Feynman diagrams

Note page 114 of P+S: "By 'connected', we now mean fully connected, that is, with no vacuum bubbles, and all external legs connected"

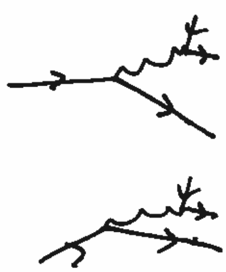
Connected : all propagators continuously connected to at least one external spacetime point

Fully connected : all external points continuously connected to each other

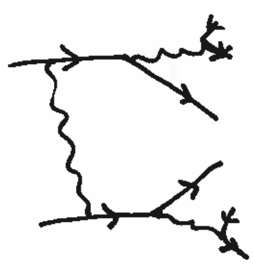
↑ only full connected diagrams contribute to the T matrix

↑ defn of P+S
Schwartz calls this "connected"

N.B. Schwarz's muon decay example



factors into 2 × 1 → 3 particle S matrix



does not

Leg: propagator connected to an external point

Vacuum/bubble : no propagator is connected to an external point

Tadpole : contributions to the vacuum expectation value (sometimes also the self energy) of the one-point function – sometimes only at one loop

Vertex : anything of the form $\wedge$

Wikipedia discusses "forest diagrams" ?!?

Tree diagram: no loops!

Loop diagram: containing a closed, continuous propagator loop

Amputated: no legs can be removed from the diagram by cutting a single propagator

One-particle irreducible: cannot be separated into consistent subdiagrams by cutting one internal line

Comments on VEVs

Vacuum diagrams are removed from S-matrix elements through our requirement that $\langle \Omega | \Omega \rangle = 1$

For the LSZ reduction formula to apply, we also require

$$\langle \Omega | \phi(x) | \Omega \rangle = 0$$

If $\langle \Omega | \phi(x) | \Omega \rangle = f(x)$ then we must have $f(x) = c$

because

$$\langle \Omega | \partial_\mu \phi(x) | \Omega \rangle \sim \langle \Omega | [P_\mu, \phi(x)] | \Omega \rangle = \langle \Omega | P_\mu \phi(x) - \phi(x) P_\mu | \Omega \rangle = 0$$

$\Rightarrow \partial_\mu f(x) = 0$ or $f(x) = c$

We can always redefine ϕ to remove this VEV

$$\phi \rightarrow \tilde{\phi} = \phi - c \quad \Rightarrow \quad \langle \Omega | \tilde{\phi} | \Omega \rangle = \langle \Omega | \phi | \Omega \rangle - c \langle \Omega | \Omega \rangle = c - c = 0.$$