

**ANNUAL REPORT**  
**OF THE**  
**MICHIGAN STATE UNIVERSITY**  
**NATIONAL SUPERCONDUCTING CYCLOTRON LABORATORY**  
**FOR THE PERIOD**  
**JANUARY 1, 1992 TO DECEMBER 31, 1992**

## Preface

This Annual Report describes the activities of the National Superconducting Cyclotron Laboratory (NSCL) from January 1, 1992 to December 31, 1992. During this period, the major efforts of the laboratory were directed towards:

- operating the NSCL as a national user facility,
- further improving the reliability and capabilities of the K1200 superconducting cyclotron,
- moving ahead vigorously with the construction of the S800 magnetic spectrograph and further increasing the capabilities of NSCL detectors,
- carrying out a program of research in nuclear science, accelerator physics, and instrumentation R&D.

Considerable resources were also devoted to completing the N4 vault and to commissioning the 7 Tesla Big Solenoid constructed by the University of Michigan group, to rebuilding the superconducting ECR ion source and developing new high-charge-state ion beams, and to starting construction of the new S2 vault which will house a large neutron multiplicity meter to be built by the Rochester University group.

Construction of the S800 magnetic spectrograph has become a high laboratory priority, and significant manpower has been assigned to this project. However funding has been less than expected, and the goal of completing the project by the end of 1994 is becoming unrealistic. Provided that sufficient funds will be received from the National Science Foundation in FY'94, construction of the S800 can be completed by mid 1995.

During 1992, the reliability of K1200 operation was 89.5%. The K1200 was scheduled to operate for 7319 hours and was operational for 6553 hours. For heavy elements (Au and U), the beams extracted from the K1200 have exceeded the original energy specifications for the NSCL facility. The highest energy  $N = Z$  beams extracted from the K1200 are He and Ne beams of  $E/A = 170$  MeV. Full energy ( $E/A=200$  MeV) He and O beams have been accelerated internally, but difficulties with the deflector voltages were encountered in the extraction of these beams. Towards the end of the year, a collaboration formed between the NSCL, the Cyclotron Laboratory of Texas A&M University, and Chalk River Laboratories (Canada) to study deflector and insulator problems, and considerable progress has been made since.

Pressure for beam time has remained high, and the NSCL continues to be oversubscribed. PAC 13 (May 1992) and PAC 14 (November 1992) received requests for a total of 8678 hours of beam time of which 5375 hours (62%) were approved. Roughly half of the beam time requests were for experiments involving radioactive beams produced by the A1200, the other half being mainly for reaction studies. Outside user participation nearly doubled for proposals submitted to PAC 13 and PAC 14 as compared to proposals submitted in the previous year to PAC 11 and PAC 12.

Major emphases of the experimental program were the study of halo nuclei (especially  ${}^{11}\text{Li}$ ), the mapping of the proton drip line in the mass  $A = 60-90$  region, elastic scattering and direct reaction studies with radioactive beams, studies of multifragmentation reactions, and the determination of the "balance energy" for which the repulsive action due to pressure counteracts the attraction provided by the nuclear mean field.

A series of discussions with representatives from the Medical Schools of Wayne State University, the University of Michigan and Michigan State University led to plans for a Michigan Proton Radiation Center. The NSCL submitted a proposal to the National Science Foundation requesting funds for design and construction of a low-cost superconducting 250 MeV proton-therapy cyclotron to be used as a prototype for later commercial duplication.

On July 1, 1992, Sam Austin stepped down as Director of the NSCL to do research at the NSCL and to resume teaching in Department of Physics and Astronomy. We are all grateful for this his long and distinguished service to the Laboratory. His responsibilities have been assumed by Konrad Gelbke.

In 1992, George Bertsch took a leave of absence to join the Nuclear Theory Institute at the University of Washington; he has recently (summer 1993) resigned from MSU, and efforts are underway to rebuild strength in the nuclear theory group. Jerry Nolen resigned from the NSCL to take the position of Director of ATLAS at Argonne National Laboratory. The NSCL has since been fortunate to attract Richard York from the SSC as the new Associate Director for Accelerators. York is leading the effort to develop and evaluate a number of options for a facility upgrade.

In closing, we solicit advice and suggestions from all readers as to any way in which the contents of this Annual Report could be made more useful, and as to things we could do to make the NSCL a more supportive place to do research.

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  
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  
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  
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  
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  
A. Galonsky -- MSU, Liaison

November 1, 1992 - October 31, 1993

F. Bertrand - Oak Ridge National Laboratory  
J. Kolata -- Notre Dame  
U. Schroeder -- Univ. of Rochester  
R. Vandenbosch - University of Washington  
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 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 (Non-voting Chair)	4,5,6,7,8,9 1,2,3
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
Randrup, J.	LBL	11,12,14,15
Haxton, W.	Univ. of Washington	13,14,15
Henning, W.	Argonne	14,15
Datz, S.	ORNL	14,15
Wozniak, G.	LBL	15

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