The Real Meaning of the Spacetime-Interval

FLORENTIN SMARANDACHE, University of New Mexico — The spacetime interval is measured in light-meters. One light-meter means the time it takes the light to go one meter, i.e. $3 \cdot 10^{-9}$ seconds. One can rewrite the spacetime interval as $\Delta s^2 = c^2(\Delta t)^2 - [(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2]$. There are three possibilities: a) $\Delta s^2 = 0$ which means that the Euclidean distance $L_1L_2$ between locations $L_1$ and $L_2$ is travelled by light in exactly the elapsed time $\Delta t$. The events of coordinates $(x, y, z, t)$ in this case form the so-called light cone. b) $\Delta s^2 > 0$ which means that light travels an Euclidean distance greater than $L_1L_2$ in the elapsed time $\Delta t$. The below quantity in meters: $\Delta s = \sqrt{c^2(\Delta t)^2 - [(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2]}$ means that light travels further than $L_2$ in the prolongation of the straight line $L_1L_2$ within the elapsed time $\Delta t$. The events in this second case form the time-like region. c) $\Delta s^2 < 0$ which means that light travels less on the straight line $L_1L_2$. The below quantity, in meters: $-\Delta s = \sqrt{-c^2(\Delta t)^2 + [(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2]}$ means how much Euclidean distance is missing to the travelling light on straight line $L_1L_2$, starting from $L_1$ in order to reach $L_2$. The events in this third case form the space-like region. We consider a diagram with the location represented by a horizontal axis $(L)$ on $[0, \infty)$, the time represented by a vertical axis $(t)$ on $[0, \infty)$, perpendicular on $(L)$, and the spacetime distance represented by an axis $(\Delta s)$ perpendicular on the plane of the previous two axes. Axis $(\Delta s)$ from $[0, \infty)$ is extended down as $(-\Delta s)$ on $[0, \infty)$. 

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