Phys 110B 28 Aug 20

Special Relativity

Tensor Analysis

Fundamental idea: Different observers see the same reality governed by the same laws of physics but they observe it differently

Coordinates and Coordinate Transformations

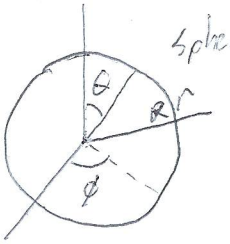
spacetime

events

coordinates label points in space(time) "events"

event $\leftrightarrow$ set of coordinates to label

"almost" one to one

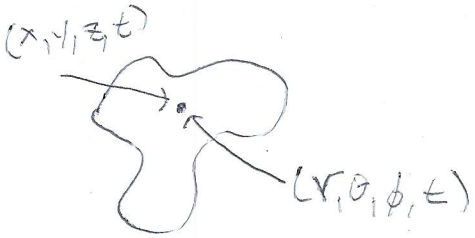


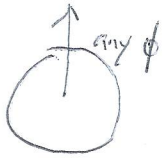
spherical coordinates

$0 \leq \theta \leq \pi$

$0 \leq \phi \leq 2\pi$

$0 \leq r < \infty$

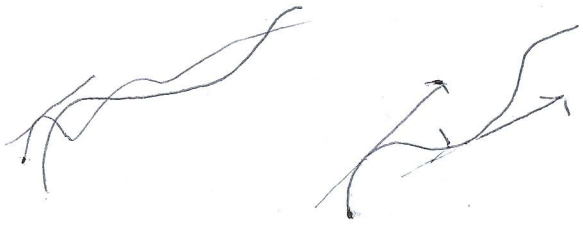




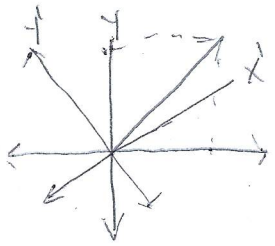
$$(t, x, y, z) \longleftrightarrow (t', x', y', z')$$
$$\updownarrow$$
$$(t', r', \theta', \phi')$$

these mappings are arbitrary

Vectors ≡ tangents to curves
infinitesimal displacements



eg. momentum



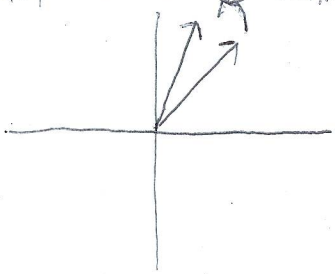
must choose coordinate system

$$R(\theta) = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$

(x', y') are related to (x, y) by a rotation (linear transformation)

passive transformation – only our description changes

~~Alibi~~ "Alias" transformations



$$R(\theta) = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$

R: Passive R

active R^{-1}

active transformation – state being described changes

"Alibi" transformation

places suspect somewhere else