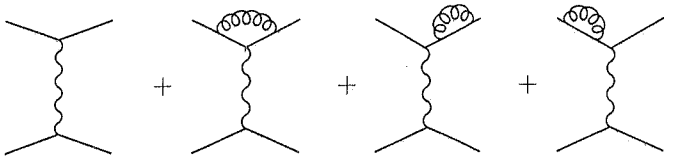
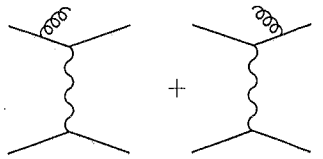
Setting Up

To $\mathcal{O}(\alpha_g)$

$$i\mathcal{M}_{ee\to\bar{q}q} =$$  $$+ \mathcal{O}(\alpha_g^2)$$

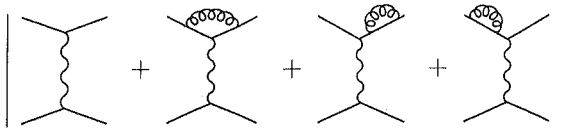
To cancel infrared divergences, we must include the following bremsstrahlung diagrams:

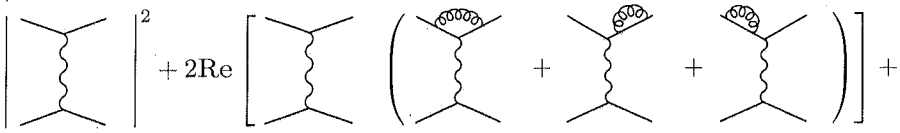
$$i\mathcal{M}_{ee\to q\bar{q}g} =$$  $$+ \mathcal{O}(g^3)$$

The full $e^+e^- \to q\bar{q}$ or $q\bar{q}g$ cross section,

$$d\sigma_{\text{Full}} = \frac{1}{(\text{Flux})}\left[\left|\mathcal{M}_{ee\to q\bar{q}}\right|^2 d(\text{LIPS}_2) + \left|\mathcal{M}_{ee\to q\bar{q}g}\right|^2 d(\text{LIPS}_3)\right] \tag{1}$$

involves the matrix element squares, given by

$$\left|\mathcal{M}_{ee\to q\bar{q}}\right|^2 =$$ 

$$=$$  $$+ \mathcal{O}(\alpha)^2$$

and

$$\left|\mathcal{M}_{ee\to q\bar{q}g}\right|^2 =$$