Klassische Teilchen und Felder
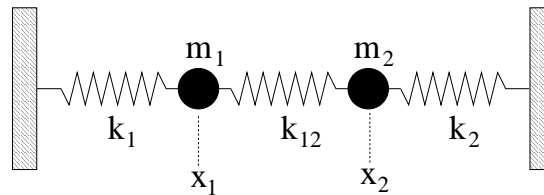
Vorlesung: Luis Santos – Übungen: Garu Gebreyesus & Tobias Wirth

[P4] coupled oscillations

Consider two masses m_1 and m_2. The masses are coupled to each other and fixed to a wall by strings with spring constants k_1, k_{12} and k_2 – see figure below. The movement is hence one-dimensional.


a) Determine the equations of motion for $y_{j=1,2} \equiv x_j - x_{j0}$, where x_{j0} is the rest position of mass m_j.

b) Look for solutions of this equations of the form $y_i = \alpha_i \cos \omega t$ and derive the possible values of ω.

c) Consider the symmetric system, i.e. $m = m_1 = m_2$ and $k = k_1 = k_2$, and determine the possible values of ω and the corresponding vectors $\vec{\alpha} = (\alpha_1, \alpha_2)$. What motions correspond to the normal modes found above?

[P5] Scattering of hard spheres

Consider two hard spheres of Radius A and masses m_1 and m_2. The sphere can move frictionless. Initially sphere 2 is at rest (in the laboratory frame) whereas sphere 1 moves with momentum $\vec{p}_1 = p_1 \vec{e}_x$ ($p_1 > 0$). The trajectory of the center of sphere 1 is parallel to the x axis at a distance A to it. The center of sphere 2 lies directly on the x axis.

– Consider the collision between the two spheres. In particular, what is the angle between the outgoing trajectory of sphere 1 and the x axis after the collision? What about sphere 2? Do the calculations in the laboratory frame.

– Express the outgoing momenta of the spheres in the center of mass frame.

Hint: The momentum transfer in the collision occurs due to the contact of the two spheres. So only the component of the momentum along the direction joining the centers is modified ($\perp$ direction in the figure).
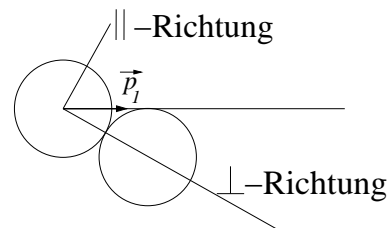
Abgabe der Ausarbeitungen der Hausübungen ist Dienstags <u>VOR</u> der Vorlesung, d.h. bis <u>08:15 Uhr</u>. Eine spätere Abgabe ist nicht möglich!