# The classical double copy for maximally symmetric spacetimes

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Based on:
1711.01296 : MCG, R.Penco, M. Trodden

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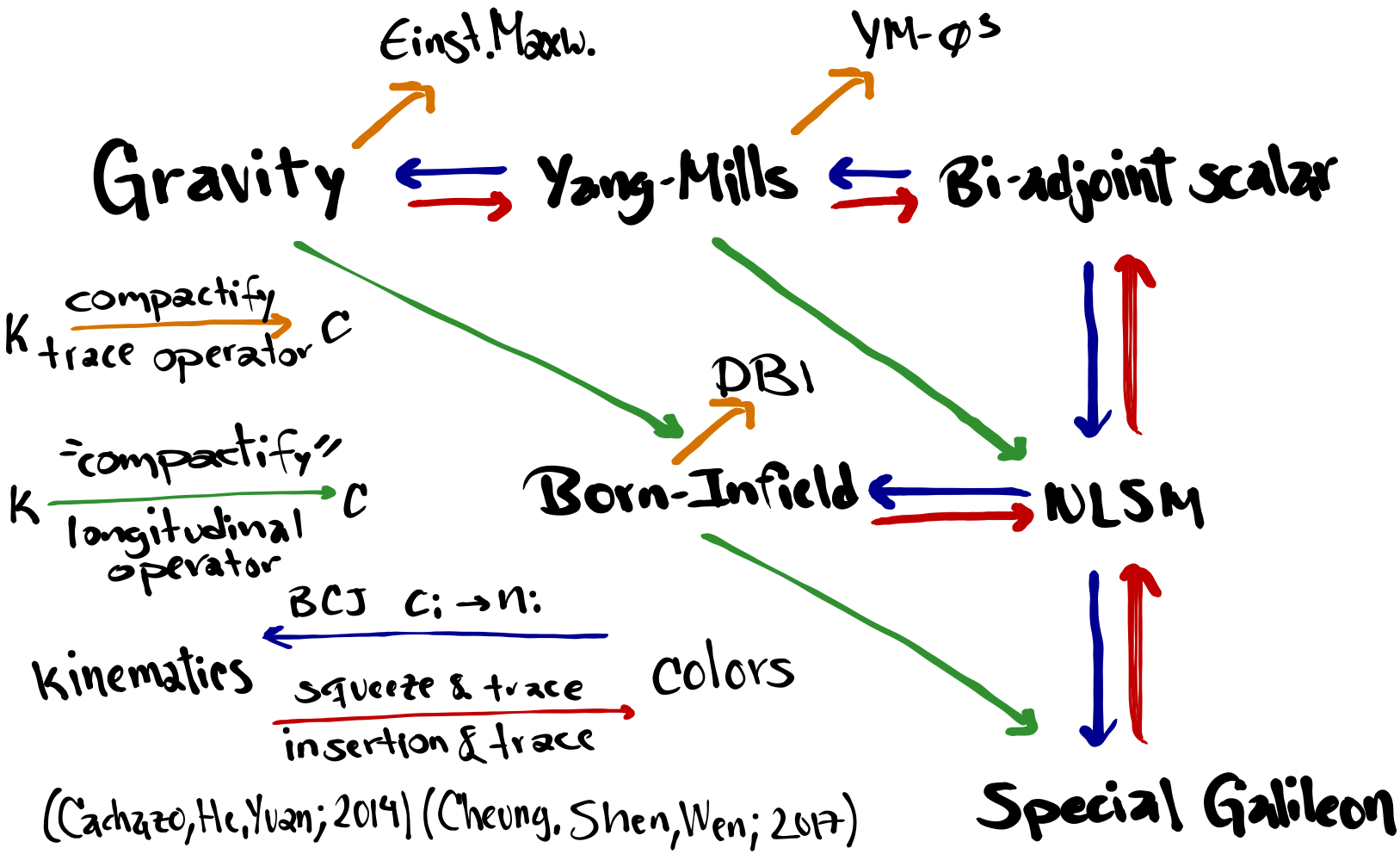
# Web of Amplitudes Relations



# Exact solutions in the double copy (Monteiro, O'Connel, White)

Kerr-Schild metrics: $g_{\mu\nu} = \bar{g}_{\mu\nu} + k_\mu k_\nu \phi$

**Color - kinematics replacements:**

$$k^\mu \to c^a \quad M \to Q \quad 8\pi G \to g$$

$$h_{\mu\nu} = k_\mu k_\nu \phi \qquad A^a_\mu = c^a k_\mu \phi \qquad \phi^{a\,a'} = c^a\, c^{a'} \phi$$

$$G_{\mu\nu} = 8\pi G\, T_{\mu\nu} \qquad \nabla_\mu F^{\mu\nu} = g J^\nu \qquad \Box\phi = J$$

**Invariance of Kerr-Schild metric that changes the copies**

$$k_\mu \to f\, k_\mu \qquad \phi \to \phi / f^2$$

# YM and $\phi^3$ eom from Einstein equations

## Einstein equations

$$-16\pi G\left(T^{\mu}_{\nu}-\delta^{\mu}_{\nu}\frac{T}{d-2}\right)=2(\bar{R}^{\mu}_{\nu}-R^{\mu}_{\nu})=\left[\bar{\nabla}_{\lambda}F^{\lambda\mu}+\frac{(d-2)}{d(d-1)}\bar{R}A^{\mu}\right]k_{\nu}+\tilde{X}^{\mu}{}_{\nu}$$

## YM eom: Apply Killing vector $V^{\nu}$

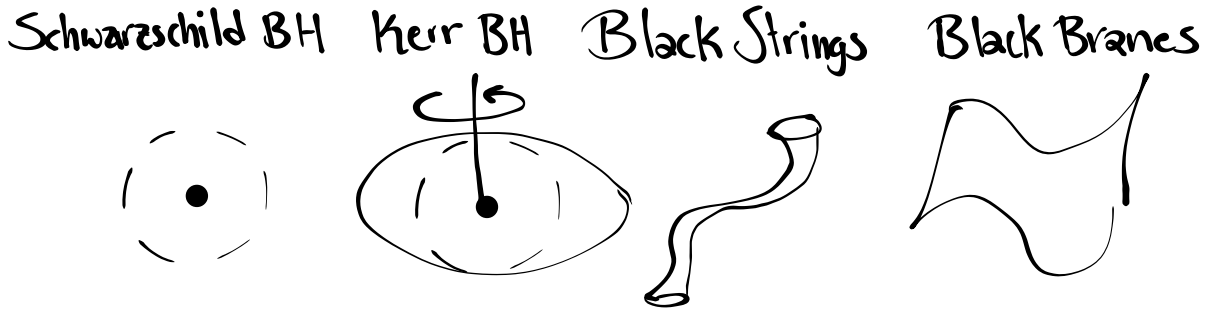
$$\bar{\nabla}_{\lambda}F^{\lambda\mu}+\frac{(d-2)}{d(d-1)}\bar{R}A^{\mu}+\frac{V^{\nu}\tilde{X}^{\mu}{}_{\nu}}{V^{\lambda}k_{\lambda}}=8\pi G\,J^{\mu}$$

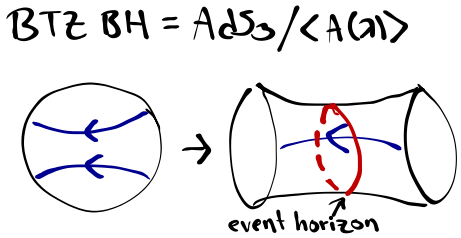
$$J^{\mu}\equiv-\frac{2V^{\nu}}{V^{\rho}k_{\rho}}\left(T^{\mu}{}_{\nu}-\delta^{\mu}_{\nu}\frac{T}{d-2}\right)$$

## $\phi^3$ eom: Apply Killing vector again $V^{\nu}V^{\mu}$ ...

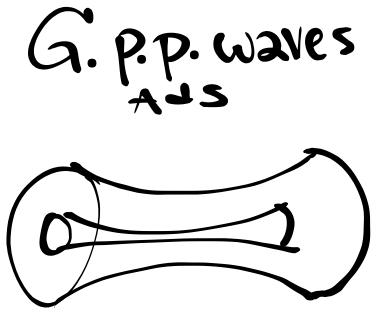
# Examples in (A)dS

Stationary: $\nabla_\mu F^{\mu\nu} = gJ^\nu$ $\quad \Box\phi - \frac{2(d-3)}{d(d-1)}\bar{R}\phi = J$

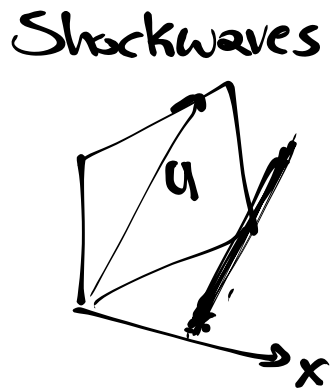



Waves: $\nabla_\mu F^{\mu\nu} + \frac{(d-2)}{d(d-1)}\bar{R}A^\mu = gJ^\nu$ $\quad \Box\phi - \frac{(d-4)}{d(d-1)}\bar{R}\phi = J$





## Open questions:

- Choice of $k_\mu$ and $\phi$
- Relation to amplitudes
- Mass terms depending on $d$
- Missing dilaton and 2-form