On the Classical Mechanics of Particles II

Annex II

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Work and Energy

The total inertial work W_a° done by the forces acting on a particle A is given by

$$W_a^\circ = \int_{\mathbf{r}_{ao}^\circ}^{\mathbf{r}_a^\circ} \sum \mathbf{F}_a \cdot d\mathbf{r}_a^\circ$$

that is

$$W_a^\circ = \int_{\mathbf{r}_{ao}^\circ}^{\mathbf{r}_a^\circ} m_a \mathbf{a}_a^\circ \cdot d\mathbf{r}_a^\circ$$

resulting in

$$W_a^\circ = \Delta E_{K_a}^\circ$$

Therefore, the total inertial work done by the forces acting on a particle A is equal to the inertial kinetic energy difference of particle A.

The inertial kinetic energy $E_{K_a}^\circ$ of a particle A is given by

$$E_{K_a}^\circ = {}^1\!/_2 m_a \mathbf{v}_a^{\circ 2}$$

where m_a is the inertial mass of particle A, and $\mathbf{v}_a^\circ$ is the inertial velocity of particle A.

The inertial velocity $\mathbf{v}_a^\circ$ of a particle A relative to a reference frame S fixed to a particle S is given by

$$\mathbf{v}_a^\circ = \mathbf{v}_a + \mathbf{v}_s^\circ$$

where $\mathbf{v}_a$ is the real velocity of particle A, and $\mathbf{v}_s^\circ$ is the inertial velocity of particle S.