

SECTION 2

PUBLICATIONS, THESIS TITLES, OUTREACH, AND VISITORS

PUBLICATIONS

PAPERS

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Bombarding Energy Dependence of Charged Particle Multiplicities for $^{84}\text{Kr} + ^{197}\text{Au}$ at $E/A = 35, 55, 70, 100, 200,$ and 400 MeV; G.F. Peaslee, W. Bauer, D.R. Bowman, N. Carlin, M. Chartier, J. Dinius, C.K. Gelbke, D.O. Handzy, W.C. Hsi, M.A. Lisa, W.G. Lynch, C.M. Mader, L. Phair, C. Schwarz, M.B. Tsang, C. Williams, R.J. Charity, L.G. Sobotka, G. van Buren, R.T. de Souza, D. Fox, W. Friedman, G.J. Kunde, U. Lynen, J. Pochodzalla, H. Sann, W. Trautmann, M.-C. Lemaire, and S.R. Souza, *Bull. Am. Phys. Soc.* **38**(1993)1853

Properties of Intermediate Mass Fragments Emitted in $^{197}\text{Au} + ^{197}\text{Au}$ Collisions at $E/A = 100$ and 400 MeV; M.B. Tsang for the Miniball/Aladin/Catania Collaboration, *Bull. Am. Phys. Soc.* **38**(1993)1854

Observation of a Saturation in the Timescale for Multifragment Emission in Symmetric Heavy Ions; R. Lacey, E. Bauge, A. Elmaani, J. Lauret, T. Reposeur, A. Vander Molen, G.D. Westfall, J.S. Winfield, W.K. Wilson, J. Lee, S. Yennello, A. Nadasen, R.S. Tickle, and E. Norbeck, *Bull. Am. Phys. Soc.* **38**(1993)1854

BOOKS EDITED

Proceedings of the International Workshop on Nonlinear Problems in Accelerator Physics, Berlin, Germany, March 30 - April 2, 1992, edited by M. Berz, S. Martin, and K. Ziegler, Institute of Physics Conference Series Number 131 (Institute of Physics Publishing, Bristol, 1993).

Proceedings of the S800 Workshop on Focal Plane Detectors, East Lansing, Michigan, January 6-7, 1993, edited by J.L. Bartlett and B.M. Sherrill (NSCL Report MSUCL-877, 1993).

"Advances in Nuclear Dynamics", Proceedings of the Ninth Winter Workshop on Nuclear Dynamics, Key West, Florida, January 30 - February 6, 1993, edited by B. Back, W. Bauer, and J. Harris, World Scientific Publishing, Singapore (1993).

"Radioactive Nuclear Beams", Proceedings of the Third International Conference on Radioactive Nuclear Beams, East Lansing, May 24-27, 1993, edited by D.J. Morrissey (Editions Frontiers, Gif-sur-Yvette, 1993).

INVITED TALKS

Some New Aspects of Nuclear Structure Near the Drip Lines; B.A. Brown, XVI Symposium on Nuclear Physics, Oaxtepec, Mexico, January 5-8, 1993.

Fragment Emission from Expanding Hot Nuclear Systems; C.K. Gelbke, *ibid.*

Charge Exchange Reactions; S.M. Austin, Workshop on S800 Focal Plane Detectors, East Lansing, Michigan, January 6-7, 1993.

Multinucleon Transfer Reactions Leading to Nuclei Far from Stability; W. Benenson, *ibid.*

Ray Reconstruction Techniques; M. Berz, *ibid.*

Data Acquisition Strategies; R. Fox, *ibid.*

Overview of the S800 Spectrograph Project; A. Zeller, *ibid.*

Map Techniques in Accelerator Physics (series of five lectures); M. Berz, 1992-93 U.S. Particle Accelerator Physics Winter School, Tallahassee, Florida, January 18-29, 1993.

Coherent Effects and Baryon-Rich Matter in Heavy Ion Collisions; A. Bulgac, Symposium on The Beauty of Physics, Philadelphia, Pennsylvania, January 20-21, 1993.

Pion Correlations in Proton-Induced Reactions at Relativistic Energies; W. Bauer, XXXI International Meeting on Nuclear Physics, Bormio, Italy, January 25-29, 1993.

Multifragmentation in Central Collisions; M.B. Tsang, *ibid.*

Pion Lasers in Nuclear Collisions; S. Pratt, Meeting on Heavy Ion Physics at the AGS, MIT, Cambridge, Massachusetts, January 1993.

Pion Correlations and Nuclear Shadowing; W. Bauer, Ninth Winter Workshop on Nuclear Dynamics, Key West, Florida, January 30 - February 6, 1993.

Impact Parameter Dependence of Two-Proton Correlation Functions; C.M. Mader, *ibid.*

Multifragmentation in Central Collisions; W.G. Lynch, *ibid.*

The Multifragmentation Phenomenon in Heavy Ion Reactions; G.F. Peaslee, *ibid.*

The Disappearance of Flow; G.D. Westfall, *ibid.*

General Aspects of Transport Theory in Nuclear Physics; P. Danielewicz, Interdisciplinary Workshop on Transport Phenomena, Les Houches, February 2-11, 1993.

New Features in COSY INFINITY; M. Berz, Third Computational Accelerator Conference, Pleasanton, California, February 22-26, 1993.

Dynamical Effects in the Formation and Decay of Compound Nuclei; M. Thoennessen, Peter Paul Symposium, Stony Brook, New York, March 6, 1993.

Rigorous Estimates for the Long Term Stability of the Dynamics in Storage Rings; M. Berz, Conference on Numerical Analysis with Automatic Result Verification, Lafayette, Louisiana, March 1993.

Nuclear Fragmentation; W. Bauer, NATO Workshop on Fragmentation Phenomena, Centre de Physique, Les Houches, France, April 7-12, 1993.

Nuclear Multifragmentation; W.G. Lynch, *ibid.*

Multifragment Disintegrations of Expanding Nuclear Systems; C.K. Gelbke, 1993 Joint Meeting of the American Physical Society and the American Association of Physics Teachers, Washington, DC, April 12-15, 1993.

Large-Basis Configuration Mixing in Light Nuclei from ^{11}Li to ^{16}O ; B.A. Brown, Inaugural Meeting of the Centre for Nuclear Physics at Surrey, United Kingdom, April 28, 1993.

Pion Interferometry in Hadronic Models; P. Danielewicz, Workshop on Meson Interferometry in Relativistic Heavy Ion Collisions, Brookhaven National Laboratory, April 1993.

Complexity and Chaos in Nuclear Dynamics; V.G. Zelevinsky, International Symposium on Nuclear Structure Physics Today, Chung Li, Taiwan, May 11-14, 1993

Infinitely Small Numbers and Almost Infinitely Large Accelerators, or: Automatic Differentiation as Non-Archimedean Analysis; M. Berz, First Theory Institute on Computational Differentiation, Argonne, Illinois, May 24-26, 1993.

Experiments with Neutron-Rich Lithium Nuclei at MSU; A. Galonsky, Third International Conference on Radioactive Nuclear Beams, East Lansing, Michigan, May 24-27, 1993.

Mentoring Young Faculty -- A Wish List; W. Bauer, Topical Conference on Physics Departments in the 1990's, Arlington, Virginia, May 1993.

Physics with the MSU 4π Array; G.D. Westfall, International School-Seminar on Heavy Ion Physics, Dubna, Moscow, Russia, May 1993.

Multifragmentation at MSU; T. Glasmacher, Colloque GANIL 1993, La Pradet, France, June 7-11, 1993

Collective Excitations of Fullerenes; A. Bulgac, International Symposium on the Theory of Atomic and Molecular Clusters, Leer, Germany, June 13-16, 1993.

Testing Transport Theories with Correlation Measurements; S. Pratt, Tenth International Conference on Ultra-Relativistic Nucleus-Nucleus Collisions (Quark Matter '93), Borlange, Sweden, June 20-24, 1993.

Pion Lasers from Nuclear Collisions; S. Pratt, Nordic Theory Workshop on Heavy Ion Collisions, Bergen, Norway, June 1993.

Nuclear Astrophysics From β -Decay Studies of Nuclei Far From Stability; B.M. Sherrill, International Conference on the Future of Nuclear Spectroscopy, Crete, Greece, June 28 - July 3, 1993.

Coherent Effects and Baryon-Rich Matter in Heavy Ion Collisions; A. Bulgac, International Workshop on Perspectives in High Energy Strong Interaction Physics at Hadron Facilities, Fermi National Laboratory, Batavia, Illinois, July 4-11, 1993.

Electromagnetic Excitation of ^{11}Li ; D. Sackett, 1993 Nuclear Chemistry Gordon Conference, New London, New Hampshire, July 5-9, 1993.

Hadron Emission from Central Heavy Ion Collisions; P. Danielewicz, Workshop on Possibilities of Future Experiments at the AGS, Upton, New York, July 12, 1993.

Hanbury-Brown-Twiss Analysis in a Solvable Model; P. Danielewicz, Workshop on Strong Interactions at Finite Temperatures, Santa Barbara, California, August 16-20, 1993.

QCD Sum Rules at Finite Temperature and Density, Y. Koike, *ibid*.

Single and Multiple Giant Resonances: Counterplay of Collective and Chaotic Dynamics; V.G. Zelevinsky, Gull Lake Nuclear Physics Conference on Giant Resonances, Gull Lake, Michigan, August 17-21, 1993.

Nucleus-Nucleus Collisions at Intermediate and Relativistic Energies; P. Danielewicz, XXIII Mazurian Lakes Summer School on Nuclear Physics, Piaski, Poland, August 18-28, 1993.

Coupling Between Fast and Slow Variables in Systems with Complex Spectra; Aurel Bulgac, Gordon Conference on Few Body Systems, Andover, New Hampshire, August 16-20, 1993.

Enhanced Charge State Distribution and High Ionization Efficiency of the SCECR; T.A. Antaya, 1993 American Chemical Society Meeting, Chicago, August 23-27, 1993.

Multifragmentation in Central Collision; W.G. Lynch, *ibid* (ACS Symposium on Fragmentation Phenomena).

Report on the Third International Conference on Radioactive Nuclear Beams; D.J. Morrissey, *ibid* (ACS Division of Nuclear Chemistry and Technology Symposium on the Technical and Scientific Issues of Radioactive Nuclear Beams).

Overview of Operating Projectile Fragment Radioactive Beam Facilities; B.M. Sherrill, *ibid*.

High-Energy Target Excitations in Inelastic Alpha Scattering; M. Thoennessen, *ibid* (ACS Symposium on Nuclear Structure Research with the New Arrays and Detectors).

Looking for Quark Droplets in Ultra-relativistic Nuclear Collisions; S. Pratt, American Chemical Society Meeting, Chicago, August 23-27, 1993.

Disappearance of Flow and Multifragment Emission; G.D. Westfall, *ibid*.

The SCECR High-B Mode and Frequency Scaling in ECR Sources; T.A. Antaya, International Conference on ECR Ion Sources 1993, Beijing, China, August 30, 1993.

Pion Correlations from Heavy Ion Collisions; W. Bauer, Theory Workshop on Meson-Nucleus Dynamics at Intermediate and High Energies, Argonne, Illinois, August 1993.

Interferometry Information from Relativistic Heavy Ion Collisions; W. Bauer, Rio de Janeiro International Workshop on Relativistic Aspects of Nuclear Physics, Rio de Janeiro, Brazil, August 1993.

Facets of Collective Expansion in Central Heavy-Ion Collisions; P. Danielewicz, International Workshop on the Dynamical Features of Nuclei and Finite Fermi Systems, Sitges, Spain, September 13-17, 1993.

Production of Light Composites at Large Angles in Energetic Reactions; P. Danielewicz, International Workshop on "Where Do We Stay in Multifragmentation", in Celebration of the 60th Birthday of J. Bondorf, Copenhagen, Denmark, September 22-24, 1993.

Rapid Multifragment Disintegration of Expanding Nuclear Systems; C.K. Gelbke, *ibid.*

The Onset of Multifragmentation; G.D. Westfall, *ibid.*

Design Study for a 250-MeV Proton Cyclotron for Cancer Therapy; H.B. Blosser, 28th European Cyclotron Progress Meeting, Jyvaskyla, Finland, September 1993.

Cluster Production in Nuclear Collisions; P. Danielewicz, NATO Advanced Study Institute on Hot and Dense Nuclear Matter, Bodrum, Turkey, September 26 - October 9, 1993.

Multifragmentation; C.K. Gelbke, *ibid.*

The Disappearance of Flow and Critical Behavior in Nuclear Collisions; G.D. Westfall, *ibid.*

Fission of Hot Nuclei; M.R. Thoennessen, Workshop on Large Amplitude Collective Motion, Institute for Nuclear Theory Program 12, October 1 - December 15, 1993, Seattle, Washington .

Exotic Modes of Nuclear Fragmentation; W. Bauer, Workshop on Multifragmentation, Asilomar, California, October 20, 1993.

Nuclear Structure Studies Far From Stability with High Energy Radioactive Beams; D.J. Morrissey, Fall Meeting of the Division of Nuclear Physics of the APS, Asilomar, California, October 20-23, 1993.

Viewing Relativistic Heavy-Ion Collisions with Two-Particle Correlations; S. Pratt, *ibid.*

Quo Vadis, BEVALAC Physics?; W. Bauer, Ninth High Energy Heavy Ion Study, Berkeley, California, October 25-29, 1993.

Multifragmentation Measured with the MSU Miniball; M.B. Tsang, *ibid.*

The Disappearance of Flow and Multifragment Emission; G.D. Westfall, *ibid.*

Simulation and Analysis of Large Particle Accelerators; M. Berz, Conference on Computational Physics, St. Louis, Missouri, October 1993.

The S800 Spectrometer; B.M. Sherrill, International Workshop on Radioactive Nuclear Beams Produced by Fragment-Separation Techniques, Varna, Bulgaria, October 1993.

High Resolution Neutron Wall; A. Galonsky, Workshop on Nuclear Reactions with Coupled Cyclotrons, East Lansing, November 12-13, 1993.

Forward Array; W.G. Lynch, *ibid.*

Radioactive Beams and the A1900 Separator; B.M. Sherrill, *ibid.*

Reaction Mechanism Tagging with the S800; B.M. Sherrill, *ibid.*

Production of Particle Unstable Nuclei; M. Thoennesen, *ibid.*

Future Directions for Reaction Physics; G.D. Westfall, *ibid.*

Upgrade: Conceptual Design and Project Overview; R. York, *ibid.*

Regularities and Chaos in the Dynamics of Particle Accelerators; M. Berz, Conference on Structure Development in Chaotic Systems, Munich, Germany, November 1993.

Rigorous Stability Estimates in Weakly Non-linear Systems; M. Berz, Symposium on Non-linear Dynamics, Theory and Applications, Hawaii, December 5-11, 1993.

Properties of Light Nuclei at the Driplines; S.M. Austin, Annual General Meeting of the TRIUMF User Group, Vancouver, Canada, December 7-8, 1993.

Symmetry, Chaos and Microscopic Collective Motion; V.G. Zelevinsky, National Institute for Nuclear Theory Program on Large Amplitude Collective Motion, Seattle, Washington, December 1993.

MSU THESIS TITLES

Kihun Joh, "Beam Dynamics Studies of Four-gap Superconducting Resonators"

Neng Jiu Ju, "Curvature Energy of Nuclei, Electronic Excitations of Carbon Clusters, and Thermal Properties of Sodium Clusters"

Tong Qing Li, "Multi-Fragmentation and Disappearance of Flow in Intermediate Energy Heavy-Ion Collisions"

Michael Lisa, "Impact Parameter-Gated Two-Proton Intensity Interferometry in Intermediate Energy Heavy Ion Collisions"

Catherine Mader, "Equilibrium and Non-Equilibrium Models for Particle Production in Heavy-Ion Collisions"

Larry Phair, "Multifragment Emission in Central Collisions of $^{36}\text{Ar}+^{197}\text{Au}$ at $E/A = 50, 80, \text{ and } 110$ MeV"

Brian Young, "Structure Studies of Lithium-11 and Lithium-10"

NSCL RESEARCH INTERN PROGRAM, SUMMER 1993

E. Kashy, W. Bauer, A. Galonsky, M. Hellstrom, W. Lynch, D.J. Morrissey,
R. Ronningen, and G. Westfall.

The outreach program of the NSCL included a program for pre-college teachers and students. The goal of this NSCL Research Intern Program was to provide teachers and students the opportunity to learn and understand some Nuclear Physics, and to carry out some experiments from which our knowledge and understanding is derived. It was aimed principally but not exclusively to serve participants from groups that are under-represented in the physical sciences, i.e., women and minorities.

This 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, and the instruction was divided among the participating teachers. They were in charge of conveying the information to the students who come 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/Demonstration of Physics Fundamentals' (with E. Kashy) and were repeated the second week. In addition, informal seminars were held for the teachers with MSU-NSCL Faculty in various areas of Nuclear Physics. These included:

1. 'Neutrons' with A. Galonsky
2. 'Conversation with a Nuclear Chemist' with D.J. Morrissey the first week and with Maggie Hellstrom the second week.
3. Radiation in our environment, with R. Ronningen.
4. Nuclear Theory: Some basic ideas, with W. Bauer.
5. Nuclear Reactions, with G. Westfall.

A key part of the program consisted of four hands-on laboratory experiments, under the direction of W. Lynch. The experiments were taken from the ISP209L physics laboratory course designed for non-science majors. The titles of the experiments were:

1. Probability vs Average
2. Human Reaction Times
3. Radioactive Background and Common Sources of Radiation
4. Neutron Activation of ^{109}Ag and Radioactive Decay of ^{110}Ag .

In order to buttress understanding, a set of problems was specifically assembled for this program. The problems dealt with fundamental concepts in Nuclear Physics, and required several weeks of computer work by one of MSU's REU students during summer '93, Sherry Wolfe, working

with NSCL faculty (EK, DJM) to be entered into the CAPA system. The teachers had the opportunity to answer the problems using MSU's newly developed CAPA system. Three problem sets (a total of 35-problems) reinforced their understanding and helped to lower the level of apprehension of the teachers faced with the task of having to solve problems. This allowed them to do so in a friendly, non-judgmental environment. The following week, the teachers supervised and helped the students with these problems, thus further confirming their own understanding.

The summer '93 program included 4 school teachers for two weeks and 13 students during the second week. The comments from teachers and students were highly positive, and several of their suggestions will be included in the later programs. This coming summer, the program will be known as PAN, Physics of Atomic Nuclei, and will include approximately 8 teachers and 30 pre-college students.

Ms. V. Simons, Outreach Coordinator for the National Superconducting Cyclotron Laboratory and for the Department of Physics and Astronomy, was responsible for getting information about the program to teacher and students, and for the selection of participants. In this task, she collaborated with R. Morin, Executive Director of the NSCL who also administered the financial aspects of the program. O. McHarris of the NSCL will be doing that task for the summer '94 program.

VISITORS IN 1993

Ross Abrams, Johns Hopkins
Dileep Agnihotri, University of Rochester
Thomas Alm, Rostock
Kjell Aleklett, Uppsala
Thilina Annakkage, University of Michigan
Anatoly Artukh, JINR
V. Balandin, Moscow
Mark Balbes, Ohio State University
Shawn Baldwin, University of Rochester
Louis Barbier, Goddard Space Flight Center
Mike Barciniak, Goddard Space Flight Center
Rich Bartman, TRIUMF
Augusto Bassi, University of Milan
Roberto Bassini, University of Milan
Didier Baumel, IPN, Orsay
Daniel Bazin, GANIL
Jim Beatty, Washington University
Fred Becchetti, University of Michigan
James Beene, Oak Ridge National Laboratory
Georg Berg, Indiana University Cyclotron
Russell Betts, Argonne National Laboratory
Robert Binns, Washington University
Mark Bird, National High Magnetic Field Laboratory
Jan Blocki, Inst. for Nuclear Studies, Swierk, Poland
Ciro Boiano, University of Milan
Aldo Bonasera, INFN, Catania
Richard Boyd, Ohio State University
Sergio Brambilla, University of Milan
Gennady Britvich, SSC Lab
Mauro Bruno, University of Milan
Galliano Busacchi, University of Milan
Brett Carlson, Sao José dos Campos
Christine Carpenter, Oberlin College
Mike Carpenter, Argonne National Laboratory
Nelson Carlin, University of São Paulo
Randy Cary, Virginia State University
Luigina Celano, University of Milan
Jerry Chance, University of California at Davis
Bob Charity, Washington University
Shaolin Chen, Indiana University Cyclotron Facility
Sergio Chiodini, University of Milan
Frank Chloupek, Ohio State University
David Christen, Oak Ridge
Eric Christian, Goddard Space Flight Center
Nicola Colonna, University of Milan
Charles Coffing, Ball State University
Homer Conzett, retired from LBL
Rick Cook, California Institute of Technology
Angelo Cortesi, University of Milan
J. Donald Cossairt, Fermilab
Stefan Coutu, University of Michigan
David Crary, Washington University
Mats Cronqvist, Lawrence Berkeley Laboratory
Maky D'Agostino, University of Milan
Oleg Dalkarov, Moscow Lebedev Physical Institute
Brian Davin, Indiana University Cyclotron Facility
Travis Day, Oregon State University
Ferenc Deak, Budapest
Jim Dempsey, Washington University
Romualdo de Souza, Indiana Univ. Cyclotron Facility
Sabine deVoghel, Marketing Vice President for IBA, Belgium
Paul DeYoung, Hope College
Bill Diamond, Chalk River
John DiCello, Clarkson and Johns Hopkins Universities
Massimo DiToro, LNS/INFN Catania
Paul Dowkoutt, Washington University
Bob Dunford, Argonne National Laboratory
John Edens, Western Michigan University
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Joe Finck, Central Michigan University
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Chuck Foster, IUCF
Dan Fox, Indiana University Cyclotron Facility
Ken Frankel, LBL
Manoru Fujiwara, RCMP, Osaka
Charles Gale, McGill University
Sydney Gales, IPN, Orsay
Fangil Gareev, Dubna
Edmundo Garcia, University of Maryland
Brownlee Gauld, California Institute of Technology
Hans Geissel, GSI
Klaus Geiger, University of Minnesota
Peter Geltenbort, ILL, Grenoble
Don Gemmel, Argonne National Laboratory
Joachim Goerres, Notre Dame
Nina Golubeva, Russian Academy of Sciences
Tim Graber, Argonne National Laboratory
Fabiana Gramegna, University of Milan
Henry Griffin, University of Michigan
Eckart Grosse, GSI
Xinyeng Gu, Ohio State University
Daniel Guerreau, GANIL
Roger Haar, Western Michigan University
Einar Hagebo, Oslo
Kevin Haglin, McGill University
Mel Halbert, Oak Ridge National Laboratory
Rick Harkewicz, Argonne National Laboratory
Lawrence Heilbronn, Lawrence Berkeley Laboratory
Tom Hemmick, SUNY at Stony Brook
Mike Hencheck, Ohio State University
Dale Henderson, Argonne National Laboratory
Mike Herman, Johns Hopkins
Akira Hitachi, University of Notre Dame
Dag Horn, Chalk River
Akos Horvath, Budapest
Mahir Hussein, University of São Paulo
Ileana Iori, University of Milan
Felix Izrailev, Novosibirsk, Russia
Joachim Janecke, University of Michigan
Dan Jerrestam, Uppsala
Jan Jogman, IPN, Orsay

Heather Johnston, Texas A&M
 Elliot Kanter, Argonne National Laboratory
 Jerry Karsh, Goddard Space Flight Center
 Jiro Kasagi, Tohoku University
 Richard Kerchner, Oak Ridge National Laboratory
 Assen Kirov, Washington University
 Adam Kiss, Budapest
 Joseph Klarmann, Washington University
 Jim Kolata, Notre Dame
 Olaf Knospe, Dresden
 Steven Koonin, California Institute of Technology
 Keith Krombel, Goddard Space Flight Center
 Kuniharu Kubodera, University of South Carolina
 Gerd Kunde, GSI
 Walter Kutschera, Argonne National Laboratory
 Roy Lacey, Stony Brook
 Serge Lamisse, Ion Beam Application Corp, Belgium
 Ken Lamkin, Notre Dame
 Alex Lande, Groningen
 Karlheinz Langanke, Calif. Institute of Technology
 Henri Laurent, IPN, Orsay
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