

ANNUAL REPORT
OF THE
MICHIGAN STATE UNIVERSITY
NATIONAL SUPERCONDUCTING CYCLOTRON LABORATORY
FOR THE PERIOD
JANUARY 1, 1994, TO DECEMBER 31, 1994

PREFACE

This Annual Report describes the activities of the National Superconducting Cyclotron Laboratory (NSCL) from January 1, 1994, to December 31, 1994. Major efforts of the laboratory were focused towards:

- operating the NSCL as a national user facility and carrying out a research program in nuclear science, accelerator physics and related instrumentation R&D,
- continuing vigorously with the construction of the S800 magnetic spectrograph,
- developing new beams as well as beams with higher energies and intensities,
- preparing a proposal for coupled "K500 ⊗ K1200" cyclotron operation, to meet the increasing physics need for radioactive beams with substantially higher intensities.

During 1994, reliability of the K1200 remained high (89.4%). In February 1994, the NSCL reached an important technical milestone by extracting beams of ^{16}O at $E/A = 200$ MeV, ^{84}Kr at $E/A = 125$ MeV, and ^{129}Xe at $E/A = 100$ MeV from the K1200 cyclotron. With this achievement, stand-alone operation of the K1200 cyclotron reached or exceeded the beam energy goals of the original NSCL Phase II facility proposal.

During a scheduled shutdown (February-April 1994), the A1200 was reconfigured to allow a smaller beam spot at the production target and thus increase the acceptance for radioactive beams by the addition of a superconducting quadrupole doublet immediately upstream of a new heavily-shielded A1200 target box. During this period, a known vertical misalignment of the cyclotron and the exit beam line was corrected.

Construction of the superconducting S800 magnetic spectrograph continued with high priority, and significant progress has been made. The S800 track has been installed, and the first large dipole magnet has been assembled onto the carriage and been operated at the full field of 1.6 T. The mapping apparatus has been installed, and a first map of the first dipole was taken. Winding of the coils for the second dipole was completed, and construction of the beamline magnets is progressing well. All required power supplies for the beam-line dipoles were completed.

Other facility/detector improvements include commissioning of the new SuperBall neutron multiplicity meter (built by the University of Rochester group), installation of a 16-element plastic scintillator array covering very small polar angles ($0.5^\circ - 1.5^\circ$) in the 4π Array, and development of a multinode system for the 4π data acquisition system to allow real time data filtering.

Pressure for beam time remains high, and the NSCL continues to be oversubscribed; PAC 17 (June 1994) received requests for 3900 hours of beam time and approved 2380 hours for research. Roughly 3/4 of the approved experiments were collaborations between outside groups and NSCL staff.

During the first half of the year, the NSCL prepared a "White Paper" (NSCL report No. 939) describing the research opportunities which could be realized by coupling the two

superconducting cyclotrons (the K500 and K1200) of the NSCL and by building a more powerful "A1900" beam analysis system; the document also gives technical details of the "K500 ⊗ K1200" project. Copies of the White Paper were sent to many colleagues and the K500 ⊗ K1200 concept found wide endorsement. Encouraged by the positive response from the nuclear physics community, the NSCL prepared a formal proposal requesting funds from the National Science Foundation which was submitted in September 1994. The NSCL upgrade project was extensively discussed during the formulation of the 1995 NSAC Long Range Plan for Nuclear Science and received very strong endorsement.

During 1994, the research productivity of the NSCL remained high, and a large number of exciting new results in reaction dynamics and in the understanding of nuclei far from stability emerged. Much of this research and of the ongoing technical work is summarized in this annual report.

We welcome advice and suggestions from all readers on how the contents of 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 the existing severe financial constraints.

C. Konrad Gelbke

NSCL USERS EXECUTIVE COMMITTEE

Members of the Users Executive Committee serve three-year terms, beginning November 1 (formerly two-year terms beginning October 1). Members are elected each year from the general membership of the Users Group, and a non-voting liaison representative from MSU is appointed by the Director of the NSCL. Committees to date are:

July 1, 1982 - September, 1982

F. Becchetti -- University of Michigan
A. Galonsky -- Michigan State University
J. Huizenga -- University of Rochester
Vic Viola -- Indiana University
G.M. Crawley -- MSU, Liaison

October 1, 1982 - September 30, 1983

F. Becchetti -- University of Michigan, Chair
J. Kolata -- Notre Dame University
V. Viola -- Indiana University
D. Youngblood -- Texas A&M University
A. Galonsky -- MSU, Liaison

October 1, 1983 - September 30, 1984

J. Kolata -- Notre Dame University, Chair
F. Prosser -- University of Kansas
R. Tickle -- University of Michigan
D. Youngblood -- Texas A&M University
A. Galonsky -- MSU, Liaison

October 1, 1984 - October 31, 1985

J. Kolata -- Notre Dame University
L. Lee -- SUNY, Stony Brook
F. Prosser -- University of Kansas
R. Tickle -- University of Michigan, Chair
A. Galonsky -- MSU, Liaison

November 1, 1985 - October 31, 1986

D. Kovar -- Argonne National Laboratory
L. Lee -- UNY, Stony Brook
F. Prosser -- University of Kansas, Chair
R. Tickle -- University of Michigan
A. Galonsky -- MSU, Liaison

November 1, 1986 - October 31, 1987

D. Kovar -- Argonne National Lab, Chair
K. Kwiatkowski -- Indiana University
L. Lee -- SUNY, Stony Brook
J. Saladin -- University of Pittsburgh
A. Galonsky -- MSU, Liaison

November 1, 1987 - October 31, 1988

D. Kovar -- Argonne National Laboratory, Chair
K. Kwiatkowski -- Indiana University
J. Saladin -- University of Pittsburgh
L. Sobotka -- Washington Univ. at St. Louis
A. Galonsky -- MSU, Liaison

November 1, 1988 - October 31, 1989

T. Awes -- Oak Ridge National Laboratory
K. Kwiatkowski -- Indiana University
J. Saladin -- University of Pittsburgh
L. Sobotka -- Washington Univ. at St. Louis, Chair
A. Galonsky -- MSU, Liaison

November 1, 1989 - October 31, 1990

T. Awes -- Oak Ridge National Laboratory
A. Nadasen -- University of Michigan
L. Sobotka -- Washington Univ. at St. Louis, Chair
G. Wozniak -- Lawrence Berkeley Lab
A. Galonsky -- MSU, Liaison

November 1, 1990 - October 31, 1991

T. Awes -- Oak Ridge National Laboratory
J. Kolata -- Notre Dame
A. Nadasen -- University of Michigan
G. Wozniak -- Lawrence Berkeley Lab, Chair
A. Galonsky -- MSU, Liaison

November 1, 1991 - October 31, 1992

J. Kolata -- Notre Dame
A. Nadasen -- University of Michigan
U. Schroeder -- Univ. of Rochester
G. Wozniak -- Lawrence Berkeley Lab, Chair
A. Galonsky -- MSU, Liaison

November 1, 1992 - October 31, 1993

F. Bertrand - Oak Ridge National Laboratory
J. Kolata -- Notre Dame, Chair
U. Schroeder -- Univ. of Rochester
R. Vandenbosch - University of Washington
N. Anantaraman - MSU, Liaison

November 1, 1993 - October 31, 1994

F. Bertrand - Oak Ridge National Laboratory
U. Schroeder -- Univ. of Rochester, Chair
R. Vandenbosch - University of Washington
M. Wiescher - Univ. of Notre Dame
N. Anantaraman - MSU, Liaison

November 1, 1994 - October 31, 1995

F. Bertrand - Oak Ridge National Laboratory
R. Boyd - Ohio State University, Chair
R. Vandenbosch - University of Washington
M. Wiescher - Univ. of Notre Dame
N. Anantaraman - MSU, Liaison

Meetings and Members of the NSCL Program Advisory Committee

PAC-1	February 1982
PAC-2	September 30, 1983
PAC-3	July 2, 1984
PAC-4	January 13-14, 1985
PAC-5	July 28-29, 1985
PAC-6	April 6-7, 1986
PAC-7	October 26-27, 1986
PAC-8	May 3-4, 1987
PAC-9	September 18-20, 1988
PAC-10	April 29-May 1, 1990
PAC-11	March 3-5, 1991
PAC-12	October 27-29, 1991
PAC-13	May 3-5, 1992
PAC-14	November 8-10, 1992
PAC-15	May 2-4, 1993
PAC-16	December 5-7, 1993
PAC-17	June 26-28, 1994
PAC-18	January 16-17, 1995
PAC-19	July 24-25, 1995

PAC Members

Members serve for about six PAC Meetings with one member leaving the PAC after each meeting. The Director of the NSCL is Convenor of the Committee. PAC Members to date and the meetings at which they have served are:

Britt, H.C.	LANL	1,2
Cline, D.	Rochester	1,2,3,4,5
Koonin, S.E.	Caltech	1,2,3,4,5,6
Paul, P.	Stony Brook	1,2
Scott, D.K.	MSU/NSCL	1,2,3
Cramer, J.	Washington	3,4,5,6,7
Viola, V.	Indiana	3,4,5,6,7,8
Benenson, W.	MSU/NSCL	4,5,6,7,8,9
Siemens, P.	Texas A&M	5,6,7,8,9,10,13
Stephens, F.	LBL	6,7,8,9,
Vary, J.	Iowa State	7,8,9,10,11,12
Young, G.	ORNL	8,9,10,11,12,13
Natowitz, J.	Texas A&M	9,10,11,12,13,14
Hardy, J.	Chalk River	10,11,12,13,14,15
Kashy, E.	MSU/NSCL	10,11,12,13,14,15,16
Randrup, J.	LBL	11,12,14,15,16,17
Haxton, W.	Univ. of Washington	13,14,15,16,18,19
Henning, W.	Argonne	14,15,16,17,18,19
Datz, S.	ORNL	14,15,16,17,18,19
Wozniak, G.	LBL	15, 16,17,18,19
Mueller, A.	IPN Orsay	16,17,18,19
Crawley, G.	MSU/NSCL	17, 18,19
Friedman, W.	Univ. of Wisconsin	18,19

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