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Centro de Fisica Teorica de Particulas
Instituto Superior Tecnico
Av. Rovisco Pais, P-1049-001 Lisboa
Portugal

February 10, 2013

Application for Postdoctoral Position

Dear Prof. Dr. Branco,

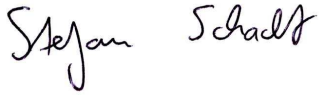
hereby I would like to apply for the postdoctoral position advertised on Inspire.

I am currently a PhD student at TU Dortmund University, Germany, under the supervision of Prof. Dr. Gudrun Hiller. I expect to obtain my doctoral degree in spring 2013. The fields of research I am currently working on include Flavor Physics, CP violation and Physics beyond the Standard Model. I investigate implications of b-Physics on squark flavor in Supersymmetry as well as CP violation in non-leptonic Charm decays using the approximate SU(3) flavor symmetry of QCD.

The LHC being up and running, I am highly interested in new projects exploring the phenomenology of particle physics. It would be a great pleasure if I could join your group.

Please find enclosed detailed and additional information including my curriculum vitae, a list of publications and a brief statement of my research interests. The letters of recommendation will be provided by my referees Gudrun Hiller, Heinrich Päs and Emmanuel Paschos.

Yours sincerely,



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Personal Details

Name	Stefan Schacht
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Office address	Theoretische Physik IV Otto-Hahn-Straße 4 D-44227 Dortmund, Germany
Phone	(+49) 231 755 3498 (office)
Mail	stefan.schacht@tu-dortmund.de
Date of Birth	7 November 1983
Place of Birth	Recklinghausen, Germany
Citizenship	German
Marital Status	Unmarried

Research Interests in brief

Theoretical Particle Physics, Flavor Physics, CP Violation,
Physics beyond the Standard Model

Education

Jan 09-spring 13	PhD student in Theoretical Elementary Particle Physics at Dortmund University of Technology (TU Dortmund) Thesis on *Flavor Physics and the Terascale* (preliminary title) expected to graduate in spring 2013 Advisor: Prof. Dr. Gudrun Hiller
Oct 03-Dec 08	German University Physics Diploma (equivalent to MSc) "mit Auszeichnung" (with distinction) at TU Dortmund Thesis on *Heavy Quark Polarization from Gluon Fusion in Hadronic Collisions* Advisor: Prof. Dr. Gudrun Hiller
Aug 94-Jun 03	German Abitur (equivalent to A-level) with final grade 1.0 (best grade) Special subjects: Mathematics, German, Physics, Philosophy School: Willy-Brandt-Gymnasium Oer-Erkenschwick Exchanges with England and France

Scholarships

Feb-Mar 12	Support from the **Wilhelm and Else Heraeus Foundation** for the DPG Spring Meeting in Göttingen 27 Feb-2 Mar 12. Talk on *Squark Flavor Constraints from* $\bar{B} \to \bar{K}^{(*)} l^+ l^-$

Jan 11-Dec 12	Doctoral scholarship from the **German-Israeli Foundation for Scientific Research and Development** (GIF)
Mar 10	Support from the **Wilhelm and Else Heraeus Foundation** for the DPG Spring meeting in Bonn 15 Mar -19 Mar 10. Talk on *Flavor and the Spurion Algebra*
Apr 09-Dec 10	Doctoral scholarship from the **Faculty of Physics** at TU Dortmund
Jun-Jul 08	**Fellow** of the **Wilhelm and Else Heraeus Foundation** for the **58th Meeting of Nobel Laureates at Lindau** 29 Jun-4 Jul 08 (dedicated to Physics)
Nov 03-Dec 08	Scholarship from the **Studienstiftung des deutschen Volkes** (German National Academic Foundation)

Employment

Feb 09-Dec 10	Research Assistant at TU Dortmund
Apr-Oct 05, Apr 07-Dec 08	Student Assistant at TU Dortmund

Further Experiences

Jun-Jul 12	Member of the local organizing committee of the FLASY12, Workshop on Flavor Symmetries, Dortmund, 2012, and co-editor of the conference proceedings
Aug 10	Visiting CERN 9-14 Aug 10

Teaching Experience, given Tutorials

2007-2012	1× Physics for Engineers 2× Higher Quantum Mechanics 4× Theoretical Particle Physics 2× Quantum Field Theory
2005	Support for students of physics in introductory study period

Talks

Sep 12	**DESY Theory Workshop** "Lessons from the first phase of the LHC" in Hamburg 25-28 Sep 12. Talk on *New Physics Patterns in non-leptonic Charm Decays*
Aug 12	**Helmholtz Alliance Statistics Workshop and School**: "Prejudice meets reality: setting limits at the LHC and global fits of LHC data and other measurements" in Bonn 20-23 Aug 12. Talk on *Squark Flavor Implications from* $\bar{B} \to \bar{K}^{(*)} l^+ l^-$
Jun-Jul 12	**FLASY12**, Workshop on Flavor Symmetries at TU Dortmund 30 Jun-4 Jul 12. Co-organization and talk on *Squark Flavor Implications from* $\bar{B} \to \bar{K}^{(*)} l^+ l^-$
Feb-Mar 12	**DPG Spring Meeting** in Göttingen 27 Feb-2 Mar 12. Talk on *Squark Flavor Constraints from* $\bar{B} \to \bar{K}^{(*)} l^+ l^-$ (with support from the Wilhelm and Else Heraeus Foundation)

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Dec 11 **5th Annual Workshop of the Helmholtz Alliance** "Physics at the Terascale" in Bonn 7-9 Dec 11. Talk on *Squark Flavor Constraints from* $\bar{B} \to \bar{K}^{(*)} l^+ l^-$

Sep 11 **43rd Autumn school for High Energy Physics Maria Laach** in Bautzen 6-16 Sep 11. Talk given on *Exploration of SUSY Flavor with* $b \to s$ *processes*

Mar 10 **DPG Spring meeting** in Bonn 15 Mar-19 Mar 10. Talk given on *Flavor and the Spurion Algebra* (with support from the Wilhelm and Else Heraeus Foundation)

Conferences, Workshops and Schools

Feb 12 **LHCb School/Workshop** in Neckarzimmern 22-24 Feb 12

Feb 11 **LHCb School/Workshop** in Neckarzimmern 16-18 Feb 11

Jul 10 **Cargese Summer School** "Physics at TeV Colliders – From Tevatron to the LHC" in Corsica 19-31 Jul 10

Feb 10 **LHCb School/Workshop** in Neckarzimmern 17-19 Feb 10

Sep 09 **FLAVIAnet summer school on Flavour Physics** in Karlsruhe 7-18 Sep 09

Feb 09 **LHCb School/Workshop** in Neckarzimmern 4-6 Feb 09

Jun-Jul 08 **58th Meeting of Nobel Laureates at Lindau** 29 Jun-4 Jul 08 (dedicated to Physics) as Fellow of the Wilhelm and Else Heraeus Foundation

Mar 08 **DPG Spring Meeting** Freiburg 3-7 Mar 08

Languages

German Native Language

English Fluent

French Fair

Programming Languages and Software Skills

Mathematica, C/C++, Fortran (Basics), LaTeX, Gnuplot, Octave, Root, Linux

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Publication List

Stefan Schacht

[1] G. Hiller, M. Jung and S. Schacht, "SU(3)-Flavor Anatomy of Non-Leptonic Charm Decays," Phys. Rev. D **87**, 014024 (2013) [arXiv:1211.3734 [hep-ph]].

[2] S. Schacht, "Squark Flavor Implications from $\bar{B} \to \bar{K}^{(*)} l^+ l^-$" in I. d. M. Varzielas, C. Hambrock, G. Hiller, M. Jung, P. Leser, H. Päs, S. Schacht and M. Aoki *et al.*, "Proceedings of the 2nd Workshop on Flavor Symmetries and Consequences in Accelerators and Cosmology (FLASY12)," arXiv:1210.6239 [hep-ph].

[3] A. Behring, C. Gross, G. Hiller and S. Schacht, "Squark Flavor Implications from $\bar{B} \to \bar{K}^{(*)} l^+ l^-$," JHEP **1208**, 152 (2012) [arXiv:1205.1500 [hep-ph]].

Research Interests

Stefan Schacht

From a theoretical perspective, today, many hints are pointing towards physics beyond what we call the Standard Model of the strong and electroweak interactions (SM). The SM neither has an explanation for the vast separation of the scales of electroweak and gravitational physics nor for the baryon asymmetry, dark matter and dark energy. Additionally, the hierarchy in the flavor sector is not understood. It is a deep gap in our knowledge that–disregarding anthropic explanations–we do not have a theory for the masses and the mixing matrices of both quarks and leptons. Furthermore, we have no clue which mechanism determines the area of the unitarity triangles, i.e. the size of CP violation. These riddles fascinate me.

On the other hand, it is a puzzling fact that the SM works better as anyone would have expected 30 years ago. New physics is strikingly hiding away, most recently exemplified by the evidence for the decay $\bar{B}_s \to \mu^+\mu^-$ with a branching ratio near its SM value. Furthermore, the recent exciting observation of a new scalar boson sort of completes the SM picture. Additionally, in most simple scenarios like for example the CMSSM the mass spectrum of supersymmetric particles is pushed up by direct searches.

The above antagonism means consequently that it is just now the right time for doing research in Theoretical Elementary Particle Physics. This is especially the case for the flavor and CP sector: Even if we are not seeing new particles in the direct searches we are sensitive to them through flavor changing neutral current (FCNC) processes. A main challenge on the theory side is here that we have only a limited knowledge of QCD at long distances. Improvements on the latter are mandatory in order to disentangle new physics effects from QCD ones.

In my research I am currently exploring both the up and the down sector of quark flavor physics: In the down sector I study implications of semileptonic beauty decays for SUSY flavor. In the up sector I investigate CP violation in non-leptonic charm decays. While in case of the former we enter the realm of precision physics with regard to the latter our ability to control hadronic effects is much more poor than in the b-system because of the intermediate value of the charm mass.

Precision probes of Supersymmetry in the down sector In Supersymmetry (SUSY) there are many new sources of flavor violation due to the soft breaking terms. Generically, these can be of $O(1)$ when one does not impose a dedicated mechanism of SUSY breaking. Here, the abscence of large FCNCs is not only a puzzle but rather a problem. From the latest data on the rare decay and LHCb roadmap channel $\bar{B} \to \bar{K}^{(*)} l^+ l^-$ Arnd Behring, Christian Gross, Gudrun Hiller and I worked out new bounds on squark flavor violation. The semileptonic channel is especially sensitive to the scharm-stop left-right mixing from the A-terms. Large A-terms are in particular necessary in order to account for the measured Higgs mass in SUSY. Therefore, there are interesting correlations with Higgs physics. Furthermore, the new flavor bounds have consequences for models with radiative flavor violation where the small off-diagonal elements of the CKM matrix are generated by quantum corrections that are proportional to the A-terms. Here, the constraints become partly even stronger than the ones from Kaon mixing. Moreover, we predicted a lower bound on the key observable $\mathcal{B}(\bar{B}_s \to \mu^+\mu^-)$,

meaning that the Standard Model contribution cannot be erased completely by SUSY. As in SUSY beauty and top physics share the same sources of flavor violation we also predicted the non-observation of rare top decays for foreseeable luminosities at the LHC.

SU(3) analysis to probe the up sector for charming new physics Recently, spectacular results showed large CP violation in charm decays which is enhanced in comparison to the naive SM prediction. The immanent difficulty is that we do not know how to reliably calculate the hadronic matrix elements from first principles due to the position of the charm quark mass in the spectrum relative to the scale of QCD. As a data-driven way out of this situation together with Gudrun Hiller and Martin Jung I performed an SU(3) analysis of non-leptonic charm decays, including for the first time linear breaking in full generality. Doing extensive numerical fits we found that the existing data can be described by SU(3)-breaking of order 30%. Furthermore, the requisite penguin enhancement that is needed in order to account for all currently available data tends to even larger values than using the current 4.6σ result of $A_{CP}(D^0 \to K^+K^-) - A_{CP}(D^0 \to \pi^+\pi^-)$ only. This further strengthens the arguments for new physics. We showed that in a future data scenario with improving data on several CP asymmetries decisions between different models could be made.

Future Plans In the near future I am planning to work on $B \to K^*$ form factors, as their current uncertainty limits the interpretation of many $\bar{B} \to \bar{K}^* l^+ l^-$ observables. Then I plan to further exploit the approximative SU(3) flavor symmetry of QCD. As to the latter I plan to include $\eta^{(\prime)}$ final states in the analysis of charm decays and to study the decays $B_{d,s} \to J/\psi\, \eta^{(\prime)}$.

More generally, I would like to further explore the physics of the terascale and especially what flavor physics can tell us about it. I am broadly interested in new projects on the path to finding new physics and I am eager for the next news from the LHC which will measure further observables with unprecedented precision.