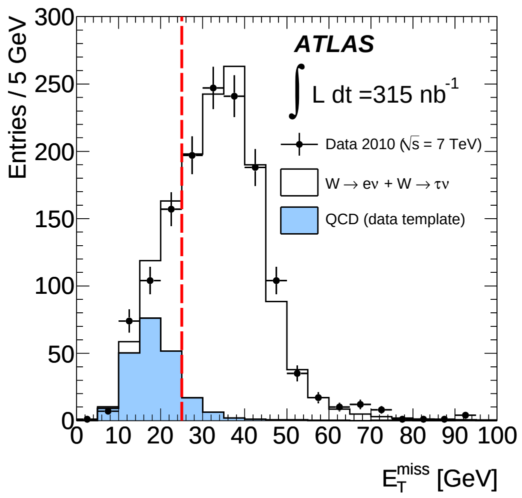

Fig. 10: *The distribution of $E_{\mathrm{T}}^{\mathrm{miss}}$ after applying all W selection cuts, except the $E_{\mathrm{T}}^{\mathrm{miss}}$ cut. The data are shown together with the results of a template fit for signal (including the dominant $W \to \tau\nu$ electroweak background contribution) and the QCD background. The dashed line indicates the cut on $E_{\mathrm{T}}^{\mathrm{miss}}$, as applied in the W analysis.*

seen in data (N_{iso}) after the full W selection, to the number of events observed (N_{loose}) if the muon isolation requirement is not applied. The number of events in the two samples can be expressed as:

$$\begin{aligned} N_{\mathrm{loose}} &= N_{\mathrm{nonQCD}} + N_{\mathrm{QCD}} \\ N_{\mathrm{iso}} &= \varepsilon^{\mathrm{iso}}_{\mathrm{nonQCD}} N_{\mathrm{nonQCD}} + \varepsilon^{\mathrm{iso}}_{\mathrm{QCD}} N_{\mathrm{QCD}}, \end{aligned} \tag{3}$$

where N_{nonQCD} includes the W signal and the background from the other, non-QCD, physics processes and $\varepsilon^{\mathrm{iso}}_{\mathrm{nonQCD}}$ and $\varepsilon^{\mathrm{iso}}_{\mathrm{QCD}}$ denote the corresponding efficiencies of the muon isolation requirement for the two event classes. If these efficiencies are known, the equations can be solved for N_{QCD}. The muon isolation efficiency for non-QCD events was measured in the data $Z \to \mu\mu$ sample, while the efficiency for QCD events was estimated from a sample of muons with transverse momenta in the range of 15 - 20 GeV, which is dominated by dijet events (see Fig. 1(b)). The efficiency factor was extrapolated to higher p_{T} values relevant for the W-signal selection using Monte-Carlo simulation. This method yields a background estimate in the W signal region of $21.1 \pm 4.5(\mathrm{stat}) \pm 8.7(\mathrm{syst})$ events. The systematic uncertainty is dominated by the uncertainty on the isolation efficiency for QCD events.

This estimate was cross-checked using a method where a similarity relationship in the plane of $E_{\mathrm{T}}^{\mathrm{miss}}$ versus lepton isolation was exploited [41]. The plane was divided into four separate regions and the number of background events in the signal region (high $E_{\mathrm{T}}^{\mathrm{miss}}$ and low values of the isolation variable) was estimated from non-isolated events at high $E_{\mathrm{T}}^{\mathrm{miss}}$ by applying the corresponding scale factor observed at low $E_{\mathrm{T}}^{\mathrm{miss}}$. The calculation was corrected for the contributions from the signal and the electroweak backgrounds and takes into account the correlation between the two variables, as predicted by Monte-Carlo simulation. This method yields a background estimate of $13.5 \pm 0.9(\mathrm{stat}) \pm 12.7(\mathrm{syst})$ events, in agreement with the baseline estimate.

As a further cross-check the background was also estimated from the dijet Monte-Carlo simulation, after applying the normalisation factor discussed in Section 5.2, and was found to be $9.7 \pm 0.4(\mathrm{stat})$, which is in agreement with the estimates presented above.

The muon channel is also subject to background contamination from cosmic-ray muons that overlap in time with a collision event. Looking at cosmic-ray muons from non-collision bunches and events that pass the full W selection but fail the primary vertex selection, this background component was estimated to be 1.7 ± 0.8 events.