

Career Development Plan - Year 1

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Name of Supervisor: Ulrich Ellwanger
Date: 12/11/2014

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS EXPECTED

The first steps are to get acquainted with supersymmetric extensions of the Standard Model and, in particular, with the NMSSM, its Higgs sector, and the possible properties (masses and couplings) of the NMSSM Higgs bosons beyond the Standard Model. Also an overview of the present results of the experiments at the LHC on properties of the 125 GeV Higgs boson and, notably, knowledge of constraints from searches for additional Higgs bosons will be necessary.

At the beginning of 2015, a study of a scenario with an additional mostly singlet-like Higgs boson with a mass below 125 GeV is foreseen: Given the present constraints on the couplings of the 125 GeV Higgs and constraints from LEP, how large can the *signal rates* for such an additional lighter Higgs state be at the LHC? Do recent upper bounds (from ATLAS) on signal rates in the gamma-gamma channel constrain such a scenario? If yes, to which extend? If no, which sensitivity will be required in order to test this scenario? Already these results may lead to a first publication.

Subsequently the focus will be on additional heavy Higgs bosons in the NMSSM. Here many different scenarios are possible, which depend on the masses, couplings and the decay modes of these extra states. The aim is to get an overview of these scenarios and to propose and to study the most promising production modes/decay channels in each case. This second (and larger) part of the project may require to react to new results from *the run2* at the LHC.

LONG –TERM CAREER OBJECTIVES (over 5 years):

1. *Goals:*

- successful completion of thesis and defence in 2017 leading to award of PhD
- original research leading to publications in high impact peer reviewed journals
- presentation of research at conferences/workshops in the field to gain exposure to the community
- first Post-Doctoral research position

2. *What further research activity or other training is needed to attain these goals?*

- Presentation skills.
- Networking and communication skills.
- Training in writing research papers.

- Training in writing applications for scientific positions/research grants.
- Secondment to Freiburg to benefit from research experience of co-workers based there.
- Secondment to Private Sector Partner to learn about research in a commercial environment.
- Learning how to effectively communicate with experimentalists who perform studies at the LHC.

SHORT-TERM OBJECTIVES (1-2 years):

1. *Research results:*

- *Anticipated publications:*
 - Prospects for the discovery of an additional lighter Higgs boson at the LHC. Publication of a corresponding article in a peer-reviewed journal.
 - Later: Prospects for the discovery of additional heavier Higgs boson at the LHC. Publication of corresponding articles in peer-reviewed journals.
- *Anticipated conference, workshop attendance, courses, and/or seminar presentations:*
 - Attending all HiggsTools meetings, schools and meetings for Young Researchers (as the ones organized by the French Physical Society)
 - Attending major conferences on Higgs physics at the LHC.

2. *Research Skills and techniques:*

- *Training in specific new areas, or technical expertise etc.:*
 - Attending seminars and courses related to high energy physics (as, e.g. the ones organized by the Doctoral School).
 - Further training in mathematical and computational methods.
 - Further training in theoretical physics: Methods in Quantum Field Theory, Astroparticle Physics, Cosmology

3. *Research management:*

- *Fellowship or other funding applications planned (indicate name of award if known; include fellowships with entire funding periods, grants written/applied for/received, professional society presentation awards or travel awards, etc.)*
 - End of the second year: start applications for postdoc positions.
 - Possibly: application for EU Marie Skłodowska-Curie Fellowship in 2017.

4. *Communication skills:*

Present the research results in Young Researcher meetings and schools, seminars in Orsay and other laboratories, workshops on Higgs physics

5. *Other professional training (course work, teaching activity)*

- Possibly training in teaching and assessing undergraduate students.

6. *Anticipated networking opportunities*

- Communicate with the other ESRs within the network, build support structures that will help my research activity.

7. *Other activities (community, etc.) with professional relevance:*

- Training in how to communicate science effectively to young people so I can share my excitement of particle physics and inspire them to study science.

Date & Signature of ESR:

 M. H. Vazquez

Date Signature of Supervisor:

 M. Elling