KSETA Annual Report 2018

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In the year 2018, I continued with my PhD. at Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT). During the first half of the year, the aTGC analysis was completed and the results were finalised from our side. During the second half, the lengthy and cumbersome review process of the analysis by CMS started which is still in progress. For tracker alignment I expanded my responsibilities a lot and worked in several other areas related to the topic. All these contributions were presented at various conferences and meetings. For KSETA I have worked as website and accounts administrator for KSETA doctoral fellows. In addition, I've actively attended topical courses and seminars organized by KSETA.

Work in CMS Experiment

aTGC Analysis

At the start of my PhD. we set out to measure anomalous triple gauge couplings (aTGC) in the electroweak sector using data from the Compact Muon Solenoid (CMS) experiment at the Large Hadron Collider (LHC) at CERN with 13 TeV center of mass energy in Run II. The analysis dealt with the WW/WZ final states in the semileptonic decay channel, where the hadronically decaying vector boson is reconstructed in the boosted regime. The analysis has been completed in terms of work and is pre-approved after review from the Standard Model Physics (SMP) group of CMS Physics. Currently, the analysis is being reviewed by the Analysis Review Committee (ARC) and we are updating things and doing cross checks under the guidance of the ARC.

The relevant documentation, paper draft and analysis note (which is the detailed document discussing everything done in the analysis), can be found at:

http://cms.cern.ch/iCMS/analysisadmin/cadilines?line=SMP-18-008

Some results from the analysis are shown here. Figure 1 shows the extraction of 95% confidence level (C.L.) limits on one of the aTGC parameters. The procedure includes scanning for profile likelihood ratio (ΔNLL) as a function of the parameter of interest. 95% C.L. implies a value of ΔNLL (the horizontal dashed green line). The point where it intersects the ΔNLL distribution is projected onto the parameter axis and limits are set there. Table 1 and Table 2 show the obtained limits. Two dimensional limits are also obtained by varying two aTGC parameters at once while fixing the third. One such contour is shown in Figure 2.

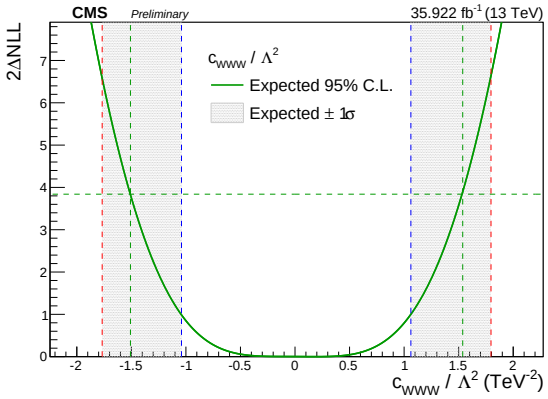

Figure 1: *Calculation of 1-D limit on one of the aTGC parameters in the EFT parametrisation.*

Table 1: *Limits on the aTGC-parameters in EFT parametrisation at 95% confidence level.*

Parameter	Expected limit [TeV^{-2}]
c_{WWW}/Λ^2	[-1.44, 1.47]
c_W/Λ^2	[-2.45, 2.08]
c_B/Λ^2	[-8.38, 8.06]

The limits obtained from the analysis are the most sensitive limits on these parameters ever measured from any direct measurement.

Table 2: *Limits on the aTGC-parameters in vertex parametrisation at 95% confidence level.*

Parameter	Expected limit
λ_Z	[-0.00595, 0.00606]
Δg_1^Z	[-0.00693, 0.00614]
$\Delta\kappa_Z$	[-0.00742, 0.00782]

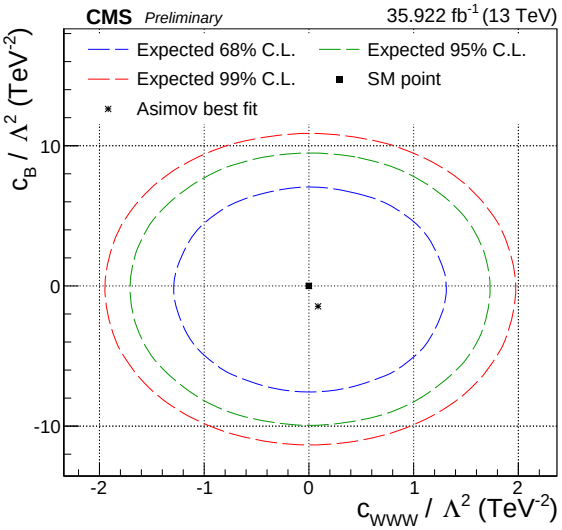

Figure 2: *2-D limits on two of the aTGC parameters where the third is fixed to zero.*

Tracker Alignment

I have extended my responsibilities with the tracker alignment group and worked in many more aspects of the area. I was one of the leading people contributing to routine alignments which include calculating corrections to the positions, rotations, geometry of the tracker detector modules using the MILLEPEDE-II algorithm. The so called geometry comparison validation for one such alignment campaigns is shown in Figure 3. Other than routine alignment and validation, I was incharge of the maintenance of the common validation area and development related to it.

Towards the second half of 2018, I was asked to become the AlCaDB contact (officially for 2019) but already taking over the work immediately. The responsibilities include performing uploads of the objects that the group derives to CMS conditions database, carrying out all communication with the AlCaDB group and maintaining record of all alignment objects in the conditions database and/or deployed for everyone to use in CMS.

KSETA Community Work

I have been working as KSETA website and fellow accounts administrator and handling the course evaluation and transcript generation system for the KSETA

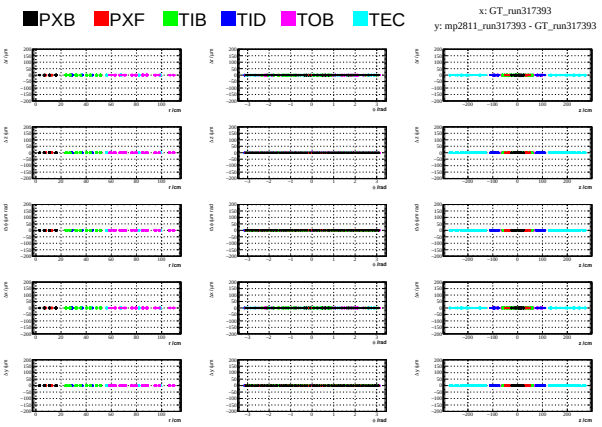

Figure 3: *Geometry comparison between pre- and post- alignment tracker module positions for one alignment campaign.*

doctoral fellows as well.

Conferences and Talks

1. "Search for Anomalous Diboson Production in the Semileptonic WW and WZ Decays Using the CMS Experiment"
   National Centre for Physics, Islamabad (Pakistan), January 11, 2018
2. "Search for Anomalous Triple Gauge Couplings in the Semileptonic WW and WZ Decays Using the CMS Experiment"
   DPG Meeting, W'urzburg (Germany), March 19-23, 2018
3. *First Electroweak Symmetry Breaking School, Maratea (Italy), April 15-21, 2018*
4. "Search for Anomalous Triple Gauge Couplings in the Semileptonic WW and WZ Decays (Full 2016 Data)"
   Pre-approval Talk SMP Meeting, CERN, Geneva (Switzerland), August 20, 2018
5. "Search for Anomalous Diboson Production in the Semileptonic WV Decays Using the CMS Experiment"
   GK Workshop, Bad Herrenalb (Germany), September 14, 2018
6. "Search for Anomalous Triple Gauge Couplings in the Semileptonic WV Decays Using the CMS Experiment"
   FSP CMS Workshop, Hamburg (Germany), September 20, 2018

KSETA Courses

1. General theoretical concepts on particle physics
2. From farmers almanac to exascale computing, the challenge of predicting the weather
3. What do I need, if I leave science towards industry