Computing tools for the SMEFT

- Observable calculation -

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Siegen
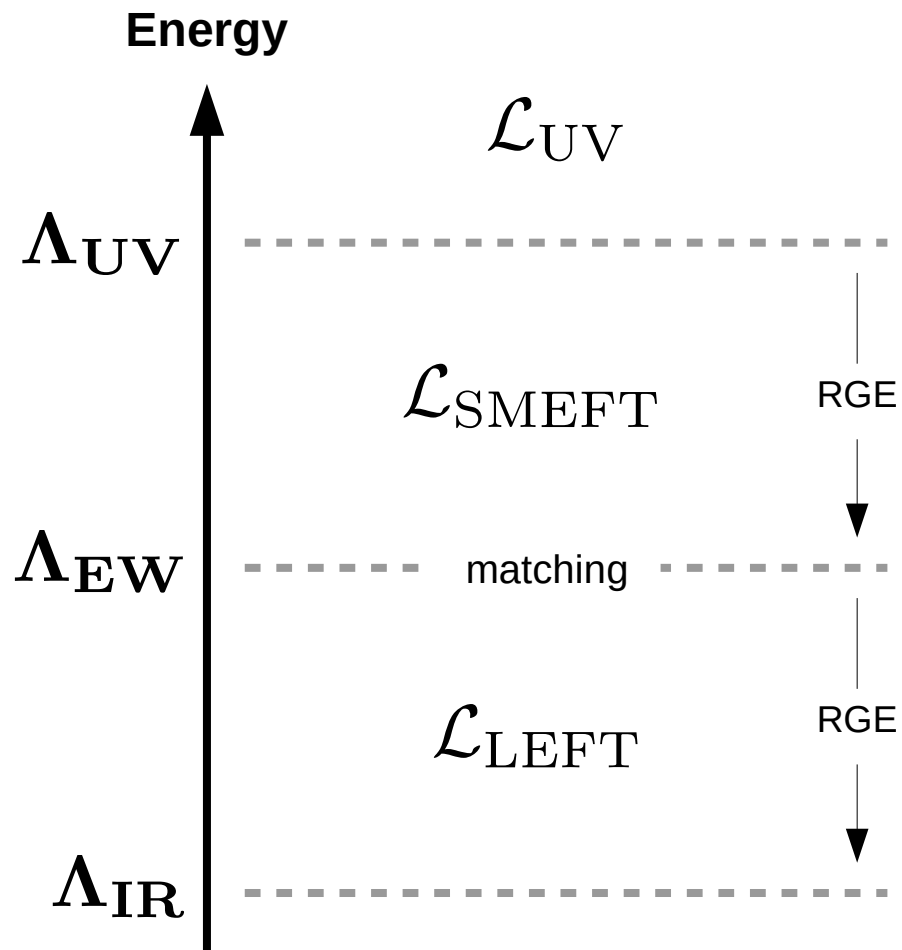July 11-15 2022

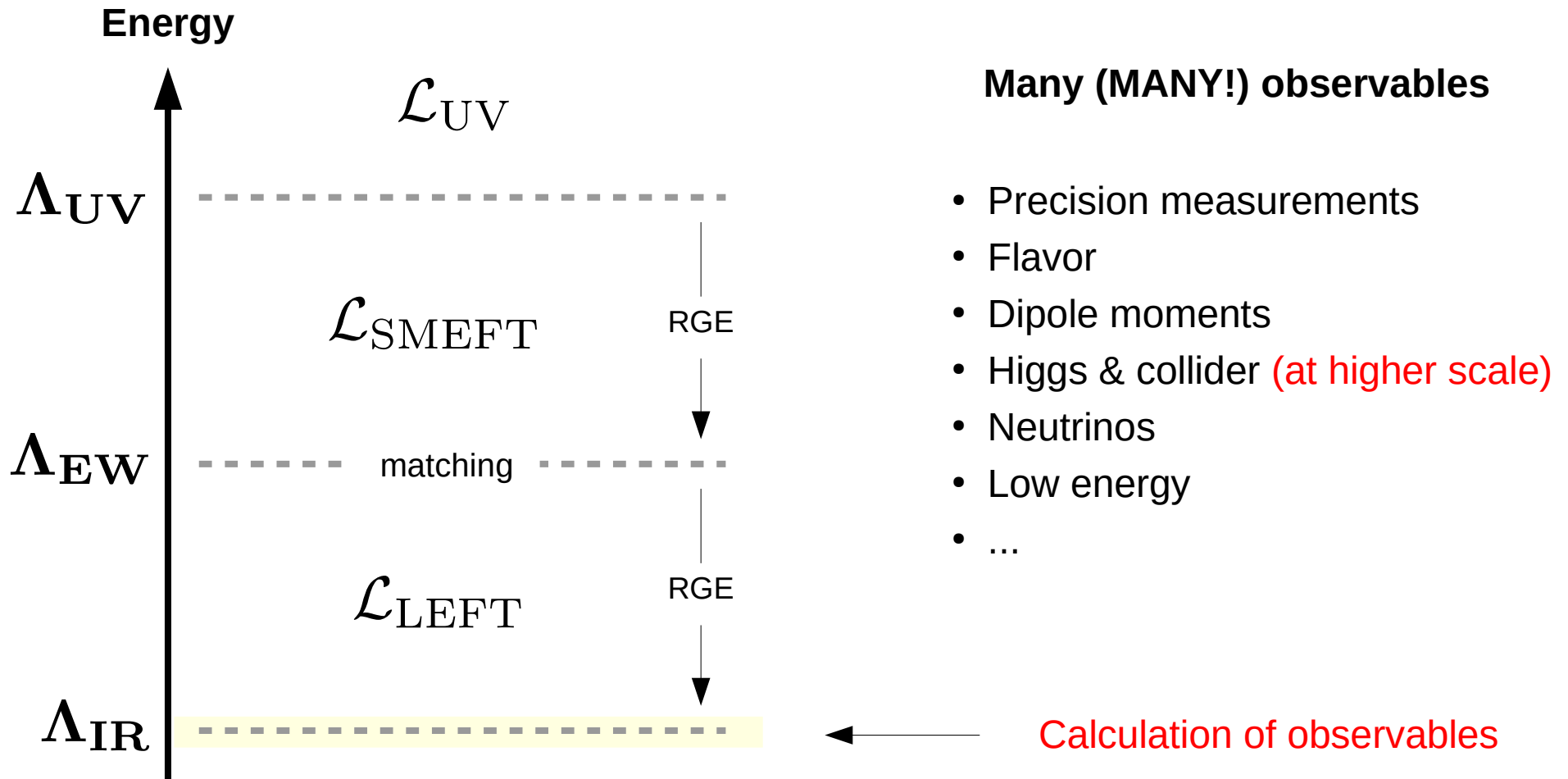# Problem we want to solve

Energy

$\mathcal{L}_{\mathrm{UV}}$

$\boldsymbol{\Lambda_{\mathrm{UV}}}$ - - - - - - - - - - - - - - - -

$\mathcal{L}_{\mathrm{SMEFT}}$ RGE

$\boldsymbol{\Lambda_{\mathrm{EW}}}$ - - - - matching - - - -

$\mathcal{L}_{\mathrm{LEFT}}$ RGE

$\boldsymbol{\Lambda_{\mathrm{IR}}}$ - - - - - - - - - - - - - - - -

Problem we want to solve

Energy

$$\mathcal{L}_{\mathrm{UV}}$$

$\mathbf{\Lambda_{UV}}$ — — — — — — — — — —

$$\mathcal{L}_{\mathrm{SMEFT}}$$

RGE

$\mathbf{\Lambda_{EW}}$ — — — matching — — —

RGE

$$\mathcal{L}_{\mathrm{LEFT}}$$

$\mathbf{\Lambda_{IR}}$ — — — — — — — — —

Many (MANY!) observables

- Precision measurements
- Flavor
- Dipole moments
- Higgs & collider (at higher scale)
- Neutrinos
- Low energy
- ...

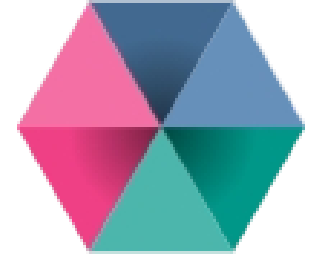Calculation of observables
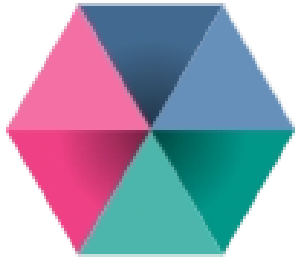
flavio

flavio is a python package for flavour physics and other precision tests of the Standard Model.

David M. Straub + large community
(~21 contributors, including Peter Stangl, the main developer)

- https://flav-io.github.io/

- arXiv:1810.08132

- Python package

- Installation: pip

- It requires **Python** 3.6+

- Alternatives: **EOS**, **SuperISO**, **FlavorKit**

What flavio can do for you

- Calculation of hundreds of observables

  In the SM or parametrized in terms of dim-6 WCs of the SMEFT/LEFT

- Large database of experimental measurements
- Construction of likelihood functions
- Plotting routines

Current version: 2.3.3

Observables

Example:

Obtained after running
with **DsixTools**

$$\mathrm{BR}(\ell_i \to \ell_j \gamma) = \frac{m_i^3}{4\pi\,\Gamma_i} \left(|(L_{e\gamma})_{ij}|^2 + |(L_{e\gamma})_{ji}|^2 \right)$$

Alternatively, one can use a tool like **flavio**

Chuck Norris fact of the day

When Chuck Norris does a pushup, he isn't lifting himself up, he's pushing the Earth down

Many "routine tasks" can nowadays be performed with the help of (easy to use) computer tools

Keep in mind:

- Do not be afraid to use them
- Always understand what you are doing