Table of contents

$\exists$ Work done or received $W \neq 0 \Rrightarrow \exists$ Change of State ("Displacement", "Deformation") $r \neq 0$:

$$E = \mathcal{K} + \mathcal{U} \qquad E_{kin} := \mathcal{K} = \frac{1}{2}pv \qquad E_{pot} := \mathcal{U} = \mathcal{V} + \mathcal{Z} \tag{1}$$

Energy is conserved in konservative systems; There is no work in closed path between two points (loop) of any shape under path variation, hence the "Principle of Action" applies (extremities of bumps and saddles exist): $\delta A = 0$

Potentials:

$$\begin{aligned} &\mathcal{U} = \mathcal{V} + \mathcal{Z} \\ &\mathcal{V} \begin{cases} = \frac{1}{2}kr^2 : \text{isotrop harmonical oscilator central field Potential,} \\ \qquad \text{closed bounded path, "spring constant" } k = m\omega^2 = 2\pi \cdot \nu \\ = -\frac{1}{r}\alpha : \text{gravitational central field Potential,} \\ \qquad \text{closed bounded path, } \alpha = \left(\frac{2\pi}{\Delta\varphi}\right)^2 = const. \\ \sim \frac{1}{r}e^{\mu r} : \text{Yukawa Potential, "Photon mass" } m_\gamma = \mu\frac{\hbar}{c} \\ \ldots \end{cases} \end{aligned} \tag{2}$$

Centrifugal Potential:

$$\mathcal{Z} = \frac{1}{2}\frac{1}{m}\left(\frac{L_0}{r}\right)^2, \text{ angular momentum} = L_0 \tag{3}$$

Work:

$$W = \partial_t A = \partial_t(E \cdot t) = \partial_t(p \cdot r) = F_1 \cdot r_1 + p_2 \cdot v_2 = \begin{cases} F \cdot r \\ p \cdot v \end{cases} \tag{4}$$

Geometrical:

$$W = F \cdot r = mr \cdot a = I \cdot \frac{v}{t} = \frac{p}{t} \cdot tv = Ft \cdot v = pv = mv^2 \tag{5}$$

Analytical:

$$\mathcal{L} = \mathcal{L}(r, \dot{r}, t) = E_{kin} - E_{pot} \tag{6}$$

© Update at eugenionet.github.io/physecon

$$\mathcal{H} = \mathcal{H}(r,p,t) = \sum_i^f \dot{r}_i p_i - \mathcal{L} \overset{konserv.}{=} E_{kin} + E_{pot} = const. \tag{7}$$

$$A = E \cdot t = p \cdot r \overset{\mathcal{H}=0}{=} \int_{t_0}^{t_x} \mathcal{L} dt \tag{8}$$

$$\begin{aligned} W &= p \cdot v = \mathcal{L} + \mathcal{H} = (\mathcal{K} - \mathcal{U}) + \mathcal{H} \\ &\overset{konserv.}{=} (\mathcal{K} - \mathcal{U}) + (\mathcal{K} + \mathcal{U}) = (\mathcal{K} - \mathcal{U}) + E \end{aligned} \tag{9}$$

Electro Magnetic:

$$W = \mathcal{L} + \mathcal{H} = \left(\frac{1}{2} m v^2 - q(\Phi - \vec{\mathcal{A}} \cdot \vec{v})\right) + \left(\frac{1}{2}\frac{1}{m}(\vec{p} - q\vec{\mathcal{A}})^2 + q\Phi\right) \tag{10}$$

Relativistic:

$$W = p \cdot v = \frac{v}{c}\sqrt{E^2 - (mc^2)^2} \tag{11}$$

Thermal:

$$\begin{aligned} W &= Fr = PV^{\iota} = T \cdot V^{\frac{f+2}{f}} = T \cdot V^{(\frac{c_P}{c_V} - 1)} = TV^{\kappa - 1} \\ &= T \cdot l \cdot g_0 = T \cdot n \cdot b_0 = T \cdot m \cdot c_0 \end{aligned} \tag{12}$$

Thermo Statistical:

$$W = \mathcal{L} + \mathcal{H} = \Delta U - \Delta H = \Delta(T \cdot \Delta S - P \cdot \Delta V) - \Delta(T \cdot S) \tag{13}$$

Quantistic:

$$W = p \cdot v = k \cdot \omega = h\nu k = Ek \tag{14}$$

$$\Delta A = \Delta p \cdot \Delta r = \Delta E \cdot \Delta t \geq \frac{1}{2}\hbar \tag{15}$$

see description of "movement" **?@eq-movement**

acronyms see **?@sec-acroworkenergy**

© Update at eugenionet.github.io/physecon