Status of the Model Builder GUI

Nicholas Setzer

University of Granada

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with Neil Christensen, Daniel Salmon,
Christian Speckner, and Stefanus

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Outline

Model Builder GUI

What A Model Builder Wants

	$SU(3)^c$	$SU(2)_L$	$U(1)_Y$	
Q_L	3	2	$+\frac{1}{3}$	$(\frac{1}{2}, 0)$
u_R	3	1	$+\frac{4}{3}$	$(0, \frac{1}{2})$
d_R	3	1	$-\frac{2}{3}$	$(0, \frac{1}{2})$
ℓ_L	1	2	-1	$(\frac{1}{2}, 0)$
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What A Model Builder Wants

$$\mathcal{L} = \mathcal{L}_{KE}$$
$$+ \left(y_u \overline{Q}_L \Phi^* u_R + y_d \overline{Q}_L \Phi d_R + y_L \overline{\ell}_L \Phi e_R + y_\nu \overline{\ell}_L \Phi^* \nu_R + \text{h.c.} \right)$$
$$+ m^2 |\Phi|^2 - \frac{1}{2} \lambda |\Phi|^4$$

- Some couplings determined by experiment
- Scan over the rest

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Structure

- Written in C++
- Core
  - Workhorse: handles all computations
  - Written as a library
- GUI
  - Interactive portion
  - Written as a web application (browser based)

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Goals (for First Release)

- Symmetries
  - Compact Lie Groups
  - Discrete Symmtery Z_n
- Fields
  - Scalars
  - Fermions
  - Vectors
  - Super
- Functionality
  - Automatic Lagrangian Generation
  - Read and Save Model
  - Output to FeynRules

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    } Dialog to enter and edit Symbol in Main Window

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    } Menu option

Outline

Model Builder GUI

Core Components: Algebra

Algebra: Finished and Tested

- Understands any fraction of the form

$$\sqrt{n}\,\frac{p}{q} \quad q, n \in \mathbb{N}^+, p \in \mathbb{Z}$$

  - Add/Subtract
  - Multiply/Divide
- Sums of fraction
  - Add/Substract
  - Multiply/Divide by single fraction
- Output
  - to MathML
  - to Mathematica

Core Components: Compact Lie Algebras

Compact Lie Algebras: Finished and Tested

- Understands any Compact Lie Algebra, $U(1)$, and $\mathbb{Z}_n$
  A_n, B_n, C_n, D_n, G_2, F_4, E_6, E_7, E_8, $U(1)$, $\mathbb{Z}_n$
    - Arbitrary Representations
    - All Generators of any Representations
- Product States
    - Gives Singlets

Core Components: Fields

Fields: Mostly Finished and Tested

- Understands Spin 0, $\frac{1}{2}$, and 1 fields (fundamental objects)
- Understands Superfields
  - Implemented as a container
  - Chiral Superfields stored as collection of spin-0 and spin-$\frac{1}{2}$
- Output
  - to MathML
  - NEED to FeynRules

Core Components: Model

Model: Mostly Finished and Partly Tested

- Understands any direct product group (of Known Groups)
    - Local or Global ($\mathbb{Z}_n$ only global)
- Lagrangian
    - Completely and automatically generated given fields
    - Handles all operators up to dimension 6
    - For SUSY Generates Kahler potential and Superpotential
    - Output to MathML
- Needs
    - Save/Read Model - XML file
    - Write complet FeynRules `.fr` file

Outline

Interface

Graphical Interface: Working, but not finished or tested

- Uses wt (c++ library for web applications)
    - Run on local machine
    - Run on remote server
- Interacts with core code..
- Better to just show

Outline

Summary

- Two Parts
  - Core
    - C++ Library
    - Nearly Complete for First Release
  - Interface
    - Broswer-based
    - In a usable state (but not by users!)
- Still Need
  - Save/Read Model
  - Output FeynRules `.fr` file
  - Fine-tuning and testing of Interface
- Audience wow'd by demo!