

# Is the principle of energy a tautology ?

Alejandro A. Torassa

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(2011) Buenos Aires, Argentina  
atorassa@gmail.com

## Abstract

This paper shows that it is possible to obtain the principle of energy starting from the acceleration of a particle.

In classical mechanics, if we consider a force field (uniform or non-uniform) in which the acceleration  $\mathbf{a}_A$  of a particle A is constant, then

$$\begin{aligned}\mathbf{a}_A &= \mathbf{a}_A \\ \int_a^b \mathbf{a}_A \cdot d\mathbf{r}_A &= \int_a^b \mathbf{a}_A \cdot d\mathbf{r}_A \\ \Delta \frac{1}{2} \mathbf{v}_A^2 &= \Delta \mathbf{a}_A \cdot \mathbf{r}_A \\ \Delta \frac{1}{2} \mathbf{v}_A^2 - \Delta \mathbf{a}_A \cdot \mathbf{r}_A &= 0 \\ m_A \left( \Delta \frac{1}{2} \mathbf{v}_A^2 - \Delta \mathbf{a}_A \cdot \mathbf{r}_A \right) &= 0 \\ \Delta T_A + \Delta V_A &= 0 & T_A = \frac{1}{2} m_A \mathbf{v}_A^2 \\ T_A + V_A &= \text{constant} & V_A = - m_A \mathbf{a}_A \cdot \mathbf{r}_A\end{aligned}$$

If  $\mathbf{a}_A$  is not constant but  $\mathbf{a}_A$  is function of  $\mathbf{r}_A$  then the same result is obtained, even if Newton's second law were not valid.