

Annual Report

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| Funding Programme: | Helmholtz Young Investigators Groups |
| Project ID No.: | VH-NG-1103 |
| Project Title: | Search for dark matter and other new physics with the Higgs boson at the ATLAS experiment |
| Group Leader: | Dr. Sarah Heim |
| Helmholtz Centre: | DESY |
| Participating University: | Hamburg |
| Report Period (=Calendar Year): | 09/2016-12/2016 |

1) Group Structure

Please report briefly on the structure and personnel development of your group.

As of end of 2016, the group consisted of

group leader Sarah Heim, since September 2016
 postdoctoral fellow William Leight, since October 2016
 graduate student Fang-Ying Tsai, since November 2016
 graduate student Namgyun Jeong, since December 2016

Work on ATLAS analysis - differential Higgs cross-sections in the H->ZZ->4l channel: Sarah Heim, William Leight, Namgyun Jeong.

Work on ATLAS detector performance - improvements of the missing transverse momentum calculation: Sarah Heim, Fang-Ying Tsai

Work on ATLAS detector performance - muon software: William Leight

Work on ATLAS Upgrade (new inner strip tracker): Sarah Heim, William Leight, Namgyun Jeong.

2) Network

Please describe how you / your research group are integrated within the Helmholtz Centre and the partner university (e.g. as member of committees).

The YIG is well integrated in the DESY ATLAS group. It contributes to the preparation activities ongoing for the ATLAS silicon detector upgrade, and works closely together with other DESY ATLAS group members. One of the topics of Kerstin Tackmann's group (former YIG) is differential cross-sections in the $H \rightarrow \gamma\gamma$ channel. This fits very well to the differential cross-section measurement that the YIG performs in the $H \rightarrow ZZ \rightarrow 4l$ channel, and the groups discuss common issues. There are also interactions ongoing with the group working on supersymmetric searches, as those use missing transverse momentum calculations as well.

Furthermore the members of the YIG take part in meetings and discussions with the CMS and theory groups at DESY.

The University of Hamburg has granted the group leader the right to supervise and graduate PhD, master and bachelor students.

The YIG plays an active part in the ATLAS collaboration, through work and organizing roles in the Higgs, muon and missing transverse momentum performance groups.

3) Satisfaction

How satisfied are you with the general working conditions provided by the Helmholtz Centre / partner university? Is there anything that meets your criticism?

I am very satisfied with the conditions. The DESY ATLAS group provides a very supportive environment with people to talk to whenever I have questions or concerns. The interactions with the university in terms of registering my students have gone smoothly, and the students will benefit from the offered workshop and schools by the Hamburg PIER graduate school.

4) Scientific Progress / Milestones

How has your work plan progressed? Which important milestones could be achieved during the report period? Is the progress of your work in accordance with original planning or has the work plan been changed?

Both graduate student started/prepared for their qualification tasks at the ATLAS experiment, which are 0.5-1 year long service-type projects, with which the students qualify to become authors on ATLAS papers.

Fang-Ying Tsai's qualification task focuses on the improvement of the electron-hadronic jet overlap removal in the missing transverse momentum calculation at ATLAS. This is an important ingredient to the ll +MET search that is foreseen to be her PhD topic.

Namgyun Jeong prepared for his qualification task (which actually started in 2017), which will cover mechanical tests on some subcomponents of the new ATLAS inner tracker. These test are important, as they will validate simulations of these components.

Work is ongoing on the $H \rightarrow ZZ \rightarrow 4l$ differential cross-section measurement (William Leight, Sarah Heim, Namgyun Jeong). The group has developed and is providing background estimates for the upcoming publication. Checks on alternative unfolding techniques are ongoing. These are important cross-checks, and will probably become even more relevant for the publication in 2018/2019, which will be based on a much larger data set. MC generation is also ongoing for possible comparisons to the measured data. Sarah Heim is editor of the differential cross section paper which is foreseen to be published this spring.

Sarah Heim is contact person for questions regarding electrons in the ATLAS Higgs group. William Leight is ATLAS muon reconstruction software convener, and contributes to the preparation of new ATLAS reconstruction software releases, which include a number of improvements, like the inclusion of hits from additional detector elements near the feet of the ATLAS detector into the muon reconstruction.

Furthermore Sarah Heim and William Leight have started to learn about building and testing prototype modules of the new ATLAS strip detector.

So far, the work agrees well with the original plan, with a bit less involvement in electrons, but the addition of muon performance work, thanks to William Leight's expertise. This fits very well, as all planned analyses have both electrons and muons in the final state.

5) Financial Plan / Time Schedule

Can you comply with the financial plan and time schedule or do you see a need for adjustment?

Since the group only started in September, no large investments have been made yet, and no extended stays at Cern have happened, so the group has not spend as much money as foreseen. This is expected to change this year.

6) Status

Do you hold a joint Junior Professorship or a W2/W3 Professorship? Do you aim for such a position? What is the status of your negotiations in this respect?

I do not hold a (junior) professorship, as this is not offered to YIG leaders by the University of Hamburg. In the future I do consider a habilitation at the University of Hamburg, but not currently.

7) Teaching Activities of the Group Leader

No teaching so far. I aim to start teaching in the Fall semester of 2017.

8) Publications of the Group

Since the start of the YIG was only in September 2016, so far there was only one publication, which members of the YIG contributed to significantly. Most of the work on this paper was actually performed before the start of the YIG.

“Electron efficiency measurements with the ATLAS detector using 2012 LHC proton-proton collision data” (Eur. Phys. J. C (2017) 77)

Both Sarah Heim and William Leight are authors on publications by the ATLAS collaboration.

9) External Funding

No external funding was applied for.

10) Patent Applications

No. of pending/granted patents

No patent application was submitted.

11) Awards received by Group Members / Professorship Appointments offered to Group Leader

No awards/appointments were received.