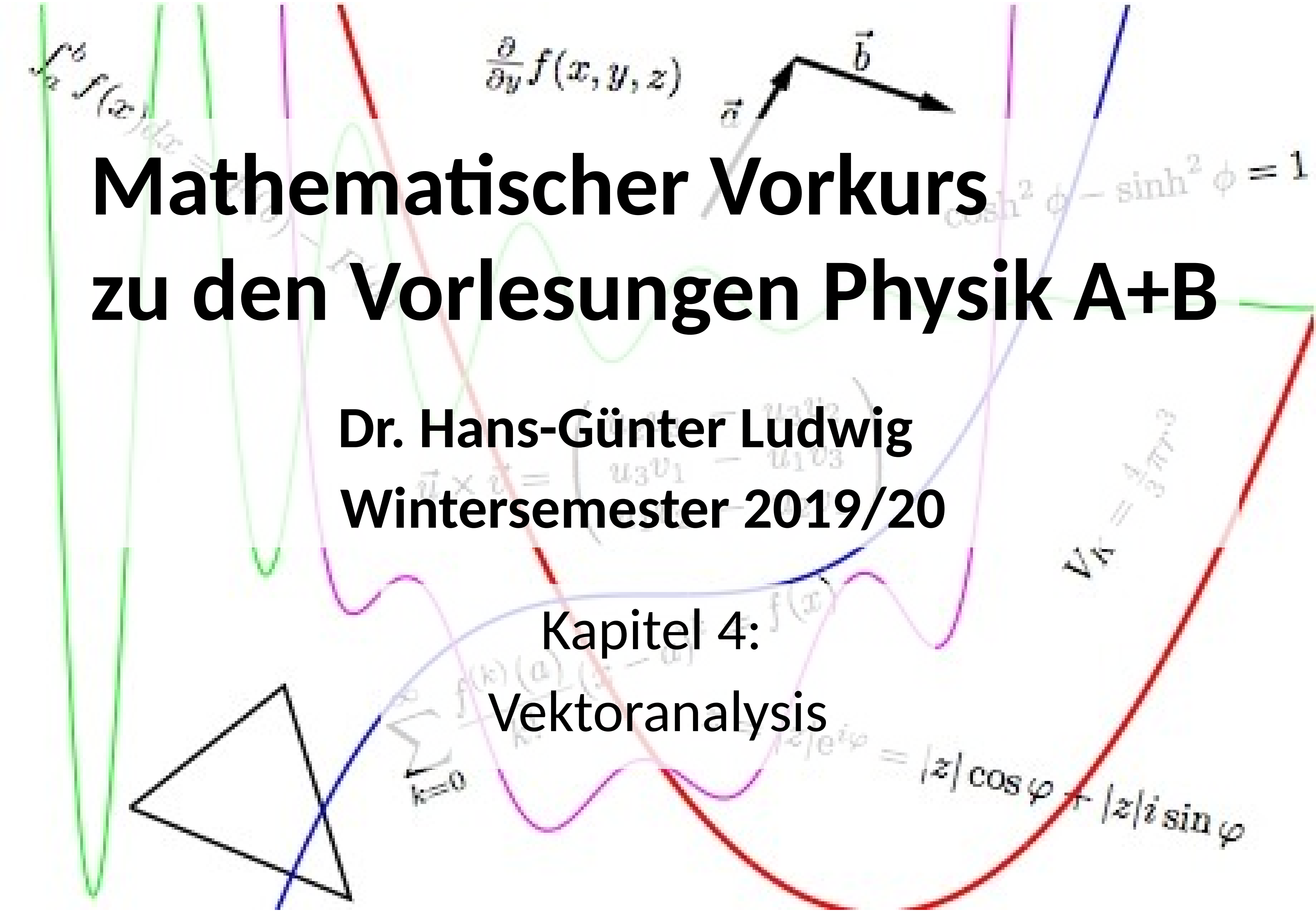


Mathematischer Vorkurs zu den Vorlesungen Physik A+B

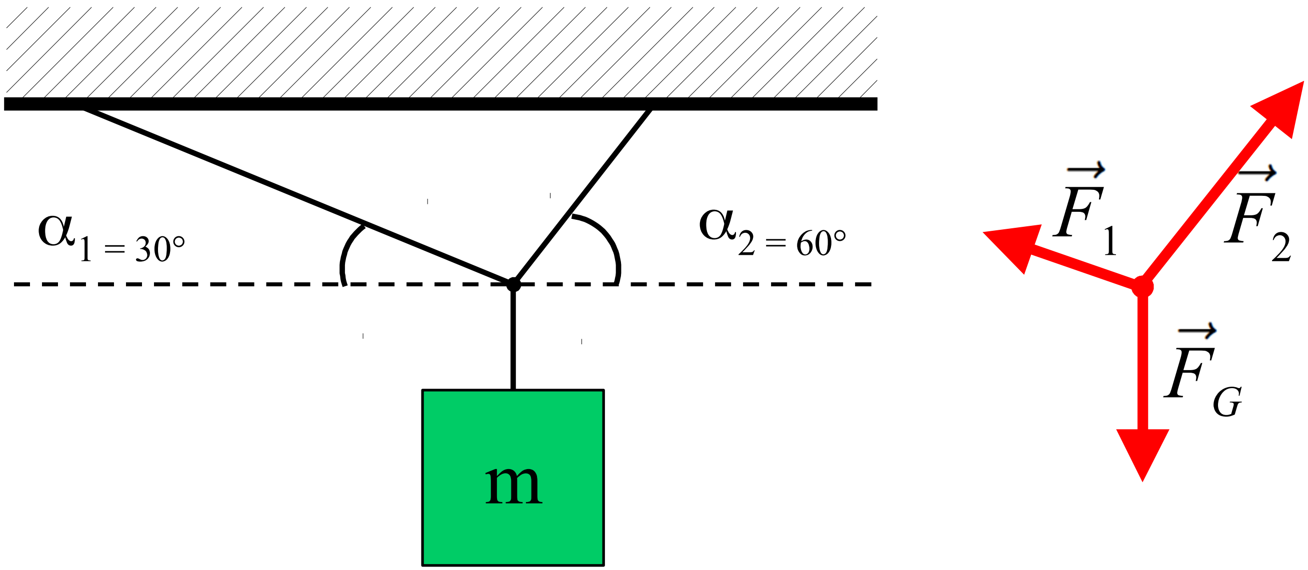
Dr. Hans-Günter Ludwig

Wintersemester 2019/20

Kapitel 4:

Vektoranalysis

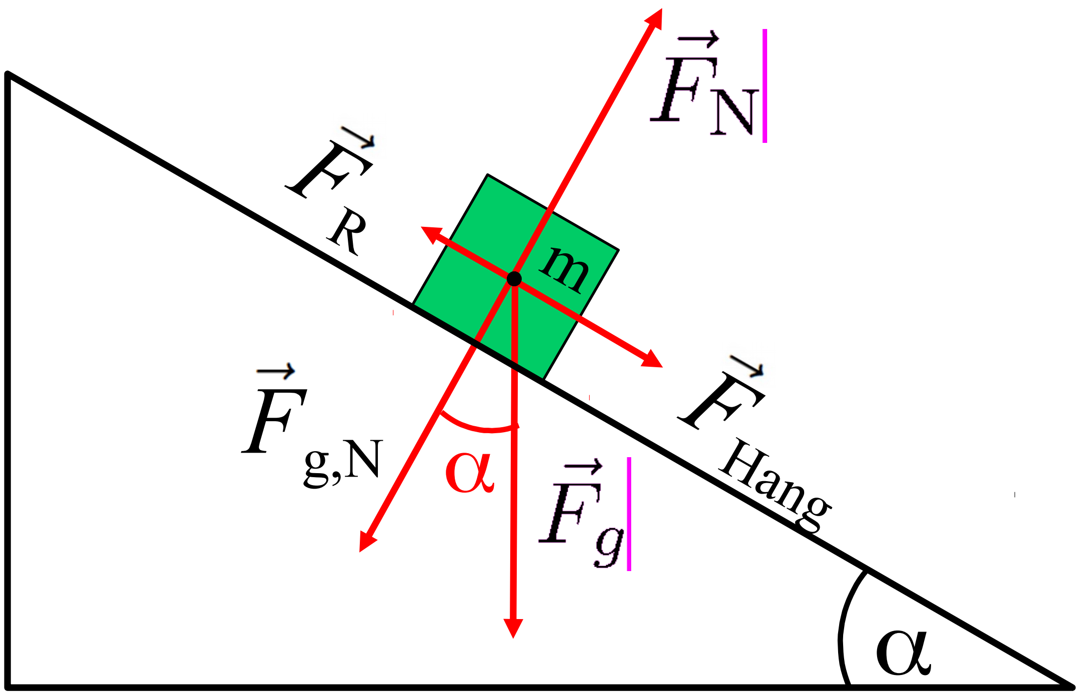
Kräftediagramme

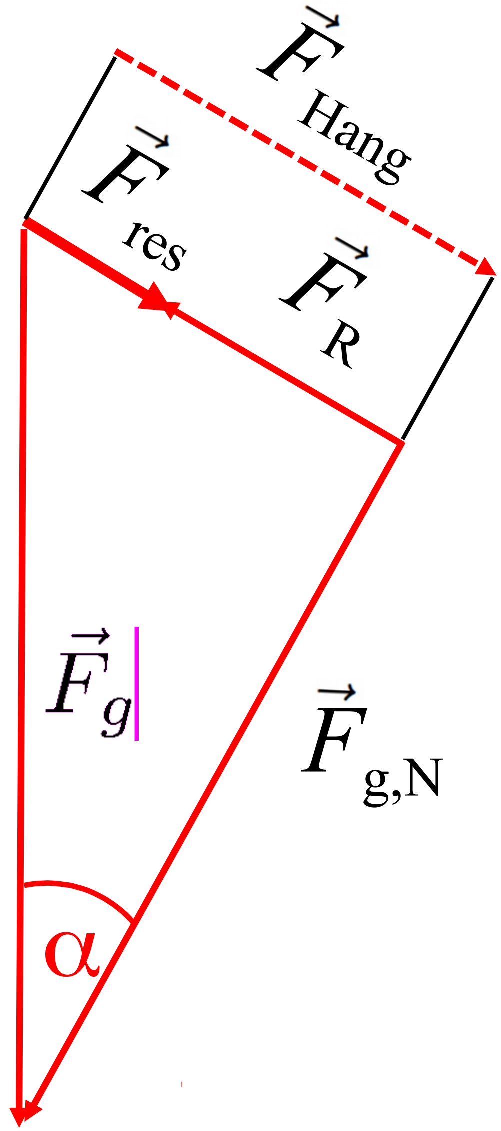


$$|\vec{F}_2| = \frac{mg}{\sin\alpha_2 + \frac{\cos\alpha_2}{\cos\alpha_1}\sin\alpha_1} = 8,5\,\mathrm{N} \qquad (m = 1\ \mathrm{kg})$$

$$|\vec{F}_1| = |\vec{F}_2| \cdot \frac{\cos\alpha_2}{\cos\alpha_1} = 4,9\,\mathrm{N} \qquad (m = 1\ \mathrm{kg})$$

Schiefe Ebene *mit* Reibung





$$\boxed{F_{res} = m \cdot g\,(\sin\alpha - \mu G \cos\alpha)}$$

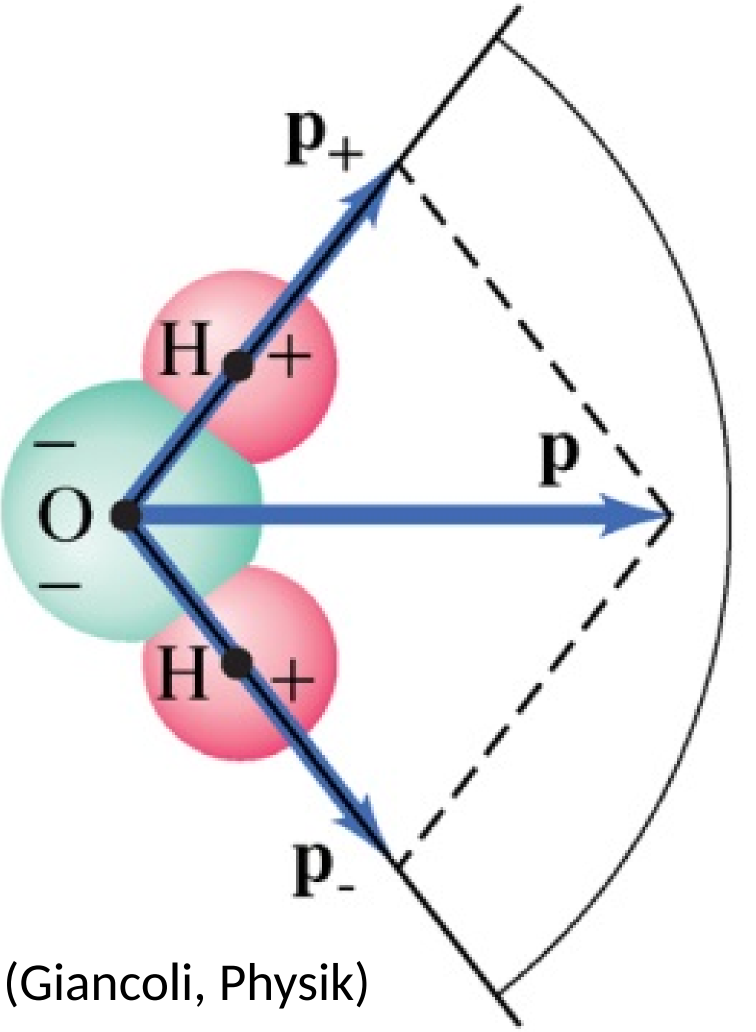
Dipolmoment von Molekülen

H_2O $6{,}152 \cdot 10^{-30}$ C m

CO $0{,}367 \cdot 10^{-30}$ C m

NaCl $28{,}356 \cdot 10^{-30}$ C m

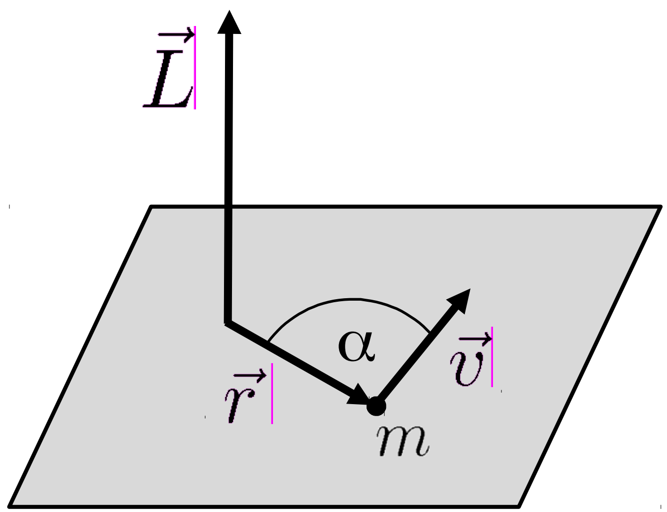
(Quelle: Wikipedia)



(Giancoli, Physik)

Drehimpuls

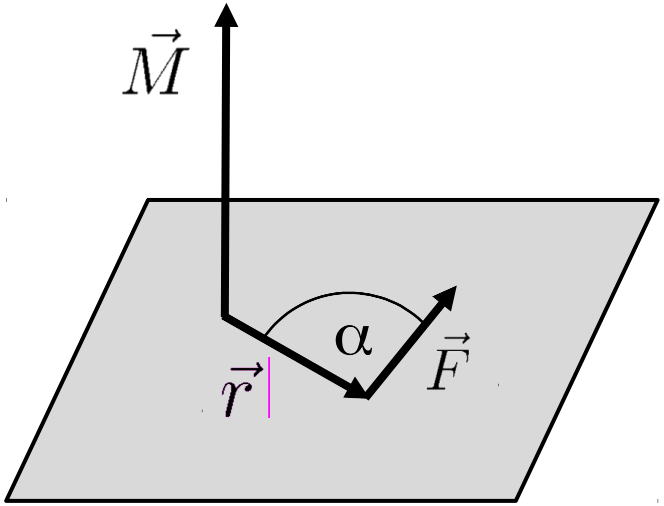
$$\boxed{\vec{L} = \vec{r} \times \vec{p} = \vec{r} \times m\vec{v}}$$



Drehmoment

$$\boxed{\vec{M} \equiv \vec{r} \times \vec{F}}$$

$$\boxed{\vec{M} = \frac{\mathrm{d}\vec{L}}{\mathrm{d}t}}$$



2D-Kinematik

- Bewegungen in einer Ebene.
- Wenn Koordinatenachsen senkrecht (z.B. kartesisches Koordinatensystem; Gegenbeispiel: Polarkoordinaten), dann ist die 2D-Bewegung die Vektorsumme zweier unabhängiger 1D-Bewegungen.
- Daher nun Übergang zu Vektorgrößen:

$$
\begin{aligned}
x &\rightarrow \vec{x} \\
v &\rightarrow \vec{v} := \lim_{\Delta t \rightarrow 0} \left(\frac{\Delta \vec{x}}{\Delta t} \right) = \frac{\mathrm{d}\vec{x}}{\mathrm{d}t} \\
a &\rightarrow \vec{a} := \lim_{\Delta t \rightarrow 0} \left(\frac{\Delta \vec{v}}{\Delta t} \right) = \frac{\mathrm{d}\vec{v}}{\mathrm{d}t}
\end{aligned}
$$

Rechte-Hand-Regel

Maxwell-Gleichungen

$$\oint \vec{E} \cdot d\vec{A} = q_{\mathrm{ein}}/\epsilon_0 \qquad \mathrm{div}\, \vec{E} = \frac{\rho}{\varepsilon_0}$$

$$\oint \vec{B} \cdot d\vec{A} = 0 \qquad \mathrm{div}\, \vec{B} = 0$$

$$\oint \vec{E} \cdot d\vec{s} = -\frac{d\Phi_B}{dt} \qquad \mathrm{rot}\, \vec{E} + \frac{\partial \vec{B}}{\partial t} = 0$$

$$\oint \vec{B} \cdot d\vec{s} - \mu_0 \epsilon_0 \frac{d\Phi_E}{dt} = \mu_0 i_{\mathrm{um}} \qquad \mathrm{rot}\, \vec{B} - \mu_0 \varepsilon_0 \frac{\partial \vec{E}}{\partial t} = \mu_0 \vec{j}$$