Two component Dark Matter

with neutrino masses

Diego Restrepo

Sep 6, 2019 - Darkwin - Natal [PDF: http://bit.ly/darkwin]

Instituto de Física
Universidad de Antioquia
Phenomenology Group
`http://gfif.udea.edu.co`

Focus on
arXiv:1811.11927 [PRD]
In collaboration with
N. Bernal (UAN), C. Yaguna (UPTC), Ó. Zapata, (UdeA)

Preliminars

http://ific.uv.es/~montesin/computer_tools.html

Computer tools in particle physics

Information

This is the website for the course 'Computer tools in particle physics' by Avelino Vicente.

- CINVESTAV, México City (México) 2015
- IFIC, Valencia (Spain) 2016
- Universidad de Antioquia, Medellín (Colombia) 2016
- IFIC, Valencia (Spain) 2017

References

The course focuses on the material contained in the following notes:

Computer tools in particle physics, A. Vicente, arXiv:1507.06349 [PDF]

For two-loops RGEs see also:

"Exploring new models in all detail with SARAH", Florian Staub, arXiv:1503.04200 [PDF]

SARAH:

"SARAH 4: A tool for (not only SUSY) model builders", Florian Staub, arXiv:1309.7223 [PDF]

About

This is the website for the course 'Computer tools in particle physics'.

Links

V1.0 August 2009: Susy Only
V4.0 September 2019: non-Susy
V4.14.2 (Transfered to W.Porod)

- SARAH
- SPheno
- MicrOMEGAs
- MadGraph
- MadAnalysis
- FlavorKit

Contact

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Computer tools in particle physics

Information

This is the website for the course Computer tools in particle physics by Avelino Vicente, to take place at Instituto de Física Corpuscular (CSIC/Universidad de Valencia).

Dates: Monday 22/05/2017 - Friday 26/05/2017
Place: IFIC - Sala de Audiovisuales (Nave experimental)
Time: 15:00
Duration: 1.5 h for the first session and 1 h for the rest

Material and required programs

This will be a hands-on course, where all participants are encouraged to run all codes in their own laptops. The only required programas are Mathematica, a LaTeX compiler and Fortran 90 and C++ compilers. If you wish to fully participate please download the following files:

- **For lecture 1:** run_sarah_Scotogenic.nb and Scotogenic.tar.gz
- **For lecture 2:** micromegas_4.2.5.tgz
- **For lecture 4:** run_sarah_DarkBS.nb, DarkBS.tar.gz and plotDarkBS.txt

You should also download the latest versions of the codes we are going to use (exception: for lecture 2 we will use an old version of MicrOMEGAs, see above). You can find them in their official websites (links on your right). Finally, the slides of the course are available here: introduction, lecture 1, lecture 2, lecture 3, lecture 4 and lecture 5.

References

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Computer tools in particle physics, A. Vicente, arXiv:1507.06349

About

This is the website for the course Computer tools in particle physics. IFIC (CSIC/U. Valencia), May 22nd - 26th, 2017.

Links

Input/Output Code

- SARAH
- SPheno
- MicrOMEGAs
- MadGraph
- MadAnalysis
- FlavorKit

Contact

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Observables already in FlavorKit

Lepton flavor	Quark flavor
$\ell_\alpha \to \ell_\beta \gamma$	$B^0_{s,d} \to \ell^+ \ell^-$
$\ell_\alpha \to 3\,\ell_\beta$	$\bar{B} \to X_s \gamma$
$\mu - e$ conversion in nuclei	$\bar{B} \to X_s \ell^+ \ell^-$
$\tau \to P\,\ell$	$\bar{B} \to X_{d,s} \nu \bar{\nu}$
$h \to \ell_\alpha \ell_\beta$	$B \to K \ell^+ \ell^-$
$Z \to \ell_\alpha \ell_\beta$	$K \to \pi \nu \bar{\nu}$
	$\Delta M_{B_{s,d}}$
	ΔM_K and ε_K
	$P \to \ell \nu$

Ready to be computed in your favourite model!

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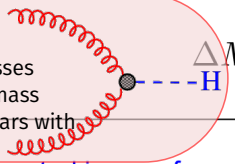
Also in SARAH

S,T,U

- One-loop corrections to All masses
- Two-loop corrections to Higgs mass
- Gluon fusion production of scalars with proper output for MadGraph



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Models already in SARAH

Supersymmetric Models

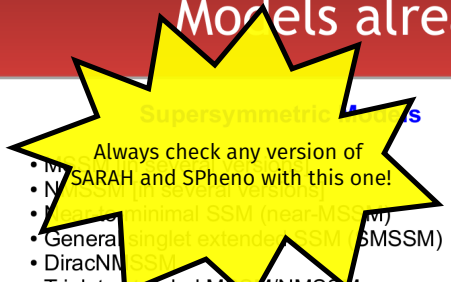
- MSSM [in several versions]
- NMSSM [in several versions]
- Near-to-minimal SSM (near-MSSM)
- General singlet extended SSM (SMSSM)
- DiracNMSSM
- Triplet extended MSSM/NMSSM
- Several models with R-parity violation
- Several U(1)-extended models
- Secluded MSSM
- Several B-L extended models
- Inverse and linear seesaws
- MSSM/NMSSM with Dirac Gauginos
- Minimal R-Symmetric SSM
- Minimal Dirac Gaugino SSM
- Seesaws I-II-III [SU(5) versions]
- Left-right symmetric model
- Quiver model
- Models with vector-like superfields

Non-Supersymmetric Models

- Standard Model
- Two Higgs doublet models (including inert)
- Singlet extensions
- Triplet extensions
- U(1) extensions
- SM extended by a scalar color octet
- Gauged Two Higgs doublet model
- Singlet extended SM
- Singlet Scalar DM
- Singlet-Doublet DM
- Models with vector-like fermions
- Model with a scalar SU(2) 7-plet
- Leptoquark models
- Left-right models
- 331 models (with and without exotics)
- Georgi-Machacek model

More info: http://sarah.hepforge.org/

Models already in SARAH



Supersymmetric Models

- MSSM
- NMSSM [in several versions]
- Low-scale minimal SSM (near-MSSM)
- General singlet extended SSM (GNMSSM)
- DiracNMSSM
- Triplet extended MSSM/NMSSM
- Several models with R-parity violation
- Several U(1)-extended models
- Secluded MSSM
- Several B-L extended models
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Parameter space

$$S = \frac{1}{\sqrt{2}}(v_1 + h_1) + \frac{i}{\sqrt{2}}A_1$$

$$S' = \frac{1}{\sqrt{2}}(v_2 + h_2) + \frac{i}{\sqrt{2}}A_2$$

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$$G',\ A$$

$$\begin{pmatrix} H_1 \\ H_2 \end{pmatrix} = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} \begin{pmatrix} h_1 \\ h_2 \end{pmatrix}$$

$$\tan\beta = \frac{v_2}{v_1}$$

$$M_{Z'}^2 = g_{BL}^2 v_2^2 \left(4 + \tan^2\beta\right)$$

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11 parameters

$$M_{Z'}^2 = g_{BL}^2 v_2^2 \left(4 + \tan^2\beta\right)$$

$m_\chi = M_1 \text{or } M_2$

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