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 of the local and external work in 2007.

The last year was the first full year in which the MLL groups have performed most of their work with the additional support of the clusters of excellence *Origin an Structure of the Universe* and *Munich Center for Advanced Photonics* MAP. Due to this support several new appointments of junior group leaders (W1 and W2 Professors) have been made or the search process started.

The contributions in this annual report describe developments for projects at the research reactor FRM II, in particular the ultra-cold neutron source, 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:

- A major focus of **nuclear structure research** is the study of nuclei far from stability in order to understand the evolution of shell structure, which may significantly change in neutron-rich systems. New results from conversion electron spectroscopy at ISOLDE/CERN and the MLL Tandem accelerator gave important new insights on shape coexistence and beta vibrational excitations in deformed nuclei. Also, using a new charged particle detector array, built by MLL scientists, the physics program of REX-ISOLDE was extended to transfer reactions. The Q3D magnetic spectrograph at the MLL Tandem with its worldwide leading sensitivity continues to be the workhorse for the in-house nuclear structure investigations. The set-up of the MLL trap system for precision mass measurements and the preparations for atomic physics studies of heavy elements is progressing well. On the instrumental side developments of new detector systems for the future FAIR facility in Darmstadt are carried out.
- The investigation of **fundamental properties of the neutron** continues to be the focus of experimental programs at PSI, ILL and the FRM II. With major funding from the Universe Cluster work is progressing well on the Mini-D_2 source for Ultra-Cold Neutrons at the FRM II. At the same time the tests of the prototype at the Mainz TRIGA reactor were so successful that the technology is being used for experiments in Mainz. At the MLL the commissioning of the superconducting coils for the PENeLOPE neutron lifetime experiment is progressing well.
- The **study of the constituents of matter at high energies** is at the center of the MLL involvement in the ATLAS experiment at the CERN LHC as well as the FNAL D0 experiment. The ATLAS detector has by now been completed and is awaiting the start of the LHC operation. In the meantime vigorous work on simulations is being performed to understand the expected physics signal from ATLAS as well as the preparations of the GIRD based Data Management system for ATLAS. The MLL Cosmic Ray test facility is being used for the long term monitoring of the ATLAS MDT chambers. In parallel data from the D0 experiment is being analyzed, e.g. to obtain a more precise mass for the top quark. On the theoretical side investigations span from string theory, particle phenomenology, and flavor physics.
- The COMPASS experiment at CERN, in which MLL groups are prominently involved, continues its productive work studying **internal structure of hadrons and their excitations**. The HADES spectrometer at GSI extended the size of nuclear systems investigated to study hadron properties in dense and hot nuclear matter. Also a study was performed to find out how the HADES RICH detector needs to be modified for the higher energies of the FAIR project. The very active theory program continues to investigate non-perturbative QCD on the basis of lattice QCD and chiral dynamics.

- MLL scientists play a leading role in the investigation of neutrinos and searches for dark matter, which is the domain of **astro-particle physics**. The first results of the BOREXINO experiment on the ^{7}Be neutrinos show perfect consistency with the expectations including neutrino oscillations. The CRESST experiment is now in operation with a few detectors at Gran Sasso in its search for weakly interacting massive particles (WIMPs). A new set-up for the production of the $CaWO_4$ crystals for CREST has come successfully online. Important developments and tests for cryogenic detectors are being performed in the MLL Underground Laboratory and using the neutron beam at the Tandem accelerator.
- The **Tandem accelerator** and its instrumentation are the backbone for the ongoing high quality nuclear physics and interdisciplinary research performed. In the past year the Tandem accelerator has again performed very reliable and steps have been taking to replace several aging components to ensure continuous operation.
- 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 semiconductors and metal alloys.

  The single-ion irradiation of biological cells at the ion beam microscope SNAKE has lead to the discovery of competing processes in the repair response of the cell. The on-line microscopy of the probes has successfully been implemented and studies within the MAP cluster for the effectiveness of short beam pulses have been started.

  The world-wide unique sensitivity of the accelerator mass spectrometry AMS has enabled the measurement of very small isotopic ratios of astrophysical, atmospheric, and geological importance. A new focus is the determination of reaction cross-sections relevant for nucleosynthesis.
- The use of laser beams for cooling, production, and acceleration of ions or electrons is at the center of activities in the MAP cluster of excellence centered at the Max-Planck institute for Quantenoptics in Garching.

Through major outside funding and the *Universe* Cluster of Excellence the laboratory is perfectly positioned to keep making major 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 Bayerische 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.

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