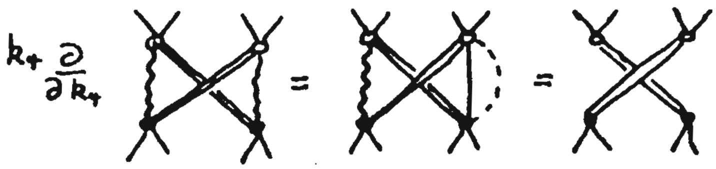
Towards Twistor Vacuum Diagrams

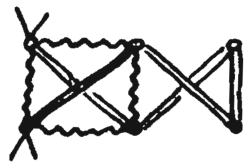
By using the Twistor skeleton expressions for first order Feynman diagrams and the idea of representing a propagator as a sum over states (APH TN31) it is easy to write down twistor expressions for low order Feynman vacuum diagrams. But it is not clear how to go about constructing the contours over which one integrates them.

As a guide one knows in the Möller case one can take the period in one of the (inhomogeneous) boundaries to give a non-interaction diagram, which is equivalent to

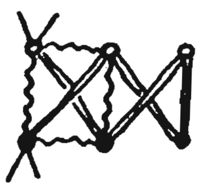


Thus in the sum-over-states case one needs a contour which will preserve the analogous version of this.

The integral one is interested in is: (all lines are inhomogeneous). One wants the extra boundary lines at infinity to be able to treat the internal double poles as restricting (A.P.H. this issue).

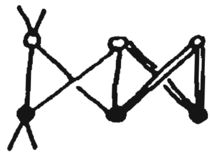
$I =$ 

The left side of this diagram is completed using one of the new Hodges spinor integrals (A.P.H. TN30). The inhomogeneous scale which is left is integrated from the boundary through the logarithmic cut and back to the boundary on the next sheet. Then using standard results from double-box diagrams gives

 $= \frac{1}{\substack{AB\\CD}}\left(1 + \log\left(\frac{k_4 k_3}{k_1 k_2}\right)\right).$

On applying $k_4 \frac{\partial}{\partial k_4}$ one gets  as required.

Now one can use an analogous contour on:

$J =$ 

Which gives $J = 0$, and justifies taking J as the twistor translation of the φ^4 tadpole diagram  which is zero in the massless limit.

Thus a contour exists for the twistor translation of $L =$ , which gives $L = 0$. Work is in progress to extend this treatment to vacuum diagrams like .

This work was done in conjunction with A. Hodges.