

# On the Classical Mechanics of Particles III

## Annex I

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### **Reformulation of the New Dynamics**

First definition: The tension  $\mathbf{T}$  acting on a particle is a vector quantity representing a type of interaction between particles.

The transformation of tensions from one reference frame to another is given by

$$\mathbf{T}' = \mathbf{T}$$

Second definition: The force  $\mathbf{F}$  acting on a particle is a vector quantity representing another type of interaction between particles.

The transformation of forces from one reference frame to another is given by

$$\mathbf{F}' = \mathbf{F}$$

Third definition: The inertial mass  $m$  of a particle is a scalar quantity representing a constant characteristic of the particle.

The transformation of inertial masses from one reference frame to another is given by

$$m' = m$$

Fourth definition: The inertial acceleration  $\mathbf{a}^\circ$  of a particle is equal to the sum of the forces  $\sum \mathbf{F}$  acting on the particle divided by the inertial mass  $m$  of the particle.

$$\mathbf{a}^\circ = \frac{\sum \mathbf{F}}{m}$$

First principle: A particle can have any state of motion.

Second principle: The tensions acting upon a particle A always remain balanced.

$$\sum \mathbf{T}_a = 0$$

Third principle: If a particle A exerts a tension  $\mathbf{T}$  on a particle B, then particle B exerts on particle A a tension  $-\mathbf{T}$  of the same magnitude but opposite direction.

$$\mathbf{T}_a = -\mathbf{T}_b$$

The dynamic tension  $\mathbf{T}_{Dab}$  exerted on a particle A by another particle B, caused by the interaction between particle A and particle B, is given by the following equation:

$$\mathbf{T}_{Dab} = \mathbf{a}_a^\circ - \mathbf{a}_b^\circ$$

where  $\mathbf{a}_a^\circ$  is the inertial acceleration of particle A, and  $\mathbf{a}_b^\circ$  is the inertial acceleration of particle B.

The kinetic tension  $\mathbf{T}_{Kab}$  exerted on a particle A by another particle B, caused by the interaction between particle A and particle B, is given by the following equation:

$$\mathbf{T}_{Kab} = \mathbf{a}_b - \mathbf{a}_a$$

where  $\mathbf{a}_b$  is the real acceleration of particle B, and  $\mathbf{a}_a$  is the real acceleration of particle A.

From the previous statements it follows that the difference between the inertial acceleration  $\mathbf{a}_a^\circ$  and the real acceleration  $\mathbf{a}_a$  of a particle A is equal to the difference between the inertial acceleration  $\mathbf{a}_b^\circ$  and the real acceleration  $\mathbf{a}_b$  of another particle B.

$$\mathbf{a}_a^\circ - \mathbf{a}_a = \mathbf{a}_b^\circ - \mathbf{a}_b$$

From the previous statements it follows that the real acceleration  $\mathbf{a}_a$  of a particle A relative to a reference frame S fixed to a particle S is equal to the difference between the inertial acceleration  $\mathbf{a}_a^\circ$  of particle A and the inertial acceleration  $\mathbf{a}_s^\circ$  of particle S.

$$\mathbf{a}_a = \mathbf{a}_a^\circ - \mathbf{a}_s^\circ$$