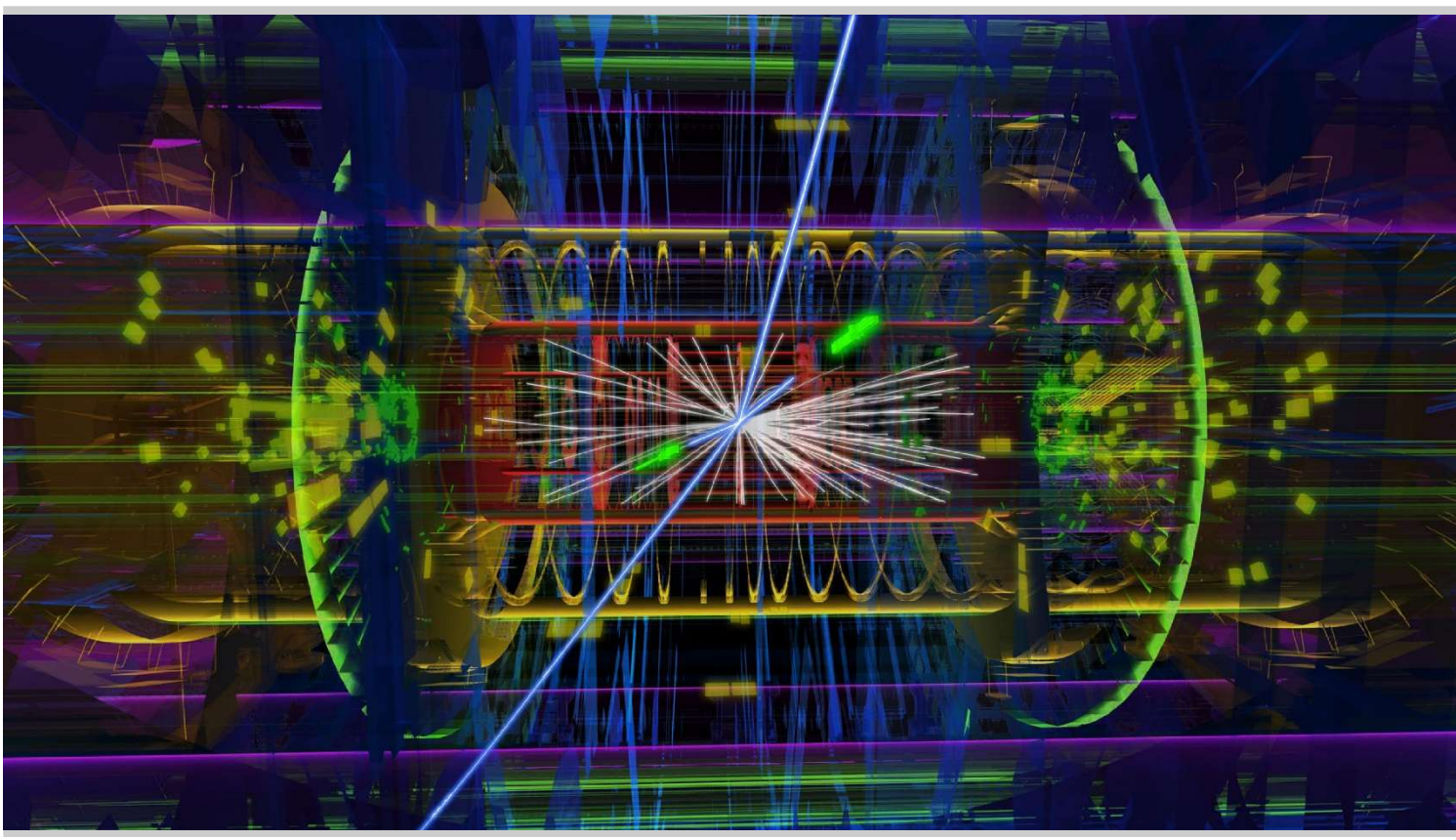




news

1/2015

Mass and Symmetries after the Discovery
GRK 2044
of the Higgs Particle at the LHC



Welcome,
Here is our first newsletter of the GRK 2044 „Mass and Symmetries after the Discovery of the Higgs Particle at the LHC“. The idea is to prepare one every two months and give information, dates and life to our GRK.
Feel free to send any input, ideas or suggestions to Susanne Kuehn.
For the editors Susanne.Kuehn@physik.uni-freiburg.de

DATES

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

Seminar series of the GRK

The seminar will take place every few weeks on Wednesday afternoon 15 c.t. There will be coffee and cake afterwards.
Preliminary schedule:

Date	Speaker	Title	Abstract/pdf-file	time and place
29.4.2015	Alberto Guffanti (NBI)	Understanding theoretical uncertainties for precision phenomenology at the LHC Run-II		HS I, 17 ct
06.05.2015	Roman Kogler (Uni Hamburg)	The global electroweak fit to precision data	abstract	HS I, 15 ct
20.05.2015	Anja Vest (TU Dresden)	Vector Boson Scattering and Anomalous Gauge Couplings	abstract	HS I, 15 ct
10.06.2015	t.b.a.	Student talks		HS I, 15 ct
24.06.2015	Werner Rodejohann (MPI Heidelberg)	Neutrinos mass and Lepton Mixing	abstract	HS I, 15 ct
08.07.2015	Margarete Mühlleitner (KIT)	t.b.a.		HS I, 15 ct
22.07.2015	Christian Steinwachs (Uni Freiburg)	Higgs inflation: a link between cosmology and particle physics	abstract	HS I, 15 ct

Inauguration meeting of the GRK with BBQ afterwards planned in June. More details on programme and organisation will be posted on the website soon.



Annual fall workshop of the GRK

This year's workshop will take place **28.-30. September 2015** at the **Schwarzwald-Hotel Gengenbach**.

Seminar series „Fundamentale

Wechselwirkungen“ every Tuesday 16 c.t. at Hochhaus 0815. The agenda is given on <http://www.tep.physik.uni-freiburg.de/seminars/fundi>

15.-17. April 2015 HiggsTools Event more on <http://higgstools2015.uni-freiburg.de/>

16. April 2015 Public Evening Talk by Rolf Heuer “60 Jahre Grundlagenforschung am CERN: Das Higgs-Teilchen und das frühe Universum“ at Audimax, 20 s.t.

17. April 2015 Speed-Dating Workshop for PhD students of the institute. Registration and more on www.phd.physik.uni-freiburg.de

15.-21. June 2015 Exhibition „Von Einstein zu Higgs: eine interaktive Ausstellung,“ at Bürgerhaus am Seepark. One week (daily 9:00-18:00) of physics for public. Please fill the doodle <http://doodle.com/xy2trt9senp9v8k6> for sharing of shifts!



Add to your calendar

PHYSICS: Outlook to data taking with the ATLAS experiment in 2015

The first data taking period at the Large Hadron Collider (LHC), *Run 1*, lasted until the end of the year 2012, with centre-of-mass energies of up to 8 TeV. The discovery of a Higgs boson in July 2012 after an almost 50 years lasting hunt – and subsequent determination of its properties with increasing precision – was certainly the highlight of Run 1. This data taking period was followed by the *Long Shutdown 1*, where the LHC accelerator has undergone a major upgrade, e.g. by repairing interconnects between dipole magnets to allow for the higher currents needed to increase the centre-of-mass energy of the colliding protons. The goal is to run at a centre-of-mass energy of 13 TeV, collecting integrated luminosities of about 10 fb^{-1} in 2015 and 100 fb^{-1} until the end of Run 2 in 2018, about four times that of Run 1. The experimental environment will be even more demanding than during Run 1, in 2015 up to 50 additional *pileup* interactions will occur in addition to hard scattering processes of interest at peak luminosities exceeding $10^{34} \text{ cm}^{-2}\text{s}^{-1}$. The first proton beams are expected to circulate in the machine very soon, starting the first physics run in early summer. The ATLAS detector also has undergone significant upgrades of the trigger system, electronics and detector components as well as the computing and data analysis models to be able to cope with the increased amount of data expected at Run 2. The installation of a new innermost pixel detector layer placed at a radius of 3.3 cm, the *Insertable B Layer* (IBL), is particularly important to improve the spatial resolution of charged particle tracks close to the interaction point, being crucial e.g. for the identification of b-quark jets. The physics goals of Run 2 are manifold. The higher centre-of-mass energy increases the cross-sections for Higgs boson production typically by a factor of 2-3 (depending on the process), together with the increased integrated luminosity resulting in a much larger number of Higgs bosons to be analysed allowing for more precise measurements crucial to determine the nature of the discovered Higgs boson. For heavy particles, as predicted by models beyond the Standard Model like e.g. Supersymmetry, the centre-of-mass energy of 13 TeV leads to a dramatically increased mass reach, potentially allowing for an early discovery of new physics beyond the Standard Model already in 2015. Exciting times are thus ahead of us and the groups in the GRK 2044 are well positioned and prepared to face the challenges of the forthcoming Run 2 data taking period.

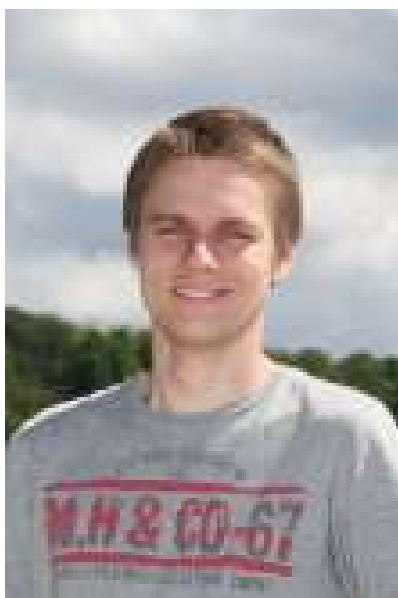
PHYSICS: Higgs Hunting with Tau Leptons

After the discovery of a Higgs Boson of a mass of approximately $m_H=125$ GeV in 2012, the focus of the ATLAS and CMS experiments has shifted towards a complete assessment of the particle properties, like its quantum numbers and coupling parameters. While the coupling between the Higgs boson and gauge-bosons is determined by the gauge-structure, the coupling to fermions is described by so-called Yukawa couplings. As a result of *Run 1* of the LHC, first evidence for the Higgs boson Yukawa coupling to tau leptons was reported by the ATLAS and CMS collaborations with significant contributions from the ATLAS groups in Freiburg [1]. This result is in good agreement with the Standard Model (SM) and determines the coupling strength to a precision of about 28%. Based on this result Elias Coniavitis, Alena Lösle, Dirk Sammel and Christian Schillo are studying the CP quantum numbers of the Higgs Boson using the specific kinematic properties in vector-boson-fusion and gluon-fusion events. The results will shed light on the question whether the observed particle is a pure CP even state or whether it maybe exhibits CP odd admixtures.

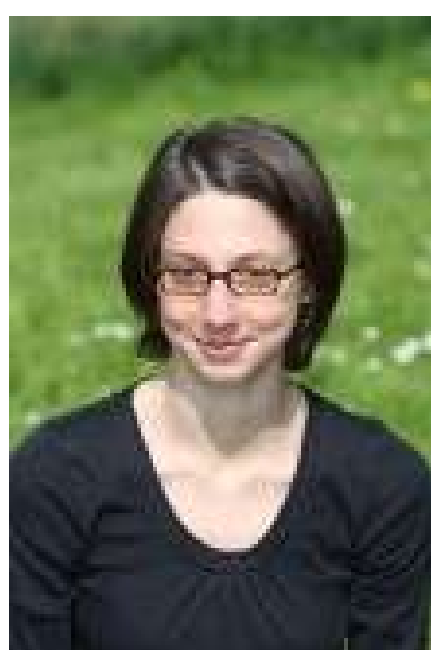
Several modifications of the SM predict the existence of additional Higgs bosons, of which some might be charged ($H^\pm$). In supersymmetric models the decay $H^\pm \rightarrow \tau^\pm \nu$ can be significantly enhanced. Anna Kopp searched for such decays resulting in an exclusion of a wide parameter region of such models [2].

With an increased centre-of-mass energy of $\sqrt{s} = 13$ TeV the data of the upcoming second run of LHC will allow for powerful new searches for departures from the SM predictions. Making use of the expertise gathered in *Run 1*, Lei Zhang and Nils Ruthmann are currently preparing to search for heavy resonances decaying into a pair of tau leptons with the early data expected in 2015. Lepton flavour violating Higgs decays like $H \rightarrow \tau^\pm \mu^\mp$ gained quite some interest lately as their presence would undoubtedly point to physics beyond the SM like composite Higgs models. Ulrich Baumann is studying such signatures and is - together with the whole tau leptons group - eagerly awaiting the new data.

[1] <http://arxiv.org/abs/1501.04943>
[2] JHEP03 (2015) 088



Contact:
Prof. K. Jakobs
Prof. M. Schumacher
Dr. E. Coniavitis
Dr. L. Zhang



„Non-Physics“: Information for additional qualification

Below you can find a few links to get additional qualifications or soft-skills

- IGA <http://www.frs.uni-freiburg.de/abteilungen/iga/kurse>
- SLI <https://www.sli.uni-freiburg.de/>
- Studium Generale <http://www.studiumgenerale.uni-freiburg.de/>
- VHS Freiburg <http://vhs-freiburg.de/>
- Sport Center of the university <http://www.hochschulsport.uni-freiburg.de/>
- Kite Mentoring <https://www.brainlinks-braintools.uni-freiburg.de/kite>
- MUT courses http://www.lakog.uni-stuttgart.de/menue_oben/veranstaltungen_termine/mut/index.html

From the GRK PhD student speakers:

Dear PhD students,

First of all, we would like to thank Markus Hecht on behalf of all PhD students for his long-standing effort as students' speaker of the past GRK: for every job associated with that like representing our interests and organizing the GRK workshop, but equally important for bringing us PhD students from different groups together both at the GRK Lunch and for common leisure activities!

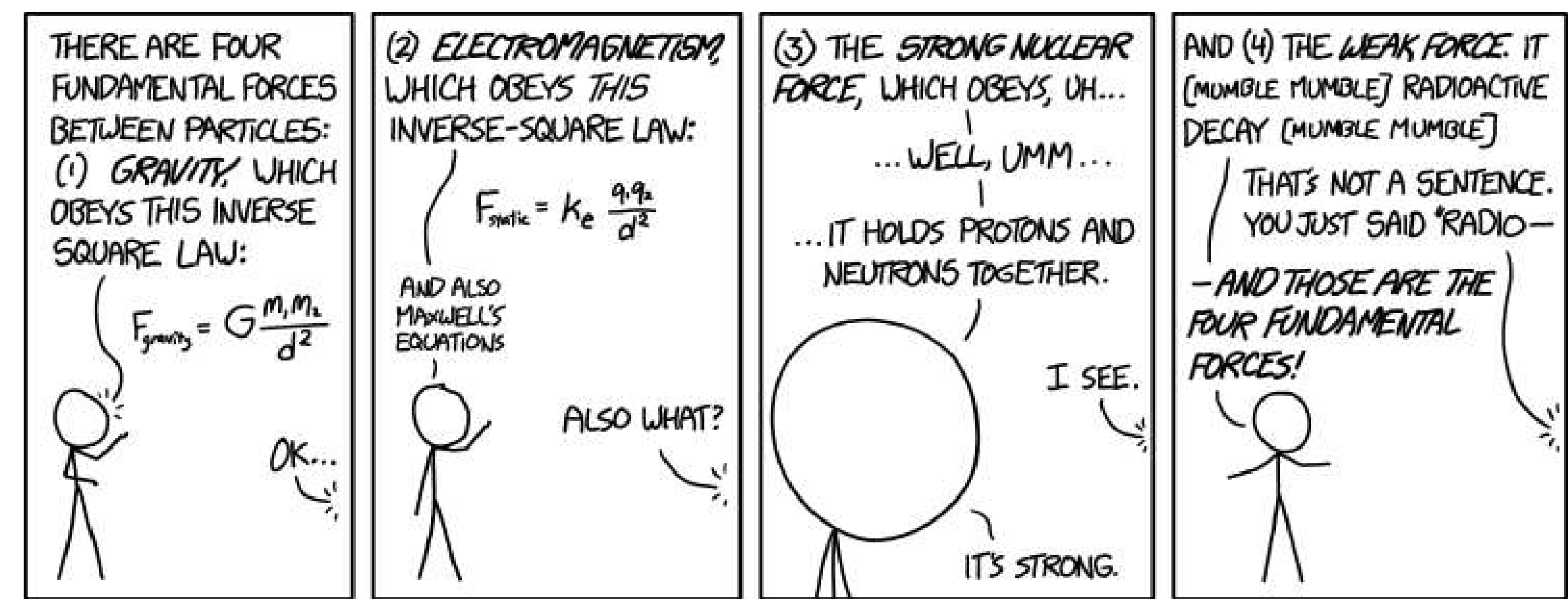
Second, we thought of few changes, most of them were already discussed at our last GRK lunch:

- 1) We will have the GRK lunch from now on once per month in the mensa as a social get-together and coffee meetings for discussing more formal topics in the highrise potentially subsequent to the lunch. We will send a separate email to find a date and time suitable for as many as possible. We think that the GRK lunch is an ideal possibility to meet and stay in touch with particle physics students from different groups, both from theory and experiment.
- 2) There has been feedback on the last GRK suggesting to organize the GRK seminar in a more student-friendly way. In order to do so we agreed with the organizers to introduce a "closed session" at the end of the seminar: The professors get a head start on the way to the cake buffet, while we have up to 10 min time to pepper the speaker with questions that we might not dare to ask in the presence of our supervisors. Besides that, the idea of having a short introduction to the general topic of the GRK seminar was brought up - students/postdocs most familiar with the topic of the seminar volunteer to give a short, unofficial and rather basic introduction. Since the feedback to these ideas at the last GRK lunch was positive, we will give this a try at the upcoming seminars and see whether or not these ideas can be successfully implemented.
- 3) The organizers of the GRK workshop asked us to decide between two potential topics for a lecture at the workshop. The topic "Analogue Electronics" was favoured over "Tracking Detectors" by the attendees. Please note that the GRK workshop will take place from 28.-30.9.2015 at Schwarzwald-Hotel, Gengenbach.

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

Cheers,

Felix A. and Hannah



<http://xkcd.com/1489/>

Thank you for contributions to: Felix Anger, Hannah Arnold, Nils Ruthmann, Christina Skorek, Philip Sommer, Christian Weiser
For any input, ideas or your favourite comic contact Susanne Kuehn.