2+1 Gravity as a Gauge Theory

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Gravity–Gauge comparison:

$$S_{\text{EH}} = \frac{1}{\kappa^2}\int \mathrm{d}^D x\,\sqrt{|g|}R \qquad \text{v.s.} \qquad S_{\text{YM}} = \frac{1}{g^2}\int \text{Tr}\left[\mathbf{F}\wedge\star\mathbf{F}\right]$$

$$\mathbf{g}\sim\phi_*\mathbf{g} \qquad\qquad \mathbf{A}\sim U(\mathbf{A}+\mathbf{d})U^{-1}$$

Using vielbein/spin-connection is possible to *polynomialize* gravity:

$$S_{\text{EH}} \overset{D=3}{=} \frac{1}{\lambda}\int \text{Tr}\left[\mathbf{R}\wedge\mathbf{e}\right] \overset{!}{=} S_{\text{CS}}$$

$$\text{Diff} \cong \text{local ISO}(2,1)$$

$2+1$ dimensional gravity is a CS gauge theory of $\text{ISO}(2,1)$