



MadDM v.3.0

Part 2 - Tutorial

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Overview

This short tutorial focusses on:

- differences between **'Fast'** vs **'Precision'** running methods
- structure of the results
- interpretation of the results
- running a scan for a few points

*MadDM v.3.0 already preinstalled,
no need to type "Install maddm" !!!*

If you wish to try-it-yourself, the tutorial requires:

- MadDM v.3.0 downloaded from

<https://cp3.irmp.ucl.ac.be/projects/madgraph/wiki/MadDm>

- PPC4DMID Tables installed
- Pythia8 (warning: slow to install)



Required for indirect detection

We will use the DM simplified model DMsimp_s_spin0_MD available at:

<http://feynrules.irmp.ucl.ac.be/wiki/DMsimp>

Quick Links – Summary

- All MadDM arXiv publications
<https://arxiv.org/find/all/1/all:+maddm/0/1/0/all/0/1>
- MadDM v.3.0 (official manual)
<https://arxiv.org/abs/1804.00044>
- Wiki page with download and installation instructions
<https://cp3.irmp.ucl.ac.be/projects/madgraph/wiki/MadDm>
- MadDM launchpad (bug reports, contacts,...)
<https://launchpad.net/maddm>
- Feynrules webpage with DM simplified models (*DMsimp_s_spin0_MD*):
<http://feynrules.irmp.ucl.ac.be/wiki/DMsimp>

Getting Started - quick

```
wget https://launchpad.net/maddm/trunk/maddmv3.0/+download/MadDM_v3.0.beta.tar.gz
tar -xvf MadDM_v3.0.beta.tar.gz
cd MadDM_v3.0.beta
cd models
wget http://feynrules.irmp.ucl.ac.be/raw-attachment/wiki/DMsimp/DMsimp\_s\_spin0\_MD\_v1.1.zip
unzip DMsimp_s_spin0_MD_v1.1.zip
cd ..
./bin/maddm
install PPC4DMID
```

optional (warning: Pythia8 installation takes time):

```
install pythia8
```

Now we have everything we need for the exercises

'Fast' vs 'Precision' methods

Two methods for calculation of indirect detection predictions

	<i>Fast</i>	<i>Precision</i>
$\langle\sigma V\rangle$	Inclusive	Reshuffling (Madevent)
Processes	DM DM > SM SM	DM DM > n-body
Spectra at Source	PPPC4DMID_ew (PPPC4DMID) *only* from SM channels	Pythia8 from any final state
Flux at Earth	Propagate and oscillate Υ and ν_i e ⁺ : PPPC4DMID_ep e ⁺ and p : DRAGON	Propagate and oscillate Υ and ν_i e ⁺ and p : DRAGON
Constraints	Fermi-LAT UL for each SM channels + SM combination	Fermi-LAT UL for each SM channels + limit for total gamma-ray spectrum including BSM states

—> See Table C.2 page 26 of the manual for the extended summary

Example 1

Goal: use the 'Fast' method to compute relic density, direct and indirect detection rates and compare with limits

```
./bin/maddm
import model
DMsimp_s_spin0_MD
define darkmatter ~xd
generate relic_density
add direct_detection
add indirect_detection
output Example_1
launch Example_1
```

Example 1

Goal: use the 'Fast' method to compute relic density, direct and indirect detection rates and compare with limits

```
./bin/maddm
import model
DMsimp_s_spin0_MD
define darkmatter ~xd →
generate relic_density
add direct_detection
add indirect_detection
output Example_1
launch Example_1
```

- If not selected by the user, maddm will ask to edit the param card;
- **INFO: Found Dark Matter candidate: xd**
- in case multiple DM candidates are found, the user will be asked to choose one , for example
- **More than one valid candidate found: Please select the one that you want: [xr, xv]**

- Since no annihilation channel is specified, MadDM will calculate all the possible DM DM > 2 body processes (SM or BSM) —> See Example 1 and 2

Example 1

You will get to the interface for options selection:

The following switches determine which programs are run:

```
/===== Description =====|===== values =====|===== other options =====\  
| 1. Compute the Relic Density          | relic = ON              | OFF                          | | |
| 2. Compute direct(ional) detection    | direct = OFF            | Please install module       |  
| 3. Compute indirect detection/flux    | indirect = sigmav       | flux_source|flux_earth|OFF  |  
| 4. Run Multinest scan                  | nestscan = OFF         | ON                            |  
\=====
```

You can also edit the various input card:

- * Enter the name/number to open the editor
- * Enter a path to a file to replace the card
- * Enter **set NAME value** to change any parameter to the requested value

```
/=====\  
| 5. Edit the model parameters          [param]                    |  
| 6. Edit the MadDM options             [maddm]                    |  
\=====
```

Inline commands:

```
set sigmav_method inclusive  
indirect=flux_source  
set indirect_flux_source_method PPC4DMID  
set Mxd 1000  
set My0 500
```

Example 1 - Screen Output Results ($\chi_{SI} > 1$)

INFO: PPC4DMID Spectra at source loaded

INFO: Calculating cosmic rays fluxes using gammas and neutrinos spectra from the PPC4DMID tables.

some warning/info messages...

INFO: MadDM Results

INFO:

***** Relic Density

INFO: Relic Density = 3.02e-01 **EXCLUDED**

INFO: χ_f = 2.20e+01

INFO: $\sigma_{\text{v}}(\chi_f)$ = 6.77e-10

INFO: χ_{SI} = 1.00e+00

INFO:

***** Direct detection [cm²]:

INFO: SigmaN_SI_p All DM = 2.05e-45 **EXCLUDED** Xenon1ton ul = 1.29e-45

INFO: SigmaN_SI_n All DM = 2.08e-45 **EXCLUDED** Xenon1ton ul = 1.29e-45

INFO: SigmaN_SD_p All DM = 5.20e-61 **ALLOWED** Pico60 ul = 3.89e-40

INFO: SigmaN_SD_n All DM = 2.01e-60 **ALLOWED** Lux2017 ul = 2.43e-40

INFO:

***** Indirect detection [cm³/s]:

INFO: $\langle \sigma v \rangle$ method: inclusive

INFO: DM particle halo velocity: 2e-05/c

INFO: xdxxdb_ccx All DM = 2.19e-43 **ALLOWED** Fermi ul = 2.64e-25

INFO: xdxxdb_ddx All DM = 3.44e-48 **ALLOWED** Fermi ul = 2.65e-25

INFO: xdxxdb_uux All DM = 8.81e-49 **ALLOWED** Fermi ul = 2.65e-25

INFO: xdxxdb_ssx All DM = 1.38e-45 **ALLOWED** Fermi ul = 2.65e-25

INFO: xdxxdb_ttx All DM = 3.83e-39 **ALLOWED** Fermi ul = 2.85e-25

INFO: xdxxdb_bbx All DM = 2.99e-42 **ALLOWED** Fermi ul = 2.42e-25

INFO: xdxxdb_y0y0 All DM = 8.45e-39 **NO LIMIT** Fermi ul = -1.00e+00

INFO: Using generic Fermi limits for light quarks (u,d,s)

INFO: Total limits calculated with Fermi likelihood:

INFO: DM DM > SM SM All DM = 3.84e-39 **ALLOWED** Fermi ul = 5.70e-25

INFO:

INFO: *** Fluxes at earth [particle/(cm² sr)]:

INFO: gammas Flux = 1.84e-25

INFO: neutrinos_e Flux = 1.68e-26

INFO: neutrinos_mu Flux = 1.67e-26

INFO: neutrinos_tau Flux = 1.52e-26

Example 1 - Screen Output Results ($\chi_{SI} > 1$)

INFO: PPC4DMID Spectra at source loaded

INFO: Calculating cosmic rays fluxes using gammas and neutrinos spectra from the PPC4DMID tables.

some warning/info messages...

INFO: MadDM Results

INFO:

***** Relic Density

INFO: Relic Density = 3.02e-01

EXCLUDED

—> depending on χ_{SI} , the output will change

INFO: χ_f = 2.20e+01

INFO: $\sigma_{\text{v}}(\chi_f)$ = 6.77e-10

INFO: χ_{SI} = 1.00e+00

INFO:

***** Direct detection [cm²]:

INFO: SigmaN_SI_p All DM = 2.05e-45

EXCLUDED

Xenon1ton ul = 1.29e-45

INFO: SigmaN_SI_n All DM = 2.08e-45

EXCLUDED

Xenon1ton ul = 1.29e-45

INFO: SigmaN_SD_p All DM = 5.20e-61

ALLOWED

Pico60 ul = 3.89e-40

INFO: SigmaN_SD_n All DM = 2.01e-60

ALLOWED

Lux2017 ul = 2.43e-40

INFO:

***** Indirect detection [cm³/s]:

INFO: <sigma v> method: inclusive

INFO: DM particle halo velocity: 2e-05/c

INFO: xdxxdb_ccx All DM = 2.19e-43

ALLOWED

Fermi ul = 2.64e-25

INFO: xdxxdb_ddx All DM = 3.44e-48

ALLOWED

Fermi ul = 2.65e-25

INFO: xdxxdb_uux All DM = 8.81e-49

ALLOWED

Fermi ul = 2.65e-25

INFO: xdxxdb_ssx All DM = 1.38e-45

ALLOWED

Fermi ul = 2.65e-25

INFO: xdxxdb_ttx All DM = 3.83e-39

ALLOWED

Fermi ul = 2.85e-25

INFO: xdxxdb_bbx All DM = 2.99e-42

ALLOWED

Fermi ul = 2.42e-25

INFO: xdxxdb_y0y0 All DM = 8.45e-39

NO LIMIT

Fermi ul = -1.00e+00

INFO: Using generic Fermi limits for light quarks (u,d,s)

INFO: Total limits calculated with Fermi likelihood:

INFO: DM DM > SM SM All DM = 3.84e-39

ALLOWED

Fermi ul = 5.70e-25

INFO:

INFO: *** Fluxes at earth [particle/(cm² sr)]:

INFO: gammas Flux = 1.84e-25

INFO: neutrinos_e Flux = 1.68e-26

INFO: neutrinos_mu Flux = 1.67e-26

INFO: neutrinos_tau Flux = 1.52e-26

Relic density

Direct detection

Indirect detection

Example 1 - Screen Output Results ($x_{si} < 1$)

If the masses change:

```
set Mxd 200
set My0 500
```

```
INFO:
***** Relic Density
INFO: Relic Density      = 4.93e-02      ALLOWED
INFO: x_f                = 2.30e+01
INFO: sigmav(xf)         = 9.98e-09
INFO: xsi                = 4.11e-01
INFO:
***** Direct detection [cm^2]:
INFO: SigmaN_SI_p        Thermal = 8.37e-46      EXCLUDED      All DM = 2.04e-45      EXCLUDED      Xenon1ton ul      = 2.60e-46
INFO: SigmaN_SI_n        Thermal = 8.48e-46      EXCLUDED      All DM = 2.06e-45      EXCLUDED      Xenon1ton ul      = 2.60e-46
INFO: SigmaN_SD_p        Thermal = 4.79e-61      ALLOWED        All DM = 1.17e-60      ALLOWED        Pico60 ul         = 9.13e-41
INFO: SigmaN_SD_n        Thermal = 7.28e-62      ALLOWED        All DM = 1.77e-61      ALLOWED        Lux2017 ul        = 5.24e-41
INFO:
***** Indirect detection [cm^3/s]:
INFO: <sigma v> method: inclusive
INFO: DM particle halo velocity: 2e-05/c
INFO: xdxxdb_ccx         Thermal = 2.56e-42      ALLOWED        All DM = 1.51e-41      ALLOWED        Fermi ul          = 4.54e-26
INFO: xdxxdb_ddx         Thermal = 4.03e-47      ALLOWED        All DM = 2.38e-46      ALLOWED        Fermi ul          = 4.67e-26
INFO: xdxxdb_uux         Thermal = 1.03e-47      ALLOWED        All DM = 6.10e-47      ALLOWED        Fermi ul          = 4.67e-26
INFO: xdxxdb_ssx         Thermal = 1.62e-44      ALLOWED        All DM = 9.57e-44      ALLOWED        Fermi ul          = 4.67e-26
INFO: xdxxdb_ttx         Thermal = 6.24e-39      ALLOWED        All DM = 3.69e-38      ALLOWED        Fermi ul          = 6.08e-26
INFO: xdxxdb_bbx         Thermal = 3.50e-41      ALLOWED        All DM = 2.07e-40      ALLOWED        Fermi ul          = 5.00e-26
INFO: Skipping zero cross section processes for: y0y0
INFO: Using generic Fermi limits for light quarks (u,d,s)
INFO: Total limits calculated with Fermi likelihood:
INFO: DM DM > SM SM      Thermal = 6.27e-39      ALLOWED        All DM = 3.71e-38      ALLOWED        Fermi ul          = 1.22e-25
INFO:
INFO: *** Fluxes at earth [particle/(cm^2 sr)]:
INFO: gammas Flux        =3.74e-24
INFO: neutrinos_e Flux   =1.13e-24
INFO: neutrinos_mu Flux  =1.23e-24
INFO: neutrinos_tau Flux  =1.11e-24
INFO:
```

Example 1 - Screen Output Results ($\chi_{si} < 1$)

If the masses change:

```
set Mxd 200
set My0 500
```

Two theory predictions:

- ‘**Thermal**’: rescaled by χ_{si} for direct det.
rescaled by χ_{si}^2 for indirect det.
- ‘**All DM**’: plain computation

```
INFO:
***** Relic Density
INFO: Relic Density           = 4.93e-02      ALLOWED
INFO: x_f                     = 2.30e+01
INFO: sigmav(xf)              = 9.98e-09
INFO: xsi                     = 4.11e-01
INFO:
***** Direct detection [cm^2]:
INFO: SigmaN_SI_p             Thermal = 8.37e-46      EXCLUDED
INFO: SigmaN_SI_n             Thermal = 8.48e-46      EXCLUDED
INFO: SigmaN_SD_p             Thermal = 4.79e-61      ALLOWED
INFO: SigmaN_SD_n             Thermal = 7.28e-62      ALLOWED
INFO:
***** Indirect detection [cm^3/s]:
INFO: <sigma v> method: inclusive
INFO: DM particle halo velocity: 2e-05/c
INFO: xdxxdb_ccx               Thermal = 2.56e-42      ALLOWED
INFO: xdxxdb_ddx               Thermal = 4.03e-47      ALLOWED
INFO: xdxxdb_uux               Thermal = 1.03e-47      ALLOWED
INFO: xdxxdb_ssx               Thermal = 1.62e-44      ALLOWED
INFO: xdxxdb_ttx               Thermal = 6.24e-39      ALLOWED
INFO: xdxxdb_bbx               Thermal = 3.50e-41      ALLOWED
INFO: Skipping zero cross section processes for y0y0
INFO: Using generic Fermi limits for light quarks (u,d,s)
INFO: Total limits calculated with Fermi likelihood:
INFO: DM DM > SM SM           Thermal = 6.27e-39      ALLOWED
INFO:
INFO: *** Fluxes at earth [particle/(cm^2 sr)]:
INFO: gammas Flux              =3.74e-24
INFO: neutrinos_e Flux         =1.13e-24
INFO: neutrinos_mu Flux        =1.23e-24
INFO: neutrinos_tau Flux        =1.11e-24
INFO:
```



```

Thermal = 8.37e-46
Thermal = 8.48e-46
Thermal = 4.79e-61
Thermal = 7.28e-62
Thermal = 2.56e-42
Thermal = 4.03e-47
Thermal = 1.03e-47
Thermal = 1.62e-44
Thermal = 6.24e-39
Thermal = 3.50e-41
Thermal = 6.27e-39
    
```

```

All DM = 2.04e-45
All DM = 2.06e-45
All DM = 1.17e-60
All DM = 1.77e-61

All DM = 1.51e-41
All DM = 2.38e-46
All DM = 6.10e-47
All DM = 9.57e-44
All DM = 3.69e-38
All DM = 2.07e-40

All DM = 3.71e-38
    
```

```

EXCLUDED Xenon1ton ul = 2.60e-46
EXCLUDED Xenon1ton ul = 2.60e-46
ALLOWED Pico60 ul = 9.13e-41
ALLOWED Lux2017 ul = 5.24e-41

ALLOWED Fermi ul = 4.54e-26
ALLOWED Fermi ul = 4.67e-26
ALLOWED Fermi ul = 4.67e-26
ALLOWED Fermi ul = 4.67e-26
ALLOWED Fermi ul = 6.08e-26
ALLOWED Fermi ul = 5.00e-26

ALLOWED Fermi ul = 1.22e-25
    
```



Example 1 - Output Results

Location of the saved outputs:

Output files saved in `<...>/MadDM_v3.0.beta/Example_1/output/run_01`
Results written in: `<...>/MadDM_v3.0.beta/Example_1/output/run_01/MadDM_results.txt`

`MadDM_results.txt`

`maddm_card.dat`

`d2NdEdcos.dat`

`dNdcos.dat`

`rate.dat`

`dNdE.dat`

`maddm.out`

`antiprotons_spectrum_PP4DMID.dat`

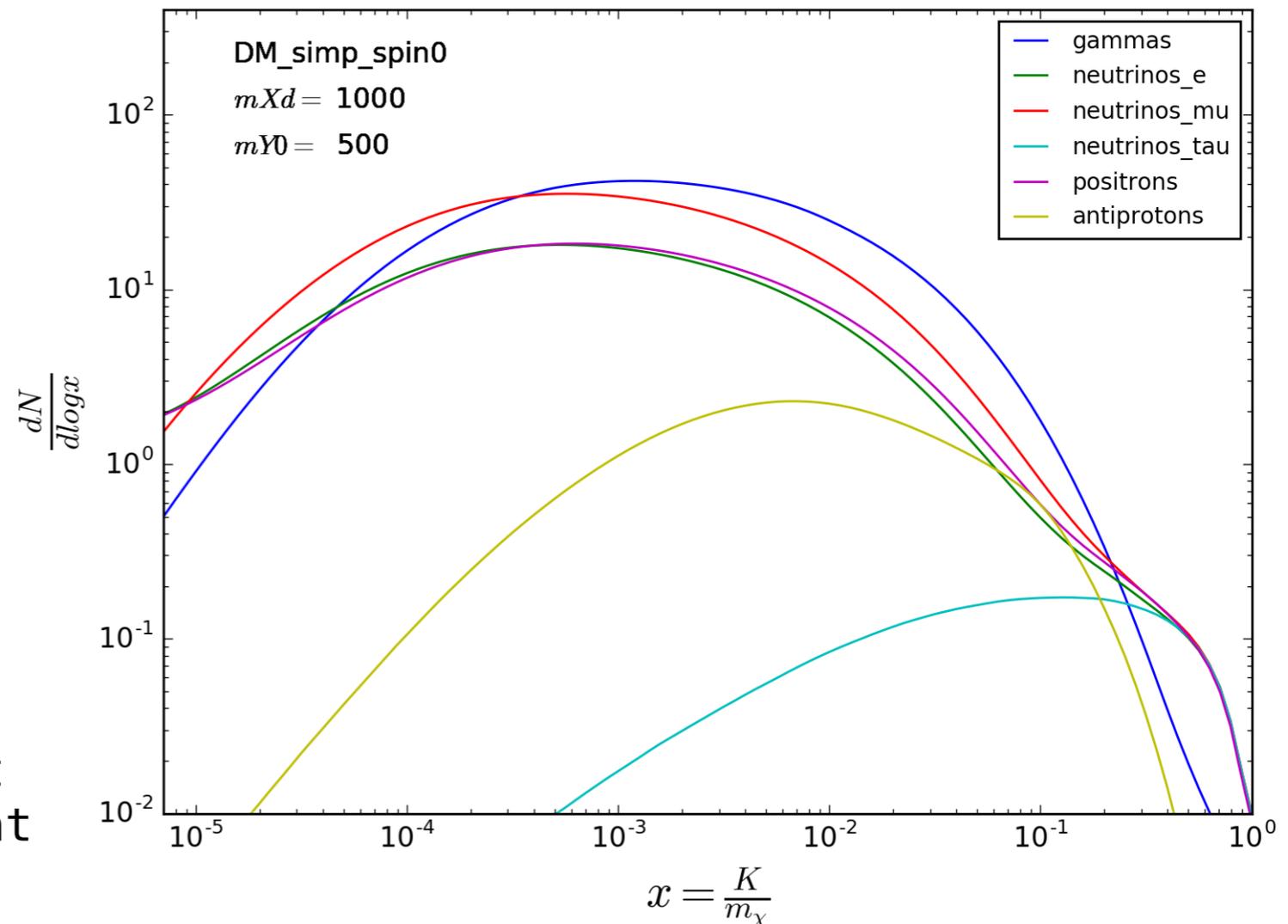
`gammas_spectrum_PP4DMID.dat`

`neutrinos_e_spectrum_PP4DMID.dat`

`neutrinos_mu_spectrum_PP4DMID.dat`

`neutrinos_tau_spectrum_PP4DMID.dat`

`positrons_spectrum_PP4DMID.dat`



Example 1 - Output: MadDM_results.txt

```
#####  
# Relic Density #  
#####  
Omegah2 = 3.02e-01  
Omegah_Planck = 1.20e-01  
xsi = 1.00e+00  
x_f = 2.20e+01  
sigmav_xf = 6.77e-10
```

```
#####  
# Direct Detection [cm^2] #  
#####  
SigmaN_SI_p = [2.05e-45,1.29e-45] # Xenon1ton  
SigmaN_SI_n = [2.08e-45,1.29e-45] # Xenon1ton  
SigmaN_SD_p = [5.20e-61,3.89e-40] # Pico60  
SigmaN_SD_n = [2.01e-60,2.43e-40] # Lux2017
```

```
#####  
# Indirect Detection [cm^3/s] #  
#####
```

```
# Annihilation cross section computed with the method: inclusive  
# Global Fermi Limit computed with PPC4DMID spectra
```

```
xxdxxdb_ccx = [2.19e-43,2.64e-25]  
xxdxxdb_ddx = [3.44e-48,2.65e-25]  
xxdxxdb_uux = [8.81e-49,2.65e-25]  
xxdxxdb_ssx = [1.38e-45,2.65e-25]  
xxdxxdb_ttx = [3.83e-39,2.85e-25]  
xxdxxdb_bbx = [2.99e-42,2.42e-25]  
xxdxxdb_y0y0 = [8.45e-39,-1.00e+00]  
TotalSM_xsec = [3.84e-39,5.70e-25]  
Fermi_Likelihood = -1.76e+01  
Fermi_pvalue = 1.50e-07
```

Format: [theory xsec , exp. UL]

Fermi-LAT likelihood and p-value

→
If $x_{\text{si}} < 1$, will distinguish between
likelihood_thermal and likelihood_nonthermal

Example 1 - Commands Summary

```
./bin/maddm
import model DMsimp_s_spin0_MD
define darkmatter ~xd
generate relic_density
add direct_detection
add indirect_detection
output Example_1
launch Example_1
set sigmav_method inclusive
indirect=flux_source
set indirect_flux_source_method PPC4DMID
set Mxd 1000
set My0 500
```

Example 2

Use the 'Precision' method to compute the cross section for a 2to3 process

Warning: this example requires Pythia8

```
./bin/maddm
import model MSSM_SLHA2
define darkmatter n1
add indirect_detection u u~ a
output Example_2
launch Example_2
set Mneu1 1100
set Msu1 1150
```

*This process can be studied
only with 'Precision' method*

Takes ~ 5 minutes to run

Example 2 - Screen Output Results

```
***** Relic Density
INFO: Relic Density      = 1.31e-02      ALLOWED
INFO: x_f                = 2.50e+01
INFO: sigmav(xf)         = 1.03e-08
INFO: xsi                = 1.09e-01
INFO:
***** Indirect detection [cm^3/s]:
INFO: <sigma v> method: reshuffling
INFO: DM particle halo velocity: 2e-05/c
INFO: n1n1_uuxa          Thermal = 2.85e-29      ALLOWED      All DM = 2.38e-27      ALLOWED      Fermi ul      = 2.98e-25
INFO: Using generic Fermi limits for light quarks (u,d,s)
INFO: Total limits calculated with Fermi likelihood:
INFO: DM DM > all        Thermal = 2.85e-29      ALLOWED      All DM = 2.38e-27      ALLOWED      Fermi ul      = 4.49e-25
```

- Only the cross section of the specified process is given
- partial cross section = total cross section
- Only limits using the Fermi likelihood using global spectrum available

For comparison, if you consider the process $D D > u u \sim$ (no extra photon):

```
INFO: n1n1_uux          Thermal = 3.16e-42      ALLOWED      All DM = 1.05e-40      ALLOWED      Fermi ul      = 2.35e-25
```

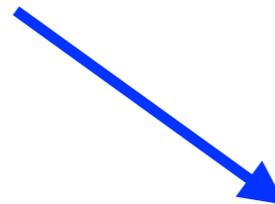


$\langle \sigma v \rangle$ increase of $\sim 10^{13}$!!!

Example 2 - Output Folder

Example_2/output/run_01/Output_Indirect

antiprotons_spectrum_pythia8.dat
gammas_spectrum_pythia8.dat
neutrinos_e_spectrum_pythia8.dat
neutrinos_mu_spectrum_pythia8.dat
neutrinos_tau_spectrum_pythia8.dat
positrons_spectrum_pythia8.dat
pythia8.log
restx_spectrum_pythia8.dat
run_01_DM_banner.txt
run_shower.sh
rwgt_events_rwgt_1.lhe.gz
unweighted_events.lhe.gz



Contains the spectra produced by Pythia8,
Pythia8 log file and
the event files produced by MG5_aMC

Example 3 - Scan

Run a small scan over the parameter space of the model
using MG5 scan functionalities

```
./bin/maddm
import model DMsimp_s_spin0_MD
define darkmatter ~xd
generate relic_density
add indirect_detection
output Example_3
launch Example_3
set sigmav_method inclusive
indirect=flux_source
set Mxd scan:[100,200]
set My0 scan:[50 ,350]
```

Example 3 - Scan Output

- Will print on the screen the full output for the first point of the scan
- Will save the rest of the output in:

```
Output files saved in <...>/MadDM_v3.0.beta_2/Example_3/output/run_01_01
Output files saved in <...>/MadDM_v3.0.beta_2/Example_3/output/run_01_02
Output files saved in <...>/MadDM_v3.0.beta_2/Example_3/output/run_01_03
Output files saved in <...>/MadDM_v3.0.beta_2/Example_3/output/run_01_04
```

Each of the run_01_xx directories will contain the saved spectra

```
Example_3/output/
run_01_01  run_01_02  run_01_03  run_01_04  run_01_maddm_card.dat  scan_run_01.txt
```

Summary file containing
the scan results



Example 3 - Scan Output Summary

- <...>/MadDM_v3.0.beta_2/Example_3/output/scan_run_01.txt

Legend mapping each variable to the corresponding column number

# [01] : run					
# [02] : mass#52					
# [03] : mass#5000000					
# [04] : Omegah ²					
# [05] : x_f					
# [06] : sigmav(xf)	run_01_01	1.00e+02	1.00e+02	6.65e-03	2.40e+01
# [07] : xsi	4.31e-08	5.55e-02	3.41e-41	2.31e-26	5.37e-46
# [08] : xdxxdb_ccx	2.39e-26	1.38e-46	2.39e-26	2.16e-43	2.39e-26
# [09] : lim_xdxxdb_ccx	0.00e+00	1.00e-15	4.66e-40	2.59e-26	1.33e-40
# [10] : xdxxdb_ddx	-1.00e+00	6.33e-40	5.00e-40	5.15e-26	0.00e+00
# [11] : lim_xdxxdb_ddx	-1.76e+01	1.65e-07	-1.76e+01		
# [12] : xdxxdb_uux	run_01_02	1.00e+02	3.00e+02	9.46e+00	1.70e+01
# [13] : lim_xdxxdb_uux	2.38e-11	1.00e+00	1.22e-41	2.31e-26	1.93e-46
# [14] : xdxxdb_ssx	2.39e-26	4.94e-47	2.39e-26	7.75e-44	2.39e-26
# [15] : lim_xdxxdb_ssx	0.00e+00	1.00e-15	1.67e-40	2.59e-26	0.00e+00
# [16] : xdxxdb_ttx	-1.00e+00	1.80e-40	1.80e-40	5.15e-26	-1.00e+00
# [17] : lim_xdxxdb_ttx	-1.00e+00	9.51e-08	-1.76e+01		
# [18] : xdxxdb_bbx	run_01_03	4.00e+02	1.00e+02	6.38e-02	2.30e+01
# [19] : lim_xdxxdb_bbx	3.44e-09	5.32e-01	1.24e-42	9.25e-26	1.95e-47
# [20] : xdxxdb_y0y0	9.38e-26	5.00e-48	9.38e-26	7.84e-45	9.38e-26
# [21] : lim_xdxxdb_y0y0	1.67e-38	1.16e-25	1.70e-41	9.65e-26	4.69e-38
# [22] : tot_Xsec	-1.00e+00	6.37e-38	1.67e-38	2.33e-25	2.69e-07
# [23] : tot_SM_xsec	-1.76e+01	5.08e-07	-1.76e+01		
# [24] : Fermi_sigmav	run_01_04	4.00e+02	3.00e+02	4.91e-02	2.30e+01
# [25] : pvalue_th	4.51e-09	4.10e-01	1.63e-42	9.25e-26	2.56e-47
# [26] : like_th	9.38e-26	6.55e-48	9.38e-26	1.03e-44	9.38e-26
# [27] : pvalue_nonth	2.19e-38	1.16e-25	2.23e-41	9.65e-26	6.38e-38
# [28] : like_nonth	-1.00e+00	8.58e-38	2.20e-38	2.33e-25	2.33e-07
	-1.76e+01	5.82e-07	-1.76e+01		

A look at the maddm_card

The maddm_card contains all the relevant information and running switches that the user might choose

```
>launch Example_3
/=====\
| 5. Edit the model parameters      [param]
| 6. Edit the MadDM options        [maddm]
| 8. Edit the Showering Card for flux [flux]
\=====/
[60s to answer]
>6
```

For indirect detection:

```
#####
#
# InDirect Detection
#
#####
# Methode of computation (affects speed and precision)
  inclusive      = sigmav_method ! inclusive, madevent, reshuffling
  pythia8        = indirect_flux_source_method ! pythia8, PPC4DMID or PPC4DMID_ew
  dragon         = indirect_flux_earth_method ! dragon or PPC4DMID_ep

# velocity in halo
  2e-05 = vave_indirect ! average velocity of DM in halos in natural units
(e.g. 1E-3 for our galaxy, 1E-5 for dSph galaxies)
```

- Will calculate Fermi-LAT limits only if the velocity compatible with dSph
- Will run DRAGON for positrons/antiprotons propagation only if compatible with Milky Way

Thank you!