Introduction
Data
Detector level
Bin-by-bin unfolding
Panos' RMs on P8
Panos' RMs on Run2015CD
P8 RMs on Run2015CD
Exercise
Back-up

Investigations on unfolding

Exercises and applications

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Deutsches Elektronen-Synchrotron

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Introduction

- unfolding of the b jet inclusive cross section:
  - unfolding of the jet inclusive cross section
  - b-tag correction (bin-by-bin)

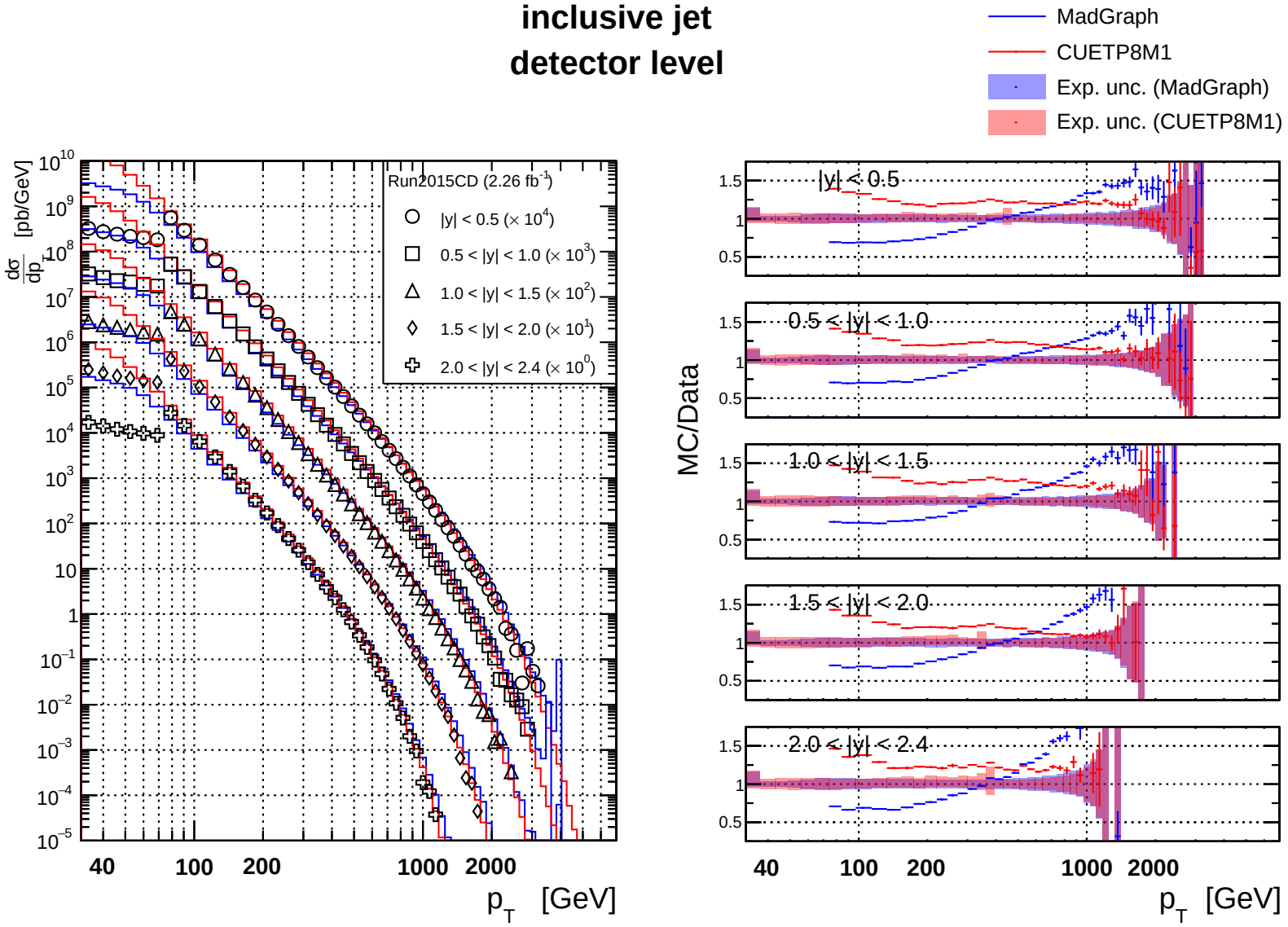
  $\longrightarrow$ only dealing with the jet inclusive
- showing Bayes-unfolded data along iterations
  - using CUETP8M1 RMs
  - using Panos' RMs
- continue investigations with standalone tool

Data

1. preliminary
   1. w/o unfolding
   2. bin-by-bin unfolding

   $\longrightarrow$ have an expectation of the effect
2. Bayes unfolding using Panos' RMs
   1. on Data
   2. on CUETP8M1
3. Bayes unfolding using CUETP8M1 RMs
   1. on Data

inclusive jet
detector level

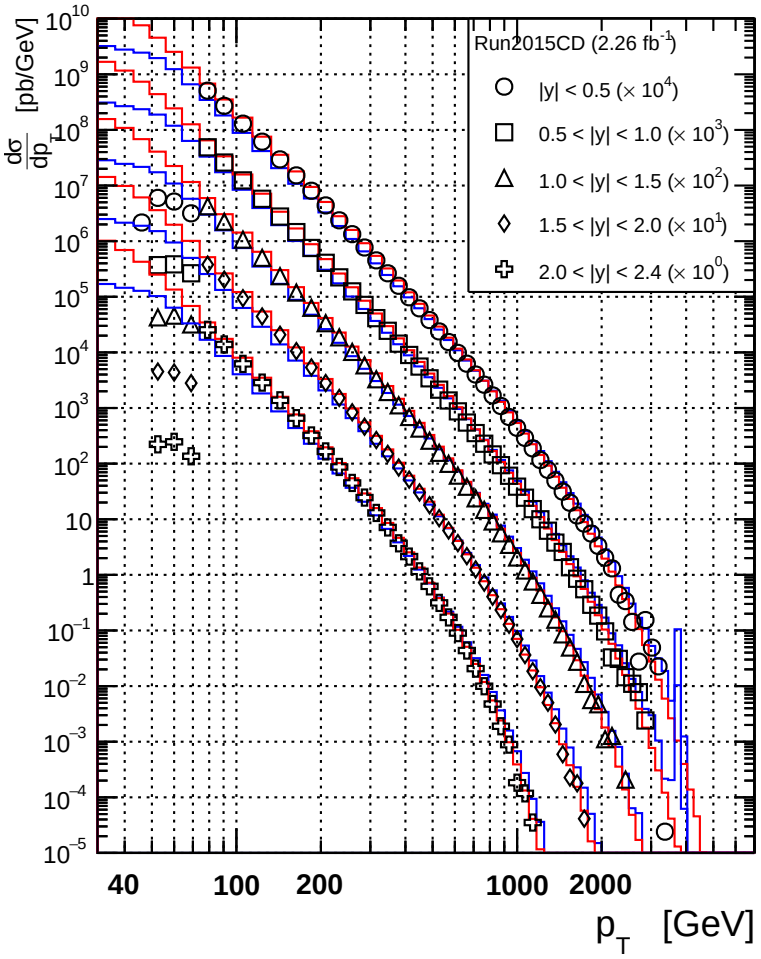


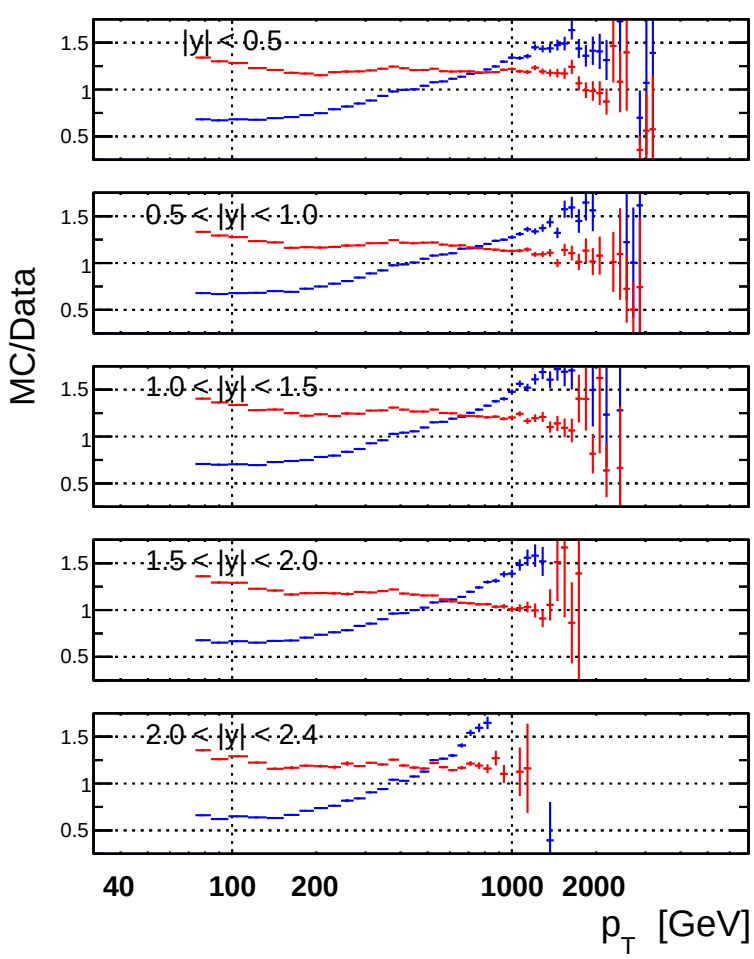
inclusive jet

hadron level (RU bin-by-bin)

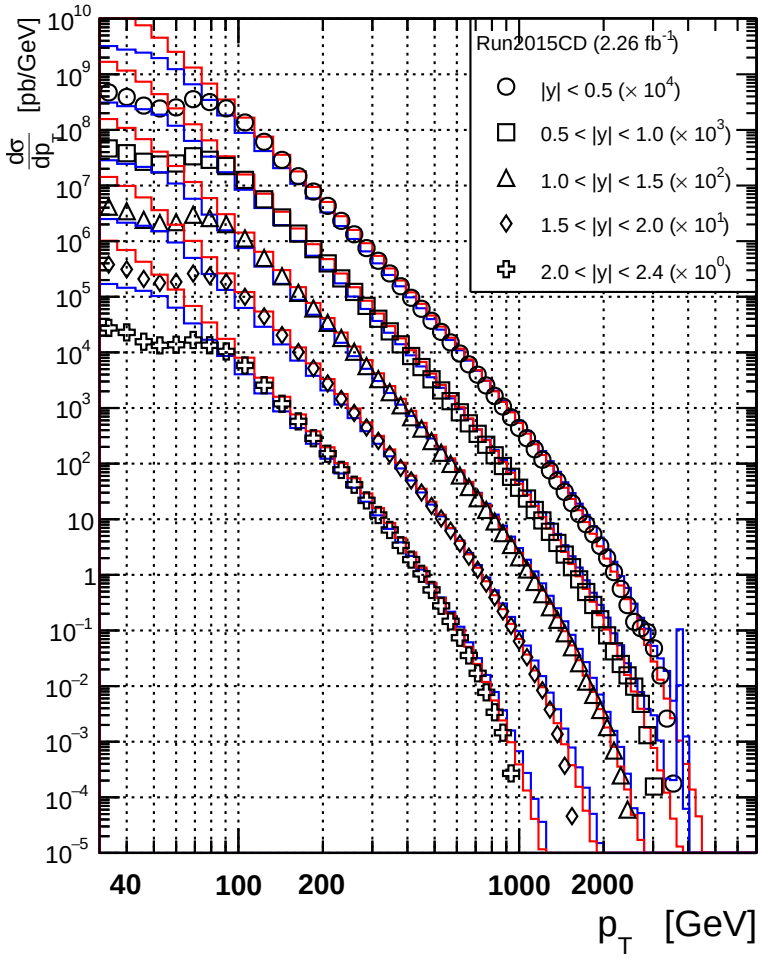
MadGraph

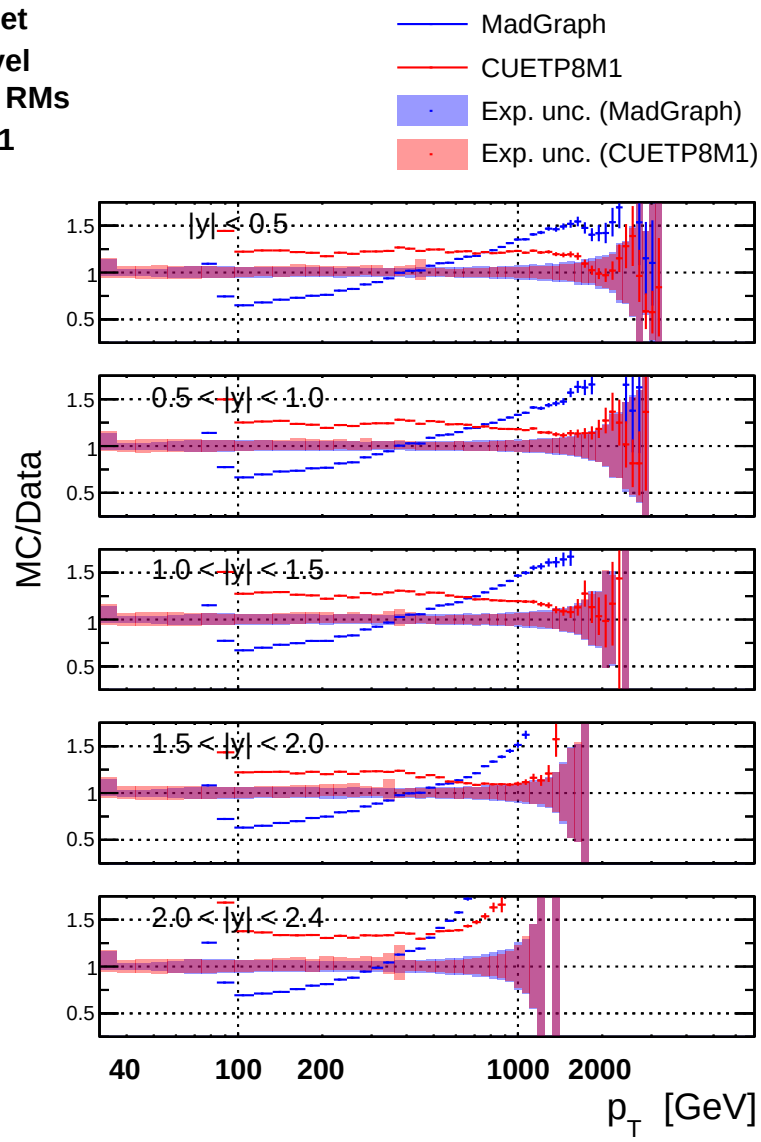
CUETP8M1



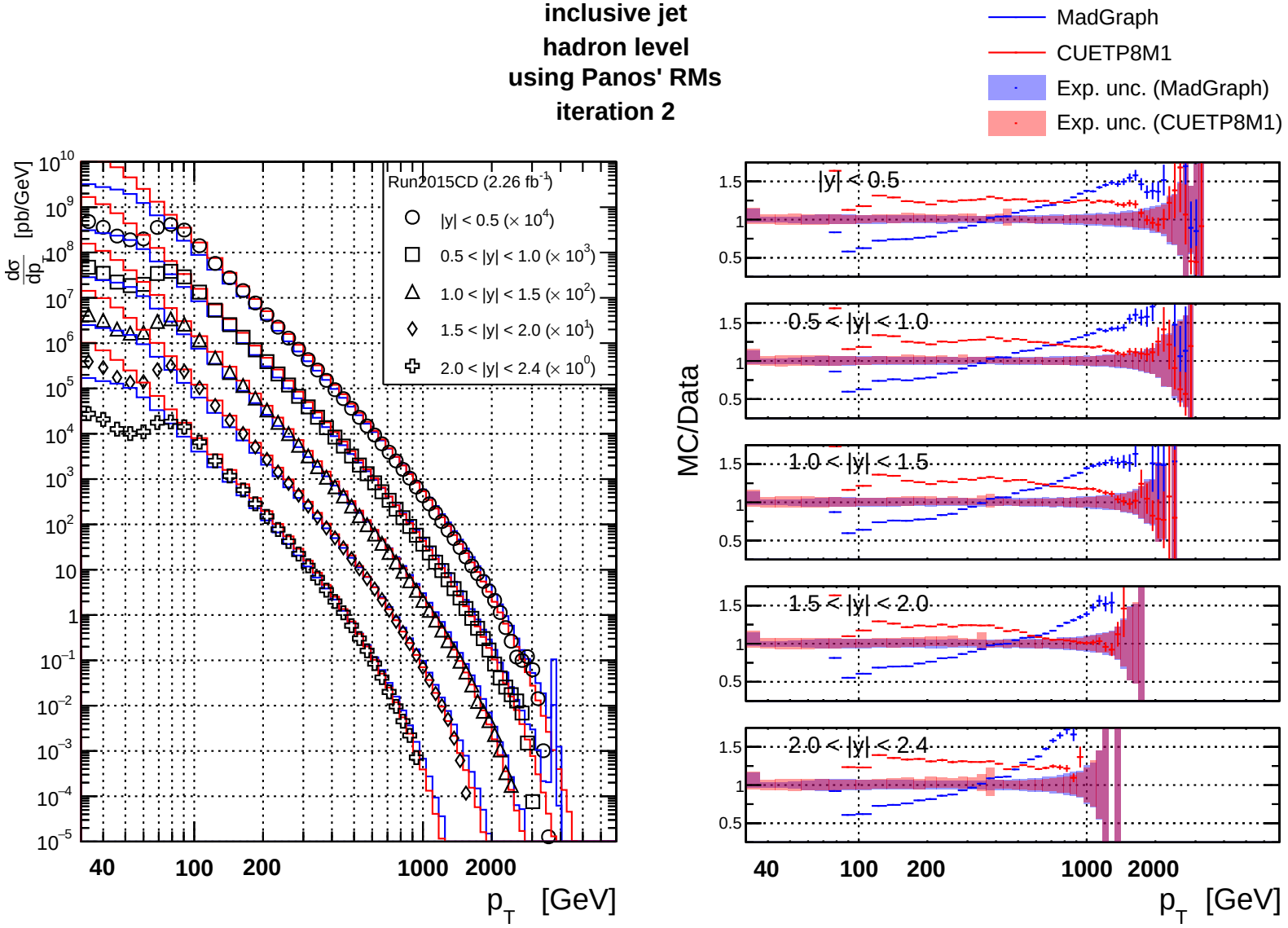


inclusive jet
hadron level
using Panos' RMs
iteration 1

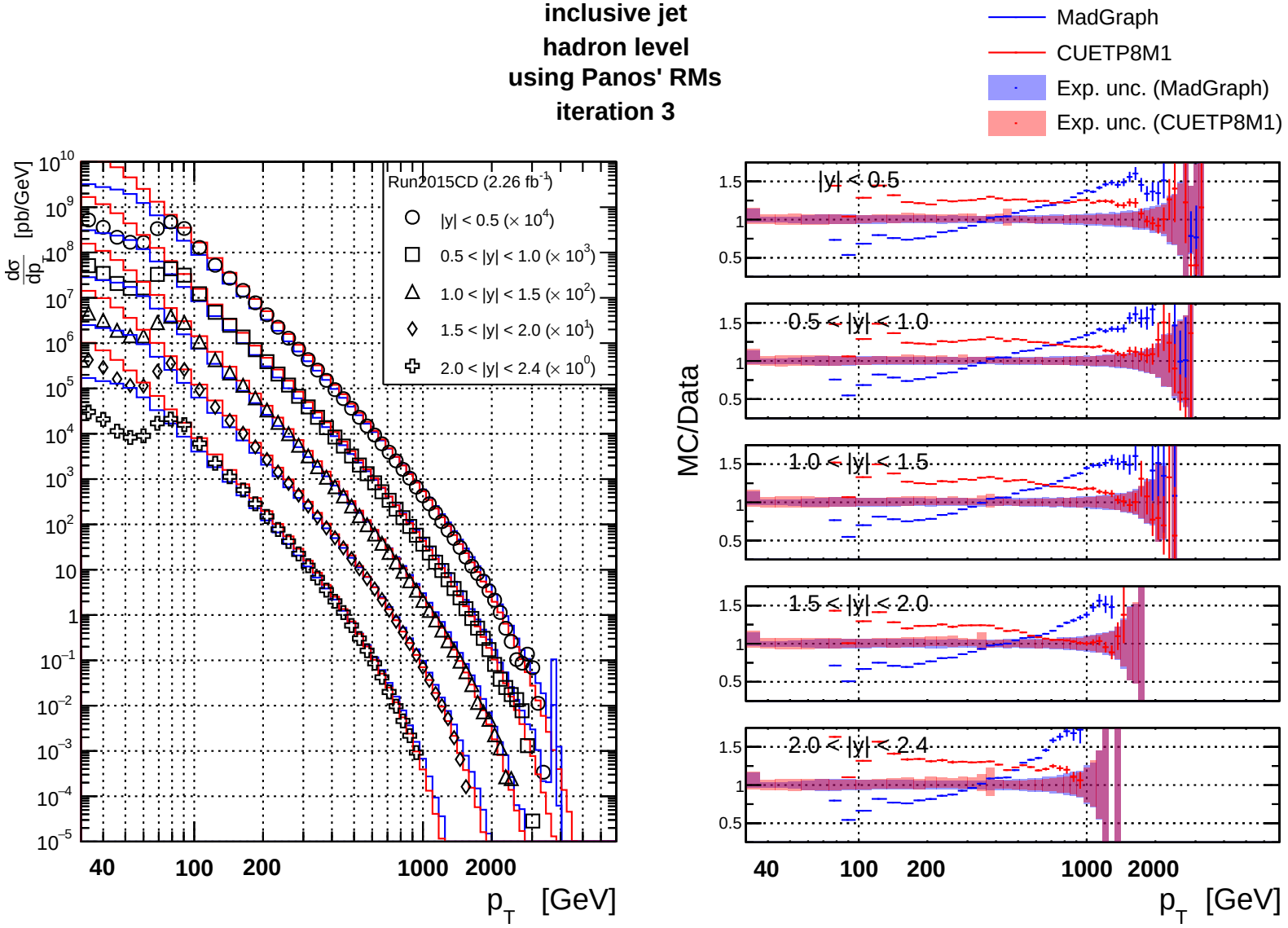




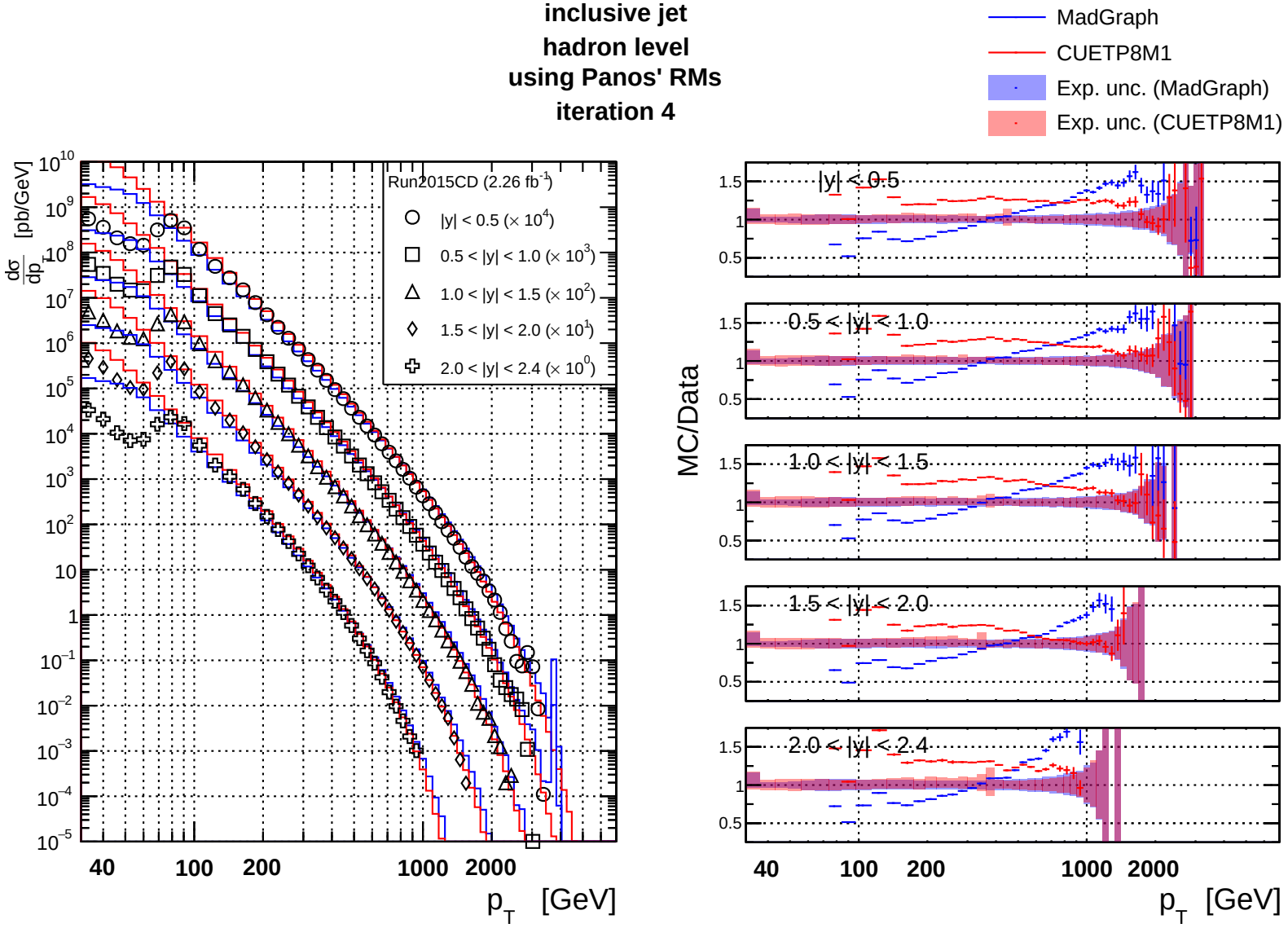
inclusive jet
hadron level
using Panos' RMs
iteration 2



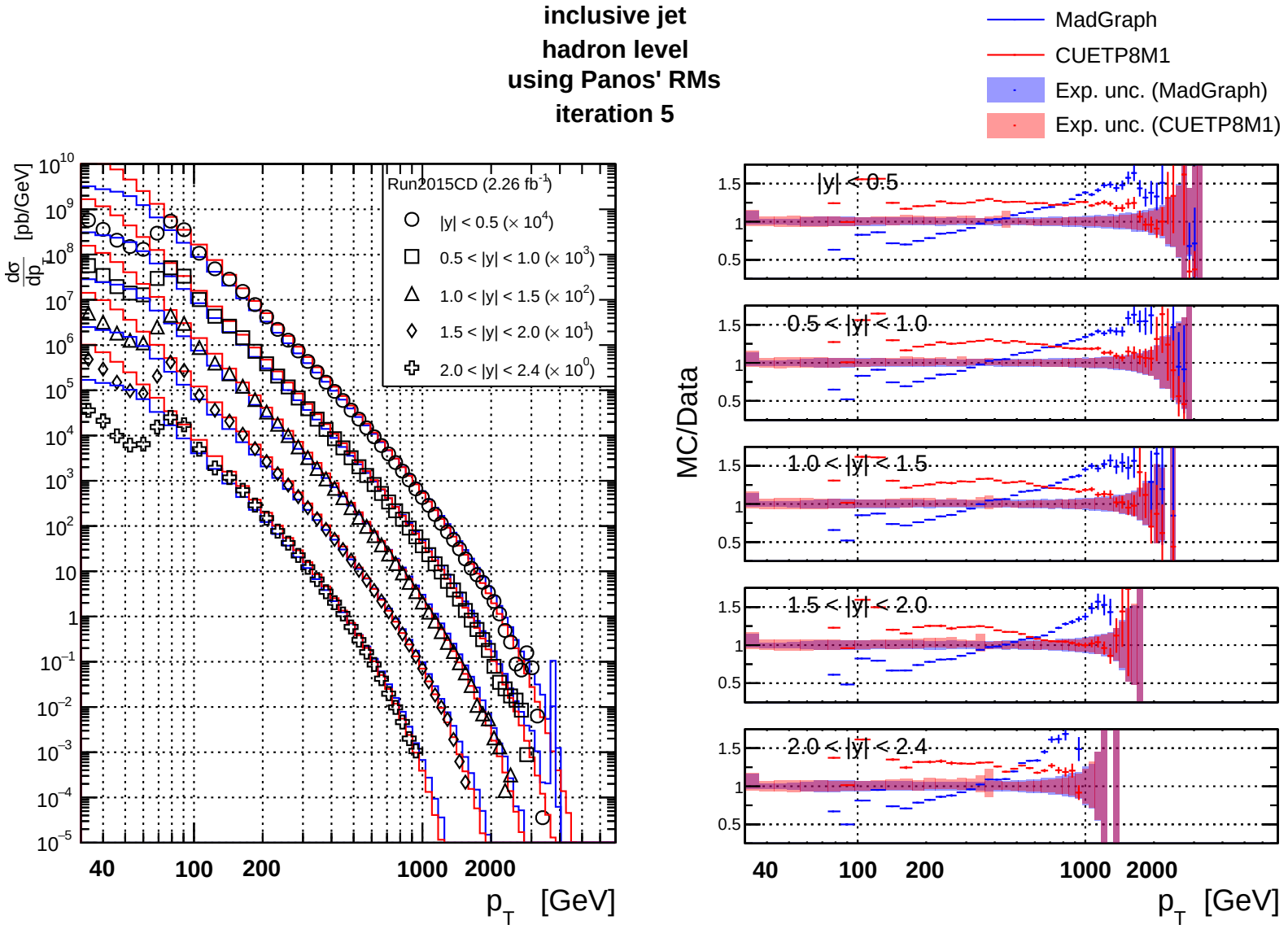
inclusive jet
hadron level
using Panos' RMs
iteration 3



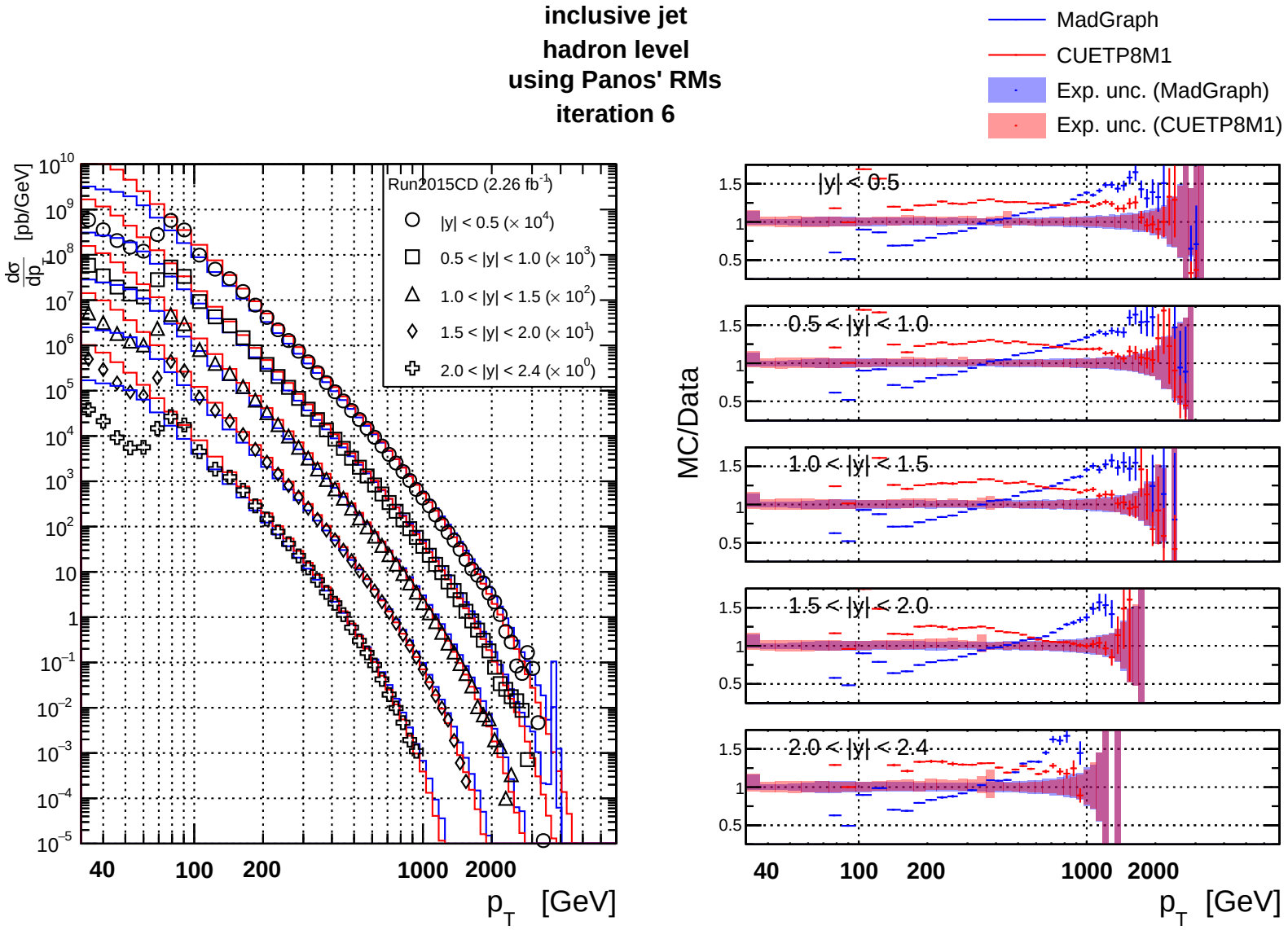
inclusive jet
hadron level
using Panos' RMs
iteration 4



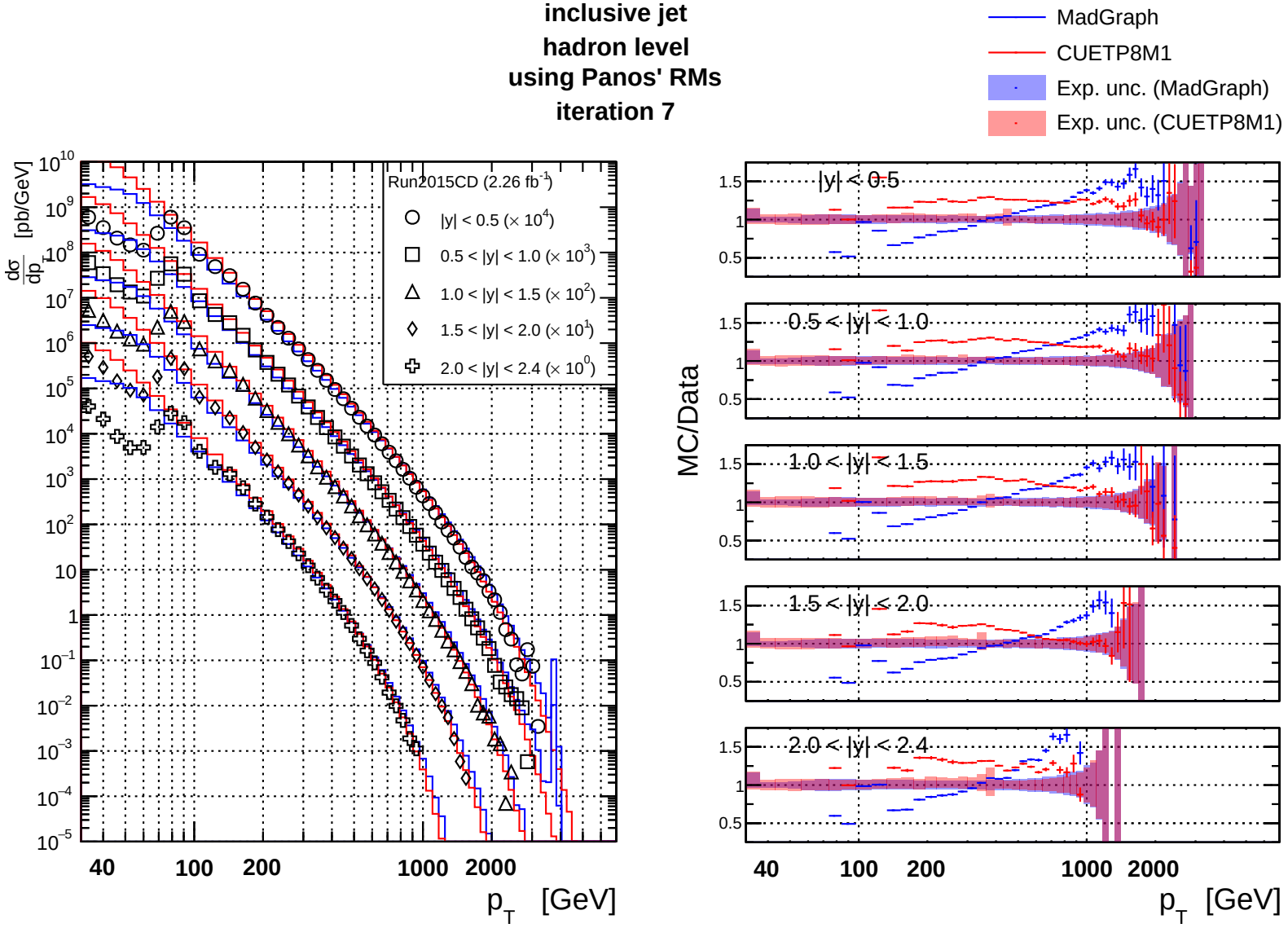
inclusive jet
hadron level
using Panos' RMs
iteration 5



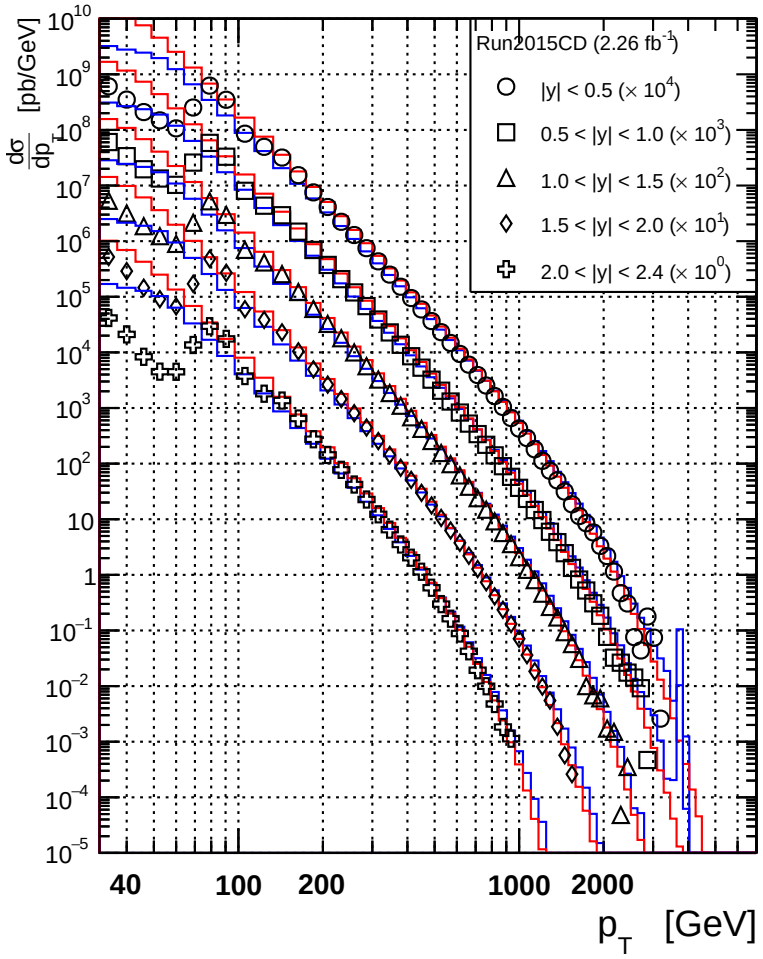
inclusive jet
hadron level
using Panos' RMs
iteration 6

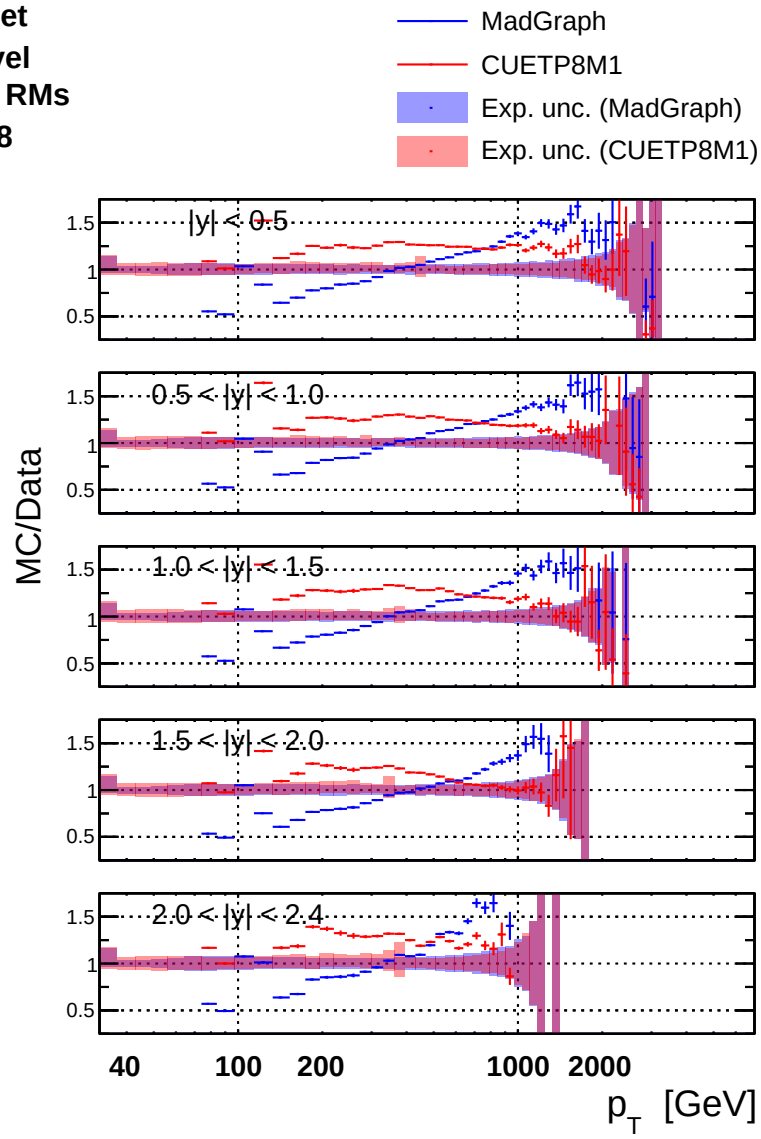


inclusive jet
hadron level
using Panos' RMs
iteration 7

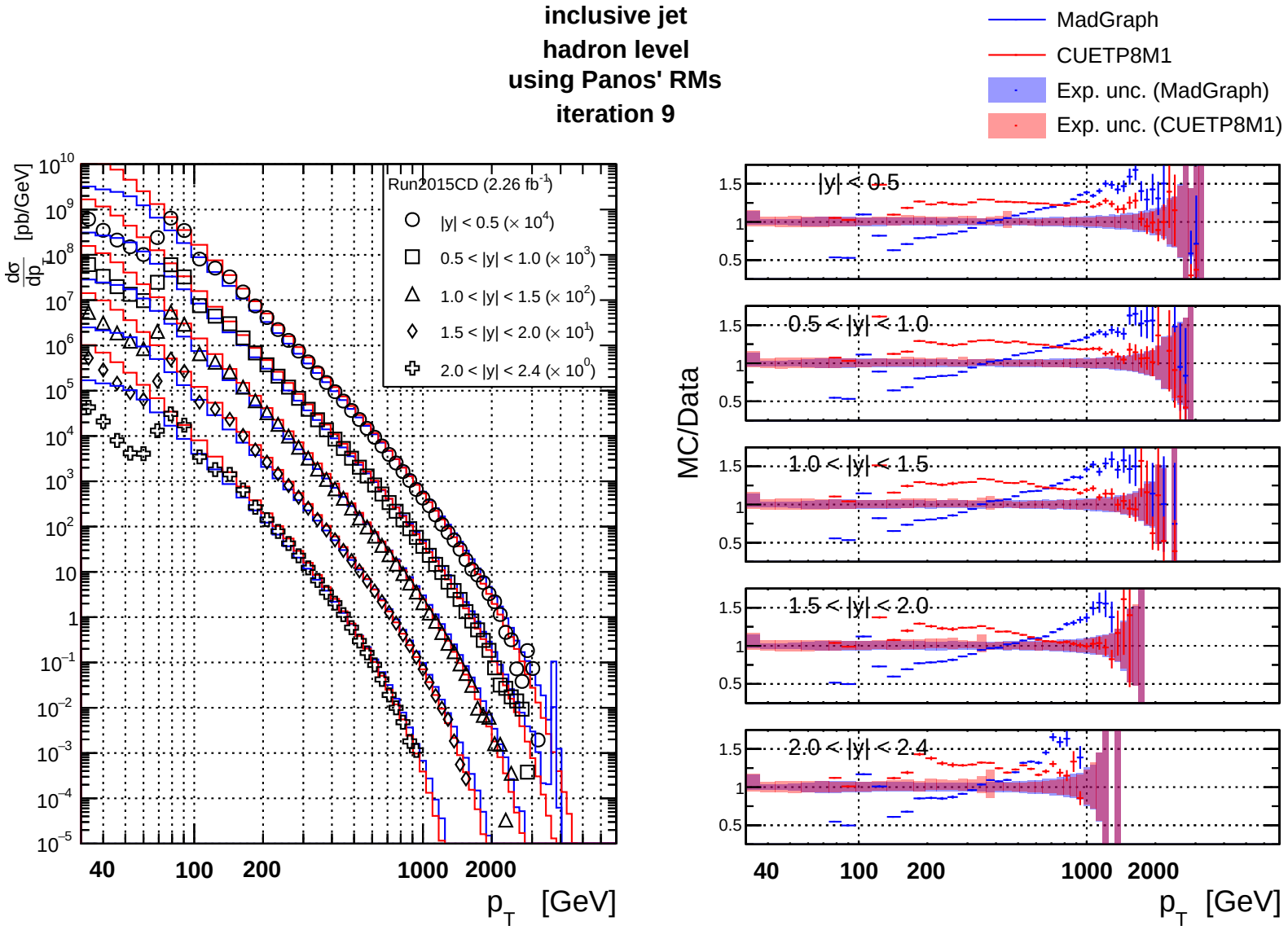


inclusive jet
hadron level
using Panos' RMs
iteration 8

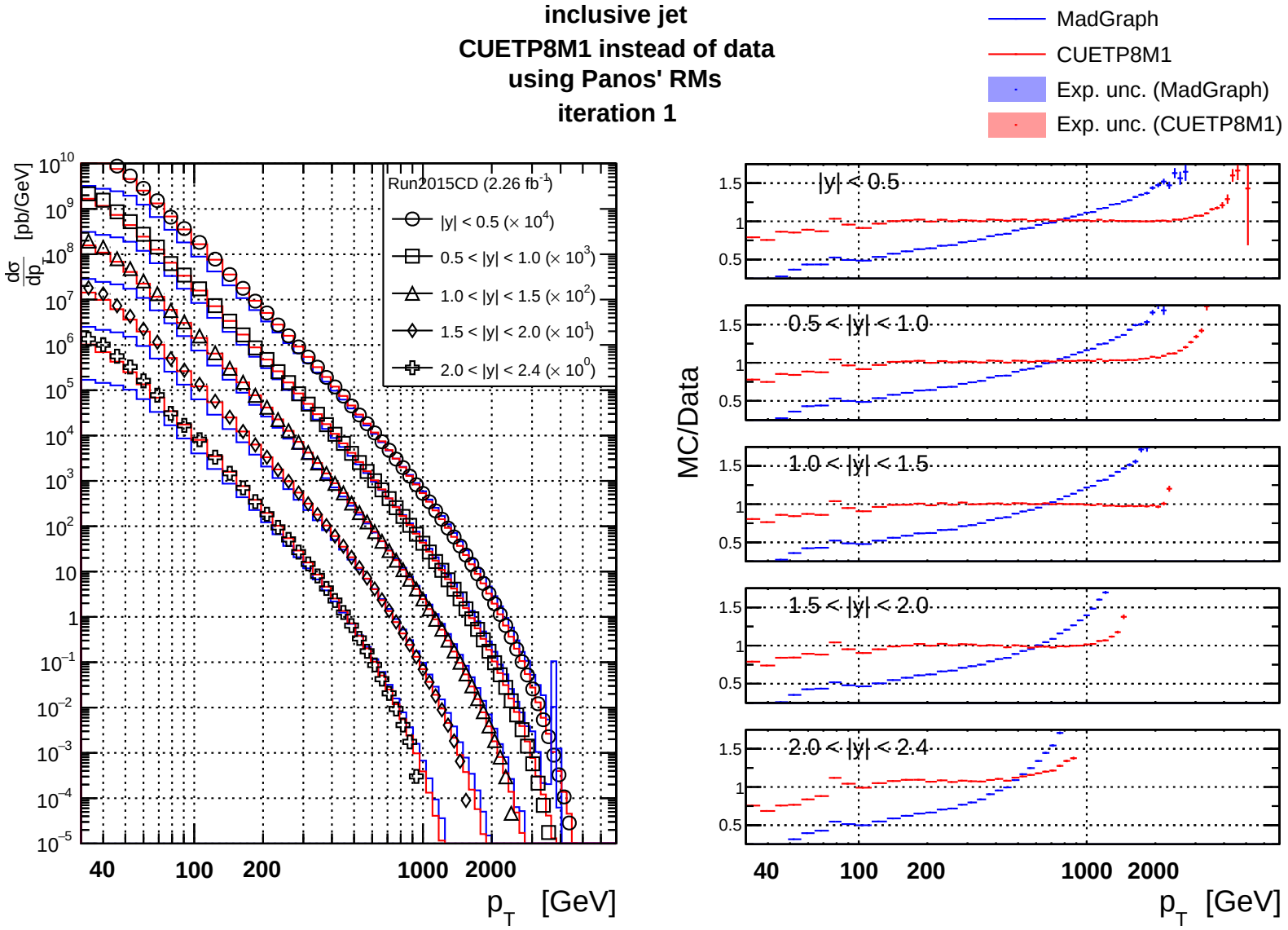




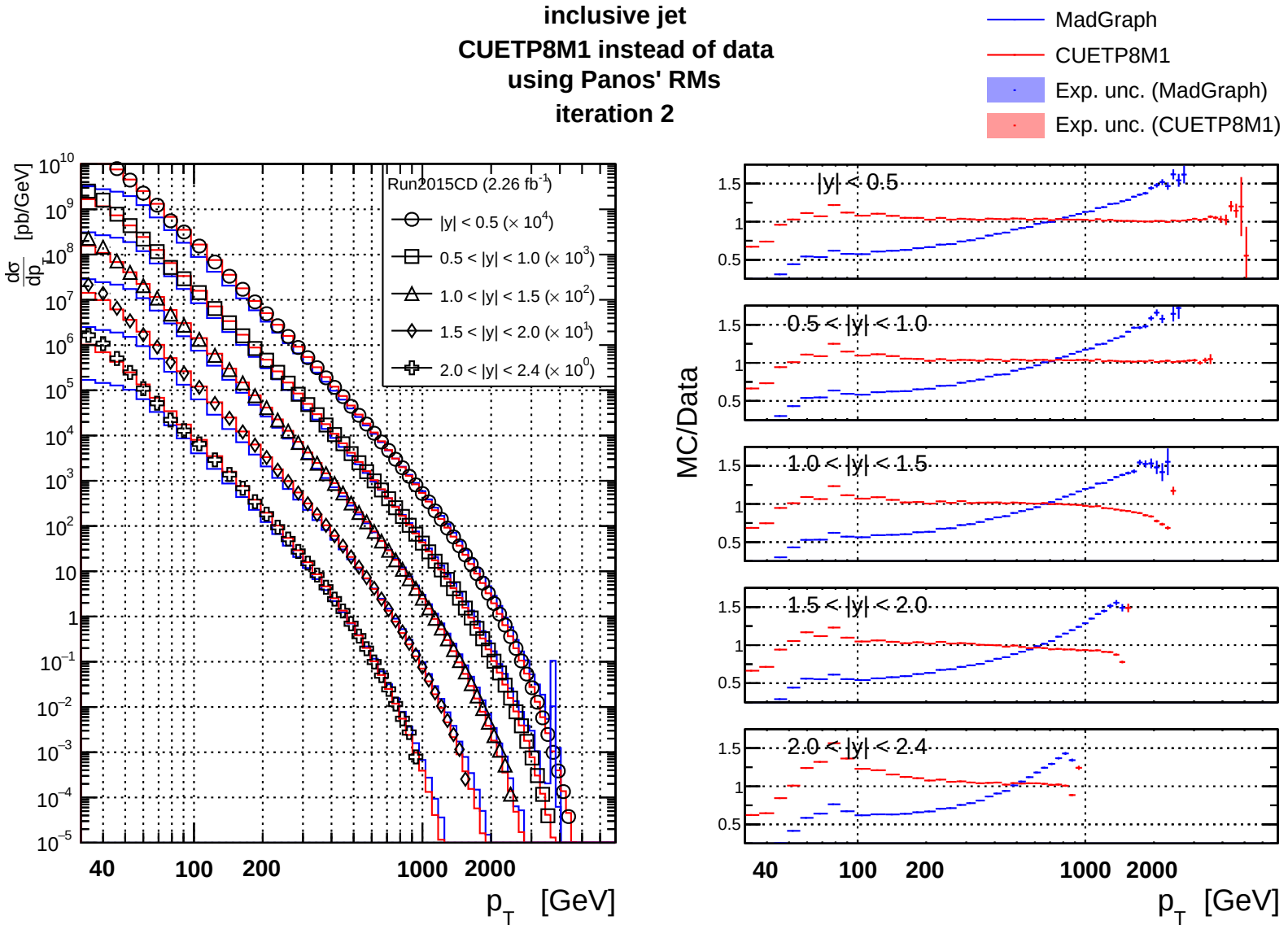
inclusive jet
hadron level
using Panos' RMs
iteration 9



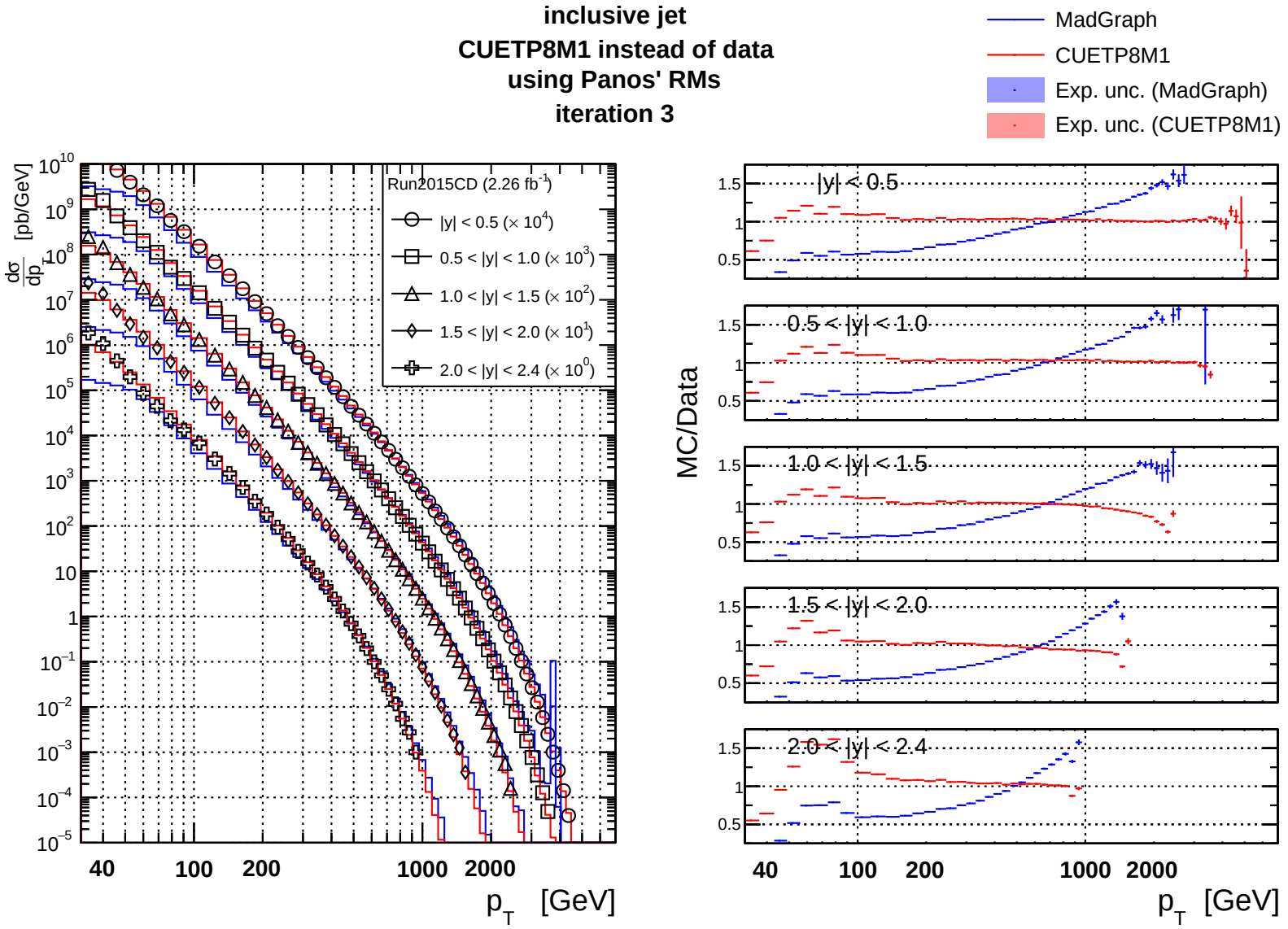
inclusive jet
CUETP8M1 instead of data
using Panos' RMs
iteration 1



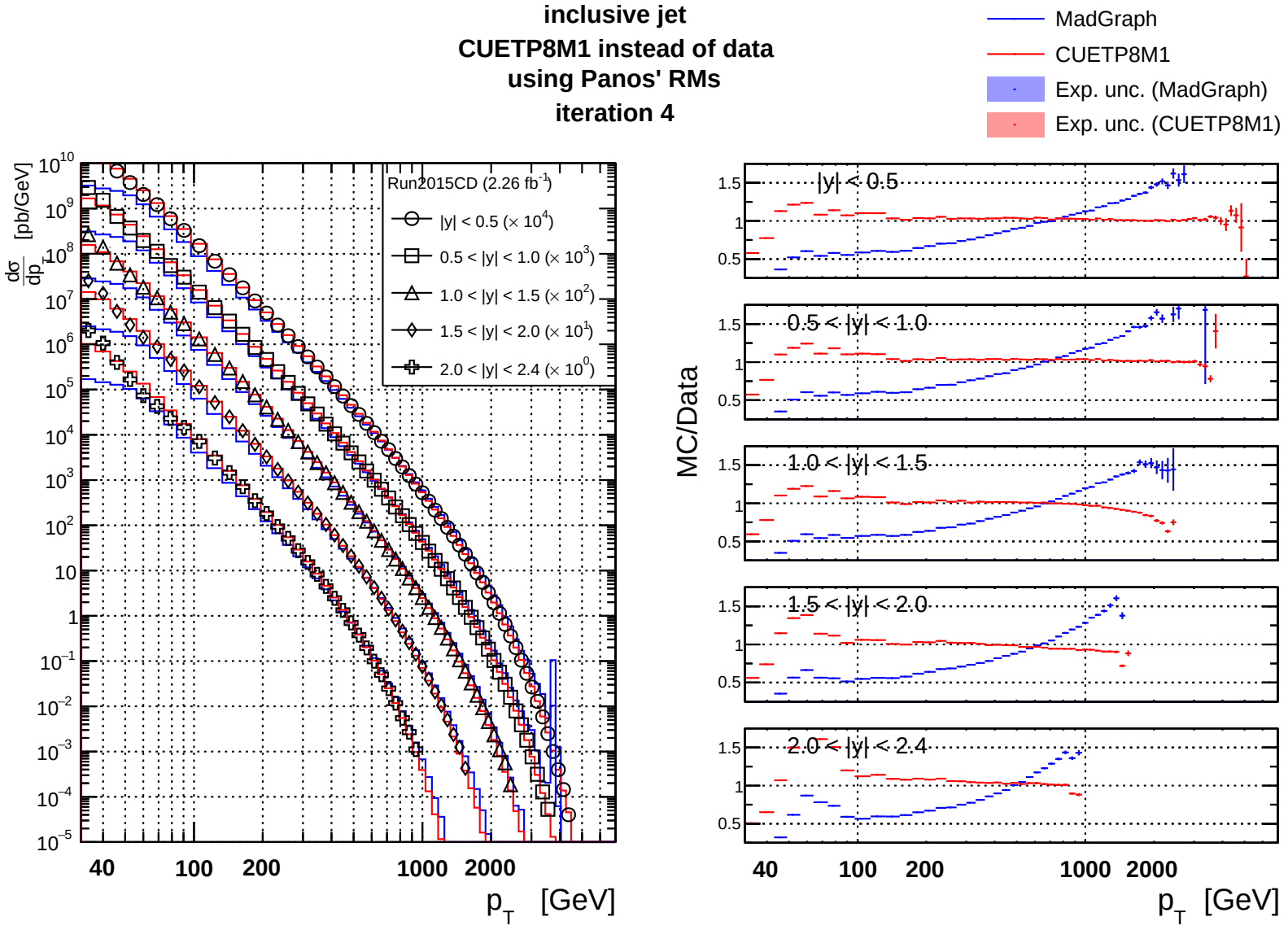
inclusive jet
CUETP8M1 instead of data
using Panos' RMs
iteration 2



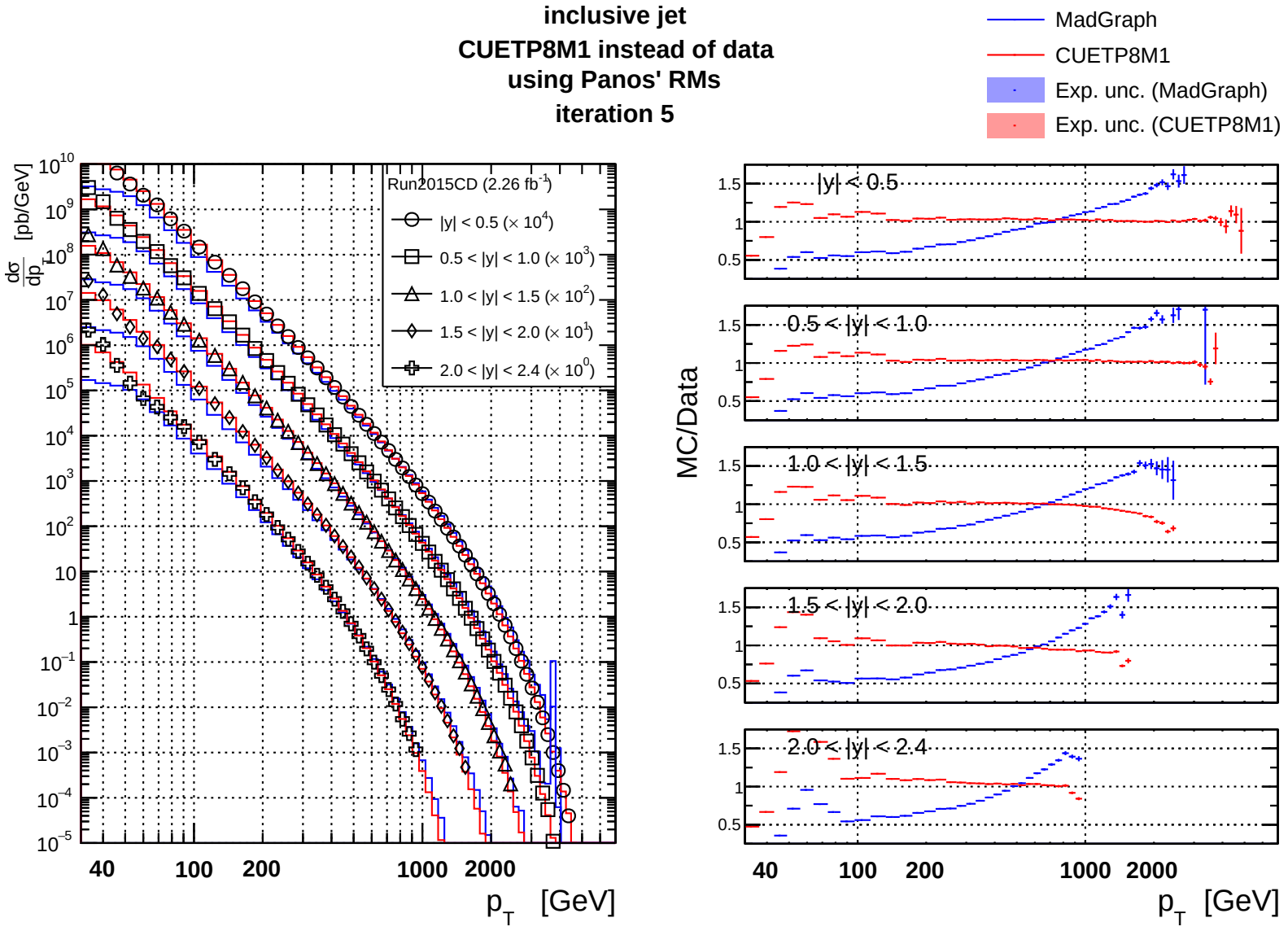
inclusive jet
CUETP8M1 instead of data
using Panos' RMs
iteration 3



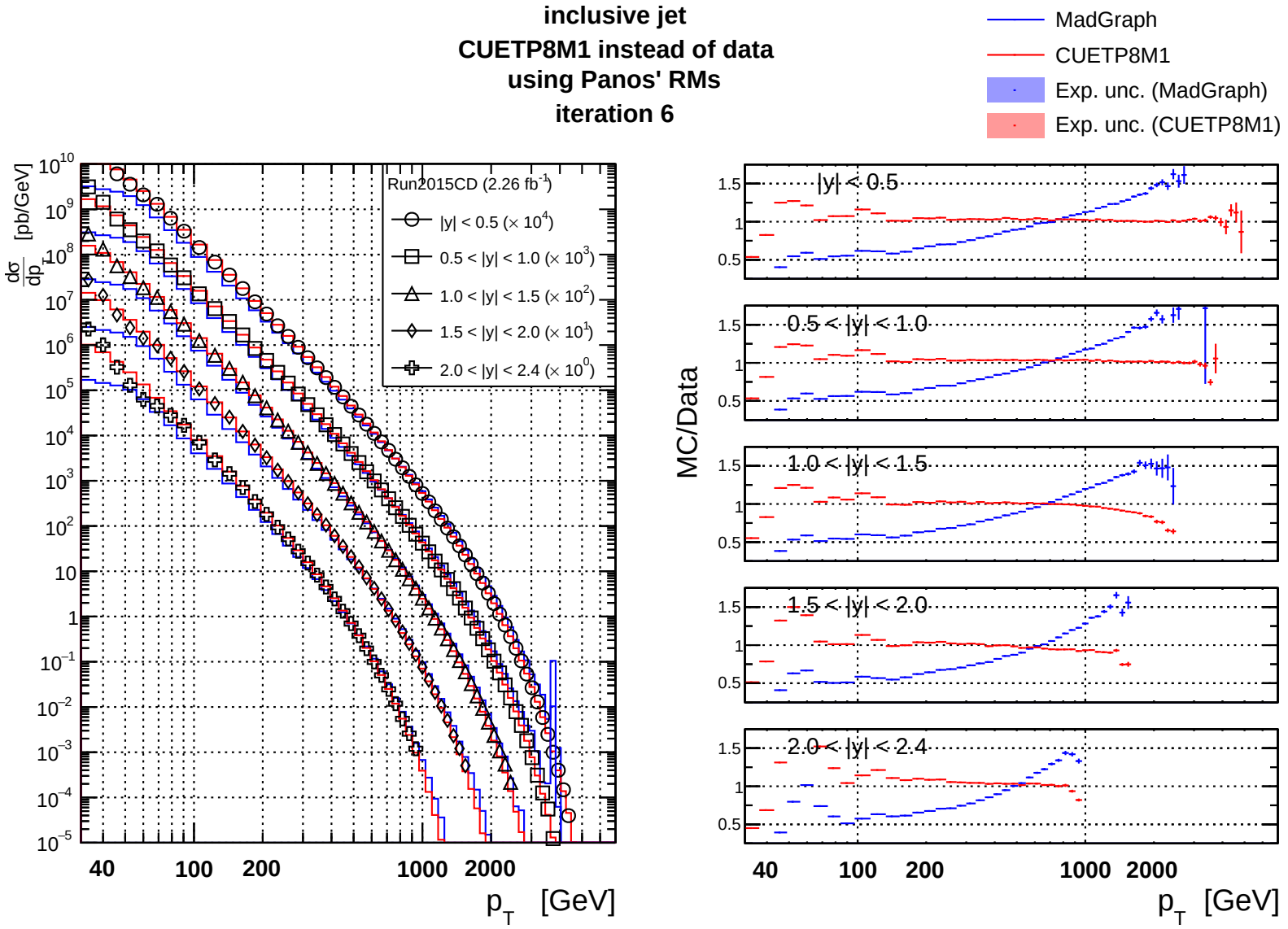
inclusive jet
CUETP8M1 instead of data
using Panos' RMs
iteration 4



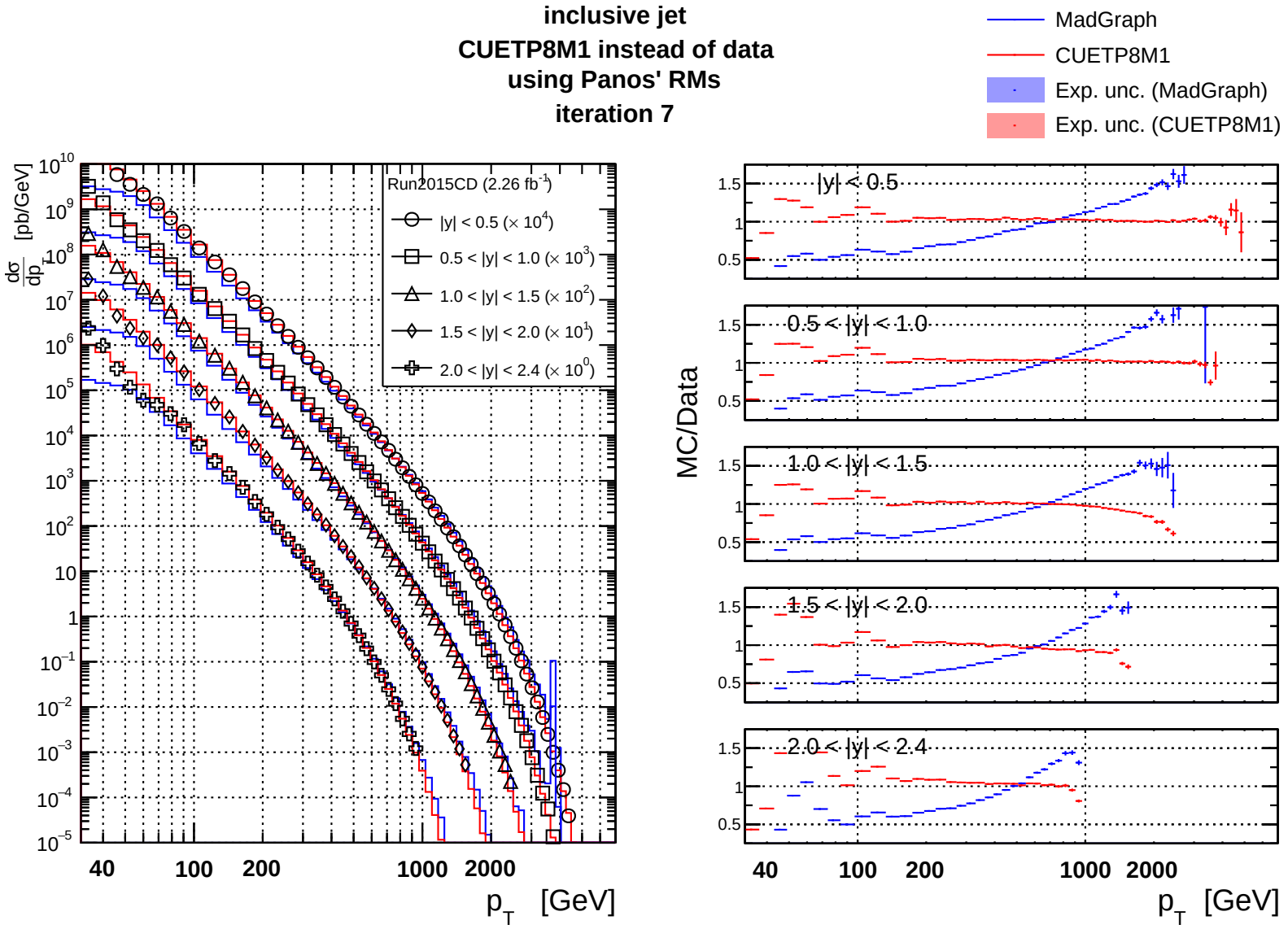
inclusive jet
CUETP8M1 instead of data
using Panos' RMs
iteration 5



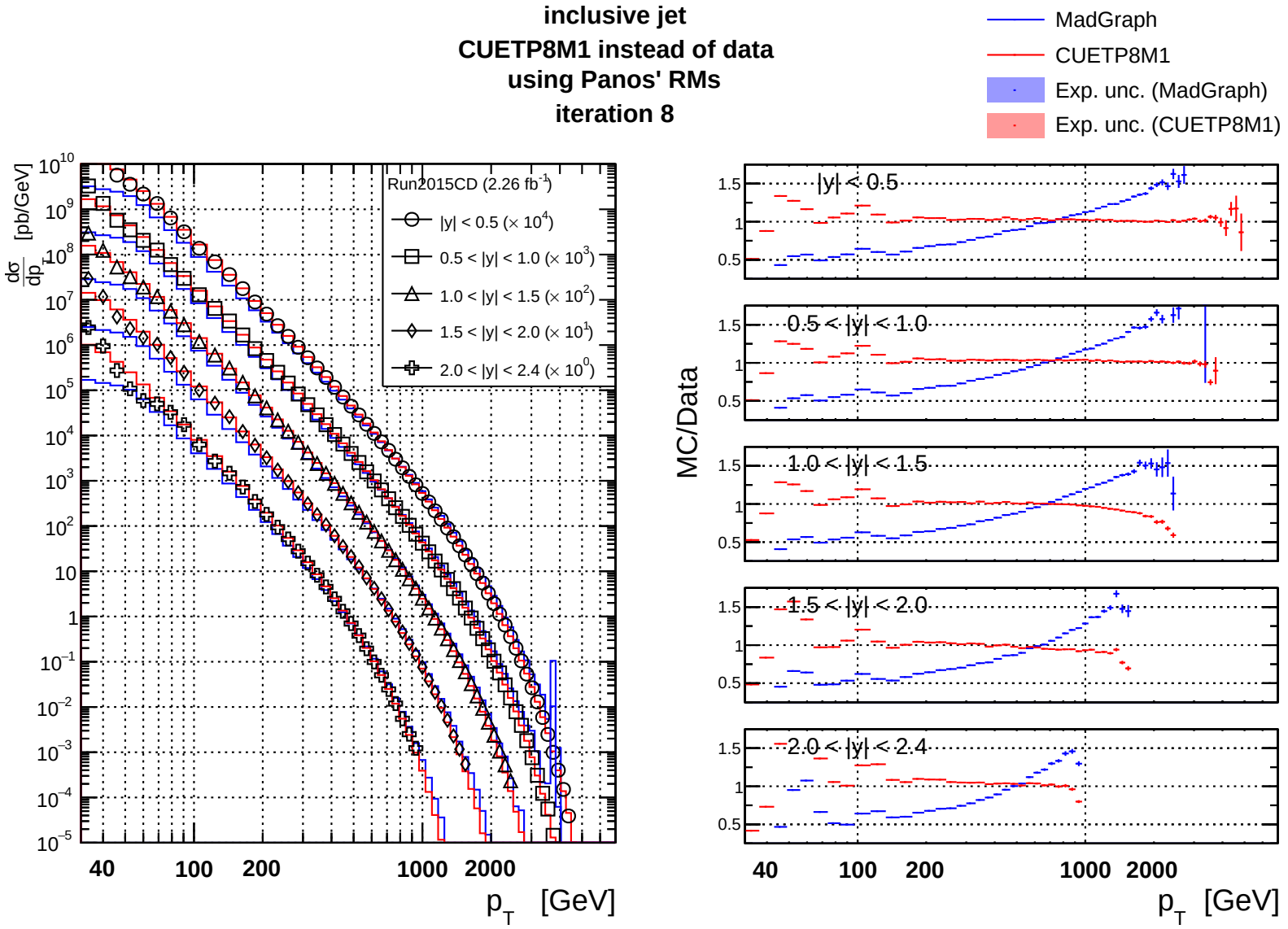
inclusive jet
CUETP8M1 instead of data
using Panos' RMs
iteration 6



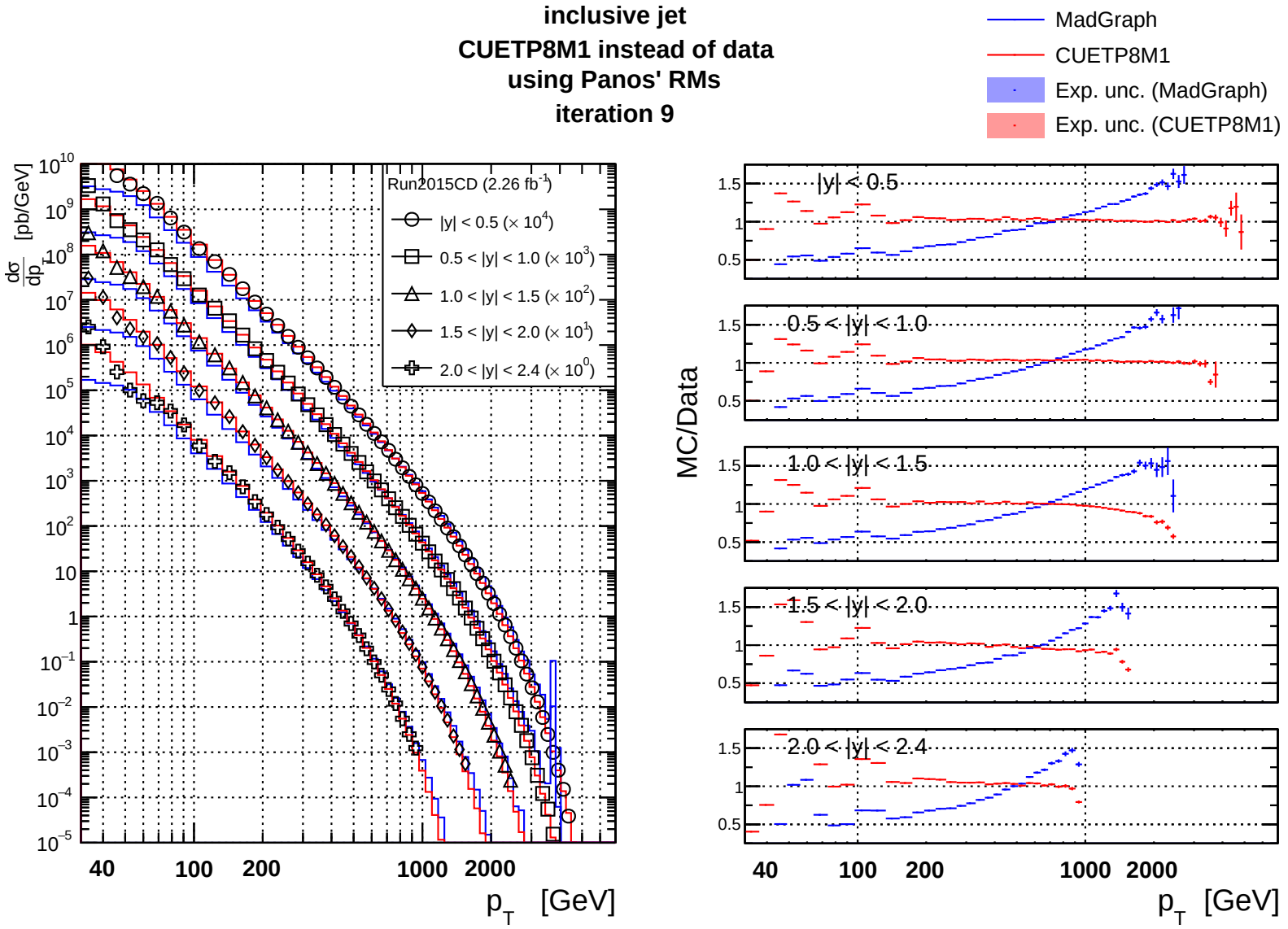
inclusive jet
CUETP8M1 instead of data
using Panos' RMs
iteration 7



inclusive jet
CUETP8M1 instead of data
using Panos' RMs
iteration 8



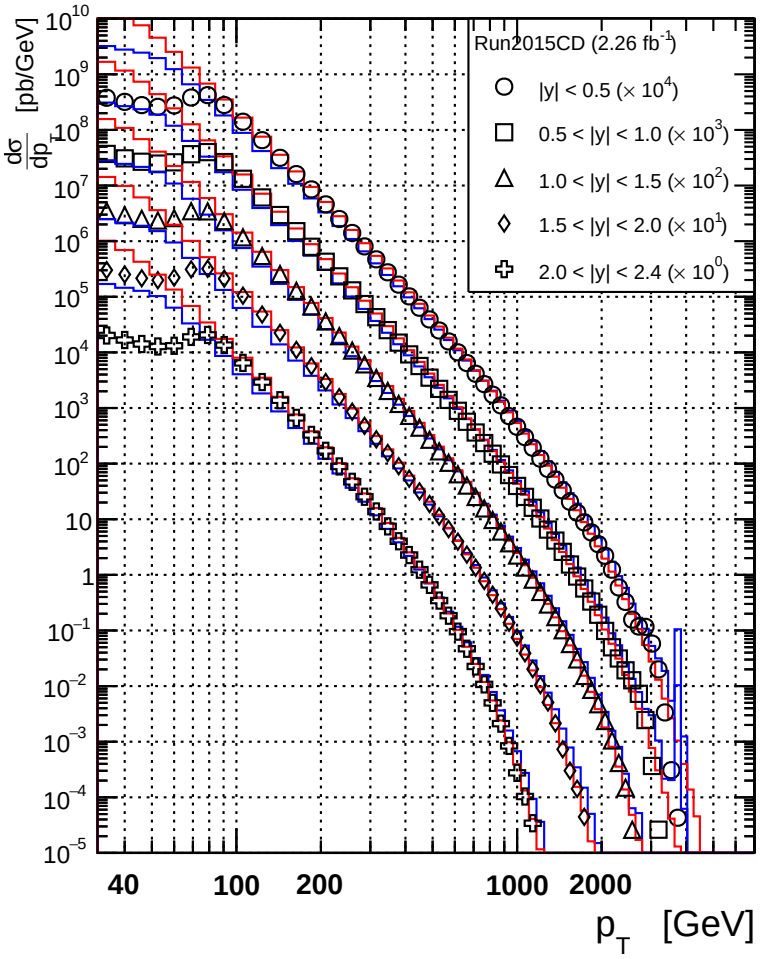
inclusive jet
CUETP8M1 instead of data
using Panos' RMs
iteration 9

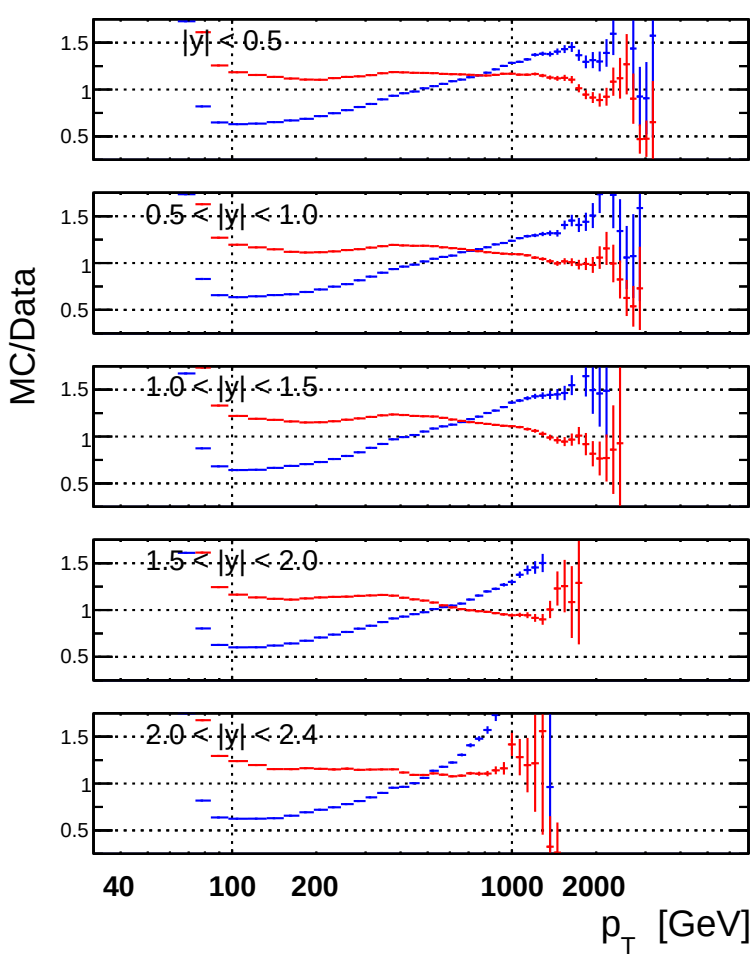


inclusive jet
hadron level
using CUETP8M1 RMs
iteration 1

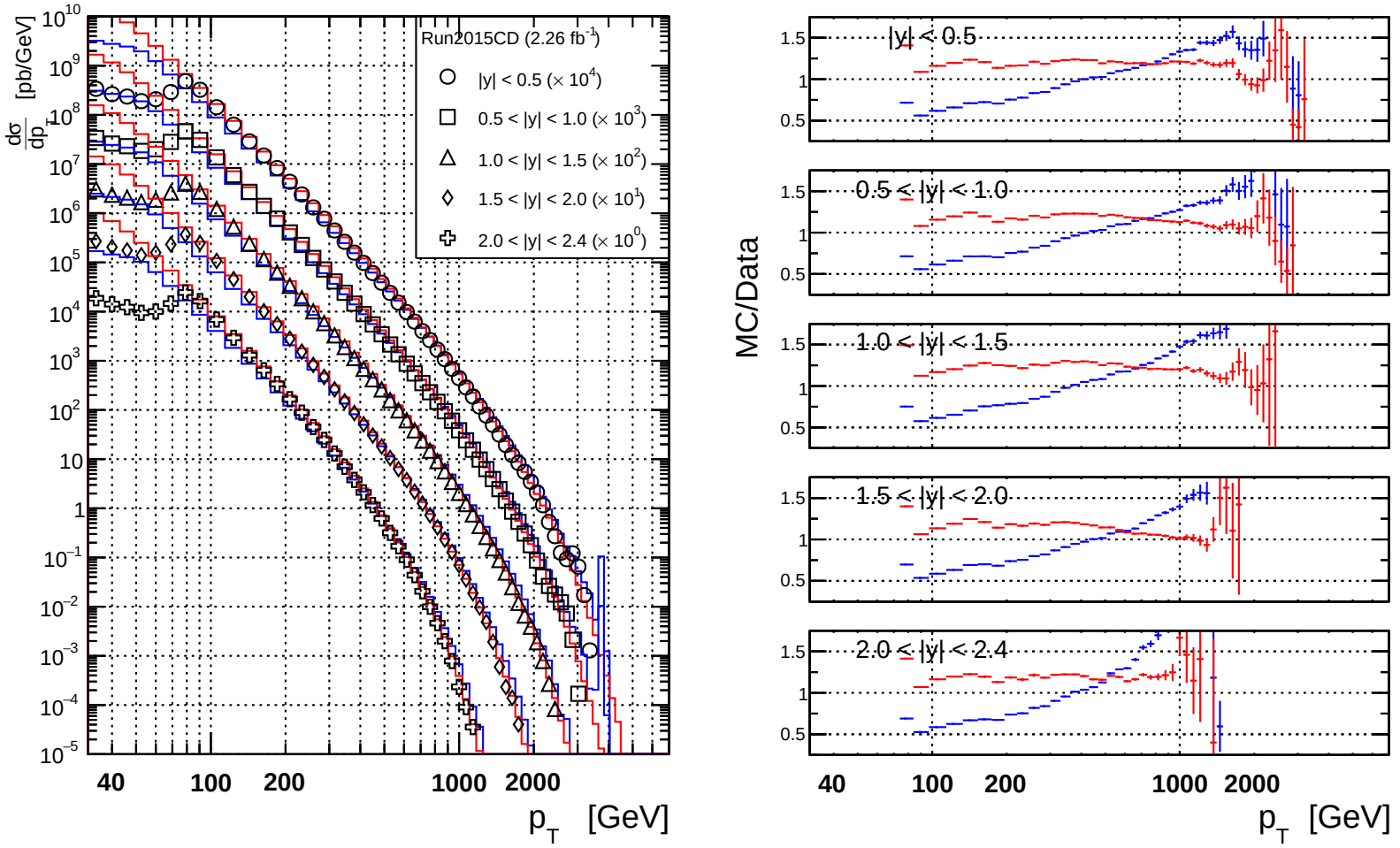
MadGraph

CUETP8M1

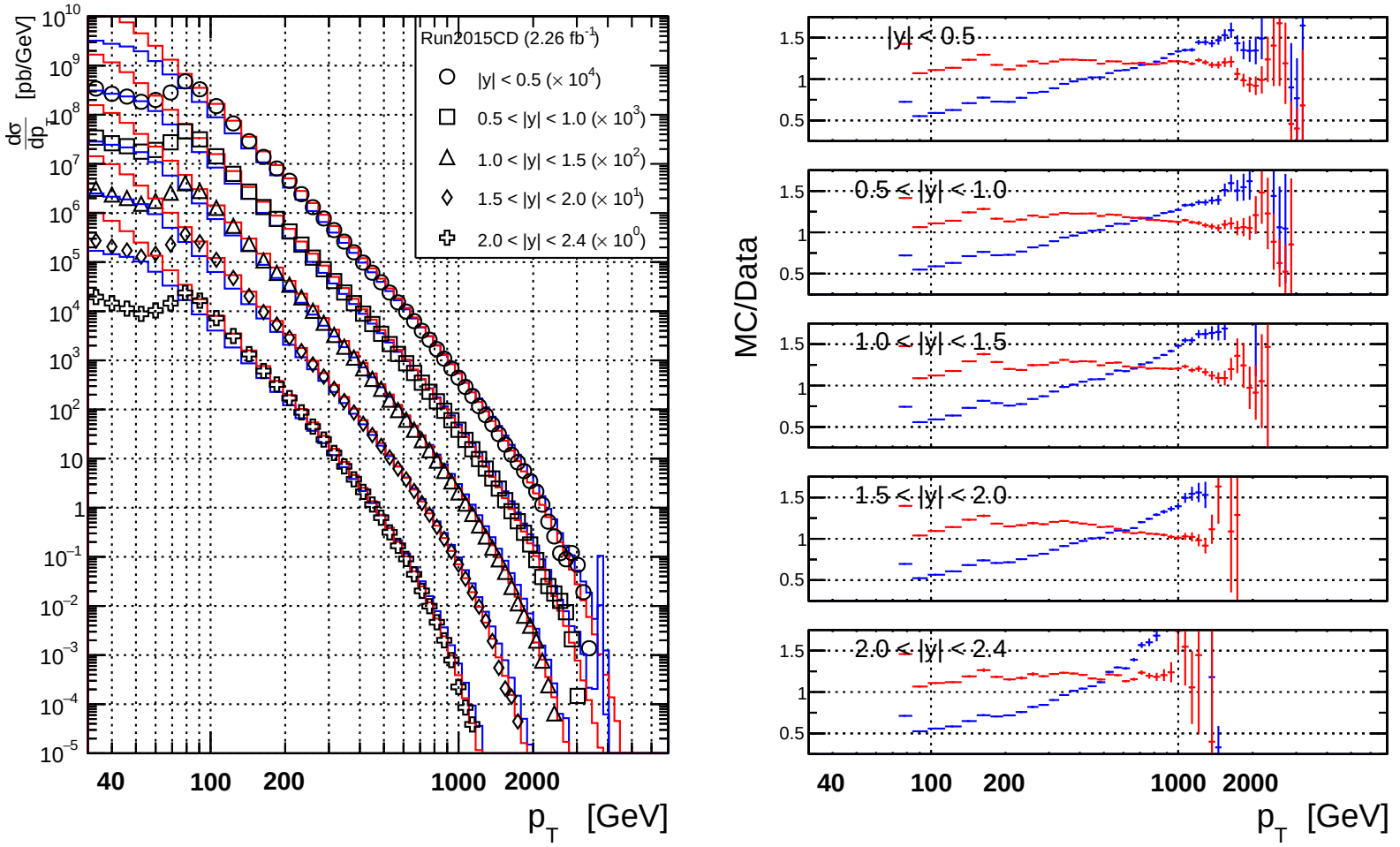




inclusive jet
hadron level
using CUETP8M1 RMs
iteration 2



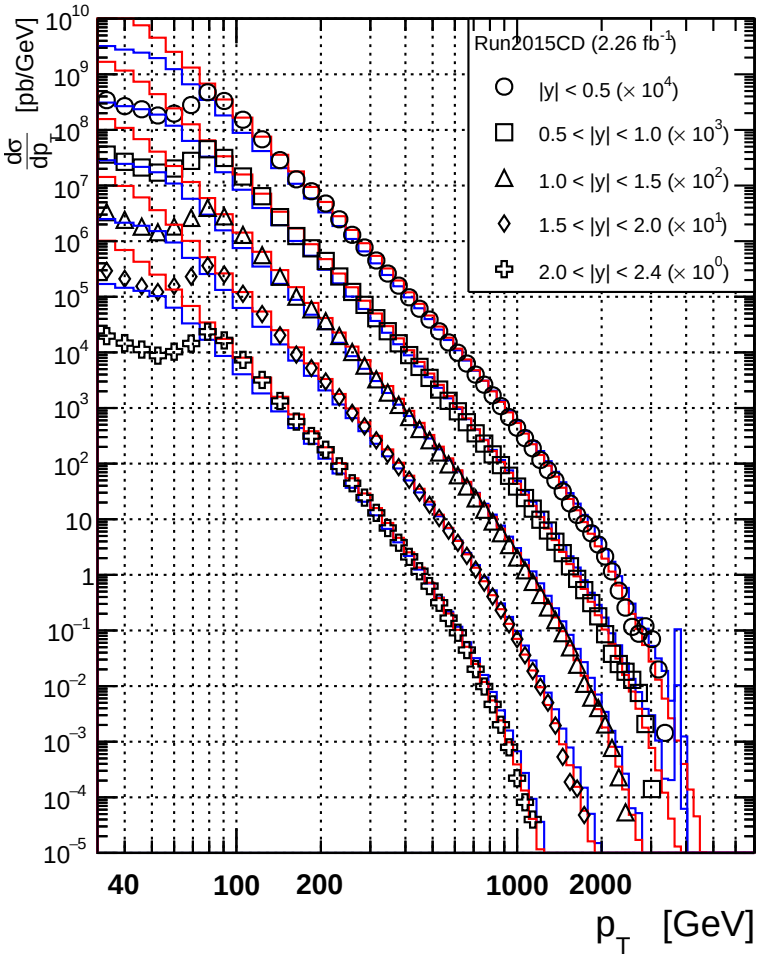
inclusive jet
hadron level
using CUETP8M1 RMs
iteration 3

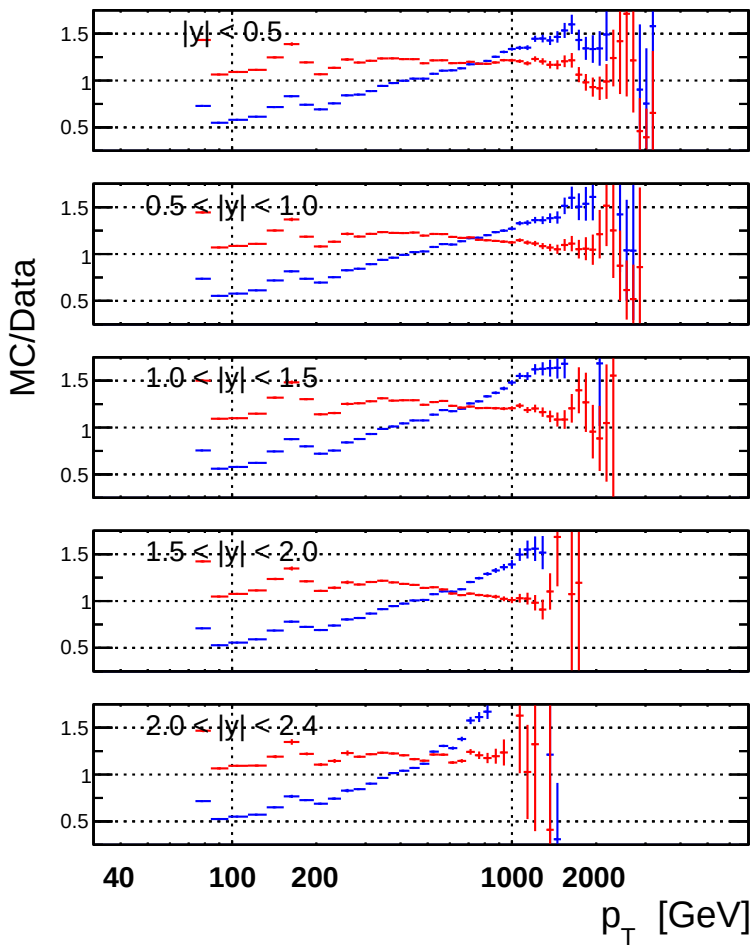


inclusive jet
hadron level
using CUETP8M1 RMs
iteration 4

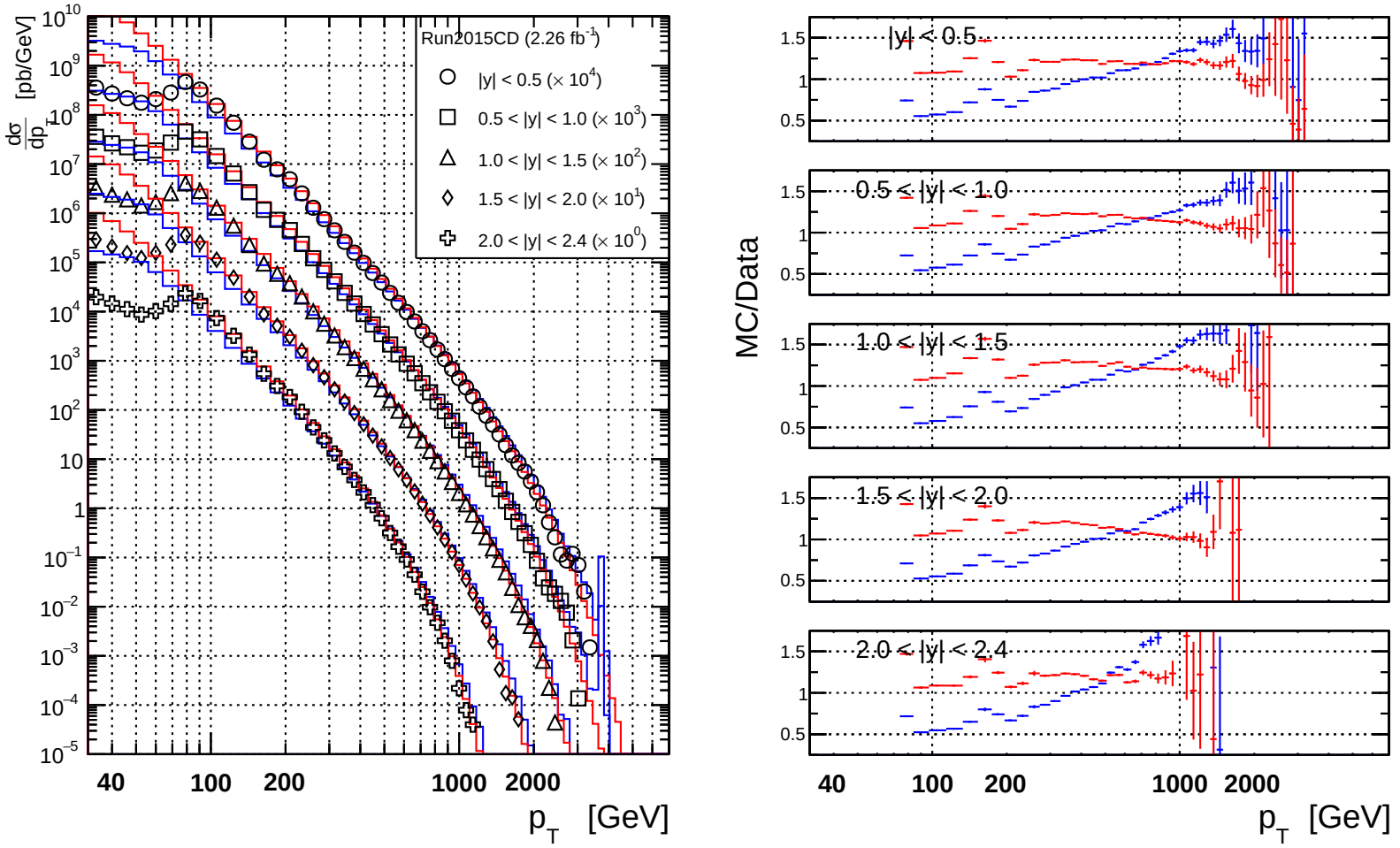
MadGraph

CUETP8M1

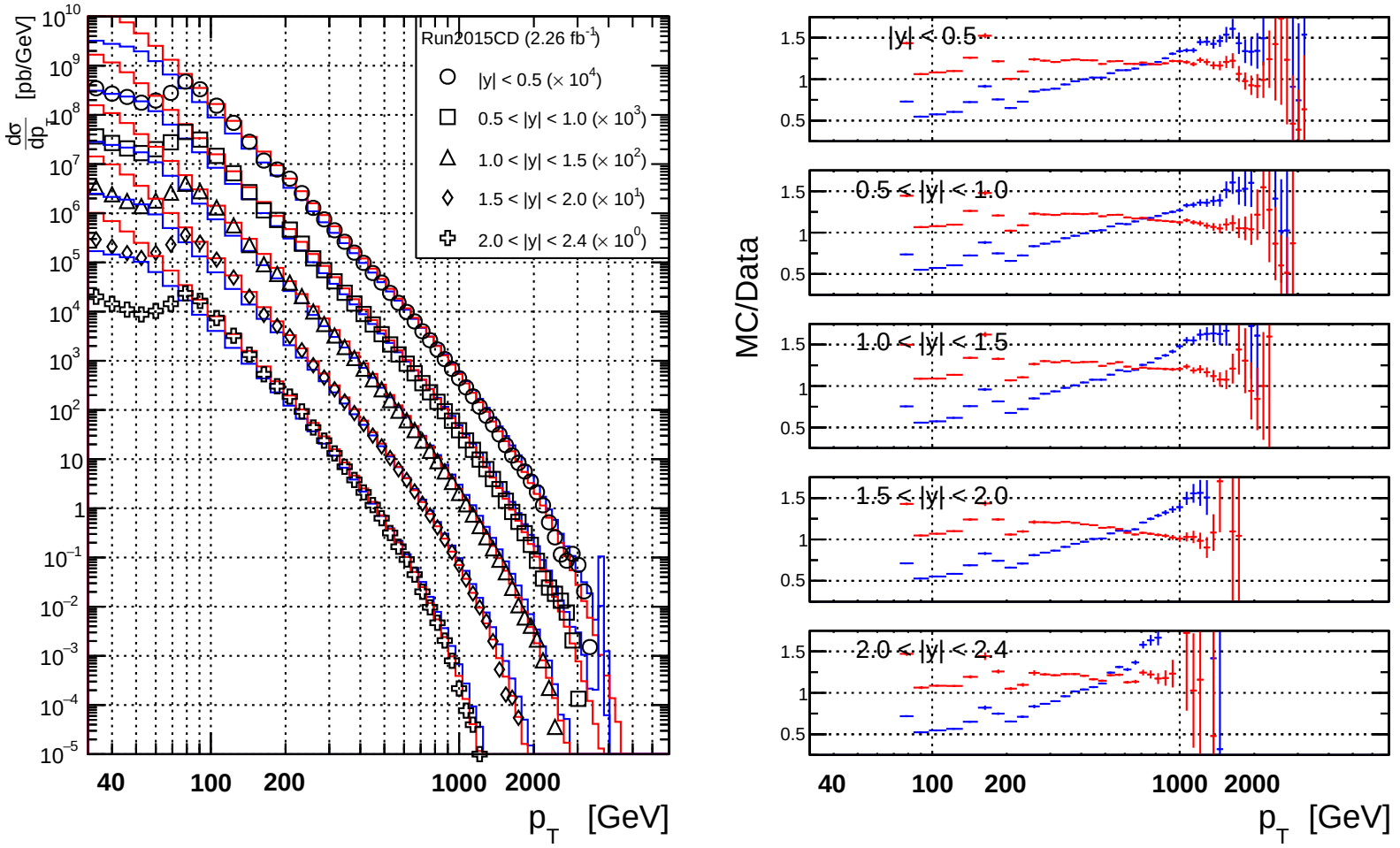




inclusive jet
hadron level
using CUETP8M1 RMs
iteration 5



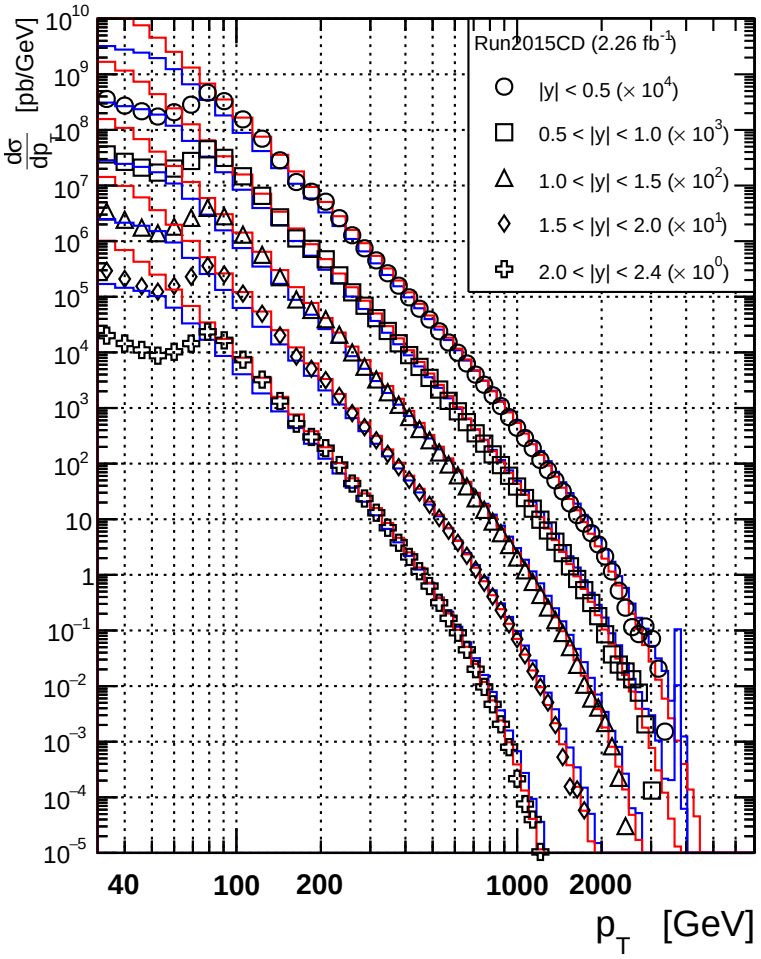
inclusive jet
hadron level
using CUETP8M1 RMs
iteration 6

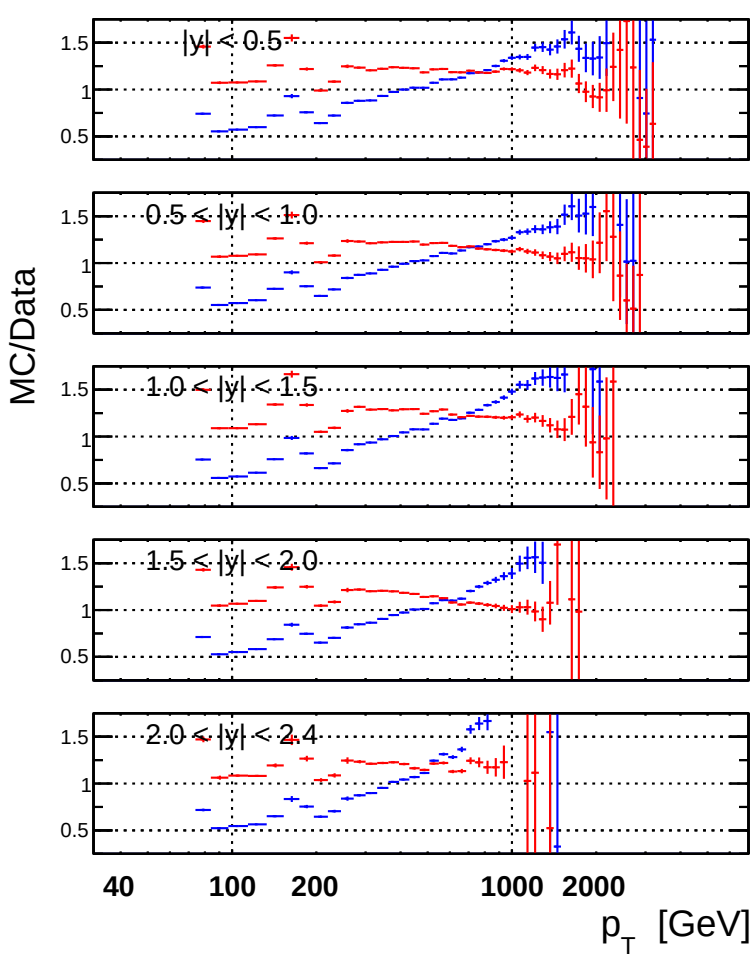


inclusive jet
hadron level
using CUETP8M1 RMs
iteration 7

MadGraph

CUETP8M1

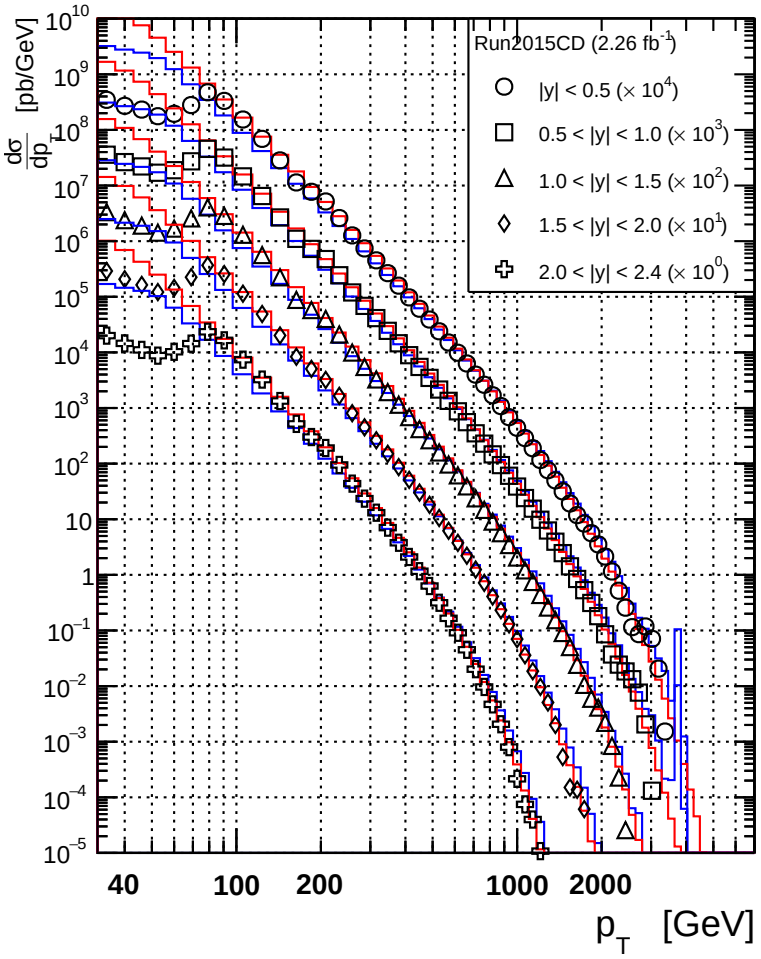


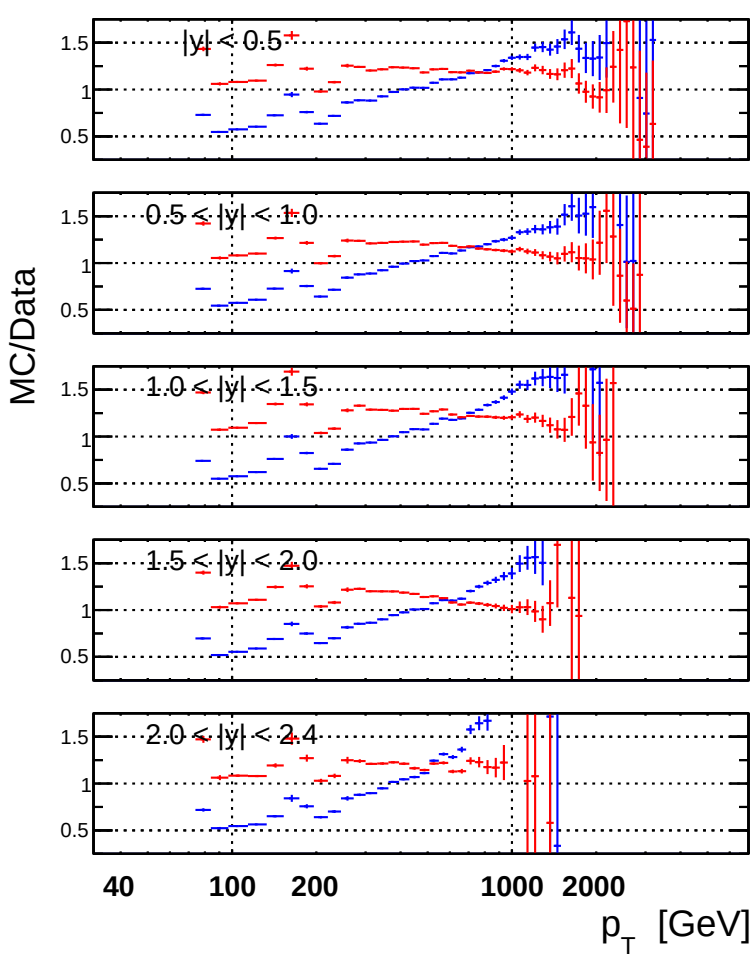


inclusive jet
hadron level
using CUETP8M1 RMs
iteration 8

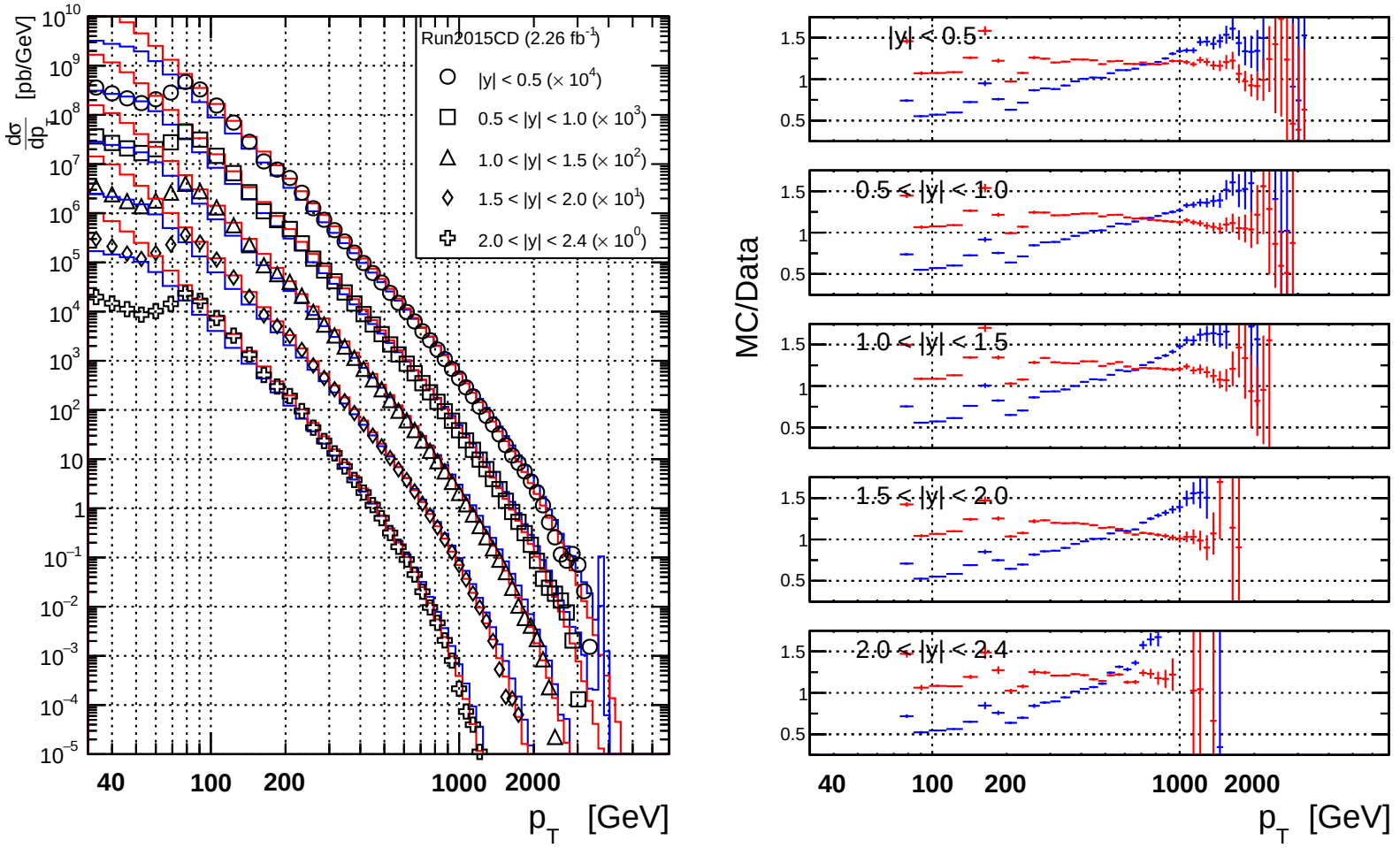
MadGraph

CUETP8M1





inclusive jet
hadron level
using CUETP8M1 RMs
iteration 9



Tool

- standalone tool, compiled with the latest `RooUnfold`[1] and with `Root6`
- inputs are:
  - resolution (simply gaussian for the moment)
  - *true* p_T cross section for the measurement
  - *MC* p_T cross section for the construction of the RM
  - binning scheme
- outputs are:
  - RM
  - differential resolution
  - ABPS
  - measured, true and unfolded spectra
  - ratios of true and unfolded spectra over measurement
- output format:
  - `.root` file
  - PDF files

[1] `svn co https://svnsrv.desy.de/public/unfolding/RooUnfold/trunk`

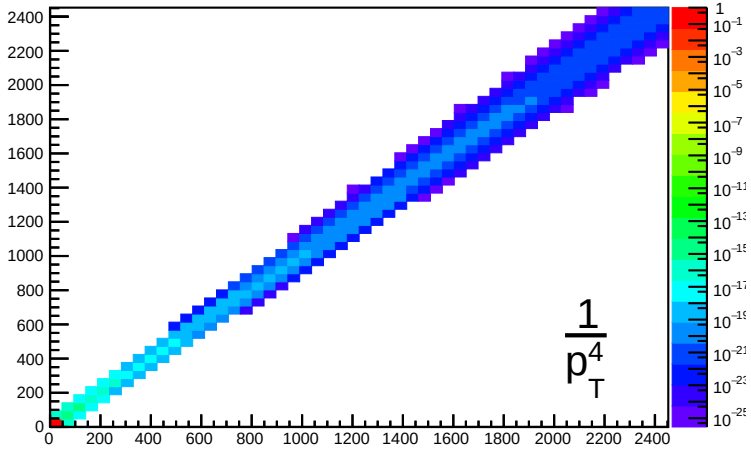
Questions

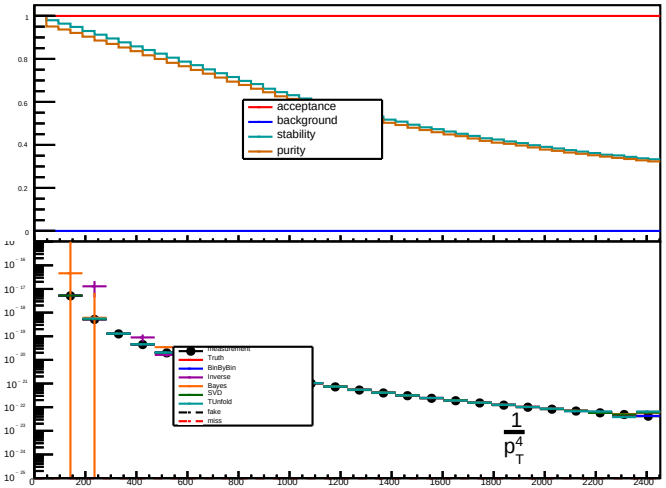
1. method (Bayes, inversion, ...)
   - how do the different method compare in performance?
   - is unfolding really improving the picture?
2. p_T spectrum and model dependence
   - looks like Panos' code is strongly model-dependent (?)
3. binning scheme + ABPS + miss/fake
   - effect can be mostly seen on purity and stability
4. statistics + sampling (perfect/uniform/core)

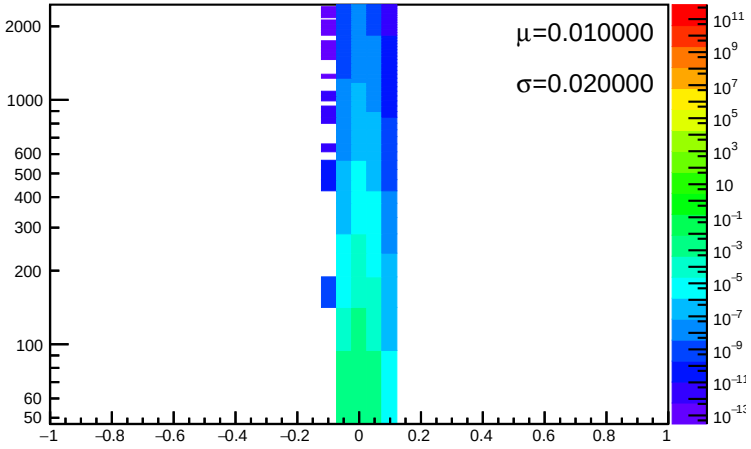
Application

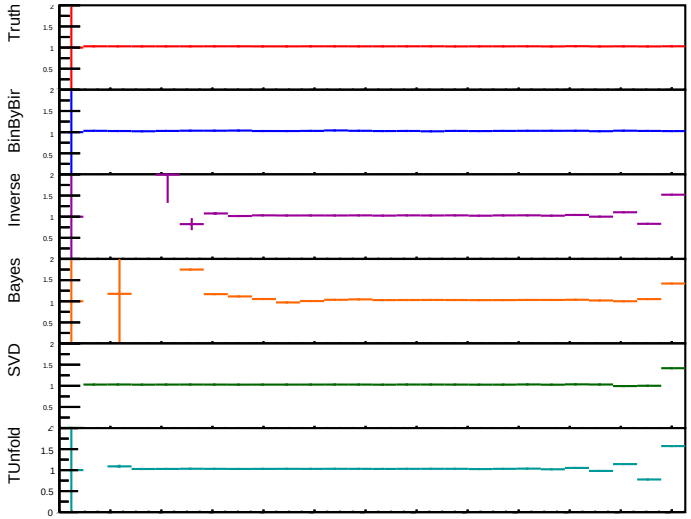
- constant binning and resolution
- using core sampling
- with 10M of entries
- spectrum going as $1/p_T^4$

Example









Other plots in `appendix.pdf`

Introduction

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Panos' RMs on P8

Panos' RMs on Run2015CD

P8 RMs on Run2015CD

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The End

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Unfolding methods

bin/bin model-dependent and wrong handling of statistical uncertainties

Bayes iterative procedure, good experience in SMP, is shown to converge but unknown number of iterations

Inversion best on principle, but possible instabilities if statistics is too low

TUnfold likelihood minimisation, including regularisation, recommended by statistics comitee, developer is at DESY

SVD ...