Srednicki Chapter 72

QFT Problems & Solutions

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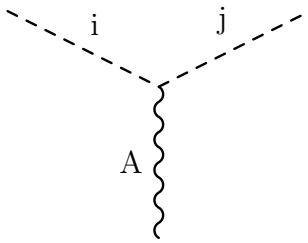
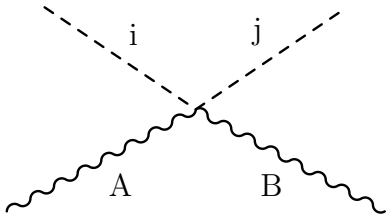
Srednicki 72.1. Consider a complex scalar field ϕ_i in a representation R of the gauge group. Find the vertices that involve this field, and the associated vertex factors.

The problem is not completely clear, but presumably these vertices should consist of (non-Abelian) scalars (as indicated) and photons (since we have considered only electrodynamics up to now). The diagrams are similar to those in figure 61.2:



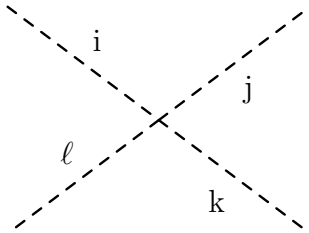
The derivation of the vertex factor will be the same as in chapter 61, except we have a photon, so we need to account for the non-commutation of the fields by adding in the generator matrix. Thus, we have:

$$V.F. = ie(k + k')_\mu T_A^{ij}$$



Same explanation as before: this time the form of the generator matrices must be an anti-commutator. We must divide by two due to the two terms:

$$V.F. = -2ieg_{\mu\nu}(T_A T_B + T_B T_A)^{ij}$$



Same explanation as before: this time there are no photons, but the scalars will not interact if the fields are different. There are two possible such terms, so we must divide by two. Then:

$$V.F. = -\frac{ie}{2}(\delta_{i\ell}\delta_{jk} + \delta_{ik}\delta_{j\ell})^{ij}$$