

SECTION 2

**PUBLICATIONS, THESIS TITLES, OUTREACH,
AND VISITORS**

PUBLICATIONS

Publications and invited talks by non-NSCL scientists which are based in whole or in part on experimental work at the NSCL are tagged with the symbol #.

PAPERS

(a) Physical Review Letters

Parallel Momentum Distributions as a Probe of Halo Wave Functions; J.H. Kelley, S.M. Austin, R.A. Kryger, D.J. Morrissey, N.A. Orr, B.M. Sherrill, M. Thoennessen, J.S. Winfield, J.A. Winger, and B.M. Young, Phys. Rev. Lett. **74**(1995)30

Fragment Flow and the Multifragmentation Phase Space; G.J. Kunde, W.C. Hsi, W.D. Kunze, A. Schüttauf, A. Wörner, M. Begemann-Blaich, Th. Blaich, D.R. Bowman, R.J. Charity, A. Cosmo, A. Ferrero, C.K. Gelbke, J. Hubele, G. Imme, I. Iori, P. Kreutz, V. Lindenstruth, M.A. Lisa, W.G. Lynch, U. Lynen, M. Mang, T. Möhlenkamp, A. Moroni, W.F.J. Müller, M. Neumann, B. Ocker, C.A. Ogilvie, G.F. Peaslee, J. Pochodzalla, G. Raciti, T. Rubehn, H. Sann, W. Seidel, V. Serfling, L.G. Sobotka, J. Stroth, L. Stuttge, S. Tomasevic, W. Trautmann, M.B. Tsang, A. Tucholski, G. Verde, C.W. Williams, E. Zude, and B. Zwieglinski, Phys. Rev. Lett. **74**(1995)38

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#Dissipative Orbiting in $^{209}\text{Bi}+^{136}\text{Xe}$ Collisions at $E_{\text{lab}}/A = 28$ MeV; S.P. Baldwin, B. Lott, B.M. Szabo, B.M. Quednau, W.U. Schröder, J. Toke, L.G. Sobotka, J. Barreto, R.J. Charity, L. Gallamore, D.G. Sarantites, D.W. Stracener, and R.T. de Souza, Phys. Rev. Lett. **74**(1995)1299

Are Multifragment Emission Probabilities Reducible to an Elementary Binary Emission Probability?; L.G. Moretto, L. Phair, K. Tso, K. Jing, G.J. Wozniak, R.T. de Souza, D.R. Bowman, N. Carlin, C.K. Gelbke, W.G. Gong, Y.D. Kim, M.A. Lisa, W.G. Lynch, G.F. Peaslee, M.B. Tsang, and F. Zhu, Phys. Rev. Lett. **74**(1995)1530

One-Neutron Halo of ^{19}C ; D. Bazin, B.A. Brown, M. Fauerbach, M. Hellström, S.E. Hirzebruch, J.H. Kelley, R.A. Kryger, D.J. Morrissey, R. Pfaff, C.F. Powell, B.M. Sherrill, and M. Thoennessen, Phys. Rev. Lett. **74**(1995)3569

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Reducibility and Thermal Scaling of Charge Distributions in Multifragmentation; L. Phair, K. Tso, R. Ghetti, G.J. Wozniak, L.G. Moretto, R.T. de Souza, D.R. Bowman, N. Carlin, C.K. Gelbke, W.G. Gong, Y.D. Kim, M.A. Lisa, W.G. Lynch, G.F. Peaslee, M.B. Tsang, and F. Zhu, Phys. Rev. Lett. **75**(1995)213

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Search for Narrow Sum-Energy Lines in Electron-Positron Pair Emission from Heavy-Ion Collisions near the Coulomb Barrier; I. Ahmad, S.M. Austin, B.B. Back, R.R. Betts, F.P. Calaprice, K.C. Chan, A. Chishti, P. Chowdhury, R.W. Dunford, J.D. Fox, S.J. Freedman, M. Freer, S.B. Gazes, A.L. Hallin, T. Happ, D. Henderson, N. Kaloskamis, E. Kashy, W. Kutschera, J. Last, C.J. Lister, M. Liu, M.R. Maier, D. Mercer, D. Mikolas, P.A.A. Perera, M.D. Rhein, D.E. Roa, J.P. Schiffer, T.A. Trainor, P. Wilt, J.S. Winfield, M. Wolanski, F.L.H. Wolfs, A.H. Wuosmaa, G. Xu, A. Young, and J.E. Yurkon, Phys. Rev. Lett. **75**(1995)2658

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Tracking of Fission-Like Processes in Central Collisions of $^{40}\text{Ar} + ^{232}\text{Th}$; $E=15-115$ A MeV; J. Yee, E.E. Gualtieri, D. Craig, S. Hannuschke, T. Li, W.J. Llope, R. Pak, N.T.B. Stone, A.M. Vander Molen, G.D. Westfall, J.S. Winfield, S.J. Yennello, R.A. Lacey, A. Nadasen, and E. Norbeck, Phys. Lett. **B356**(1995)191

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MSU THESIS TITLES

Eugene Gualtieri, "The Disappearance of Fusion-fission and the Onset of Multifragmentation."

Damian Handzy, "Two-Proton Intensity Interferometry of Impact-Parameter Selected $^{36}\text{Ar} + ^{45}\text{Sc}$ Collisions at $E/A = 80, 120, \text{ and } 160 \text{ MeV}$."

Wen Chien Hsi, "Onset of Vaporization in $^{197}\text{Au} + ^{197}\text{Au}$ Collisions."

Dong-O Jeon, "Nonlinear Effects in the Vertical Motion of Ions in a Superconducting Cyclotron."

John Henry Kelley, "The Halo Nuclei ^{11}Be and ^8B Studied by Fragmentation Reactions."

Easwar Ramakrishnan, "Giant Dipole Resonance in Highly Excited ^{208}Pb Nuclei."

Steven Larry Snyder, "Study and Redesign of the NSCL K500 Injection, Central Region and Phase Selection System."

Mathias Steiner, "The Mirror Charge-Exchange Reaction $^{13}\text{C}(^{13}\text{N}, ^{13}\text{C})^{13}\text{N}$."

Weishi Wan, "Theory and Applications of Arbitrary Order Achromats."

THESES AT OTHER UNIVERSITIES USING EXPERIMENTS PERFORMED AT THE NSCL

Thilina Annakkage at the University of Michigan, "Spin-Flip Studies with the $(^7\text{Li}, ^7\text{Be}-\gamma)$ Reaction."

Shawn Baldwin at the University of Rochester, "Study of $^{209}\text{Bi} + ^{136}\text{Xe}$ Collision Dynamics at an Intermediate Energy of $E/A = 28 \text{ MeV}$."

L.B. Yang at the University of Iowa, Master's thesis on "Detector Array for Heavy Ion Reactions."

Pavel Pogodin at the University of Iowa, Master's thesis on "Electronics for Iowa Forward Array."

ALL-UNIVERSITY OUTREACH SCIENCE AND MATHEMATICS CHALLENGE FOR HIGH SCHOOL STUDENTS

E. Kashy, D. J. Morrissey, C. Tsai [1], Y. Tsai, S. L. Wolfe

The outreach program of the NSCL included a program for high school teachers and students. The primary goal of the Michigan State All-University Outreach Challenge for High School Students was to develop a program in collaboration with participating high school teachers to motivate and challenge students from across the midwest to improve, and then demonstrate, their understanding of science and mathematics. It also provided high school teachers and students an opportunity to become familiar with the Internet and to use MSU's networked software system, CAPA, which provides a Computer-Assisted Personalized Approach for problem-solving.

The 1995-6 Challenge included providing both challenging problems and physical puzzles to the teachers and students. The problems were developed and chosen during two teacher workshops at Michigan State University. Problems were prepared, coded, and tested for the challenge by the participating teachers and the NSCL faculty and staff for mathematics, chemistry and physics. A common introductory set of problems focusing on mathematical skills served as the first set for all three subjects, while the second set was restricted to the particular topic. Both quantitative and qualitative, conceptual problems were included.

During the workshops the physical puzzles were selected from an assortment already developed. Three physical experiments were chosen as puzzles by the participating high school teachers with the goal of having students perform (and repeat) the experiments, observe the phenomena and then propose explanations. The students were free to seek information from ANY source and consult anyone other than the participating teacher in order to formulate their answer. The puzzles chosen this year were:

- Levitron™
- Image Formation and Rotational Motion
- Curie Point (temperature) of iron

This year's program included 10 teachers and 728 students from Michigan and Ohio. The comments from teachers and students were very positive, and many of their suggestions will be included in subsequent programs.

T. Keehn and S. Snyder helped coordinate the distribution of information about the program to teachers and students. T. Keehn was instrumental in many of the financial aspects of the program.

1. Department of Mathematics, Michigan State University

NSCL PHYSICS OF ATOMIC NUCLEI PROGRAM, SUMMER 1995

E. Kashy, W. Bauer, B.A. Brown, R. Fox, C. K. Gelbke, A. Galonsky, W. Lynch, D. J. Morrissey
R. Ronningen, and S. L. Wolfe

The outreach program of the NSCL included a program for pre-college teachers and students. The goal of this program was to provide teachers and students the opportunity to understand basic Nuclear Physics, and to carry out simple nuclear experiments that they would not be able to carry out at their own institutions.

The first week was "Teacher's Week", during which the teachers went through the program without any students present. During the second week, the students took part in the same program, with the instruction divided among the participating teachers. They were in charge of conveying the information to the students who came to the MSU campus for the program. This format was designed to insure that the teachers, who were asked for input and suggestions for working with the students, would see most of the materials twice: once with their fellow teachers, and then again as they helped run the program during the second week.

The first week's program included several hours of 'Experiments/Demonstrations of Physics Fundamentals' (EK) which were repeated the second week. T. Rogalski, from the career placement office at MSU, led an informative workshop on career opportunities in science. Informal discussion sessions were held for the teachers with the MSU-NSCL Faculty in various areas of Nuclear Physics. These included:

- 'Neutrons' with A. Galonsky
- 'Nuclear Applications' with C. K. Gelbke
- 'Computer Networking and Communications' with R. Fox
- 'Radiation in our environment' with R. Ronningen
- 'Nuclear Theory, with W. Bauer

Three hands-on laboratory experiments, taken from the ISP 209L physics laboratory course designed for non-science majors, were conducted (BAB, WL). The titles of the experiments were:

- Probability vs. Average
- Radioactive Background and Common Sources of Radiation
- Neutron Activation of ^{109}Ag and Radioactive Decay of ^{110}Ag

In order to buttress learning and understanding, a set of problems was specifically assembled for this program. The problems dealt with fundamental concepts in Nuclear Physics, and were developed as part of an MSU REU [1] project during summer '93 (EK, DJM, SLW). The teachers had the opportunity to answer the problems in a friendly, non-judgmental environment using MSU's networked software system, CAPA, which provides a Computer-Assisted Personalized Approach to problem-solving. Three problem sets (a total of 40 problems) reinforced their understanding and helped to lower the level of apprehension of the teachers faced with the task of having to solve problems. The following week, the teachers supervised and helped the students with these problems, thus further confirming their own understanding.

The summer '95 program included 8 teachers and 33 students. The comments from teachers and students were highly positive, and several of their suggestions will be included in subsequent programs. T. Keehn was instrumental in getting information about the program to teachers and students, for selection of participants, and for administration of the financial aspects of the program.

1. This Research Experience for Undergraduates program was sponsored by the National Science Foundation.

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