EXAMPLE OF RELABELLING OF SUMMATION INDICES

Let: $\qquad x^\mu = (ct, X, Y, Z)$ $\hspace{5cm}$ (1)

$\qquad\qquad x_\mu = (ct, -X, -Y, -Z)$ $\hspace{4cm}$ (2)

Then: $\qquad x^\mu x_\mu = c^2 t^2 - X^2 - Y^2 - Z^2$ $\hspace{3cm}$ (3)

$\qquad\qquad = x^0 x_0 + x^1 x_1 + x^2 x_2 + x^3 x_3$ $\hspace{2.5cm}$ (4)

Therefore a repeated μ index implies summation. This is the Einstein convention.

If we change μ to ν, for example, then:

$$x^\mu x_\mu = x^\nu x_\nu = c^2 t^2 - X^2 - Y^2 - Z^2 \hspace{2.5cm} (5)$$

This is known as <u>relabelling of summation índices</u>. Sometimes these are known as dummy indices. This procedure occurs in many proofs of Riemann and Cartan geometry. In the latter, Latin indices are used, so, for example:

$$x^a x_a = c^2 t^2 - X^2 - Y^2 - Z^2 \hspace{2.5cm} (6)$$