Basic QED rules

External Lines

incoming particle	$u(p)$		
outgoing particle	$\overline{u}(p)$		Spin ½
incoming antiparticle	$\overline{v}(p)$		
outgoing antiparticle	$v(p)$		

incoming photon	$\varepsilon^{\mu}(p)$		Spin 1
outgoing photon	$\varepsilon^{\mu}(p)^{*}$		
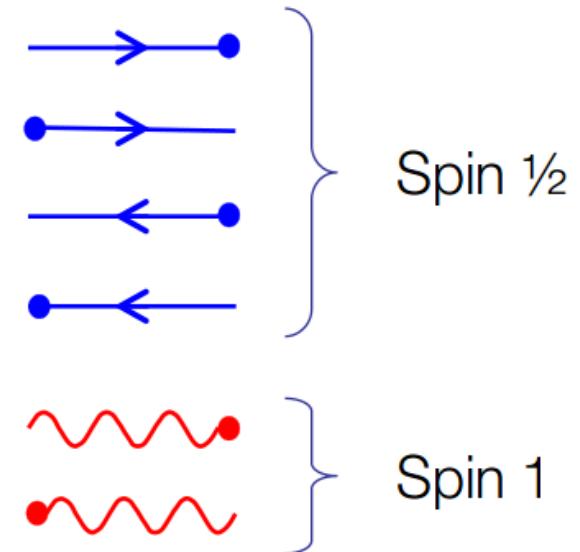
Internal Lines

photon	$-\dfrac{ig_{\mu\nu}}{q^2}$		Spin 1
fermion	$\dfrac{i(\gamma^{\mu}q_{\mu}+m)}{q^2-m^2}$		Spin ½
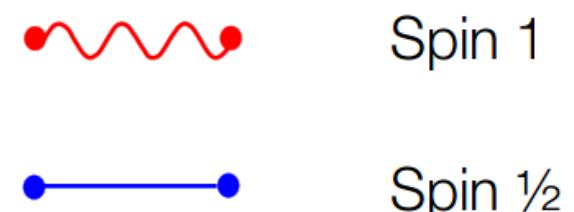
Vertex Factor

fermion [charge: e]	$ie\gamma^{\mu}$	

e⁺e⁻ → μ⁺μ⁻ annihilation

dotted curve: incl. electroweak corrections

$(1 + \cos^2\theta)$

$\dfrac{d\sigma}{d\cos\theta}$

$|M(LR \to RL)|^2$
$+|M(RL \to LR)|^2$

$|M(LR \to LR)|^2$
$+|M(RL \to RL)|^2$

lowest order QCD predictions

$s\dfrac{d\sigma}{d\cos\theta}$ (nb GeV^2)

$\cos\theta$

$\cos\theta$

solid line: lowest-order QED prediction

e⁺e⁻ → μ⁺μ⁻ annihilation

$$\sigma = \frac{4\pi\alpha^2}{3s}$$

Legend:
- ○ JADE
- ▲ Mark J
- □ PLUTO
- ● TASSO

Axes: σ (pb) versus $\sqrt{s}$ (GeV)
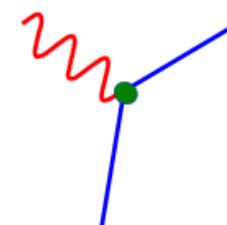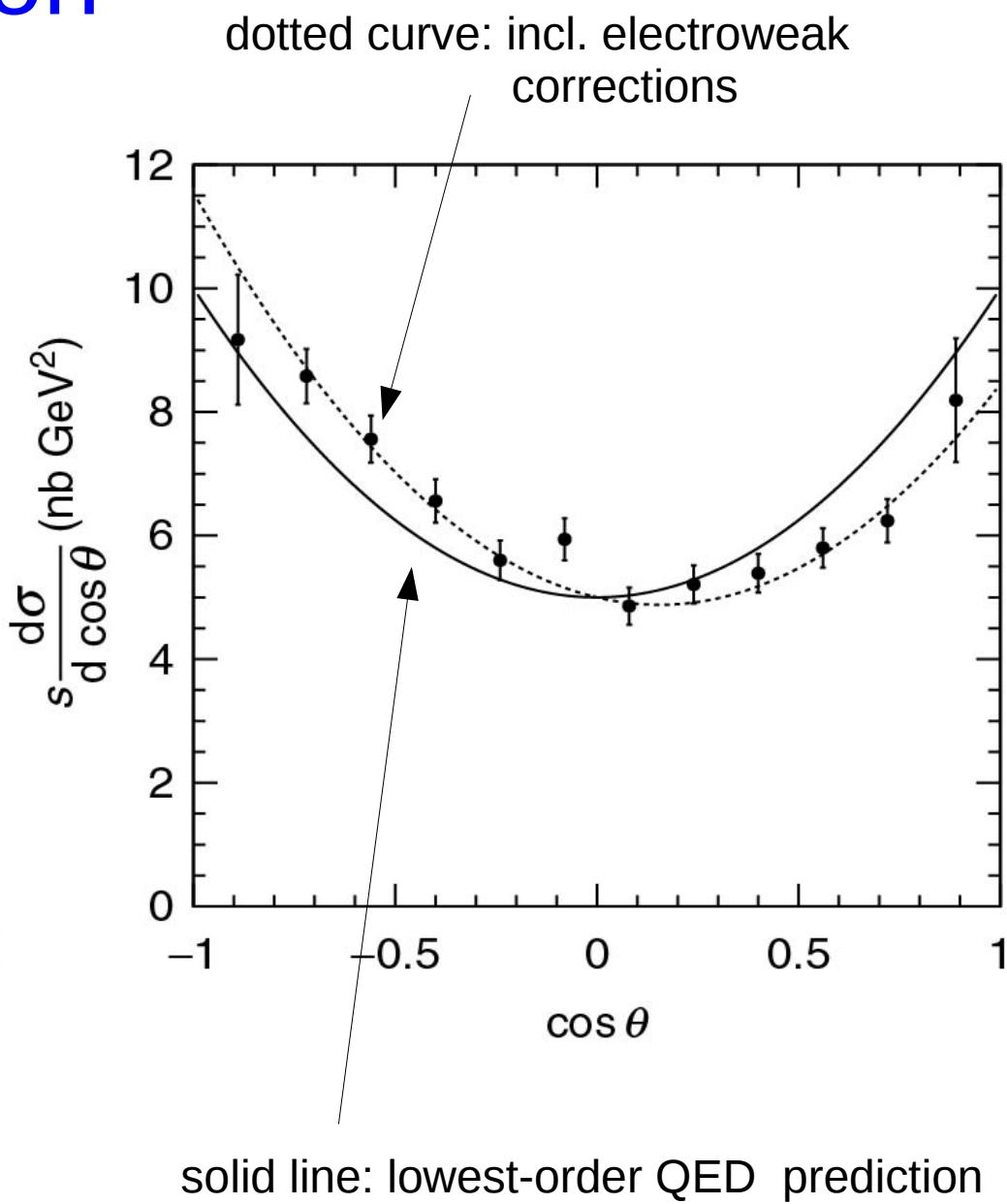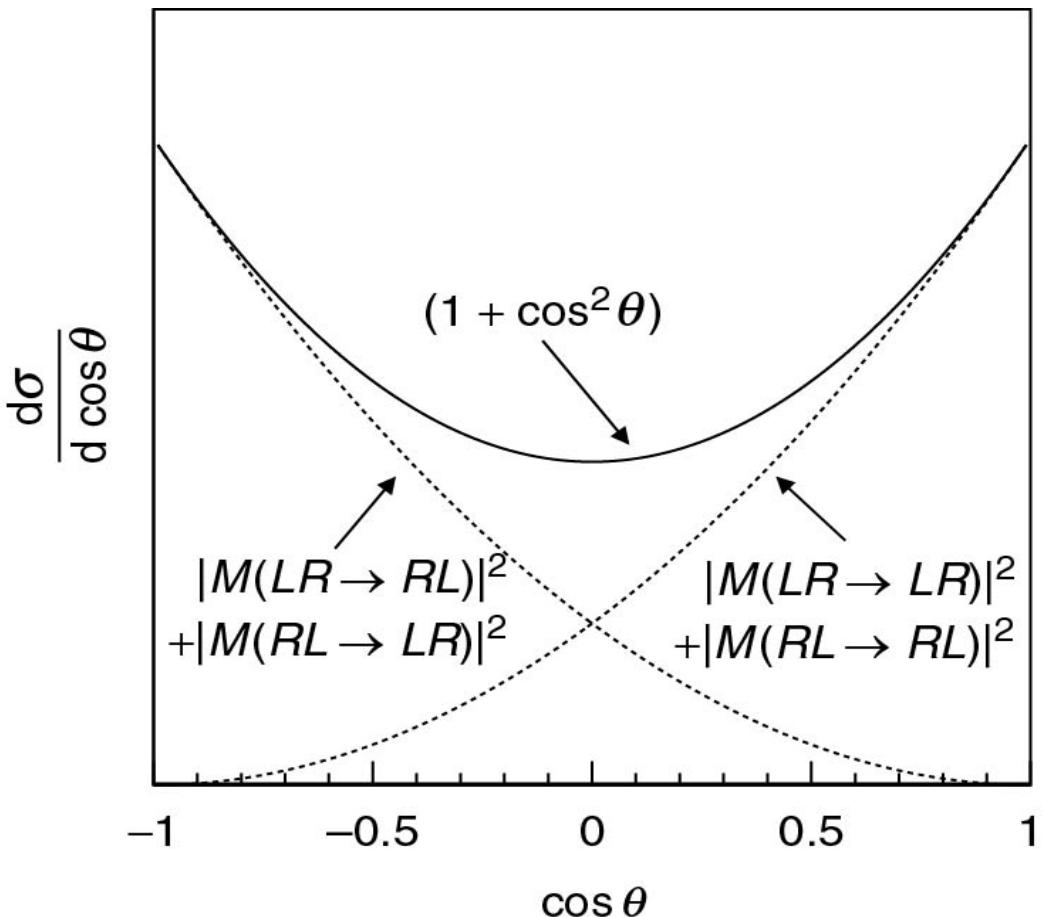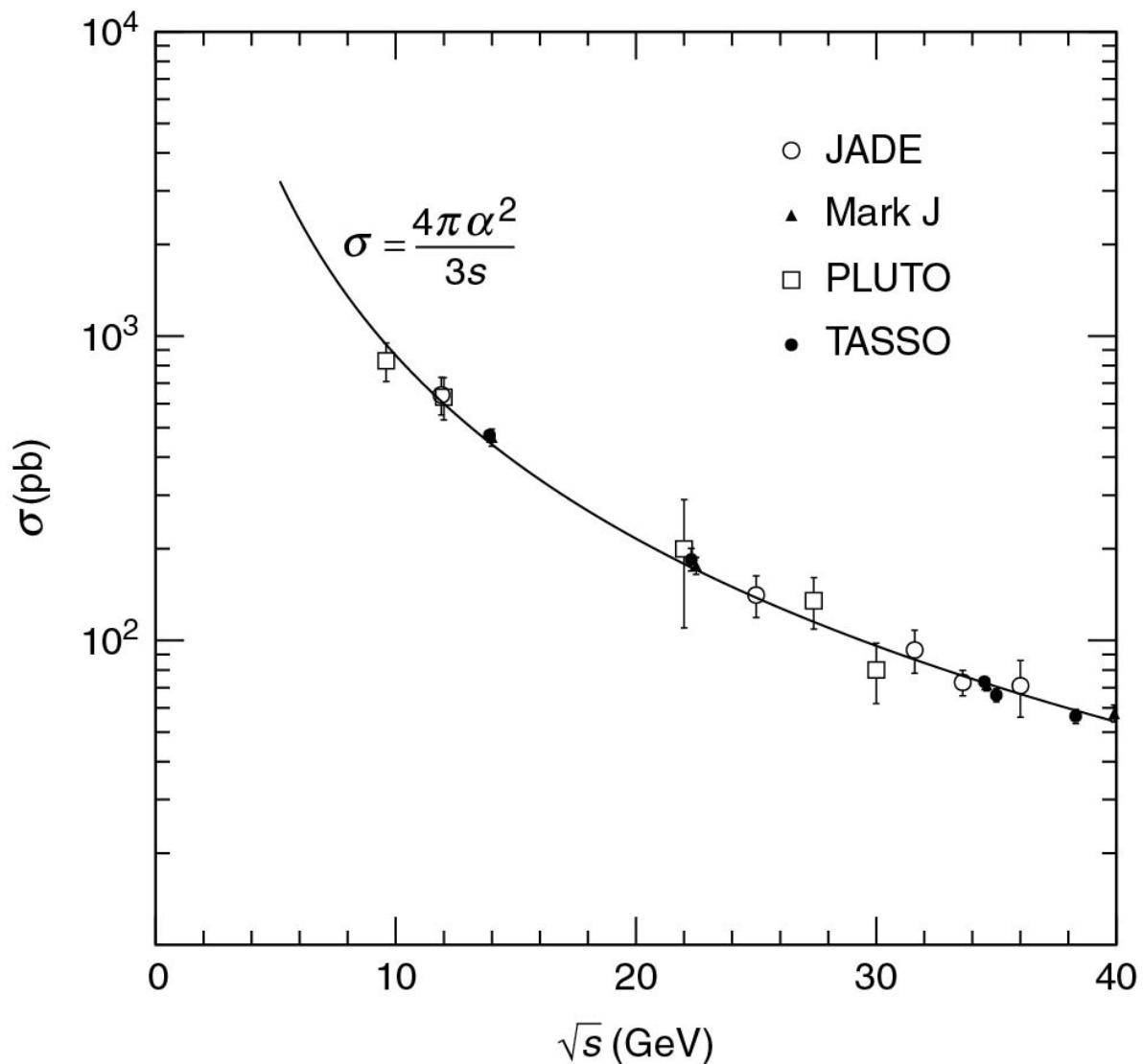
Total cross-section, solid line: lowest-order QCD prediction