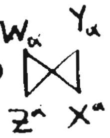
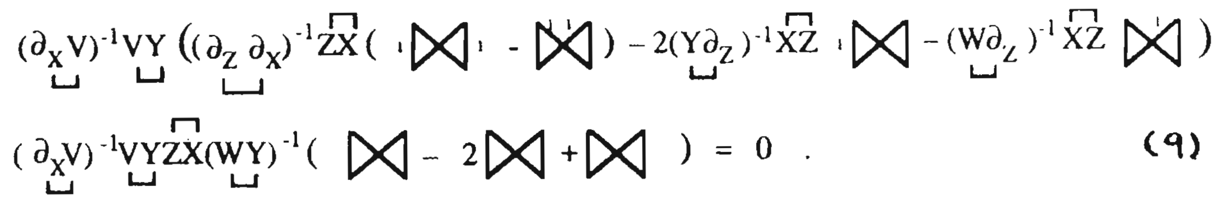
Operating on the single box this yields D  =



The amplitude corresponding to the a.s.d. part of F_{ab} leads to a twistor diagram independent of U^{α} corresponding to the spinor expression

$$\Delta^{A'BB'C'}\phi(k_4)\chi_{C'}(k_3)B_{BB'}(k_2)\psi_{A'}(k_1) = \frac{k_1k_2 - k_1k_3}{(k_1k_2)(k_2k_3)(k_3k_1)}\, k_{1E'}{}^{B}\, k_3{}^{DE'}\, \chi^{A'}\psi_{A'}\Theta_{DB}\phi \ .$$

Similarly in the non-abelian case a perturbative expansion in powers of coupling constants (g^n) relates the exterior free fields $\overset{0}{\Psi}_{(A'B')\Theta}{}^{\Phi}$, $\overset{0}{\Theta}_{(AB)\Theta}{}^{\Phi}$ of order g^0 in

$$\overset{0}{F}_{ab\Theta}{}^{\Phi} + g\overset{1}{F}\ldots = \varepsilon_{AB}\overset{0}{\Psi}_{A'B'\Theta}{}^{\Phi} + \varepsilon_{A'B'}\overset{0}{\Theta}_{AB\Theta}{}^{\Phi} + g\varepsilon_{AB}\overset{1}{\Psi}\ldots$$

$$= 2\partial_{[a}A_{b]\Theta}{}^{\Phi} - 2igA_{X[a}{}^{\Phi}A_{b]\Theta}{}^{X} \qquad (10)$$

linearly to the gauge potentials (again taken to satisfy the Lorenz gauge condition $\nabla_a A^a{}_\Theta{}^\Phi = \partial_a A^a{}_\Theta{}^\Phi = 0$). An analogous construction as in (6) can therefore be used.

One can apply this also to cases of higher helicities, such as for example in [2], as long as one is over flat space. If one looks at these potentials classically one has to ask, however, what their space-time version looks like (i.e. how they are to be 'contour-integrated') and they might turn out not to be very general.

[1] F. Müller (1991). Twistor Diagrams for some scattering amplitudes arising from the Standard Model. Qualifying dissertation.

[2] R. Penrose (1990). Twistor Theory for Vacuum Space-Times: a New Approach, T N **31**, 6–8.

Franz Müller

To appear in: P. Bergmann's Festschrift, ed. N. Sanchez:

Twistors as Spin 3/2 Charges

by Roger Penrose
Mathematical Institute
Oxford, UK

Abstract It is pointed out that twistors play a role as the charges for helicity 3/2 massless fields. Since such fields can be defined consistently in general Ricci-flat 4-manifolds, a possible new approach to defining twistors in vacuum