

## Teaching Philosophy and Experience

### Teaching Philosophy

My experience both as student and as researcher taught me how intimately research and teaching are related. I want to incite in students of all levels the feeling of discovery, of curiosity and excitement which I experience daily in my research, thus inducing independent thinking and an un-quenchable interest in Nature. My intention is to inspire the students to ask themselves the type of questions that lead to developing and understanding key physical concepts and the skills of scientific reasoning.

During my graduate and post-graduate education and research in three different university systems (Germany, England and the USA), I was exposed to students at all levels of experience. I worked first as tutor, and for six years now as senior lecture assistant whose tasks include the organisation of tutorials and autonomous choice and preparation of examples and exams including their solutions at all levels of university education. I frequently pose, manage and grade the written examinations for the Vordiplom in Mechanics and Electrodynamics. In addition, I am frequently asked to substitute for teachers in course lectures (e.g. Mechanics, Electrodynamics, Quantum Mechanics II, Nuclear and Particle Physics). With the advent of a new rule allowing senior Postdocs to give independent lectures at the TU München, I accepted the offer to read “Quantum Field Theory” (in English) in the Summer Term 2004. This lecture scored the mark 1.1 in the students’ evaluation (1: best; 5: worst). I was also invited as independent examiner for the oral final Diplom-exams starting July 2004. This was even before I obtained from the Physics Department of TU München on 15th June 2005 the LEHRBEFÄHIGUNG IM FACH THEORETISCHE PHYSIK or HABILITATION, namely the qualification to teach Theoretical Physics at German universities. For Winter Term 2005/06, I accepted the offer of a temporary Sabbatical Substitute Professorship (W2, formerly C3) at University Erlangen-Nürnberg.

My work allowed me to motivate, understand difficulties and observe progress also in less-prepared students. In order not to lose contact with the students’ advances, I found it indispensable to continue to give example classes as senior lecture assistant. In this position, I was granted a high degree of independence in preparing all tutorials and exams at all university levels, discussing the contents of both exercises and lectures with the lecturers. I used this freedom to develop “research projects” which students solved in addition to the conventional course exercises. My experience was that because the students’ imagination was sparked, they soon learned with enthusiasm not only the curriculum but a scientific and independent approach to research already in their second and third year. This was constantly appreciated at the end of the term in the students’ evaluations of the tutorials and example classes in general, and of the specific tutor in particular. Several of these students then joined me or my institute for their research work.

I see learning as an active process which takes place within the individual more than in the lecture hall. To me, it is a process whose difference to discovery in research is mostly the fact that in the latter one learns things which are not yet found in textbooks. The teacher can assist, guide, motivate, trigger and speed up the process. And well-motivated students see the demands of complex subjects rather as a challenge than as a burden.

As I believe that the difference between research and learning should best be gradual, I involve students on the Diploma or Doctoral level who work under my supervision as much as possible

in my own research. There is a vast number of open and not-too-difficult questions in nuclear and particle physics. Even problems in toy-models lead often as natural extension to quantitative methods applicable to complex systems. Continuous learning is part of our research, and I therefore feel privileged that I have been invited to deliver a variety of lectures and colloquia on progress in my field to other theorists, experimentalists and graduate students, see list on p. 5-1. I also edited and contributed to two books of lectures for beginning graduate students, see Ref. [41]. The collaboration with outstanding senior researchers and lecturers in the preparation of these lecture notes was a defining experience for me.

In June 2002, I was appointed Coordinator of the lecture assistances, examinations and tutorials in the theory section of the Physics Department at TU München. My responsibility is assigning the lecture assistants and tutors to the lecturers of (examinable) course lectures in theoretical physics. The goal is not only to make sure that all Doktorands, Diploma students and Postdocs are assigned an even share of the teaching duties they are skilled for. I also see the fact that junior researchers *do* teach as an essential part of their education. This also means that they have to get the chance to learn teaching methods and skills. Moreover, my task is to help ensure and improve the quality and efficiency of teaching by detailed suggestions to the faculty.

I believe that knowledge management, i.e. the dissemination of existing knowledge, is the other pillar besides knowledge acquisition, i.e. research, on which a fruitful academic environment is built. This also means that besides the formal knowledge which of course forms the core of any university education, its context and foundations must be made clear to the students. A good lecturer will also support the student, freshman or graduate, to find an own style to effectively and understandably communicate the research results to the peers in academia or in industry, and to the general public.

In my view, good research and good teaching are too interwoven to be separable in higher education. My personal goal is a continuous advance in both.

## Teaching Experience

At present, I supervise my former Diploma student R. Hildebrandt in his PhD-work, paid for by a grant I obtained from the Deutsche Forschungsgemeinschaft. I assisted in the education of ten Diploma and PhD students and Doktorands who worked in close contact with me or under my direct supervision, amongst others S. Christlmeier, O. Jahn, J.-W. Chen and G. Rupak. I hold the LEHRBEFÄHIGUNG IM FACH THEORETISCHE PHYSIK (HABILITATION), i.e. the official qualification to teach Theoretical Physics at German universities, since 15th June 2005.

- *Winter Term 2005/06* Vertretungsprofessur (Sabbatical Substitute Professorship) for Theoretical Physics, Universität Erlangen-Nürnberg (Germany).  
Lectures “Kompaktkurs Elektrodynamik und klassische Feldtheorie” (Compact Course Electrodynamics and Classical Field Theory) for students of the *Hochbegabtenstudiengang Physik im Rahmen des Elitenetzwerks Bayern* (Physics for Highly Gifted Persons as part of the Elite-Network Bavaria, allowing qualified students to obtain their PhD in altogether 6 instead of 8 years); “Quantum Field Theory II” (in English).
- *Summer Term 2004 – Winter Term 2005/06* Examiner for the oral final Diplom-exams, TU München.
- *Summer Term 2004* Teaching mandate for lecture “Basics of Quantum Field Theory” (in English), grade 1.1 in students’ evaluation (1: best, 5: worst), TU München.
- *June 2002 – September 2005* KOORDINATOR DER LEHRVERPFLICHTUNGEN FÜR DIE THEORIE (Coordinator of the Lecture Assistances, Examinations and Tutorials in the Theory section of the Physics Department), TU München.  
This involves assigning the lecture assistants and tutors to the lecturers of (examinable) course lectures in theoretical physics. I was also asked to co-ordinate improvements in teaching-quality and efficiency to the faculty, which I suggested.
- *Summer Term 2000 – Summer Term 2005* Posing, managing and grading the written examinations for the Vordiplom in Mechanics and/or Electrodynamics every semester, TU München.
- *Summer Term 2000 – Summer Term 2005* CO-ORGANISER AND SUPERVISOR OF SEMINARS every semester for *Diplom* students (compulsory, examination), TU München. Topics: QCD at Low and High Energies; Symmetries; Quantum Field Theory; Physics of the Standard Model.  
Part of the seminars are jointly supervised by experimentalists and theorists, so that students of both sides can profit from them. This involves guiding the students through the literature and helping them to prepare their talks.
- *Winter Term 1999/2000 – Summer Term 2005* Frequent SUBSTITUTIONS FOR COURSE LECTURERS at the TU München (Mechanics, Electrodynamics, Quantum Mechanics II, Nuclear and Particle Physics).
- *Winter Term 1999/2000 – Summer Term 2005* SENIOR LECTURE ASSISTANT (*Vorlesungsassistent*), Technische Universität München.

Topics: Mechanics, Quantum Mechanics I and II, Electrodynamics and Field Theory (compulsory courses with examinations). This involves preparing weekly problems and solutions for tutorial groups and supervising the operation of the various groups, as well as organising, preparing and grading the exams.

- *Winter Term 1998/99* SUBSTITUTIONS FOR COURSE SENIOR LECTURERS at the University of Washington (Electrodynamics, Astrophysics).
- *Winter Term 1997/98 – Summer Term 1999* ORGANISER OF THE SEMINARS, Nuclear Theory Group, University of Washington. This consisted of two kinds, each once a week: Formal Group seminars with invited speakers from other institutions, and informal “Brown Bag” seminars for internal presentations, students and brain-storming.
- *Summer Term 1997* CO-ORGANISER AND SUPERVISOR OF THE SEMINAR on the Foundations of Quantum Mechanics and the Measurement Problem for *Diplom* students (non-examinable), Universität Erlangen-Nürnberg.
- *Winter Term 1994/95 – Winter Term 1995/95 and Winter Term 1996/97* SENIOR LECTURE ASSISTANT (*Vorlesungsassistent*), Universität Erlangen-Nürnberg.  
Topics: Mechanics, Quantum Mechanics II, Electrodynamics and Field Theory, Statistical Mechanics and Thermodynamics (compulsory courses with examinations).
- *Summer Term 1994* CO-ORGANISER AND SUPERVISOR of the Graduate Seminar on the Quark Gluon Plasma (compulsory, examination), Universität Erlangen-Nürnberg.
- *Winter Term 1992/93* CO-ORGANISER AND SUPERVISOR OF THE SEMINAR on Chaos and Quantum Chaos for *Diplom* students (non-examinable), Universität Erlangen-Nürnberg.
- *Winter Term 1991/92 – Winter Term 1993/94* TUTOR in undergraduate and graduate physics, Universität Erlangen-Nürnberg.  
Topics: The course on Theoretical Physics (Introduction to Theoretical Physics, Mechanics, Quantum Mechanics I & II, Electrodynamics and Field Theory, Statistical Mechanics and Thermodynamics). This involved the preparation of solutions and personal tutoring for groups of 10-15 students in Physics.