Karlsruher Institut für Technologie

SARAH/ HiggsAutomator: the past, present & future

Florian Staub | Mini-workshop on automating Higgs and BSM calculations, Paris, 10.October 2017

KARLSRUHE INSTITUTE OF TECHNOLOGY, ITP & IKP

HELMHOLTZ | ASSOCIATION

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Evolution of SARAH

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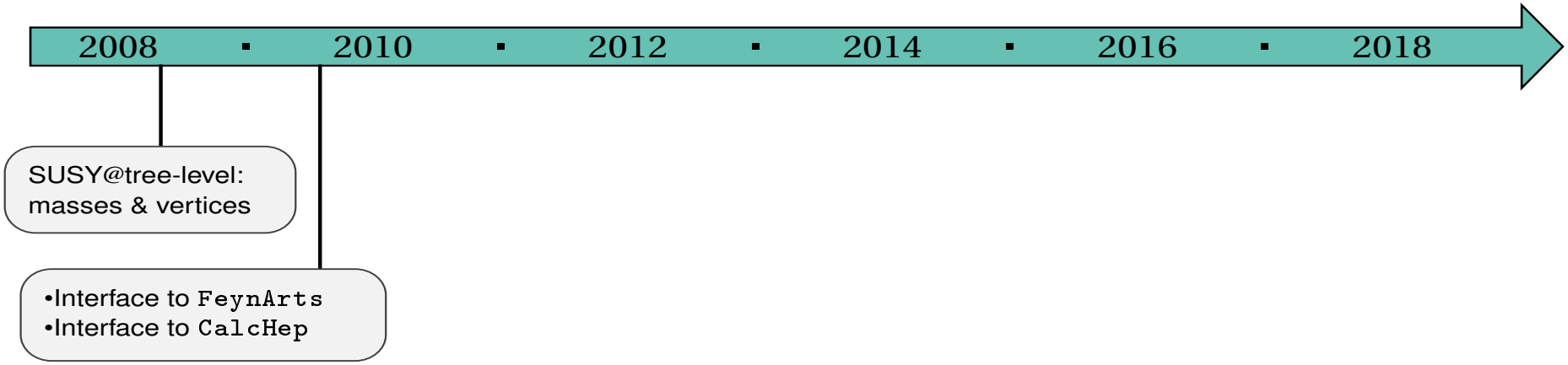

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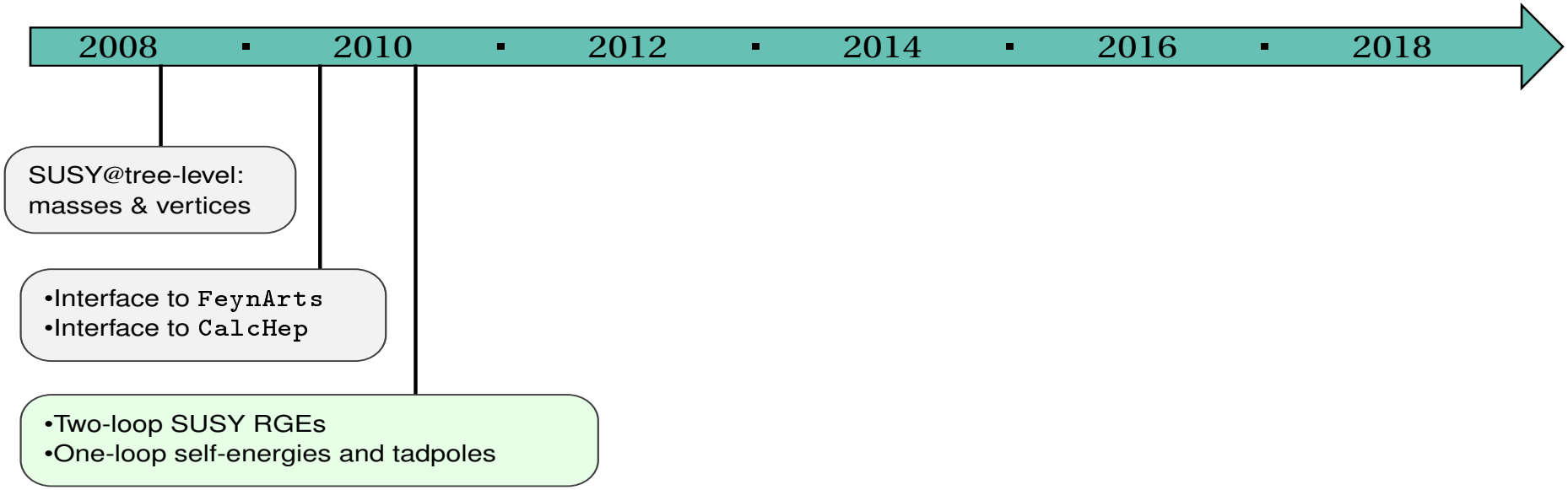

Automation of precisi-
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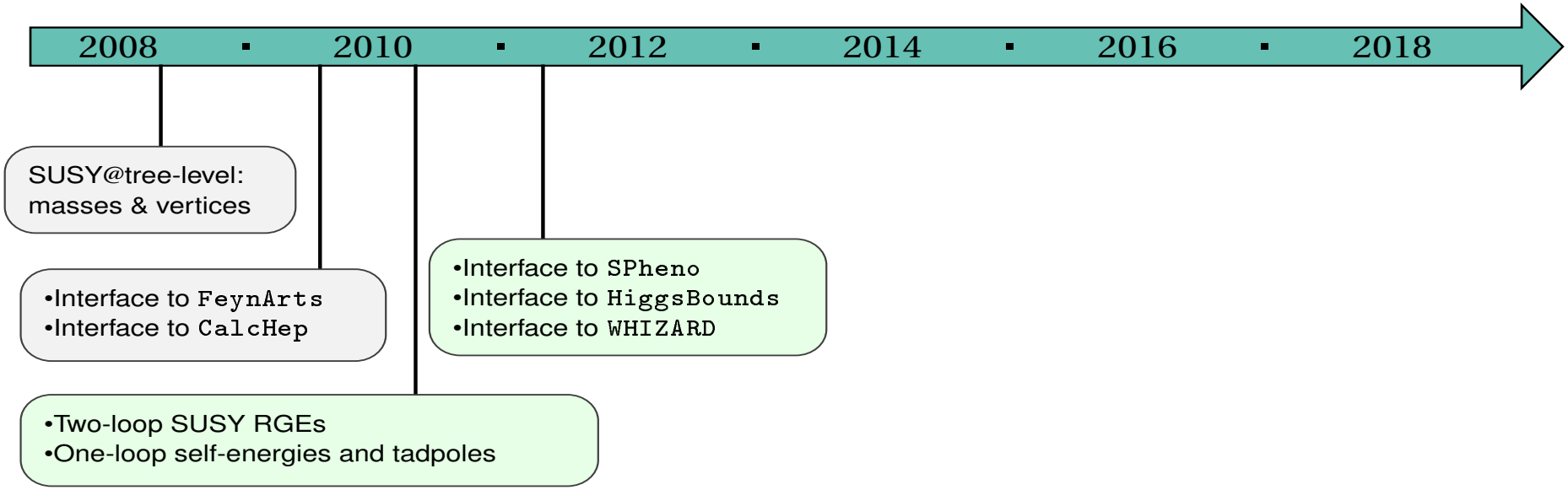

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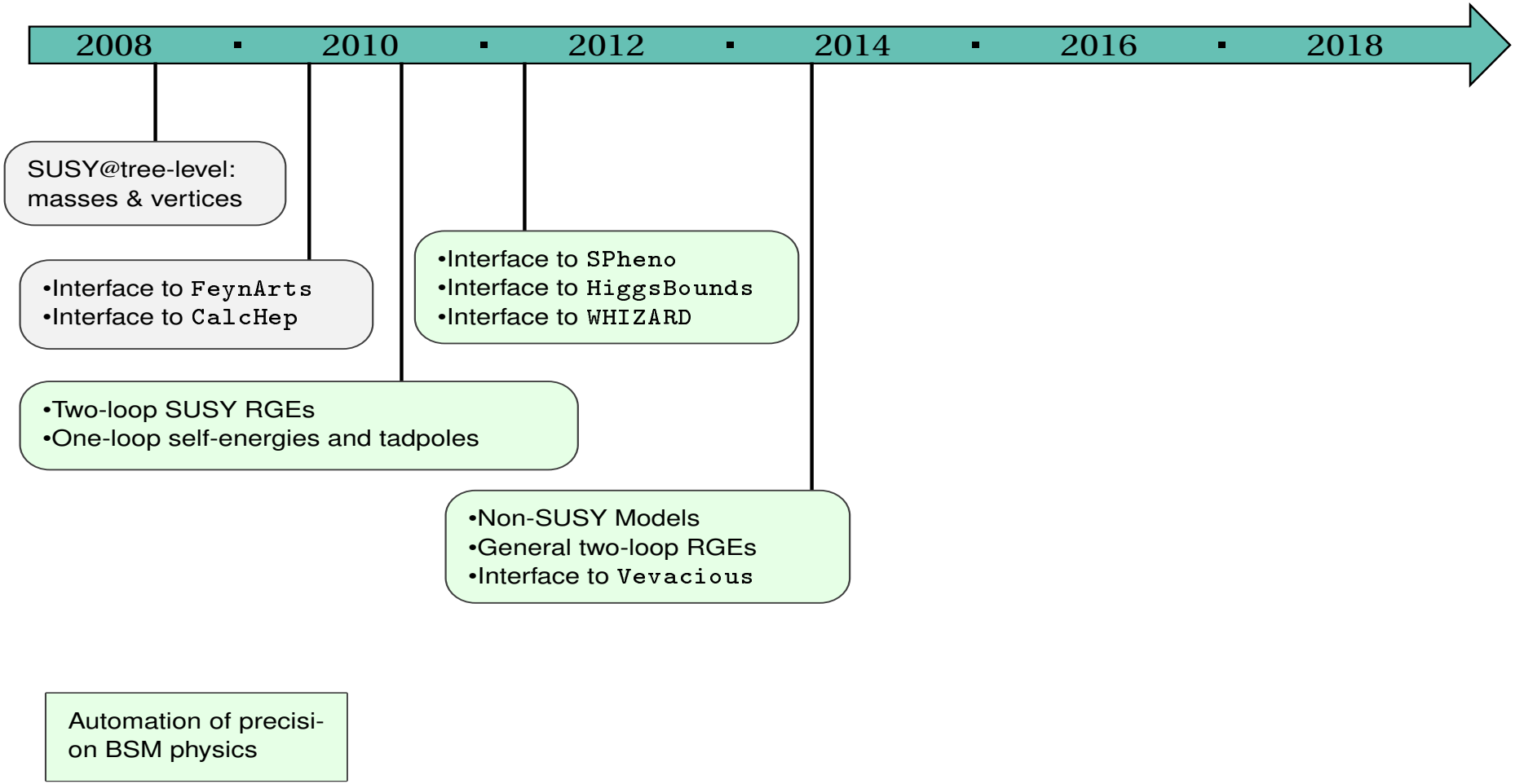

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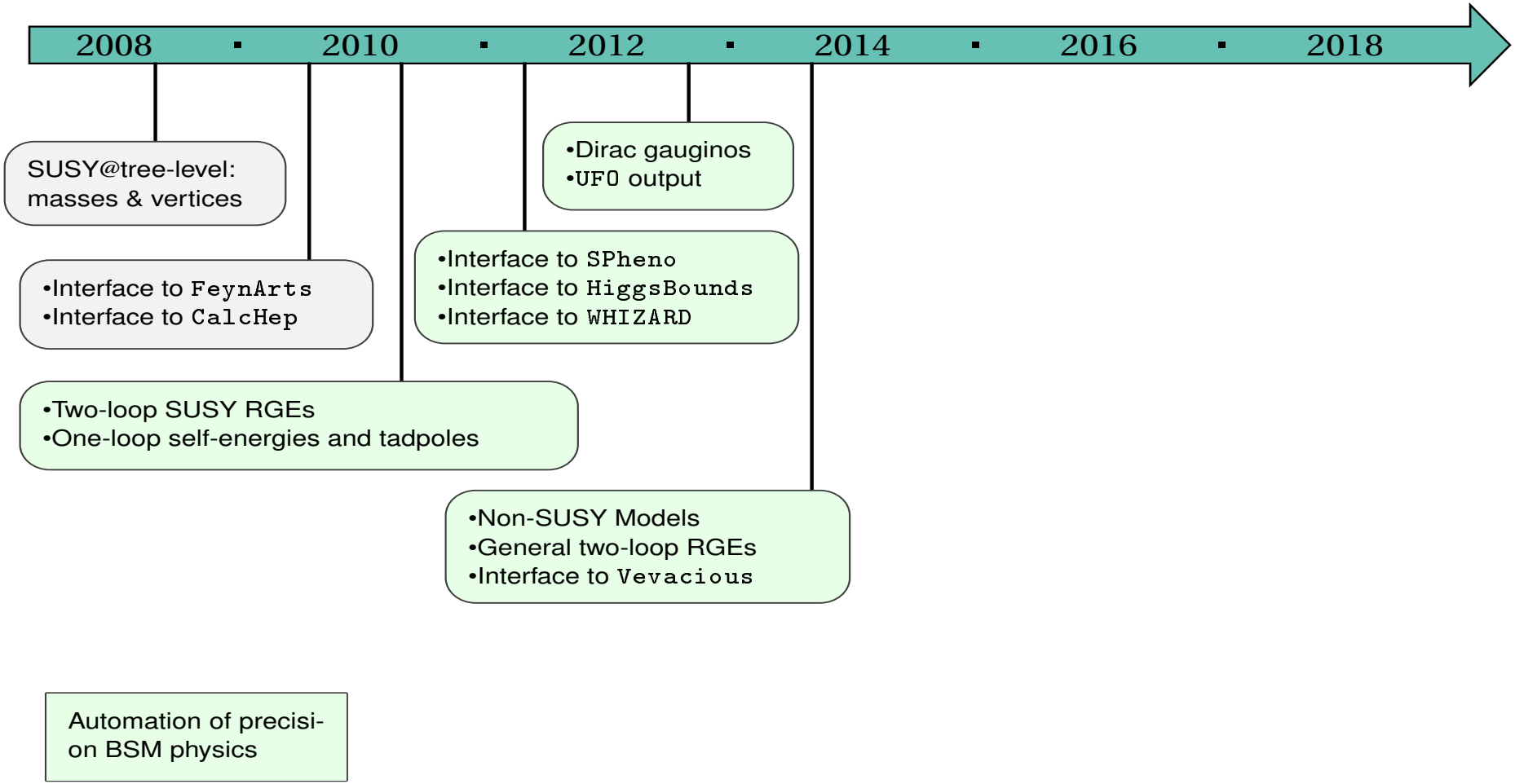

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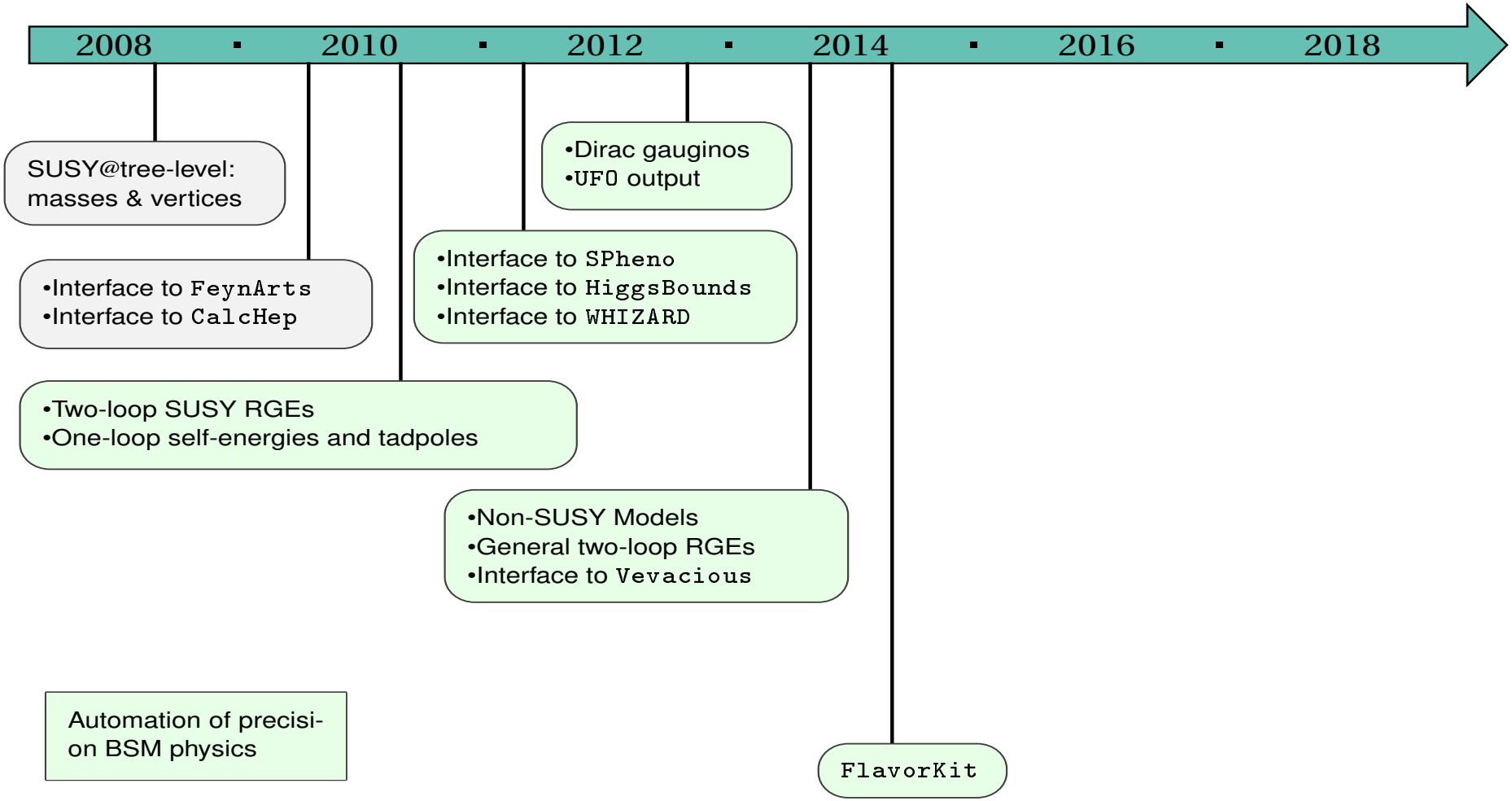

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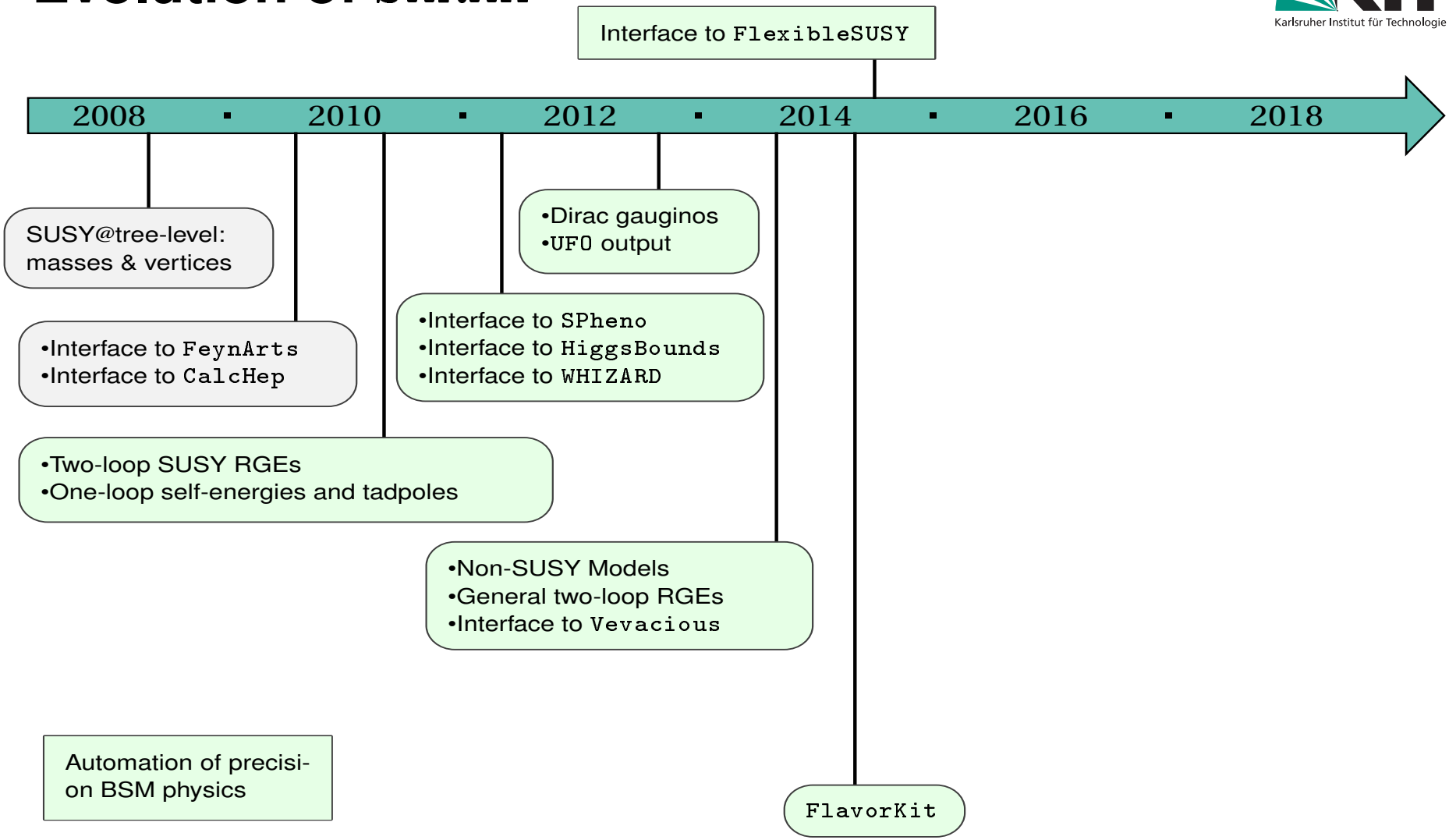

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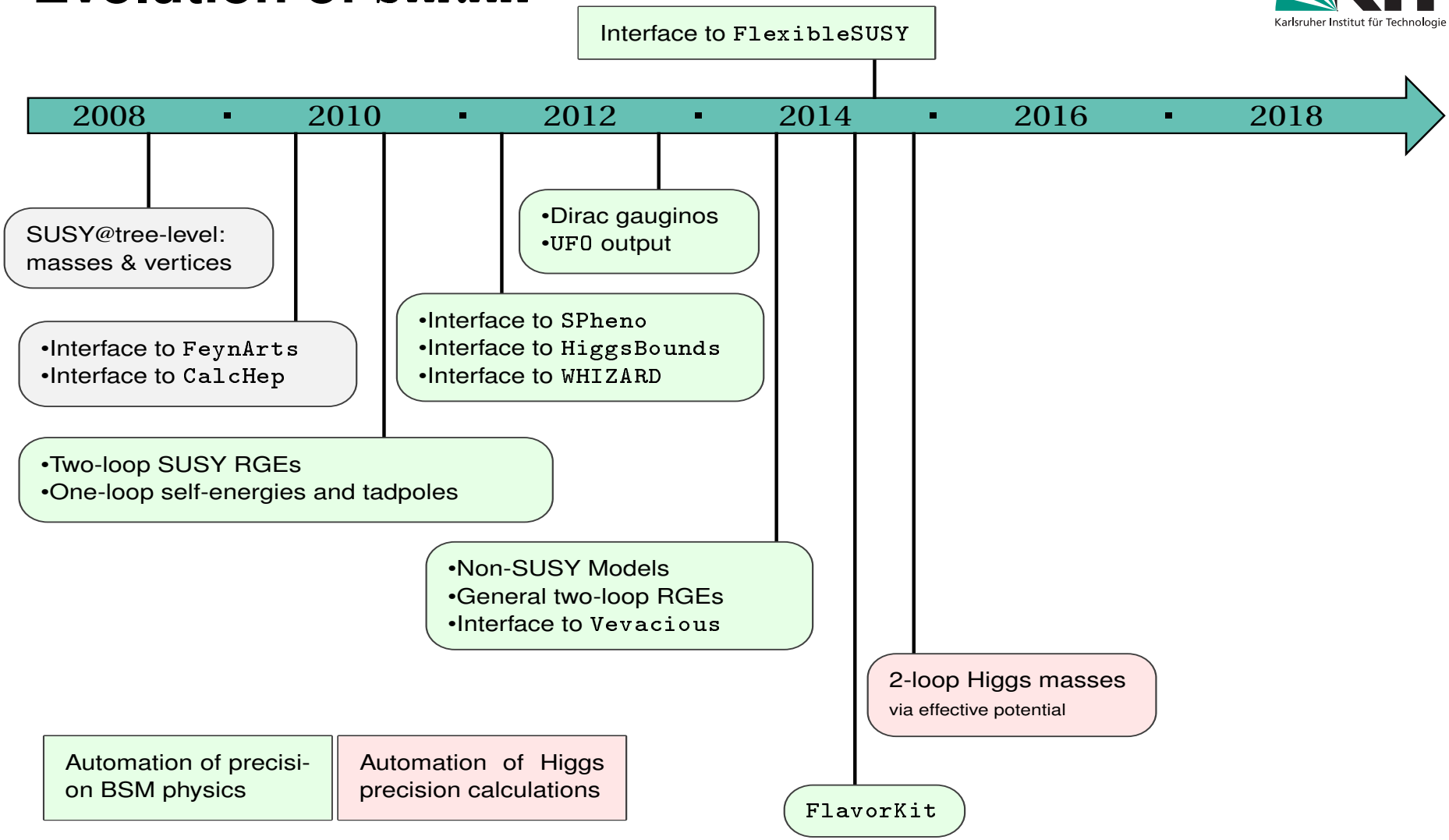

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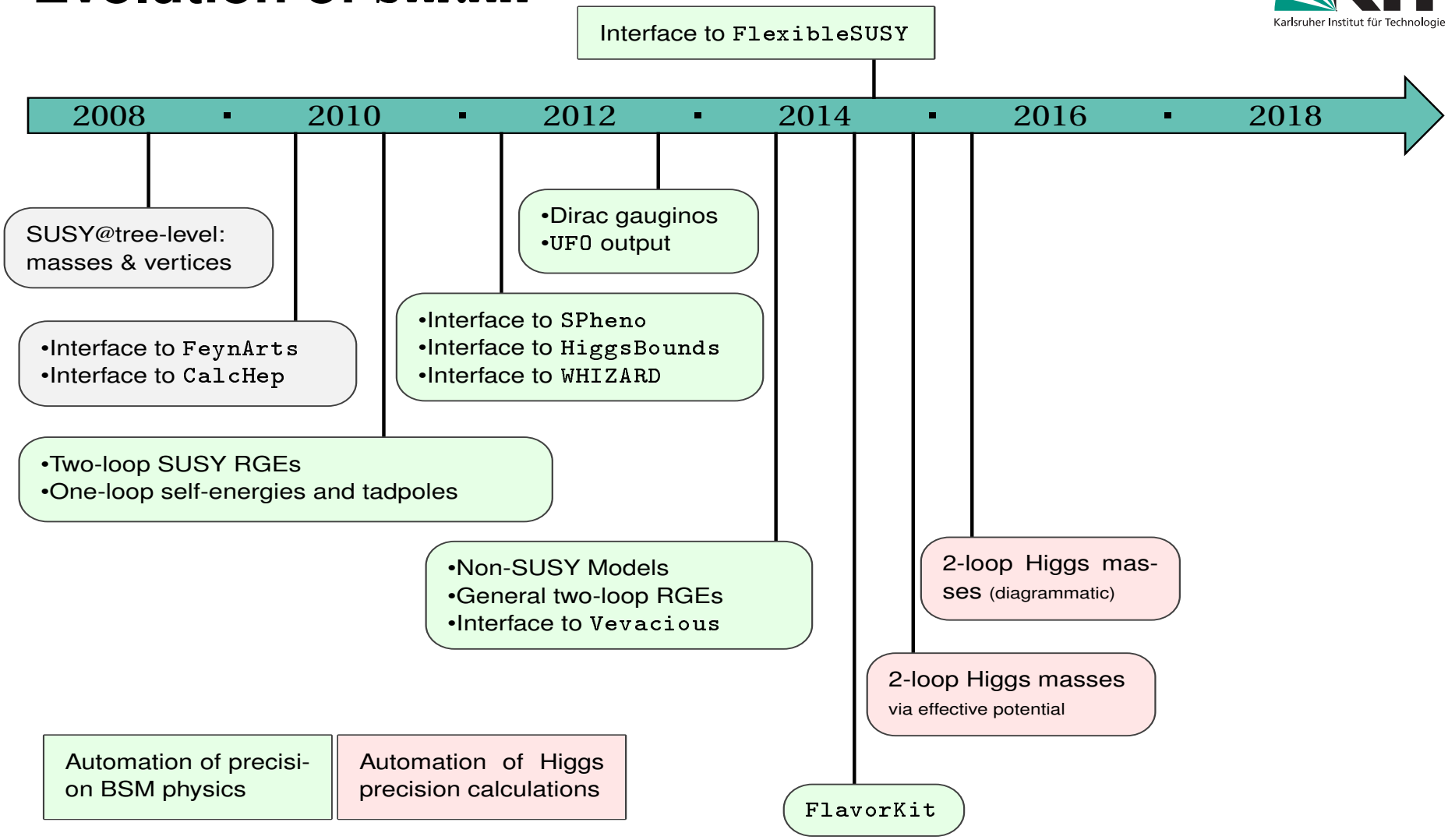

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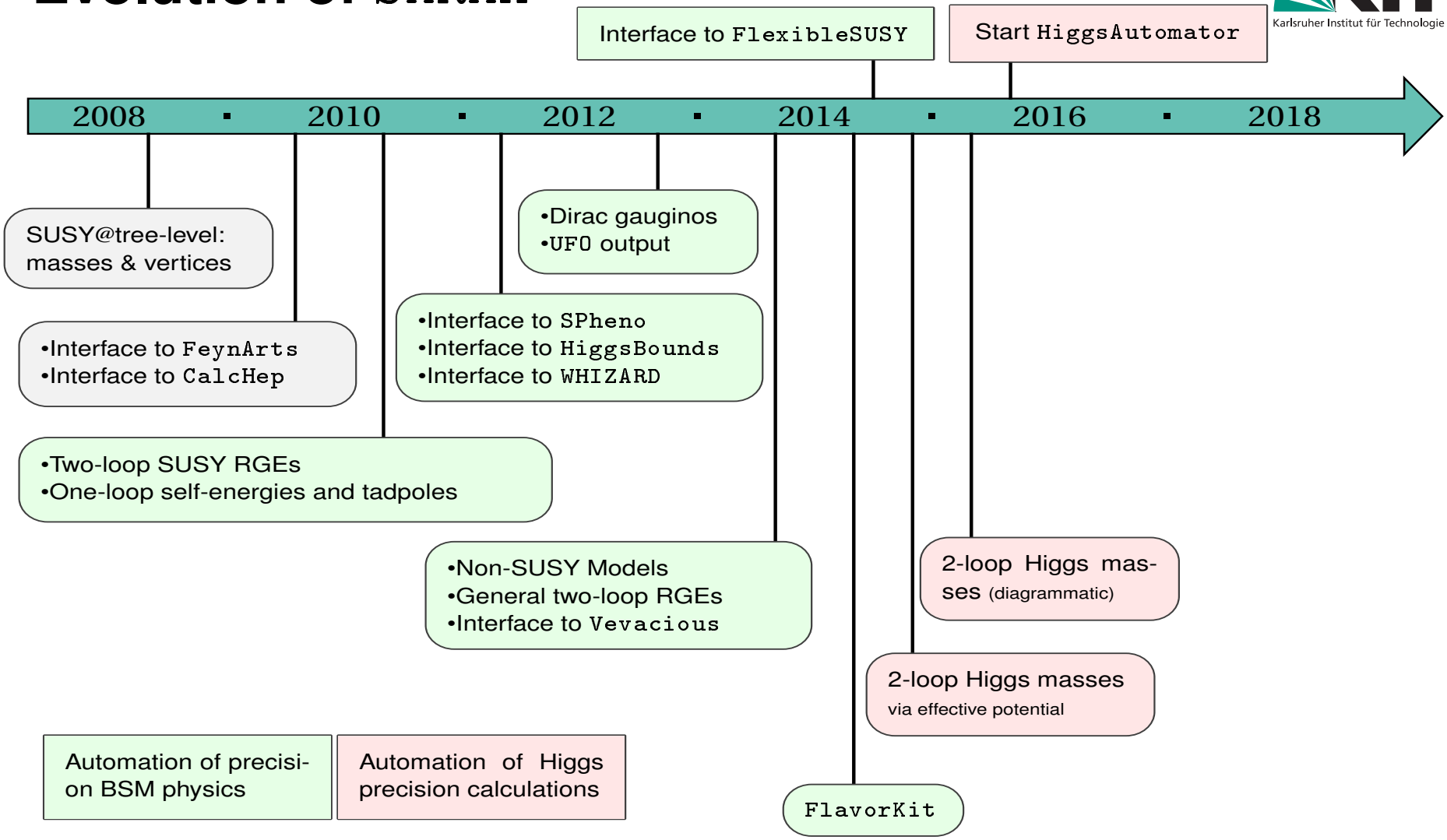

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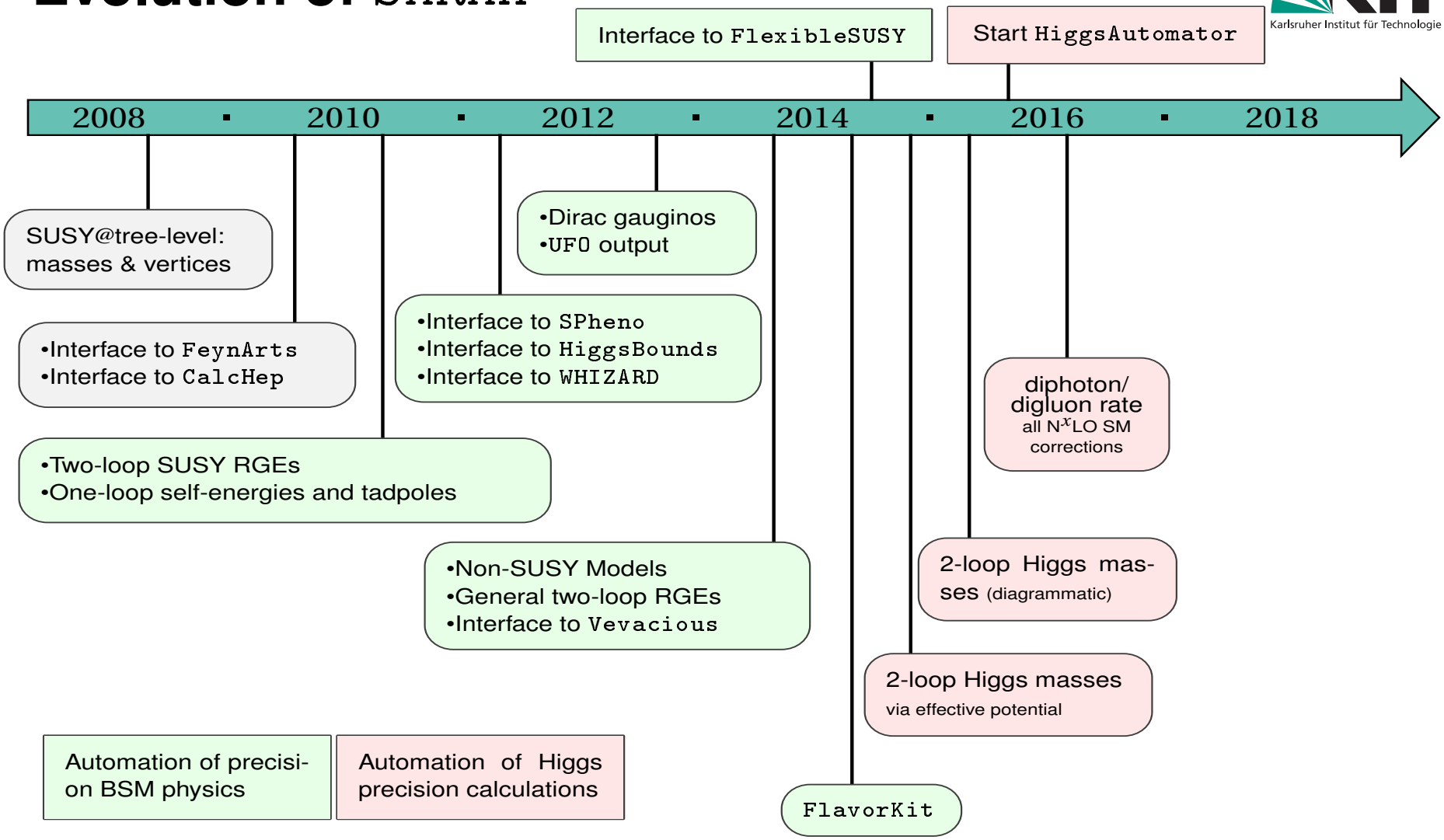

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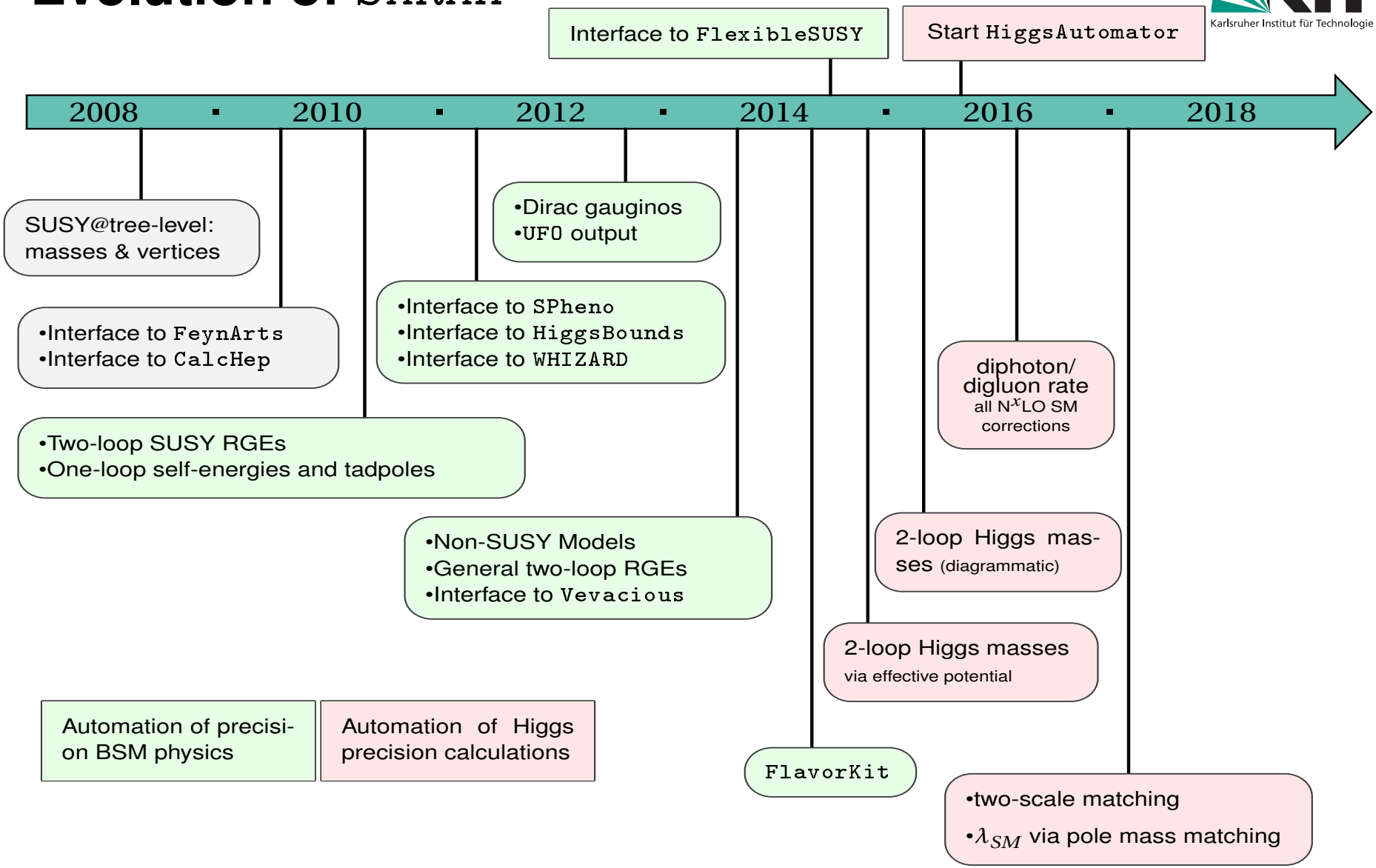

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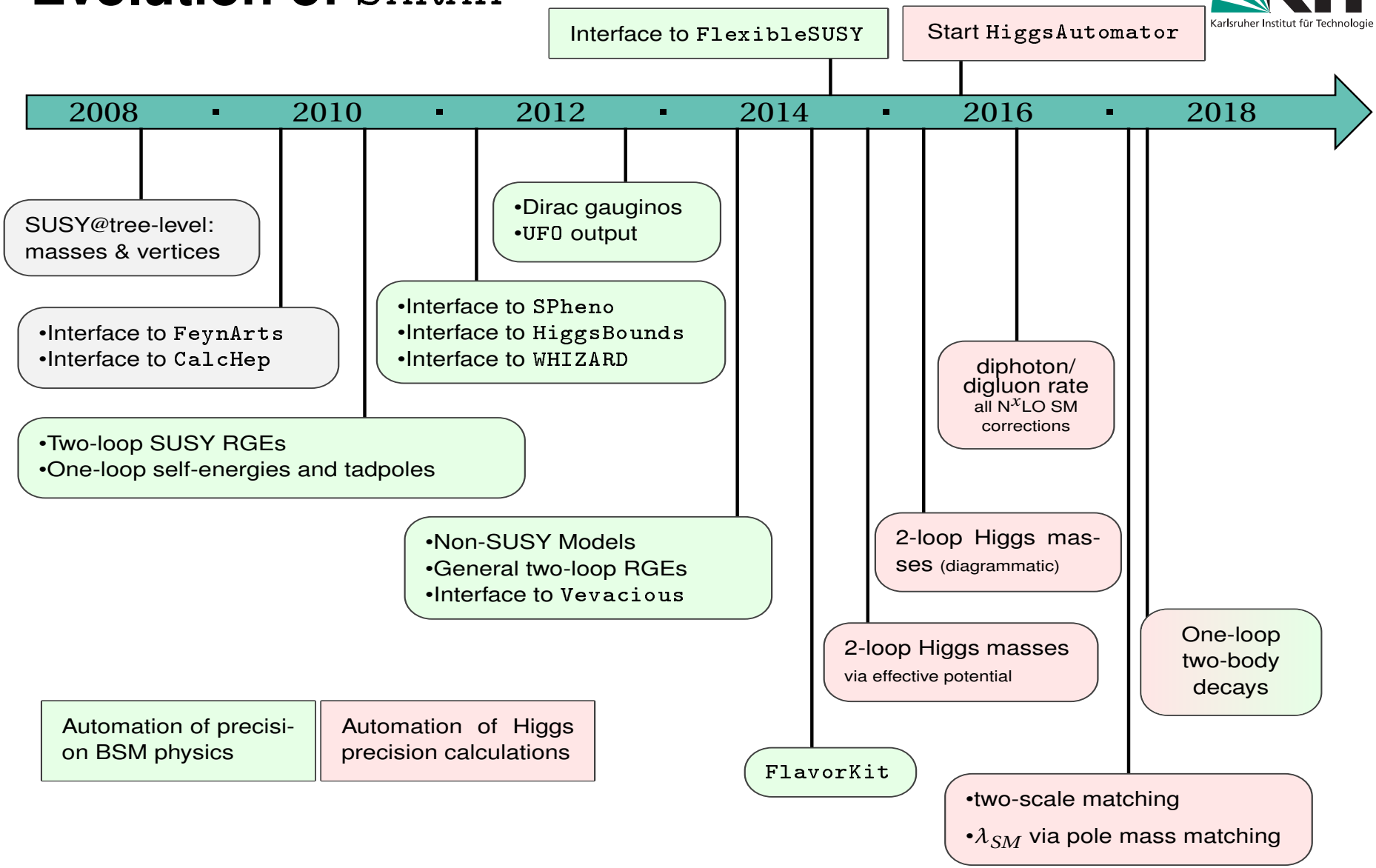

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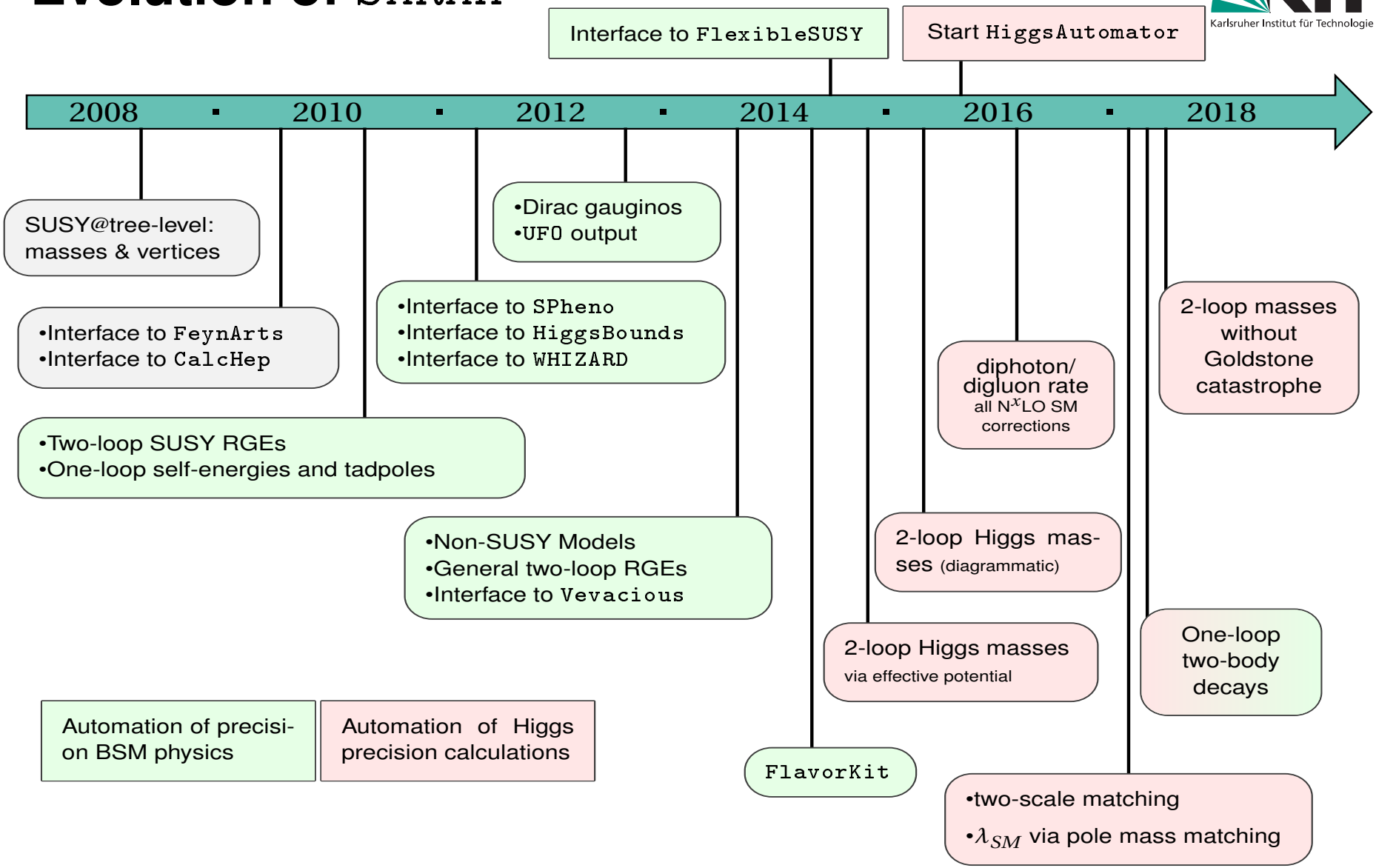

Recent updates I

Dealing with heavy scales [Staub,Porod,1703.]

- Improved derivation of model parameters (2-scale matching to SM)
- Effective Higgs Mass calculation:
  - New physics contributions absorbed into λ_{SM} at BSM scale via pole mass matching
  - SM RGEs between BSM scale and m_t
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- large differences in the Higgs mass for heavy SUSY/BSM scales possible
- drawbacks of pole mass matching
  - Other effective models than SM?
  - Consistency beyond 1-loop?

→ **Matching of couplings better?! What's about IR divergences?**

Recent updates II

Generic calculation of one-loop decays [Goodsell,Liebler,Staub,1703.09237]

- All two-body decays of scalars & fermions
- Loop induced decays (e.g. $S \to \gamma\gamma$, $F \to F'\gamma$) included

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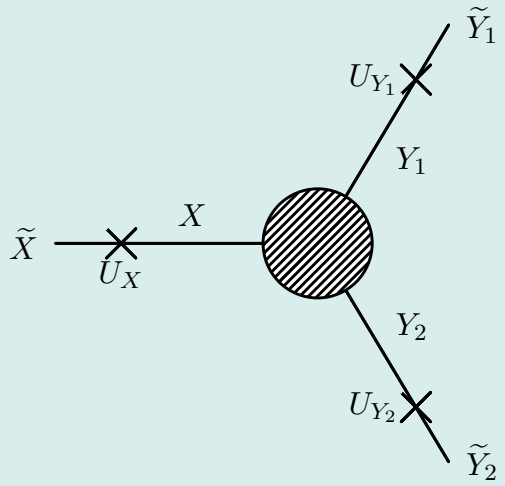

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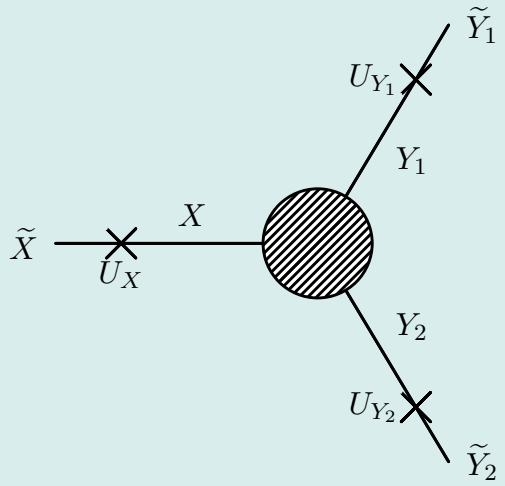

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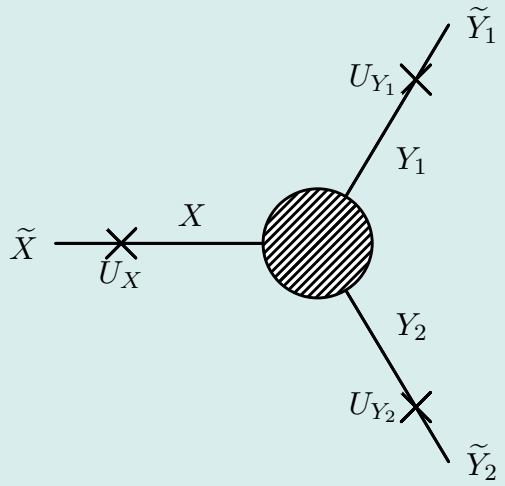

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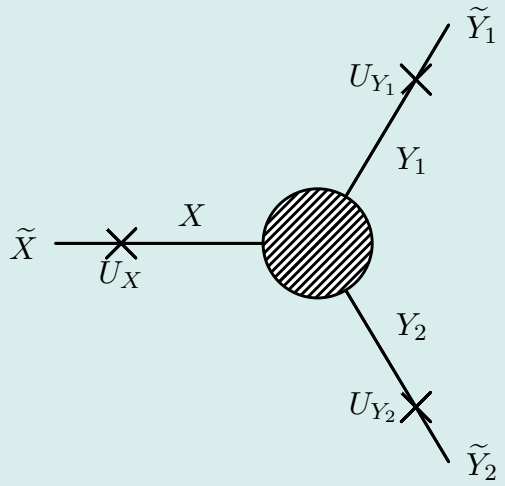

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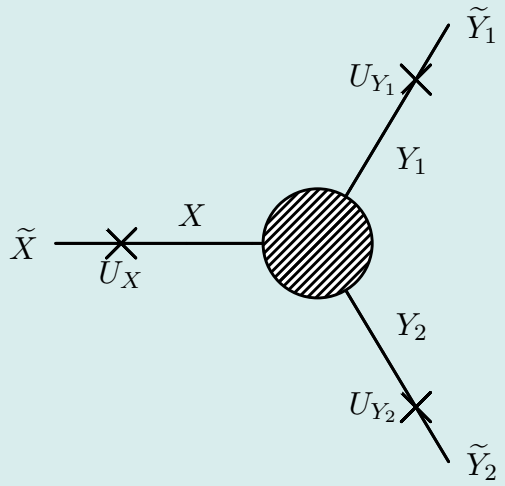

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- **Interfacing counter-terms with other codes (aMC@NLO)?**

Recent updates III

Solution to the Goldstone boson catastrophe [Braathen,Goodsell,Staub,1706.05372]

- Usually: divergences in 2-loop Higgs masses in non-SUSY models or SUSY models beyond the MSSM (even in gauge-less limit!)
- Can be solved via a special treatment of the Goldstone bosons

[Braathen, Goodsell,1609.06977]

- This solution is now available in SARAH:
  - → Very good agreement with SMH for the SM
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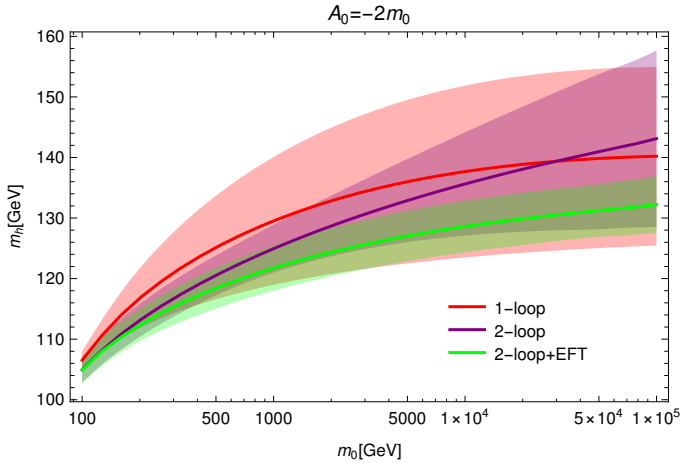
- **Time to address ew two-loop corrections?** → Z **self-energies needed**

Current developments

- Estimate of the mass uncertainty with SARAH/SPheno (Werner, Florian, ?)



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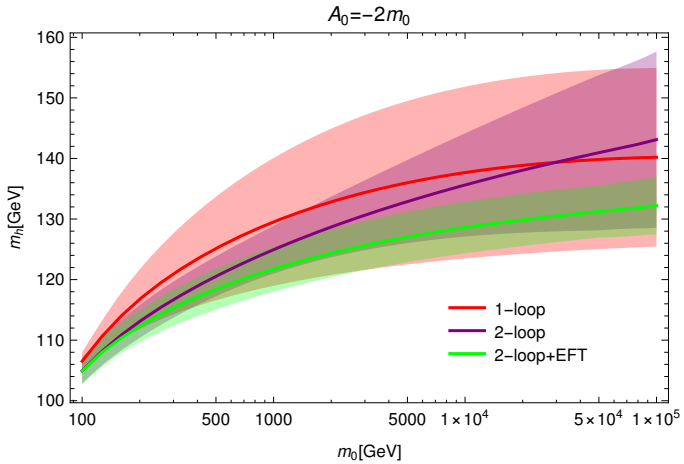

- Matching of couplings instead of pole masses (Martin, Maggie, Florian)
- ...

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