Account of research and teaching activities

I started my study of physics at the university of Leipzig in 1974. In 1978 it was offered to me a 3 years graduate study to get the degree of Dr. rer. nat. . I realized this in the high energy physics group in Leipzig under the leadership of Prof. J. Ranft. The topic of my research in this time was the parton - parton - scattering in the framework of quantum chromodynamics, especially the lepton pair production at large transverse momenta. I was able to present results which agreed with the calculation of CERN theorists published nearly at the same time. The comprehensive analytical calculations were done with **REDUCE** on the available main frame computers; since that time algebraic programs and languages belong to me special interests.

After the defending of my dissertation in 1982 I turned my research activities into the field of elementary particles and cosmology. I did this together with my colleague J. Kripfganz. We investigated consequences of the models of supersymmetries and superstrings for the state of the early universe. We got some interesting results especially from the qualitative different behaviour of one dimensional objects (strings) concerning the dynamics of the universe somewhat below the Planck scale. In simplified models we could show that a compactification from higher dimensions (greater than four) to four dimensions can occur consistently.

In 1986 I began a 3 years graduation study (Aspirantur) for receiving the academic title *Dr. sc. nat.* thereby continuing my work on cosmology. I investigated the coupled Einstein–quantum field–equations in semi–classical approximation and obtained the one-loop renormalized equations for a simple scalar field in curved space time. I could realize a 3 month stay at the Joined Institute for Nuclear Research in Dubna. In the group of V. A. Gerdt (Algebraic Computing) I investigated problems of the application of algebraic computing methods in physics. Together with A. Grozin from Novosibirsk we put a special purpose algebraic program (DIRAC) from main frame computers to PC. At this point I should remark perhaps that in the former GDR I did not get the permission and possibility to work in western countries. So I used the research connections of my group to collaborate with colleagues especially in Dubna and Nowosibirsk. My thesis of dissertation have been defended in 1990 successfully. In the same year I received the permission to teach at the university *Facultas docendi*.

From April 1991 to October 1991 I worked at the university Heidelberg together with M. G. Schmidt. This was part of a **Humboldt fellowship**. In Heidelberg we investigated the problem of instanton induced cross sections in the electroweak standard model. We were able to construct the constraint instanton numerically and to calculate the total baryon number violating cross section. This collaboration has been continued together with J. Kripfganz to include the investigation of the electroweak phase transition.

Because of the intensive use of computational methods (numeric and algebraic) I have quit a comprehensive experience with computers. Among the machines which I use are workstations but also IBM main frame computers and APE/Quadrics massive parallell computers. I prefer to solve numerical problems with FORTRAN or C, analytical tasks are investigated with Mathematica, Maple or AXIOM.

I have been involved also in the teaching process at our university since the beginning of my assistance. I have given seminars for students in physics and for students who will become teachers in physics and mathematics. Usually I have been responsible for problems in theoretical physics. Moreover, we also give some introduction to numerical methods in physics on personal computers. Since 1991 I give lectures on gravitation and cosmology which has been included as a new topic in our lecture program at the department of physics. Together with J. Kripfganz we wrote a book on the use of the algebraic system Mathematica in physics. It was published in the Carl Hanser Verlag. Many of our colleagues proved it useful. My lectures on gravitation in the summer course 1997 are available as an interactive notebook under Mathematica 3.0. In autumn 1997 I received a grant from Wolfram Research (the developers of Mathematica) to write some special purpose packages.

From 1993 up to July 1997 I worked under grants of the DFG (german research association). Togehther with colleagues from Berlin and Heidelberg we studied the phase transition in the standard model in view of the baryon asymmetry of the universe. This basically non–perturbative process has been investigated with the lattice formulation of quantum field theory. Our results supported the point of view that the standard model phase transition is too weakly first order as to be responsible for the measured baryon asymmetry. Currently I am involved in a collaboration (DESY, Berlin, Leipzig, Regensburg) computing hadron structure functions on the lattice. Using so-called improved actions in quenched approximation we were able to get results which partly coincides with phenomenological fits surprisingly well. In Leipzig (A. Schiller and I) the perturbative calculations are performed. They are needed to relate the lattice quantities to their continuum analogs. The calculation are performed with a comprehensive package doing these calculations analytically. It was written by us in Mathematica. From August 1997 I am paid by DESY based on a cooperation contract between DESY and the Leipzig university.