Algebraic symmetry breaking in multi-Higgs models

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Multi-Higgs models

General perspective:

- Building and testing models beyond the Standard Model is the most active field in particle physics;

- One popular direction — multi-Higgs-doublet models (NHDMs);

- More Higgses → more fun! In the SM, one poor Higgs is responsible for everything it can do; non-minimal Higgs sector can do much more.

Symmetries in NHDM and flavour physics

Starting from 1970's people tried to find a symmetry-based NHDM explanation of quark masses and mixing

- take an NHDM with some flavour symmetry group G;
- find minimum of the Higgs potential;
- derive masses/mixing/CPV.

Many symmetry groups G were tested; none worked as nicely as wanted; nice illustration for 3HDM with A_4 symmetry group in [Gonzales Felipe et al, 1302.0861, 1304.3468].

This is why people move to more elaborated constructions.

Breaking symmetries in NHDM

The fundamental obstacle [Gonzales Felipe et al, 1401.5807]:

- to be compatible with the experiment, the symmetry group G must break down completely at the minimum;
- but for large groups, this is algebraically impossible with usual (renormalizable) Higgs potential.

The task

- Overcome this obstacle with higher-order interactions.
- Construct viable examples of 3HDM with large symmetry groups.

Skills you will acquire

Working on the project, you will acquire

- **analytical skills**: learn how to build and analyze extended Higgs sectors with symmetries;

- **numerical skills**: cross-checking your analytical results, interfacing to standard computer packages for phenomenology exploration;

- **critical thinking**: separating essential from redundant, telling physically relevant results from mathematical tricks, asking yourself good questions;

- **presenting your work**: writing short summaries, giving presentations, discussing the work with colleagues, writing papers and your thesis.

All of these skills will be valuable for your future scientific projects.

> **Join our team!**