

Computer tools in particle physics

- Lecture 2 : MicrOmegas -

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Workshop in computational High Energy Physics

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MicrOmegas

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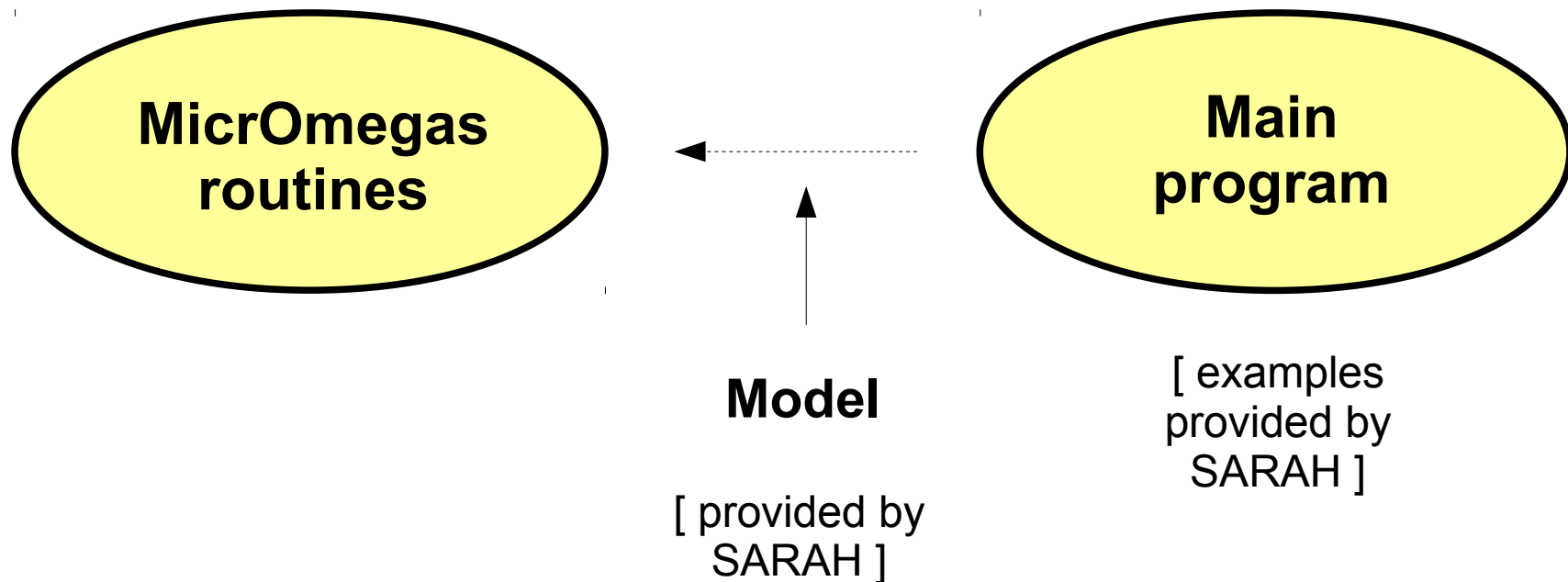
[Bélanger, Boudjema, Pukhov, Semenov]

- **Name of the tool:** MicrOmegas
- **Authors:** Genevive Blanger, Fawzi Boudjema, Alexander Pukhov and Andrei Semenov (micromegas@lapth.cnrs.fr)
- **Type of code:** C and Fortran
- **Website:** <https://lapth.cnrs.fr/micromegas/>

MicrOmegas

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- Dark matter **relic density** ($\Omega_{\text{DM}} h^2$)
- **Direct** detection rates
- **Indirect** detection rates

Chuck Norris fact of the day

*Chuck Norris lost his virginity
before his dad*



Dark matter in the scotogenic model

The lightest particle charged under Z_2 is stable: **dark matter candidate**

Fermion Dark Matter: N_1

- It can only be produced via **Yukawa** interactions
- Potential problems with lepton flavor violation: is it compatible with the current bounds?

Scalar Dark Matter: **the lightest neutral η scalar, η_R or η_I**

- It also has **gauge** interactions
- Not correlated to lepton flavor violation

Scotogenic: benchmark point

BS1 benchmark point

$$\lambda_1 = 0.26$$

$$\lambda_2 = 0.5$$

$$\lambda_3 = 0.5$$

$$\lambda_4 = -0.5$$

$$\lambda_5 = 8 \cdot 10^{-11}$$

$$m_\eta^2 = 1.85 \cdot 10^5 \text{ GeV}^2$$

$$M_N = \begin{pmatrix} 345 \text{ GeV} & 0 & 0 \\ 0 & 4800 \text{ GeV} & 0 \\ 0 & 0 & 6800 \text{ GeV} \end{pmatrix}$$

$$Y_N = \begin{pmatrix} 0.0172495 & 0.300325 & 0.558132 \\ -0.891595 & 1.00089 & 0.744033 \\ -1.39359 & 0.207173 & 0.253824 \end{pmatrix}$$

Scotogenic: benchmark point

BS2 benchmark point

$$\lambda_1 = 0.26$$

$$\lambda_2 = 0.5$$

$$\lambda_3 = 0.5$$

$$\lambda_4 = -0.5$$

$$\lambda_5 = 8 \cdot 10^{-11}$$

$$m_\eta^2 = 5 \cdot 10^4 \text{ GeV}^2$$

$$M_N = \begin{pmatrix} 345 \text{ GeV} & 0 & 0 \\ 0 & 4800 \text{ GeV} & 0 \\ 0 & 0 & 6800 \text{ GeV} \end{pmatrix}$$

$$Y_N = \begin{pmatrix} 0.0172495 & 0.300325 & 0.558132 \\ -0.891595 & 1.00089 & 0.744033 \\ -1.39359 & 0.207173 & 0.253824 \end{pmatrix}$$