



Precision Working Group Update

GAMBIT 14

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What is the Precision WG?

Handles (precision) theory calculations not directly related to flavour, collider or dark matter.

We are responsible for the following “Bits” of GAMBIT.

- SpecBit – Provides the mass spectrum and couplings, spectrum generator backends, vacuum stability calculations
- DecayBit – Provides decay tables, backends decay calculators
- PrecisionBit – precision calculations and likelihoods (e.g. muon $g-2$, EWPO, W-mass..)
- There is no cake or cake-based activities.

Organisation

- Started having monthly meetings
- Early discussion centered around the question I tried to answer on the last slide.
- Restructured: Models, moved to Core
- Renamed “Models Working Group” → “Precision Working Group”
- We do seem to have been successful in attracting more interest amongst GAMBIT members / people who expressed an interest
- Members: PA, Eliel, Tomas Gonzalo, Anders Kvellestad, Douglas Jacob, Cristian Sierra, Roberto Ruiz, Yongcheng Wu, Martin White, Wei Su
- New members marked in blue, dramatic growth but very recent so many haven't attended a meeting yet
- Sadly Douglas is almost certainly leaving academia for personal reasons :(, but still a lot of new people.

Physics Proposals

- **EW observables and Global fits:**
 - ▶ Yongcheng contacted me and has joined GAMBIT
 - ▶ Has experience using GFitter recently.
 - ▶ Interested improving/extending what we can do in GAMBIT
 - ▶ Discussed also getting into SM EW fits, backending EW fitting codes for BSM use (output S, U and T which we then calculate), adding more EW observables directly
- **MSSM MW targetting global:**
 - ▶ idea extend MSSM work by Yang Zhang and Jin Min Yang, very constrained scenario.
 - ▶ Will have many authors, externals Jin Min Yang + MW experts I work with (Dominik Stockinger etc). So while not a long author paper officially, not trying to keep author list short.
 - ▶ Time sensitive: I am taking a long time to move as I have a big backlog of work so danger of becoming redundant

Physics Proposals

- Phase Transitions / GravitationalWaves / EWBG/ EDMs:
 - ▶ A lot of discussion in PrecisionBit about projects to motivate work
 - ▶ Many discussions / ideas were on Phase Transition related ideas as many have interest there (e.g. both convenors).
- Some ideas like:
 - Straight FOPT study NMSSM, with a GW motivation
 - EDM constraints in specific models
 - Simple Higgs extensions with muon $g-2$, FOPT, Higgs limits.
 - All with the goal to progressively build the capabilities to tackle a larger EW baryogenesis fit

Code Updates

This is where progress has been slow.

Meetings so far mostly interesting discussion / planning, but not yet progressed to actionable points.

- FeynHiggs update:
 - ▶ Update to latest version 2.18.1
 - ▶ This is happening now, actually pushed forward by Martin some significant progress,
 - ▶ We will remove the module function `FeynHiggs_MSSMMasses` and capability: `MSSMMasses`. The signature changed. This was never used, its existence led to misunderstandings, I do not believe this is intended to give the user predictions for MSSM pole masses, but others thought it was.
 - ▶ There is unfortunately a lot of careful testing required, many concerns were uncovered in project with Alyshah.
 - ▶ This will be useful for MSSM MW project, maybe one of the gravitino projects. And for long term projects of the impact of Higgs mass calcs and uncertainty on global fits

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- [GM2Calc_THDM](#) – Douglas Jacob, Work In Progress
- [SpecBit Redesign \(SpecBit_redesign_dev_rebase\)](#)
 - ▶ Only being reactivated now
 - ▶ At least BOSS now should work for FS, so this can be done
 - ▶ its just a matter of finding time (which is pretty hard)
- [SUSYPOPE](#) – We are removing this interface to a non-public code. There is now a FeynHiggs routine FHEWPO though this is just giving MW, $\sin\theta_W$, and the loop corrections that enter them, $\Delta\alpha$, $\Delta\alpha_h$,

- **VEVAcious**

Vevacious finds “dangerous” minima of the scalar potential, calculates loop and thermal corrections and the decay width of the EW minimum. Model file from SARAH thus part of GUM.

- Often slower part of Specbit.
- In large part because of path deformation and overshoot/undershoot method.
- Straight path estimation might be a way to go to speed it up if necessary (for some models).
- Same goes for loop corrections. Calculating tunnelling with the 1-loop effective potential is not always the most consistent thing anyway (though no much better automatable option exists for generic models where the EW minimum only exists at > 1 Loop).
- Tree-level might be enough in some models though.
- *(Elie) I need to bite the bullet and start working on this.*
- For MSSM, where we have run Vevacious extensively, a ML-powered fit might help in making things faster.

Personal Comment

I really hope with more members we can move to where others are active, leading things.

I have less and less time for anything since joining NNU

I don't know how that will progress or change, but I really want to be able to step down from this role within the next 2 years