QFT

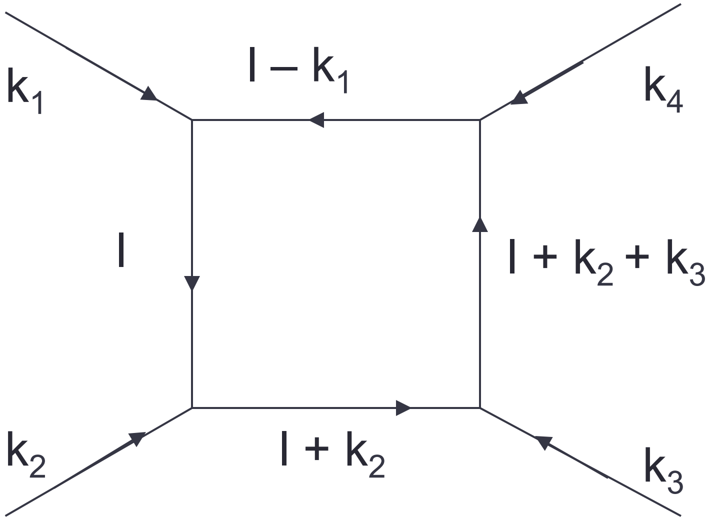
Chapter 17: Other One-Loop 1PI Vertices

N-Point Functions

- The exact vertex function is defined as:
  - "The sum of all 1PI diagrams with N external lines, and these N external propagators removed."

- We considered this before for $n = 3$. Now let's consider higher n (still for φ^3 theory).
  - No tree-level diagrams (obviously – the "point" vertex can by definition only attach to three things).
  - The one-loop contribution is finite for $d < 2n$. Since this is φ^3 theory, we note that all one-loop diagrams are finite for $d = 6$.

The 4-point 1PI vertex in φ³ theory



- The result is that:

$$V_4 = \frac{g^4}{6(4\pi)^3} \int dF_4 \left(\frac{1}{D_{1234}} + \frac{1}{D_{1324}} + \frac{1}{D_{1243}} \right) + O(g^6)$$

$$D_{1234} = x_1 x_4 k_1^2 + x_2 x_4 k_2^2 + x_2 x_3 k_3^2 + x_1 x_3 k_4^2 + x_1 x_2 (k_1 + k_2)^2 + x_3 x_4 (k_2 + k_3)^2 + m^2$$

Conclusions

- All one-loop corrections will contribute to the vertex factor.
- These are finite and well-defined, so it is just a matter of drawing and calculating these vertices to the order at which we are working (each vertex introduces an additional factor of g).
- We now have the exact vertex up to one-loop. We've seen that the 3-point vertex requires us to redefine Z_g, the higher point vertices are already finite.