Disconnected Diagrams

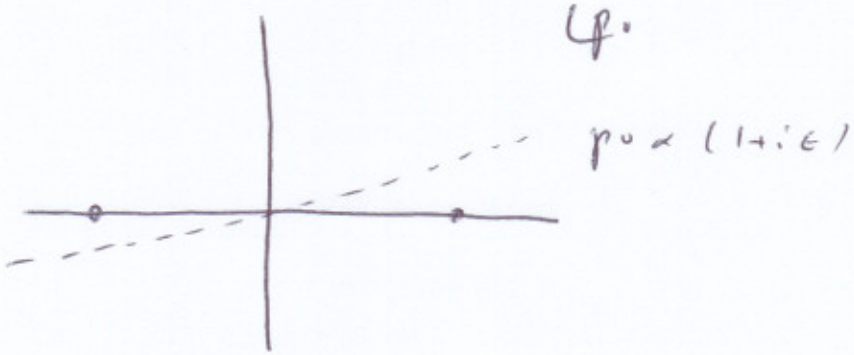
What about our weird limit $T \to \infty(1-i\epsilon)$??

This should be a momentum conserving δ-fn:

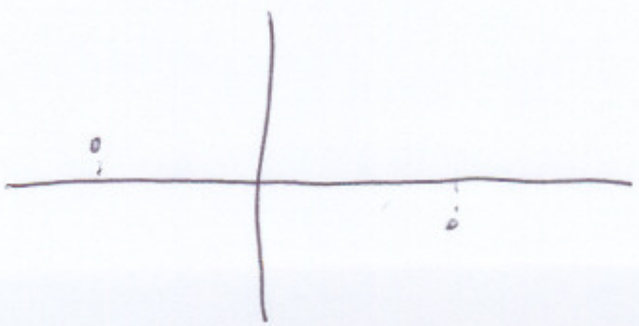
$$\lim_{T\to\infty(1-i\epsilon)} \int_{-T}^{T} dz^0 \int d^3z\, e^{-i(p_1+p_2+p_3-p_4)z}$$

Exponential blows up unless argument is pure imaginary as $z_0 \to \pm\infty$

Fix: $p^0 \propto (1+i\epsilon)$



Rules consistent w/ Feynman prescription:

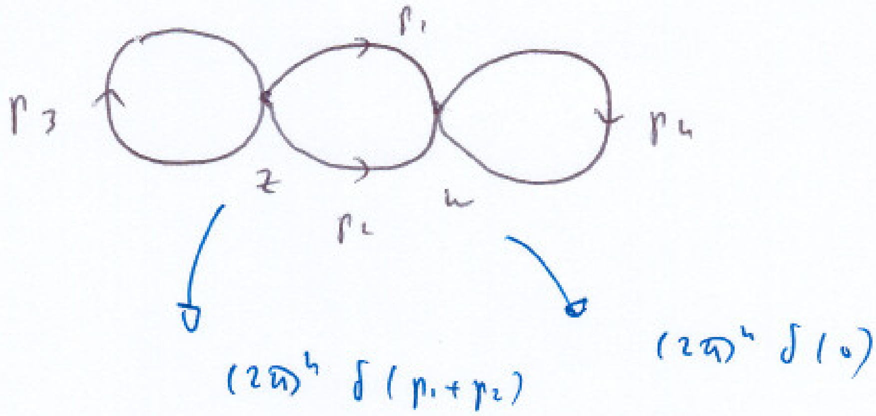


{ integration contour is slightly rotated from real axis }

Explicit T dependence seems to vanish...

But be careful..

Consider



In position space: $\int d^4w \, \mathbb{1} \propto \underbrace{(2T)\cdot V}_{\text{S-T volume}}$

> Every disconnected diagram (vacuum diagram) will have one $(2\pi)^4\delta(0) = 2T\cdot V$ factor associated with it.

{ This vacuum process can happen any place in space and at any time between $-T$ and T }