 \\ \hline 0 & \overset{\circ}{\sqrt{1-\overset{*}{z}z}} \end{array}\right)$$

$$= \left(\begin{array}{c|c} \overset{\circ}{\sqrt{1-w\overset{*}{w}}} & 0 \\ \hline 0 & \overset{\circ}{\sqrt{1-\overset{*}{w}w}} \end{array}\right) \left(\begin{array}{c|c} 1-w\overset{*}{z} & z-w \\ \hline \overset{*}{z}-\overset{*}{w} & 1-\overset{*}{w}z \end{array}\right) \left(\begin{array}{c|c} \overset{\circ}{\sqrt{1-z\overset{*}{z}}} & 0 \\ \hline 0 & \overset{\circ}{\sqrt{1-\overset{*}{z}z}} \end{array}\right) = \text{RHS}$$

$$[\gamma_w^{-1}\,\gamma_z] = \left[\begin{array}{c|c} \dfrac{\sqrt{1-z\overset{*}{z}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\underbrace{w-z}\,\overset{\circ}{\sqrt{1-\overset{*}{z}z}}}{\sqrt{1-w\overset{*}{w}}\,\overbrace{1-\overset{*}{z}w}^{\circ}\,\sqrt{1-\overset{*}{z}z}} & \dfrac{\sqrt{1-z\overset{*}{z}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\sqrt{1-w\overset{*}{w}}}{\overset{\circ}{\sqrt{1-\overset{*}{w}w}}\,\underbrace{\overset{*}{z}-\overset{*}{w}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\sqrt{1-w\overset{*}{w}}} \end{array}\right]$$

$$= \left[\begin{array}{c|c} \dfrac{{}^{z}B_z^{-\,1/2}\left(w-z+Q_{w\,-\,z}z^w\right)}{\sqrt{1-\overset{*}{w}w}\,\overbrace{1-\overset{*}{z}w}^{\circ}\,\sqrt{1-\overset{*}{z}z}} & \dfrac{\sqrt{1-z\overset{*}{z}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\sqrt{1-w\overset{*}{w}}}{{}^{\overset{*}{w}}B_{\overset{*}{w}}^{-\,1/2}\left(\overset{*}{z}-\overset{*}{w}+P_{\overset{*}{z}\,-\,\overset{*}{w}}w^z\right)} \end{array}\right]$$

$$a = \overset{\circ}{\sqrt{1-w\overset{*}{w}}}\,\underbrace{1-w\overset{*}{z}}\,\overset{\circ}{\sqrt{1-z\overset{*}{z}}}$$

$$\Longrightarrow\; a^{-1} = \sqrt{1-z\overset{*}{z}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\sqrt{1-w\overset{*}{w}}: \quad \overset{+}{a}^{-1} = \sqrt{1-\overset{*}{w}w}\,\overbrace{1-\overset{*}{z}w}^{\circ}\,\sqrt{1-\overset{*}{z}z}$$

$$b = \overset{\circ}{\sqrt{1-w\overset{*}{w}}}\,\underbrace{z-w}\,\overset{\circ}{\sqrt{1-\overset{*}{z}z}} \Longrightarrow \bar{b} = \overset{\circ}{\sqrt{1-\overset{*}{w}w}}\,\underbrace{\overset{*}{z}-\overset{*}{w}}\,\overset{\circ}{\sqrt{1-z\overset{*}{z}}}$$

$$\underbrace{1-z\overset{*}{z}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\underbrace{w-z} = \left(1-w\overset{*}{z}+\underbrace{w-z}\,\overset{*}{z}\right)\overbrace{1-w\overset{*}{z}}^{\circ}\,\underbrace{w-z}$$

$$= w-z+\underbrace{w-z}\,\overset{*}{z}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\underbrace{w-z} = w-z+\underbrace{w-z}\,\underbrace{\overbrace{1-z\overset{*}{w}}^{*}z}_{-1}\,\underbrace{w-z} = w-z+Q_{w\,-\,z}\,z^w$$

$$-\,a^{-1}b = \sqrt{1-z\overset{*}{z}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\sqrt{1-w\overset{*}{w}}\,\overset{\circ}{\sqrt{1-w\overset{*}{w}}}\,\underbrace{w-z}\,\overset{\circ}{\sqrt{1-\overset{*}{z}z}} = \sqrt{1-z\overset{*}{z}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\underbrace{w-z}\,\overset{\circ}{\sqrt{1-\overset{*}{z}z}}$$

$$= \overset{\circ}{\sqrt{1-z\overset{*}{z}}}\left(\underbrace{1-z\overset{*}{z}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\underbrace{w-z}\right)\overset{\circ}{\sqrt{1-\overset{*}{z}z}}$$

$$= \overset{\circ}{\sqrt{1-z\overset{*}{z}}}\left(w-z+Q_{w\,-\,z}z^w\right)\overset{\circ}{\sqrt{1-\overset{*}{z}z}} = {}^{z}B_z^{-\,1/2}\left(w-z+Q_{w\,-\,z}z^w\right)$$

$$\underbrace{\overset{*}{z}-\overset{*}{w}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\underbrace{1-w\overset{*}{w}} = \underbrace{\overset{*}{z}-\overset{*}{w}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\left(1-w\overset{*}{z}+w\underbrace{\overset{*}{z}-\overset{*}{w}}\right)$$

$$= \overset{*}{z}-\overset{*}{w}+\underbrace{\overset{*}{z}-\overset{*}{w}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,w\underbrace{\overset{*}{z}-\overset{*}{w}} = \overset{*}{z}-\overset{*}{w}+\underbrace{\overset{*}{z}-\overset{*}{w}}\,w^z\,\underbrace{\overset{*}{z}-\overset{*}{w}} = \overset{*}{z}-\overset{*}{w}+P_{\overset{*}{z}\,-\,\overset{*}{w}}\,w^z$$

$$\bar{b}\,a^{-1} = \overset{\circ}{\sqrt{1-\overset{*}{w}w}}\,\underbrace{\overset{*}{z}-\overset{*}{w}}\,\overset{\circ}{\sqrt{1-z\overset{*}{z}}}\,\sqrt{1-z\overset{*}{z}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\sqrt{1-w\overset{*}{w}}$$

$$= \overset{\circ}{\sqrt{1-\overset{*}{w}w}}\,\underbrace{\overset{*}{z}-\overset{*}{w}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\sqrt{1-w\overset{*}{w}} = \overset{\circ}{\sqrt{1-\overset{*}{w}w}}\left(\underbrace{\overset{*}{z}-\overset{*}{w}}\,\overbrace{1-w\overset{*}{z}}^{\circ}\,\underbrace{1-w\overset{*}{w}}\right)\overset{\circ}{\sqrt{1-w\overset{*}{w}}}$$

$$= \overset{\circ}{\sqrt{1-\overset{*}{w}w}}\left(\overset{*}{z}-\overset{*}{w}+P_{\overset{*}{z}\,-\,\overset{*}{w}}w^z\right)\overset{\circ}{\sqrt{1-w\overset{*}{w}}} = {}^{\overset{*}{w}}B_{\overset{*}{w}}^{-\,1/2}\left(\overset{*}{z}-\overset{*}{w}+P_{\overset{*}{z}\,-\,\overset{*}{w}}w^z\right)$$

$$
{}_{z}^{x}\mathcal{B}_{y}^{w} = {}^{{}^{w}B_{w}^{-\,1/2}x}\mathcal{E}_{z-w+Q_{z-w}w^{z}}\;{}^{{}^{w}B_{w}^{1/2}x}\mathcal{J}_{{}^{z}B_{w}^{-1z}B_{z}^{1/2}y}\;{}^{w-z+Q_{w-z}z^{w}}\mathcal{E}_{{}^{z}B_{z}^{-\,1/2}y}
$$

$$
\overset{+}{\zeta}\,\overset{\circ}{\sqrt{1-\overset{*}{w}w}}\left(\overset{*}{z}-\overset{*}{w}+\underbrace{\overset{*}{z}-\overset{*}{w}}w^{z}\underbrace{\overset{*}{z}-\overset{*}{w}}\right)\overset{\circ}{\sqrt{1-w\overset{*}{w}}}\zeta = \operatorname{tr}\,\zeta\overset{+}{\zeta}\,\overset{\circ}{\sqrt{1-\overset{*}{w}w}}\left(\overset{*}{z}-\overset{*}{w}+\underbrace{\overset{*}{z}-\overset{*}{w}}w^{z}\underbrace{\overset{*}{z}-\overset{*}{w}}\right)\overset{\circ}{\sqrt{1-w\overset{*}{w}}}
$$

$$
= \underbrace{\zeta\overset{+}{\zeta}}\bowtie\overset{\circ}{\sqrt{1-w\overset{*}{w}}}\,\underbrace{z-w+\overbrace{z-w}\overset{*}{\overbrace{w^{z}}}\overbrace{z-w}}\,\overset{\circ}{\sqrt{1-\overset{*}{w}w}}
$$

$$
= x\bowtie{}^{w}B_{w}^{-\,1/2}\,\overbrace{z-w+Q_{z-w}w^{z}} = {}^{w}B_{w}^{-\,1/2}x\bowtie\overbrace{z-w+Q_{z-w}w^{z}}
$$

$$
\overset{*}{\omega}\,\overset{\circ}{\sqrt{1-z\overset{*}{z}}}\left(w-z+Q_{w-z}z^{w}\right)\overset{\circ}{\sqrt{1-\overset{*}{z}z}}\,\bar{\omega} = \operatorname{tr}\,\overset{\circ}{\sqrt{1-z\overset{*}{z}}}\left(w-z+Q_{w-z}z^{w}\right)\overset{\circ}{\sqrt{1-\overset{*}{z}z}}\,\bar{\omega}\,\overset{*}{\omega}
$$

$$
= \operatorname{tr}\,\overset{\circ}{\sqrt{1-z\overset{*}{z}}}\left(w-z+Q_{w-z}z^{w}\right)\overset{\circ}{\sqrt{1-\overset{*}{z}z}}\,\overset{*}{\overbrace{\omega\overset{+}{\omega}}} = \overset{\circ}{\sqrt{1-z\overset{*}{z}}}\left(w-z+Q_{w-z}z^{w}\right)\overset{\circ}{\sqrt{1-\overset{*}{z}z}}\bowtie y
$$

$$
= {}^{z}B_{z}^{-\,1/2}\,\underbrace{w-z+Q_{w-z}z^{w}}\bowtie y = \underbrace{w-z+Q_{w-z}z^{w}}\bowtie{}^{z}B_{z}^{-\,1/2}y
$$

$$
\overset{*}{\omega}\sqrt{1-z\overset{*}{z}}\,\overset{\circ}{\overbrace{1-w\overset{*}{z}}}\,\sqrt{1-w\overset{*}{w}}\zeta = \operatorname{tr}\,\zeta\underbrace{\sqrt{1-w\overset{*}{w}}\overset{\circ}{\overbrace{1-z\overset{*}{w}}}\sqrt{1-z\overset{*}{z}}\omega}_{*} = <\zeta|\sqrt{1-w\overset{*}{w}}\,\overset{\circ}{\overbrace{1-z\overset{*}{w}}}\,\sqrt{1-z\overset{*}{z}}\omega>
$$

$$
\sqrt{1-w\overset{*}{w}}\,\overset{\circ}{\overbrace{1-z\overset{*}{w}}}\,\sqrt{1-z\overset{*}{z}}\omega\,\underbrace{\sqrt{1-w\overset{*}{w}}\overset{\circ}{\overbrace{1-z\overset{*}{w}}}\sqrt{1-z\overset{*}{z}}\omega}_{+}
$$

$$
= \sqrt{1-w\overset{*}{w}}\,\overset{\circ}{\overbrace{1-z\overset{*}{w}}}\,\sqrt{1-z\overset{*}{z}}\omega\overset{+}{\omega}\sqrt{1-\overset{*}{z}z}\,\overset{\circ}{\overbrace{1-\overset{*}{w}z}}\,\sqrt{1-\overset{*}{w}w} = {}^{w}B_{w}^{1/2}\,{}^{z}B_{w}^{-1}\,{}^{z}B_{z}^{1/2}y
$$

$$
\int_{dH}^{{}^{\ell}\mathbb{R}_{\ell}^{\mho}} \mathfrak{e}^{2<\zeta[H]|\sqrt{1-w\overset{*}{w}}\overset{\circ}{\overbrace{1-z\overset{*}{w}}}\sqrt{1-z\overset{*}{z}}\omega>} = {}^{\zeta\overset{+}{\zeta}}\mathcal{J}_{\sqrt{1-w\overset{*}{w}}\overset{\circ}{\overbrace{1-z\overset{*}{w}}}\sqrt{1-z\overset{*}{z}}\omega\underbrace{\sqrt{1-w\overset{*}{w}}\overset{\circ}{\overbrace{1-z\overset{*}{w}}}\sqrt{1-z\overset{*}{z}}\omega}_{+}}
$$

$$
= {}^{x}\mathcal{J}_{{}^{w}B_{w}^{1/2z}B_{w}^{-1z}B_{z}^{1/2}y} = {}^{{}^{w}B_{w}^{1/2}x}\mathcal{J}_{{}^{z}B_{w}^{-1z}B_{z}^{1/2}y}
$$