Soft and Hard Diffraction at CMS

Ann-Karin Sanchez, on behalf of the CMS collaboration
Institute for Particle Physics, ETH Zurich
CH-8093 Zurich, SWITZERLAND

1 Introduction and Motivation

A considerable fraction of the total proton-proton cross section at the LHC corresponds to diffractive events. At present, the description of these processes relies largely on the generator specific tuning of data. Therefore, the measurement and extensive study of such events can be used in the understanding and implementation of detailed simulations of diffraction. Diffractive processes can be observed in minimum-bias events but also in events where a hard scale is present in the form of a heavy object such as a W or a Z boson. The observation of diffractively produced particles at a soft [**?**] and a hard [**?**] scale measured with the CMS experiment at the CERN LHC [**?**] with focus on the implementation of this data in Monte Carlo (MC) tuning is presented.

2 Methods and Results

The signature for single diffractive events is a large rapidity gap (LRG). This can be visualized in the summed energy distribution (Fig. **??**) obtained from all the energy deposits in the forward hadronic calorimeter (HF) of CMS.

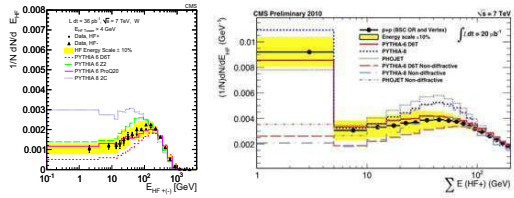

Figure 1: The summed HF+(-) energy distributions in W $\rightarrow \mu\nu$X candidate events (left) and minimum-bias (right) are shown for data and for several MC simulations. The band indicates the uncertainty related to a ±10% HF energy scale variation.

In the minimum-bias event sample a clear diffractive peak can be observed, indicating the presence of single diffractive events in the inclusive sample, while for the $W \rightarrow \mu\nu X$ candidates no such conclusion can be drawn. Nevertheless hard-diffractive events can be observed through an asymmetry in the signed lepton pseudorapidity distribution in LRG events (Fig. **??**). The data show that charged leptons from W decays are found more often in the hemisphere opposite to the gap while the various non-diffractive MC tunes predict a symmetric distribution.

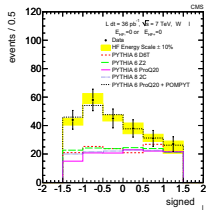

Figure 2: Signed lepton pseudorapidity in W events with a LRG signature. The fit result for the combination of PYTHIA6 (Pro-Q20tune) and POMPYT predictions is shown as a dotted black line. For the other PYTHIA tunes, only the non-diffractive component is shown.

3 Conclusions

Soft- and hard-diffractive events have been observed and studied at CMS. The available MC tunes describe the data only partially and large efforts are needed towards a consistent description of all data, specially at the hard scale. These measurements can be used to further constrain and improve the available models.

References

[1] CMS Collaboration, "Observation of diffraction in proton-proton collisions at 7 TeV centre-of-mass energies at the LHC", CMS-PAS-FWD-10-007 (2010).

[2] CMS Collaboration, "Forward Energy Flow, Central Charged-Particle Multiplicities, and Pseudorapidity Gaps in W and Z Boson Events from pp Collisions at $\sqrt{s} = 7$ TeV", arXiv:1110.0181 [hep-ex] (2011)

[3] CMS Collaboration, "The CMS experiment at the CERN LHC", JINST 3:S08004 (2008).