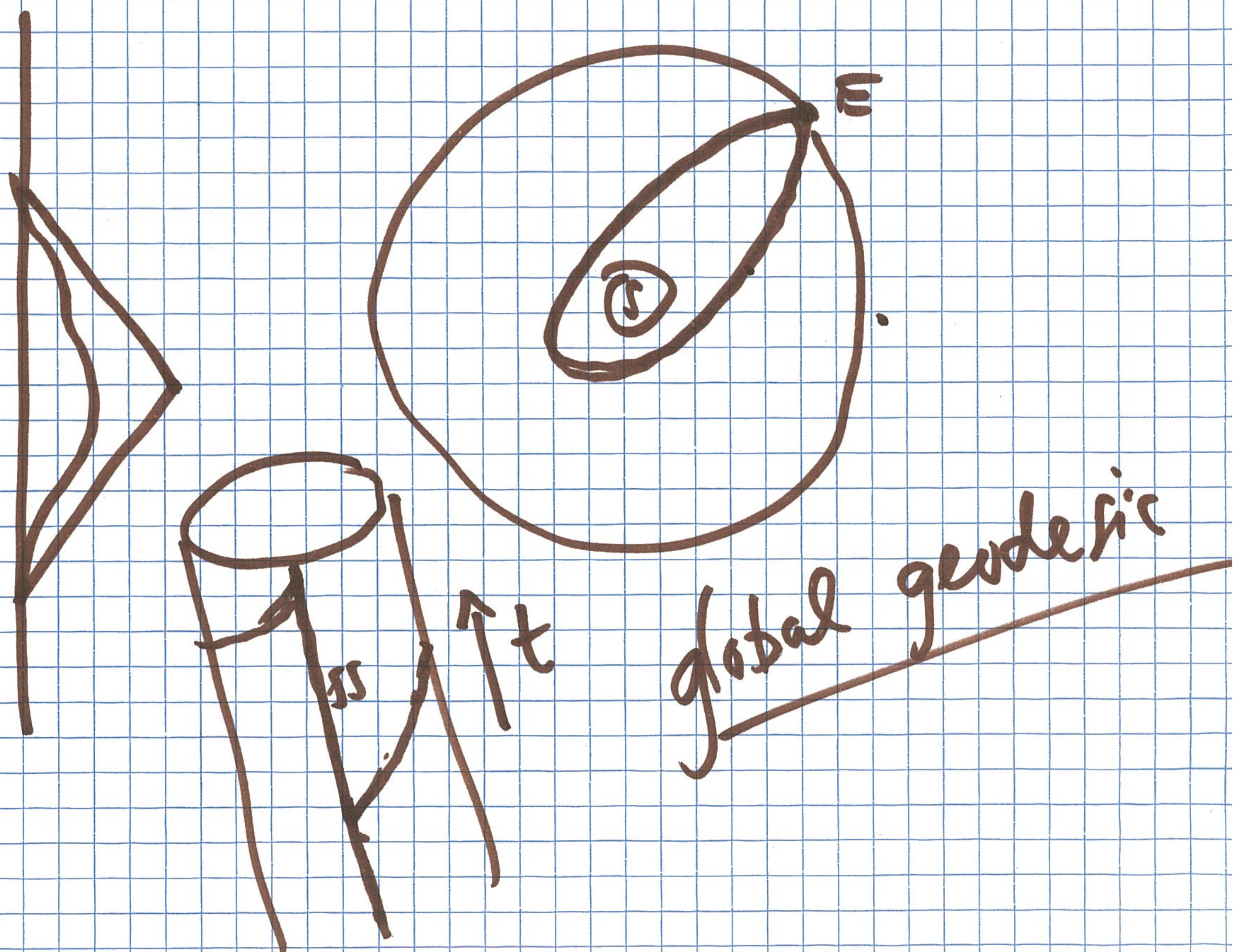
NYU Physics I 2017-12-07

Agenda — Reading Chs 4, 5, 6

— Qs

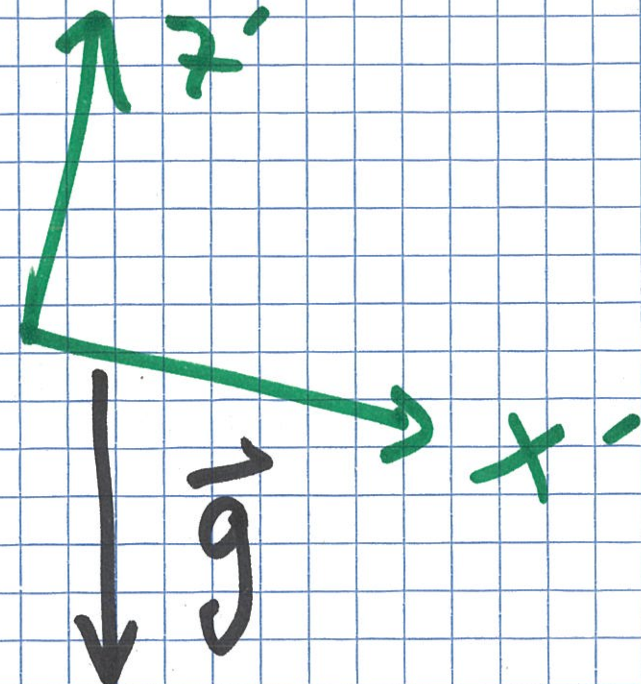
— 4-vectors.

— Exam 6


E
t
global geodesic

"3-vectors"

- invariant to rotation
- magnitude & direction.



$$|\vec{g}| = \sqrt{\vec{g}\cdot\vec{g}}$$

$$\vec{g}\cdot\vec{A}$$

$$\arccos\left(\frac{\vec{g}\cdot\vec{A}}{|\vec{g}|\,|\vec{A}|}\right) = \theta_{gA}$$

4-vectors

- ~~have a time component, 3 spatial components.~~
- have a space-time direction & "magnitude"
- invariant to boosts — Lorentz transforms.
  (& 3-space rotations)

4-displacement $\overset{4}{\overrightarrow{\Delta s}} = (c\Delta t, \Delta x, \Delta y, \Delta z)$

"magnitude" $\Delta s^2 = (c\Delta t)^2 - \Delta x^2 - \Delta y^2 - \Delta z^2$

$= (c\Delta t)^2 - (\Delta \vec{r})^2$

4-velocity $\vec{u} = (u_t, \underbrace{u_x, u_y, u_z}) $

$(\gamma c, \gamma v_x, \gamma v_y, \gamma v_z)$

$$|\vec{u}|^2 = u_t^2 - u_x^2 - u_y^2 - u_z^2 = \gamma^2 c^2 - \gamma^2 (v_x^2 + v_y^2 + v_z^2)$$
$$= \gamma^2 c^2 \left[1 - \frac{v^2}{c^2}\right] = c^2$$

4-momentum $\vec{p} = m_0 \vec{u} = (E, p_x, p_y, p_z)$

Energy conservation — time symmetry

Momentum conservation — translation symmetry