Preface

This Annual Report describes the activities of the National Superconducting Cyclotron Laboratory (NSCL) from January 1, 1999, to December 31, 1999. Major efforts of the laboratory were focused on implementing the coupled cyclotron project (CCP) and a major helium refrigerator upgrade project, on completing the approved experimental program for stand-alone K1200 operation, and on carrying out a forefront research program in nuclear science, accelerator physics, and related instrumentation R&D.

In 1999, the CCP and the cryo-upgrade projects were the top priorities for laboratory activities. All milestones were reached on or ahead of schedule.

In spite of the need to redirect resources from operations to these projects, a seven-days per week operating schedule was maintained until the beginning of the scheduled shutdown at the end of June. All approved experiments, but one, were completed successfully before the shutdown.

Construction of the new room temperature ECR ion source was completed, and the ion source was commissioned in August 1999. Initial tests have shown that the new ECR ion source works well.

The continuing effort to increase the power handling ability of the K1200's electrostatic deflectors led to a satisfactory outcome when a septum design was found that was able to handle up to 1 Kilowatt of beam power. Further R&D is underway to improve the deflector's high-voltage-holding ability.

Significant progress was made during the year towards augmenting the experimental apparatus available for the experimental program with the coupled cyclotron facility, including a granular Germanium detector array, a sweeper magnet for neutron coincidence experiments at forward angles, and a high resolution silicon strip detector array.

During 1999, NSCL staff was actively involved in shaping the concept for an advanced rare isotope accelerator, RIA, that combines the key advantages of the two rare isotope production techniques: projectile fragmentation or fission with in-flight separation; and target spallation or fission with isotope separation on-line followed by acceleration of specific isotopes. More details about RIA and ongoing R&D activities can be found at http://www.nscl.msu.edu/research/ria/home.html and its various links.

Georg Bollen and Hendrik Schatz accepted offers for tenure stream faculty positions with joint appointments in the Department of Physics and Astronomy and the NSCL. Georg Bollen will spearhead the construction of an ion trap facility at the NSCL. Hendrik Schatz will focus on nuclear astrophysics research and is one of the founding members of JINA, the Joint Institute for Nuclear Astrophysics of Michigan State University and Notre Dame University.

During 1999, the research productivity of the NSCL remained high, and a large number of exciting new results in reaction dynamics, nuclear astrophysics, and in the

understanding of nuclei far from stability emerged. Particularly noteworthy is the development of knock-out reactions and intermediate energy Coulomb excitation into highly sensitive, quantitative spectroscopic tools that can be used with beam intensities smaller than 1 particle/second. For energetic nucleus-nucleus collisions, first experimental evidence for a neutron fractionation in the liquid-gas coexistence region was observed. Much of this and other research and of the ongoing technical work is summarized in this annual report.

In order to reduce printing and shipping costs, the NSCL will publish this and future Annual Reports on the World Wide Web. As in the past, we welcome advice and suggestions from all readers on how this Annual Report could be made more useful or what could be done to make the NSCL a more supportive place to do research within existing financial constraints.

C. Konrad Gelbke, Director