PREFACE

The annual report of the *Beschleunigerlaboratorium der Ludwig-Maximilians-Universität München und der Technischen Universität München* for the year 2001 provides information on experimental and theoretical studies performed by physicists from both universities in the field of *Nuclear Physics and Particle Physics*. The contributions describe experiments performed at the *Tandem accelerator in München* and investigations pursued at external research centers in which physicists from Munich have played a major role, as well as theoretical work related to these activities. Highlights of these activities are listed below:

- The *Tandem accelerator* has performed very well during approximately 280 days of operation supporting a substantial amount of results on nuclear and applied physics as well as test beam studies for detector development and prototyping for the new experimental facilities at the FRM-II.

  Nuclear particle spectroscopy with polarized hydrogen projectiles focused on the investigation of quartets of supersymmetric nuclei. Multi-particle transfer-reactions necessary to assign quantum numbers in the odd-odd members of the quartets became feasible by the high intensity of the polarized ion beam and the radiation hardness of the focal plane detector in the Q3D magnetic spectrograph.

  In the field of applied and interdisciplinary research, the development of new techniques for material analysis encountered further break throughs: Proton proton scattering at the new ion microprobe SNAKE allowed for the first time hydrogen microscopy in three dimensions even on biological samples. The sensitivity and accuracy of high resolution ERD experiments could be increased to enable the analysis of implantation profiles of low energy carbon ions and to use heavy ion channeling to determine the lattice position of light impurities in thin crystalline layers. In accelerator mass spectrometry novel methods have been tested to access low astrophysical cross sections and the methods for neutron dosimetry have been considerably refined. The newly discovered phenomenon of transverse cooling and heating in ion channeling is further investigated by measuring charge state distributions in channeling conditions.
- Accelerated radioactive nuclear beams represent a new tool to study nuclei far off stability. The successful commissioning of the REX-ISOLDE radioactive beam facility at CERN in the second half of 2001 confirmed the concept of combining effective charge breeding with a compact linac for post-accelerating radioactive beams. This concept is vital for the Munich Fission Fragment Accelerator MAFF at the FRM II which will open up a new domain for the study of superheavy elements. Major progress has been made in the development of the target ion source, the resonator structures and the cryopanels for MAFF. The γ-ray detector MINIBALL, which will be one of the first detector systems at MAFF has been installed in the REX-ISOLDE beamline at CERN to take data in 2002.
- A source of ultra-cold neutrons UCN to be installed at the FRM II will test the fundamental question of time reversal invariance by a measurement of the electric dipole moment of the neutron with unprecedented precision. Substantial progress has been achieved towards the final approval by the technical safety authorities. Based on the agreements reached, the construction of a common vessel housing the deuterium gas system and the vacuum system has started. Several concepts and experimentation techniques relevant for the UCN source at the FRM II are probed at the ILL in Grenoble.
- Hadron properties inside nuclear matter at high densities will be investigated by the new dielectron spectrometer HADES at the GSI. In a first run in 2001 HADES has recorded several millions of events for commissioning the detector with a strong emphasis on the detector readout speed.

- Hadron structure and hadron spectroscopy will be studied with high intensity muon and hadron beams by the COMPASS experiment at CERN which has started data taking in 2001 with a first detector configuration. Munich is substantially contributing to the commissioning of the detector in its final configuration.
- The study of the constituents of matter at energies corresponding to temperatures of the early universe above their condensation into known bound states is subject of highly focused international efforts. The e^+e^--collider LEP at CERN has completed operation end of 2000 and the analysis of the full harvest of data is providing valuable results on the properties of electroweak gauge bosons, Quantum-Chromo-Dynamics and extensions of the Standard Model. The $p\bar{p}$-collider *TeVatron* at Fermilab offers the unique possibility to extend these studies to higher energies. Munich has joined the DØ experiment and is heavily involved in the triggering and identification of muons which will also be a prime signal for new phenomena in the next generation experiment ATLAS at the pp-collider LHC. The construction and calibration of large-area drift tubes for the muon spectrometer as a Munich contribution to the ATLAS detector has reached the production stage.
- In the field of Astro-particle physics the question of the contribution of non-baryonic particles to the mass of the universe (the so called "Dark Matter") is of utmost importance. Neutrino masses and mixing are investigated in the solar neutrino experiments GNO and BOREXINO. In GNO the integral spectrum of solar neutrinos is determined whereas BOREXINO aims for the measurement of the monoenergetic ^{7}Be neutrinos. This allows to study neutrino oscillations, which are consequences of neutrino and mixing, with unprecedented accuracy. The CRESST experiment is aiming for the search of weakly interacting massive particles (WIMPs), predicted in supersymmetry, which could be responsible for the observed rotation curves of galaxies. For their detection CRESST is developing successfully cryogenic detectors. All experiments are performed in the Gran Sasso underground laboratory.

Several activities are linked to a restructuring of this laboratory focusing on the development of powerful local research facilities at the new FRM-II and the participation in key experiments at the forefront of basic research at large scale international facilities. In addition, the link with theoretical physicists from both universities has been strengthened with a very fruitful mutual inspiration concerning present and future experiments. In particular, collaborations have been formed in the field exotic nuclei, the properties of hadrons in nuclear matter, relativistic heavy ion collisions, the study of hadron structure using high energy lepton beams at *DESY* and *CERN*, the search for new types of interactions at *CERN*, *DESY* and *Fermilab* and the study of massive neutrinos and dark matter. In 2001 the concept for the future has been evaluated and recommended by an international council of distinguished experts in their fields nominated by the university directorate of both universities.

The Beschleunigerlaboratorium offers a high quality education in modern research which is reflected in the diploma and PhD theses listed at the end of this report and also by external funds acquired specifically for the training of young physicists.

As in all the previous years the budget for running experiments and the laboratory was supported by the state of Bavaria providing the basis for substantial grants by the DFG, the BMBF, the DAAD, the Alexander-Humboldt-Stiftung and the European Union. With this annual report we want to inform all our sponsors and our friends and colleagues about our work, and we want to thank them.

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