What's New in Matchete?

Matthias König
JGU Mainz
on behalf of the
Matchete collaboration

"SMEFT-Tools 2025"
MITP Mainz
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European Research Council
Established by the European Commission

Cluster of Excellence
PRISMA+
Precision Physics,
Fundamental Interactions
and Structure of Matter

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Matching of BSM $\to$ EFT is a **laborious** task:

- Target **basis** is **large**, many things to compute
- Interesting pheno often **beyond tree-level**, especially in flavor
- Not a terribly difficult, but quite frankly **boring** to do by hand

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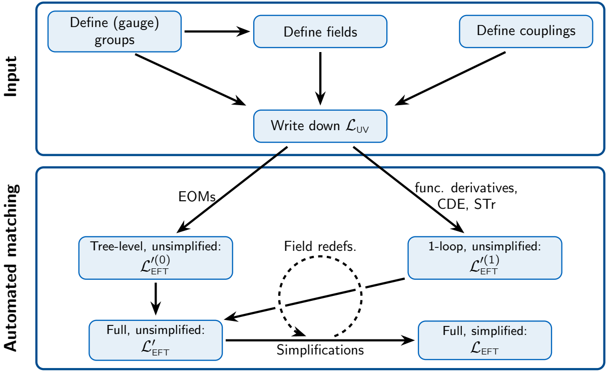

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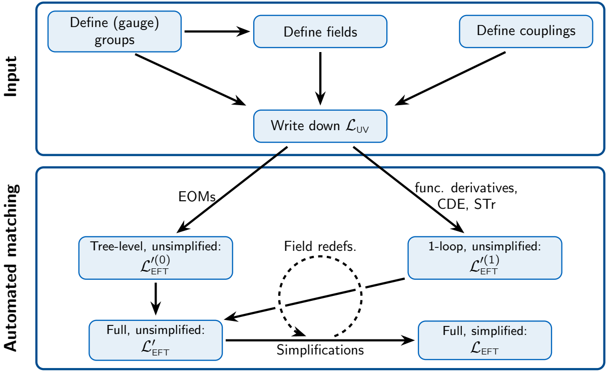

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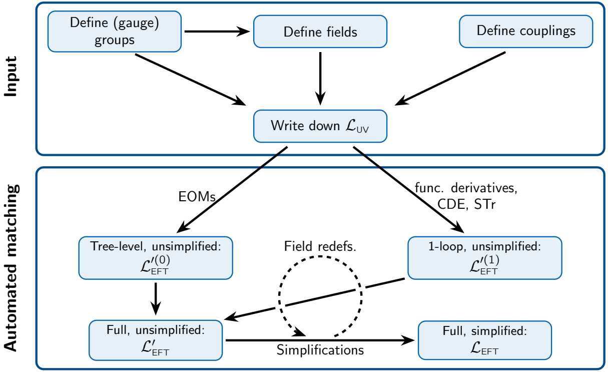

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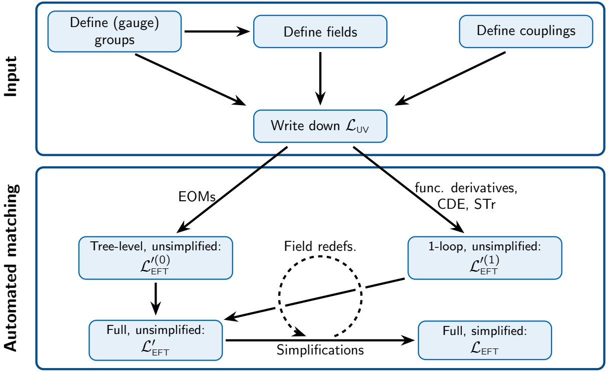

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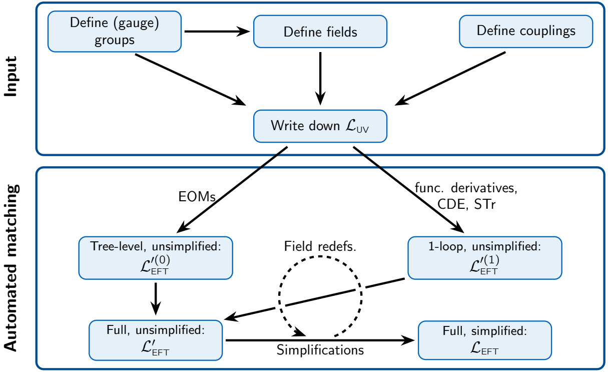

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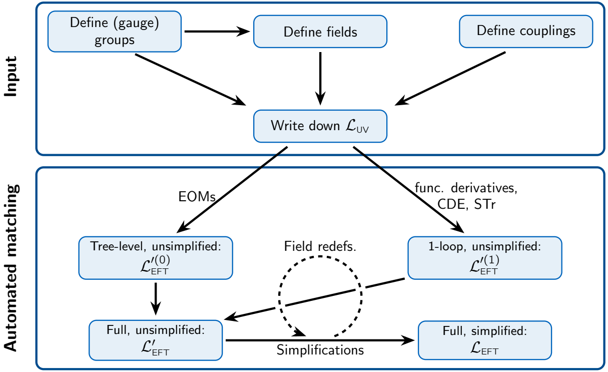

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- **no knowledge** of the target **basis** required!
- not limited to **dimension six**
- automatic **simplifications and reductions**
- **human-readable** output

Toy Model Example

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one-loop matching dimension six, on-shell

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Matchete: An Ongoing Effort

Matchete had its **inititial release** `v0.1.0` in December 2022

- ▷ `https://gitlab.com/matchete/matchete`

[Matchete, EPJ-C 83, 662 (2023), `arXiv:2212.04510`]

Being in `v0.2.0` now, what has happened?

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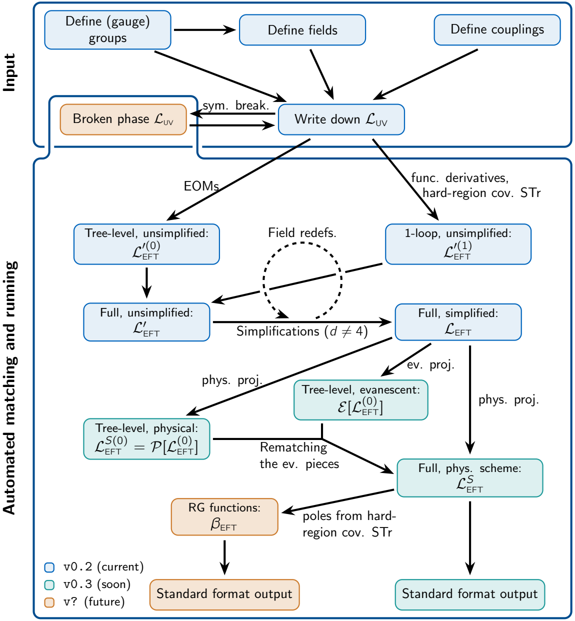
- Various bugfixes, thanks for everyone's **feedback**, keep it coming!

What's next for Matchete?



Coming features:

- Automatic handling of **evanescent** contributions, simplifications now include Fierzing, ...
- Matching to a **given basis**
- **Interface** to other EFT codes
- Computation of **anomalous dimensions**
- Built-in documentation

- Spontaneous Symmetry Breaking & **massive vectors**

Evanescent Operators

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These contributions can be **absorbed** into a **finite renormalization** of other **(physical) operators**.

Once done, the **evanescent operator** can be (has to be) dropped.

Evanescent Operators - An Example

Consider 2HDM, integrate out second Higgs doublet Φ:

$$\mathcal{L} \supset \mathcal{L}_{\text{SM}} + D_\mu \Phi^\dagger D^\mu \Phi - M_\Phi^2 \Phi^\dagger \Phi - \left(y_{\Phi e}^{pr} \, \overline{\ell}_p \Phi e_r + \text{h.c.} \right)$$

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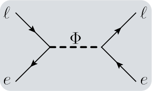

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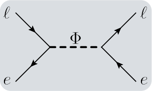

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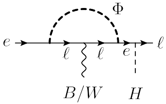
$$[Q_{eW}]^{pr} = \bar{\ell}_p \sigma_{\mu\nu} e_r \, \tau^I H W^{I\mu\nu}$$



Evanescent Operators - An Example

Consider 2HDM, integrate out second Higgs doublet Φ:

$$\mathcal{L} \supset \mathcal{L}_{\text{SM}} + D_\mu \Phi^\dagger D^\mu \Phi - M_\Phi^2 \, \Phi^\dagger \Phi - \left(y_{\Phi e}^{pr} \, \bar{\ell}_p \Phi e_r + \text{h.c.} \right)$$

Generates, amongst many other operators:

$$[R_{\ell e}]^{prst} = (\bar{\ell}_p e_r)(\bar{e}_s \ell_t)$$

$$\downarrow$$

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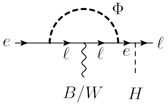
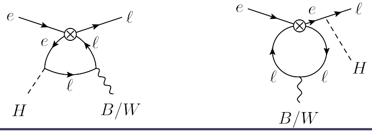
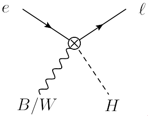


The operators $R_{\ell e}$ and $Q_{\ell e}$ generate **different** amplitudes for the **dipole transitions**!





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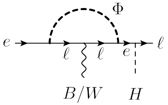

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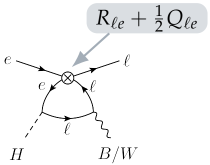

This graph contributes through $\epsilon \cdot (1/\epsilon_{\text{UV}})$ and can be absorbed into a **finite counterterm** to Q_{eW}!

Handling Evanescence in Matchete

Matchete is equipped to handle such operators **automatically**.

Loading the SM and defining a redundant operator:

```
In[4]:= LSM = LoadModel["SM"];

DefineCoupling[c, Indices → {Flavor, Flavor, Flavor, Flavor}];
redundant =
  PlusHc[c[p, r, s, t] Bar@l[i, p] ** e[r] Bar@e[s] ** l[i, t]] //
   RelabelIndices;
redundant // NiceForm
```

Out[7]//NiceForm=

$$c^{prst} \left(\bar{e}^{s} \cdot P_L \cdot l^{it}\right) \left(\bar{l}_i^{p} \cdot P_R \cdot e^{r}\right) + \bar{c}^{prst} \left(\bar{e}^{r} \cdot P_L \cdot l^{ip}\right) \left(\bar{l}_i^{t} \cdot P_R \cdot e^{s}\right)$$

The naive 4d identity:

```
In[8]:= NiceForm@GreensSimplify[redundant,
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```

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$$\frac{1}{2} \left(-\bar{c}^{rspt} - c^{tpsr}\right) \left(\bar{e}^{s} \cdot \gamma_\mu P_R \cdot e^{p}\right) \left(\bar{l}_i^{t} \cdot \gamma_\mu P_L \cdot l^{ir}\right)$$

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Handling Evanescence in Matchete

Matchete is equipped to handle such operators **automatically**.

When a complete Lagrangian is given, the simplifications evaluate the Evanescent shifts automatically and add them to the Lagrangian:

```
In[10]:= Lreduced = GreensSimplify[LSM + redundant,
            ReductionIdentities → EvanescenceFree];
         Lreduced - LSM // GreensSimplify // NiceForm
```

Out[11]//NiceForm=

$$
\begin{aligned}
&\hbar \left(\bar{Y}_e^{st}\,\bar{Y}_e^{uv}\,Y_e^{ut}\,c^{svrp} + \bar{Y}_e^{tu}\,\bar{Y}_e^{vs}\,Y_e^{vu}\,\bar{c}^{prst}\right) \bar{H}_i\,\bar{H}_j\,H^j \left(\bar{e}^r \cdot P_L \cdot l^{ip}\right) + \\
&\hbar \left(\bar{Y}_e^{uv}\,Y_e^{sv}\,Y_e^{ut}\,\bar{c}^{stpr} + \bar{Y}_e^{st}\,Y_e^{su}\,Y_e^{vt}\,c^{rpuv}\right) \bar{H}_i\,H^i\,H^j \left(\bar{l}_j^r \cdot P_R \cdot e^p\right) + \\
&\frac{1}{2}\hbar \left(\bar{Y}_e^{ts}\,\bar{c}^{prst} + \bar{Y}_e^{st}\,c^{strp}\right) D^2\bar{H}_i \left(\bar{e}^r \cdot P_L \cdot l^{ip}\right) + \\
&\frac{1}{2}\hbar \left(Y_e^{st}\,\bar{c}^{stpr} + Y_e^{ts}\,c^{rpst}\right) D^2 H^i \left(\bar{l}_i^r \cdot P_R \cdot e^p\right) + \\
&\frac{3\,i}{8}\hbar\, g_Y \left(\bar{Y}_e^{ts}\,\bar{c}^{prst} + \bar{Y}_e^{st}\,c^{strp}\right) \bar{H}_i\,B^{\mu\nu} \left(\bar{e}^r \cdot \Gamma_{\mu\nu} P_L \cdot l^{ip}\right) - \\
&\frac{i}{4}\hbar\, g_L \left(\bar{Y}_e^{ts}\,\bar{c}^{prst} + \bar{Y}_e^{st}\,c^{strp}\right) \bar{H}_i\,W^{\mu\nu I} \left(\bar{e}^r \cdot \Gamma_{\mu\nu} P_L \cdot l^{jp}\right) T_j^{Ii} + \\
&\frac{3\,i}{8}\hbar\, g_Y \left(Y_e^{st}\,\bar{c}^{stpr} + Y_e^{ts}\,c^{rpst}\right) H^i\,B^{\mu\nu} \left(\bar{l}_i^r \cdot \Gamma_{\mu\nu} P_R \cdot e^p\right) - \\
&\frac{i}{4}\hbar\, g_L \left(Y_e^{st}\,\bar{c}^{stpr} + Y_e^{ts}\,c^{rpst}\right) H^j\,W^{\mu\nu I} \left(\bar{l}_i^r \cdot \Gamma_{\mu\nu} P_R \cdot e^p\right) T_j^{Ii} + \\
&\frac{1}{4}\hbar \left(-\bar{Y}_e^{vt}\,Y_e^{up}\,\bar{c}^{usrv} - \bar{Y}_e^{vt}\,Y_e^{ur}\,\bar{c}^{uspv} - \bar{Y}_e^{us}\left(Y_e^{vp}\,c^{urtv} + Y_e^{vr}\,c^{uptv}\right)\right) \\
&\quad \left(\bar{e}^s \cdot \gamma_\mu P_R \cdot e^r\right) \left(\bar{e}^t \cdot \gamma_\mu P_R \cdot e^p\right) + \left(\frac{1}{2}\left(-\bar{c}^{rspt} - c^{tpsr}\right) + \right. \\
&\quad \left. \frac{1}{4}\hbar \left(-\bar{Y}_e^{vs}\,Y_e^{tu}\,\bar{c}^{rupv} - \bar{Y}_e^{us}\,Y_e^{tv}\,c^{upvr} - \bar{Y}_e^{rv}\,Y_e^{up}\,\bar{c}^{usvt} - \bar{Y}_e^{ru}\,Y_e^{vp}\,c^{tusv}\right)\right) \\
&\quad \left(\bar{e}^s \cdot \gamma_\mu P_R \cdot e^p\right) \left(\bar{l}_i^t \cdot \gamma_\mu P_L \cdot l^{ir}\right) + \frac{1}{4}\hbar \left(-\bar{Y}_e^{rv}\,Y_e^{su}\,\bar{c}^{puvt} - \bar{Y}_e^{pu}\,Y_e^{tv}\,c^{suvr}\right) \\
&\quad \left(\bar{l}_i^s \cdot \gamma_\mu P_L \cdot l^{ir}\right) \left(\bar{l}_j^t \cdot \gamma_\mu P_L \cdot l^{jp}\right)
\end{aligned}
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The result is a **mapping** between the **effective couplings** of the two Lagrangians.

Matching to a Specific Basis

This functionality is finally coming to **Matchete**, with a **convenient** function to map **directly to the SMEFT**:

```
newLag = GreensSimplify[LEFT, ReductionIdentities → FourDimensional] /. ϵ^-1 → 0;
```

```
coefs = MapToWarsaw@newLag;
```

The Warsaw Lagrangian currently simplifies with 4D IDENTITIES!

```
coefs // TableForm // NiceForm
```

NiceForm=

$$g_Y \to g_Y - \frac{1}{18}\hbar\, g_Y{}^3 \operatorname{Log}\left[\frac{\bar\mu^2}{M1^2}\right] - \frac{1}{6}\hbar\, g_Y{}^3 \operatorname{Log}\left[\frac{\bar\mu^2}{M3^2}\right]$$

$$g_s \to g_s - \frac{1}{12}\hbar\, g_s{}^3 \operatorname{Log}\left[\frac{\bar\mu^2}{M1^2}\right] - \frac{1}{4}\hbar\, g_s{}^3 \operatorname{Log}\left[\frac{\bar\mu^2}{M3^2}\right]$$

$$g_L \to g_L - \hbar\, g_L{}^3 \operatorname{Log}\left[\frac{\bar\mu^2}{M3^2}\right]$$

$$Y_d{}^{i1\_i2\_} \to Y_d{}^{i1i2}$$

$$Y_e{}^{i1\_i2\_} \to Y_e{}^{i1i2}$$

$$Y_u{}^{i1\_i2\_} \to Y_u{}^{i1i2}$$

$$\lambda \to \lambda$$

$$\mu 2 \to 3\hbar\, \lambda H1\, M1^2 + 9\hbar\, \lambda H3\, M3^2 + \mu 2 + 3\hbar\, \lambda H1\, M1^2 \operatorname{Log}\left[\frac{\bar\mu^2}{M1^2}\right] + 9\hbar\, \lambda H3\, M3^2 \operatorname{Log}\left[\frac{\bar\mu^2}{M3^2}\right]$$

$$C_{llHH}{}^{i1\_i2\_} \to 0$$

$$C_{dB}{}^{i1\_i2\_} \to \frac{1}{18}\hbar\, g_Y\, \overline{y1L}^{i1p}\, y1L^{rp}\, Y_d{}^{ri2} \frac{1}{M1^2} + \frac{1}{6}\hbar\, g_Y\, \overline{y3L}^{i1p}\, y3L^{rp}\, Y_d{}^{ri2} \frac{1}{M3^2}$$

$$C_{dd}{}^{i1\_i2\_i3\_i4\_} \to -\frac{1}{240}\hbar\, g_s{}^4 \frac{1}{M1^2}\delta^{i1i4}\delta^{i2i3} - \frac{1}{80}\hbar\, g_s{}^4 \frac{1}{M3^2}\delta^{i1i4}\delta^{i2i3} + \frac{1}{720}\hbar\, g_s{}^4 \frac{1}{M1^2}\delta^{i1i2}\delta^{i3i4} - \frac{1}{1620}\hbar\, g_Y{}^4 \frac{1}{M1^2}\delta^{i1i2}\delta^{i3i4} + \frac{1}{240}\hbar\, g_s{}^4$$

$$C_{dG}{}^{i1\_i2\_} \to -\frac{1}{24}\hbar\, g_s\, \overline{y1L}^{i1p}\, y1L^{rp}\, Y_d{}^{ri2} \frac{1}{M1^2} - \frac{1}{8}\hbar\, g_s\, \overline{y3L}^{i1p}\, y3L^{rp}\, Y_d{}^{ri2} \frac{1}{M3^2}$$

$$C_{dH}{}^{i1\_i2\_} \to \frac{1}{12}\hbar\, \overline{y1L}^{pr}\, y1L^{tr}\, \overline{Y_d}^{ps}\, Y_d{}^{ti2}\, Y_d{}^{i1s} \frac{1}{M1^2} + \frac{1}{4}\hbar\, \overline{y3L}^{pr}\, y3L^{tr}\, \overline{Y_d}^{ps}\, Y_d{}^{ti2}\, Y_d{}^{i1s} \frac{1}{M3^2} - \frac{1}{20}\hbar\, Y_d{}^{i1i2}\, g_L{}^4 \frac{1}{M3^2} - \frac{1}{2}\hbar\, \overline{y3L}^{i1p}\, y3L^{st}\, Y_d{}^{si}$$

$$C_{duq}{}^{i1\_i2\_i3\_i4\_} \to 0$$

Interfacing with Existing Codes

The mapping to Warsaw coefficients allows us now to develop **translation functions** for **other codes**, to enable a **streamlined pheno workflow**.

A **WIP** example: interfacing to `smelli/jelli` (see Aleks' talk)

```
ExportSMEFT["full_stack", LEFT]
```

full_stack.json

Schema: <No Schema Selected>


```
[
  "wilson_coefficients",
  [
    [
      "C_llphiphi",
      "0"
    ],
    [
      "C_dB",
      "-0.003472222222222222*(einsum_1*gY)\/(M_1**2*Pi**2) - (einsum_2*gY)\/(96.*M_3**2*Pi**2)"
    ],
    [
      "C_dd",
      "-0.0002604166666666666*(einsum_4*gs**4*(3*M_1**2 + M_3**2))\/(M_1**2*M_3**2*Pi**2) + (e
    ],
    [
      "C_dG",
      "(einsum_1*gs)\/(384.*M_1**2*Pi**2) + (einsum_2*gs)\/(128.*M_3**2*Pi**2)"
    ],
    [
      "C_dphi",
      "einsum_5*(-0.003125*(gL**4 - 20*lambda_H_3p**2)\/(M_3**2*Pi**2) - (3*lambda_H_13*lambda_
    ],
    [
      "C_duql",
      "0"
    ],
    [
      "C_duue",
      "-einsum_11"
    ],
    [
```


- output provides the details for target code to construct a function from UV parameters

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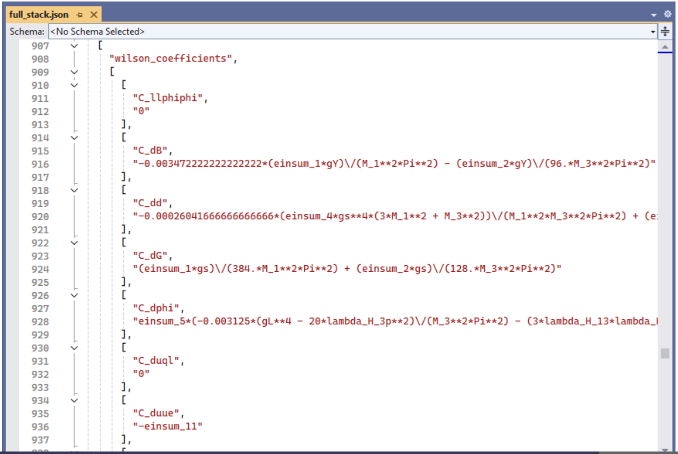

- output provides the details for target code to construct a function from UV parameters
- Einstein summation has to be made explicit

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    [
      "C_dB",
      "-0.003472222222222222*(einsum_1*gY)\/(M_1**2*Pi**2) - (einsum_2*gY)\/(96.*M_3**2*Pi**2)"
    ],
    [
      "C_dd",
      "-0.0002604166666666666*(einsum_4*gs**4*(3*M_1**2 + M_3**2))\/(M_1**2*M_3**2*Pi**2) + (e
    ],
    [
      "C_dG",
      "(einsum_1*gs)\/(384.*M_1**2*Pi**2) + (einsum_2*gs)\/(128.*M_3**2*Pi**2)"
    ],
    [
      "C_dphi",
      "einsum_5*(-0.003125*(gL**4 - 20*lambda_H_3p**2)\/(M_3**2*Pi**2) - (3*lambda_H_13*lambda_
    ],
    [
      "C_duql",
      "0"
    ],
    [
      "C_duue",
      "-einsum_11"
    ],
    [
```


- output provides the details for target code to construct a function from UV parameters
- Einstein summation has to be made explicit
- target code should know loop functions to handle equal mass limit:

$$\int_\ell \frac{1}{\ell^2-m_1^2}\frac{1}{\ell^2-m_2^2} = \frac{A_0(m_1^2)-A_0(m_2^2)}{m_1^2-m_2^2}$$

Interfacing with Existing Codes

The mapping to Warsaw coefficients allows us now to develop **translation functions** for **other codes**, to enable a **streamlined pheno workflow**.

A **WIP** example: interfacing to `smelli/jelli` (see Aleks' talk)

```
ExportSMEFT["full_stack", LEFT]
```

full_stack.json

Schema: <No Schema Selected>


```
[
  "wilson_coefficients",
  [
    [
      "C_llphiphi",
      "0"
    ],
    [
      "C_dB",
      "-0.003472222222222222*(einsum_1*gY)\/(M_1**2*Pi**2) - (einsum_2*gY)\/(96.*M_3**2*Pi**2)"
    ],
    [
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      "C_dphi",
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- output provides the details for target code to construct a function from UV parameters
- Einstein summation has to be made explicit
- target code should know loop functions to handle equal mass limit:
  $$\int_\ell \frac{1}{\ell^2 - m_1^2}\frac{1}{\ell^2 - m_2^2} = \frac{A_0(m_1^2) - A_0(m_2^2)}{m_1^2 - m_2^2}$$
- predefined contractions and loop functions make evaluation fast, allowing for large MC scans

Interfacing with Existing Codes

The `jelli` export is currently being worked out in collaboration with Peter Stangl, but we are **happy** to build interfaces to **other codes**!

The vision for the ideal BSM workflow:

- Easily define a BSM model

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- RG-evolve coefficients (either in-house or interfacing to other tools, i.e. `DSixTools`)
- Interface to pheno codes for parameter scans, collider studies, ...

The individual steps are **automatable** enough to turn **months-long** pheno studies into **quick** afternoon sessions of coding (+ drinking coffee while waiting for the machine to finish computing results)

Renormalization and RG Evolution

Matching proceeds through evaluating the **hard region** of the effective one-loop action.

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Recipe is simple:

- Expand loop integrals around small parameters, $\ell \gg m_i, p_i$

$$\int \frac{d^d\ell}{(2\pi)^d} \frac{1}{l^2} \frac{1}{(l-p)^2 - m^2} = \int \frac{d^d\ell}{(2\pi)^d} \frac{1}{l^4} + \int \frac{d^d\ell}{(2\pi)^d} \frac{2l \cdot p}{l^6} + \dots$$

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- Introduce IR regulators to isolate UV poles & evaluate

$$\rightarrow \int \frac{d^d\ell}{(2\pi)^d} \frac{1}{(l^2 - \Lambda^2)^2} + \int \frac{d^d\ell}{(2\pi)^d} \frac{2l \cdot p}{(l^2 - \Lambda^2)^3} = \frac{i}{16\pi^2\epsilon} + \text{(finite)}$$

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- Last step amounts to simply replacing $\int d^d\ell/\ell^4 \to i/\epsilon$ and calling it a day.

Renormalization & RG Evolution

This functionality is coming to **Matchete** soon™!

Renormalization & RG Evolution

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Simple **first step** is to compute the `UVDivergentAction`:

In[6]:=
```
LSM = LoadModel["SM"];
GreensSimplify@UVDivergentAction@LSM // NiceForm
```

Out[7]//NiceForm=

$$-\frac{41}{24}\hbar\frac{1}{\epsilon}g_Y^2 B^{\mu\nu 2}+\frac{3}{2}\hbar\frac{1}{\epsilon}g_s^2 G^{\mu\nu A2}+\frac{5}{8}\hbar\frac{1}{\epsilon}g_L^2 W^{\mu\nu I2}+$$
$$\frac{1}{4}\hbar\frac{1}{\epsilon}\mu 2\left(9g_L^2+3g_Y^2-4\left(3\bar{Y}_d^{pr}Y_d^{pr}+\bar{Y}_e^{pr}Y_e^{pr}+3\bar{Y}_u^{pr}Y_u^{pr}+3\lambda\right)\right)\bar{H}_i H^i+$$
$$\hbar\frac{1}{\epsilon}\left(\frac{9}{16}g_L^4+\frac{3}{16}g_Y^4-3\bar{Y}_d^{pr}\bar{Y}_d^{st}Y_d^{pt}Y_d^{sr}-\bar{Y}_e^{pr}\bar{Y}_e^{st}Y_e^{pt}Y_e^{sr}-3\bar{Y}_u^{pr}\bar{Y}_u^{st}Y_u^{pt}Y_u^{sr}+\frac{3}{8}g_L^2\left(g_Y^2-6\lambda\right)-\frac{3}{4}\lambda g_Y^2+3\bar{Y}_d^{pr}Y_d^{pr}\lambda+\bar{Y}_e^{pr}Y_e^{pr}\lambda+3\bar{Y}_u^{pr}Y_u^{pr}\lambda+3\lambda^2\right)\bar{H}_i\bar{H}_j H^i H^j+$$
$$\frac{1}{24}\hbar\frac{1}{\epsilon}\left(18\left(\bar{Y}_d^{ps}\bar{Y}_d^{tr}Y_d^{ts}-\bar{Y}_d^{sr}\bar{Y}_u^{pt}Y_u^{st}\right)+\bar{Y}_d^{pr}\left(-27g_L^2-96g_s^2-5g_Y^2+36\bar{Y}_d^{st}Y_d^{st}+12\bar{Y}_e^{st}Y_e^{st}+36\bar{Y}_u^{st}Y_u^{st}\right)\right)\bar{H}_i\left(\bar{d}_a^r\cdot P_L\cdot q^{aip}\right)+$$

From this, the **counterterms** - and with that the **anomalous dimensions** - are easily* extracted.

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Renormalization & RG Evolution

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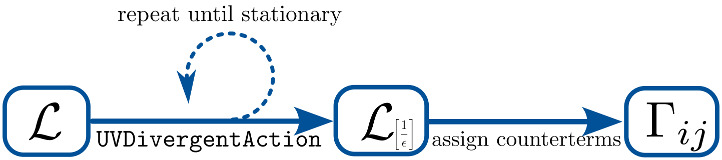
The calculation of anomalous dimensions then becomes an **iterative** procedure:



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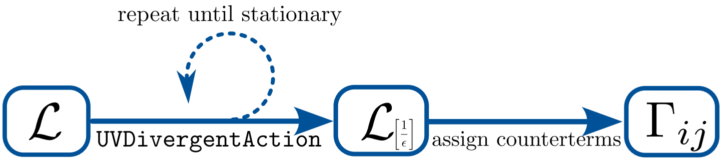

This procedure is **not** guaranteed to generate a complete basis, but it **will** produce all **operators** that **mix** with the ones in the starting $\mathcal{L}$ under renormalization.

Let's have a **peek** at what this will look like...

Defining a **toy model** with $\mathcal{L}_{\text{int}} = y\bar{\psi}_L\phi\chi_R + \text{h.c}$

and matching at **tree-level**:

```
DefineGaugeGroup[QED, U1, e, A]

DefineField[ψ, Fermion, Mass → 0, Charges → {QED[-1]}, Chiral → LeftHanded]
DefineField[χ, Fermion, Mass → 0, Charges → {QED[-1]}, Chiral → RightHanded]
DefineField[ϕ, Scalar, Mass → Heavy, SelfConjugate → True]
DefineCoupling[y, SelfConjugate → False]

LUV = FreeLag[] + PlusHc[y[] × ϕ[] Bar[ψ[]] ** χ[]];
LEFT = EOMSimplify@ Match[LUV, LoopOrder → 0];

NiceForm@ PlusHc[y[] × ϕ[] Bar[ψ[]] ** χ[]]
NiceForm@ SeriesEFT[LEFT, EFTOrder → {6}]
```

NiceForm=

$\bar{y}\,\phi\,(\bar{\chi}\cdot P_L\cdot\psi) + y\,\phi\,(\bar{\psi}\cdot P_R\cdot\chi)$

NiceForm=

$\frac{1}{2}\bar{y}^2\frac{1}{M\phi^2}(\bar{\chi}\cdot P_L\cdot\psi)^2 + \frac{1}{2}y^2\frac{1}{M\phi^2}(\bar{\psi}\cdot P_R\cdot\chi)^2 - \frac{1}{2}\bar{y}\,y\,\frac{1}{M\phi^2}(\bar{\chi}\cdot\gamma_\mu P_R\cdot\chi)(\bar{\psi}\cdot\gamma_\mu P_L\cdot\psi)$

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show only dimension-six terms

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Early Preview of RG Calculations

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← $\mathcal{L}_{\text{int}}$ contains $\psi^2\chi^2$ operators

Note how this is in no way a **complete basis**.

Early Preview of RG Calculations

The RG module does a **second pass** because it needs ψ^4 and χ^4 counterterms - operators that were **not present** in the **input** Lagrangian:

```
PrintBetafunctions@LEFT
```

» New operators found, rerunning... Plus[...]

Lagrangian:

$$-\frac{1}{4}A^{\mu\nu 2} + i\,(\bar{\chi}\cdot\gamma_\mu P_R\cdot D_\mu\chi) + i\,(\bar{\psi}\cdot\gamma_\mu P_L\cdot D_\mu\psi) + C_{\psi^2\chi^2}\,(\bar{\chi}\cdot P_L\cdot\psi)^2 + C_{\chi^4}\,(\bar{\chi}\cdot\gamma_\mu P_R\cdot\chi)^2 + C_{\psi^2\chi^2}\,(\bar{\psi}\cdot P_R\cdot\chi)^2 + C_{\chi^2\psi^2}\,(\bar{\chi}\cdot\gamma_\mu P_R\cdot\chi)\,(\bar{\psi}\cdot\gamma_\mu P_L\cdot\psi) + C_{\psi^4}\,(\bar{\psi}\cdot\gamma_\mu P_L\cdot\psi)^2$$

NiceForm=

$$\mu\frac{dC_{\chi^4}}{d\mu} \to \frac{1}{12}\frac{1}{\pi^2}C_{\chi^2\psi^2}e^2 + \frac{13}{12}\frac{1}{\pi^2}C_{\chi^4}e^2$$

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couplings renamed
new terms introduced

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$$\mu\frac{dC_{\chi^2\psi^2}}{d\mu} \to -\frac{7}{12}\frac{1}{\pi^2}C_{\chi^2\psi^2}e^2 + \frac{1}{3}\frac{1}{\pi^2}C_{\chi^4}e^2 + \frac{1}{3}\frac{1}{\pi^2}C_{\psi^4}e^2$$

This is **very** work-in-progress, and **subject to lots of change**!

RG Calculations with Matchete

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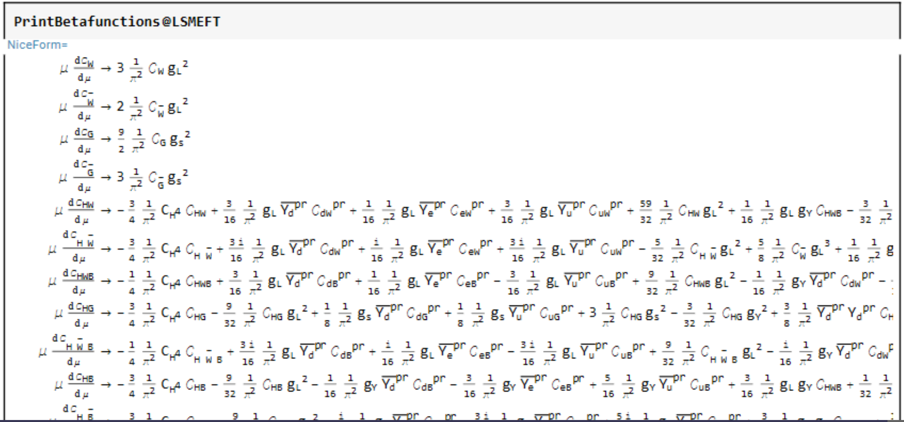
Especially **valuable** in cases where the target basis is **not just SMEFT**, i.e. SMEFT + light particles, **multi-scale** BSM models, ...



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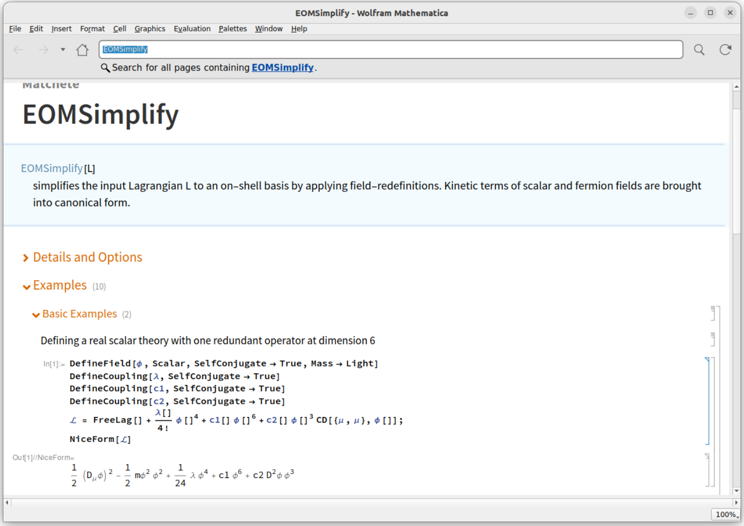
Achieved in `v0.2.0` through "usage strings" for all exported tokens:

```
?EOMSimplify
```

Symbol

EOMSimplify[L] takes a Lagrangian and removes redundant operators by the means of field redefinitions. The option 'EFTOrder' allows to define a maximal order in EFT counting. The standard value (Automatic) determines it from the input Lagrangian. The option 'DummyCoefficients' internally replaces matching coefficients with symbols, potentially improving performance when simplifying very large Lagrangians (standard is False).

For more details: use Mathematica’s **built-in documentation** system.



Just press “**F1**” on a command to bring up detailed **documentation**!

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Thanks for listening!

https://gitlab.com/matchete/matchete