

1. Experimentally all descriptions of physics must be relativistic.

Any observer will always be confronted with *one* maximum speed of massless particles (the only two bosons: spin2 graviton and spin1 photon). In our universe this constant maximum speed is the so-called lightspeed. Analysis of this fact with respect to more observers with different *constant* speeds of motion (without acceleration) is given in the so-called theory of S(pecial)R(elativity). In SR it is shown that space and time together have to be described with 4Dvectors.

Space and time are dependent and two observers with different (constant) speeds experience both time dilatation (lengthening) and so-called Lorentz-contraction (shortening) of lengths. When analyzing observers with accelerations with respect to each other, Hendrik Antoon Lorentz showed Albert Einstein that space-time is curved. Albert Einstein solved this mathematically difficult problem while being Professor at the Kaiser Wilhelm Institute for Physics in Berlin, see footnote 3. Einstein discussed this search for a solution with Max Planck and many other physicians, who asked him to come to this German University in Berlin. He solved the mathematical problem of curved space-time with the mathematical analysis of Bernhard Riemann, invoked by German physicist Marcel Großmann. The solution is a simple mathematical concept: Double the degrees of freedom in the mathematical description of curvature. This is the well-known theory of G(eneral)R(elativity) which was proven correct in 1919 by the English experimentalist Arthur Stanley Eddington. Related to his investigations related to GR, he had the following quotation: "The quest of the absolute leads into the four-dimensional world", also see the link "Some Quotations" in footnote 4. In 1921 Albert Einstein did proof that any mathematical solution of physics should always also describe curvature of space-time, i.e. include the gravitational action. Einstein called this fact the C(omprehensive)A(ction)P(inciple), i.e. all descriptions of arbitrary actions should always also include the gravitational action. Outside never accessible singularities in space-time (black holes and Big Bangs) curvature of space-time requires a description with the amount of degrees of freedom doubled. This view on SR and GR is my personal mathematical view after a thorough mathematical analysis of curvature in 1997. This analysis is verified and tested completely with the booklet "General Theory of Relativity", by P.A.M. Dirac, see footnote 1. In this footnote 1, chapter 6 "Parallel displacement", the 4D-space-time must be described with rectilinear coordinates in a space with more than 4 degrees of freedom, represented by integer $N > 4$. In 1997 I discovered on mathematical grounds that $N = 2 \times 4$, i.e. the amount of degrees doubled to describe curvature mathematically, i.e. linear.

Mathematics always is linear, i.e. the unit in which all quantities are expressed will have the same size in all analyzed space-time. For example, an integral of a certain space and specified with a boundary is always equal to a sum of infinitesimal parts all summed together in the limit where the size of the part-length becomes zero. This analysis always is linear, i.e. the size of the integrated (infinitesimal summed) parts is the same at all integrated space locations (and relativistic time multiplied by the lightspeed c). Curvature of space-time implies that the size of the measuring unit depends on the curvature at the measured region. At a region with higher curvature the measuring unit will be smaller. This effect explains gravitational redshift from light send from the sun to the earth together with gravitational time dilatation (the higher the local distortion of space-time (curvature) due to gravity, the more slowly time passes). In 1997 I came to the conclusion that curvature mathematically requires (outside singularities) a doubling of degrees of freedom. This is explained, in easy (linear) mathematics, in footnote 2.

In the mathematical representation of all possible elementary particles the doubling of degrees of freedom results in all elementary particles to be describes as harmonic oscillating points in the 2D(imensional)-plane orthogonal to the observed direction of motion, i.e. the SR worldline. The mathematical solution of this 2D-extendedness requires 2 B(oundary)C(onditions), because instead of just one time-derivative, as in SR, the equations of motion now have two consecutive first-order time derivatives or one second-order time derivative. Any description of acceleration always requires 2 time derivatives!

The BC are either open or closed. Closed BC only allow one kind of elementary particle of each possible symmetry group, which are only able to interact with other elementary particles in the direction of motion given by the worldline. So, closed BC describe all so-called bosons. Open BC allow more so-called families of elementary particles, which interact with other elementary particles in all directions. As a direct result all elementary particles with open BC interact with the gravitational field, i.e. must have masses > 0 . Elementary particles with open BC are the well-known fermions of which our universe has 3 different families, which only differ in (so-called rest) mass. The mathematical (linear) description of the harmonic oscillating motion in the 2D-plane orthogonal to the worldline implies constants through symmetries. The timelike constant is the particle's energy $H = hf$, with h Planck's constant and f the detected frequency of the oscillating extended (elementary) particle. The spacelike constant appears to be the constant angular momentum in the direction of motion given by the worldline. This is the well-known helicity or spin in the direction of motion of the (elementary) particle. The 2D-extendedness, to yield a mathematical description in compliance with the CAP, does not increase the amount of variables in the description, but explains why all particles have spin and energy proportional to a detected frequency.

Any description of physics must comply with the CAP. None of the well-known Q(uantum)F(ield)T(theories) comply to

the CAP. In all QFT elementary particles are assumed to be point-particles, which carry vector-fields describing all characteristics of these elementary particles. For example, the photon is a point-particle moving along its worldline and the EM-field and the spin are described with vector fields centered on this point and filling all space-time around this point with an expansion speed equal to the speed of light. In this point analysis the actual position of the photon is described by its (SR) worldline. If instead the elementary photon is described as an extended harmonic oscillating point in the 2D-plane orthogonal to the observed direction of motion (worldline), both the spin and the EM-field carried by the photon come to life at once in this linear description which complies to the CAP. However, in this CAP complying description the photon is not able to be on its worldline. As a result of this extendedness of all elementary particles, the closest distance between two different (elementary) fermions will be of the order of the Planck length. I.e. all divergences in all QFT due to zero-distance are removed at once. All bosons are solved with closed BC and are not able to interact in the 2D-plane orthogonal to the direction of motion. This fact allows bosons to be at the same 4Dspacetime position. In this CAP complying description of the photon all characteristics of the EM-field are explained completely. For example, the fact that the polarization of the EM-field is only possible in the 2D-plane orthogonal to the direction of motion. The extendedness of the photon not only explains its spin (i.e. conserved helicity), but also all characteristics of the EM-field carried by this photon in a non-reducible way. I.e. the photon does not carry the EM-field, but is itself the non-reducible exact representation of this EM-field and this field represented by uncountable amounts of, non-reducible SR mathematical described, photons carries spin 1.

In all QFT spin is up to today, 18-12-2008, still a not understood phenomenon!

For example see: <http://musr.physics.ubc.ca/~jess/p200/spin/node4.html>

The explanation of spin in this article is in fact called "Bogus", i.e. not explaining the concept "spin" as it really is. At first sight the explanation seems just a littlebit acceptable, but after realizing that all QFT use an exact pointlike mathematical, i.e. linear, description, it on these grounds proved to be not compliant with Einstein's CAP!

Up to this day the so-called Higgs mechanism is assumed to be a valid mathematical mechanism to explain why most elementary particles have non-zero restmasses: http://en.wikipedia.org/wiki/Higgs_mechanism
 But the Higgs mechanism does NOT comply with Einstein's CAP and does not explain why QM results into so-called uncertainty relations! As soon as a mathematical description of all so-called elementary particles is used which complies with the CAP, all characteristics of spin and all possible other characteristics of all non-reducible mathematical represented possible elementary particles, is accessible at once!!! In my mathematical, i.e. linear, analysis of SR QFT, in compliance with the CAP, all characteristics of all QFT are explained mathematically completely!

Used other work:

1. General Theory of Relativity P.A.M. Dirac, Princeton Landmarks in Physics. ISBN 0-691-01146-X
2. CAP (i.e. curvature) induced doubling of degrees of freedom is explained in the paper:
<http://quantumuniverse.eu/Tom/Curvature%20and%20QM.pdf> .
3. Einstein's research in physics in Berlin: (this is a short Google books representation of a biography of A. Einstein his Berlin years, described by David E. Rowe) http://books.google.nl/books?id=wHv58UXIBsC&pg=PA117&lpg=PA117&dq=%22Einstein+in+Berlin+David%22&source=bl&ots=zQxIQ1BrJs&sig=wT7K4fBJqHSvQNb-8H8huQs0oQM&hl=en&sa=X&oi=book_result&resnum=1&ct=result#PPA122,M1
4. Arthur Stanley Eddington 1882 – 1944 <http://www-history.mcs.st-and.ac.uk/Mathematicians/Eddington.html>