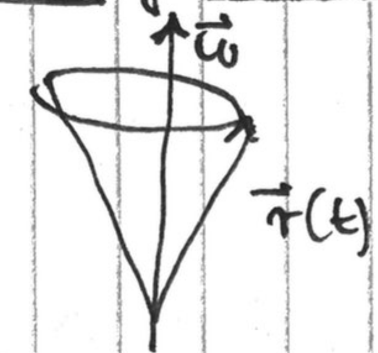
Herleitung Coriolis

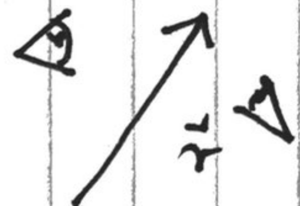
~~Dransfeld, Kienle, Vonach Exp. phys I~~

Erinnerung



$$\dot{\vec r} = \vec\omega \times \vec r$$

$\vec r$ alles



$$\underset{\sim}{\vec r_0} = x_0(t)\,\hat x_0 + y_0(t)\,\hat y_0 + z_0(t)\,\hat z_0$$

$$= x(t)\,\hat x(t) + y(t)\,\hat y(t) + z(t)\,\hat z(t) = \underset{\sim}{\vec r}$$

$$\vec v_0 = \dot{\vec r}_0 = \dot x\,\hat x + \dot y\,\hat y + \dot z\,\hat z$$

$$+\, x\,\dot{\hat x} + y\,\dot{\hat y} + z\,\dot{\hat z} = \dot{\vec r}$$

$$\vec a_0 = \ddot{\vec r}_0 = \ddot x\,\hat x + \ddot y\,\hat y + \ddot z\,\hat z$$

$$+2\dot x\,\dot{\hat x} + 2\dot y\,\dot{\hat y} + 2\dot z\,\dot{\hat z} \longrightarrow \text{Coriolis}$$

$$+\, x\,\ddot{\hat x} + y\,\ddot{\hat y} + z\,\ddot{\hat z} \longrightarrow \text{Zentrif.}$$

20

$$\dot{\hat{x}} = \vec{\omega}\times\hat{x} \qquad \ddot{\hat{x}} = \overset{\cdot}{\overbrace{\vec{\omega}\times\hat{x}}}^{\dot{\hat{x}}} = \dot{\vec{\omega}}\times\hat{x} + \vec{\omega}\times\dot{\hat{x}} = \dot{\vec{\omega}}\times\hat{x} + \vec{\omega}\times(\vec{\omega}\times\hat{x})$$

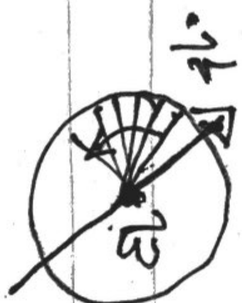
$$\dot{\hat{y}} = \vec{\omega}\times\hat{y} \qquad \ddot{\hat{y}} = \dot{\vec{\omega}}\times\hat{y} + \vec{\omega}\times(\vec{\omega}\times\hat{y})$$

$$\dot{\hat{z}} = \vec{\omega}\times\hat{z} \qquad \ddot{\hat{z}} = \dot{\vec{\omega}}\times\hat{z} + \vec{\omega}\times(\vec{\omega}\times\hat{z})$$

Einsetzen

$$\boxed{\alpha(\vec{a}+\vec{b}) = \alpha\vec{a}+\alpha\vec{b}}$$

$$\begin{aligned}\vec{a}_0 = {}& \ddot{x}\hat{x} + \ddot{y}\hat{y} + \ddot{z}\hat{z} \\ &+ 2\left[\dot{x}\,\vec{\omega}\times\hat{x} + \dot{y}\,\vec{\omega}\times\hat{y} + \dot{z}\,\vec{\omega}\times\hat{z}\right] \\ &+ \underline{x}\,\vec{\omega}\times(\vec{\omega}\times\hat{x}) + y\,\vec{\omega}\times(\vec{\omega}\times\hat{y}) + z\,\vec{\omega}\times(\vec{\omega}\times\hat{z}) \\ &+ x\,\dot{\vec{\omega}}\times\hat{x} + y\,\dot{\vec{\omega}}\times\hat{y} + z\,\dot{\vec{\omega}}\times\hat{z}\end{aligned}$$



System

im System

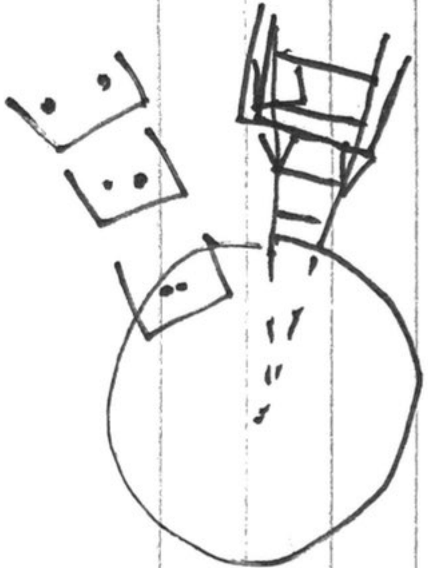
$$\begin{aligned}\vec{a}_0 = {}& \ddot{x}\hat{x} + \ddot{y}\hat{y} + \ddot{z}\hat{z} \\ &+ 2\,\vec{\omega}\times(\dot{x}\hat{x} + \dot{y}\hat{y} + \dot{z}\hat{z}) \\ &+ \vec{\omega}\times(\vec{\omega}\times(x\hat{x} + y\hat{y} + z\hat{z})) \\ &+ \dot{\vec{\omega}}\times(x\hat{x} + y\hat{y} + z\hat{z})\end{aligned}$$

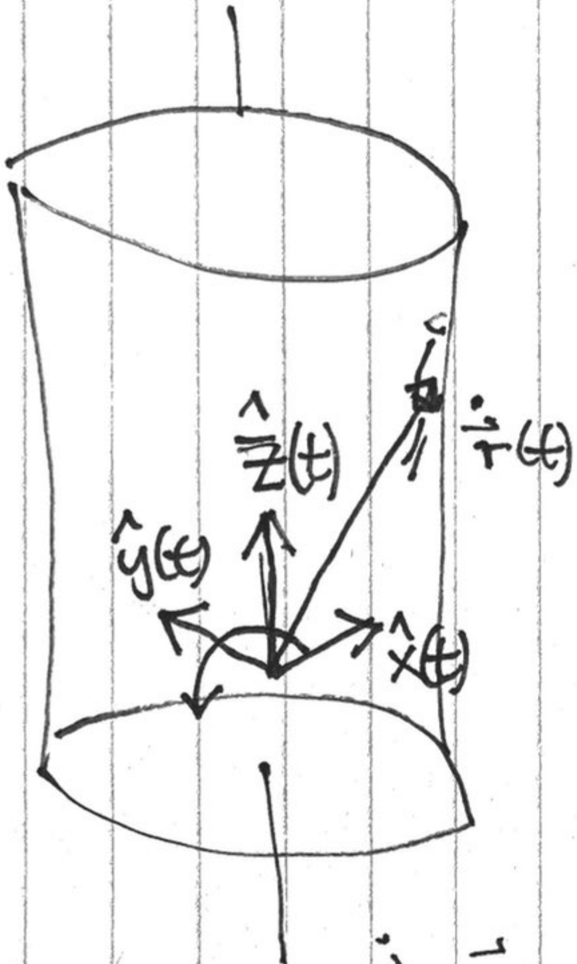
$$\boxed{\ddot{\vec{r}}_0} = \ddot{\vec{r}} + 2\vec{\omega}\times\dot{\vec{r}} \;!! + \vec{\omega}\times(\vec{\omega}\times\vec{r}) + \dot{\vec{\omega}}\times\vec{r}$$

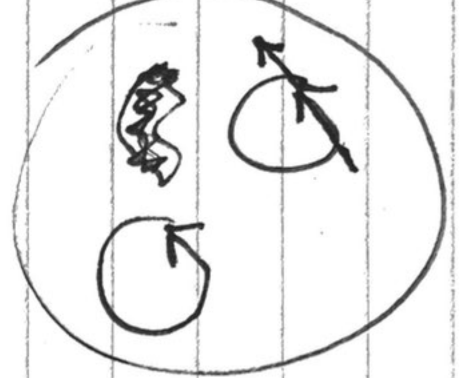
Coriolis

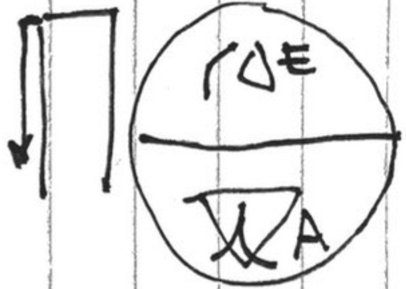
Zentrif.

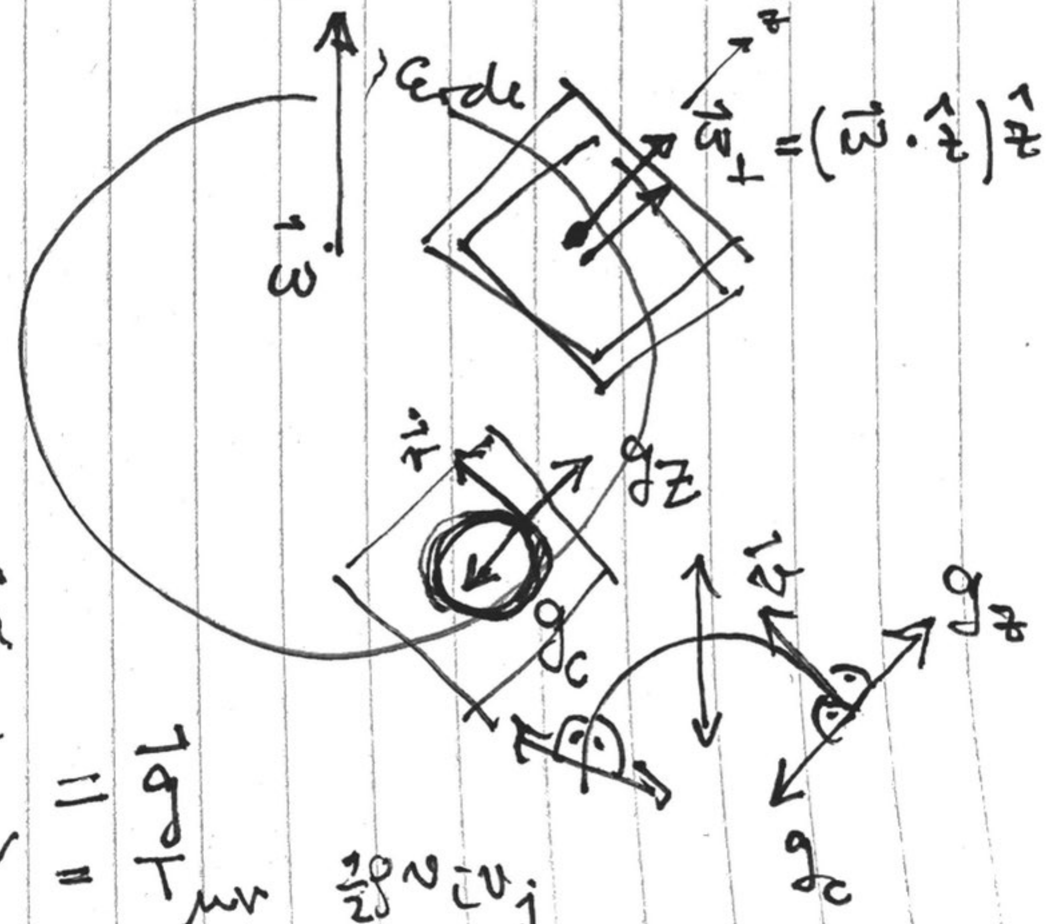
Euler











Trägheitskraft

= Scheinbeschl.

- träge Masse

$\underbrace{Z \quad C \quad E}_{rot}$, $\underbrace{A''}_{lin}$ G

$\dot{\vec p} = \vec F$

$\vec F_t = m\vec a_t$

$\vec a = \dfrac{\vec F}{m} = \vec g$

$G_{\mu\nu} = T_{\mu\nu}$ $\quad \frac{1}{2}\rho v_i v_j$

$(\underset{\sim}{\partial} x) \times \underset{\sim}{v} =$

$\underset{\sim}{\partial} \times (\underset{\sim}{v} x) = (\underset{\sim}{\partial} \times \underset{\sim}{v}) x$

$(\partial x) v =$

$(v x) =$

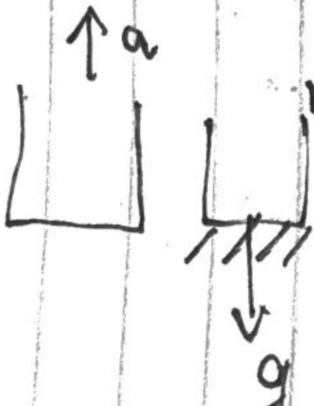
$(\partial v) x$

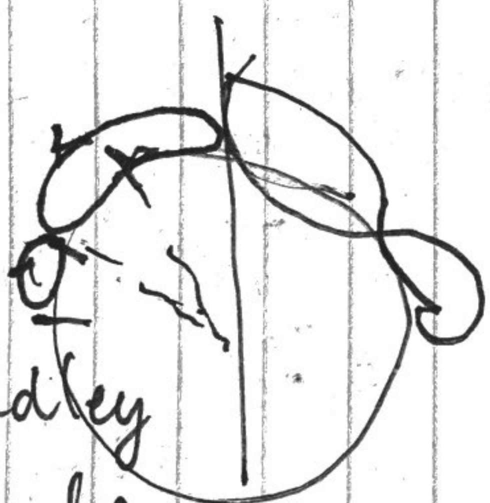
$$\ddot{\hat{x}} = \dot{\overline{\dot{\hat{x}}}} = \dot{\overline{\vec{\omega} \times \hat{x}}}$$

$$\parallel$$

$$\frac{d}{dt}\left(\frac{d\hat{x}}{dt}\right) = \dot{\vec{\omega}} \times \hat{x} + \vec{\omega} \times \dot{\hat{x}}$$

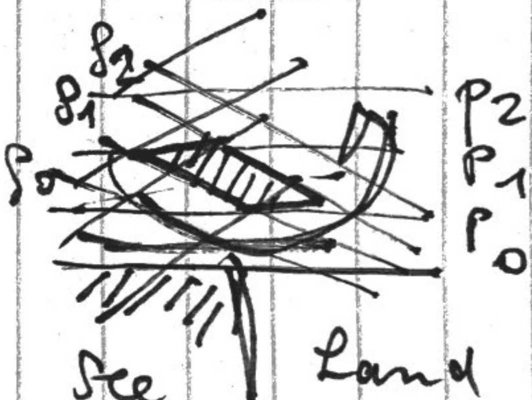
$$= \dot{\vec{\omega}} \times \hat{x} + \vec{\omega} \times (\vec{\omega} \times \hat{x})$$



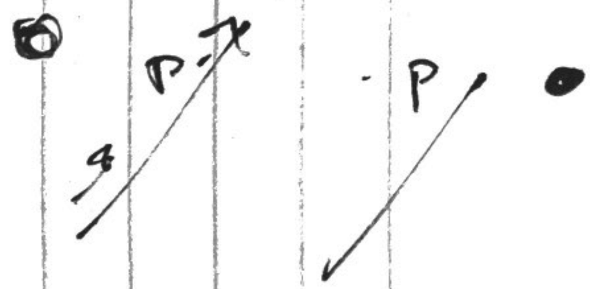


Hadley

Trade Winds



See Land



Bjerknes