SHRiMPS — Status of soft interactions in SHERPA

Holger Schulz for the SHERPA collaboration[1]

[1]IPPP, Durham

1 Status of SHRiMPS

SHRiMPS is a Monte-Carlo implementation of the Khoze-Martin-Ryskin model [1] within the event generator SHERPA [2]. It aims to describe Minimum-Bias and Underlying Event observables with similar precision. Ultimately, SHRiMPS will replace the default model for multiple parton interactions in SHERPA. Despite exhaustive tuning studies the predictive power of SHRiMPS is currently not entirely satisfactory. This report contains the parameter settings the authors find best suited to get a fair assessment of the capabilities of SHRiMPS (Table 1).

2 Tuning

The release of SHERPA version 2.2 necessitated a re-tuning of the parameters of the dynamical part of SHRiMPS. The tuning was done to ATLAS data at $\sqrt{s} = 7$ TeV. We included minimum bias [3], underlying event [4] and rapidity gap [5] data. The tuning aimed at a balanced description of that data as the model is not yet able to reproduce all observables equally well.

The SHRiMPS predictions suitable for comparison with data were obtained with Rivet [6] while the tuning itself was carried out using version 2 of the Professor [7] tool. Figure 1 shows an encouraging prediction of SHRiMPS for the $\sqrt{s} = 13$ TeV minimum bias data recorded with CMS [8].

A summary of the tuning effort is given in Figures 2 and 3 for a selection of typical observables. A discussion can be found in the respective captions.

Parameter	Tuned value
`Q_0^2`	3.02
`Chi_S`	0.65
`Shower_Min_KT2`	1.19
`KT2_Factor`	3.48
`RescProb`	1.01
`RescProb1`	0.18
`Q_RC^2`	0.50
`ReconnProb`	-15.30

Table 1: Tuned SHRiMPS parameter for usage with with Sherpa 2.2.

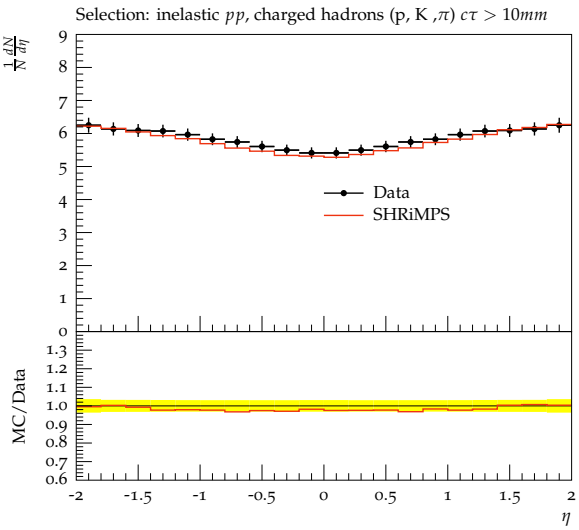

Figure 1: Comparison of 13 TeV CMS data [8] with SHRiMPS prediction.

References

[1] M. G. Ryskin, A. D. Martin, and V. A. Khoze, "Soft processes at the LHC. I. Multi-component model," *Eur. Phys. J.*, **C60**(2009), 249, 0812.2407.

[2] T. Gleisberg, *et al.*, "Event generation with SHERPA 1.1," *JHEP*, **02**(2009), 007, 0811.4622.

[3] G. Aad *et al.* (ATLAS), "Charged-particle multiplicities in pp interactions measured with the ATLAS detector at the LHC," *New J. Phys.*, **13**(2011), 053033, 1012.5104.

[4] Georges Aad *et al.* (ATLAS), "Measurements of underlying-event properties using neutral and charged particles in pp collisions at 900 GeV and 7 TeV with the ATLAS detector at the LHC," *Eur. Phys. J.*, **C71**(2011), 1636, 1103.1816.

[5] Georges Aad *et al.* (ATLAS), "Rapidity gap cross sections measured with the ATLAS detector in pp collisions at $\sqrt{s} = 7$ TeV," *Eur. Phys. J.*, **C72**(2012), 1926, 1201.2808.

[6] Andy Buckley, *et al.*, "Rivet user manual," *Comput. Phys. Commun.*, **184**(2013), 2803, 1003.0694.

[7] Andy Buckley, Hendrik Hoeth, Heiko Lacker, Holger Schulz, and Jan Eike von Seggern, "Systematic event generator tuning for the LHC," *Eur. Phys. J.*, **C65**(2010), 331, 0907.2973.

[8] Vardan Khachatryan *et al.* (CMS), "Pseudorapidity distribution of charged hadrons in proton-proton collisions at $\sqrt{s}$ = 13 TeV," *Phys. Lett.*, **B751**(2015), 143, 1507.05915.

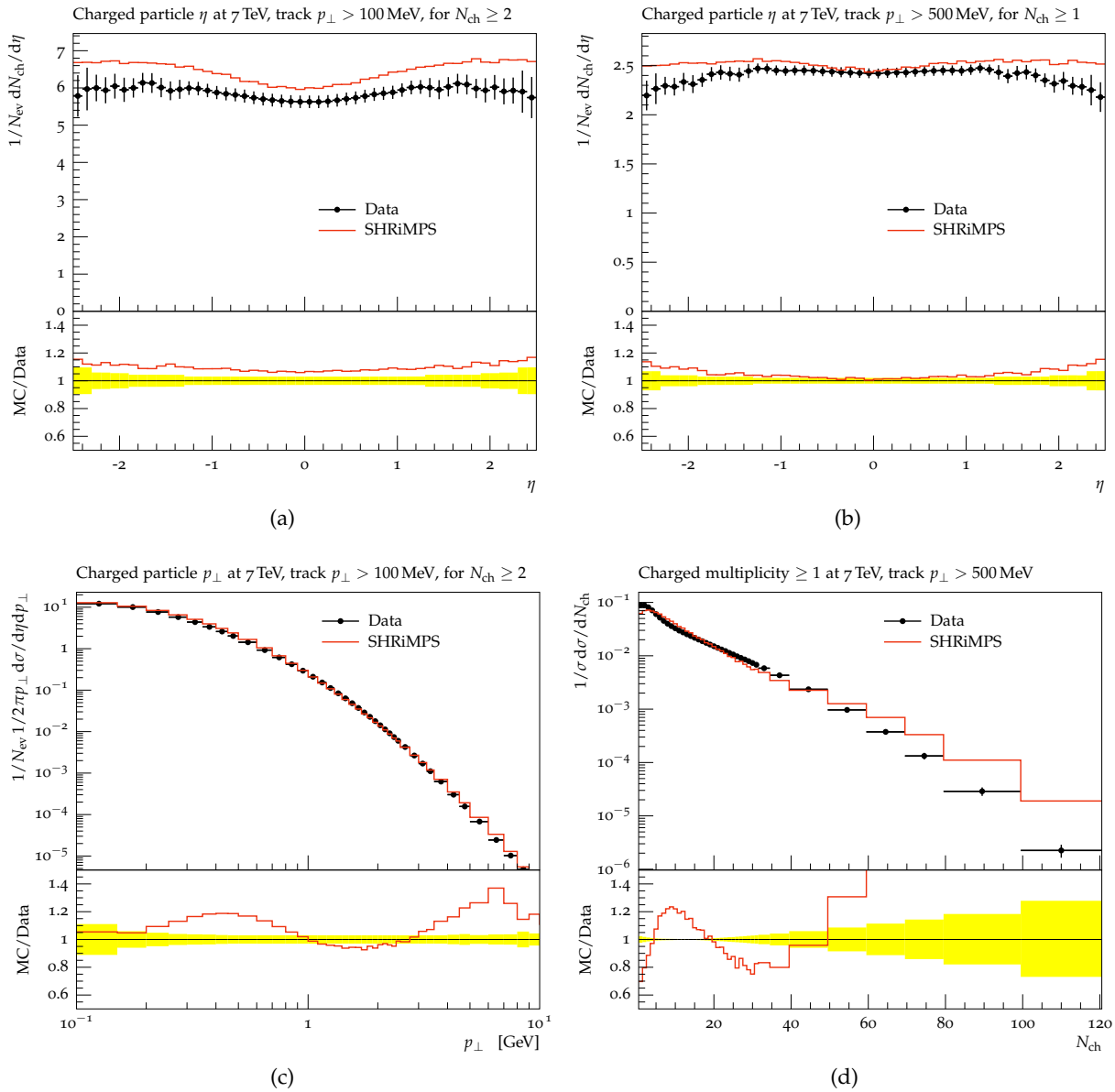

Figure 2: SHRiMPS predictions for minimum bias distributions at $\sqrt{s} = 7$ TeV [3].
(a) and (b) show that on average SHRiMPS produces too many particles at high rapidities.
In (c) a modulation of the prediction of generated particle transverse momenta with respect to the data can be seen although the overall shape is satisfying.
The plot in (d) again shows and issue with the generated multiplicity i.e. events with more than 50 particles are generated far too frequently.

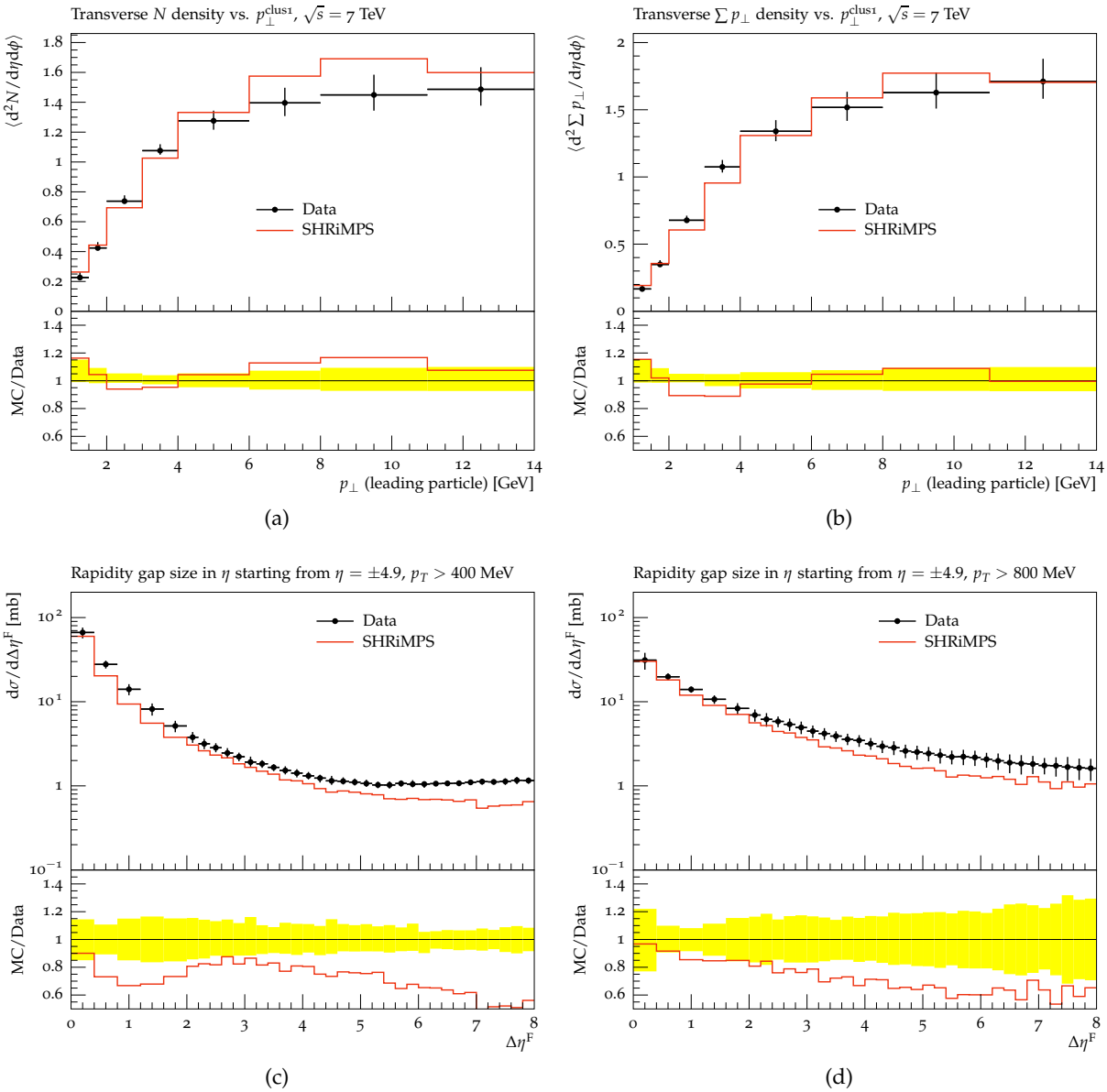

Figure 3: SHRiMPS predictions for underlying event [4] and rapidity gap distributions at $\sqrt{s} = 7$ TeV [5].
The plots in (a) and (b) show a satisfying prediction of SHRiMPS for typical underlying event observables. The plateau region is compatible with the data if measurement uncertainties are taken into account.
Similarly, the prediction of rapidity gaps ((c) and (d)) can be considered satisfying.