

02/23/03

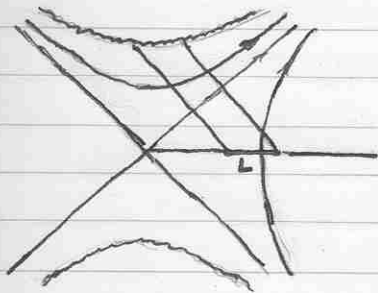
last time:

conserved currents: $j^a = T^{ab} \xi_b$: ξ_b is Killing vector.

Killing tensor $\rightarrow$ Carter constant in Kerr.

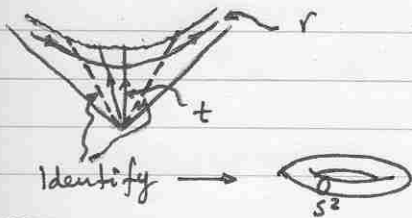
boost (like) Killing vectors $\leftrightarrow$ rotation

ergoregion: where the asymptotic time translation Killing vector become spacelike
 $\rightarrow$ penrose process, Hawking effect



L stretches
 while the S^2 spheres
 contract
 (vacuum GR, volume
 is preserved).

Kantowski-Sachs homogeneous cosmology



Without Event Horizon, ergoregion
 is unstable: perturbations at the
 ergoregion with negative energy will:
 - in a black hole: fall inside EH.
 - in a star: stay "around" and accumulate
 with other perturbations of negative energy
 will grow and stop rotation

Lie derivative

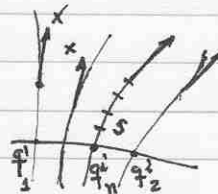
- metric independent
- defined with respect to a vector field
 (derivative w.r.t. the flow of the
 vector field)

Easy to define on a

Adapted coordinate system to the vector field:

- take coord. q^i constant on flow line of X ,
 points on curves are labeled by s ,
 such that $\frac{d}{ds} = X$, (q^i, s)
 adapted coord syst.

$$(X^\alpha \partial_\alpha f = \frac{df}{ds})$$



$\rightarrow$ (gauge) freedom: $q^i \rightarrow q'^i = q^i(q^i)$
 $s \rightarrow s' = s + f(q^i)$

We define:

$$\left(\mathcal{L}_X T \right)_{\beta \dots}^{\alpha \dots} = \frac{2}{2s} T^{\alpha \dots}_{\beta \dots} \quad \text{in adapted coordinates.}$$