of flight axis. This distribution describes the decay of a spin-one particle (W) into a photon and a pseudoscalar pion averaged over W boson polarizations and summed over photon polarizations. The detector response is simulated with a GEANT3 based simulation program [13].

The photon identification efficiency is determined using MC simulated events and corrected using $Z^0 \to e^+e^-$ data events, where only probe electrons with suppressed bremsstrahlung, $|E/p - 1| < 0.1$, are selected. The method assumes that the detector response to photons is the same as that to non-radiating electrons. Comparing simulations of electron and photon showers in the CEM, we verified that the accuracy of this assumption is better than 1%.

The identification efficiency for pions from the $W^\pm \to \pi^\pm\gamma$ decay is also calculated using MC simulation. The correction factor to this efficiency, which takes into account the effects of calorimeter shower mismodeling and instantaneous luminosity, is determined by comparing properties of the reconstructed jets in photon+jet data to those in photon+jet MC.

The total corrected acceptance times efficiency for $\pi^\pm\gamma$ selection is $A \times \epsilon = 0.0503 \pm 0.0006(stat) \pm 0.0011(sys)$. The uncertainty is dominated by the systematic uncertainty on the pion identification efficiency.

The dominant backgrounds to this search come from photon+jet events, where the jet fragments into a single charged particle, and from multi-jet events, where one of the jets fragments into a single charged particle and another is misidentified as a photon. Drell-Yan pair production and W/Z decays, especially to τ leptons, also contribute to the background at a level of $\approx 10\%$. The signal from the $W^\pm \to \pi^\pm\gamma$ decay would appear as a peak in the $\pi^\pm\gamma$ invariant mass spectrum centered at the W boson mass with a resolution of 2.5 GeV/c^2, which includes the experimental resolution and the full width of the W boson, 2.1 GeV/c^2 [14]. We therefore define the signal region as $75 < M_{\pi^\pm\gamma} < 85$ GeV/c^2, which includes 90% of $W^\pm \to \pi^\pm\gamma$ decays. The background within the signal region is estimated by fitting the sidebands, $67.5 < M_{\pi^\pm\gamma} < 75$ GeV/c^2 and $85 < M_{\pi^\pm\gamma} < 120$ GeV/c^2, with an exponential function using a χ^2 minimization.

Figure 1 shows the $M_{\pi^\pm\gamma}$ distribution as well as the