

Computing tools for the SMEFT

- EFT basis derivation -

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Siegen
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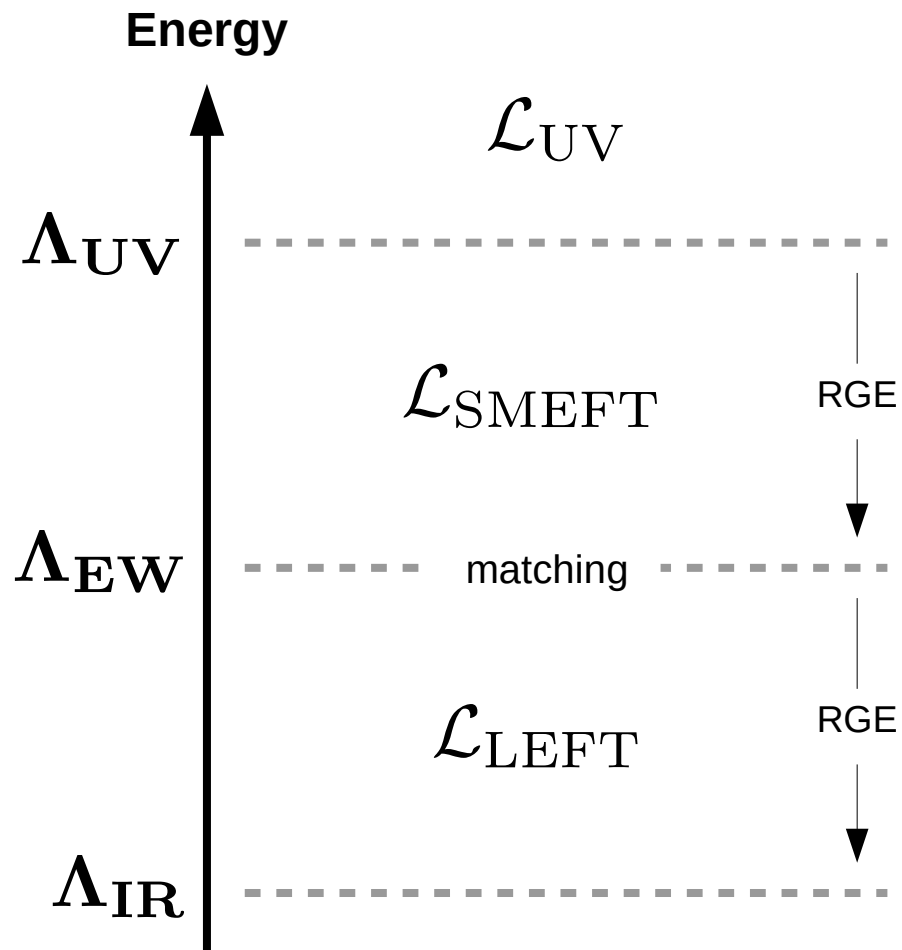


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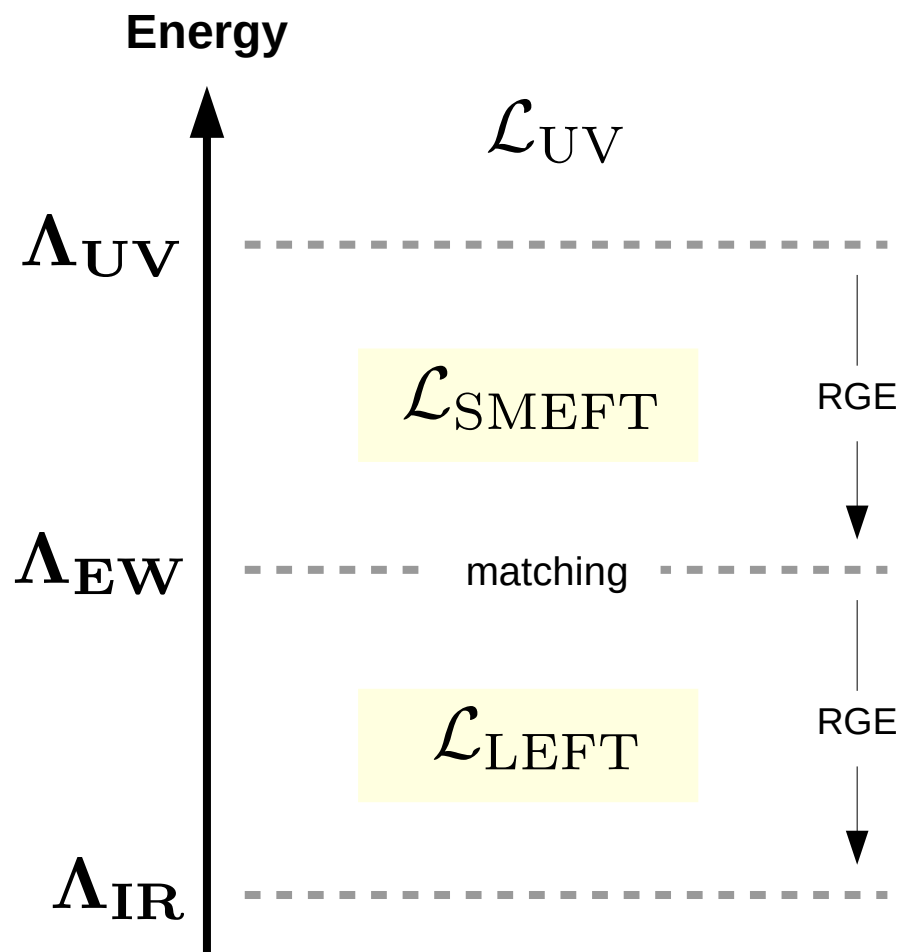
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Problem we want to solve



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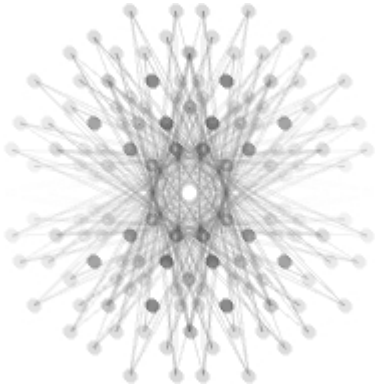
Defining a **complete** and **non-redundant** basis for an EFT is **not** a trivial task

- Equations of motion
- Integration by parts
- Fierz identities

SMEFT
Warsaw basis
[Grzadkowski, Iskrzynski, Misiak, Rosiek, 2010]

LEFT
San Diego basis
[Jenkins, Manohar, Stoffer, 2017]

Sym2Int

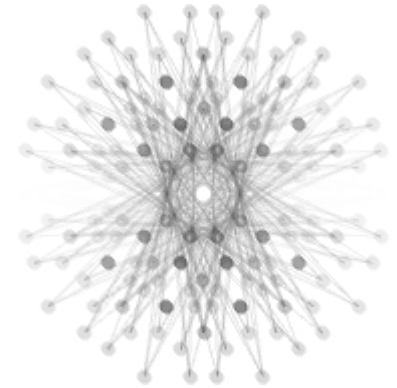


Sym2Int is a Mathematica package that lists all valid interactions given a model's gauge group and fields.

Renato M. Fonseca

- <https://renatofonseca.net/sym2int>
- [arXiv:1703.05221](https://arxiv.org/abs/1703.05221) and [arXiv:1907.12584](https://arxiv.org/abs/1907.12584)
- Mathematica package
- Installation: manual (just like any Mathematica package)
- It requires **Mathematica 9+** and **GroupMath**
- Alternative: **BasisGen**

What Sym2Int can do for you



- List **all interactions** in a model

Up to any arbitrarily large operator dimension

- **Reduce** (or not) the list of operators by using EOM, IBP, ...
- Parameter **counting**

The current version of **Sym2Int** cannot build the operators explicitly (no known code can), but future versions will include this feature.

[Fonseca, HEFT 2022]

Current version: **2.2**

Special thanks to **Renato Fonseca** for his assistance when learning how to use **Sym2Int**

Some dim-8 operators

$$Q_{l^2 q^2 H^2}^{(1)}$$

$$(\bar{l}_p \gamma^\mu l_r)(\bar{q}_s \gamma_\mu q_t)(H^\dagger H)$$

$$Q_{l^2 q^2 H^2}^{(2)}$$

$$(\bar{l}_p \gamma^\mu \tau^I l_r)(\bar{q}_s \gamma_\mu q_t)(H^\dagger \tau^I H)$$

$$Q_{l^2 q^2 H^2}^{(3)}$$

$$(\bar{l}_p \gamma^\mu \tau^I l_r)(\bar{q}_s \gamma_\mu \tau^I q_t)(H^\dagger H)$$

$$Q_{l^2 q^2 H^2}^{(4)}$$

$$(\bar{l}_p \gamma^\mu l_r)(\bar{q}_s \gamma_\mu \tau^I q_t)(H^\dagger \tau^I H)$$

$$Q_{l^2 q^2 H^2}^{(5)}$$

$$\epsilon^{IJK} (\bar{l}_p \gamma^\mu \tau^I l_r)(\bar{q}_s \gamma_\mu \tau^J q_t)(H^\dagger \tau^K H)$$

Christopher W. Murphy

[arXiv:2005.00059]

Complete SMEFT
dim-8 basis

(see also Li et al,
2005.00008)

Chuck Norris fact of the day

*When Chuck Norris crosses
the street, cars look both
ways for Chuck Norris.*



Tomorrow

Lecture 2 : Matching to specific UV models



MatchMakerEFT is a fully automated tool to perform tree-level and 1-loop matching of arbitrary UV models onto arbitrary effective field theories in the diagrammatic approach.

**Adrián Carmona, Achilleas Lazopoulos, Pablo Olgoso,
José Santiago**

- <https://ftae.ugr.es/matchmakereft/>
- [arXiv:2112.10787](https://arxiv.org/abs/2112.10787)
- Python package