BNL 34518
Fifteenth Edition
Informal Report

BROOKHAVEN NATIONAL LABORATORY
Upton, Long Island
New York 11973-5000

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Collider Accelerator Complex

AGS Experiments 1996 ♦ 1997 ♦ 1998 ♦ 1999

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AGS Experiments - 1996 1997 1998 1999

P. Lo Presti

March 1999

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MASTER

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AGS Experiments - 1996, 1997, 1998 and 1999

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This is the *fifteenth*. Please forward suggestions and changes for future editions to:

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Upton, New York 11973-5000 U.S.A.

The Cutoff Date for Approved Experiments Included In This Edition is March 1999.

AGS As Run Schedule, FY1997

By: Ralf Prigl Date: 9-11-97

Normal Running
Detector Tests
Single Cycle on Demand
Facility Commissioning

[illegible]

AGS AS Run Schedule, FY1998

Normal Running
Cycle on Demand

By: W. Meng, Date: 2 Feb 99
hours to 1 Oct 98

			FY98																										
			AGS Beam/Mode		Fe		pp		S		Au		Fe		S		p (SEB)		p (FEB)										
Beam	Exp #	Experiment Spokespersons or Activity	Charged Hours	Approved Hours	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct												
					7 14 21 28	4 11 18 25	2 9 16 23 30	6 13 20 27	4 11 18 25	3 10 17 24 31	7 14 21 28	5 12 19 26	2 9 16 23 30	7 14 21 28	4 11 18 25	1 8 15 22 29	6 13 20 27												
		AGS Startup																											
		AGS/Booster Studies	as required																										
		BLIP	1564																										
A1	852	Cason/Chung/Seth	5309	6109																									
A1	900	Kwiatkowski/Viola	1545	1827																									
A2	865	Zeller	6269	6500																									
A3	941	Huang/Majka	261	400																									
A3	864	Sandweiss	2709	3500																									
A3	919	Vazquez	319	300																									
B1	925	Makdisi/Yokosawa	317	384																									
B1	943	Dietrich/Hartouni	244	300																									
B1	944	Binns	80	100																									
B1	946	Westphal	3	2																									
B2		Test Beam																											
C1	850	Carroll/Heppelman	3453	4000																									
C4	787	Bryman/Littenberg/Smith	14007	15500																									
C4	940	Molzon	4	4000																									
C5	896	Crawford/Hallman	1052	1000																									
C6	913	Sadler/Spinka/Tippens	320	700																									
C6	914	Kycia/Kruglov/Nelkens	337	700																									
C8	907	Hungerford/Peng	1501	1450																									
C8	931	Dehnhard/Hungerford/Zeps	0	800																									
D6	906	Chrien/Fukuda/Rusek	903	1600																									
D6	929	Kishimoto	763	800																									
V1	821	Hughes/Morse/Roberts	996	2100																									
AGS	880	Roser/Lee	729	320																									

Legend

S Scheduled Shutdown
 p proton beam (25 GeV/c)
 pp polarized protons
 SEB slow extracted beam
 FEB fast extracted beam

AGS AS Run Schedule, FY1999 (in progress)

By: P. Pile/W. Meng/H. Huang, Date: 20 Mar 99
hours to 8 Mar 99

AGS Beams, July 98

Beam	GeV/c	$\delta p/p$ (% fwhm)	Prod. Angle (deg)	$\Delta\Omega$ (msr)	Flux / 10^{13} 24 GeV/c protons on target						GeV/c	Purity	Remarks
					K^+	K^-	p	$\bar{p}$	π^+	π^-			
Separated Charged Particle Beams													
C4	≤ 0.83	4	0	12.0	4.6×10^6	1.5×10^6	1.5×10^9	1.0×10^6	6.0×10^9	6.0×10^9	0.80	$\pi^+/K^+ = 0.4$	L = 18 m - "LESBIII" ~ 1×10^6 stopped $K^+/10^{13}$ protons
C6,C8	≤ 0.75	5	5	10.0	1.0×10^6	3.3×10^5	3.3×10^8	4.6×10^4	2.0×10^9	2.0×10^9	0.70	$\pi^-/K^- = 5$ $\pi^+/K^+ = 1$	L = 15 m - "LESBII"
D6	≤ 1.9	6	5	1.6	5.5×10^6	2.3×10^6	3.0×10^8	1.1×10^6	4.9×10^8	4.1×10^8	1.80	$\pi^-/K^- = 0.8$ $\pi^-/\bar{p} = .07$	L = 31 m - "2GEV"
Unseparated Charged Particle Beams													
A1*	5-28	3	0	0.2	1.9×10^6	2.9×10^4	5.0×10^9	2.3×10^3	3.0×10^7	1.0×10^7	18		L = 130 m to MPS - "HEUB"
A2	< 6.5	5	3.5	0.75	5.8×10^7	1.9×10^7	6.9×10^8	6.3×10^6	1.3×10^9	8.8×10^8	6		L = 34 m - "6GEV"
A3*	1-28	4	0	0.1			6.0×10^8		1.0×10^8	4.0×10^7	14		Primarily HI "OR" with A1
B1*	5-28	3	0	0.05			3.0×10^8		3.0×10^7	2.0×10^7	14		HI/Test Beam "OR" with B5
B1'	0.5-28	8	3	.001			3.0×10^4		6.0×10^4	4.0×10^4	5		L = 56 m - Test Beam
B2	< 9	5	6	0.5	3.4×10^5	1.2×10^5	8.5×10^6	9.5×10^4	1.2×10^7	9.0×10^7	4		L = 40 m - Test Beam
C1	1-20	5	0	0.8	3.0×10^7	3.5×10^6	1.0×10^9	0.7×10^6	3.5×10^8	1.6×10^8	13		L = 100 m - "OR" with C5
C5*	1-28	2	0	0.15			1.0×10^8				13		L = 81 m - "OR" with C1
Neutral Beam													
B5	2-20		1-4.5	0.1	K_L^0 flux = 1.3×10^8 @ 3.75°						2-20	$n/K_L^0 = 20$	L = 10 m - "OR" with B1
Muon Channel													
D2	0.025-0.15	9 (π) 30 (μ)	135 (π)	24 (π)	μ^+ flux = 2.0×10^6 Surface μ^+ flux = 2.0×10^6								L = 12 m Inactive, not yet commissioned
Neutrino Beam													
U					ν flux = $2.0 \times 10^{10}/m^2$ (Wide Band) $\bar{\nu}$ flux = $1.4 \times 10^{10}/m^2$ (Wide Band)								Not Presently Available FEB Flux avg. over 1.5 m R. $\langle E \rangle = 1.4$ GeV/c ² Wide Band
g-2 π - μ Transfer Line													
V1	< 3.0	0.6	0		π^+ flux = 1.7×10^8 μ^+ flux = 7×10^5						3.0		L = 120, for injection to g-2 ring commissioned in 1996

* These 0° beam lines can be used for full energy polarized protons and/or heavy ion beams

AGS Experimental Area

FY96 Physics Program – As Run

30 Sep 96

NASA: 1 Oct – 13 Oct 95, 1 GeV/nucleon Fe

HI: 25 Oct – 20 Dec 95, 11.6 GeV/c/nucleon Au

27 Dec – 24 Jan 96, 4 & 2 GeV/nucleon Au

proton: 1 Mar – 27 Jun 96, 24 GeV/c

DOE-DP: 28 Jun – 9 Jul 96, 24 GeV/c proton

polarized protons (ring): 10 – 15 Jul 96

AGS Experimental Area

FY97 Physics Program - As Run

11 Aug 97

NASA : 21 - 30 Oct 96, 1 GeV/nucleon Fe

HI : 4 Nov - 2 Dec 96, 6 & 8 GeV/nucleon Au

3 Dec 96 - 31 Jan 97, 11.7 GeV/c/nucleon Au

Proton (SEB): 1 Apr - 3 Jun 97, 25 GeV/c

Proton (FEB) : 3 Jun-12 Jul; 19-21 Jul 97, 25 GeV/c

Polarized Proton (AGS Ring) : 12-18 Jul 97

I10, E880
Partial Snake

AGS Ring, E932
 $\mu\mu$ Collider Studies

D2- μ Channel

D-Target

A-Target

E906, $\Lambda\Lambda$ Hypernuclei - CDS
{E937, Radiation Induced Upsets
E929, Λ Hypernuclei - NaI

A2-6GeV, E865, $K^+ \rightarrow \pi^+ \mu^+ e^-$

A3, E864, Strangelets (HI); E898, NASA (Fe)

B-Target

A1-MPS, E895, QGP (HI); E852, Exotics

C-Target

B2-Test Beam (many users)

B'-Target

B1, E917, QGP (HI); E925, RHIC Spin
E926, $K_L^0 \rightarrow \pi^0 \nu \bar{\nu}$ (Tests)
Test Beam - PHENIX

C4-LESBIII
E787, $K^+ \rightarrow \pi^+ \nu \bar{\nu}$

C'-Target

B5, E935, Gluino Search

C8-LESBII
E907, Λ Hypernuclei - NMS

C1-EVA

C5, E896, H-Search (HI)
E922 & E934, NASA Tests (HI)

C6-LESBII
E913, E914, Baryon Spectroscopy - Crystal Ball

E821, μ g-2

V1, π - μ Beam Line

U, {E938, Neutron Spallation
E939, APT

V-Target

U Line

RHIC Transfer Line

Experiment Multiplicity

SEB ≤ 10

SEB+FEB ≤ 12

20 April 99

AGS Experimental Area

FY98-99 Physics Program- Planned/In Progress

Proton: 25 weeks 25 GeV/c SEB
12 weeks 25 GeV/c FEB
4 weeks Polarized Protons

HI: 4 weeks 11.7 GeV/c/n Au
8 weeks RHIC Commissioning

NASA: 2 weeks 0.6-1 GeV/n Fe
1 day 11.7 GeV/n Au

Experiment Multiplicity
SEB ≤ 10
SEB+FEB ≤ 12

LIST OF EXPERIMENTS

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821	A New Precision Measurement of the Muon g-2 at the Level of 0.35 PPM Boston/BNL/Budker Institute/Cornell/Fairfield/Heidelberg/Illinois/LBL/ Max Planck Inst/Minnesota/KEK/Tokyo/Yale <i>Hughes, Morse, and Roberts</i>	3
850	EVA, A Solenoidal Detector for Large Angle Exclusive Reactions Experiment 850-Determining Color Transparency to 22 GeV/c Auckland/BNL/JINR/Mt. Holyoke/Penn St/Massachusetts-Dartmouth/Tel-Aviv <i>Carroll and Heppelmann</i>	5
852	Search for Mesons with Unusual Quantum Numbers BNL/Indiana/Massachusetts-Dartmouth/Moscow St/Northwestern/ Notre Dame/IHEP-Protvino/RPI <i>Cason and Chung</i>	7
864	Production of Rare Composite Objects in Relativistic Heavy Ion Collisions BNL/ Iowa St/Ames Lab/MIT/Penn St/Purdue/Bari/Massachusetts/Vanderbilt/ Wayne St/Yale/UCLA <i>Sandweiss</i>	9
865	Proposal to Perform an Improved Search for the Decay $K^+ \rightarrow \pi^+ \mu^+ e^-$ BNL/Bern/Connecticut/Hampton/INR-Moscow/New Mexico/Paul Scherrer Inst/Basel/Pittsburgh/Tbilisi St/Yale/Zurich <i>Zeller</i>	11
866	Studies of Particle Production at High Baryon Density Using the Au Beam BNL/Columbia/INS-Tokyo/Kyoto/LLL/Maryland/MIT/NYU/UC-Space Sciences Lab/UC-Riverside/Tokyo/Tsukuba/Yonsei <i>Chasman, Hamagaki, and Steadman</i>	13
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*Summary
Of
Experiments*

E787 DETECTOR

EXPERIMENT 787 – A STUDY OF THE DECAY $K^+ \rightarrow \pi^+ \nu \bar{\nu}$

SPOKESMEN: D. A. BRYMAN, L. S. LITTENBERG, A. J. S. SMITH

- **Brookhaven National Laboratory**
S. Adler, M. S. Atiya, I-H. Chiang, M. Diwan, J. S. Frank, J. S. Haggerty, V. Jain, S. Kettell, T. F. Kycia,
K. K. Li, L. S. Littenberg, C. F. Ng, R. C. Strand, C. Witzig
- **Fukui University**
M. Miyajima, Y. Tamagawa
- **KEK-National Laboratory for High Energy Physics**
M. Aoki, T. Inagaki, S. Kabe, M. Kobayashi, T. K. Komatsubara, Y. Kuno, M. Kuriki, T. Morimoto,
N. Muramatsu, H. Okuno, K. Omata, A. Otomo, T. Sato, T. Shinkawa, S. Sugimoto, K. Ukai,
Y. Yoshimura
- **Osaka University** - T. Nakano
- **Princeton University**
A. Bazanko, P. D. Meyers, D. R. Relyea, F. C. Shoemaker, A. J. S. Smith, J. R. Stone
- **TRIUMF**
P. Bergbusch, E. W. Blackmore, D. A. Bryman, S. Chen, A. Konaka, J. A. Macdonald,
J. Mildenerger, T. Numao, J-M. Poutissou, R. Poutissou, G. Redlinger
- **University of Alberta**
P. Kitching, S. Ng, R. Soluk

Experiment 787 is a search for reactions of the type $K^+ \rightarrow \pi^+ XX'$, where X is a weakly interacting light neutral particle. The experiment is sensitive to such decays at the 10^{-10} level. The prime candidate is $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ which provides a uniquely stringent test of the Standard Model and its parameters because it is the only experimentally accessible process that is dominated by an unambiguously calculable higher order weak interaction. Two body decays $K^+ \rightarrow \pi^+ X$ are also searched for to place constraints on the existence of a variety of hypothetical particles such as axions, familons, hyperphotons and supersymmetric neutrals predicted by extensions to the SM. Several other rare decays including $K^+ \rightarrow \pi^+ \gamma \gamma$, $K^+ \rightarrow \pi^+ \mu^+ \mu^-$, $\pi^0 \rightarrow \nu \bar{\nu}$, and $\pi^0 \rightarrow \gamma XX$ are also being investigated. The former two, $K^+ \rightarrow \pi^+ \gamma \gamma$ and $K^+ \rightarrow \pi^+ \mu^+ \mu^-$, were discovered by this experiment. Recently a candidate for $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ was observed by E787.

EXPERIMENT 821

Home Page • <http://www.phv.bnl.gov/e2muon/home.html>

EXPERIMENT 821 - A NEW PRECISION MEASUREMENT OF THE MUON G-2 AT THE LEVEL OF 0.35 PPM

SPOKESMEN: V.W. HUGHES, W.M. MORSE, B.L. ROBERTS

- **Boston University** - R.M. Carey, W. Earle, E. Efstathiadis, M. Hare, E.S. Hazen, F. Krienen, J.P. Miller, O. Rind, B.L. Roberts, L.R. Sulak, A. Trofimov
- **Brookhaven National Laboratory** - J. Benante, H.N. Brown, G. Bunce, G.T. Danby, R. Larsen, Y. Y. Lee, W. Meng, W.M. Morse, C. Pai, R. Prigl, R. Sanders, Y. K. Semertzidis, L. Snodstrup, T. Talerico, M. Tanaka, D. Warburton
- **Budker Institute for Nuclear Physics** - V.P. Druzhinin, G.V. Fedotov, B.I. Khazin, I. Logashenko, N. Ryskulov, S. Serednyakov, Yu.M. Shatunov, E. Solodov
- **Cornell University** - Y. Orlov
- **Fairfield University** - D. Winn
- **Max Planck Institut fur Physik** - U. Haeberlen
- **National Laboratory for High Energy Physics (KEK)** - A. Yamamoto
- **Tokyo Institute of Technology** - M. Iwasaki, M. Kawamura
- **Yale University** - H. Deng, S.K. Dhawan, F.J.M. Farley, M. Grosse-Perkecamp, V.W. Hughes, D. Kwall, W. Liu, J. Pretz, S. I. Redin, A. Steinmetz
- **University of Heidelberg** - A. Grossmann, K. Jungmann, G. zu Putlitz
- **University of Illinois** - P. Debevec, W. Deninger, F. Gray, D.W. Hertzog, C. J. G. Onderwater, C. Polly, S. Sedykh, M. Sossong, D. Urner
- **University of Minnesota** - P. Cushman, L. Duong, S. Giron, J. Kindem, I. Kronkvist, R. McNabb, D. Miller, C. Timmermans, D. Zimmerman

The anomalous gyromagnetic ratio of the muon ($g-2$) will be measured to 0.35 ppm or a factor of 20 times better than it is currently known. The predicted contribution to ($g-2$) from the first and second order $W^\pm$ and Z^0 radiative corrections is predicted to be 1.3 ppm, so this experiment will provide a direct test of the electroweak radiative corrections, and hence of the renormalizability of the Glashow-Weinberg-Salam theory. Since a_μ is sensitive to a wide range of non-standard model effects there is a window in which to search for new physics. W or muon substructure, super-symmetry and the existence of new gauge bosons are several possibilities. A 14 m diameter superfermic muon storage ring is now operational. Data collection began in FY 1997.

**EVA, A SOLENOIDAL DETECTOR FOR LARGE ANGLE EXCLUSIVE REACTIONS
EXPERIMENT 850 - DETERMINING COLOR TRANSPARENCY TO 22 GeV/c**

SPOKESMEN: A.S. CARROLL AND S. HEPELMANN

- **Brookhaven National Laboratory**
D.S. Barton, G. Bunce, A.S. Carroll, S. Gushue, Y.I. Makdisi, T. Roser
 - **J.I.N.R., Dubna**
Y. Panebratsev, S. Shimanskiy, I. O. Tsvetkov
 - **Mt. Holyoke College** - H. Nicholson, C. S. Sutton
 - **Pennsylvania State University**
V. Baturin, S. Heppelmann, A. Leksanov, E. Minor, A. Ogawa, D. Tsalov
 - **Tel-Aviv University**
H. Aclander, J. Alster, S. Durant, E. Kosonovsky, I. Mardor, Y. Mardor, I. Navon, E. Piasetzky
 - **University of Auckland** - N. Christensen
 - **University of Massachusetts-Dartmouth** - J.J. Russell
-

In order to extend the range and sensitivity of measurements of large angle exclusive reactions, a new solenoidal detector, EVA, has been built. This detector increases the solid angle acceptance by over a factor of 20 over the existing dipole detector of E834, and provides for momentum measurements of all outgoing particles. The initial experiment, E850, has made new determinations of color transparency for carbon nuclei. Also measurements of carbon spectral functions at large momentum transfers were made. With a neutron detector, the correlations of neutrons associated with quasi-elastic (p,2p) reactions were determined. The solenoidal magnet which has not had reliable operation, has been substantially rebuilt, and now performs in a satisfactory manner.

EXPERIMENT 852 - SEARCH FOR MESONS WITH UNUSUAL QUANTUM NUMBERS

SPOKESMEN: N. CASON AND S.U. CHUNG

- **Brookhaven National Laboratory** - S.U. Chung, K. Danyo-Blackett, R. W. Hackenburg, K. Olchanski, D.P. Weygand, H.J. Willutzki
- **Indiana University** - B.B. Brabson, R.R. Crittenden, A.R. Dzierba, R. Gardner, J. Gunter, R. Lindenbusch, D.R. Rust, E. Scott, P.T. Smith, T. Sulanke, S. Teige,
- **University of Massachusetts-Dartmouth** - Z. Bar-Yam, J. Dowd, P. Eugenio, M. Hayek, W. Kern, E. King
- **Moscow State University** - L. I. Belzer, V. A. Bodyagain, A. Demianoi, A.M. Gribushin, O.L. Kodolva, V.L. Korotkikh, M.A. Kostin, N. Kurglov, A.I. Ostrovidov, A. Proskuryakov, L. I. Sarycheva, N. B. Sinev, I. N. Vardanyan, A. A. Yershov
- **Northwestern University** - D. S. Brown, T. Pedlar, K. Seth, J. Wise, D. Zhao
- **University of Notre Dame** - T. Adams, J.M. Bishop, N.M. Cason, E.I. Ivanov, J.M. LoSecco, J. J. Manak, A. Sanjari, W. D. Shephard, D. L. Stienike, S. A. Taeger, D.R. Thompson
- **Institute for High Energy Physics - Protvino, Russia** - S. Denisov, V. A. Dorofeev, A. Dushkin, I. A. Kachaev, V. Kochetkov, V. Lipaev, A. V. Popov, D. I. Ryabchikov, I. Shein, A. Soldatov
- **Rensselaer Polytechnic Institute** - G. Adams, J. P. Cummings, J. Kuhn, J. Napolitano, M. Nozar, J. Smith, D. White, M. Witkowski

Despite a number of experimental searches there is still no unambiguous candidate for a glueball, hybrid or four-quark state, although QCD predicts such objects. However, there are some tantalizing states, among them the $M(1405)$ which has exotic $J^{PC} = 1^{-+}$ and the scalar $G(1590)$ which has unusual branching ratios for a quark-antiquark state.

The experimenters will study these and other states, concentrating on decay modes of mesons with multi-photons and 0, 1 or 2 charged particles. The detector is built around the MPS. The target will be surrounded by a CsI veto, charged particle detectors and a scintillation counter. The target will be followed by charged particle detectors, a Cerenkov counter and a 3000-element lead glass calorimeter to detect photons from meson decays.

BNL AGS Experiment E864

**EXPERIMENT 864 - PRODUCTION OF RARE COMPOSITE OBJECTS IN
RELATIVISTIC HEAVY ION COLLISIONS**

SPOKESMAN: J. SANDWEISS

- **Ames Laboratory** - H. Skank, G. Sleege
- **Brookhaven National Laboratory** - T. G. Throwe
- **Iowa State University** - L. Ewell, K. Haversten, J. C. Hill, B. Libby, F. K. Wohn
- **Massachusetts Institute of Technology** - E. S. Hafen, P. Haridas, I. Pless, G. Van Buren
- **Penn State University** - T. Armstrong, R. A. Lewis, G. A. Smith
- **Purdue University** - R. M. Davies, A. S. Hirsch, N. T. Porile, R. P. Scharenberg, B. K. Srivastava,
B. C. Stringfellow, M. L. Tincknell
- **Vanderbilt University** - V. S. Greene, J. Reid
- **Wayne State University** - R. Bellwied, B. Bennett, T. Cormier, J. Hall, C. Pruneau
- **Yale University** - S. Coe, N. George, J. Lajoie, R. D. Majka, J. Nagle, J. K. Pope, F. S. Rotondo,
J. Sandweiss, B. Shiva Kumar, A. J. Slaughter
- **University of Bari, Italy** - P. Spinelli
- **University of California-Los Angeles** - K. Barish, H. Z. Huang
- **University of Massachusetts** - M. S. Z. Rabin

The experimenters have begun to carry out a systematic set of measurements and searches for "composite" objects produced in high energy heavy ion collisions. These measurements are aimed at studies utilizing the heaviest ions available at the AGS, including gold ions. A major focus of the experiment is on charged composites; however, studies of neutral systems are also considered significant in the study. The experiment is designed to study particles produced in the central region of rapidity which are produced in central collisions. Since composite systems must be produced by the overlap of particles produced in the collision, it is expected that composites will be made mostly in the central rapidity region where overlaps would be most probable.

E865 Apparatus
Plan Diagram

EXPERIMENT 865 - PROPOSAL TO PERFORM AN IMPROVED SEARCH FOR THE DECAY

$$K^+ \rightarrow \pi^+ \mu^+ e^-$$

SPOKESMAN: M. E. ZELLER

- **Brookhaven National Laboratory** - D. Lazarus, L. Leipuner, H. Ma, B. Magurno, P. Rehak
- **Hampton University** - K. Assamagan, K. Baker
- **High Energy Physics Inst. Tbilisi State University** - N. Amaglobeli, Y. Bagaturia, D. Mazavia, T. Sachelashvili
- **Institute for Nuclear Research, Academy of Sciences of Russia (Moscow)** - G. S. Atoian, S. N. Gninenko, V. V. Issakov, V. Lebedev, A. A. Poblaguev, V. Postoev, A. Proskuryakov
- **Paul Scherrer Institute** - J. Egger, W. D. Herold, H. Kaspar, H. Weyer
- **Yale University** - D. Bergman, S. Dhawan, H. Do, W. Majid, M.E. Zeller
- **University of Basel** - W. Menzel
- **University of Bern** - J. Gasser
- **University of Connecticut** - J. Lozano
- **University of New Mexico** - J. Armendariz, B. Bassalleck, S. Eilerts, H. Fischer, J. Lowe, R. Stotzer, D. Wolfe
- **University of Pittsburgh** - R. Appel, C. Felder, B. Giles, D. E. Kraus, J.A. Thompson
- **University of Zurich** - S. Pislak, P. Robmann, P. Truoel

E865, a second generation search for $K^+ \rightarrow \pi^+ \mu^+ e^-$ at the branching ratio level of $\sim 3 \times 10^{-12}$, a factor of 70 improvement over the previous limit of 2.1×10^{-10} . Data obtained in the FY95 run show a clear $K^+ \rightarrow \pi^+ \mu^+ e^-$ signal above background visible on one data tape or about one shift of running. The branching ratio for this decay was measured to be 2.8×10^{-7} in E851 and a few hours of running gathers more events than the world sample of 41 events that existed prior to the BNL rare kaon decay program. From this rate and those for $K^+ \rightarrow \pi^+ \pi^+ \pi^-$ and $K^+ \rightarrow \pi^+ \pi^0$ followed by $\pi^0 \rightarrow e^+ e^- \gamma$ we estimate our current branching ratio sensitivity to be $< 5 \times 10^{-11}$ for $K^+ \rightarrow \pi^+ \mu^+ e^-$, well beyond 2.2×10^{-10} obtained in E777.

An upgrade of the data acquisition system should result in a factor of two increase in data rate in FY96. Additions to the experiment include special triggering electronics for the decay $K^+ \rightarrow \pi^+ \mu^+ \mu^-$ and a beam tracking detector in order to improve vertex reconstruction and sensitivity to rare decays with missing energy.

**EXPERIMENT 866 - STUDIES OF PARTICLE PRODUCTION AT HIGH BARYON DENSITY
USING THE AU BEAM**

CO-SPOKESMEN: C. CHASMAN

ALTERNATING CO-SPOKESMEN: H. HAMAGAKI AND S. STEADMAN

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- **Columbia University** - I. Chemakin, C. Y. Chi, B. A. Cole, M. Moulson, S. Nagamiya, F. Wang, Y. Wang, Y. Wu, X. Yang, W. A. Zajc
- **Institute for Nuclear Study-University of Tokyo** - Y. Akiba, H. Hamagaki, S. Homma, H. Sako
- **Kyoto University** - H. Kaneko
- **Lawrence Livermore Laboratory** - H. C. Britt, M. N. Namboodiri, T. Sangster, R. Soltz, J. H. Thomas
- **Massachusetts Institute of Technology** - L. Ahle, M. Baker, V. Cianciolo, J. Dunlop, G. Heintzelman, C. Ogilvie, J. Ryan, S. G. Steadman, G. S. F. Stephens, D. Woodruff, H. Yao
- **New York University** - B. Budick
- **Yonsei University** - J. Kang, E. J. Kim
- **University of California, Space Sciences Laboratory** - H. J. Crawford, J. Engelage, E. Judd
- **University of California at Riverside** - J. Chang, W. Eldredge, S.-Y. Fung, H. Liu, R. Seto, H. Xiang, Q. Xu, Q. Zhu
- **University of Maryland** - E. Garcia, A. Mignerey, J. Shea
- **University of Tokyo** - R. S. Hayano
- **University of Tsukuba** - A. Kumagai, K. Kurita, Y. Miake, S. Sato, K. Yagi

In keeping with the original purpose of E802 and E859, this experiment will continue the investigation of semi-inclusive single particle spectra using the gold beam: (1) to measure the particle momentum spectra as a function of p_t and y' (2) to find how these cross sections vary with "central" or "peripheral" collisions as taken from the event characterizing detectors; (3) to measure two-particle correlations; (4) to look for systemic variations in the cross sections with different beams and targets so as to clarify the reaction dynamics; and (5) to seek evidence in this measurement for the production of very dense nuclear matter, or ultimately, the quark-gluon plasma.

Schematic diagram of the emulsion stack exposures.

Schematic diagram of the emulsion chamber exposures.

**EXPERIMENT 868 - INTERACTIONS OF 10.6 GeV/NUCLEON¹⁹⁷ AU NUCLEI
IN NUCLEAR EMULSIONS**

SPOKESMAN: C.J. WADDINGTON

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 - **Institute of Theory and Experimental Physics Moscow**
A.I. Dubinina, O.K. Egorov, E.D. Kolganova, E.A. Pozharova, T.Yu. Skorotko, V.A. Smirnitski
 - **Louisiana State University**
M.L. Cherry, P. Dienes-Jones, W.V. Jones, K. Sengupta, J.P. Wefel
 - **University of Minnesota - C.J. Waddington**
-

The Krakow-Louisiana-Minnesota (KLMM) collaboration has previously exposed small stacks of nuclear emulsions to the light nuclei beams available from the AGS, Exp. 808. The results of this work, when combined with similar exposures of stacks and chambers made at CERN to higher energy beams, EMU07, have been reported in a number of published papers. In April 1992, when beams of heavier nuclei became available with the commissioning of the Booster, the collaboration exposed stacks and chambers of nuclear emulsions to a beam of gold nuclei with a nominal energy of 10.6 GeV/nucleon. Excellent exposures were obtained and the emulsions successfully processed at Dubna. Analysis by Minnesota and Krakow of the interactions in these emulsions has been completed and some of the results published.

Another exposure, conducted by Minnesota, was made in January 1996 to a beam of 4.0 GeV/n gold nuclei. These emulsions have been processed in Dubna and returned to Krakow, where they will be analyzed. Inspection of these emulsions show that they were successfully exposed but are characterized by a heavy background.

The UHIC experiment configuration for the 1996 Brookhaven AGS run.

The ion chambers are designated with I#, the Cherenkov detectors with C#, the multiwire proportional position-sensitive counters with MW, and the TIGER test scintillator instruments with S#. The position of the Pb degraders used to lower the energy of the beam in some runs is designated with D, and the position of the automatic target changer is designated with T. In the 1996 BNL AGS run, we investigated interactions of 0.9 - 4 GeV/nuc gold in CH2 and C targets (from which H cross-sections are obtained) as well as Al, Cu, Sn and Pb targets.

**EXPERIMENT 869 - MEASUREMENT OF FRAGMENT YIELDS FOR 14 GeV/NUCLEON
AU + X COLLISIONS**

SPOKESMAN: C. J. WADDINGTON

- **Caltech** - J. R. Cummings, T. L. Garrard, E. C. Stone
- **Washington University** - W. R. Binns, L. Y. Geer, J. Klarmann
- **University of Minnesota** - B.S. Nilsen, C. J. Waddington

This experiment was proposed in order to continue a study of the fragmentation of ultra heavy, UH, nuclei begun at the Bevalac as part of a program of cosmic ray studies. It required additional experiments using heavy ion beams at the Brookhaven AGS. The experiments at the AGS extended the energy range of the measurements upwards, to match the energies of the majority of observed cosmic ray nuclei. These measurements will improve our ability to predict the partial cross sections for the production of fragments and allow better calculations of the abundances of the cosmic ray UH nuclei at the sources by taking account of the effects of propagation on the observed abundances. These measurements also extend our current studies of the nuclear physics topics of factorization, limiting fragmentation, charge pickup, Coulomb disassociation and fission.

The detector array used during exposures to the AGS gold beam in April 1992 and January 1996 is shown. It consists of a combination of ion chambers and Cherenkov counters, which identify the particles entering a target and then measure the sum of the charges emitted from interactions in the targets. During the 1992 exposure, 10.6 GeV/n gold projectiles were allowed to fall on targets of polyethylene, carbon, aluminum, copper, tin and lead. In each case sufficient data was taken to determine partial cross sections of 10 mb with better than 10% accuracy. In addition, a fragmentor was placed in the primary beam, generating secondary beams of fragments. Sufficient of these fragments were generated to allow partial cross sections to be determined in the targets for all projectiles between $Z = 79$ and 70 . The excellent resolution of the detector array allows the identification of fragments with charges as low as $Z = 50$ coming from gold projectiles.

In January 1996 a beam of 4.0 GeV/n gold nuclei was used in a similar set-up. In addition, data were taken at seven other lower energies using a combination of internal and external degraders. These results allowed a determination of the energy dependence of the partial cross sections, which will be very important in modeling the propagation of the heavy cosmic ray nuclei through the interstellar medium.

EXPERIMENT 871

Home Page • <http://dec1.hep.utexas.edu>

E871 Schematic Plan View

EXPERIMENT 871 - A NEW SEARCH FOR VERY RARE K_L^0 DECAYS

SPOKESMEN: J. R. KANE, W. R. MOLZON, J. L. RITCHIE, S. G. WOJCICKI

- **College of William and Mary**
M. Eckhause, A.D. Hancock, C. Hoff, J.R. Kane, Y. Kuang, R.D. Martin, R.E. Welsh, E. Wolin
- **Stanford University**
K. Ecklund, C. Hartman, M. Hebert, G.M. Irwin, M. Pommot-Maia, S. G. Wojcicki
- **University of California at Irvine**
M. Bachman, D. Connor, P. DeCecco, N. Kanematsu, R. Lee, W. R. Molzon
- **University of Richmond - P. Rubin**
- **University of Texas at Austin**
D. Ambrose, S. Graessle, S. Hamilton, G. W. Hoffmann, K. Lang, M. R. Marcin, J. McDonough, A. Milder, P. J. Riley, J. L. Ritchie, C. B. Ware, S. Worm

This group is carried out a new search for the decays $K_L^0 \rightarrow \mu e$ and $K_L^0 \rightarrow ee$, building on the experience from the recently completed experiment, E791. The $K_L \rightarrow \mu\mu$ branching ratio measurement will also be improved. The final E791 single event sensitivity for $K_L^0 \rightarrow \mu e$ was about $1-2 \times 10^{-11}$. The new experiment reached a single event sensitivity below 10^{-12} , and set an upper limit of about 2×10^{-12} . About 10,000 $K_L^0 \rightarrow \mu\mu$ decays were observed.

The experiment took the novel approach of stopping the neutral beam in a beam stop near the upstream end of the spectrometer.

**EXPERIMENT 877 - STUDY OF RELATIVISTIC NUCLEAR COLLISIONS
WITH HEAVY BEAMS USING THE E814 4π CALORIMETRY
AND MODIFIED FORWARD SPECTROMETER**

SPOKESMAN: P. BRAUN-MUNZINGER

- **Brookhaven National Laboratory**
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- **GSI, Darmstadt** - N. Herrmann
- **Idaho National Engineering Laboratory** - J. Cole, M. Drigert, E. Reber
- **McGill University** - J. Barrette, Y. Dai, R. Lacasse, S. K. Mark, L. Normand, N. Starinsky
- **SUNY at Stony Brook** - R. Bersch, P. Braun-Munzinger, T. K. Hemmick, B. Hong, S. Johnson, Y. Kwon, D. Miskowicz, S. Panitkin, P. Paul, T. Piazza, J. Stachel, M. Trzaska, T. Vongpaseuth, J. Wessels, Y. Zhang, C. Zou
- **Wayne State University**
R. Bellwied, T. Budny, T. Cormier, A. French, F. Gang, J. Hall, B. Kim, K. Lahab, Q. Li, C. Pruneau, J. Sheen, H. Xiong
- **University of Pittsburgh** - W. Cleland, M. Clemen, U. Sonnadara, S. Voloshin
- **University of São Paulo** - N. DaSilva, O. Dietzsch, M. Takagui

Using an upgraded E814 setup, this experiment studied central collisions between heavy nuclei and projectiles from the Booster/AGS accelerators. The main emphasis is on a detailed study of the energy flow into 4π and measurements of the spectra of nucleons and produced particles for rapidities $y > 1.5$ and low transverse momenta, with event characterization over the full solid angle. In addition, nucleons, nuclear fragments and produced particles in the target fragmentation region were measured.

Polarized Proton Experiments in the AGS with a Partial Siberian Snake (E880)

(ANL,BNL,INDIANA,TRIUMF,KEK,RIKEN,IHEP)

**EXPERIMENT 880 - THE EFFECTS OF A PARTIAL SIBERIAN SNAKE ON POLARIZATION
AT THE AGS**

SPOKESMEN: S. Y. LEE AND T. ROSER

- **Argonne National Laboratory** - C. Allgower, M. Bai,⁽¹⁾ K. Krueger, H. Spinka, L. Teng, D. G. Underwood, A. Yokosawa
- **Brookhaven National Laboratory** - L. Ahrens, J. Alessi, K. Brown, G. Bunce, P. Cameron, E. D. Courant, J. W. Glenn, H. Huang, P. Ingrassia, Y. Y. Lee, A. Luccio, Y. I. Makdisi, L. Ratner, K. Reece, T. Roser, J. F. Skelly, A. Soukas, M. Syphers, S. Tepikian, R. E. Thern, N. Tsoupas, W. van Asselt, N. Williams
- **Fermilab** - V. Bharadwaj, S. Hseuh
- **Indiana University IUCF** - P. Chu, D. Jeon, S.Y. Lee
- **Institute for High Energy Physics, Serpukhov** - A. Ufimtsev
- **KEK** - S. Hiramatsu, Y. Mori, H. Sato, K. Yokoya
- **Riken** - T. Katayama, M. Okamura, T. Tominaka
- **TRIUMF** - U. Wienands⁽²⁾

This group has built a 4.7 Tesla-meter room temperature solenoid which has been installed in a 10-foot long AGS straight section. AGS polarized proton beam time is used to perform *partial snake experiments*. These experiments tested successfully the idea of using a partial snake to correct all de-polarizing imperfection resonances. Intrinsic depolarizing resonances are successfully overcome by using an AC vertical dipole to generate coherent betatron oscillation.

(1) Also at Indiana University

(2) Present address: SLAC

Detector Configuration for E885

Drift chambers ID1, ID2, and ID3, along with the micro-strip chamber IM1 determine the incoming K-trajectory and are combined with upstream hodoscope data to determine the K-momentum. Drift chambers FD0 through FD3, BD1, BD2, and micro-strips FM1 and FM2 determine the K⁺ trajectory through the spectrometer. Scintillators IT and BT determine the K⁺ time-of-flight. Hodoscopes FP and BP determine the spectrometer acceptance. Aerogel Cherenkovs IC, FC, and BC1 reject pions, while FC0 rejects protons. Above and below the target are the scintillating fiber detectors. On the left and right of the target are the large efficiency/solid angle neutron detectors.

EXPERIMENT 885 - EXPERIMENT TO DETECT $\Lambda\Lambda$ HYPERNUCLEI

SPOKESMEN: M. MAY, G. FRANKLIN AND C. DAVIS

- **Brookhaven National Laboratory** - D. Alburger, R. E. Chrien, M. May, P. H. Pile, A. Rusek, R. Sawafta, R. Suter
- **Carnegie-Mellon University** - A. Bersoz, A. Biglan, D. Carman, G. Franklin, P. Khaustov, P. Koran, R. Magahiz, R. McCrady, C. Meyer, K. Paschke, B. Quinn, R. Schumacher
- **Freiburg University** - T. Bürger, H. Fischer, J. Franz, K. Königsmann, H. Schmitd
- **KEK** - T. Iijima
- **Kyoto University** - A. Ichikawa, K. Imai, Y. Kondo, K. Yamamoto, Y. Yosoi
- **Los Alamos National Laboratory** - P. Barnes, F. Merrill
- **Rutgers University** - R. Ransome
- **TRIUMF** - C. Davis, J. Doornbos
- **University of Kentucky** - V. Zeps
- **University of Kyoto-Sangyo** - F. Takeuchi
- **University of Manitoba** - J. Birchall, L. Gan, M. Landry, L. Lee, S. Page, D. Ramsay, V. Sum, W. van Oers
- **University of New Mexico** - B. Bassalleck, R. Stotzer

This collaboration built an experiment to produce and detect $\Lambda\Lambda$ hypernuclei by stopping many more Ξ^- than in any previous attempt.

Running of the experiment primarily utilized a diamond target for high stopping rate of short-lived $\Lambda\Lambda$ hypernuclei. Negative kaons at 1.8 GeV/c are used to produce Ξ^- some of which stop in the diamond and K^+ which are detected in the spectrometer. Capture of Ξ^- by carbon nuclei produce $\Lambda\Lambda$ hypernuclei for a fraction of the events. A scintillating fiber array track hypernuclear decay products, and a large TOF array detects the recoil neutron. In the event that H particles are produced, their decays can be detected.

Schematic diagram of the experiment. The signature for electron capture from electron - positron pair production is the capture of the electron, changing the charge of the Au^{79+} to Au^{78+} , in coincidence with the detection of the emitted positron. The Au^{78+} is magnetically separated from the main Au^{79+} beam, and each charge state is detected, at the end of the beamline, by a plastic scintillator-photomultiplier detector. The positron is detected, and its energy is measured, by a plastic scintillator-photomultiplier detector. In addition, one of the two 511-keV positron-annihilation photons is detected using a NaI detector set behind the plastic scintillator. In a valid event we detect the Au^{78+} ion in coincidence with the positron and a 511 keV photon from the positron's annihilation. The target thickness and the total number of Au ions are the normalizations that yield a cross section.

EXPERIMENT 892 - CAPTURE FROM PAIR PRODUCTION

SPOKESMAN: H. GOULD

- **Lawrence Berkeley Laboratory** - A. Belkacem, N. Claytor, T. Dinneen, B. Feinberg, H. Gould
-

The experiment measures the cross section for electron capture from pair production of Au^{79+} at 10.8 GeV/n. Electron capture from pair production is the process in which an electron - positron pair is produced in the strong transient electromagnetic field of a relativistic heavy ion atomic collision (no nuclear contact) with the electron emerging from the collision bound to the ion. This process can take place between two bare ions, resulting in a charge change of one of the ions. It is predicted to account for a significant portion of the beam loss for bare Au^{79+} ions in the RHIC and for bare Pb^{81+} ions at LHC. Capture from pair production is the mechanism recently used to produce antihydrogen at CERN and FNAL.

Capture from pair production cross sections have previously been measured only in the 1 GeV/n (fixed target) energy range where the cross section is increasing rapidly with energy, and cannot be reliably extrapolated to RHIC and LHC energies. At $\gamma = 2$ (fixed target) calculations differ from experiment by a factor of 2 or more. Calculations, made to predict RHIC and LHC lifetimes use approximations that are valid only for $\gamma \gg 1$ and hence cannot be compared either untested or are in disagreement with experiment.

E892 has measured the cross sections for electron capture from pair production by 10.8 GeV/n ($\gamma=12.6$) bare Au^{78+} ions in Au, Ag, Cu and Al targets. These are the first measurements that can be compared with calculations used to predict beam lifetimes in RHIC and LHC.

**EXPERIMENT 893 - TEMPERATURE/ZENITH ANGLE CALIBRATION
OF POLYCARBONATE TRACK DETECTORS**

SPOKESMAN: A. THOMPSON

- **Dublin Institute for Advanced Studies**

This experiment measured the track response of polycarbonate track detectors to relativistic Au ions at -20°C and to investigate the isotropy of track response to Au at the same energy. This was a continuation of a program to calibrate polycarbonate SSNTD systems and to optimize their resolving power with special reference to the long term exposure which took place during the NASA LDEF Mission.

Data from first run of E895

This central Au on Au collision at 4 GeV/nucleon kinetic energy comes from the January 1996 run of E895. Ionization clusters in the EOS Time Projection Chamber are shown in red, and in this event, some 18,000 clusters are distributed over the 2+ million pixels of the TPC.

EXPERIMENT 895 - EXCLUSIVE STUDY OF NUCLEAR COLLISIONS AT THE AGS

SPOKESMAN: G. RAI

- **Brookhaven National Laboratory** - S. Gushue
- **Carnegie-Mellon University** - M. Kaplan, Z. Milosevich, J. Whitfield
- **Columbia University** - B. Cole
- **Harbin Institute of Technology** - L. Huo, Y. M. Liu, W. N. Zhang
- **Kent State University** - M. Justice, D. Keane, H. Liu, S. Panitkin, S. Wang, R. Witt
- **Lawrence Berkeley National Laboratory** - D. Best, T. Case, K. Crowe, G. Odyniec, D. Olson, G. Rai, H. G. Ritter, L. Schroeder, N. Stone, J. Symons, T. Wienold
- **Ohio State University** - A. Das, M. Lisa, R. Wells
- **Purdue University** - A. Hirsh, E. Hjort, M. Gilkes,* N. Porile, B. Srivastava, R. Scharenberg
- **State University of New York at Stony Brook** - N. Ajitanand, J. Alexander, P. Chung, R. Lacey, R. McGrath, C. Pinkenburg
- **University of Auckland** - D. Krofcheck
- **University of California-Davis** - P. Brady, W. Caskey, D. Cebra, J. Chance, J. Draper, M. Heffner, J. Romero

The experimenters carried out a systematic and exclusive measurement of the energy (2-10 A GeV) and mass dependence of particle production, correlations, and collective flow effects in Au+Au collisions. They sought to determine the highest compression achievable in nuclear matter and to study its properties and they searched for evidence for an exotic Equation of State, that is, new physics such as Resonance Matter, Exotica, and QGP. The experimenters searched for signatures of critical phenomena in dilute nuclear matter.

The experiment measured the four-momentum of light mass particles ($\pi^\pm$, K_s^0 , $K^\pm$, Λ , n, p, d, ^3He , ^4He , ^6He , and the isotopes of Li and Be), projectile fragments from Z=6 to Z=79, and anti-proton production. The majority of the data was acquired, on an event by event basis, from a state-of-the-art Time Projection Chamber (EOS TPC) built and used at LBL by the EOS collaboration. The TPC provides continuous tracking, almost 4π acceptance and particle identification for the light mass particles.

* Deputy at the AGS

BNL-AGS E896 EXPERIMENTAL LAYOUT

**EXPERIMENT 896 - A PROPOSAL TO THE BNL AGS:
TO SEARCH FOR A SHORT-LIVED H_0 DI-BARYON, SHORT-LIVED STRANGE MATTER,
AND TO INVESTIGATE HYPERON PRODUCTION IN 11.6 A GeV/c AuAu COLLISION**

SPOKESMEN: H. CRAWFORD AND T. HALLMAN

- **Brookhaven National Laboratory** - W. Christie, R. Debbé, T. Hallman, T. Ljubicic, R. Longacre, D. Lynn, J. Mitchell, E. Mogavero, A. Saulys
- **Carnegie-Mellon University** - C. Brown, M. Kaplan, Z. Milosevich, D. Russ
- **CERN** - P. Sonderegger
- **Johns Hopkins University** - L. Madansky
- **Lawrence Berkeley Laboratory** - L. Greiner, P. Lindstrom, J. Marx, I. Sakrejda
- **NASA-Goddard Space Flight Center** - J. W. Mitchell
- **Ohio State University** - T. Humanic, I. Kotov, G. LoCurto, E. Sugarbaker
- **Rice University** - B. Bonner, K. Kainz, W. Llope, G. Mutchler, E. Platner, P. Yepes
- **Space Science Laboratory** - M. Bennett, H. Crawford, M. Cronqvist, J. Engelage, M. Flores, L. Greiner, E. Judd, G. Visser
- **Wayne State University** - R. Bellwied, M. Nachaet, S. Nehmeh, S. Pandey, J. Sheen, J. Takahashi, K. Wilson
- **Yale University** - G. Kunde, S. Kumar, F. Rotondo, N. Smirnoff
- **University of California-Los Angeles** - H. Huang, G. Igo, S. Kelly, S. Trentalage
- **University of Catania** - S. Albergo, D. Boemi, Z. Caccia, S. Costa, A. Insolia, C. Nociforo, R. Potenza, G. Russo, A. Tricoma, C. Tuve
- **University of Michigan** - R. Welsh
- **University of Texas-Austin** - G. Hoffman, P. Jensen, S. Paganis, P. Riley, J. Schambach, J. Tang

The experiment is a search for the H^0 dibaryon and for new states of nuclear matter produced in nucleus-nucleus (AuAu) collisions at the AGS. The experiment enhances the existing AA program by extending the search into regions of shorter lifetime and complements the existing double-strangeness-exchange program by offering access to a new, more probable doorway channel, the coalescence of two Λ 's into a bound di- Λ . The detector is capable of unambiguously identifying the topological signature of unstable particle decays as well as the rigidity of each particle produced, affording a sensitive search for new metastable states and investigation of the properties of known strange particles such as the Λ polarization and the $\Lambda\Lambda$ potential.

EXPERIMENT 898 - RADIOBIOLOGY AND BIOPHYSICS WITH HIGH ENERGY HEAVY IONS

SPOKESMEN: J. MILLER, A. KRONENBERG, G. A. NELSON

- **Bemidji State University - A. L. Lindgren**
- **Brookhaven National Laboratory - B. M. Sutherland, M. E. Vazquez**
- **Colorado State University - J. T. Lett, C. Waldren**
- **Columbia University - T. K. Hei**
- **Georgetown University Medical Center - T. J. Jorgensen**
- **Jet Propulsion Laboratory - G. A. Nelson**
- **Lawrence Berkeley Laboratory - M. H. Barcellos-Hoff, P. Cooper, A. Kronenberg, J. Miller**
- **Los Alamos National Laboratory - D. J. Chen**
- **NASA Johnson Space Center - T. C-H. Yang**
- **Pacific Northwest National Laboratory - N. F. Metting**
- **University of California - L. H. Lutze-Mann**
- **University of Maryland - B. M. Rabin**
- **University of Maryland School of Medicine - E. K. Balder-Kubiczek**

This experiment studied effects produced by heavy ions (principally 1 GeV/u⁵⁶Fe) in a hierarchy of biological systems. The biological effects of densely ionizing radiation are studied for a number of genetic and cellular endpoints, constituting a broad range of quantifiable endpoints for the molecular to the whole animal level, in some cases including genetic responses over several generations. The biology experiments are supported by physics components designed to provide basic dosimetric information as well as the detailed characterization of the radiation field essential for the accurate interpretation of biological data.

E898 differed from a typical AGS experiment in that it actually consisted of a number of more or less independent biology and physics experiments. The list of experiments and principal investigators varied from year to year. Please contact Dr. Marcelo Vazquez (BNL x 3443) for a list of investigators for 1995-1997.

Full View of the ISiS Detector

**EXPERIMENT 900 - ENERGY DISSIPATION AND MULTIFRAGMENTATION IN
H + A REACTIONS BETWEEN 2 AND 24 GeV/c**

SPOKESMEN: K. KWIATKOWSKI AND V. E. VIOLA

- Argonne National Laboratory - B. Back
- Brookhaven National Laboratory - S. Gushue, L. P. Remsberg
- Indiana University - W.-Ch Hsi, K. Kwiatkowski, T. Lefort, V. E. Viola, N. R. Yoder
- Los Alamos National Laboratory - D. S. Bracken, K. B. Morley
- Simon Fraser University - R. Korteling
- Texas A&M University - F. Gimeno-Nogues, E. Ramakrishnan, D. Rowland, S. J. Yennello
- Warsaw University - L. Pienkowski
- University of Maryland - H. Breuer

Exclusive studies of target fragmentation in 2 - 24 GeV/c hadron (p , $\bar{p}$ and π^-)-induced reactions have started. Measurements are performed with the Indiana Silicon Sphere 4π detector array, capable of identifying H and He isotopes and $Z = 3 - 20$ fragments for target rapidity ejectiles over a wide dynamic range. The primary physics objectives are twofold: (1) to improve the understanding of energy dissipation phenomena for central collisions in the $h + A$ reaction at relativistic energies, and (2) to examine the decay modes of hot nuclear matter excited by simple hadron probes. The bombarding energy regime is chosen to overlap the region in which previous inclusive measurements at AGS have been interpreted in terms of a liquid-gas phase transition in hot finite nuclei. It is in this energy region that the excitation of Δ , N^* and higher resonances provide an effective means of dissipating projectile energy into internal excitation energy of the target nucleus. Thus, these data will place fresh constraints on the new generation of transport codes, as well as current models of multifragmentation. During the 1996 proton cycle, studies were successfully completed on the $p + {}^{197}\text{Au}$ system at 6.0, 10.0, 12.0 and 14.6 GeV/c and $\pi^- + {}^{197}\text{Au}$ at 5.0, 9.2 and 11.0 GeV/c. These measurements demonstrated an independence of energy deposition on projectile momentum and type for these reactions. In 1998 it is intended to measure the 7 GeV/c $\bar{p} + {}^{197}\text{Au}$ reaction to search for enhanced energy deposition with antiproton beams.

EXPERIMENT 904 - A STUDY OF COLUMNAR PINNING CENTERS IN HIGH T_c SUPERCONDUCTOR

SPOKESMAN: R. WEINSTEIN

- **Indiana University Cyclotron Facility - C. C. Foster**
- **Texas Southern University - V. Obot**
- **University of Houston - J. Liu, D. Parks, Y. Ren, R-P Sawh, R. Weinstein**

The experimenters will irradiate several stacks of YBCO tiles. The chemistry ($Y_{1.7}Ba_2Cu_3Pt_{0.01}$) of these tiles, and their heat processing and oxygen annealing, are the best known at present for field trapping. One set of tiles will each be 20 mm in diameter and 8 mm thick. A stack of several such tiles will be used. As the Au ions penetrate, dE/dx increases. The ions will first form string-of-beads defects. This experiment will provide a string-of-beads test for the first time and will provide the materials to produce a trapped field magnet (TFM) of greater field than any previously achieved. The experimenters estimate that the field will be 5 Tesla at 77K, and 12.5 Tesla at 65K.

In addition, 4 sets of smaller tiles (3.7 mm in diameter and 2 mm thick) will also be irradiated. The small size of the tiles in these runs is suitable to VSM or SQUID measurement of the magnetic moment and hence J_c . These runs will provide a desirable cross check on the large scale analysis of J_c via trapped field. In order to get the same fluence as in the case of 20 mm diameter tiles, these smaller tiles require 1/16 of the beam x time. The 4 sets of tiles will be run at 4 values of fluence.

The 0^+ , $T = \frac{1}{2}$ state observed in ${}^4\text{He}(\text{K}^-, \pi^-)$ in experiment 905.

EXPERIMENT 905 - SEARCH FOR A Σ HYPERNUCLEAR BOUND STATE IN $^4\text{He} (K^-, \pi^\pm)$ REACTIONS

SPOKESMAN: T. NAGAE

- **Brookhaven National Laboratory** - R. E. Chrien, A. Rusek, R. Sutter
- **George Washington University** - W. Briscoe
- **Hampton University** - W. Naing
- **INS-University of Tokyo** - T. Fukuda, T. Miyachi, T. Nagae, J. Nakano, H. Outa, T. Tamagawa,
- **North Carolina A&T** - R. Sawafta
- **Zagreb University** - M. Planinic
- **University of Houston** - T. Empl, E. V. Hungerford
- **University of North Carolina** - K. Johnston, C. Neerman
- **University of Tokyo** - R. S. Hayano, K. Kubota, Y. Shimizu, H. Tamura

The evidence for the existence of Σ (bound)-nuclei derives from three experiments: the first in a ^4He bubble chamber at the AGS, the second at KEK with stopped K^- in ^4He , and the third, BNL experiment E774. The purpose of E905 was to remeasure helium, using in-flight reactions to verify the existence of a bound state and to obtain the binding energy and width with high precision. This was accomplished by making use of experience gained in BNL's E774 and E887 to get better control of systematic errors, suppress backgrounds due to electrons and muons and to obtain increased statistics. The precise measurement of the position and width of the postulated bound state may allow a definite allocation of the structure observed in these experiments to a bound state or to a threshold cusp, which is an alternative explanation. The precise measurement of the Σ -production cross sections in the bound and unbound regions allowed a choice between competing model explanations.

**EXPERIMENT 906 - EXPERIMENT TO DETECT DOUBLE- Λ HYPERNUCLEI
BY OBSERVING CHARACTERISTIC π^- MESONIC DECAYS**

SPOKESMEN: R. E. CHRIEN, T. FUKUDA, A. RUSEK

- **Brookhaven National Laboratory** - R. E. Chrien, M. May, P. Pile, A. Rusek, R. Sutter
- **Carnegie-Mellon University** - D. Carman, G. B. Franklin, P. Koran, K. Parchke, B. P. Quinn, R. A. Schumacher
- **Gifu University** - M. Hanabata, K. Nakazawa
- **INR-Russia** - M. Prohvatilov, K. Sileev
- **INS-University of Tokyo** - J. Ahn, H. Akikawa, T. Fukuda, K. Kubota, T. Myuchi, T. Nagae, J. Nakano, K. Omata, H. Outa, M. Sekimoto, T. Tamagawa, H. Tamura, K. Tanida
- **Kyoto University** - K. Imai, K. Yamamoto, M. Yosoi
- **North Carolina A&T University** - R. Sawafta
- **Osaka University** - S. Ajimura, T. Kishimoto
- **Temple University** - E. Mezziani
- **University of Freiburg** - H. Fischer, J. Franz, K. Konigsmann, H. Schmitt
- **University of New Mexico** - B. Bassalleck, H. Fischer, J. Lowe, D. M. Wolfe

The experimenters propose a new way to produce and to identify several hundred double- Λ hypernuclei by observing two (successive) mesonic-decay pions with about 1.7 MeV resolution. The rate is larger by two orders of magnitude than other experiments done so far and will enable us to open a new study of double- Λ hypernuclei spectroscopy.

Double- Λ hypernuclei will be produced using the (K^- , K^+) reaction through multi-step processes. The successive mesonic-decay pions will be detected by a cylindrical detector system and solenoidal magnetic spectrometer (CDS) surrounding the target. The 2 GeV/c kaon beam line and the same experimental setup used for E813 and E836 (with some minor modifications), were used for this experiment.

EXPERIMENT 907

Home Page • <http://bart.phys.uh.edu/~mep/E907/>

The above picture shows the conceptual setup of the experiment.

**EXPERIMENT 907 - INVESTIGATION OF LIGHT HYPERNUCLEI USING THE
(K^-_{STOP} , π^0) REACTION**

SPOKESMEN: E. HUNGERFORD AND JEN-CHIEH PENG

- Arizona State University - J. R. Comfort, C. Gauland
- Brookhaven National Laboratory - R. E. Chrien, M. May, P. H. Pile, A. Rusek, R. Sutter
- Carnegie-Mellon University - G. B. Franklin, B. Quinn
- CEBAF - L. Tang
- Christopher Newport College - J. Gerald
- George Washington University - W. Briscoe
- Los Alamos National Laboratory - J. Amann, D. Boudrie, C. Edwards, B. F. Gibson, C. Morris, J. O'Donnell, J-C. Peng, A. Thiessen
- Louisiana Tech University - M. Barakat, K. Johnston
- North Carolina A&T - R. Sawafta
- R. Boskovic Institute - I. Supek
- Tohoku University - O. Hashimoto
- University of California at Los Angeles - B. Nefkens, W. B. Tipples
- University of Colorado - G. A. Peterson
- University of Houston - M. Ahmed, X. Cui, A. Empl, E. V. Hungerford, A. Lan, B. Mayes, L. Pinsky
- University of Kentucky - V. Zeps
- University of Maryland - P. G. Roos
- University of Minnesota - D. Dehnhard
- University of Texas at Austin - G. Glass, C. Fred Moore, H. Ward
- University of Zagreb - D. Androic, M. Furic, T. Petkovic, M. Planinic

The experimenters used the combination of a multi-layer active target and the Neutral Meson Spectrometer (NMS) to detect π^0 's in order to study hypernuclear physics. The reaction used is (K^-_{STOP} , π^0), with stopping K^- obtained from the LESB-II beam line at the AGS. The NMS was moved from LAMPF to BNL for this experiment.

EXPERIMENT 910

Home Page • <http://nevis.columbia.edu/heavyion/e910/>

**EXPERIMENT 910 - A FACILITY TO STUDY PROTON-NUCLEUS AND HEAVY ION COLLISIONS
USING A LARGE-ACCEPTANCE DETECTOR WITH PARTICLE IDENTIFICATION CAPABILITIES**

SPOKESMAN: B. A. COLE

- **Brookhaven National Laboratory** - R. Fernow, S. Gushue, H. Kirk, L. Remsberg, M. Rosati, Y. Torun
- **Columbia University** - I. Chemakin, B. A. Cole, H. Hiejima, M. Moulson, D. Winter, X. Yang, W. A. Zajc, Y. Zhang
- **Florida State University** - A. D. Frawley
- **Kent State University** - M. Justice, D. Keane
- **Lawrence Berkeley Laboratory** - G. Rai
- **Lawrence Livermore National Laboratory** - V. Cianciolo, M. Kreisler, M. N. Namboodiri, T. C. Sangster, R. Soltz, J. Thomas
- **State University of New York at Stony Brook** - M. Gilkes, R. L. McGrath
- **Yonsei University** - J. H. Kang, Y. H. Shin
- **University of Tennessee** - S. Mioduszewski, D. Morrison, K. Read, S. Sorensen
- **University of Tsukuba- Institute of Physics** - K. Kurita, Y. Miake

The experimenters studied proton-nucleus (p-A) and heavy ion collisions at the AGS using a large-acceptance detector. The main focus of the experiment measured strange particle production and a search for H^0 dibaryon formation in p-A collisions. The strange-particle production measurements provided data for comparison to recent measurements in heavy-ion collisions and also allowed more detailed studies of the mechanisms that are responsible for strangeness enhancement in p-A and heavy-ion collisions. The main component of the detector is the EOS TPC, a part of Exp. 895. The TPC was augmented with downstream tracking, a high-resolution time-of-flight wall and a second-level trigger capable of triggering on kaons in the final state. The apparatus provided a dedicated facility for the EOS TPC which allowed the detector to be employed during all modes of AGS running.

EXPERIMENT 913 - BARYON SPECTROSCOPY WITH THE CRYSTAL BALL

SPOKESMAN: M. E. SADLER, H. SPINKA, W. B. TIPPENS

- **Abilene Christian University** - R. Bagga, B. Draper, J. Huddleston, D. Isenhower, Z. Mulkey, M. Sadler
- **Argonne National Laboratory** - T. Kasprzyk, H. Spinka
- **Arizona State University** - J. Comfort, K. Craig, A. Ramirez
- **Brookhaven National Laboratory** - T. Kycia
- **George Washington University** - W. J. Briscoe, A. Shafi
- **Kent State University** - D. M. Manley
- **Petersburg Nuclear Physics Institute-Gatchina** - V. Abaev, V. Bekrenev, S. Kruglov, A. Kulbardin, I. Lopatin, A. Starostin
- **Rudjer Boskovic Institute** - I. Šlaus, I. Supek
- **Valparaiso University** - A. Gibson, D. Grosnick, D.D. Koetke, R. Manweiler, P. Nord, S. Stanislaus
- **University of California-Los Angeles** - M. Clajus, S. McDonald, A. Marusic, B.M.K. Nefkens, M. Pulver, W. B. Tippens
- **University of Colorado** - J. Patterson, J. Peterson
- **Universit at Karlsruhe** - H. Staudenmaier
- **University of Regina** - N. Knecht, G. Lolos, Z. Papandreou

This is a comprehensive experimental program in baryon spectroscopy using the SLAC Crystal Ball detector to make precision measurements of total and differential cross sections for neutral final states in π^+p interactions using pion beams in the momentum range 0.4 - 1.9 GeV/c. The angular distributions of all the neutral final states such as γn , π^0 are measured simultaneously. The purpose is to improve the mass, width, and neutral branching fractions for the N^* resonances in this energy region. The Crystal Ball detector is a nearly 4π multi-photon spectrometer which is used to analyze events by reconstructing the invariant mass and, in conjunction with the measured beam momentum, the missing mass of the produced γ rays. The Crystal Ball was located in the C6 beam line during this phase of the experiment. The beam momentum was limited to ≤ 750 MeV/c.

EXPERIMENT 914

Home Page • <http://ucla5.phy.bnl.gov/Crystalball/crystal1.html>

EXPERIMENT 914 - NEUTRAL HYPERON SPECTROSCOPY

SPOKESMAN: B.M.K. NEFKENS, T. KYCIA, S. P. KRUGLOV

- Abilene Christian University - R. Bagga, B. Draper, J. Huddleston, D. Isenhower, Z. Mulkey, M. Sadler
- Argonne National Laboratory - T. Kasprzyk, H. Spinka
- Arizona State University - J. Comfort, K. Craig, A. Ramirez
- Brookhaven National Laboratory - T. Kycia
- George Washington University - W. J. Briscoe, A. Shafi
- Kent State University - D. M. Manley
- Petersburg Nuclear Physics Institute-Gatchina - V. Abaev, V. Bekrenev, S. Kruglov, A. Kulbardin, I. Lopatin, A. Starostin
- Rudjer Boskovic Institute -I. Šlaus, I. Supek
- Valparaiso University - A. Gibson, D. Grosnick, D.D. Koetke, R. Manweiler, P. Nord, S. Stanislaus
- University of California-Los Angeles - M. Clajus, S. McDonald, A. Marusic, B.M.K. Nefkens, M. Pulver, W. B. Tippens
- University of Colorado - J. Patterson, J. Peterson
- Universit at Karlsruhe - H. Staudenmaier
- University of Regina - N. Knecht, G. Lolos, Z. Papandreou

This experiment proposes to investigate the spectrum of Λ^* and Σ^* resonances via their neutral decays in the reactions:

$K^- p \rightarrow \Lambda \gamma$	600-1800 MeV/c (p_{lab})
$K^- p \rightarrow \Lambda \pi^0$	"
$K^- p \rightarrow \Lambda 2\pi^0$	"
$K^- p \rightarrow \Lambda \eta$	720-1800 MeV/c (p_{lab})
$K^- p \rightarrow \Sigma^0 \gamma$	600-1800 MeV/c (p_{lab})
$K^- p \rightarrow \Sigma^0 \pi^0$	"
$K^- p \rightarrow \Sigma^0 2\pi^0$	"
$K^- p \rightarrow \Sigma^0 \eta$	890-1800 MeV/c (p_{lab})

Measurements of total and differential cross sections of these reactions will be made simultaneously over the full angular range, using the Crystal Ball multi photon spectrometer and a LH2 target. The Crystal Ball has a 94% solid angle coverage and good energy and angular resolution. This phase of the experiment was conducted in the C6 beam line with a maximum momentum of 750 MeV/c.

**EXPERIMENT 915 - PROPOSAL FOR 11.4 A GeV Au EXPOSURE AT THE AGS
THE TREK COLLABORATION**

SPOKESMAN: A. WESTPHAL

- **Space Research Institute (IKI) - Moscow - V. V. Akimov**
- **University of California at Berkeley - A. Westphal**

The Trek Collaboration used the 11.4 A GeV Au beam at the AGS to calibrate the large collector of the Trek experiment. Trek is a collaborative experiment consisting of the physicists at Berkeley and at the Space Research Institute in Moscow. Trek consists of two detectors. The small detector (0.09 m² in area) was mounted on an outside wall of the living quarters of the space station and has already been returned to earth for analysis. Its goal was to measure the isotopic abundances of iron-group elements in the galactic cosmic-rays. A large collector for ultraheavy galactic cosmic rays was mounted on the outside of the Kvant-2 module for the Mir Space Station by two cosmonauts in June 1991. The goals of the large Trek collector were to resolve and measure the composition of both odd-Z and even-Z cosmic-ray nuclei from tin (Z=50) through uranium (Z=92) and searched for transuranic nuclei and exotic particles such as strangelets. The experimenters to calibrated the detectors with a highly relativistic gold beam at the AGS at the first opportunity after recovery.

**EXPERIMENT 916 - STUDY OF PROJECTILE FRAGMENTATION FOR ^{197}Au IONS AT $\sim 4\text{A GeV}$
IN VARIOUS TARGETS**

SPOKESMAN: Y. D. HE

- **University of California - Berkeley - Y. D. He, P. B. Price**

This was a small-scale experiment with ^{197}Au ions at $\sim 4\text{A GeV}$. We exposed 10 BP-1 glass detectors interleaved with targets ranging from C to Pb to a defocused low intensity beam over an area of $5\text{ cm} \times 5\text{ cm}$ at a density of $1200 \pm 200\text{ cm}^{-2}$. Using our automated scanning system, the charge resolution from one single measurement is found to be ~ 0.14 charge unit. The charge resolution for beam particles and projectile fragments obtained from 5 plates of detectors is ~ 0.06 charge unit. This charge resolution is more than adequate to identify fragments and hence to measure cross sections for charge-changing interactions. With this experiment, we hope to accomplish the following:

1. **Fragmentation Study:**

We studied nuclear reactions that we have previously studied at $\sim 1\text{ A GeV}$ at BEVALAC and $\sim 11\text{ A GeV}$ at AGS. In particular, we measured cross sections at $\sim 4\text{ A GeV}$ for fragmentation both nuclear and electromagnetic, for charge pickup reaction, and for other processes in collisions of $\sim 4\text{ A GeV}$ on various targets. We established the energy dependence of these cross sections, which enabled us to understand the physics in peripheral collisions of relativistic heavy ions.

2. **Detector Response Study:**

Another interesting topic is the study of the response of BP-1 glass detectors to relativistic heavy ions with different energies. We have previously established the dependence of the detector response on charge Z for a given velocity βc . The response is empirically known to be a complicated function of $(Z/\beta)^2$, to a good approximation, for a limited range of β tested. However, the dependence of the response on Lorentz factor γ for a wide range of β remains unknown. With this experiment, we studied the dependence of the detector response on β for a given Z . This set of data permitted an interesting examination of the dependence of restricted energy loss on γ in addition to $(Z/\beta)^2$ term.

EXPERIMENT 917

Home Page • <http://phyun0.ucr.edu/~e917/>

Experiment 917 - Studies of High Density Baryon Matter Using Rare Probes

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- **Brookhaven National Laboratory** - Y. Y. Chu, J. Cumming
- **Columbia University (Nevis Labs.)** - C. Y. Chi
- **Massachusetts Institute of Technology** - J. Dunlop, G. Heintzelman, C. Ogilvie, G. Stephans, H. Yao
- **Yonsei University** - J. H. Kang, E-J. Kim, S. Y. Kim, Y. Kwon
- **University of California-Riverside** - J. Chang, W. Chang, W. Elderege, S. Y. Fung, R. Seto, H. Wang, H. Xiang, G. Xu, C Zou
- **University of Illinois - Chicago** - R. Betts, C. Conner, R. Ganz, B. Holtzman, D McLeod
- **University of Maryland** - H. Britt, E. Garcia, A. Mignerey, A. Ruangma, D. Russ, J. Stanskas
- **University of Rochester** - R. Pak, F. Wolfs

This experiment studied the physics of the high-baryon density matter being created in Au-Au collisions at the AGS. Through the systematic measurement of short lived vector mesons and baryons, the measurement of strange anti-baryons and anti-protons, and high statistics HBT studies were done.

**EXPERMENT 919 - A STUDY OF THE GENETIC AND EPIGENETIC EFFECTS
PRODUCED BY HIGH ENERGY HEAVY IONS**

SPOKESMEN: M. VAZQUEZ

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- **Brookhaven National Laboratory - J. Bullis, J. Gatley, B. Sutherland, M. Vazquez**
- **Case Western Reserve University - H. Evans**
- **Colorado State University - T. Borak, G. Mariano, C. A. Waldren**
- **Columbia University - T. K. Hei**
- **Georgetown University medical Center - T. Jorgensen**
- **Lawrence Berkeley National Laboratory - P. Cooper, A. Kronenberg, J. Miller**
- **Loma Linda University - G. Nelson**
- **Los Alamos National Laboratory - D. J. Chen**
- **NASA Johnson Space Center - T. C-h Yang**
- **Natl. Inst. Of Radiological Sciences, Japan - Y. Furusawa**
- **Pacific Northwest National Laboratory - N. F. Metting**
- **USAF Armstrong Laboratory - A. Cox**
- **Washington State University - A. Brooks**
- **University of California - L. H. Lutze-Mann, W. Morgan**
- **University of Maryland Baltimore - E. Balcer-Kubiczek, B. Rabin**
- **University of Texas - M. Natarajan**

This is a NASA effort in the AGS to study the genetic and epigenetic effects produced by high energy heavy ions. There were two runs labeled BNL-3, 4 for the period of October 1, 1996 to September 31, 1998. Each run provided approximately 150 hours of 1GeV/nucleon Fe ions.

EXPERIMENT 920

Home Page • http://w4.lanl.gov/physics/PR95-96/pr_html/rh13.html

Proton Radiograph of the French Test Object using 10-GeV Protons from
The AGS at BNL

Experiment 920 - Lens Tests for Proton Radiography

SPOKESMAN: J. ZUMBRO

- **Los Alamos National Laboratory** - G. Hogan, K. Morley, C. Morris, K. Mueller, J. Sarracino, H. Ziock, J. Zumbro

The goal of this experiment was to provide data for standard test objects which can be benchmarked against models of proton transport and magnetic optics. Additionally the performance of proton radiography was directly compared with X-ray measurements on the same set of objects.

**Experiment 922 - Radiation Testing of NASA's Global Positioning System and
Inertial Navigation Sensor (GPS/INS)**

SPOKESMAN: W. X. CULPEPPER

- **National Aeronautics and Space Administration - W. X. Culpepper**

NASA has elected to pursue the development of an integrated global positioning system (GPS) and inertial navigation system (INS) (GPS/INS) for use as common hardware on the Intl. Space Station (ISS), the Space Shuttle Orbiter and the ISS Crew Return Vehicle (CRV). NASA's Johnson Space Center (JSC) is the lead center for this activity. This GPS/INS will perform the prime state vector estimation and navigation functions for the flight vehicles involved and is considered a criticality 1 subsystem, *i.e.*, impacts crew safety, vehicle survivability and mission success.

A facility producing heavy ions with sufficient energy per nucleon was needed to perform system level tests with heavy ions similar to the IUCF proton tests to establish latchup susceptibility for the proposed hardware. The 10-11 GeV gold ion beam at the AGS in the fall/winter of 1996 was the only American resource known that could accomplish this special testing.

Schematic of the experiment. A typical $K^+ \rightarrow \mu^+ \pi^0 \nu$ event is superimposed.

EXPERIMENT 923 - SEARCH FOR T VIOLATING MUON POLARIZATION IN $K^+ \rightarrow \mu^+ \pi^0 \nu_\mu$ DECAY

SPOKESMEN: R. ADAIR, M. V. DIWAN, HONG MA

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- **Institute for High Energy Physics, Protvino, Russian** - V. Semenov
- **Louisiana Tech University** - M. Elaasar, D. Greenwood, K. Johnston
- **Yale University** - R. Adair, R. Larsen

This experiment proposes a new search for the time reversal violating polarization of the muon normal to the decay plane of the $K^+ \rightarrow \mu^+ \pi^0 \nu_\mu$ decay. The experiment will be performed with in-flight decays in an intense (2×10^7 K^+ per sec) 2 GeV/c separated kaon beam in an existing beam line at the AGS. The center piece of the detector will be a new polarimeter which will consist of 128 carbon wedges, with active detector elements (either scintillator or wire chambers) between the wedges, arranged in a cylindrical manner around the kaon beam. More than 10^9 events are expected to be analyzed to obtain sensitivity to the T-violating polarization of ± 0.0007 to $\text{Im}\xi$, an improvement by approximately 40 over the previous best limit.

EXPERIMENT 924

Home Page • <http://www.npl.uiuc.edu/exp/cb%2b%2b/>

**Experiment 924 - Study of the ξ (2220) in $\bar{p}p \rightarrow$ Neutral Final States
Using the Crystal Ball in the AGS D6 Line**

SPOKESMAN: D. W. HERTZOG

- **Boston University** - J. Miller
- **Brookhaven National Laboratory** - T. Kycia, P. Pile
- **Carnegie-Mellon University** - G. Franklin, C. Meyer, B. Quinn, R. A. Schumacher
- **College of William and Mary in Virginia** - M. Eckhause, J. Kane, R. Welsh
- **George Washington University** - C. Bennhold, W. J. Briscoe
- **Kent State University** - D. M. Manley
- **Northwestern University** - K. Seth
- **Petersburg Nuclear Physics Institute** - V. V. Abaev, V. S. Bekrenev, N. G. Kozlenko, S. P. Kruglov, I. V. Lopatin, A. B. Starostin
- **Valparaiso University** - D. Grosnick, D. D. Koetke, R. W. Manweiler, S. Stanislaus
- **University of California at Los Angeles** - M. Clajus, S. C. McDonald, A. Maruši, B. M. K. Nefkens, W. B. Tippens
- **University of Colorado** - R. J. Peterson
- **University of Connecticut** - R. T. Jones
- **University of Illinois at Urbana-Champaign** - P. Debevec, D. W. Hertzog, P. E. Reimer, J. Ritter, S. Sedykh, D. Uner
- **University of Karlsruhe** - H. M. Staudenmaier
- **University of Maryland** - D. Peaslee
- **University of Regina** - G. J. Lolos, Z. Papandreou

The experimenters propose to study the reactions $\bar{p}p \rightarrow \pi^0 \pi^0$, $\bar{p}p \rightarrow \pi^0 \eta$, $\bar{p}p \rightarrow \eta \eta$, and $\bar{p}p \rightarrow \eta \eta'$ in the region of the ξ using the high-resolution Crystal Ball detector and the D6 (antiproton) beam line.

EXPERIMENT 925

Home Page • <http://www.ags.bnl.gov/~e925/E925.html>

Sketch of the experimental setup for the proposed inclusive pion experiment.

**EXPERIMENT 925 - ASYMMETRIES IN INCLUSIVE PION PRODUCTION AT LARGE $X_F = (0.5 \text{ TO } 0.8)$
AND $P_T \geq 0.8 \text{ GeV}/c$ WITH A POLARIZED BEAM FOR A RHIC POLARIMETER**

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- **University of Iowa** - N. Akchurin
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* Also Argonne National Laboratory

** Also Kyoto University, Japan

The experimenters propose to measure asymmetries in the inclusive reactions,

$$\begin{aligned} p \uparrow p &\rightarrow \pi^+ \text{ anything}, p \uparrow C \rightarrow \pi^+ \text{ anything}, \\ p \uparrow p &\rightarrow \pi^- \text{ anything}, p \uparrow C \rightarrow \pi^- \text{ anything} \end{aligned}$$

using a transversely polarized beam, a liquid hydrogen target, and a carbon target. The measurements would be made using the 23-GeV/c proton beam in an extracted beam line from the AGS, a spectrometer consisting of an analyzing magnet, scintillation hodoscopes, scintillation trigger counters, and a gas threshold Cerenkov counter. The kinematic range covered by the experiments would be p_T up to 1.0 GeV/c and $x_F = P_L^*/P_{\text{max}}^* \approx 0.5$ to 0.8.

The purpose of this experiment is to obtain basic information in order to design a polarimeter for the RHIC polarized beams. The RHIC polarimeter is a crucial item for the success of the RHIC spin program.

Layout of the $K_L^0 \rightarrow \pi^0 \nu \bar{\nu}$ experiment.

EXPERIMENT 926 - MEASUREMENT OF $K_L^0 \rightarrow \pi^0 \nu \bar{\nu}$

SPOKESMEN: D. BRYMAN, L. LITTENBERG, M. ZELLER

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- **Yale University** - S. Dhawan, H. Kaspar, W. Majid, M. Zeller
- **University of British Columbia** - M. Hasinoff
- **University of New Mexico** - B. Bassalleck, J. Lowe

This experiment will be a measurement of the branching ratio for the rare decay $K_L \rightarrow \pi^0 \nu \bar{\nu}$. The method employs kaon time-of-flight and full kinematic reconstruction of the π^0 to suppress backgrounds to a level well below an anticipated signal in the range of $3 \pm 2 \times 10^{-11}$.

2GeV Beam Line and Experimental Area for P927

Experiment 927 – Measurement of the K_{e3}^+ Decay Rate and Spectrum

SPOKESMAN: T. KYCIA AND B. M. K. NEFKENS

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- **Abilene Christian University** - L. D. Isenhower, M. E. Sadler
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- **Rudjr Bošković Inst., Zagreb, Croatia** - M. Batinić, I. Šlaus, I. Supek, A. Švarc
- **University of Colorado** – R. J. Peterson
- **George Washington University** – C. Bennhold, W. J. Briscoe
- **University of Karlsruhe, Germany** – H. M. Staudenmaier
- **Kent State University** – D. M. Manley
- **St. Petersburg Nuclear Physics Inst., Gatchina** – A. B. Starostin
- **University of Regina, Canada** – G. J. Lolos, Z. Papandreou
- **Valparaiso University** – J. Alyea, D. Grosnick, D. D. Koetke, R.W. Manweiler, S. Stanislaus

The goal of this experiment is to measure the K_{e3}^+ decay rate to better than 0.7%. This translates into an absolute determination of V_{us} to better than 0.35%, not including the error in the theoretical evaluation of the small correction for the finite quark masses. Combined with the relatively well known values for V_{ud} and V_{ub} , this will provide the most stringent test of the unitarity of the CKM matrix. Among several reasons that such a test is of interest is the proposed existence of supersymmetry (SUSY) particles which are predicted to cause a small deviation from the unitarity relation.

Schematic layout of the target region and the detector are shown.

EXPERIMENT 929 - SPIN-ORBIT SPLITTING OF SINGLE Λ STATE STUDIED BY THE ^{13}C ($K^-\pi^+\gamma$) REACTION

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- **Manitoba University** - L. Lee
- **National Laboratory of High Energy Physics** - H. Noumi
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- **Tohoku University** - K. Maeda, T. Suda
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The experimenters measured the spin-orbit (ls) splitting of single Λ particle states in a hypernucleus.

Ge Detector System for Hypernuclei

**EXPERIMENT 930 - HIGH-RESOLUTION γ SPECTROSCOPY OF HYPERNUCLEI
USING LARGE-ACCEPTANCE GERMANIUM DETECTOR**

SPOKESMAN: H. TAMURA

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- **Tohoku University** - O. Hashimoto, H. Tamura, T. Takehashi
- **University of Tokyo - Department of Physics** - T. Ishikawa, K. Tanida

The experimenters propose a high-resolution γ -ray spectroscopy measurement of several light Λ hypernuclei employing a large-acceptance germanium detector system which is being constructed in Japan. Λ hypernuclei are produced by the (K^-, π^-) reaction and their γ transitions are detected in coincidence. They will use K^- beam at D6 beam line together with the E813 spectrometer. The aim is to determine ΛN spin-dependent interactions through γ spectroscopy of some light hypernuclei. Data will be taken with ${}^9\text{Be}$, ${}^{16}\text{O}$, ${}^{12}\text{C}$ and ${}^7\text{Li}$ targets and to study γ transitions of ${}^{15}_{\Lambda}\text{N}$, ${}^9_{\Lambda}\text{Be}$, ${}^{16}_{\Lambda}\text{O}$, ${}^{12}_{\Lambda}\text{C}$, ${}^7_{\Lambda}\text{Li}$, which will give information on the spin-spin, spin-orbit, and tensor interactions between Λ and nucleon.

EXPERIMENT 931 - STUDY OF THE $\Delta I = \frac{1}{2}$ RULE IN THE WEAK DECAY OF S-SHELL HYPERNUCLEI

SPOKESMAN: D. DEHNHARD, E. HUNGERFORD, V. ZEPS

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- **University of Colorado** - G. A. Peterson
- **University of Houston** - M. Ahmed, X. Cui, A. Empl, E. V. Hungerford, A. Lan, B. Mayes, L. Pinsky
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- **University of Maryland** - P. G. Roos
- **University of Minnesota** - D. Dehnhard
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- **University of Zagreb** - D. Androic, M. Furic, T. Petkovic, M. Planinic

This experiment addresses an unresolved, fundamental question of "why" and "when" to apply the $\Delta I = \frac{1}{2}$ rule to the weak decay of strange hadrons. An opportunity now exists to determine if this apparently universal rule applies to the non-mesonic weak decay of a Λ , by studying particle emission from the weak decay of $^4_\Lambda\text{He}$. The experiment will use the NMS spectrometer and the LESBII beam line.

Fig. 1: Mountain Range Plot of the Bunch
After the Transition Energy was Dropped to the Beam Energy.

Fig. 2: Bunch Shapes Before and After Bunching Showing a Final Corrected Bunch Length of 2.0 ns.

EXPERIMENT 932 - STUDY OF RF BUNCHING TECHNIQUES

SPOKESMAN: J. H. NOREM

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- Fermi National Laboratory - C. Ankenbrandt, C. Johnstone, B. Ng, Z. Qian, M. Popovic

The proton driver for the muon collider must produce short pulses of protons in order to facilitate muon cooling and operation with polarized beams. In order to test methods of producing these bunches we have operated the AGS near transition and studied procedures which involved moving the transition energy, γ_t to the beam energy. We were able to produce stable bunches of $3 - 5 \times 10^{12}$ protons with RMS widths of $\sigma = 2.0 - 2.7$ ns for longitudinal bunch areas of 1.5 eV s, in addition to making measurements of the lowest two orders of the momentum compaction factor. The initial results have been published.

In this experiment the beam was flat topped close to the normal transition energy while the transition jumping quadrupoles were turned off suddenly, producing a much higher bucket. As the bunch rotated in this higher bucket its energy spread increased and its length decreased, as shown in Figure 1. The shortest bunch we measured had $\sigma = 2$ ns, as shown in Figure 2.

At transition, the momentum dependent phase drift is primarily nonlinear as a function of momentum and although we tried to minimize this effect, it was difficult to do in a short time. We are studying ways in which the nonlinear effects can be better understood.

E933 Schematic

Schematic of the Proton Radiography magnetic lens system showing both the X and Y views. The beam is first prepared with a diffuser and matching lens to meet optics requirements. It then passes through the object being radiographed. The transmitted beam passes through an iris, or aperture located in the middle of the 4-quadrupole -I magnetic lens cell and is focused on the first detector. It then enters the second identical -I lens cell, which this time has a smaller diameter iris, and is focused on a second detector. Together, the two detectors provide the information needed to reconstruct both the density profile and material composition of the object.

EXPERIMENT 933 - PROTON RADIOGRAPHY

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- **Los Alamos National Laboratory** - J. F. Amann, R. L. Boudrie, G. E. Hogan, N. S. P. King, A. R. Mathews, J. B. McClelland, K. B. Morley, C. L. Morris, C.T. Mottershead, K. H. Mueller, J. S. Sarracino, G. J. Yates, H. J. Ziock, J. D. Zumbro

Proton radiography is being investigated as a promising new technology for hydrodynamic testing in support of a science based stockpile stewardship program. It has the potential to outperform traditional X-ray Techniques in meeting the full range of requirements that are being developed by a DOE-DP chartered tri-lab working group. This group was established to identify technical approaches by which an advanced hydrodynamic testing capability could certify the stockpile in the absence of underground testing.

**EXPERIMENT 934 - PROPOSAL FOR BROOKHAVEN CALIBRATION OF DETECTORS
FOR USE ON ACCESS**

SPOKESMAN: W. R. BINNS

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 - **Naval Research Laboratories** – J. H. Adams, Jr.
 - **Washington University in St. Louis** – W. R. Binns, P. L. Hink, M. H. Israel
 - **University of Minnesota** – C. J. Waddington
 - **University of Siegen** – W. Menn, M. Simon
-

The purpose of this calibration run at Brookhaven was to test and calibrate detectors to determine if they are capable of making precision measurements of the elemental abundances and energy spectra of galactic cosmic rays with $10 \leq Z \leq 92$. The Advanced Cosmic Ray Composition Experiment for Space Station (ACCESS) has been approved by NASA for a Mission Concept Study over the next two years. The present concept includes detectors which will be used to precisely measure the charge of these ultra-heavy nuclei.

Experimental goals of the ultra-heavy portion of the mission are: to determine whether the chemical fractionation pattern of GCRs is better organized by first ionization potential or volatility; test whether galactic cosmic rays originate from interstellar dust grains, mass loss from main sequence stars, freshly synthesized supernova debris, special sources, such as Wolf-Rayet stars; determine whether $Z < 30$ and $Z \geq 30$ nuclei have a common source; test if r-processes that contributed to GCRs were driven further than those that formed the solar system mix by measuring the r/s-process mix as a function of charge.

The detectors which were tested in this collaboration are Li-drifted silicon detectors for dE/dx , scintillating fibers for hodoscope and time-of-flight, acrylic Cherenkov light collection box counter, aerogel ($n=1.04$) Cherenkov light collection box counter, acrylic Cherenkov waveshifter bar readout, and aerogel ($n=1.04$) Cherenkov waveshifter bar readout.

EXPERIMENT 935 - A DECAY SEARCH FOR A LIGHT GLUINO BOUND STATE IN THE B5 LINE

SPOKESMAN: Y. KUANG

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- **University of California, Irvine** – M. Bachman, G. Kagel, R. Lee, T. Liu, W. Molzon
- **University of Richmond** – P. Rubin

The experimenters searched at the AGS for the supersymmetry-based R^0 hadron in terms of a decay channel involving a photino and two charged pions with a sensitivity in the product of production cross section and branching fraction of $5 \times 10^{-36} \text{ cm}^2/\text{GeV}^2$. A positive signal would be a first observation of a supersymmetric particle.

The detector facility assembled by the E871 collaboration to conduct rare kaon decay studies offers the highest flux neutral beam available and a detector that has acceptable sensitivity to the decay of the hadron. The E871 detector in its present configuration was used to look for two-pion vertex events originating in the decay volume. Achieving an improved vacuum decay tank of $< 10^{-6}$ torr is the main modification required for the detector system.

Cross-Section View of the E936 Detector Set Up

EXPERIMENT 936 - SEARCH FOR T-VIOLATION IN THE $K^+ \rightarrow \pi^0 \mu^+ \nu$ DECAY USING STOPPED KAONS

SPOKESMAN: J. IMAZATO

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- **Virginia Polytechnic Institute and State University – M. Blecher**
- **University of British Columbia and TRIUMF – M. Hasinoff, J. A. Macdonald**
- **University of Montreal – P. Depommier**
- **University of Saskatchewan – C. Rangacharyulu, B. Shin**
- **University of Tsukuba – I. Arai, Y. Asano**

This experiment is to search for T-violation in the $K^+ \rightarrow \pi^0 \mu^+ \nu$ decay using a stopped beam method. The muon transverse polarization will be examined with high precision and with small systematic errors. The experimental setup will be transferred from the KEK E246 T-violation experiment after the completion of data taking early in 1999. After 3000 hours of running at AGS, the sensitivity of $\Delta P_T \cong 3.5 \times 10^{-4}$ will be obtained corresponding to the sensitivity of $\Delta \text{Im} \xi = 1.5 \times 10^{-3}$.

**EXPERIMENT 937 - A STUDY OF THE OCCURRENCE OF RADIATION-INDUCED
SOFT ERROR UPSETS (SEU)**

SPOKESMAN: R. J. PETERSON

- **University of Colorado - C. J. Gelderloos, R. J. Peterson**
-

We exposed one sample of a 16 Mbit high density memory chip to negative pion beams of 1.2 and 1.8 GeV/c on the D-line. A plastic scintillator with the same dimensions as the chip was used to monitor the pion fluence. Cross sections for soft errors, changing the bit content of the chip without permanent damage, were found to be much smaller than observed at lower pion momenta. The experiment result obtained was sufficient for the needs to understand avionics failures in commercial aircraft.

BNL-AGS Target Test Experiment

Schematic section along beam center line

EXPERIMENT 938 - SPALLATION NEUTRON TARGET STUDIES AT THE AGS

SPOKESMEN: G. BAUER, J. HAINES, J. B. HASTINGS, N. WATANABE

- **Argonne National Laboratory - J. M. Carpenter**
- **Brookhaven National Laboratory - J. B. Hastings**
- **Forschungszentrum Jülich - H. Conrad**
- **High Energy Accelerator Research Organization (KEK) - H. Ikeda**
- **Japan Atomic Energy Research Institute - N. Watanabe**
- **Los Alamos National Laboratory - G. Russell**
- **Oak Ridge National Laboratory - J. Haines**
- **Paul Scherrer Institute - G. Bauer**

There is a worldwide effort in planning and designing the next generation neutron source; the focus is on spallation source with average power of up to 5 MW and single pulse energies of 100 kJoules. The design issues center around the heavy metal target; liquid mercury is the current first choice. The AGS is a unique resource to study in detail neutron production, pressure wave mitigation and other issues in target design. It is the **only** proton source in the world with the energy per pulse equal to the proposed future sources.

The experiment will initially measure the neutron production and energy deposition in liquid mercury as a function of incident proton energy. The pressure wave behavior under peak power loading will then be measured and proposed mitigation measures evaluated. Finally, the performance of a liquid mercury target in conjunction with a lead reflector and moderators will be measured to study the complete system performance. The total proton fluence required at a given proton energy is minimal (typically a few time 10^{14}) for the first two proposed measurement periods.

**EXPERIMENT 939 - EXPERIMENTS FOR THE DOE ACCELERATOR PRODUCTION OF TRITIUM
(APT) PROJECT**

SPOKESMEN: N. S. P. KING AND A. L. HANSON

- **Bechtel Nevada** - R. Thompson, R. Liljestrand
- **Brookhaven National Laboratory** - G. Greene, A. L. Hanson, L. Snead, M. Todosow
- **CEA** - J. Frehaut
- **Lawrence Livermore National Laboratory** - G. Henry, D. Slaughter
- **LNS-CNRS** - S. Leray
- **Los Alamos National Laboratory**
K. Alrick, F. Cverna, N. S. P. King, G. L. Morgan, L. Waters, J. Ullmann
- **U. S. Department of Energy** - T. Ward

The purpose of this experiment is to advance the R&D work for the accelerator production of tritium as a part of a national program now underway in this subject. Using fast extracted protons, thin aluminum and lithium foils will be exposed to proton beams of 800, 1200, 1600 and 2000 MeV to measure the production cross sections for the $^{27}\text{Al}(p,3n)^{24}\text{Na}$ and $^7\text{Li}(p,n)^7\text{Be}$ reactions.

E940 – Muon Electron Conversion (MECO) Schematic View

**EXPERIMENT 940 - A SEARCH FOR $\bar{\mu}N \rightarrow eN$ WITH SENSITIVITY BELOW 10^{-16}
MUON-ELECTRON CONVERSION (MECO)**

SPOKESMAN: W. MOLZON

- **Institute for Nuclear Research** - R. M. Djikibaev, V. M. Lobashev, A. N. Toropin
- **New York University** - A. Mincer, P. Nemethy, J. Sculli
- **Purdue University** - S. Carabello, D. Koltick
- **University of California at Irvine** - M. Bachman, G. Kagel, R. Lee, T. J. Liu, W. Molzon, M. Overlin
- **University of Houston** - A. Empl, E. V. Hungerford, K. J. Lan, B. W. Mayes, L. S. Pinsky, J. Wilson, M. Youn
- **University of Pennsylvania** - W. D. Wales

This experiment proposes to search for the process $\bar{\mu}N \rightarrow eN$ with a significantly improved sensitivity with respect to past and proposed future searches. Interest is in searching for violations of additive quantum numbers associated with each type of lepton. Violation of these quantum numbers is commonly referred to as lepton flavor violation (LFV). The process will provide direct evidence of muon and electron number violation.

The experiment will be conducted in a new μ beam line produced using a pulsed proton beam. The proton energy will be chosen in the range 8-20 GeV to optimize the μ flux per unit time and minimize operating costs of the experiment. The expected sensitivity, normalized to the kinematically similar process of μ capture on the nucleus, is one event for a branching fraction of 2×10^{-17} .

**EXPERIMENT 941 - STUDY OF CHARGED AND NEUTRAL LEADING PARTICLES
IN P+A COLLISIONS AT THE BNL-AGS**

SPOKESMEN: H. HUANG, R. MAJKA

- **Columbia University** - J. Nagle
- **Iowa State University** - B. Fadem, J. Hill, R. Hoversten, J. Lajoie, A. Petridis, H. Skank, G. Sleege, F. Whohn
- **Massachusetts Institute of Technology** - M. Bertain, I. Pless
- **Purdue University** - A. Hirsch, N. Porile, R. Scharenberg
- **Vanderbilt University** - V. Greene, C. Maguire, T. Miller, J. Reid, A. Rose
- **Wayne State University** - S. Bennett, T. Cormier, P. Fachini, H. Jaradat, M. Munhoz, C. Pruneau
- **Yale University** - S. Batsouli, A. Chikanian, E. Finch, N. George, R. Majka, J. Sandweiss, J. Slaughter, Z. Xu
- **University of Massachusetts** - M. Rabin
- **University of California at Los Angeles** - H. Huang, H. Long, A. Tai, G. Van Buren, E. Yamamoto
- **University of California at Riverside** - K. Barish

Although charged leading particles in p+A collisions have been studied extensively at the beginning of the era for ultra-relativistic heavy ion collisions, neutral leading particles have not been measured accurately and systematically. Neutral leading particles represent a significant fraction of the cross sections for incident proton fragmentation. When the incident proton is described by its quark content and is broken up during nuclear collisions, the emerging leading particles can be combinations of neutron + π^+ or proton + π^0 in the framework of a diquark-quark breakup scenario. This experiment measured both charged and neutral leading particles in p+Pt, p+Cu, p+Al and p+Be collisions at the beam momenta of 18 and 12 GeV/c with the E864 spectrometer.

EXPERIMENT 943

Home Page •

**EXPERIMENT 943 - HIGH-PRECISION MEASUREMENTS OF p , π^+ , K^+
REACTION CROSS SECTIONS ON NUCLEI**

SPOKESMEN: F. S. DIETRICH, E. P. HARTOUNI

- **Brookhaven National Laboratory** - A. L. Hanson
- **Lawrence Livermore National Laboratory** - F. S. Dietrich, E. P. Hartouni, G. J. Schmid, R. A. Soltz
- **Los Alamos National Laboratory** - W. P. Abfalterer, R. C. Haight, N. S. P. King, G. L. Morgan,
L. S. Waters

The experiment will measure proton, pion, and kaon reaction cross sections on a variety of nuclei spanning the periodic table. The momentum range of interest extends from 1 GeV/c or lower up to the maximum available. High-accuracy (about 3% uncertainty or better) data of this type are needed by the APT project in the kinetic energy range up to 2 GeV for the development of optical models that will be used for improvement of the physics in the code (LAHET) used for desing of the APT target. Sufficiently accurate and extensive data for the development of a global optical model are not presently available.

EXPERIMENT 944 - DETECTORS FOR USE ON ACCESS

SPOKESMEN: W.R. BINNS

- **Caltech** - R. A. Mewaldt, S. Schindler, G. DeNolfo, G. Albrittan
 - **Goddard Space Flight Center** - E. R. Christian, L. M. Barbier, J. W. Mitchell
 - **JPL** - M. E. Wiedenbeck
 - **Washington University at St. Louis** - W. R. Binns, D. Braun, P. L. Hink
 - **University of Siegen** - W. Menn
-

The objective of this experiment is to calibrate and study the charge resolution of various detectors suggested for use in the Advanced Cosmic Ray Composition Experiment for Space Station (ACCESS). Part of the planned ACCESS mission is the measurement of elemental abundances of the so called ultra-heavy galactic cosmic rays. This experiment will focus on detectors that would clearly resolve individual elements in the interval $23 \leq Z \leq 83$ in the energy range $0.3 \leq E \leq 20$ GeV/N, and can be used to study the charge resolution of the detectors as a function of energy.

EXPERIMENT 945

Home Page • http://www-phys.llnl.gov/N_Div/APT/

**EXPERIMENT 945 - PHYSICS BENCHMARK MEASUREMENT OF ENERGY DEPOSITION
IN AN APT TARGET/BLANKET PROTOTYPE**

SPOKESMEN: R. COOPER AND G. MORGAN

- **Bechtel Nevada** - R. Cooper, J. Langenbrunner, R. Liljestrand, A. Whiteson
- **Brookhaven National Laboratory** - A. L. Hanson
- **General Atomics** - M. Madlener, T. Torres
- **Lawrence Livermore National Laboratory** - D. Slaughter
- **Los Alamos National Laboratory** - P. Ferlguson, N. King, G.Morgan, E. Pitcher, L. Waters, K. Woloshun

In order to finalize the design of the APT target/blanket, a code validation experiment needs to be performed which will measure the energy deposition from a proton beam, as a function of position, in a prototype target/blanket. The measured distribution of the deposited energy will be compared with the distribution calculated by the MCMPX transport code. This validation is needed to understand uncertainties in the calculations, which will be used to optimize the target/blanket design and maximize the tritium production rate.

This experiment will take data at two energies, 1.2 and 1.6 GeV, and with the line operating at maximum current, with approximately $5 \cdot 10^{12}$ protons per spill.

**EXPERIMENT 945A – MEASUREMENT OF RADIATION DAMAGE IN METALS AT LIQUID HELIUM
TEMPERATURE BY RESISTIVITY CHANGE**

SPOKESMEN: G.A.GREEN AND W. F. SOMMER

- **Brookhaven National Laboratory** – B.S. Bowerman, C. C. Finfrock, G.A. Greene, A. L. Hanson, C. L. Snead
- **Los Alamos National Laboratory** – M. R. James, W. F. Sommer, L. S. Waters

An experiment for code validation purposes is needed to measure resistivity changes in several pure metals after defects have been introduced at liquid-helium temperature by exposure to energetic protons. This data is needed to quantify the uncertainties in the calculations used to predict radiation damage to spallation targets under proton irradiation. Wire samples will be tested in a cryostate which was used for similar studies at BNL.

The proposed experiment will be installed in the U-line across from the UGE2 entrance, and will be directly upstream from E945, the LANL energy deposition experiment. Experiments will be conducted at four proton energies: 0.8, 1.2, 1.6 and 2.0 GeV, and with the beam line operating at maximum current, with approximately 5×10^{12} proton per spill. It is desirable to have at least two measurements at each energy. A tight beam profile is required for this experiment to minimize heating of the sample holder. The beam should be focused to give a spot diameter at the target location of no larger than 1.0 cm full-width at half-height.

**EXPERIMENT 946 - MEASUREMENT OF ABUNDANCES OF ULTRA-HEAVY
GALACTIC COSMIC RAYS**

SPOKESMEN: A. WESTPHAL

- **Caltech** - R. A. Leske, R. A. Mnewaldt, S. M. Schindler, MN. E. Wiedenbeck
- **Goddard Space Flight Center** - L. M. Barbier, E. R. Christian, J. W. Mitchell, J. F. Ormes,
R. E. Streitmatter
- **Naval Research Labortory** - J. H. Adams
- **University of California at Berkeley** - A. Westphal
- **University of Minnesota** - C. J. Waddington
- **Washington University at St. Louis** - W. R. Binns, P. L. Hink, M. H. Israel

The objectives of this experiment are to determine whether the chemical fractionation pattern of GCRs is better organized by first ionization potential or volatility. This experiment will test whether galactic cosmic rays originate from interstellar dust grains, mass loss from main sequence stars, freshly synthesized supernova debris or special sources such as Wolf-Rayet stars. We also want to determine whether $Z < 30$ and $Z \geq 30$ nuclei have a common source. Testing if r-processes that contributed to GCRs were driven further than those that formed the solar system mix by measuring the r/s-process mix as a function of charge, will also be done.

EXPERIMENT 947 – NASA – RADIOBIOLOGY TESTING

SPOKESMEN: M. VAZQUEZ

- **Alabama A&M University - P. Kale**
- **Brookhaven National Laboratory - B. Sutherland, M. Vazquez**
- **Case Western Reserve University – H. Evans**
- **Colorado University – J. Bedford, C. Waldren**
- **Columbia University – T. K. Hei**
- **John Hopkins Medical Inst. – J. Dicello**
- **Lawrence Berkeley Laboratory – H. Barcellos-Hoff, J. Miller, P. Cooper, A. Kronenberg**
- **Los Alamos National Laboratory – D. J. Chen**
- **Pacific Northwest National Laboratory – N. Metting**
- **Texas A&M University – R. R. Sinden**
- **University of Maryland - B. Rabin**
- **Washington State University – A. L. Brooks**

This is an initial group of experiments in radiobiology, funded by the National Aeronautics and Space Agency (NASA) as part of their space-related research efforts in the life sciences.

EXPERIMENT 948 - CHARGE EXCHANGE SCATTERING

SPOKESMEN: E. J. STEPHENSON

- **Indiana University** - J. Balewski, L. C. Bland, W. W. Jacobs, K. Komisarcik, T. Rinckel, J. Sowinski, E. J. Stephenson, J. Vanderwerp, S. E. Vigdor, S. W. Wissink

This experiment proposes $pn \rightarrow np$ charge exchange as an alternative reaction with potentially large analyzing powers for polarimetry at RHIC. To demonstrate its feasibility, tests may be made in conjunction with E925 to investigate whether the analyzing powers remain large at the injection energy for RHIC and are not degraded in a carbon target.

The new detector.

**EXPERIMENT 949 - AN EXPERIMENT TO MEASURE THE BRANCHING RATIO
 $B(K^+ \rightarrow \pi^+ \nu \bar{\nu})$**

SPOKESMEN: D. BRYMAN, S. KETTELL, S. SUGIMOTO

- **Brookhaven National Laboratory** - M. S. Atiya, I-H. Chiang, M. V. Diwan, J.S. Frank, J. S. Haggerty, V. Jain, S. H. Kettell, T. F. Kycia, K. K. Li, L. S. Littengerg, R. C. Strand, C. Witzig
- **Centre for Subatomic Research-U. Alberta** - P. Kitching, H-S. Ng
- **Fukui University** - M. Miyajima, J. Nishide, K. Shimada, T. Shimoyama, Y. Tamagawa
- **KEK** - M. Aoki, T. Inagaki, S. Kabe, M. Kobayashi, T. K. Komatsubara, Y. Kuno, M. Kuriki, N. Muramatsu, K. Omata, T. Sato, T. Shinkawa, S. Sugimoto, Y. Yoshimura
- **Osaka Univrsity** - T. Nakano, M. Nomachi
- **TRIUMF** - P. C. Bergbusch, E. W. Blackmore, D. A. Bryman, S. Chn, A. Konaka, J. A. Macdonald, J. Mildenerger, T. Numao, J-M. Poutissou, R. Poutissou, G. Redlinger

A new, more precise measurement of the $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ branching ratio is proposed in this experiment. Improvements to the E787 apparatus and running mode will be made to reach a sensitivity of $(8-14) \times 10^{-12}$, an order of magnitude below the Standard Model prediction. This should result in a determination of $|V_{td}|$ to better than 27%.

EXPERIMENT 950 - RHIC POLARIMETER

SPOKESMEN: D. E. FIELDS, K. IMAI

- **Argonne Natinal Laboratory - D. Underwood**
- **Brookhaven National Laboratory - G. Bunce, H. Huang, Y. Makdisi, T. Roser**
- **Indiana U. Cyclotron Facility - M. Bai, J. Doskow, K. Kwiatkowski, B. Lozowski, H.O. Meyers, B. V. Przewoski, T. Rinckel**
- **Inst. High Enery Physics (Protvino)/Moscow Engineering Physics Institute - S. B. Nurusev, M. N. Strikhanov, M. F. Runtzo**
- **Kyoto University/RIKEN - K. Imai, M. Nakamura, J. Tojo, K. Yamamoto**
- **RIKEN - Y. Goto, N. Hayoshi, M. Ishihara, K. Kurita, M. Okamura, N. Saito**
- **Unviersity of New Mexico - B. Bassalleck, S. Eilerts, D. E. Fields, B. Lewis, B. Smith, T. L. Thomas, D. Wolfe**

This experiment will use a very thin internal carbon target, with two recoil arms to observe the slow carbon recoil. The setup will be located upstream of the present internal AGS polarimeter.

List of Publications of AGS Experiments

Publications - AGS Experiments 1982 - 1999

This listing was originally prepared using the SLAC data base SPIRES; we now rely on the experimenters themselves to supply us with information. It is easy to miss publications in such a wide search and we apologize for any left out or misidentified. Please let us know about these as well as keeping us posted on your recent publications of AGS experiments.

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