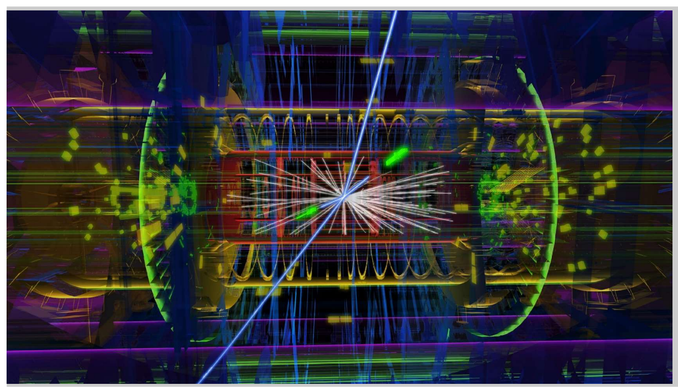


news

3/2015

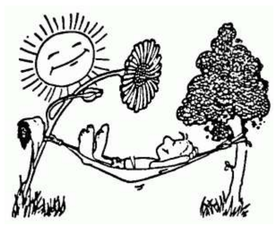
Mass and Symmetries after the Discovery of the Higgs Particle at the LHC

GRK 2044

UNI FREIBURG

DFG

Dear all,
here is the third newsletter, just during the summer break. Hopefully you have/had good and relaxing holidays.



DATES

Add to your calendar

All dates, news, and updates are given on the website of the GRK 2044: **www.grk2044.uni-freiburg.de**

Seminar series of the GRK

The planning of the seminar for the winter term has begun. Below you can find the foreseen dates. It will be scheduled every few weeks on **Wednesday afternoon 16 s.t.!**

Date	Speaker	Seminar Title
12.10.2015 to 14.10.2015	Stefan Dittmaier	Special Lectures on Electroweak Theory
28.10.2015		
11.11.2015	Christian Schwanenberger (DESY)	Top precision measurements at the LHC
2.12.2015		
16.12.2015	Student talks	
13.1.2016		
27.1.2016		
10.2.2016		
17.2.2016		
24.2.2016		

Special Lecture on Elektroweak Theory by **Stefan Dittmaier** before the start of the new semester!
More details will follow.

Annual fall workshop of the GRK at the Schwarzwald-Hotel Gengenbach from 28.-30. September 2015.

Please don't forget to register for the workshop before August 24th.
http://www.grk2044.uni-freiburg.de/dateien/anmeldungklausur2015/view

The agenda can be found here:
http://www.grk2044.uni-freiburg.de/qualifikatoin/fallworkshop2015

SERIES: Members of our GRK: Physics with Multiboson Processes

The production of two or more electroweak gauge bosons (photon, W or Z) involves self-interactions that are predicted by the Standard Model. Large cancellations between the direct production where the gauge bosons are scattered off quarks and the diagrams involving self-interactions are typical for these processes. The measurement of diboson production cross sections at the LHC constitutes a test of the electroweak sector of the Standard Model at the TeV scale. Since multiboson processes are not known at the same level of accuracy as e.g. direct or Higgs production, measuring these processes also tests the validity of QCD calculations. Both, measurements of multiboson cross sections and precise calculations of QCD and electroweak corrections are performed in Freiburg.

New physics effects potentially contribute to these processes. These effects can be parametrised by generalizing the couplings in the electroweak Lagrangian, and adding so-called anomalous couplings, in an effective theory. Many theories beyond the Standard Model predict modifications to diboson processes. Placing experimental limits on anomalous couplings is a model-independent way to constrain new physics models and complementary to direct searches. Anomalous gauge couplings are particularly useful if new physics lies at an energy range not directly accessible at the LHC, i.e. new particles cannot be produced on-shell and direct searches fail. Also if new physics only couples weakly, the indirect searches provide a deeper energy reach.

The most common processes involving gauge-boson self-interactions are the production of a single W or Z boson in association with a photon. Markus Hecht and Stefan Dittmaier are calculating NLO electroweak corrections to these processes. These are particularly important in the kinematic range that is sensitive to anomalous $WW\gamma$, $ZZ\gamma$ and $Z\gamma\gamma$ couplings which have been investigated by Markus as well. NLO EW corrections to $WW \rightarrow 4f$ have been calculated in double-pole approximation in 2013 [1].

Felix Bührer, Valerio Dao and Philip Sommer are working on measurements of W pair production cross sections and the extraction of model-independent limits on anomalous WWZ and $WW\gamma$ couplings. Felix and Valerio are looking at semi-leptonic final states, Philip is using the fully leptonic final state. Philipp Hoffmann, Fernando Febres Cordero and Harald Ita have been working on NLO QCD corrections to the same process in association with up to three hadronic jets.

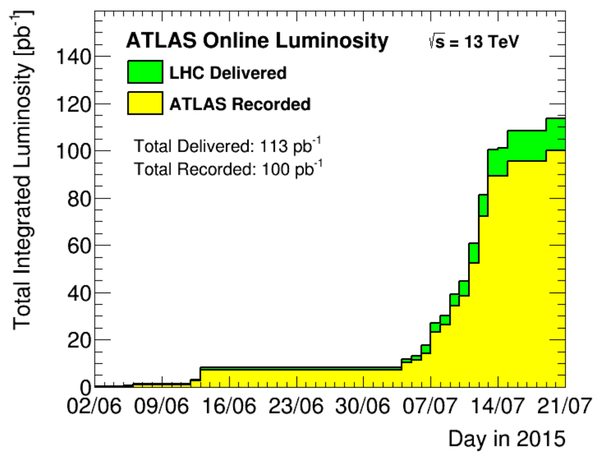
Andrea di Simone and Martina Pagacova work on the first measurement of triple W production. Gernot Knippen and Stefan Dittmaier are calculating NLO electroweak corrections to this process. Triple W production involves the unitarity violating quartic W coupling that is unitarized by the Higgs boson. The same coupling is targeted by Giulia and Valerio, who are preparing the measurement of WW scattering for the data to be recorded by the ATLAS experiment in 2015. A theoretical calculation at NLO precision (QCD, EW, and mixed QCD-EW) is being performed by Christopher Schwan. Both vector boson scattering and triple gauge-boson production processes help to determine the nature of electroweak symmetry breaking in the Standard Model, i.e. if the Higgs sector is as predicted by the Higgs mechanism or not. Improving the limits on anomalous quartic gauge couplings is also part of the programme in both analyses.

The multiboson team:

[1] arXiv:1311.5491

PHYSICS: Data taking at the ATLAS experiment

After first collisions, the LHC is up and running. About 100 pb^{-1} data was recorded by the ATLAS experiment with 50 ns bunch spacing. After a scheduled break for machine development, collisions are continuing with 25 ns bunch spaching.
The ATLAS detector is taking data with an efficiency of about 88%. The online luminosity of the 50 ns data taking can be seen in the figure.



https://twiki.cern.ch/twiki/bin/view/AtlasPublic/LuminosityPublicResultsRun2

At the EPS conference already new results with √s = 13 TeV have been shown:
https://indico.cern.ch/event/356420/overview

Watch out for more new results!

From the GRK PhD student speakers:

Dear PhD students,

We hope all of you have/had a good summer break!

Please contact us in case you have questions, comments or additional suggestions or meet us at the up-coming GRK lunch on **4.9.2015** – we hope to see most of you there!

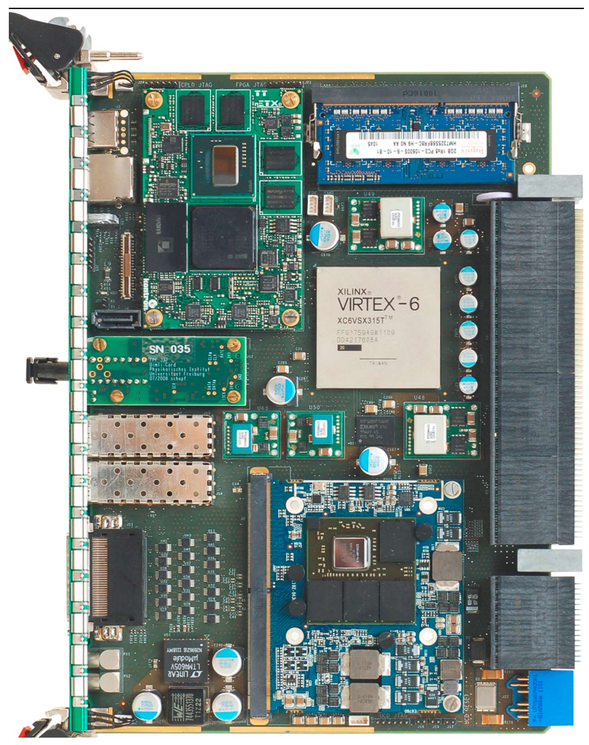
Cheers,
Hannah & Felix A.

SERIES: Members of our GRK: Developments for Digital Front-End and Trigger Electronics

Developing front-end and trigger electronics has been a long term pillar in the COMPASS Group of Freiburg. It started out in early 1997 when the COMPASS experiment was set-up with readout electronics developed here at Freiburg, and some of this is still in use. This proves the far sight in the design and the reliability of the electronics in those days.
Detector upgrades and new projects, however, require continuously state of the art electronics. Demands for higher integration and data throughput have to be matched, while financial constraints have to be considered. Here reconfigurable logic such as field programmable gate array devices (FPGA) provide versatile and flexible solutions. To this end a next generation general purpose module hosting solely FPGA chips instead of application specific custom integrated circuits has been developed to comply to the very different readout challenges by LHC, fixed target or dark matter experiments. This general purpose module is then complemented with different application specific standardized mezzanine cards for digital copper based I/O buffers, high speed optical transmitters or gigahertz sampling of analog signals, respectively. Today different firmware has been realized, e.g. a 128 channel high precision time-to-digital conversion with quantization error of 50 ps, a low resolution, but highly integrated, time-to-digital converter with up to 18000 channels per module for micro structured gas detectors for ionizing particles or a gigahertz pipelined sampling analog-to-digital conversion which allows for real time pulse feature extraction.

Close-up of the GANDALF module

The developments are accompanied by another general purpose module. Realized as a VXS switch board it features individual direct interconnections to 18 payload units in a single VME64x/VXS crate. The module is designed as a high-performance trigger processor that fits perfectly in the framework described above and extends its versatility. The synchronous link transfer protocol was optimized for low latencies and offers a bandwidth of up to 8 Gbit/s per link. The centerpiece of the board is a Xilinx Virtex-6 SX315T FPGA, offering vast programmable logic, embedded memory and DSP resources. The FPGA is supported by DDR3 memory, a COM Express CPU and a MXM GPU for additional high performance computing. Besides the VXS backplane ports, the board features two SFP+ transceivers, 32 LVDS inputs and the same number of outputs to interface with additional trigger modules and a Gigabit Ethernet port for configuration and monitoring. Recently developments of trigger algorithms, based on constraints of geometrical pattern, time correlation and energy deposit, have started. For such developments it is necessary to start out with a detailed analysis of the physics channel of interest. Cuts have to be optimized in the event reconstruction to maximize signal over background and finally the results must stand a comparison to previous measurements or models. Along this line improved selection criteria for the VHDL code of the FPGA or CUDA code for the GPU can successfully be implemented. Here our present focus lies on pattern optimization and verification for exclusive reactions.



TIGER – A programmable digital trigger and readout concentrator VXS-switch board

This effort is driven by: Horst Fischer, Matthias Gorzellik and Philipp Jörg

„Non-physics“ : Enjoy a hike or a lake or your bike

Some ideas to continue your holidays with a trip in the black forest

Hikes

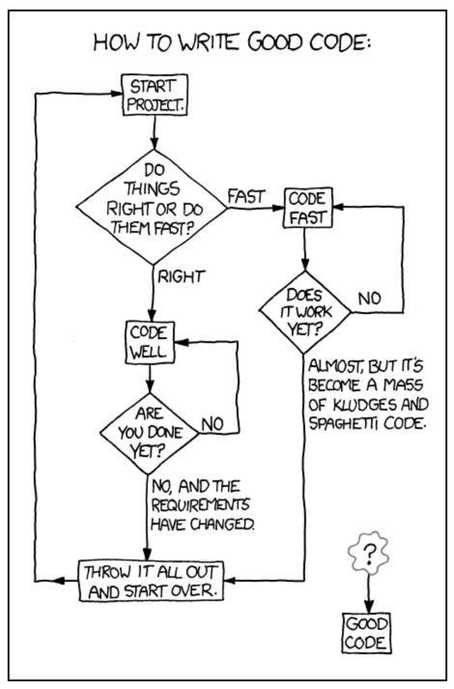
- Geissenpfad Menzenschwand
  http://www.hochschwarzwald.de/Heimatbotschafter/Geniesserpfad-Menzenschwander-Geissenpfad
- Wutachschlucht
  http://www.hochschwarzwald.de/Heimatbotschafter/Die-Wutachschlucht-erleben
- Zweribach Wasserfälle
  http://www.hochschwarzwald.de/Wandern/Durch-mystischen-Bannwald-zum-Zweribach-Wasserfall
- St. Märgen – St. Peter (+ cake at Café Krone)
  http://www.hochschwarzwald.de/Wandern/Panoramaweg-von-St.-Maergen-nach-St.-Peter

Lakes

- Mathisleweiher
- Schluchsee
- Windgfällweiher

Bike tours

- 2-Seentour
  http://www.hochschwarzwald.de/Radfahren-Mountainbike/Rad-fahren-im-Schwarzwald/2-Seen-Tour
- Südschwarzwald-Radweg
  http://www.hochschwarzwald.de/Media/Touren/Suedschwarzwald-Radweg
- Hinterwaldkopf
- Staufen via Wiiwegle and Hexental (+ cake at Café Decker)



http://xkcd.com/844/

Thank you for contributions to: Felix Bührer, Stefan Dittmaier, Horst Fischer, Matthias Gorzellik, Christina Skorek, Philip Sommer and Susanne Kühn (Editor)