

A brief note on space-time spin

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Abstract: Space-time signature can be derived via a simple sort of spin-formalism. This formalism is described in a short comment .It comes from a simple Boole-algebra.

Key-words: spacetime-signature; spin-formalism; boole-algebra; rank;dual-system;spin-2-particle.

1. Introduction:

In classical local flat spacetime of tangential space in Minkowski-type but also in description of GRT and gravity there is used a four-dimensional form of spacelike and timelike dimensions of signature in main diagonal-line of a fundamental tensor: $s=(+1/+1/+1/-1)$ or $s=(-1/-1/-1/+1)$ [1.],[2.],[3.]. Since in Minkowski-space covariant and contravariant vectorfields are indistinguishable, the choice of version is arbitrary there but in GRT there must be told, which form is used [4.],[5.],[6.].

2.Concrete modelling:

The imaginary, concrete model (analog to Maxwells methods) on which the problem is based consists of an electric circuit diagram of a lamp and two switches in a series construction. There are four possibilities:

1. Both switches A,B closed, - lamp lightning,
2. Switch A closed, switch B opened, - lamp out,
3. Switch A open, switch B closed, - lamp out,
4. Both switches A and B open, - lamp out.

3.Calculation:

Each state of the switches can be related to a defined form of spacetime-spin in a system: the different states are called SpIN and SpOUT.

1. $\psi_1 \Rightarrow \Leftarrow \psi_2$ means $s=-1$, timelike state of spacetime: “SpIN-SpIN”,
2. $\psi_1 \Leftarrow \Leftarrow \psi_2$ means $s=1$, spacelike state of spacetime: ”SpOUT-SpIN” , (1.a-1.d)
3. $\psi_1 \Rightarrow \Rightarrow \psi_2$ means $s=1$, spacelike state of spacetime: “SpIN-SpOUT”,
4. $\psi_1 \Leftarrow \Rightarrow \psi_2$ means $s=-1$. spacelike state of spacetime: “SpOUT-SpOUT”.

The arrows explain the spacetime spin-state direction, however these will be interpreted.

Remark: Instead of speaking of “up and down” like ordinary spin-system its here the meaning of “in and out” . This also can be written in a version of Diracs bracket-notation $\langle SpIN|SpOUT \rangle$ or in formulation of QFTH with creation- and annihilation quantum operators a^{+1}, a^{-1} . Possibly these states can be connected to causal ingoings and outgoings of an fourcevent in lightcone- or conoid-description.

Furthermore this spin system confirms a simple form of a Boole-Algebra:

$$\begin{array}{ll}
 \psi_1 \wedge \psi_2 = W & 1 \wedge 1 = 1 \\
 \neg \psi_1 \wedge \psi_2 = F & \rightarrow 1 \wedge 0 = 0 \\
 \psi_1 \wedge \neg \psi_2 = F & 0 \wedge 1 = 0 \\
 \neg \psi_1 \wedge \neg \psi_2 = F & 0 \wedge 0 = 0
 \end{array} \quad , \quad (2.a-2.d)$$

where 1 means “SpIN” and 0 means “SpOUT”.

This corresponds with the signature structure of $(+1/-1/-1/-1)$ of the local classical four-spacetime. The inverted analogon of signature s then can be constructed via an “or”- relation in Boole-algebra (this means concrete a parallel-circuit of a lamp and two switches):

$$\begin{array}{ll}
 \psi_1 \vee \psi_2 = W & 1 \vee 1 = 1 \\
 \neg \psi_1 \vee \psi_2 = W & \rightarrow 0 \vee 1 = 1 \\
 \psi_1 \vee \neg \psi_2 = W & 1 \vee 0 = 1 \\
 \neg \psi_1 \vee \neg \psi_2 = F & 0 \vee 0 = 0
 \end{array} \quad (3.a-3.d)$$

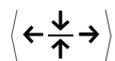
And this structure corresponds with signature-form s of $(+1/+1/+1/-1)$.

4. Spin-structure of spin-2-particles generates four-signature:

The classical signature s can be generated by structure of spin-1-particles (s1p) or spin-2-particles (s2p). Since s1p are included in s2p, the situation is only discussed for s2p. The condition for s1p can be derived from this.

Real spacetime is not really empty, in reality there is no flat spacetime, there are always gravitational vacuum-structures after model of GRT called vacuum-fluctuations, which span the basic ground structure of spacetime, not only for quantum systems but even in classical Einstein gravity.

The following arrow-graph symbolizes the structure of a s2p in two dimensions, because it has to be invariant under rotations about $180^\circ \simeq \pi$.



picture 1: 2-dimensional structure of a s2p.

Now two of them sp2 are coupled; the inner horizontal arrows represent the coupling structure. That's why they are shown larger now. But this is only screened for optics of the coupling now because for invariance after rotation about 180° the opposite arrows have to be seen in the same size. So neglect the size by looking at the structures. It's only for optics, no “rotation variation of size”, although this meaning could be supposed in a later hypothesis if the forces are calculated.

$$\begin{aligned}
\left\langle \left\langle \left\langle \downarrow \uparrow \right\rangle \right\rangle \right\rangle & \dots \left\langle \left\langle \left\langle \downarrow \uparrow \right\rangle \right\rangle \right\rangle && \text{This arrangement means signature of } s = -1 . \\
\left\langle \left\langle \left\langle \uparrow \downarrow \right\rangle \right\rangle \right\rangle & \dots \left\langle \left\langle \left\langle \downarrow \uparrow \right\rangle \right\rangle \right\rangle && \text{This arrangement means signature of } s = 1 . \quad (4.a-4.d) \\
\left\langle \left\langle \left\langle \downarrow \uparrow \right\rangle \right\rangle \right\rangle & \dots \left\langle \left\langle \left\langle \uparrow \downarrow \right\rangle \right\rangle \right\rangle && \text{This arrangement means signature of } s = 1 . \\
\left\langle \left\langle \left\langle \uparrow \downarrow \right\rangle \right\rangle \right\rangle & \dots \left\langle \left\langle \left\langle \uparrow \downarrow \right\rangle \right\rangle \right\rangle && \text{This arrangement means signature of } s = 1 .
\end{aligned}$$

Explanation of rotations of spin-coupling:

4a) Normal “zero-state”, both particles are in the same expression.

4b) Left particle rotates about $\alpha = 90^\circ$ clockwise, so the difference between the states is $\Delta\alpha = 90^\circ$.

4c) Left s2p rotates about $\alpha = 90^\circ$ clockwise and right s2p rotates about $\alpha = 90^\circ$ clockwise. The difference now is still $\Delta\alpha = 90^\circ$.

4d) Left s2p rotates about $\alpha = 90^\circ$ and right s2p doesn't rotate. The difference now is $\Delta\alpha = 180^\circ$.

So also the rotating difference can represent the spin-2-state but of course this rotating systems also can be represented by s1-particles as is said above.

5. Conclusion and Summary:

The structure of signature form s of real spacetime can be reduced to a form of spinning system, which gives the tension of the four- spacetime dimension system in a real simple dual quality of SpIN and SpOUT by coupling of two spin-2-particles („gravitons“). That completeness of description may be one reason, why classical spacetime is a fourdimensional manifold and has no other dimension-number.

6. References:

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7.Verification:

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