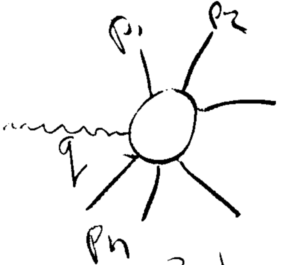
Soft theorem

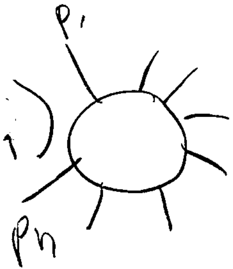
$\Leftrightarrow$ asymmetries

$\lim_{q \to 0}$ ε



Lysov & Pasterski

$= \left(S^{0} + S^{1}\right)$



$=$ infinitesimal symmetry

$[Q, S] = 0$

QED $S_0 = \sum_{k=1}^{n} e_k \frac{\varepsilon \cdot p_k}{q \cdot p_k}$

susy

QED $\boxed{S_0}$, $\boxed{S_1}$

YM S_0 S_1

other dimens.

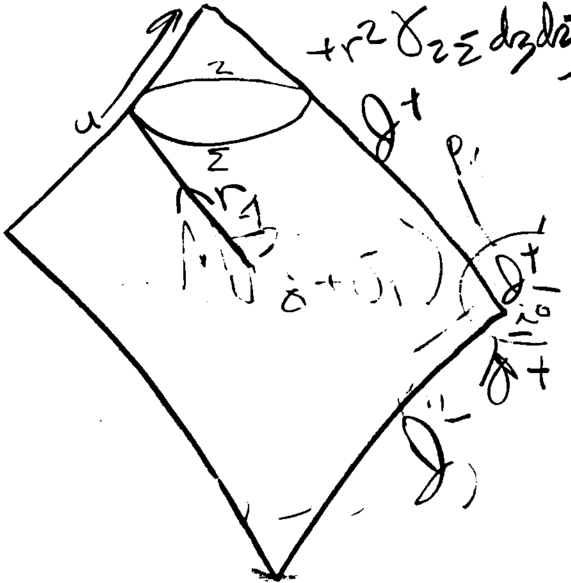
Gravity S_0 S_1 S_2

$[T, S] = 0$

1. Minkowski space holography ⟺ string theory
2. Reorganize/improve [illegible] comp for collider physics
3. Insight into amplitudes/twistors

Asymptotic symmetries

$$ds^2 = -du^2 - 2du\,dr + r^2 \gamma_{z\bar{z}}\, dz\, d\bar{z}$$



$$\nabla^\mu F_{\mu\nu} = j^M_\nu$$

$$A_r = 0$$

$$A_u|_{\mathscr{I}^+} = 0$$

$$A_z = \underline{A_z(u,z,\bar{z})} + \ldots$$

$$\left(A_u = \frac{1}{r} A_u(u,z,\bar{z}) + \mathcal{O}\!\left(\frac{1}{r^2}\right)\right)$$

$$\gamma_{z\bar z}\partial_u A_u = \partial_u(\partial_z A_{\bar z} + \partial_{\bar z} A_z) + e^2 \gamma_{z\bar z} j_u = 0$$

$$\delta A_z = \partial_z \varepsilon(z,\bar z)$$

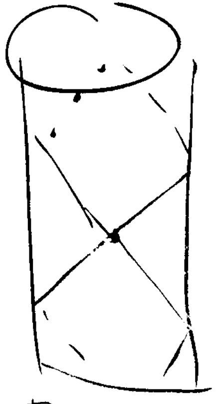
$$Q^+_\varepsilon = \int_{\mathscr{I}^+_-} d^2 z\ \varepsilon\ F_{ru} = \int_{\mathscr{I}^+} \partial_u(\partial_z A_{\bar z} + \partial_{\bar z} A_z + \gamma_{z\bar z} j_u) = \bar{Q}_\varepsilon$$

$$\frac{1}{r} A^1(u,z,\bar z) + \ldots$$

$$= Q_\varepsilon$$

$$\delta B_z = \partial_z \varepsilon^-$$

$$\boxed{\varepsilon(z,\bar z) = \varepsilon^-(z,\bar z)} \qquad [Q_\varepsilon, S] = 0$$



$$\langle \ldots \rangle = 0$$

$$\varepsilon(z) = \ldots$$

$$S(p_1, \ldots, p_n)$$

$$= \sum_k e_k \frac{\varepsilon \cdot p_k}{\varepsilon \cdot p_k} S(p_1 \ldots p_n)$$