Oppg. 3, øving 12

1) $$u_x = \frac{dx}{dt} = \frac{dx'}{\gamma(dt' + \frac{v}{c^2}dz')} = \frac{u_x'}{\gamma(1+vu_z'/c^2)}$$

$$u_y = \frac{dy}{dt} = \frac{u_y'}{\gamma(1+vu_z'/c^2)}$$

$$u_z = \frac{dz}{dt} = \frac{\gamma(dz' + v\,dt')}{\gamma(dt' + \frac{v}{c^2}dz')} = \frac{u_z'+v}{1+vu_z'/c^2}$$

Differensierer:

$$du_x = \frac{du_x'}{\gamma(1+vu_z'/c^2)} - \frac{u_x'}{\gamma(1+vu_z'/c^2)^2}\cdot\frac{v}{c^2}du_z' \xrightarrow{(\vec{u}'=0)} \gamma^{-1}du_x'$$

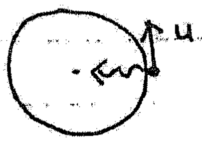
Tilsvarende for $du_y = \gamma^{-1}du_y'$.

$$du_z = \frac{du_z'}{1+vu_z'/c^2} - \frac{u_z'+v}{(1+\frac{vu_z'}{c^2})^2}\cdot\frac{v}{c^2}du_z' \to du_z' - \frac{v^2}{c^2}du_z' = (1-\beta^2)du_z'$$

Av $dt = \gamma dt'(1+\frac{v}{c^2}u_z')$ fås $dt = \gamma dt'$.

$$\Rightarrow \underline{a_x} = \frac{du_x}{dt} = \underline{(1-\beta^2)a_x'}, \text{ tilsvarende } \underline{a_y = (1-\beta^2)a_y'}$$

$$\underline{a_z = \frac{du_z}{dt} = (1-\beta^2)^{3/2}a_z'}$$

2) 

$\nu^0 = \frac{dN}{dt^0}$, hvor dN er antall bølger emittert i tiden dt^0 i det instantane hvilesystemet S'.

En har $dt^0 = d\tau$ (egentiden til preparatet).

Hvis t er ~~observert~~ observatørens tid vil $dt = \gamma d\tau$.

Frekvensen ν mottatt i sentrum altså

$$\underline{\nu} = \frac{dN}{dt} = \frac{dN}{\gamma d\tau} = \frac{\nu^0}{\gamma} = \underline{\sqrt{1-\beta^2}\,\nu^0, \quad \beta = \frac{u}{c}}$$

Transversal Dopplereffekt.