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

$$\begin{aligned} r &= r(t) = r_x(t_x) - r_0(t_0) = \Delta r(\Delta t) \\ &\overset{Path}{=} State(arrival) - State(start) = Trajectory(Change) \end{aligned} \tag{1}$$

$$v = \dot{r} = \frac{d}{dt}r \qquad p = \frac{1}{v}\sqrt{E^2 - (mv^2)^2} \qquad F = \dot{p} = \frac{d}{dt}p \tag{2}$$

$$E = E_{kin} + E_{pot} \qquad E_{kin} = \frac{f}{n}pv \qquad E_{pot} = \mathcal{V} + \mathcal{Z} \tag{3}$$

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

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:

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

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

$$\begin{aligned} W &= p \cdot v = \mathcal{L} + \mathcal{H} = (\mathcal{K} - \mathcal{U}) + \mathcal{H} \\ &\overset{konserv.}{=} (\mathcal{K} - \mathcal{U}) + (\mathcal{K} + \mathcal{U}) = (\mathcal{K} - \mathcal{U}) + E \end{aligned} \tag{8}$$

Electro Magnetic:

$$W = \mathcal{L} + \mathcal{H} = \left(\frac{1}{2}mv^2 - q(\Phi - \vec{A} \cdot \vec{v})\right) + \left(\frac{1}{2}\frac{1}{m}(\vec{p} - q\vec{A})^2 + q\Phi\right) \tag{9}$$

Relativistic:

$$W = p \cdot v = \frac{v}{c}\sqrt{E^2 - (mc^2)^2} \tag{10}$$

Thermal:

$$W = F \cdot r = PV^{\iota} = T \cdot V^{\frac{f+2}{f}} = T \cdot V^{(\frac{c_P}{c_V} - 1)} = T \cdot V^{\kappa - 1} = T \cdot l \cdot g_0 = T \cdot n \cdot b_0 = T \cdot m \cdot c_0 \tag{11}$$

Thermo Statistical:

$$W = \mathcal{L} + \mathcal{H} = \Delta U - \Delta H = \Delta(T \cdot \Delta S - P \cdot \Delta V) - \Delta(T \cdot S) \tag{12}$$

Quantistic:

$$W = p \cdot v = k \cdot \omega = h\nu k = Ek \tag{13}$$

$$\Delta A = \Delta p \cdot \Delta r = \Delta E \cdot \Delta t \geq \frac{1}{2}\hbar \tag{14}$$

see description of "movement" Equation 2

acronyms see **?@sec-acroworkenergy**