PREFACE

This annual report of the *Maier-Leibnitz-Laboratorium für Kern- und Teilchenphysik der Ludwig-Maximilians-Universität München und der Technischen Universität München* (MLL), will summarize the highlights 2005 of the local and external work of the research groups.

In April 2005 the research reactor FRM II in Garching obtained the permission for routine operation. It soon reached its nominal power of 20 MW and the neutron fluxes delivered to the first users were very encouraging. In parallel the two major MLL projects at the FRM II, the ultra-cold neutron source Mini-D_2 and the fission fragment accelerator MAFF have made significant steps towards start-up.

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 MLL Tandem accelerator, as well as related theoretical investigations.

In the following some of the highlights from the various activities are summarized:

- The understanding of the structure of nuclei far from stability is one of the key problems in **nuclear structure research** today. 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. With the commissioning of the REX-ISOLDE facility and the MINIBALL gamma-ray spectrometer, in which MLL researchers had a leading role, it is now possible to make systematic studies of key properties of exotic nuclei over wide regions in the nuclear chart and first publications are emerging. At the Tandem accelerator in Garching the Q3D magnetic spectrograph is used for high-resolution spectroscopy. 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 layout 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 set-up to study UCN production has been taken into operation at the pulsed TRIGA reactor in Mainz.
- A new instrument for the **study of the constituents of matter at high energies** will be the LHC which is well on schedule to meet its goal of first beams in 2007. For the muon spectrometer of the LHC experiment ATLAS, MLL scientists have successfully commissioned and calibrated 88 large drift tube-chambers in the Cosmic-Ray measurement-facility of the MLL.

  In parallel MLL physicists contributed significantly to a precise determination of the top quark mass and the search for the Higgs boson and New Physics beyond the Standard Model with the DØ experiment at the $p\overline{p}$-collider TeVatron and acted as main authors of several publications.
- Several publications are emerging from the COMPASS experiment at CERN which reveal the **internal structure of hadrons and their excitations**. Hadron properties in dense and hot nuclear matter are being investigated by the HADES Di-electron spectrometer at GSI, which also has continued its physics program with C+C and p+p experiments. A very active theory program is investigating the various aspects of non-perturbative QCD that are investigated with these experiments.

- MLL scientists are deeply involved in the investigation of the role of non-baryonic particles in the universe, which is the domain of **astro-particle physics**. The major experiments under MLL participation are the GNO and BOREXINO experiments at Gran Sasso which study the integral neutrino spectrum and the monoenergetic ^{7}Be neutrinos, respectively.

  The development of highly efficient cryogenic detectors for the GNO experiment at the MLL has been continued for the CRESST and EURECA experiments which search for dark matter candidates.
- The **Tandem accelerator** performed very reliably. The machine and its instrumentation are the backbone for the ongoing high quality nuclear physics and **interdisciplinary research using nuclear techniques**:

  High resolution ERD and channeling ERD experiments at the Q3D magnetic spectrograph analyzed ultra thin high-k oxides and ultra shallow contacts of micro electronic structures. The ion beam microscope SNAKE used single-ion irradiation of biological cells, to study details of DNA repair after time separated irradiation and along heavy ion tracks. The RadBioMat project finished the construction of the implanter for radioactive isotopes and successfully demonstrated its properties with stable isotopes. The world-wide unique sensitivity of the accelerator mass spectrometry has enabled the measurement of very small isotopic ratios of astrophysical, atmospheric, and geological importance.
- The use of laser beams for cooling, production, and acceleration of ions or electrons is promising new field that is being pursued by MLL scientists in close collaboration with the Max-Planck institute for Quantumoptics in Garching.

Today the laboratory is well positioned to keep making significant contributions to the fields of particle and nuclear physics and take full advantage of the opportunites opening with LHC at CERN and the FAIR faciltiy at GSI Darmstadt. Two draft proposals with participation from the MLL, 'Fundamental Physics' and 'Advanced Photonics', have been submitted to the Excellence Initiative of federal funding and were evaluated by international review panels. Both groups were then invited to submit a full proposal for a cluster of excellence.

The MLL offers a high quality education in modern research which is reflected in the diploma and PhD theses at the end of this report and also by numerous external funds acquired specifically for the training of young physicists. As an example, members of the MLL have been granted the DFG Graduiertenkolleg 'Particle Physics at the Energy Frontier of New Phenomena' which started in 2004. The MLL also participates in the 'International Max Planck Research School (IMPRS) for Elementary Particle Physics in Munich' which was founded in 2005.

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