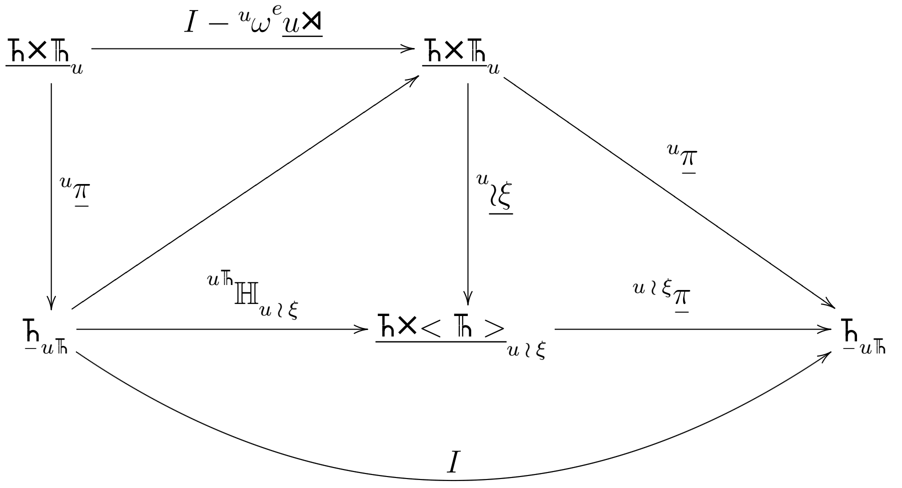
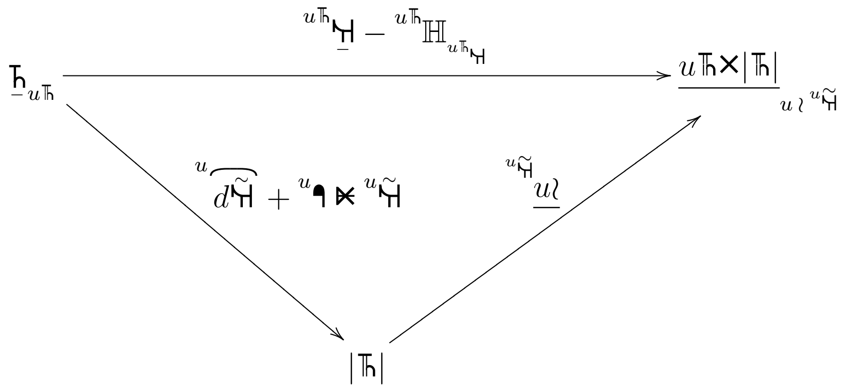


$$X\,{}^{u}\underline{\pi} = 0 \Rightarrow X = A\,{}^{e}\underline{u\rtimes} \Rightarrow X\,{}^{u}\omega = A \Rightarrow X - \underbrace{X^{u}\omega}\,{}^{e}\underline{u\rtimes} = A\,{}^{e}\underline{u\rtimes} - A\,{}^{e}\underline{u\rtimes} = 0 \Rightarrow {}^{u\mathbb{h}}\mathbb{H}_{u\wr\xi} \text{ well-def}$$

$${}^{u}\underline{\wr\xi}\,{}^{u\wr\xi}\underline{\pi} = {}^{u}\underline{\widehat{\wr\xi}\pi} = {}^{u}\underline{v\mapsto v\wr\xi\mapsto\pi\left(v\wr\xi\right) = v\mathbb{h}} = {}^{u}\underline{\pi}$$

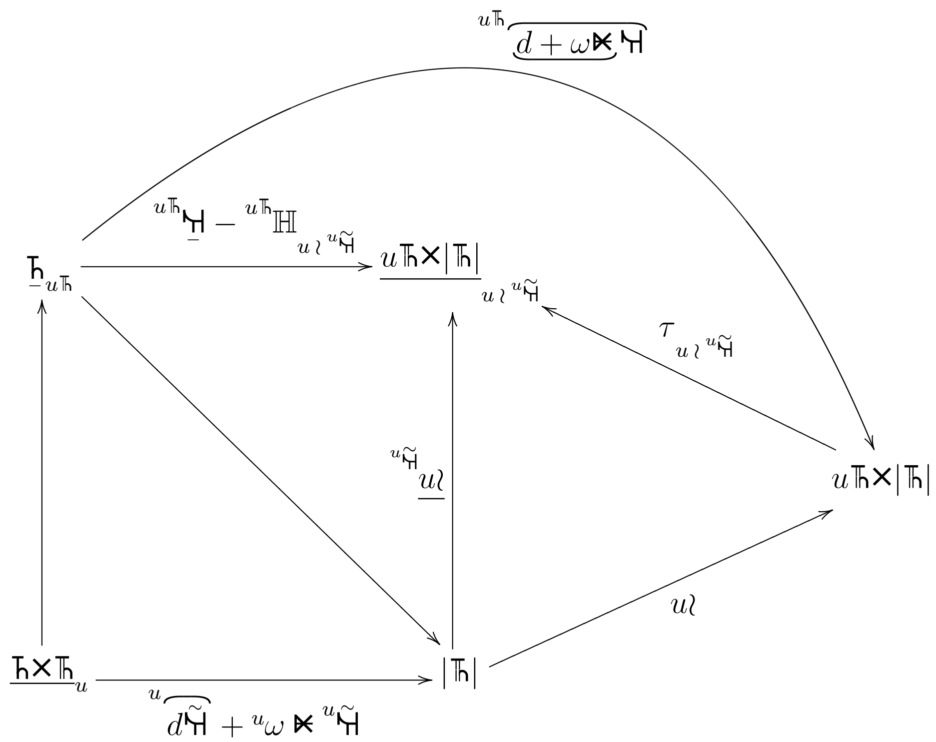
$$\underbrace{X^{u}\omega}\,{}^{e}\underline{u\rtimes}\,{}^{u}\underline{\pi} = \underbrace{X^{u}\omega}\,{}^{e}\underline{\widehat{u\rtimes}\pi} = \underbrace{X^{u}\omega}\,{}^{e}\underline{\mathbb{h}\mapsto u\rtimes\mathbb{h}\mapsto\pi\left(u\rtimes\mathbb{h}\right) = u\mathbb{h}} = 0$$



$$X\,{}^{u}\underline{\pi}\,\overbrace{{}^{u\mathbb{T}}\underline{\mathsf{H}} - {}^{u\mathbb{T}}\mathbb{H}_{u\mathbb{T}\mathsf{H}}} = X\,\underbrace{id\times\,{}^{u}\overbrace{d\widetilde{\mathsf{H}}}}\,{}^{u:{}^{u}\widetilde{\mathsf{H}}}\underline{\wr} - X\,{}^{u}\underline{\pi}\,{}^{u\mathbb{T}}\mathbb{H}_{u\wr{}^{u}\widetilde{\mathsf{H}}} = \underbrace{X{:}X\,{}^{u}\overbrace{d\widetilde{\mathsf{H}}}}\,{}^{u:{}^{u}\widetilde{\mathsf{H}}}\underline{\wr} - \overbrace{X - \underbrace{X^{u}\omega}\,{}^{e}\underline{u\rtimes}}\,{}^{u}\underline{\wr^{u}\widetilde{\mathsf{H}}}$$

$$= X\,{}^{u}\underline{\wr^{u}\widetilde{\mathsf{H}}} + X\,{}^{u}\overbrace{d\widetilde{\mathsf{H}}}\,{}^{u\widetilde{\mathsf{H}}}\underline{u\wr} - X\,{}^{u}\underline{\wr^{u}\widetilde{\mathsf{H}}} + \underbrace{X^{u}\omega}\,{}^{e}\underline{u\rtimes}\,{}^{u}\underline{\wr^{u}\widetilde{\mathsf{H}}}$$

$$= X\,{}^{u}\overbrace{d\widetilde{\mathsf{H}}}\,{}^{u\widetilde{\mathsf{H}}}\underline{u\wr} + \underbrace{\overbrace{X^{u}\omega}\ltimes{}^{u}\widetilde{\mathsf{H}}}\,{}^{u\widetilde{\mathsf{H}}}\underline{u\wr} = \underbrace{X\,{}^{u}\overbrace{d\widetilde{\mathsf{H}}} + \overbrace{X^{u}\omega}\ltimes{}^{u}\widetilde{\mathsf{H}}}\,{}^{u\widetilde{\mathsf{H}}}\underline{u\wr}$$



$$\begin{array}{ccc} \underline{\hbar \times \mathbb{h}}_{u} & \xrightarrow{\ {}^{u}\omega \ltimes {}^{u}\tilde{\mathsf{H}}\ } & |\mathbb{h}| \\ \Big\downarrow {}^{u}\underline{\rtimes \mathbb{h}} & & \Big\downarrow \mathbb{h}^{-\ltimes} \\ \underline{\hbar \times \mathbb{h}}_{u\mathbb{h}} & \xrightarrow{\ {}^{u\mathbb{h}}\omega \ltimes {}^{u\mathbb{h}}\tilde{\mathsf{H}}\ } & |\mathbb{h}| \end{array}$$

$$ {}^{u}\underline{\rtimes \mathbb{h}}\, \underbrace{{}^{u\mathbb{h}}\omega \ltimes {}^{u\mathbb{h}}\tilde{\mathsf{H}}} = \mathbb{h}^{-\ltimes}\, \underbrace{{}^{u}\omega \ltimes {}^{u}\tilde{\mathsf{H}}} $$

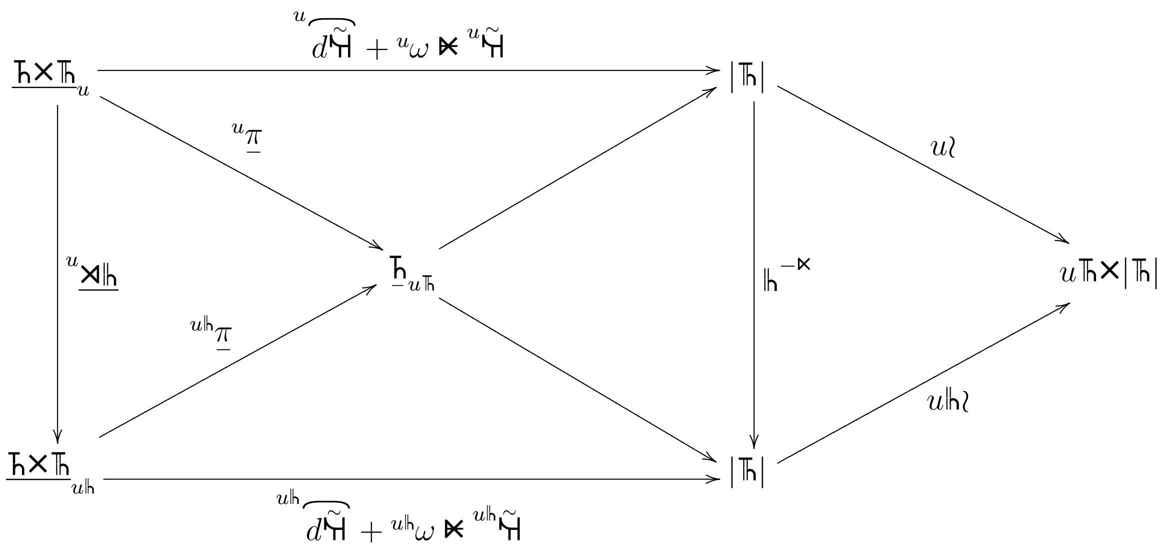
$$ {}^{u}\underline{\rtimes \mathbb{h}}\, \underbrace{{}^{u\mathbb{h}}\omega \ltimes {}^{u\mathbb{h}}\tilde{\mathsf{H}}} = \overbrace{{}^{u}\underline{\rtimes \mathbb{h}}\, {}^{u\mathbb{h}}\omega} \ltimes {}^{u\mathbb{h}}\tilde{\mathsf{H}} = \overbrace{{}^{u}\omega\, {}^{e}\underline{\rtimes \mathbb{h}}} \ltimes {}^{u\mathbb{h}}\tilde{\mathsf{H}} = \mathbb{h}^{-\ltimes}\, \overbrace{{}^{u}\omega \ltimes \underbrace{\mathbb{h}^{\ltimes u\mathbb{h}}\tilde{\mathsf{H}}}} = \mathbb{h}^{-\ltimes}\, \underbrace{{}^{u}\omega \ltimes {}^{u}\tilde{\mathsf{H}}} $$

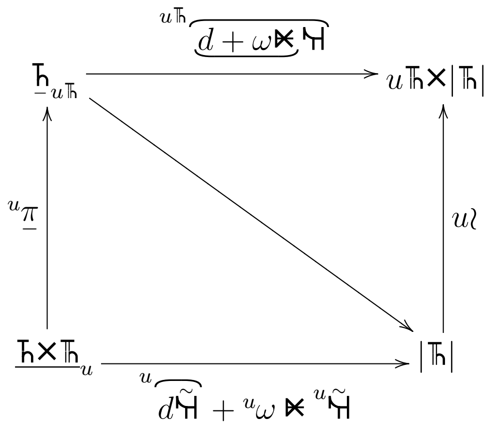
$$ \ker {}^{u}\underline{\pi}\,|^{\,u}\, \overbrace{d\tilde{\mathsf{H}}} + {}^{u}\omega \ltimes {}^{u}\tilde{\mathsf{H}} = 0 $$

$$ \ker {}^{u}\underline{\pi} \ni A\, {}^{e}\underline{u \rtimes} \Longrightarrow \overbrace{A\, {}^{e}\underline{u\rtimes}\, {}^{u}\omega} \ltimes {}^{u}\tilde{\mathsf{H}} = A \ltimes {}^{u}\tilde{\mathsf{H}} $$

$$ \overbrace{A\, {}^{e}\underline{u\rtimes}}\ {}^{u}\overbrace{d\tilde{\mathsf{H}}} = A\, {}^{e}\underline{u\rtimes}\, {}^{u}\underline{\tilde{\mathsf{H}}} = A\, {}^{u}\underline{\overbrace{u\rtimes}\tilde{\mathsf{H}}} = A\, {}^{e}\underline{\mathbb{h} \mapsto u \rtimes \mathbb{h} \mapsto {}^{u\mathbb{h}}\tilde{\mathsf{H}} = \mathbb{h}^{-\ltimes u}\tilde{\mathsf{H}}} = -A \ltimes {}^{u}\tilde{\mathsf{H}} $$

$$ \underline{\hbar}_{u\mathbb{h}} \ni \mathbb{X}\, {}^{u}\underline{p} \curvearrowright X\, \underbrace{{}^{u}\overbrace{d\tilde{\mathsf{H}}} + {}^{u}\omega \ltimes {}^{u}\tilde{\mathsf{H}}} = X\ {}^{u}\overbrace{d\tilde{\mathsf{H}}} + \underbrace{X\, {}^{u}\omega} \ltimes {}^{u}\tilde{\mathsf{H}} \ \text{well-def} $$





$$\underline{\hbar \times \mathbb{h}}_u \ni X \mapsto X\, {}^u\underline{\pi}\ {}^{u\mathbb{h}}\overbrace{\underbrace{d+\omega\ltimes}\,\mathrm{H}} = u \wr \underbrace{X\ {}^u\overbrace{d\tilde{\mathrm{H}}} + \overbrace{X^u\omega} \ltimes {}^u\tilde{\mathrm{H}}}$$