MadDM 3.0 EW

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Contents

Abstract

This documents summarises the status of the studies of the discrepancies found in the energy spectra provided in the PPPC4DMID tables (labelled **PPPC4DMIDew** in MadDM v.3.0) and the spectra produced with MadDM 3.0.

1 PPPC Electroweak Corrections

In this section the energy spectra for the Cosmic Rays $CRs = e^+, \nu_e, \gamma$ extracted from the `PPPC4DMID` and `PPPC4DMID_ew` Tables are compared, to get an idea of the effect of the EW correction (according the `PPPC4DMID`collaboration).

2 EW with `MadGraph5_aMC@NLO`

2.1 Processes

The processes used for the production of the samples with emission of extra electroweak bosons (Higgs, W and Z bosons) are the following:

```
import model DMsimp_s_spin0_EW
define X = W- W+ Z h
generate xd xd~ > w- w+
add process xd xd~ > w- w+ X
add process xd xd~ > w- w+ X X
add process xd xd~ > w- w+ X X X
```

Note that the short notation e.g. "XXW" includes the lower order processes (in this case only the tree level xdxd>WW) and up to one extra "X" boson, and likewise for the higher order processes.

Syntax for excluding diagrams with photons:

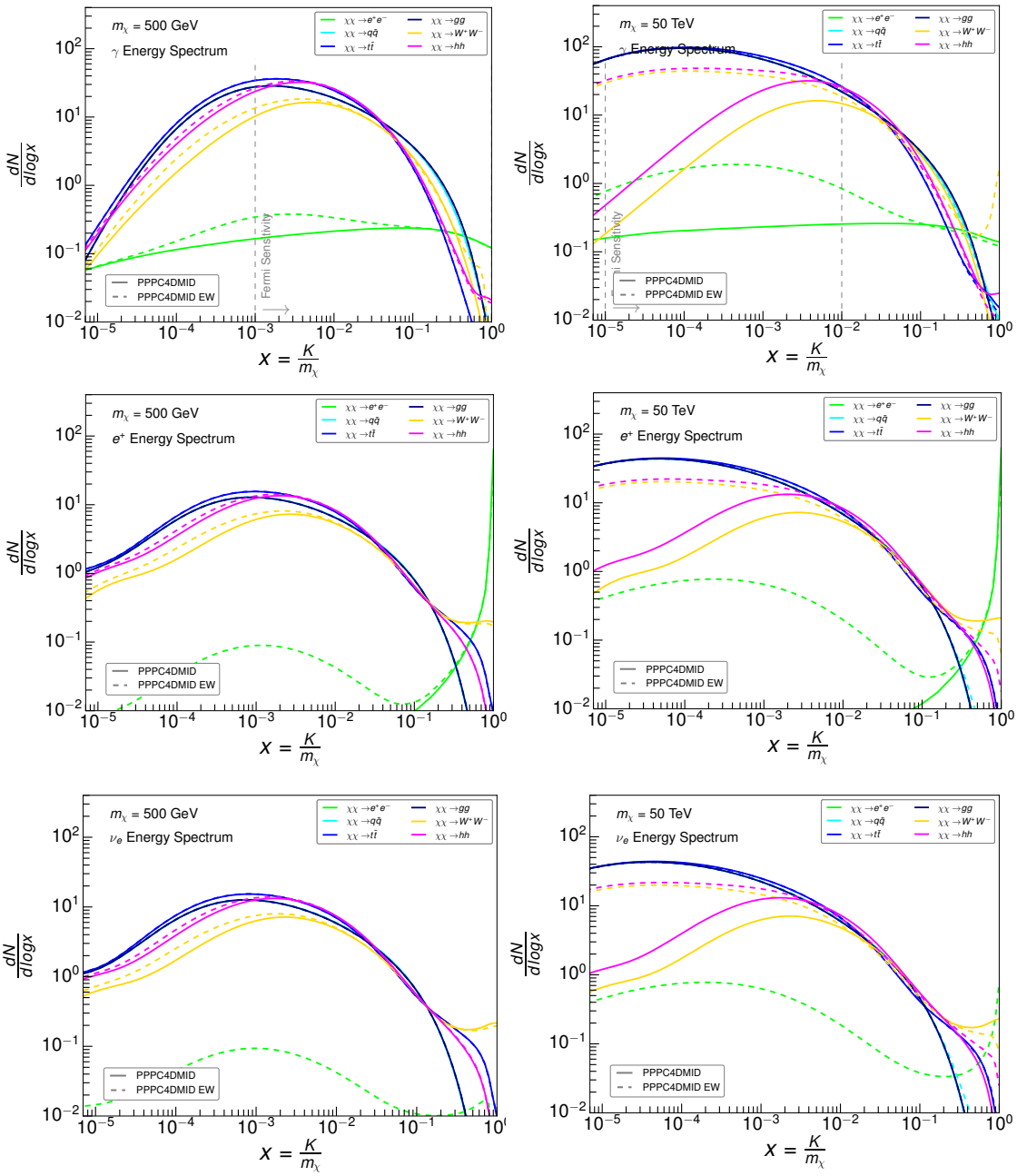

Figure 1. Energy spectra (γ, e^+, ν_e) for m_χ =500 GeV (left) and 50 TeV (right) extracted from the `PPPC4DMID` and `PPPC4DMID_ew` tables, for selected annihilation channels.

```
import model DMsimp_s_spin0_EW
define X = W- W+ Z h
generate xd xd~ > w- w+ /a
add process xd xd~ > w- w+ X  /a
```

```
add process xd xd~ > w- w+ X X  /a
add process xd xd~ > w- w+ X X X  /a
```

2.2 Cross Sections Comparison

In Tab. 1 the cross sections obtained with different runs are shown. Relevant parameters in the param_card and run_card:

```
*** run_card
1001.0     = ebeam1  for $m_{\chi_D}$=1 TeV
10001.0    = ebeam1  for $m_{\chi_D}$=10 TeV
100001.0    = ebeam1  for $m_{\chi_D}$=100 TeV

*** param_card
52 1.00000e+03 # MXd
54 2.00000e+03 # MY0  (= 2 x MXd )
```

m_{χ_D}	$\chi_D\chi_D \to WW$	$\chi_D\chi_D \to WWX$	$\chi_D\chi_D \to WWXX$	$\chi_D\chi_D \to WWXXX$
1.0 TeV (Old)	474	130*	600	600
1.0 TeV (Old, no γ)	474	676	704	-
1.0 TeV (New)	173	215	219	-
1.0 TeV (Chiara)	147.3	148.2	148.2	-
10.0 TeV (Old)	15.1 $\times 10^3$	30.501 $\times 10^3$	37.018 $\times 10^3$	-
10.0 TeV (Old,no γ)	15.1 $\times 10^3$	2.7 $\times 10^7$	1.5 $\times 10^{10}$	-
10.0 TeV (New)	15.1 $\times 10^3$	30.542 $\times 10^3$	-	-
100.0 TeV (Old)	4.7 $\times 10^5$	-	-	-

Table 1. The "New" cross sections were computed with N_{Events}=10,000, while the "Old" ones with N_{Events}=100,000.

2.3 Spectra

2.3.1 $m_{\chi_D} = 1$ TeV

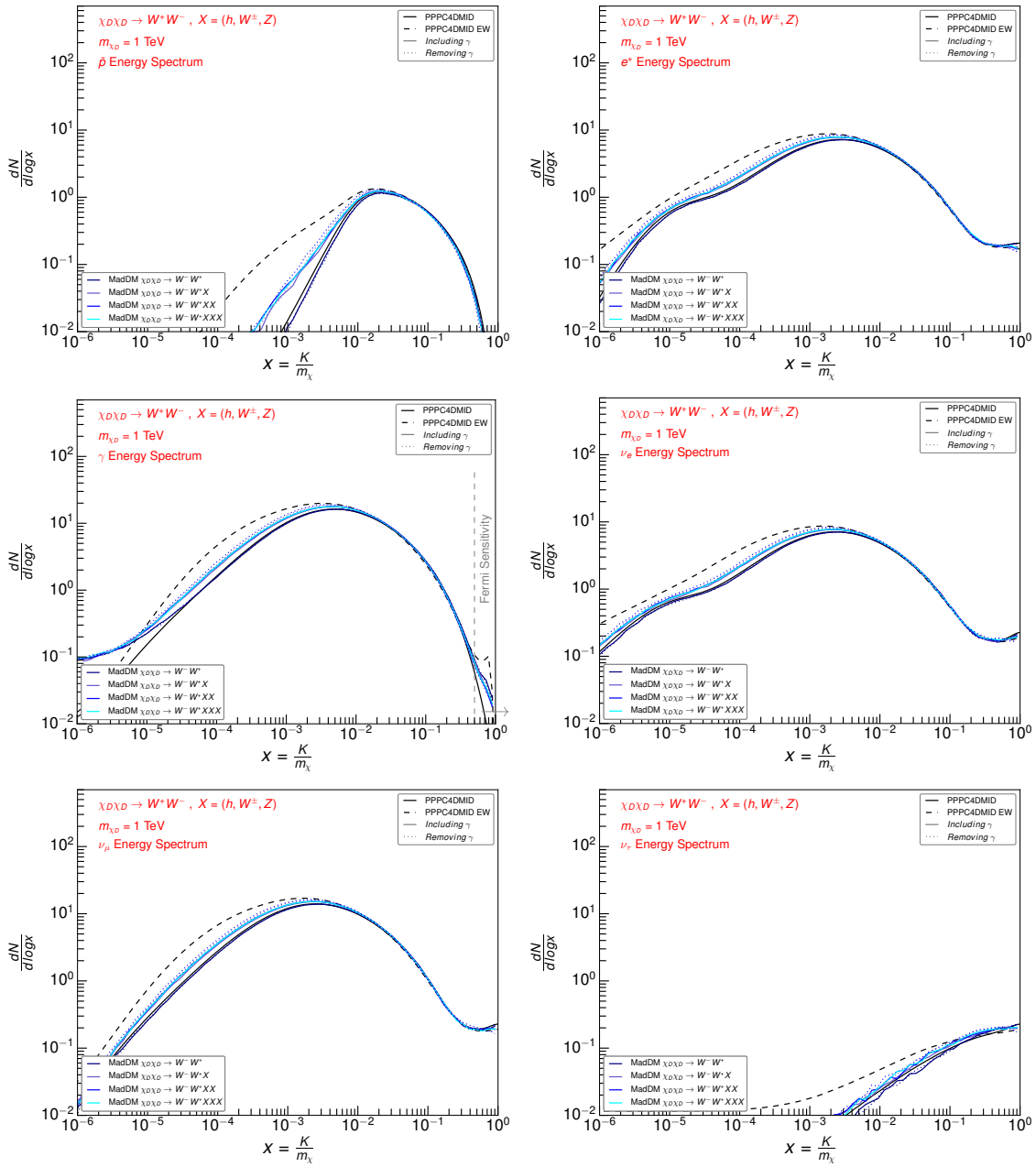

Figure 2. Energy Spectra for $m_{\chi_D} = 1$ TeV

2.3.2 "Old" $m_{\chi_D} = 100$ TeV

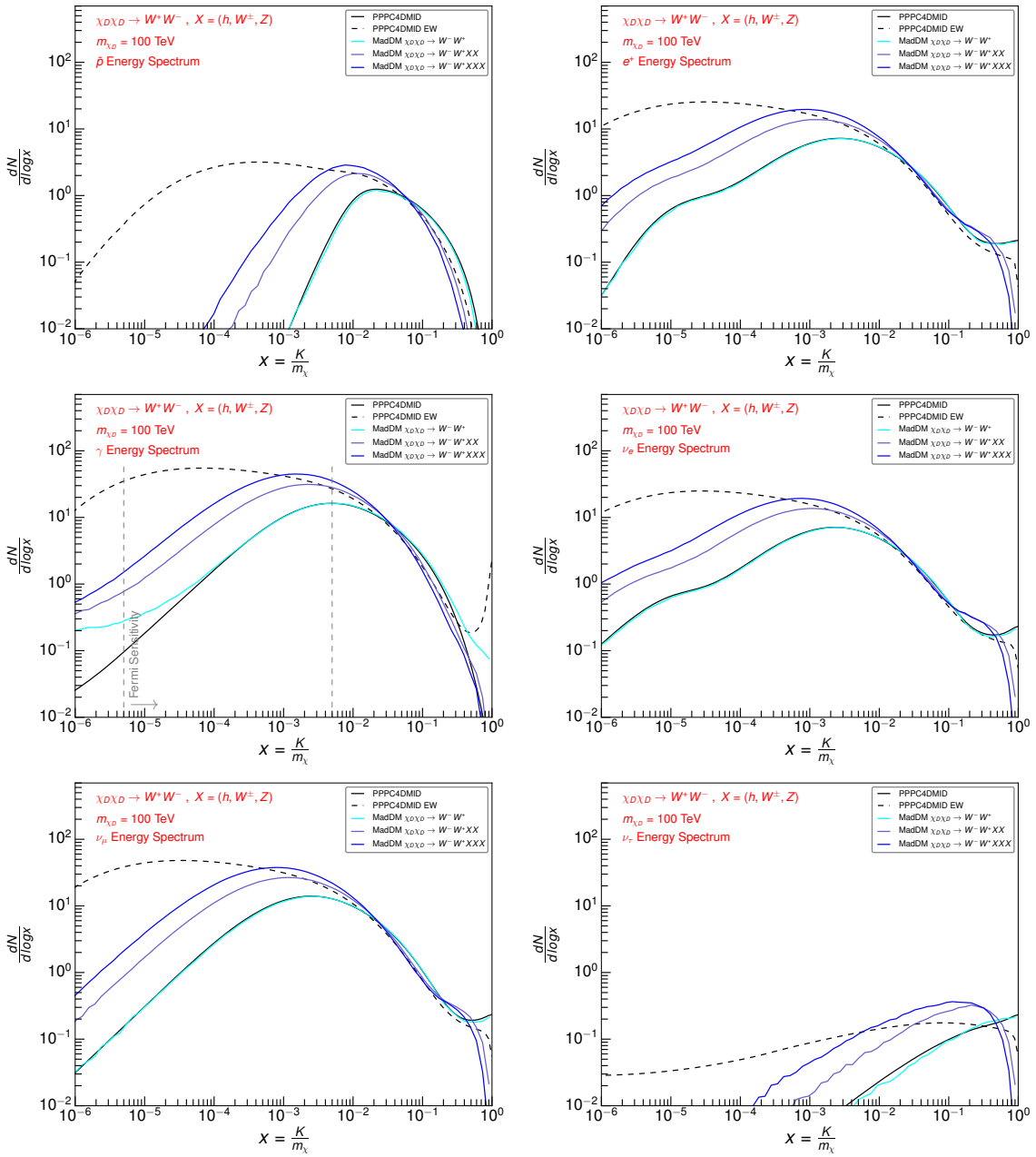

Figure 3. Energy Spectra for $m_{\chi_D} = 100$ TeV (Old data)

Acknowledgments

Thanks