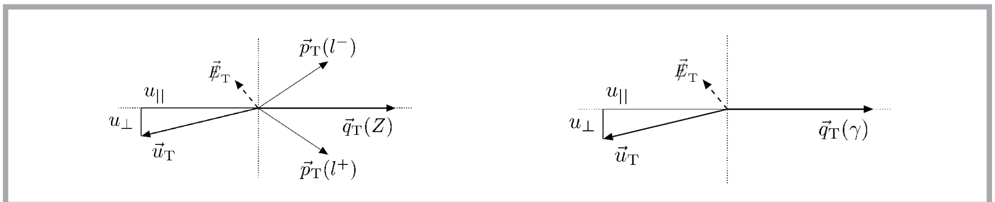
Performance of Missing Energy Reconstruction at the CMS detector with 2016 data

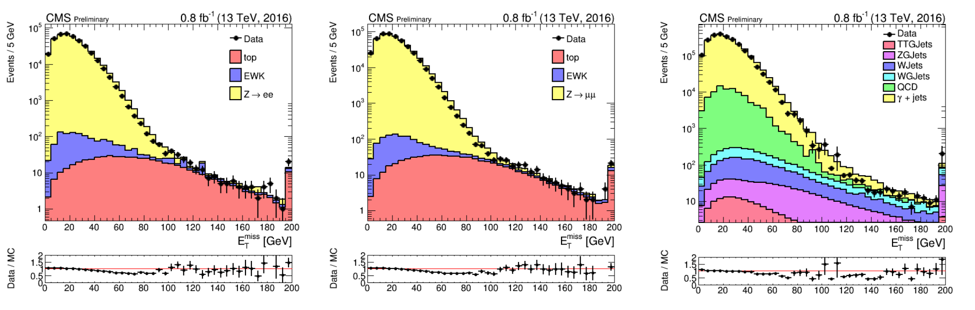
Leonora Vesterbacka, for the CMS Collaboration

Introduction

The Missing Energy observable is computed as the negative vectorial sum of the momenta of all reconstructed particles in an event. Response and resolution are measured in events with an identified Z boson and an isolated photon. The studies presented are performed using PF E_T^{miss} corrected for the jet energy scale where the correction scale uncertainties are propagated into E_T^{miss}. Events with anomalous E_T^{miss} are studied and the performance of the algorithm used to identify and remove these events is presented.

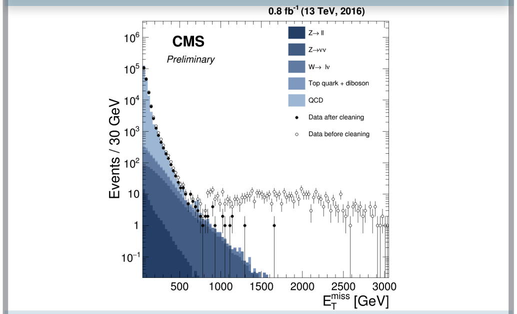


In Z→ll and γ+jets events, we can probe the detector response of the hadronic system and measure the response and resolution of E_T^{miss} by comparing the transverse momentum of the well measured vector boson to that of the hadronic recoil system. The parallel ($u_{||}$) and perpendicular component ($u_\perp$) of the hadronic recoil is used the study the performance of the E_T^{miss} .



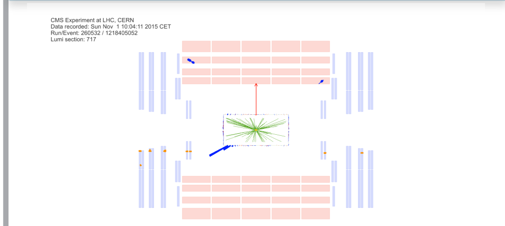
E_T^{miss} distributions for events passing a Z→ee (left), Z→μμ (middle) or single γ selection (right), in data (filled markers) and the various background processes stacked.

Anomalous E_T^{miss}



The high E_T^{miss} tail is populated by anomalous events due to misreconstruction, detector noise and non-collision backgrounds. The plot shows the E_T^{miss} distribution for events passing a dijet selection without cleaning algorithms applied (open markers), with cleaning algorithms applied (filled markers), and simulated events (stacked histograms).

Beam Halo Event Display



Event display showing a beam halo event that was tagged by the beam halo filter, with hits in the CSC and a large ECAL Deposit resulting in anomalous E_T^{miss}.

E_T^{miss} Response and Resolution

Distributions of the parallel ($u_{||}$ +Z p_T) and perpendicular ($u_\perp$) components Z→μμ in of the hadronic recoil are shown on the right.

The E_T^{miss} response is defined as the mean of the parallel component of the recoil over the boson p_T. Results for the E_T^{miss} response as a function of the boson p_T are shown for Z→μμ events (blue triangles), Z→ee events (red triangles) and γ events (green circles) in the bottom left plot.

The E_T^{miss} resolution is assessed with a parametrization of the $u_{||}$ + boson p_T and $u_\perp$ by a Voigtian function. Resolution of the parallel recoil component (bottom mid plot) and perpendicular recoil component (right) versus Z/γ p_T in events with a Z-boson or γ.

The upper frame shows the response or resolution in data; the lower frame shows the ratio of data to simulation with the error band displaying the systematic uncertainty of the simulation, estimated as the Z→ee channel systematic uncertainty.

The response shows an expected turn-on for low boson p_T, and reaches unity at high p_T. The resolution increase with increasing boson p_T, and data and simulation are in good agreement for each channel.