PREFACE

This is the first annual report of the newly established *Maier-Leibnitz-Laboratorium für Kern- und Teilchenphysik der Ludwig-Maximilians-Universität München und der Technischen Universität München* (MLL). The MLL succeeds the former *Beschleunigerlaboratorium* and is carried by the experimental and theoretical groups working in the areas of nuclear and particle physics from both Munich universities.

This report, while summarizing last years work, is being written at an exciting time when the research reactor FRM II in Garching has just obtained its permission for operation. This also means that the two major MLL projects for the FRM II, the ultracold neutron source Mini-D_2 and the fission fragment accelerator MAFF can now enter their final planning and construction phase.

The contributions in this annual report describe preparations for these projects, investigations pursued at external research facilities in which members of the MLL played a major role, experiments performed at the Tandem accelerator in München, as well as related theoretical investigations. A strong synergy of the common infrastructure and activities of the MLL can be seen in the large number of instrumental developments in the various areas of research. In the following highlights from the various activities are summarized:

- A major focus of **nuclear structure research** is the study of nuclei far off the valley of stability in order to study the effective nucleon-nucleon interaction. MLL groups are actively pursuing the construction of the MAFF accelerator for beams of exotic nuclei from fission fragments at the FRM II, which continues on several fronts including source, extraction, and accelerator components as well as future instrumentation. The REX-ISOLDE accelerator at CERN has begun regular operation with first experiments on neutron-rich Na, and Mg isotopes using the MINIBALL spectrometer. At the Tandem accelerator in Garching the Q3D magnetic spectrograph is used for high-resolution spectroscopy searching for further examples of the existence of supersymmetric nuclei and investigating the decay of shape isomers and the fission barriers in actinide nuclei. Additionally, experiments on exotic nuclei are also being performed at GSI Darmstadt.
- The Mini-D_2 source for Ultra-Cold Neutrons will perform precision measurements of **fundamental properties of the neutron**, such as its lifetime and the search for an electric dipole moment. The detailed lay-out for the Mini-D_2 source for Ultra-Cold Neutrons at the FRM II has made significant progress. Various components with relevance to the barrier concept of the source have been successfully tested for their reliability. A test cryostat is under construction for first tests at the TRIGA reactor at Mainz University.
- MLL groups are very actively involved in several international collaborations for the **study of the constituents of matter at high energies**. The analysis of the OPAL data from the e^+e^- collider LEP at CERN is being continued. In particular the precision measurement of the mass and decay width of the W-Boson are being finalized. MLL scientists are participating in the DØ experiment at the $p\overline{p}$-collider TeVatron at Fermilab with an emphasis on the search for leptoquarks, the Higgs boson, and supersymmetry. At the same time preparations for the next generation experiment ATLAS at the pp-collider LHC at CERN are continuing, e.g. with the Garching Cosmic-Ray test-facility for the ATLAS muon-spectrometer drift tube chambers, which is now under operation.
- The **internal structure of hadrons and their spectroscopy** is being studied with high intensity muon and hadron beams by the COMPASS experiment at CERN. COMPASS has successfully started to take data during last year. Hadron properties in dense and hot nuclear matter are being investigated by the HADES Di-electron spectrometer at GSI, which also has performed its first physics run in the past year with C+C collisions. A very active theory program is investigating the various aspects of non-perturbative QCD that are investigated with these experiments.

- The investigation of the role of non-baryonic particles in the universe is the domain of **astro-particle physics**. MLL scientists are major participants in the GNO and BOREXINO experiments at Gran Sasso which study the integral neutrino spectrum and the monoenergetic ^{7}Be neutrinos, respectively. These experiments will make major contributions to the study of neutrino oscillations. The development of highly efficient cryogenic detectors for the GNO experiment will enhance the detection efficiency significantly. The CRESST experiment searches for weakly interacting massive particles (WIMPs), predicted by supersymmetric theories. Detector developments and tests are being performed in Garching, while the experiments are all situated in Gran Sasso underground laboratory.
- Due to past investments the infrastructure of the **Tandem accelerator** and its instrumentation is in very good shape providing the basis for the high quality nuclear physics and interdisciplinary research performed. In the past year the Tandem accelerator has again performed very reliable and provided about 7000 hours of beam on target. Continuous use of this well performing facility is being foreseen at least until MAFF is operational.
- The **interdisciplinary research using nuclear techniques** has been performed very actively at the Tandem accelerator. High resolution ERD and channeling ERD experiments were performed using the Q3D to determine structural properties and surface properties of semi-conductors and metal alloys.

  Using the superb lateral and depth resolution of the ion beam microscope SNAKE it was for the first time possible to detect hydrogen on grain boundaries of CVD-grown diamond, which is important for electronic and chemical properties. An new set-up for the single-ion irradiation of biological cells has been installed for the study of DNA repair mechanism.

  The world-wide unique sensitivity of the accelerator mass spectrometry has enabled the measurement of very small isotopic ratios of astrophysical and geological importance. A new measurement of the fast neutron flux on copper samples from Japan was able to clear up longstanding discrepancies supporting the present dosimetry system for Hiroshima.

The restructuring of the laboratory, with a new focus on the development of major local research facilities at the FRM II, an intensified interaction of the various experimental and theoretical groups, and a significant support of basic research at various large scale facilities has been mostly completed. The laboratory is now well positioned to keep making significant contributions to the fields of particle and nuclear physics.

The budget of the MLL provided by the Freistaat Bayern has been the basis for substantial grants by the BMBF, the DFG, the DAAD, the European Union, the Alexander-von-Humboldt Stiftung, and the Bayrische Forschungsstiftung. This annual report serves the information of our sponsors, friends, and colleagues about the work of the past year. We would like to thank them for their support.

Prof. Dr. Reiner Krücken — Prof. Dr. Gerhard Graw