From McTaggart to the Relativistic Time-like Dimension

Witold Wiszniewski

This paper deals with the nature of the relativistic time-like dimension and interval metric. There are two metaphysical assumptions of this analysis. Firstly the A-type theory of time is taken as correct. After Dummett McTaggart's proof of unreality of time is also taken to be correct with the conclusion that yet this proof does not refute this theory. The second assumption is that a subjective Newtonian spacetime, that is inertial frame of reference, is real and all spatiotemporal observations taken there are also real.

The core idea of the paper is that in certain cases diverse *things* appear to be at the same time whereas they should be sequentially in time. First of all we have philosophical claim of McTaggart that "If events are located in a real A-series, then each event acquires the absolute properties of past now and future". Secondly in STR we have the Poincaré's clock or the Twins paradox in which an observer placed in real but subjective Newtonian spacetime witnesses the fact that the light ray (or the twin which travels with the speed asymptotically close to speed of light) returns from the round trip not aged at all. Factually it travelled the non-zero distance at the same time, which is a contradiction from the perspective of a Newtonian spacetime but not from perspective of relativistic one. In turn QM presents the situation where for example the spin of electron can be in a superposition state with two values $\frac{1}{2}\hbar$, $-\frac{1}{2}\hbar$ at the same time.

We now propose that time-like dimension is composed of something being unnaturally at the same time. Because we are always *now* it is impossible to grasp more than one moment of time. But the time-like dimension must be a superposition of all moments positioned on a space-like line. As this line is the collection of diverse moments therefore they are taken *at the same time* in the same way as the collection of the spatial points is. So how can we construct such a time-line? Well if we take the propagation of light along a straight line then from the perspective of a subjective Newtonian spacetime we have such a line, but *from the light perspective* (inertial frame of reference moving with the speed of light) we will have of all moments of time appear at the same time. Therefore a straight propagation the light ray can represent time-like dimension. If this reasoning is applied to the Poincaré's clock which defines time with the forward $\frac{1}{2}ct$ and back $-\frac{1}{2}ct$ light displacements, then we see that the moments of light emission, reflection and detection are not only sequential in time but they are also at the same time as well. If so, then the displacements $\frac{1}{2}ct$, $-\frac{1}{2}ct$ occur at the same time which is equivalent to the displacements $\frac{1}{2}ct$, $-\frac{1}{2}ct$ occurring forward and back in time. Thus the time-like dimension can be given by a superposition of two inversely orientated axes on which displacements $\frac{1}{2}ct$ and $-\frac{1}{2}ct$ are laid on.

Now we will provide further justification for the co-temporal displacements $\frac{1}{2}ct$ and $-\frac{1}{2}ct$, which we denote $[\frac{1}{2}ct - \frac{1}{2}ct]$. For the philosophical justification we say that time flow is given by an actual and sequential change, which is a change in respect to time. But time flow is abstraction from all changes therefore it changes in relation to nothing and therefore cannot be sequential. Upholding the reality of time flow we are bound to say that time flow is the occurrence of the diverse moments of time and thus displacements at the same time because there is no other way of temporal ordering as A-type and B-type

ordering will not do. This means that an observer *sitting on time wagon* has all events of the world contracted to one temporal point. Time from time perspective is not as strange as it might sound. After all in STR time is a propagation of light and therefore there is a legitimate perspective of time from the time point of view. Again in this light and therefore time perspective all happens at the same time as long as it is not infinitely separated in the perspective of subjective Newtonian spacetime. This was also the insight of McTaggart when justifying the contradictory occurrence sequential things at the same time he claimed that there had to be temporal account according to which it is true that Queen Ann will dye, Queen Ann has died and Queen Ann died. Interestingly the justification of our proposed model of time-like dimensions becomes the same task as the justification of McTaggart's proof.

Now we go to a more physics-like justification by giving the so-called double arrow contradiction argument which arises from the relativistic rule of compounding velocities: $w = (u + v)/(1 + uv/c^2)$ as seen from the subjective Newtonian spacetime perspective. Specifically STR implies that for $u = v = c$ the compounded displacement in time t is $ct + ct \rightarrow ct$. The observer in the subjective spacetime concludes that it should rather be $ct + ct = 2ct$ which contradicts the above. Considering the factual nature of the first point the observer stipulates that it could be that in the second displacement ct consists of displacements ½ ct and - ½ ct at the same time so the compounding occurs as $ct + ct \rightarrow ct + [½\ ct - ½\ ct]$ where the bracket term becomes zero. This argument can be extended to cover cases of perpendicular light rays displacements especially the case of Poincaré's clock In summary and formally we can make sense out of the relativistic compounding rule by proposing opposite sign displacements at the same time. Finally as said before the analysis of Poincaré's clock and Twins Paradox taken from the perspective of subjective Newtonian spacetime also supports the claim that apart of normal sequential way ½ ct and -½ ct also occur at the same time but this time without collapsing to zero.

Now we want to consider a possibility that displacements [½ ct - ½ ct] are not formal but real in a sense that they do not collapse to zero but rather they create inseparable union of two equal length opposite vectors marked for short $\uparrow\downarrow$ where $\uparrow = ½\ ct$ and $\downarrow = -½\ ct$? This union is similar to a quantum superposition state say of two opposite sign spin values. In agreement with the intuitive account of time-like dimension we claim that in the relativistic spacetime the time-like dimension is given by $\uparrow\downarrow$. To prove it is enough to show that $(\uparrow\downarrow)^2 = -(ct)^2$. Let us evaluate the nature of a bond creating union $\uparrow\downarrow$. A chemical analogy may be helpful here. We treat $\uparrow\downarrow$ as something like a chemical compound formed by the *reaction* $\uparrow\downarrow = \uparrow\bullet + \bullet\downarrow$ where the dot symbol $\bullet$ represents *unsaturated* bond. We also assume that $(\uparrow\bullet \times \bullet\downarrow) = -(ct)^2/4$ and the following apply: $\uparrow\bullet = -\bullet\uparrow$ and $\uparrow\bullet = -\downarrow\bullet$. Doing calculations we have: $(\uparrow\downarrow)^2 = (\uparrow\bullet + \bullet\downarrow)\times(\uparrow\bullet + \bullet\downarrow) = (\uparrow\bullet\times\uparrow\bullet) + (\uparrow\bullet\times\bullet\downarrow) + (\bullet\downarrow\times\uparrow\bullet) + (\bullet\downarrow\times\bullet\downarrow)$. $(\uparrow\bullet\times\bullet\downarrow) = -(ct)^2/4$ and $(\uparrow\bullet\times\uparrow\bullet) = (-\uparrow\bullet\times\bullet\uparrow) = (\uparrow\bullet\times\bullet\downarrow) = -(ct)^2/4$ and $(\bullet\downarrow\times\uparrow\bullet) = (\uparrow\bullet\times\bullet\downarrow) = -(ct)^2/4$ and finally $(\bullet\downarrow\times\bullet\downarrow) = -\downarrow\bullet\times\bullet\downarrow = \uparrow\bullet\times\bullet\downarrow = -(ct)^2/4$. Thus in sum: $(\uparrow\downarrow)^2 = -(ct)^2$. The interval metric is derived.