

# Curriculum Vitae:

## Personal Data:

Name: Priv. Doz. Dr. Roger Wolf  
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## Scientific Experience after Ph.D.:

**Postdoc (group leader) at the Institut für Experimentelle Teilchenphysik (IETP) of the Karlsruhe Inst. für Technologie (KIT) (2013 – ongoing):**

### Scientific & technical achievement record:

- *Measurement of the  $Z \rightarrow \tau\tau$  cross section in  $pp$  collisions at 13 TeV and validation of  $\tau$  lepton analysis techniques, ([EPJC 78 \(2018\) 708](#)).*
- *Observation of the Higgs boson decay to a pair of  $\tau$  leptons, ([Phys. Lett. B 779 \(2018\) 283](#)).*
- *Handbook of LHC Higgs Cross Sections: 4. Deciphering the Nature of the Higgs Sector, ([arXiv:1610.07922](#)).*
- *[The Higgs Boson Discovery at the Large Hadron Collider](#), published as part of Springer Tracts in Modern Physics, 187p, Mai 2015, in the context of the German teaching license (Habilitation).*
- *Search for additional neutral Higgs bosons in the decay channel into  $\tau$  leptons, with the CMS experiment, ([JHEP 9 \(2018\) 7](#), [JHEP 10 \(2014\) 160](#)).*
- *Summary of BSM Higgs boson searches of the CMS experiment during the LHC Run-1 data taking period, ([CMS-PAS-HIG-16-007](#)).*
- *An embedding technique to determine genuine  $\tau\tau$  backgrounds from CMS data, ([CMS-PAS-TAU-18-001](#))*
- *Reconstruction and identification of  $\tau$  lepton decays to hadrons and  $\tau$  neutrino at CMS, ([JINST 11 \(2016\) P01019](#)).*
- *Identifying the relevant dependencies of the neural network response on characteristics of the input space, ([Comp. Softw. Big Sci. 2 \(2018\) 5](#)).*

- Continuous development of strategies for the simplified representation of the data for searches for BSM Higgs bosons in the context of various new physics models.
- Continuous development of tools for statistical inference in searches for additional BSM Higgs bosons.
- Continuous development of the implementation and understanding of the  $\tau$ -embedding method at CMS used for all kinds of analyses where  $\tau$  leptons are involved.
- Continuous exploration of multivariate analysis methods for classification and regression tasks in the context of high energy physics experiments.

### **Boards, charges, coordination:**

- Member of the steering committee of the LHCHXS Working Group (2018 – ongoing).
- Software coordinator of the *Tau Physics Object Group (POG)* (2015 – 2018).
- Co-Convener of the LHCHXS Working Group 3 for BSM Higgs physics (2015 – 2018).
- Convener of the CMS working group: *Higgs To Tau* (2014 – 2015).
- CMS Contact of the LHCHXS Working Group 3 sub-group for the MSSM (2014 – 2015).
- Principle investigator (PI) of the *Karlsruhe School of Elementary Particle and Astroparticle Physics: Science and Technology (KSETA)*.
- Associated scientist of the *KIT-Centrum Elementarteilchen- und Astrophysik (KCETA) Graduiertenkolleg (GRK 1694): Elementarteilchenphysik bei höchster Energie und höchster Präzision*.
- Funded by the *KCETA Graduiertenkolleg* with more than 15'000 Euro for the installation of local computing resources for Higgs physics at IETP, for the analysis of the LHC data from 2015 on.
- Fellow of the *Elite-Postdoktoranden* program of the *Baden-Württemberg* foundation (BW), funded with 100'000 Euro for two years (2014 – 2016).
- Leader of the working group for Higgs boson physics at the IETP with the following scientific targets: (i) most precise measurement of the coupling of the SM Higgs boson to fermions, esp.  $\tau$  leptons with the CMS data; (ii) measurement of the CP properties of the coupling of the Higgs boson to  $\tau$  leptons; (iii) search for additional neutral and charged Higgs bosons in non-trivial extensions of the SM.
- Organiser of the workshop: *CMS Experiment & Theory: Search for Higgs Bosons Beyond the SM* at KIT, funded by the HGF Terascale Alliance with 2'000 Euros (30 participants, among those leading theoretical physicists in SM and beyond SM Higgs physics, March 2014).

### **Student supervision:**

- Supervisor of 9 Ph.D. theses and 17 master theses with topics related to Higgs boson physics, CMS event reconstruction, statistical data analysis, and theory:
  - *General exploration of experimental methods in  $di$ - $\tau$  related Higgs boson analyses with the LHC Run-2 dataset of CMS*, (working title, **Ph.D.** KIT, Janek Bechtel, ongoing).
  - *Exploring multivariate analysis techniques in HEP environments*, (working title, CERN Gentner fellow associated to my group, **Ph.D.** KIT, Stefan Wunsch, ongoing).
  - *Best possible determination of the couplings of the observed Higgs boson at 125 GeV to fermions on the complete LHC Run-2 dataset of CMS*, (working title, **Ph.D.** KIT, Sebastian Wozniowski, ongoing).

- *Search for new Higgs bosons in the di- $\tau$  final state on the full LHC run-2 dataset of CMS*, (working title, **Ph.D.** KIT, Artur Gottmann (Akhmetshin), ongoing).
- [\*Confining the Higgs sector via investigations of di- \$\tau\$  final states with LHC Run-2 data of 2016\*](#), (**Ph.D.** KIT, Rene Caspart, 2017).
- [\*Establishing the Standard Model Higgs Boson in the Decay Channel  \$H \rightarrow \tau\tau\$  with LHC Run-2 data\*](#), (**Ph.D.** KIT, Raphael Friese, 2017).
- [\*Packaging and assembly technologies for the pixel detector upgrade and measurement of  \$\tau\$  final states with the CMS experiment at the LHC\*](#), (**Ph.D.** KIT, Fabio Colombo, 2016).
- [\*Analysis of Standard Model Higgs boson decays to  \$\tau\$ -pairs with the CMS detector at the LHC\*](#), (**Ph.D.** KIT, Thomas Müller, 2015).
- [\*Search for Higgs bosons beyond the Standard Model in proton-proton collisions with the CMS detector at the LHC\*](#), (**Ph.D.** KIT, Felix Frensch, 2015).
- *Preparation of the  $\tau$ -embedding method for the LHC Run-2 legacy measurements*, (working title, **Master**, KIT Oliver Kuntze).
- *Development of the trigger setup for legacy analyses in the  $\tau$  final state with CMS*, (working title, **Master**, KIT, Maximilian Burkart).
- *Further development and full integration of the  $\tau$ -embedding technique in the CMS software and computing model*, (working title, **Master**, KIT, Sebastian Brommer).
- *Study of multivariate regression techniques on the example of MET, measured with CMS*, (working title, **Master**, KIT, Tania Kopf).
- [\*Extension of searches for additional MSSM Higgs bosons with the CMS experiment towards the NMSSM\*](#), (**Master**, KIT, Irina Fateeva).
- [\*Implementation of the electron identification in  \$\mu \rightarrow \tau\$  embedded hybrid events\*](#), (**Master**, KIT Per Ahrens).
- [\*Determination of the transverse momentum distribution for the production of THDM and MSSM Higgs bosons via gluon fusion at next-to-leading order using POWHEG\*](#), (**Master**, KIT, Josry Metwaly).
- [\*Cross-check of the CMS search for additional MSSM Higgs bosons in the di- \$\tau\$  final state using  \$\mu \rightarrow \tau\$  embedded events\*](#), (**Master**, KIT Janek Bechtel, 2017).
- [\*A novel strategy for the standard model  \$H \rightarrow \tau\tau\$  analysis with emphasise on minimizing systematic uncertainties in presence of modern multivariate methods\*](#), (**Master**, KIT Stefan Wunsch, 2017).
- [\*Multivariate Analysemethoden zur Vorhersage der fehlenden transversalen Energie am CMS Experiment\*](#), (**Master**, KIT Nicola Zaeh, 2017).
- [\*Entwicklung multivariater Analysemethoden zur Steigerung der Sensitivität auf supersymmetrische Higgs Bosonen im  \$H \rightarrow \tau\tau\$  Zerfallskanal\*](#), (**Master**, KIT Sebastian Wozniewski, 2017).
- [\*Validierung einer neuen Methode zur Bestimmung von Untergrund aufgrund von  \$Jet \rightarrow \tau\$  Fehlidentifizierung in  \$\tau\$  analysen\*](#), (**Master**, KIT, Gregor Köhler, 2017).
- [\*Embedding – a data driven method to estimate the  \$Z \rightarrow \tau\tau\$  background in the  \$H \rightarrow \tau\tau\$  searches\*](#), (**Master**, KIT, Artur Gottmann (Akhmetshin), 2016).
- [\*Improved statistical methods for searches for supersymmetric Higgs bosons decaying into pairs of  \$\tau\$ -leptons\*](#), (**Master**, KIT, Dennis Roy, 2016).
- [\*Application of multivariate analysis techniques to an analysis of Higgs boson decays to  \$\tau\$ -leptons\*](#), (**Master**, KIT, Marcus Schmitt, 2016).
- [\*Estimation of the background from  \$Z \rightarrow \tau\tau\$  in  \$H \rightarrow \tau\tau\$  analyses\*](#), (**Master**, KIT, Benjamin Treiber, 2015).

- [Bestimmung der Kopplung des Higgs Bosons an das  \$\tau\$ -Lepton durch statistische Kombination verschiedener Produktions- und Zerfallskanäle mit Daten des CMS Experiments am LHC](#), (Master, KIT, Rene Caspart, 2014).

### Lectures & student education:

- [Introductory course: Statistik für Wirtschaftswissenschaftler](#), (2018, DHBW first year students, 6 days a 3 hours, login: DHBW, passwd: statistics).
- [Software course: An introduction to C++](#), (2018, for Ph.D. students, 4 days a 6 hours with exercises, login: cppintro, passwd: C++2018).
- [Software course: An introduction to python](#), (2018, for Ph.D. students, 4 days a 6 hours with exercises, login: pythonintto, passwd: Python2018).
- Organizer and supervisor of student exercises for the course: [Moderne Experimentalphysik III \(Hadronen und Teilchen, Physik VI\)](#), (~150 participants) (2018, evaluation grade **2.0** – 1: very good 5: bad), held with Prof. Dr. T. Müller.
- Co-Lecturer of the course [Physik für Informatiker II](#) (2017, evaluation grade **2.0** – 1: very good 5: bad), held with Priv. Doz. Dr. M. Mozer.
- Co-Lecturer of the KSETA topical course: [Introduction to particle physics](#), (2017, evaluation grade **1.8** – 1: very good 5: bad), held with Priv. Doz. Dr. M. Mozer.
- Lecturer of the course: [Moderne Experimentalphysik III \(Kerne und Teilchen, Physik VI\)](#), (~150 participants) (2017, evaluation grade **1.66** – 1: very good 5: bad, **lecture price**).
- Lecturer of the Helmholtz Gemeinschaft (HGF) school [Terascale statistics school](#) (2017).
- Organizer and supervisor of student exercises for the course: [Klassische Experimentalphysik I: Mechanik](#) (~250 participants) (2016, evaluation grade **2.0** – 1: very good 5: bad).
- German Habilitation, Lecture: [LHC run-2: Von den Ufern bekannter zu unbekannter Physik](#), (Antrittsvorlesung 2016)
- Lecturer of the course: [Experimentelle Teilchenphysik II: Higgsphysik](#) (2016, evaluation grade **1.1** – 1: very good 5: bad, second best lecture of advanced physics, faculty wide).
- Co-Lecturer of the KSETA topical course: [Introduction to particle physics](#), (2016, evaluation grade **1.8** – 1: very good 5: bad), held with Dr. Matthias Mozer.
- Co-Lecturer of the course: [Rechnernutzung in der Physik](#) (2015/2016, evaluation grade **2.3** – 1: very good 5: bad), held with Prof. Dr. M. Steinhäuser and Dr. M. Giffels.
- Lecturer of the Helmholtz Gemeinschaft (HGF) school [Introduction to the Terascale](#) (2015).
- Lecturer of the course: [Experimentelle Teilchenphysik II: Higgsphysik](#) (2015, evaluation grade **1.3** – 1: very good 5: bad).
- Co-Lecturer of the Hauptseminar: [BSM Higgs physics](#) (2015), held with Prof. Dr. M. Mühlleitner (not evaluated).
- Lecturer of the course: [Experimentelle Teilchenphysik II: Higgsphysik](#) (2014, evaluation grade **1.3** – 1: very good 5: bad).
- Coordination of student exercises for the course: [Datenverarbeitung](#) (2013/2014), held by Prof. Dr. G. Quast.
- Co-Lecturer of the course: [Experimentelle Teilchenphysik II: Higgsphysik](#) (2013), held with Prof. Dr. G. Quast.

**Fellow of the Deutsche Forschungsgemeinschaft (DFG) affiliated to the Massachusetts Inst. of Technology (MIT), located at CERN (2011 – 2012):**

**Scientific & technical achievement record:**

- Search for additional neutral Higgs bosons in the decay channel into  $\tau$  leptons with the CMS experiment, ([PLB 713 \(2012\) 68](#)).
- Evidence for the SM Higgs boson decaying to a pair of  $\tau$  leptons with the CMS experiment, ([JHEP 05 \(2014\) 104](#)).
- Search and discovery of the SM Higgs boson in the combination of the main decay channels analysed within the CMS collaboration, ([JHEP 06 \(2013\) 081](#)).
- Search for the SM Higgs boson in extensions of the SM with four fermion generations, ([PLB 725 \(2013\) 36](#)).
- Projections of the uncertainties of the existing estimates of the coupling strength of the SM Higgs boson to fermions and vector bosons to the expected amount of data one, two and three years after the restart of the LHC in 2015, used as basis for further analysis strategies of CMS (published for [ESG meetings](#) and [snowmass reports](#)).
- Projections of the sensitivity of the main analyses for Higgs boson searches with CMS to the expected amount of data at the end of the LHC Run-1 data taking period 2011 – 2012, used as basis for further analysis strategies of CMS.

**Boards, charges, coordination:**

- Convener of the CMS working group: “*CMS Offline Analysis Tools*“ (2011 – 2012).
- Contributions to the development of the CMS analysis software, CMSSW (main developer of *Physics Analysis Toolkit* PAT, the main s/w used by CMS analysts for data analysis).
- Organiser and main responsible person of 13 one-week lasting tutorials in the use of the CMS analysis software, CMSSW, with 50% hands-on computer sessions, for more than 500 students and senior scientists, taking place at CERN and FNAL, Chicago. In this context exploration of web and computer based learning techniques (e.g. presented and published at the CHEP conference 2011).
- Main developer of a software package for the statistical interpretation of the results of the search for the SM Higgs boson and for additional neutral Higgs bosons in SUSY models in the decay channel into  $\tau$  leptons.

**Student supervision:**

- Supervisor of 2 Ph.D. theses with topics related to Higgs boson physics:
  - „*Search for neutral Higgs bosons in the SM and in SUSY in the decay channel into  $\tau$  leptons with an electron and a muon in the final state*“, (**Ph.D.** MIT, Valentina Dutta, 2014).
  - „*Search for the SM Higgs boson in the decay channel into  $\tau$  leptons in subsequent decays of the  $\tau$  leptons with a single electron or muon in the final state*“, (**Ph.D.** MIT, Matthew Chan, 2013).

**Postdoc at the Institut für Experimentalphysik, Universität Hamburg, located at Hamburg and CERN (2007 – 2010):**

**Scientific & technical achievement record:**

- *First measurement of the cross section for top-quark pair production in proton-proton collisions at  $\sqrt{s}=7$  TeV, ([PLB 695 \(2011\) 424-443](#)).*
- *First measurement of the inclusive cross section for the production of top anti-top quark pairs in the semi-leptonic decay channel with the CMS experiment, ([EPJ C71 \(2011\) 1721](#)).*
- *First measurement of the inclusive cross section for the production of top anti-top quark pairs in the full hadronic decay channel with the CMS experiment, ([JHEP 05 \(2013\) 065](#)).*
- *First measurement of differential cross sections for the production of top anti-top quark pairs with the CMS experiment, ([EPJ C73 \(2013\) 2339](#)).*
- Calibration of the CMS Hadron calorimeter exploiting a global fit *ansatz*, followed up by the University of Hamburg till today.

**Boards, charges, coordination:**

- Co-Convener of the Top Commissioning Working Group IV: “*Monte Carlo and data quality monitoring in the kinematic regime of top-quark pair production*“ (2010 – 2011, in use till 2012).
- Coordinator of the CMS Analysis software package *physics analysis toolkit (PAT)* for facilitated analysis of the CMS data (2009 – 2011, effort lead by Roberto Tenchini).
- Leader and coordinator of the working group for physics with top quark pairs of the University of Hamburg and DESY with more than 15 under graduate students, Ph.D. students and postdocs.

**Student supervision:**

- Supervisor of 3 Ph.D. theses and 7 German Diploma theses at the University of Hamburg (and DESY) with topics related to top quark physics:
  - *Differential top-quark pair cross sections in pp collisions at 7TeV with CMS and charge multiplication in highly irradiated silicon sensors, (Ph.D. Univ. Hamburg, Jörn Lange, 2012).*
  - *Top-quarks as a tool for calorimeter calibration at the CMS experiment, (Ph.D. Univ. Hamburg, Sebastian Naumann-Emme, 2011).*
  - *First measurements with top-quarks with the CMS experiment, (Ph.D. Univ. Hamburg, Holger Enderle, 2011).*
  - *Top-quarks as tools for efficiency measurements from data, (Diplom, Univ. Hamburg, Shahram Aryan, 2010).*
  - *Differential measurements with events with top-quark signatures with first data, (Diplom Univ. Hamburg, Martin Görner, 2010).*
  - *First measurement of top-quarks in the hadronic decay channel, (Diplom, Univ. Hamburg, Eike Schlieckau, 2010).*
  - *BSM signatures in standard top-quark selections, (Diplom, Univ. Hamburg, Niklas Pietsch, 2009).*
  - *Estimation of QCD-multijet background for top-quark events from data, (Diplom, Univ. Hamburg, Lukasz Kretcko, 2008).*
  - *Measurement of top-quarks in the semi-leptonic decay channel with electrons in the final state, (Diplom, Univ. Hamburg/DESY, Markus Marienfeld, 2008).*

- *Rediscovery of top-quarks in first data in the semi-leptonic decay channel with a muon in the final state*, (**Diplom**, Univ. Hamburg, Julia Dräger, 2007).

### Lectures & student education:

- Tutor of the Helmholtz Gemeinschaft (HGF) school [Terascale Statistics School](#) (2010).
- Tutor of the DESY *summer student program* (student Juri Smirnov, 2009).
- Tutor of exercises for the course: *Einführung in die Experimentelle Teilchenphysik* (2009, held by Prof. Dr. J. Haller).
- Lecturer of the Helmholtz Gemeinschaft (HGF) school [Detector Understanding with First LHC Data](#) (2009).
- Supervisor of the advanced student laboratory: *Luftschauer*, (2008 – 2010, together with Prof. Dr. D. Horns).

### Education:

- 2005:** Participant of the *CTEQ summer school*, Puebla.
- 2003 – 2006:** Ph.D. student at the Ruprecht-Karls-Universität, Heidelberg, in the subject of physics (Ph.D., grade: '**sehr gut**', '**magna cum laude**', July 2006): „*Measurement of diffractive open-charm production in deep-inelastic ep scattering and photoproduction at HERA*“ (supervisor: Prof. Dr. Franz Eisele).
- 2002 – 2003:** Diploma student of the Ruprecht-Karls-Universität, Heidelberg, in the subject of physics (grade: '**sehr gut**', February 2003): „*Studies on the estimation of the centrality of proton-nucleus collisions with the HERA-B Detector*“ (supervisor: Prof. Dr. Franz Eisele).
- 2003:** Participant of the *German School of High Energy Physics*, Maria-Laach.
- 2000 – 2001:** Participant of the ERASMUS student exchange program to Eindhoven, NL (grade: '**sehr gut**', March 2001): „*Review of the general theory of Cherenkov radiation and transition radiation*“ (FVT-TIB 2001-03).
- 2000:** Participant of the DESY *summer student program*, Hamburg.
- 1997 – 2003:** Studies at the Ruprecht-Karls-Universität, Heidelberg, in the subject of physics (Diploma).
- 1996 – 1997:** Military services, Regensburg.
- 1987 – 1996:** Abitur at the Hanns-Seidel Gymnasium, Hösbach (grade: **1.8**, June 1996).
- 1983 – 1987:** Elementary school, Mainaschaff.