MASTER

ANGULAR DISTRIBUTIONS FOR LEPTONS FROM W MESONS *

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Several members of the facilities subgroup at this Summer Study wished to have additional angular distributions for leptons coming from W mesons. These are calculated here by using the model (and computer program) of Peierls, Trueman, and Wang.¹ In accordance with recent data² the Weinberg angle is taken to be

$$\sin^2 \theta_W = 0.25 \quad (M_{W^\pm} = 76 \text{ GeV}, M_Z = 87.8 \text{ GeV})$$

but the model is otherwise unchanged.

Figures 1a to c show triple differential cross sections. $d\sigma/dp \, d\Omega \, d\cos\theta'$, for $p + p \rightarrow e^+e^- + X$ vs $p_\perp = p \sin\theta$ for various lepton angles θ and θ' . Both the Z^0 and the Drell-Yan continuum are included. For $\sin^2 \theta_W = 0.25$ the coupling of the Z^0 to electrons is purely axial, so the e^+ and e^- distributions are identical.

To obtain a cross section for leptons coming from W mesons it is necessary to integrate over the W mass peak. The required Jacobean is easily obtained from formulas in the appendix of ref. 1:

$$\begin{aligned} \frac{d\sigma}{ds \, d\Omega \, d\cos\theta'} &= \frac{1}{2\pi \sin^2 \theta \sin^2 \theta'} \frac{\partial(t, \hat{y})}{\partial(y_p, y'_p)} \frac{d\sigma}{ds \, dt \, dy} \\ &= \frac{s}{2\pi \sin^2 \theta \sin^2 \theta'} \frac{1}{\cosh^2 y_p} \frac{d\sigma}{ds \, dt \, dy} \end{aligned}$$

The integration is done over the range

$$M^2 - 5M^* < s < M^2 + 5M^* ,$$

account being taken of the kinematic limits. Figure 2 shows the angular distribution of an e^+ from the Z^0 for $10^\circ < \theta < 170^\circ$ at various fixed e^- angles θ' . For $\sin^2 \theta_W = 0.25$ the e^- distribution is identical. The turnover of the $\theta' = 20^\circ$ curve for $\cos\theta > 0.9$, a behavior which arises from forcing the Z^0 to have large x_F , has been distorted somewhat by the DISSPLA cubic interpolation routine.

Figures 3a and b show analogous curves respectively for the e^+ and the ν_e from a W^+ . The stronger peaking of the ν_e cross section at small angles arises because the $\gamma_\mu(1 - \gamma_5)$ coupling favors production of the ν_e in the same direction as the quark, which has a larger average energy than the antiquark.¹

REFERENCES

1. R.F. Peierls, T.L. Trueman, and L.L. Wang, Phys. Rev. **D16**, 1397 (1977).
2. M. Holder et al., Phys. Lett. **72B**, 254 (1977).

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Fig. 1a. Cross section for $p + p \rightarrow e^+e^- + X$ at $\sqrt{s} = 800$ GeV.

Fig. 1b. Cross section for $p + p \rightarrow e^+e^- + X$ at $\sqrt{s} = 800$ GeV.

Fig. 1c. Cross section for $p + p \rightarrow e^+e^- + X$ at $\sqrt{s} = 800$ GeV.

Fig. 2. e^+ angular distribution from Z^0 at $\sqrt{s} = 800$ GeV.

Fig. 3a. e^+ angular distribution from W^+ at $\sqrt{s} = 800$ GeV.

Fig. 3b. ν_e angular distribution from W^+ at $\sqrt{s} = 800$ GeV.