Since for our purposes the occurrence of hadrons and hadron currents J^a_μ is a trivial complication we will drop them from now on.

The equations of motion (4),(5) may be derived from the Lagrangian density

$$\mathcal{L} = -\frac{1}{4} G^a_{\mu\nu} G^a_{\mu\nu} - \frac{1}{2} M^2 W^a_\mu W^a_\mu \tag{7}$$

with

$$G^a_{\mu\nu} = \partial_\mu W^a_\nu - \partial_\nu W^a_\mu + g\, \epsilon_{ade} W^d_\mu W^e_\nu . \tag{8}$$

In detail the Lagrangian is:

$$\mathcal{L} = -\frac{1}{4} (\partial_\mu W^a_\nu - \partial_\nu W^a_\mu)(\partial_\mu W^a_\nu - \partial_\nu W^a_\mu) - \frac{1}{2} M^2 W^a_\mu W^a_\mu - \frac{1}{2} g\, \epsilon_{abc} (\partial_\mu W^a_\nu - \partial_\nu W^a_\mu) W^b_\mu W^c_\nu$$
$$- \frac{1}{4} g^2 \epsilon_{abc} \epsilon_{ade} W^b_\mu W^c_\nu W^d_\mu W^e_\nu . \tag{9}$$

Note that g is a dimensionless coupling constant. For $M = 0$ this is just the theory introduced by Yang and Mills. We write:

$$\mathcal{L} = \mathcal{L}_{YM}(W^a_\mu) - \frac{1}{2} M^2 W^a_\mu W^a_\mu . \tag{10}$$

The Feynman rules corresponding to this Lagrangian involve a vector meson propagator of the form

$$\frac{\delta_{\mu\nu} + k_\mu k_\nu / M^2}{h^2 + M^2 - i\epsilon} . \tag{11}$$

Furthermore there is a vertex with three bosons and a vertex with four bosons. Simple power counting of the diagrams indicates that an infinite number of subtraction terms has to be added to $\mathcal{L}$ in order to make the S-matrix finite. This would not be so if the $k_\mu k_\nu / M^2$ term in the W-propagator were not present. The fact now that the divergence of W-source current is zero implies that probably a good many of the $k_\mu k_\nu$ terms may be dropped, or at least behave effectively much less than quadratic in the limit of large momenta. In order to investigate this