BNL 34518
(Revised 1/97)
Thirteenth Edition
Informal Report

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

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AGS Experiments 1994 • 1995 • 1996

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Thirteenth Edition
(Revised 1/97)
Informal Report

AGS Experiments - 1994 • 1995 • 1996

J. C. Depken

January 1997

AGS Department
Experimental Planning and Support Division

Brookhaven National Laboratory
Associated Universities, Inc.
Upton, New York 11973-5000
United States of America

A handwritten signature in black ink, appearing to be 'J. C. Depken'.

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AGS Experiments - 1994, 1995 and 1996

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

Division Head, EP&S Division
Brookhaven National Laboratory
Building 911B
Upton, New York 11973-5000 U. S. A.

THE CUTOFF DATE FOR APPROVED EXPERIMENTS INCLUDED IN THIS EDITION IS JANUARY 1997.

AGS As Run Schedule, FY1996

Detector Tests
Single Cycle Fast Extracted Beam
Slow Extracted Beam

By: M. Blaskiewicz Date: 10-1-96

FY96

3

By: Phil Pile; Date: 09 April 97, hours to 6 April 97

Legend	
S	Scheduled Shutdown
p	proton beam (25 GeV/c)
pp	polarized proton beam
SEB	slow extracted beam
FEB	fast extracted beam
Lo E Au	6 & 8 GeV/nucleon gold beam

AGS Beams, Jan 97

Beam	GeV/c	$\delta p/p$ (% fwhm)	Prod. Angle $\Delta\Omega$ (deg)	Flux / 10^{13} 24 GeV/c protons on target						GeV/c	Purity	Remarks	
Separated Charged Particle Beams													
C4	≤ 0.83	4	0	12.0	K^+	K^-	p	$\bar{p}$	π^+	π^-	0.80	$\pi^+/K^+ = 0.4$	L = 18 m - "LESBH" ~ 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 - "LESBH"
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 III "OR" with A1
B1*	5-28	3	0	0.05		3.0×10^8		3.0×10^7	2.0×10^7	14			Primarily III "OR" with B5
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°						$n/K_L^0 = 20$	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							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. $<E> = 1.4$ GeV/c ² Wide Band	
g-2 $\pi^+\pi^-$ 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

FY1994 Physics Program

Proton : 1 May – 31 July 94, 24 GeV/c

HI : 1 Sep – 31 Oct 94, 11.6 GeV/c/nucleon Au

AGS Experimental Area

1995 Physics Program - In Progress/Planned

14 June 95

Proton : 1 Dec 94 - 18 June 95, 24 GeV/c

NASA : 1 Oct - 14 Oct 95, 1 GeV/nucleon Fe

HI : 16 Oct - 11 Dec 95, 11.6 GeV/c/nucleon Au

HI : 12 Dec 95 - 9 Jan 96, < 11.6 GeV/c/nucleon Au

I10, E880

Partial Snake

D2-μ Channel

D-E892, Capture from pair Prod (HI)

A-E904, penning effects (Small-HI)

Experiment Multiplicity
SEB ≤ 10
SEB+FEB ≤ 12

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

C8-LESBII
E890 and E909, η Physics

C6-LESBII
Hypernuclear Spectrometer

C5, E877, QGP (HI)
E900 - Test, Nuclear Fragmentation

C1-EVA, E850
Color Transparency

B1, E866, QGP (HI)
E868, E869, E893 (Small-HI)
B5, E871, $K_L^0 \rightarrow \mu e$

B2-Test Beam, > 15 groups
E821 - SBE, Test, $\mu g-2$

A1-MPS { E852, Exotics
E895, EOS (HI)

D6-2GeV, { E813, H Search
E885, $\Lambda\Lambda$ Hypernuclei

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

U Line

VI, π - μ Beam Line, construction
RHIC Transfer Line construction

E821, $\mu g-2$, construction

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

Experiment Multiplicity

SEB ≤ 10

SEB+FEB ≤ 12

AGS Experimental Area

FY97 Physics Program – Planned / In Progress

9 May 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 – 31 May 97, 25 GeV/c

Proton (FEB) : 1–28 Jun 97, 25 GeV/c

Polarized Proton (AGS Ring) : 1–7 Jul 97

E821, μ g-2

V1, π - μ Beam Line

U, {E938, Neutron Spallation
E939, APT

U Line

RHIC Transfer Line

I10, E880
Partial Snake

D2- μ Channel

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

D-Target

A-Target

D6-2GeV, {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, E896, 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, E850
Color Transparency

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

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

Experiment Multiplicity

SEB ≤ 10

SEB+FEB ≤ 12

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S*ummaries*
of
E*xperiments*

E-787 DETECTOR

130 JULY 1990 TO MAY 1991

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, S. Kettell,
T. F. Kycia, K. K. Li, L. S. Littenberg, C. F. Ng, A. J. Stevens, R. C. Strand, C. Witzig
- **INS-Tokyo**
M. Kasumori, T. Komatsubara, M. Kuriki, N. Muramatsu, H. Okumo, S. Sugimoto, K. Ukai
- **KEK**
M. Aoki, T. Inagaki, S. Kabe, M. Kobayashi, Y. Kuno, T. Sato, T. Shinkawa, Y. Yoshimura
- **Osaka University** - Y. Kishi, T. Nakano, T. Sasaki
- **Princeton University**
M. Ardebili, M. Convery, M. M. Ito, D. R. Marlow, R. McPherson, P. D. Meyers,
F. C. Shoemaker, A. J. S. Smith, B. Stone
- **TRIUMF**
P. Berbusch, E. W. Blackmore, D. A. Bryman, P. Kitching, A. Konaka, J. A. Macdonald,
J. Mildenerger, T. Numao, P. Padley, J.-M. Poutissou, R. Poutissou, G. Redlinger, J. Roy,
M. Rozon, R. Soluk, A. S. Turcot

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.

EXPERIMENT 813

Home Page • <http://www.phys.cmu.edu/e813/e813.html>

Schematic layout of the $(\Xi^-, d)_{\text{atom}}$ experiment. The detection of neutrons from the reaction $(\Xi^-, d)_{\text{atom}} \rightarrow H + n$ will be the signature of H particle production.

EXPERIMENT 813 - SEARCH FOR A STRANGENESS -2 DIBARYON
Spokesmen: G. B. Franklin and P. D. Barnes

- **Carnegie-Mellon University**
A. Berdoz, G. Franklin, R. Magahiz, R. McCrady, F. Merrill, C. Meyer, B. Quinn,
R. A. Schumacher, R. Sukaton, V. Zeps
- **University of Alberta** - M. Rozon
- **University of Birmingham** - J. Lowe, J. Nelson, R. Zybert
- **Brookhaven National Laboratory** - R. Chrien, P. Pile, R. Sawafta, R. Sutter
- **Freiburg University**
T. Buerger, M. Burger, H. Fischer, J. Franz, E. Rössle, H. Schmitt, M. Wieder
- **Indiana Univ. Cyclotron Facility** - J. Szymanski
- **University of Kyoto** - H. Enyo, T. Iijima, K. Imai, N. Saito, S. Yokkaichi
- **University of Kyoto-Sangyo** - K. Okada, F. Takeutchi
- **LAMPF** - P. Barnes
- **University of Manitoba**
C. Davis, L. Gan, M. Landry, L. Lee, S. Page, D. Ramsay, V. Sum, W. van Oers
- **University of New Mexico** - B. Bassalleck, M. Chapman, A. Rusek, R. Stotzer, D. Wolfe
- **TRIUMF** - D. Gill
- **Vassar College** - R. Stearns
- **Yale University** - G. Diebold

Motivated by Jaffe's 1977 prediction of a six-quark object with strangeness -2 and $J^{\pi}=0^{+}$ at a mass of 2150, this experiment proposed to study the strangeness of -2 two-baryon mass spectrum from 100 MeV below the mass of the lightest known two-baryon strangeness -2 system, $\Lambda\Lambda$ mass. This particle, called the "H," has been predicted by later bag models as well. Although the mass calculation is model dependent, the predictions are considered within the expected range of sensitivity. The possibility of resonances near the $\Lambda\Lambda$ mass due to conventional meson exchange forces can also be explored using the experiment covers the region both above and below the $\Lambda\Lambda$ mass.

EXPERIMENT 817

Home Page • [http:](http://)

EXPERIMENTAL LAYOUT for E-817

EXPERIMENT 817 - POLARIZATION TRANSFER IN HYPERON PRODUCTION
Spokesmen: B. E. Bonner and J. B. Roberts

- **Rice University**
D. L. Adams, S. Ahmad, B. E. Bonner, J. A. Buchanan, J. M. Clement, M. D. Corcoran,
H. E. Miettinen, G. S. Mutchler, J. B. Roberts, J. Skeens, P. M. Stevenson
- **Brookhaven National Laboratory** - S. U. Chung, H. Willutzki
- **Johns Hopkins University** - T. Hallman, L. Madansky
- **University of Arizona** - K. A. Johns

Since the discovery that inclusively produced hyperons are polarized, the underlying cause of the effect has remained a mystery. No perturbative QCD predictions are possible for the kinematic range covered by experiment, but simple parton-based theories that explain the effect in terms of breaking of strings or Thomas precession of strongly accelerated quarks have had a remarkable degree of success in explaining the effect. This experiment aims to measure the hyperon polarization when produced by a polarized proton beam. The question being addressed is how much the hyperon polarization is influenced by that of the proton. The experiment has been performed for the case of lambdas produced by polarized protons at 13 and 18 GeV/c. In rough agreement with the model, the lambda polarization is independent of that of the proton ($D_{NN} \approx 0$) and the left-right asymmetry for lambda production is also near zero. A first measurement of these quantities for Σ^0 production has shown large deviations from the predictions of the model. We expect to continue the Σ^0 experiment to be able to make a definitive test of an extended model which we have proposed.

EXPERIMENT 821

Home Page • <http://www.phy.bnl.gov/g2muon/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**
D.H. Brown, R.M. Carey, W. Earle, E. Efsthadiadis, E.S. Hazen, B. J. Hughes, F. Krienen,
J.P. Miller, O. Rind, B.L. Roberts, L.R. Sulak, W. Worstell
- **Brookhaven National Laboratory**
J. Benante, G. Bennett, H.N. Brown, G. Bunce, J.R. Cullen, Jr., G.T. Danby, C. Gardner,
J. Geller, H-C. Hseuh, J.W. Jackson, L.X. Jia, R. Larsen, Y.Y. Lee, R. Meier, W.-Z. Meng,
W.M. Morse, C. Pai, I. Polk, R. Prigl, S. Rankowitz, J. Sandberg, Y. Semertzidis, R. Shutt,
L. Snjystrup, A. Soukas, A. Stillman, T. Talerico, P.A. Thompson, F. Toldo
- **Budker Institue for Nuclear Physics**
L.M. Barkov, A. Chertovskikh, V.P. Druzhinin, G.V. Fedotovitch, V. B. Golubev,
D.N. Grigoriev, B.I. Khazin, E.A. Kuraev, Yu. Merzliakov, N. Ryskulov, S. Serednyakov,
Yu.M. Shatunov, E. Solodov
- **Cornell University** - T. Kinoshita, Y. Orlov
- **Fairfield University** - D. Winn
- **University of Heidelberg** - A. Grossmann, K. Jungmann, P. von Walter, G. zu Putlitz
- **University of Illinois** - P. Debevec, W. Deninger, D.W. Hertzog, S. Sedyky, D. Urner
- **Lawrence Berkeley Lab./Brookhaven National Lab.** - M.A. Green
- **Max Planck Institut fur Physik** - U. Haeberlen
- **University of Minnesota**
P. Cushman, S. Giron, J. Kindem, D. Miller, C. Timmermans, D. Zimmerman
- **National Laboratory for High Energy Physics (KEK)**
K. Endo, H. Hirabayashi, S. Ichii, S. Kurokawa, K. Mashata, S. Sakamoto, T. Sato, A. Yamamoto
- **University of Riken** - K. Ishida
- **Science University of Tokyo** - Y. Mizumachi
- **Yale University**
S.K. Dhawan, F.J.M. Farley, M. Grosse-Perkekamp, V.W. Hughes, D. Kawall, S.I. Redin

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 superferric muon storage ring is now operational. Data collection will begin in FY 1997.

EXPERIMENT 836

Home Page • <http://www.phys.cmu.edu/mep-index.html>

EXPERIMENT 836 - SEARCH FOR A STRANGENESS -2 DIBARYON USING A ^3He TARGET
Spokesmen: G.B. Franklin and P.D. Barnes

- **Carnegie-Mellon University**
A. Berdoz, G. Franklin, R. Magahiz, R. McCrady, F. Merrill, C. Meyer, B. Quinn,
R. Schumacher, R. Sukaton, V. Zeps
- **University of Alberta** - M. Rozon
- **University of Birmingham** - J. Lowe, J. Nelson, R. Zybert
- **Brookhaven National Laboratory** - R. Chrien, P. Pile, R. Sawafta, R. Sutter
- **Freiburg University**
T. Buerger, M. Burger, H. Fischer, J. Franz, E. Rössle, H. Schmitt, M. Wieder
- **Indiana University Cyclotron Facility** - J. Szymanski
- **University of Kyoto** - H. Enyo, T. Iijima, K. Imai, N. Saito, S. Yokkaichi
- **Kyoto Sangyo University** - K. Okada, F. Takeutchi
- **LAMPF** - P. Barnes
- **University of Manitoba**
C. Davis, L. Gan, M. Landry, L. Lee, S. Page, D. Ramsay, V. Sum, W. van Oers
- **University of New Mexico** - B. Bassalleck, M. Chapman, A. Rusek, R. Stotzer, D. Wolfe
- **TRIUMF** - D. Gill
- **Vassar College** - R.L. Stearns
- **Yale University** - G. Diebold

The two component target, used in the $(\Xi^-, d)_{\text{atom}}$ H search of Exp. 813 will be replaced with a single ^3He target used in the reaction $K^- + ^3\text{He} \rightarrow K^+ + H + n$. With the ^3He target, greater sensitivity to a more tightly bound H is achieved. The ^3He target is to be considered a logical addition to the two component target measurement to extend the region of sensitivity to greater values of binding energy.

EXPERIMENT 844

Home Page • [http:](http://)

Evolution of angular distributions of Xe-127 and Ar-37 from the fragmentation of gold by heavy ions as a function of projectile rapidity, y . Filled points from AGS experiment E-844 are compared with existing data at Bevalac energies. Smooth curves indicate general trends. Note that the upper and lower data sets for each product are displaced by a factor of three from central set to simplify the display.

**EXPERIMENT 844 - MEASUREMENT OF ANGULAR DISTRIBUTIONS FOR FRAGMENTS
IN THE TARGET RAPIDITY REGION
Spokesman: J.B. Cumming**

- Brookhaven National Laboratory - D. Beavis, J.B. Cumming, P.E. Haustein, R.W. Stoenner
- Oregon State University - W. Loveland

Angular distributions have been measured for typical light (Ar-37) and heavy (Xe-127) products from the fragmentation of gold by 13.6-GeV/nucleon Si-28 ions. Preliminary results from the April 1992 running period are compared with existing data at Bevalac energies in the accompanying figure. Projectile rapidity, y , rather than its mass is expected to be the dominant variable determining the shape of a distribution. The E844 results, shown as filled points, indicate only small changes in the Xe-127 angular distribution between $y = 1.85$ and $y = 3.44$, consistent with the hypothesis of limiting fragmentation. In contrast, those for Ar-37 suggest a significantly increased suppression of fragments at forward angles for the $y = 3.44$ projectile. These results confirm the integral F/B measurements of AGS E825 which indicated an enhanced "backsplash" for light multifragmentation products which was not expected on the basis of existing studies of p-nucleus collisions up to 400 GeV or of nucleus-nucleus interactions at Bevalac energies. Unfortunately, technical problems led to loss of some E844 data, particularly for Ar-37 at forward angles, and additional measurements are anticipated.

EXPERIMENT 850

Home Page • <http://www.phys.psu.edu/LEPS/EVA/eva.html>

EVA, A SOLENOIDAL DETECTOR FOR LARGE ANGLE EXCLUSIVE REACTIONS
EXPERIMENT 850 - DETERMINING COLOR TRANSPARENCY TO 22 GeV/c
Spokesmen: A.S. Carroll and S. Heppelmann

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

In order to extend the range and sensitivity of measurements of large angle exclusives scattering, a solenoidal detector, EVA, has been built. This new detector increases the solid angle acceptance by a factor of 20 over the existing dipole detector and provide for momentum measurements of all outgoing particles. The initial experiment, 850, intends to determine the nuclear transparency up to 20 GeV/c incident proton momentum. The additional momentum constraint derived from the measurement of both outgoing protons will produce a much improved signal to noise ratio. At 6 GeV/c, the missing energy determination allows a partial separation of nuclear states. The solenoidal configuration provides an excellent geometry for studying a wide variety of two-body exclusive reactions near 90° in the center of mass. For example, reactions involving the two-body decays of neutral particles

$$\pi^+ n \rightarrow p X^0$$

↑

$$\rightarrow X^0 \rightarrow \pi^+ \pi^- \quad \text{are very interesting.}$$

EXPERIMENT 852

Home Page • http://lemond.phy.bnl.gov/~e852/home_e852.html

E852 Plan View

EXPERIMENT 852 - SEARCH FOR MESONS WITH UNUSUAL QUANTUM NUMBERS

Spokesmen: N. Cason and S.U. Chung

- **Brookhaven National Laboratory**
S.U. Chung, R. W. Hackenburg, K. Olchanski, D.P. Weygand, H.J. Willutzki
- **Indiana University**
B.B. Brabson, R.R. Crittenden, A.R. Dzierba, J. Gunter, R. Lindenbusch, B. Kern,
R. Lindenbusch, M. McKerley, D.R. Rust, E. Scott, P.T. Smith, T. Sulanke, S. Teige,
D. Zieminska, Z. Ziliak
- **University of Louisville - C. L. Davis**
- **University of Massachusetts-Dartmouth**
Z. Bar-Yam, J. Dowd, P. Eugenio, 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, A. Dushkin, V. Kochetkov, V. Lipaev, I. Shein, A. Soldatov
- **Rensselaer Polytechnic Institute**
G. Adams, J. Kuhn, J. Napolitano, M. Nozar, J. Smith, D. White, M. Witkowski, A. Wright

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 $M^0(1405)$ 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.

EXPERIMENT 856

Home Page • [http:](http://)

EXPERIMENT 856 - EXPLORATION OF THE BIOMEDICAL POTENTIAL OF ANTIPROTONS
Spokesman: T. Kalogeropoulos

- **Brookhaven National Laboratory**
S. Bart, G. Bennett, R. Chrien, M. Sakitt, R. Sawafta, R. Sutter
- **Case Western Reserve University** - W. Fickinger, D. K. Robinson
- **Harvard Cyclotron Laboratory** - A. Koehler
- **Loma Linda University** - J. Archambeau
- **University of Massachusetts** - A. B. Brill
- **Syracuse University** - T. Kalogeropoulos, J. Reed, Z. Sobolewski
- **SUNY Health Science Center** - D. Bassano, S. Manglos, S. C. Prasad

The potential of antiprotons for practical applications within present antiproton collection capabilities is promising. Suggested applications include direct 3D electron density imaging, 3D multi-elemental imaging, guiding precise and easy delivery of ion beams to targets, and radiation therapy.

In this initial phase of the research, the following physics questions will be addressed: (a) Comparison of antiproton capture rates in complex targets with the Z-law; (b) Studies of the annihilation mechanism in nuclei. These studies of physics are interesting on their own right and will provide basic information in evaluating the proposed applications as well.

EXPERIMENT 862

Home Page • [http:](http://)

Schematic diagram of target array for low beam intensity bombardments.

Schematic diagram of target array for high beam intensity bombardments.

Beam: A/B1
Status: Au beam completed 1993;
Awaiting La beam
Hours Charged/Approved: 42/36

EXPERIMENT 862 - ELECTROMAGNETIC DISSOCIATION OF ^{59}Co AND ^{197}Au BY ^{139}La AND ^{197}Au
Spokesman: J.C. Hill

- Iowa State University - L. Ewell, J.C. Hill, B. Libby, F.K. Wohn
- Brookhaven National Laboratory - J.B. Cumming

Electromagnetic Dissociation (ED) is a purely electromagnetic process occurring in relativistic heavy ion (RHI) reactions in which the Coulomb field of one of the participants generally excites a giant resonance in the other. The most likely decay channel for heavy nuclei is by one-neutron emission. ED was first reported in accelerator experiments (projectile fragmentation) by Heckman and Lindstrom and for target fragmentation by this experimental group. The ED cross section for the reaction $^{197}\text{Au}(^{238}\text{U}, \text{X})^{196}\text{Au}$ at 0.96 GeV/nucleon was measured to be 3.16 ± 0.23 barns. The experimenters are extending their measurements of the ED process to higher energies by measuring yields of target fragments from the collision of ^{139}La and ^{196}Au projectiles on ^{59}Co and ^{197}Au targets. Preliminary analysis of the data from high and low intensity bombardments yields an ED cross section of 9.7 barns for the $^{197}\text{Au}(^{197}\text{Au}, \text{X})^{196}\text{Au}$ reaction using ^{197}Au projectiles from the AGS.

EXPERIMENT 864

Home Page • <http://quantum.phy.vanderbilt.edu/e864>

E864, Strangelet Search Experiment

The E864 "Spectrometer" measures

- Charge (Z) and Mass (M)
- Strangelets from $M > 7 \text{ GeV}/c^2$ with $Z/M < 0.3 \text{ e}/\text{GeV}/c^2$

Elevation View

- M1 & M2** = dipole spectrometer magnets
III1, II2 & II3 = scintillation hodoscopes
S1, S2 & S3 = straw tube arrays

**EXPERIMENT 864 - PRODUCTION OF RARE COMPOSITE OBJECTS
IN RELATIVISTIC HEAVY ION COLLISIONS
Spokesman: J. Sandweiss**

- **Brookhaven National Laboratory** - C. B. Dover, T. G. Th Rowe
- **Iowa State University** - L. Ewell, J. C. Hill, B. Libby, F. K. Wahn
- **Ames Laboratory** - H. Skank, G. Sledge
- **Massachusetts Institute of Technology** - E. S. Hafen, P. Haridas, I. Pless
- **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
- **University of Bari, Italy** - P. Spinelli
- **University of Massachusetts** - M. S. Z. Rabin
- **Vanderbilt University** - V. S. Greene
- **Wayne State University** - R. Bellwied, B. Bennett, T. Cormier, J. Hall, C. Pruneau
- **Yale University**
K. Barish, M. Bennett, G. E. Diebold, J. Germani, J. Lajoie, R. D. Majka, J. Nagle, J. K. Pope,
F. S. Rotondo, J. Sandweiss, B. Shiva Kumar, A. J. Slaughter, E. J. Wolin
- **University of California-Los Angeles** - H. Z. Huang

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.

Home Page • http://130.132.48.201/www_info/e865/e865.html

Home Page • http://130.132.48.201/www_info/e865/e865.html

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
- **University of Bern** - J. Gasser
- **University of Connecticut** - J. Lozano
- **Hampton University** - K. Assamagan, K. Baker
- **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
- **University of New Mexico**
J. Armendariz, B. Bassalleck, S. Eilerts, H. Fischer, J. Lowe, R. Stotzer, D. Wolfe
- **Paul Scherrer Institute** - J. Egger, W. D. Herold, H. Kaspar, H. Weyer
- **University of Basel** - W. Menzel
- **University of Pittsburgh** - R. Appel, C. Felder, B. Giles, D. E. Kraus, J.A. Thompson
- **High Energy Physics Inst. Tbilisi State University**
N. Amaglobeli, Y. Bagaturia, D. Mazavia, T. Sachelashvili
- **Yale University** - D. Bergman, S. Dhawan, H. Do, W. Majid, M.E. Zeller
- **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 $K^+ \rightarrow \pi^+ e^+ e^-$ 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

Home Page • <http://marie.mit.edu/server/e866/e866main.html>

**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

- **Brookhaven National Laboratory**
K. Ashktorab, D. Beavis, C. Chasman, Z. Chen, Y. Y. Chu, J. B. Cumming, R. Debbe,
S. Gushue, J. H. Lee, M. LeVine, B. Moskowitz, C. Muentz, J. Olness, L. P. Remsberg,
M. J. Tannenbaum, F. Videbaek, F. Zhu
- **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. Namboordiri, T. Sangster, R. Soltz, J. H. Thomas
- **University of Maryland** - E. Garcia, A. Mignerey, J. Shea
- **Massachusetts Institute of Technology**
L. Ahle, M. Baker, V. Cianciolo, J. Dunlop, G. Heintzelman, C. Ogilvie, J. Ryan,
S. G. Steadman, G. S. F. Stephans, D. Woodruff, H. Yao
- **New York University** - B. Budick
- **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 Tokyo** - R. S. Hayano
- **University of Tsukuba** - A. Kumagai, K. Kurita, Y. Miake, S. Sato, K. Yagi
- **Yonsei University** - J. Kang, E. J. Kim

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.

EXPERIMENT 868

Home Page • <http://>

Schematic diagram of the emulsion stack exposures.

Schematic diagram of the emulsion chamber exposures.

EXPERIMENT 868 - INTERACTIONS OF 10.6 GeV/NUCLEON ^{197}Au NUCLEI IN NUCLEAR EMULSIONS
Spokesman: C.J. Waddington

- **University of Minnesota - C.J. Waddington**
- **Louisiana State University**
M.L. Cherry, P. Dienes-Jones, W.V. Jones, K. Sengupta, J.P. Wefel
- **Institute of Nuclear Physics, Krakow**
A. Dambrowska, R. Holynski, A. Jurak, A. Olszewski, M. Szarska, A. Trzupek, B. Wilczynska, H. Wilczynski, W. Wolter, B. Wosiek, K. Wozniak
- **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

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. Further analysis of specific aspects is continuing and further publications can be expected.

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. No analysis will be possible in Minnesota due to a lack of funding. Inspection of these emulsions show that they were successfully exposed but are characterized by a heavy background.

1992 BNL layout

Exp 869

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Schematic diagram of the detector setup used for the April 1992 AGS gold run. Ion chambers I - 0 to 4 are four gap parallel plate chambers filled with P10 gas. Cherenkov counters C - 0 to 3 contain radiators of Pilot 425 plastic mounted in white diffusion boxes. The multiwire proportional counters MW have 1 mm wire spacing. The target holder can place any of the targets in the beam by remote command. Thirty-two channels of data are recorded for each event at rates of up to 1,000 events/sec.

**EXPERIMENT 869 - MEASUREMENT OF FRAGMENT YIELDS FOR 14 GeV/NUCLEON
AU + X COLLISIONS
Spokesman: C. J. Waddington**

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

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 the new Booster facility at the Brookhaven AGS. The experiments at the AGS would extend the energy range of the measurements upwards to match the energies of the majority of observed cosmic ray nuclei. These measurements would 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 would also extend our current studies of the nuclear physics topics of factorization, limiting fragmentation, charge pickup, Coulomb dissociation 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 will allow 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. The analysis of these data has only just begun.

EXPERIMENT 871

Home Page • <http://egnext1.slac.stanford.edu/klue.html>

EXPERIMENT 871 - A NEW SEARCH FOR VERY RARE K_L DECAYS
Spokesmen: J. R. Kane, W. R. Molzon, J. L. Ritchie, 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**
- **Stanford University**
K. Ecklund, C. Hartman, M. Hebert, G.M. Irwin, M. Pommot-Maia, S. G. Wojcicki
- **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
- **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

This group is carrying out a new search for the decays $K_L \rightarrow \mu e$ and $K_L \rightarrow ee$, 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 $K_L \rightarrow \mu e$ was about $1-2 \times 10^{-11}$. The new experiment will reach a single event sensitivity below 10^{-12} , and if no events are observed, will set an upper limit of about 2×10^{-12} . About 10,000 $K_L \rightarrow \mu\mu$ decays will also be observed.

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

EXPERIMENT 877

Home Page • <http://skipper.physics.sunysb.edu/~e877/E877.html>

**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**
G. David, T. Ludlam, S. McCorkle, E. O'Brien, M. Rosati, C. Woody
- **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
- **University of Pittsburgh** - W. Cleland, M. Clemen, U. Sonnadara, S. Voloshin
- **University of São Paulo** - N. DaSilva, O. Dietzsch, M. Takagui
- **SUNY at Stony Brook**
R. Bersch, P. Braun-Munzinger, T. K. Hemmick, B. Hong, S. Johnson, Y. Kwon, D. Miskowiec, 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

Using an upgraded E814 set-up, this experiment proposes to study 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 will be measured.

EXPERIMENT 878

Home Page • <http>

**EXPERIMENT 878 - INVESTIGATION OF ANTINUCLEUS PRODUCTION
AND SEARCH FOR NEW PARTICLES IN NUCLEUS-NUCLEUS COLLISIONS AT THE AGS
Spokesman: H. J. Crawford**

- **University of California Space Science Laboratory**
H. J. Crawford, Y. Dardenne, J. Engelage, L. Greiner
- **Brookhaven National Laboratory** - D. Beavis, R. Debbe
- **University of California-Los Angeles** - J. Carroll, T. J. Hallman, G. Igo
- **KEK** - J. Chiba, K. H. Tanaka
- **University of Waseda** - T. Doke, T. Kashiwagi, J. H. Kikuchi
- **Johns Hopkins University** - R. Welsh
- **University of Tokyo** - R. S. Hayano
- **Lawrence Berkeley Laboratory** - I. Flores, H. Heckman, P. J. Lindstrom, R. Wright
- **Columbia University** - S. Nagamiya, P. Stankus
- **University Space Research Association** - J. Mitchell
- **Yale University** - M. Bennett, J. Nagel, K. Pope, B. Shiva Kumar

The purpose of the experiment is to investigate antideuteron ($\bar{d}$) production and to search for new states of matter produced in Au-Au collisions at the AGS using the A3 line as a spectrometer. This is a follow-on to the E858 program, an investigation of $\bar{d}$ production in Si+Al, Si+Cu, and Si+Au interactions, which achieved high statistics measurements of the $\pi^- K^-$, $\bar{p}$ spectra at 0° and set new limits on the production of stable negative particles. It was shown that the $\bar{p}$ yield per interaction was smaller than expected and the $\bar{d}$ yield was well below the level calculated from a simple coalescence model. The goal of E878 is to further investigate the hadronization process with a systematic study of pA, SiA, and AuA collisions, to determine $\bar{d}$ production from these systems, and to provide high statistics measurements of the π , K, p spectra at 0° over a broad range of secondary momenta, 1.5 - 20 GV.

E880 Partial Snake Test at the AGS
(ANL, BNL, Indiana)

AGS Internal Polarimeter

**EXPERIMENT 880 - THE EFFECTS OF A PARTIAL SIBERIAN SNAKE
ON POLARIZATION AT THE AGS
Spokesmen: S. Y. Lee and T. Roser**

- **Indiana University IUCF** - S.Y. Lee
- **Brookhaven National Laboratory**
L. Ahrens, J. Alessi, K. Brown, G. Bunce, P. Cameron, E. D. Courant, H. Huang,
P. Ingrassia, Y. Y. Lee, A. Luccio, Y. I. Makdisi, F. Mariani, 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
- **Argonne National Laboratory**
M. Bai,⁽¹⁾ K. Krueger, H. Spinka, L. Teng, D. G. Underwood, A. Yokosawa
- **TRIUMF** - U. Wienands⁽²⁾
- **Fermilab** - V. Bharadwaj, S. Hseuh
- **KEK** - S. Hiramatsu, Y. Mori, H. Sato, K. Yokoya
- **Institute for High Energy Physics, Serpukhov** - A. Ufimtsev
- **Riken** - T. Katayama, M. Okamura, T. Tominaka

This group has built a 4.7 Tesla-meter room temperature solenoid which will be installed in a 10-foot long AGS straight section. AGS polarized proton beam time is used to perform *partial snake experiments*. These experiments test the idea of using a partial snake to correct all de-polarizing imperfection resonances and also test the feasibility of betatron tune jump in correcting intrinsic resonances in the presence of a partial snake.

(1) Also at Indiana University
(2) Present address: SLAC

EXPERIMENT 882A

Home Page • [http:](http://)

Layout of first experiment, showing end of beam pipe, Pb target, and slowing stacks of CR-39 plastic detectors alternating with Pb, at a distance of 1 m downstream from the target. Shaded stacks consist of 12 repeat units of CR-39/Pb; unshaded stacks consist of 3 repeat units.

**EXPERIMENT 882A - MEASUREMENTS OF CHARGE-CHANGING
 CROSS SECTION FOR AU IONS
 Spokesman: P. B. Price**

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

E882-A is a series of small-scale experiments using a novel phosphate glass detector BP-1 and an automated scanning system. Fragments with $Z \geq 68$ were identified in BP-1 detector with a charge resolution of $\sigma_Z = 0.1$ charge unit. The main topics studied are nuclear charge pickup reaction, nuclear spallation, electromagnetic dissociation, and electron capture and stripping processes. We also measured the cross sections for fragmentation of secondary beams with $68 \leq Z \leq 80$.

1. **Charge Pickup Reaction:** We established that the charge pickup cross section scales with target mass as $\sim A_T^{0.37}$. We found that the projectile dependence is more rapid than linear, and not inconsistent with the quadratic dependence as found at ~ 1 A GeV. We discovered that the cross section for charge-changing fragmentation of the secondary beams with $Z=80$ formed in charge pickup is enhanced roughly by a factor of two compared to that for a Au ion.
2. **Nuclear and Electromagnetic Spallation:** We discovered that the large Coulomb barrier for Au reduces the electromagnetic contribution σ_{em} in a Pb target to only $\sim 8\%$ of nuclear contribution σ_{nuc} , compared with $\sim 70\%$ for 14.5 A GeV ^{28}Si and $\sim 120\%$ for 200 A GeV ^{32}S . With σ_{em} taken to be $\propto Z \frac{1.8}{T}$, σ_{nuc} can be fitted with $\sigma_{nuc} = \alpha(A_P^{1/3} + A_T^{1/3} - b)^2$, with $b=0.83$ and $\alpha=59$ mb, essentially the same as found at energies of ~ 1 A GeV (see Fig. 1).
3. **Fragmentation of Secondary Beams:** We observed an enhancement in total charge-changing cross sections for secondary beams compared to those for stable beams with similar charges. The amount of enhancement depends on the target in which the secondary fragments are produced, being 10 to 30% for light targets and up to 80% for a Pb target. We found an enhancement in partial cross sections for breakup into visible charge loss channels.
4. **Electron Capture and Stripping Processes:** The measured electron capture cross section in BP-1 glass is consistent with the prediction of radiative capture, and with the calculation of the vacuum capture. However, the measured cross section for stripping differs from the prediction by a factor of 2. We set an upper limit for vacuum capture which constrains recent non-perturbative calculations. The vacuum capture is expected to become the dominant electron-capture process at high energies, and hence could intrinsically limit the beam lifetime for future heavy ion colliders such as RHIC.

EXPERIMENT 882B

Home Page • [http:](http://)

Layout of second experiment, showing end of beam pipe, Pb target, high-field region of bending magnet, and three tracking chambers consisting of 25 thin CR-39 sheets at 2 cm intervals.

EXPERIMENT 882B - SEARCH FOR STRANGELETS AND OTHER EXOTIC OBJECTS
Spokesman: Y. D. He and P. B. Price

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

In this series of experiments, we search for production of various short-lived exotic objects in high energy heavy ion collisions.

1. Search for Abnormally Ultradense Nuclear Matter: A detector system consisting of 17 sheets of BP-1 phosphate glass and a 1.27-cm Pb target was exposed to 3.5×10^9 ions of ^{197}Au at 11.4 A GeV in 1992. This experiment was designed to search for the production of abnormally dense nuclei suggested by Lee and Wick and others. Exploiting one of the useful features of the BP-1 detector - that its sensitivity can be tuned by suitable choice of chemical etchants - we can set the detector to be sensitive only to $Z/\beta > 82$. In 10^9 interactions, we observed none of such composites emitted within an angle of 140 mrad to the beam direction, which led us to set an upper limit of ~ 20 nb for the production cross section for abnormally dense nuclear matter.

2. Search for Strange Quark Matter: We have conducted an exploratory search for strangelets and other exotic composites using the beam of ~ 10 A GeV ^{197}Au ions in 1993. Our setup consisted of a Pb target, 3 tracking chambers, each contained 25 sheets of CR-39 track-etch detectors, inside a magnet of 1.5 T at C5 beamline. The total fluence reached 10^9 Au ions in ~ 20 hours of run. The purpose of the experiment was to search for negatively highly charged ($|Z| \geq 6$) and short-lived ($\tau \sim 10^{-9}$ sec) exotic fragments produced at mid-rapidities in 10 A GeV $^{197}\text{Au} + \text{Pb}$ collisions. The experiment will reach a sensitivity of 10^{-8} / interaction. The short lifetime to which this experiment is sensitive makes it complementary to other experiments.

3. Search for Dirac Magnetic Monopole Production: We exposed a detector module to $\sim 10^{11}$ Au ions in 1994 run. The detector module consisted of 12 sheets of 10 cm x 10 cm x 0.1 cm BP-1 glass detectors and a 1.5 cm thick Pb target. Extensive searches for monopole pair production in e^+e^- and pp have been performed at various energies and upper limits to its production cross section have been placed. In all these collisions, the monopole pairs are expected to be produced via Drell-Yang mechanism. Moreover, in heavy-ion collisions the thermal production of monopole pairs has been predicted. We estimate that our detector is sensitive to a magnetic monopole with $n = 2$ and with various possible masses. This experiment is the first search for monopole pair production in heavy ion collisions. A sensitivity of 10^{-35} cm² in its production cross section is expected. This sensitivity is well below the extrapolation of Drell-Yang cross section for pair production. This setup will also allow us to search for ultradense nuclear composites with $Z/\beta > 82$ and $\tau \sim 10^{-10}$ sec in central collisions. Given a fluence of 10^{11} Au ions, we could reach a limit that is three orders of magnitude lower than previously achieved.

EXPERIMENT 885

Home Page • <http://www.phys.cmu.edu/e885.e885.html>

Detector configuration for $\Lambda\Lambda$ experiment. Drift chambers ID1, ID2, and ID3 determine incoming K^- trajectory and are combined with upstream hodoscope data to determine K^- momentum. Drift Chambers FD1, FD2, FD3, BD1 and BD2 determine K^+ momentum. Scintillators IT and BT determine K^+ time-of-flight. Hodoscopes FP and BP determine spectrometer acceptance. Aerogel Cerenkovs IC1, IC2, FC, and BC reject pions. Hydrogen Cerenkov FCH rejects protons.

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, A. Rusek, R. Sawafta, R. Sutter
- **Carnegie-Mellon University**
A. Berdoz, 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. Konigsmann, H. Schmidt
- **University of Kentucky - V. Zeps**
- **KEK - T. Iijima**
- **Kyoto University**
A. Ichikawa, K. Imai, Y. Kondo, K. Yamamoto, Y. Yosoi
- **University of Kyoto-Sangyo - F. Takeuchi**
- **Los Alamos National Laboratory - P. Barnes, F. Merrill**
- **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**
- **Rutgers University - R. Ransome**
- **TRIUMF - C. Davis, J. Doornbos**

The existence and properties of $\Lambda\Lambda$ hypernuclei are intimately related to the H particle, a proposed six quark state (uuddss) and the question of strange matter and strangelets. If the H exists and is sufficiently bound, two Λ s in a hypernucleus will fuse to form an H. The collaboration has built an experiment to form and detect $\Lambda\Lambda$ hypernuclei by stopping many more χ^- than in any previous attempt.

Running of the experiment to date has primarily utilized a diamond target for high stopping rate of short-lived χ^- . K^- at 1.8 GeV/c incident on a diamond target form χ^- which stop in the diamond and K^+ which are detected in the spectrometer. Capture of χ^- by carbon nuclei form $\Lambda\Lambda$ hypernuclei. A scintillating fiber array tracks hypernuclear decay products, and a large TOF array detects the formation neutron. If H particles are formed, their decays can be detected. S = -2 systems formed in the initial K^- interaction will also be studied.

BNL-AGS D6 Beam Line & E886 Experimental Setup

- * Beam Line selects p/Z ($\pm 3\%$)
- * E1 Separator selects range of M/Z
- * TOF selects M/Z (front and back)
- * $\Delta E/\Delta X$ in E1-E4 selects Z
- * Full particle tracking through front and back spectrometers
--> p/Z determined twice

EXPERIMENT 886-SEARCH FOR NEW PARTICLES IN NUCLEUS-NUCLEUS COLLISIONS

Spokesmen: K. Imai, P. Pile, and G. Diebold

- **Kyoto University**
H. Enyo, T. Iijima, K. Imai, A. Masaike, S. Mihara, N. Saito, K. Yamamoto, S. Yamashita, S. Yokkaichi
- **Kyoto Sangyo University** - K. Okada, F. Takeuchi
- **University of Birmingham** - N. Nelson, R. Zybert
- **Brookhaven National Laboratory** - D. Beavis, R. Chrien, P. Pile, R. Sawafta, R. Sutter
- **Carnegie Mellon University**
G. Franklin, R. Magahiz, F. Merrill, B. Quinn, R. Schumacher, R. Sukaton, V. Zeps
- **Yale University** - G. Diebold
- **University of New Mexico** - B. Bassalleck, J. Hall, J. Lowe, * A. Rusek, D. M. Wolfe
- **Freiburg University** - M. Burger, T. Bürger, J. Franz, E. Rössle, H. Schmitt
- **Vassar College** - R.L. Stearns

The purpose of this experiment is to search for new particles, such as strange quark matter (strangelets), in nucleus-nucleus collisions. It has been suggested that strangelets might exist and may be produced in relativistic nucleus-nucleus collisions. Using the 2 GeV/c K-beam line as a mass spectrometer, the experimenters propose to search for long-lived ($\tau > 10^{-8}$ s) particles with large mass to charge ratios ($M/Z > 3$ GeV/c²) as is expected for strangelets.

E886 was approved in late February 1992 for a nominal 100 hour test run during the 1992 heavy ion running period. This marked the first time heavy ions were delivered to the D line. During this test run E886 ran smoothly and efficiently, completing its test runs using available beam not required by other users. A total of 283 beam hours were charged; however, the beam intensity during most of this running was low. Of the 283 hours charged, approximately 20 hours of Au beam and 50 hours of Si beams were at the highest available intensities ($\approx 10^7$ Au and 10^9 Si ions per spill). As a result of the excellent particle identification and high rate capabilities of the D6 beam line and spectrometer system, the production cross sections of a broad range of known particles were quickly measured. This included $\pi^\pm$, $K^\pm$, $p^\pm$, d, t, ^3He , and ^4He . In the high sensitivity runs associated with the Si strangelet searches, rare nuclear species such as ^6He and ^8He were also measured. For Au running, sensitivity was limited due to the relatively low (10^7 /spill) beam intensity. The strangelet search was made in FY 93-94. The strangelet sensitivity was sufficient to seriously constrain strangelet production models based on intermediate quark-gluon plasma formation.

* Also at the University of Birmingham.

EXPERIMENT 887

Home Page • <http://>

Schematic drawing of LESB2 (Low Energy Separated Beamline 2).

Pion angular acceptance	18 msr
Pion momentum acceptance	see Figure C.2 in Appendix C
Energy resolution	4.2 MeV FWHM

Performances of the Pion spectrometer

EXPERIMENT 887 - DO NARROW Σ HYPERNUCLEAR STATES EXIST?
Spokesmen: R. Sawafta and K. Hicks

- Brookhaven National Laboratory - S. Bart, R. E. Chrien, R. Sawafta
- CEBAF and Hampton University - K. Baker, W. Naing, L. Tang
- Yale University - M. Barakat
- University of Indiana - W. Franklin, S. W. Wissink
- INS-Tokyo - T. Fukuda, T. Nagae, H. Outa
- University of Houston - K. Gross, E. V. Hungerford, B. Mayes, I. Zhu
- Ohio University - K. Hicks, R. Michael
- University of Tokyo - R. S. Hayano, Y. Shimizu

Recently, hypernuclear mass spectra for in-flight ($K^-, \pi^\pm$) reactions from ^1H , ^2H , ^6Li , and ^9Be have been measured at $p_K = 600 \text{ MeV}/c$. The new ($K^-, \pi^\pm$) spectra have greatly changed the experimental situation with regard to the narrow structures above the Σ binding threshold. The experimenters have obtained spectra with almost 10 times better statistics than previous measurements, and preliminary analysis of the data show no evidence of any of the putative structure. A detailed comparison of the new and old data sets makes clear that the earlier claims have an inadequate statistical foundation, and hence all previously claimed examples of such narrow structure in the unbound energy region can be excluded.

EXPERIMENT 890

Home Page • <http://ucla5.phy.bnl.gov/htdocs/e890/e890.html>

**EXPERIMENT 890 - A NEW TEST OF CHARGED SYMMETRY
IN ETA PRODUCTION ON DEUTERIUM
Spokesmen: B. M. K. Nefkens, R. E. Chrien, J. C. Peng**

- **University of California-Los Angeles**
M. J. Clajus, S. McDonald, T. Moriwaki, B. M. K. Nefkens, J. W. Price, W. B. Tippens,
D. B. White
- **Brookhaven National Laboratory** - R. E. Chrien, R. Sawafta, R. J. Sutter
- **Los Alamos National Laboratory** - M. J. Leitch, J. C. Peng
- **Forschungszentrum Jülich** - H. Seyfarth
- **Ruder Boskovic Institute** - M. Batinić, A. Marušić, I. Šlaus, A. Švarc
- **George Washington University** - W. Briscoe, T. Morrison, Z. Papandreou
- **Petersburg Nuclear Physics Institute** - V. V. Abaev, V. S. Bekrenev, N. G. Kozlenko, S. P. Kruglov,
A. B. Starostin
- **JINR, Dubna** - A. Efendiev
- **Abilene Christian University** - M. Sadler, L. D. Isenhower

The experimenters have measured the ratio of η production on deuterium by positive and negative pions over the momentum range from 640 MeV/c to 755 MeV/c. This range spans the onset of the $S_{11}(1535)$ resonance, which has a very large branching ratio for η decay. The η s are observed by detection of the photons from the neutral decay of the η into two photons.

The measurement of this ratio is a direct test of the validity of charge symmetry in this unexplored domain of nuclear physics. Violations of the symmetry are to be expected because of π^0 - η mixing.

The experiment showed large asymmetries, ranging up to over 10% at the highest momentum pions.

A preliminary fit of the data to a model of η production which includes π^0 - η mixing as the only adjustable parameter requires a value for the mixing angle of ~ 1 - 2° . This is the first direct evidence of π^0 - η mixing in a nuclear environment.

The experiment also demonstrated the power of the AGS as a potent source of η mesons.

EXPERIMENT 891

Home Page • http://www/phy.bnl.gov/usr1/people/e891/doc/www/welcome_891.html

**EXPERIMENT 891 - A SEARCH FOR QUARK MATTER (QGP)
AND OTHER NEW PHENOMENA UTILIZING AU-AU COLLISIONS AT THE AGS
Spokesmen: E. D. Platner**

- **Brookhaven National Laboratory**
S. E. Eisman, A. Etkin, K. J. Foley, R. W. Hackenburg, R. S. Longacre, W. A. Love
- **Brookhaven National Laboratory and City College of New York** - S. J. Lindenbaum
- **University of California, Berkeley** - J. Marx, L. Schroeder
- **City College of New York** - C. S. Chan, E. Efstathiadis, M. A. Kramer, K. Zhao, Y. Zhu
- **Rice University**
S. Ahmad, B. E. Bonner, J. A. Buchanan, J. M. Clement, G. S. Mutchler, E. D. Platner

A program is underway to study Au-Au collisions at the AGS by measuring the angles and momenta of charged tracks, K_s^0 's and Λ 's using the TPC's and trigger detectors from E810. In order to handle the higher track multiplicities produced by Au beams, a modified geometric arrangement of the TPC modules is used. This program allows the experimenters to look for anomalous behavior in rapidities (or pseudorapidities), multiplicity, strangeness enhancements, $P_\perp$ ($E_\perp$), energy flow; possibly observe Hanbury-Brown and Twiss effects and other new phenomena. These observations are on an event-by-event basis so that particularly interesting classes of events can be selected and added together to search for new effects (like strangelets) implying a QGP or other new states of matter in a manner which tends to maximize signal-to-background ratios.

EXPERIMENT 892

Home Page • <http://www/ags.bnl.gov/~e892/>

Schematic diagram of the apparatus. The adiabatically decreasing solenoid field (shown schematically by the coil height) transports and focuses the positrons. Small dipoles at either end deflect the positrons and electrons into the scintillator detectors. These detectors measure the positron energy and, from time of flight, determine the emission angle of the positron. Positrons are verified by the 511 keV annihilation radiation detected in the gamma detectors. A large dipole magnet(s) located downstream from the APS separates the charge states of the emerging ions.

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 capture from pair production and free pair production of 10 GeV/n Au⁷⁹⁺ on Au collisions. This provides the first measurement of capture from pair production at energies above the 1 GeV/n region. The results are essential to understand the process, to guide ongoing efforts, to develop a nonperturbative theory, and to supply important data for the operations of RHIC. Capture from pair production is the process in which an electron-positron pair is produced by the transient electromagnetic field from a relativistic heavy-ion atomic collision (no nuclear contact) and the electron emerges bound to the projectile ion. It is unique because it is the only recombination process in which the cross section *increases* with energy at relativistic energies. At sufficiently high energies it is predicted to become the dominant re-combination mechanism.

EXPERIMENT 893

Home Page • [http:](#)

Beam: B1
Status: Complete FY 1996
Hours Approved: 10/1

**EXPERIMENT 893 - TEMPERATURE/ZENITH ANGLE CALIBRATION
OF POLYCARBONATE TRACK DETECTORS
Spokesman: A. Thompson**

Dublin Institute for Advanced Studies

This experiment proposes to measure the track response of polycarbonate to relativistic Au ions at -20°C and to investigate the isotropy of track response to Au at the same energy.

Gold Event - TPC

EXPERIMENT 895 - EXCLUSIVE STUDY OF NUCLEAR COLLISIONS AT THE AGS

Spokesman: G. Rai

- **Lawrence Berkeley National Laboratory**
T. Case, K. Crowe, P. Kammel, D. Olson, T. Wienold
- **Brookhaven National Laboratory** - S. Gushue
- **Carnegie-Mellon University** - M. Kaplan, Z. Milosevich, J. Whitfield
- **Columbia University**
I. Chemakin, B. Cole, H. Hiejima, X. Yang, Y. Zhang
- **University of California-Davis**
P. Brady, D. Cebra, J. Chance, J. Draper, J. Romero
- **Harbin Institute of Technology**
L. Huo, Y. Liu, W. Zhang
- **Kent State University** - M. Justice, D. Keane, H. Liu, W. Wang
- **Lawrence Livermore National Laboratory** - V. Cianciolo, R. Soltz
- **Purdue University**
A. Hirsch, E. Hjort, N. Porile, R. Scharenberg, B. Srivastava

The experimenters are carrying 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 seek to determine the highest compression achievable in nuclear matter and to study its properties and they will search for evidence for an exotic Equation of State, that is, new physics such as Resonance Matter, Exotica, and QGP. The experimenters are also interested in signatures of critical phenomena in dilute nuclear matter.

It is proposed to measure 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 will be 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.

EXPERIMENT 896

Home Page • [http:// aquila.lbl.gov/bnl896/home_e896.html](http://aquila.lbl.gov/bnl896/home_e896.html)

E896 H_0 Search Experiment Layout

BIRD'S EYE VIEW

**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. Debbe, R. Longacre, J. Mitchell, E. Mogavero
- **University of California-Berkeley**
M. Bennett, H. Crawford, M. Cronqvist, J. Engelage, I. Flores, L. Greiner, E. Judd, P. Lindstrom
- **University of California-Los Angeles**
J. Carroll, T. Hallman, H. Huang, G. Igo, S. Kelly, S. Trentalange
- **Carnegie-Mellon University** - C. Brown, M. Kaplan, P. Karol, Z. Milosevich, J. Whitfield
- **University of Catania** - S. Albergo, Z. Caccia, S. Costa, A. Insolia, R. Potenza, G. Russo, C. Tuve
- **CERN** - P. Sonderegger
- **Johns Hopkins University** - L. Madansky
- **Lawrence Berkeley Laboratory** - L. Greiner, J. Marx, I. Sakrejda
- **University of Michigan** - R. Welsh
- **NASA-Goddard Space Flight Center** - J. W. Mitchell
- **Ohio State University** - T. Humanic, P. Sanjeev, E. Sugarbaker, G. Vilkelis
- **University of Texas-Austin** - G. Hoffman, P. Jensen, S. Paganis, P. Riley, J. Schambach, J. Tang
- **Rice University**
B. Bonner, K. Kainz, W. Llope, G. Mutchler, E. Platner, C. Stokeley, H. Themann, M. Wright, P. Yepes
- **Wayne State University** - R. Bellwied, A. French, Y. Guo, J. Hall, J. Sheen, K. Wilson
- **Yale University** - V. Bernardo, S. Kumar, F. Rotondo, N. Smirnoff, X. Zhangbu

The experimenters propose to search for the H_0 dibaryon state and for new states of nuclear matter produced in nucleus-nucleus (AA) collisions at the AGS. This experiment enhances the existing AA program by extending the search into regions of short lifetime, $\approx \tau_\Lambda$, and complements the existing double-strangeness exchange (Ξ -p) program by offering access to a new, more probable doorway channel, the coalescence of two Λ 's into a bound di-lambda. The detector under construction is capable of unambiguously identifying the topological signature of unstable particle decays as well as the rigidity of each charged particle produced, affording a sensitive search for new metastable states and investigation of the properties of known strange particle states.

**EXPERIMENT 898 - RADIOBIOLOGY AND BIOPHYSICS WITH
HIGH ENERGY HEAVY IONS
Spokesmen: J. Miller, A. Kronenberg, G. A. Nelson**

- **Colorado State University** - C. Waldren
- **Brookhaven National Laboratory** - M. Vazquez
- **Jet Propulsion Laboratory** - G. A. Nelson
- **Lawrence Berkeley Laboratory**
M. H. Barcellos-Hoff, P. Cooper, A. Kronenberg, J. Miller

This experiment studies 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 differs from a typical AGS experiment in that it actually consists of a number of more or less independent biology and physics experiments. The list of experiments and PI's may vary from year to year. Please contact Dr. Marcelo Vazquez (BNL x 3443) for a list of investigators for 1995-1996.

EXPERIMENT 899

Home Page • [http://](#)

EXPERIMENT 899 - HIGH ENERGY PION-INDUCED NUCLEAR FRAGMENTATION
Spokesmen: R. J. Peterson

- **University of Colorado - R. J. Peterson**
- **Federal University of Rio de Janeiro - S. de Barros**
- **University of the State of New York, Stony Brook - R. McGrath**
- **PINSTECH - H. A. Khan, N. A. Khan**

Experiment 899 measured pion-induced fission fragment cross sections for multiplicities of up to four with Solid State Nuclear Track Detectors (SSNTD) directly in beams of π^- from 500 to 1460 MeV kinetic energy. A recent exposure at LAMPF measured fission cross sections but not multiplicities at negative pion energies of 350 and 500 MeV. Targets of several heavy elements were exposed to each of four AGS beam energies within the same stack of detectors.

High multiplicity events have been found to be rare in early analyses, but a marked forward peaking of fission events shows linear momentum transfer from the pion beam.

EXPERIMENT 900

Home Page • <http://>

Engineering sketch of ISIS.

Telescope configuration for forward hemisphere array. Each unit is part of an 18-member ring; forward-most element is segmented into two halves.

**EXPERIMENT 900 - ENERGY DISSIPATION AND MULTIFRAGMENTATION IN
H + A REACTIONS BETWEEN 2 AND 24 GeV/c
Spokesmen: K. Kwiatkowski and V. E. Viola**

- **Indiana University**
M. Carlson, D. S. Ginger, W.-Ch Hsi, K. Kwiatkowski, V. E. Viola, G. Wang, N. R. Yoder
- **Simon Fraser University** - R. Korteling
- **University of Maryland** - H. Breuer, P. G. Roos
- **Texas A&M University**
F. Gimeno-Nogues, E. Ramakrishnan, D. Rowland, S. J. Yennello
- **Michigan State University** - W. G. Lynch, M. B. Tsang
- **Brookhaven National Laboratory** - S. Gushue, L. P. Remsberg

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. In 1997 it is intended to measure the $\bar{p} + {}^{197}\text{Au}$ reaction.

EXPERIMENT 903

Home Page • [http:](#)

EXPERIMENT 903 - A STUDY OF DOMAIN WALL PINNING IN IRRADIATED SAMPLES OF $\text{Nd}_2\text{Fe}_{14}\text{B}$
Spokesman: C. L. Snead and D. K. Finnemore

- **Brookhaven National Laboratory** - C. L. Snead
- **Ames Laboratory** - P. C. Canfield, D. K. Finnemore, R. W. McCallum

The experimenters proposed to irradiate specimens of permanent-magnet materials so that the defect pinning of magnetic domain walls due to particle tracks can be evaluated.

An assortment of 10 samples ranging in thickness from 0.1 to 1.0 mm, each being about 1 mm square were used. The most interesting spacing for the damage tracks is in the range of 10 to 100 nm which implies irradiation to a dose of about 10^{10} ions per cm^2 . After the samples had been irradiated and characterized, annealing experiments were carried out to determine the micro-structural changes induced by the annealing and the corresponding changes in domain wall pinning and performance characteristics of the material. Some samples were irradiated parallel to the c-axis and others at 45° to the c-axis.

The above has been completed. Follow-on irradiations are being planned.

EXPERIMENT 904

Home Page • [http:](#)

EXPERIMENT 904 - A STUDY OF COLUMNAR PINNING CENTERS IN HIGH T_C SUPERCONDUCTOR
Spokesman: R. Weinstein

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

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.

EXPERIMENT 905

Home Page • <http://www.phy.bnl.gov/~bnlhyp/e905.html>

A comparison of the in-flight (BNL) observations of the Σ -structure in ^4He and the stopped kaon experiments at KEK. In both sets, the structure is present in (K^-, π^-) reactions, but not for (K^-, π^+) .

EXPERIMENT 905 - SEARCH FOR A Σ HYPERNUCLEAR BOUND STATE IN ^4He (K^- , $\Pi^\pm$) REACTIONS
Spokesman: T. Nagae

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

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 is 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 will be 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 will allow a choice between competing model explanations.

EXPERIMENT 906

Home Page • <http://www.phy.bnl.gov/~bnlhyp/t.html>

**EXPERIMENT 906 - EXPERIMENT TO DETECT DOUBLE- Λ HYPERNUCLEI
BY OBSERVING CHARACTERISTIC Π - MESONIC DECAYS
Spokesmen: T. Fukuda and R. E. Chrien**

- **INS-University of Tokyo**
T. Fukuda, T. Nagae, J. Nakano, K. Omata, M. Sekimoto
- **Brookhaven National Laboratory**
S. Bart, R. E. Chrien, M. May, P. Pile, R. Sawafta, R. Sutter
- **Carnegie-Mellon University**
A. Berdoz, D. Carman, G. B. Franklin, R. Magahiz, C. Meyer, B. P. Quinn, R. A. Schumacher
- **Gifu University** - M. Hanabata, K. Nakazawa
- **University of Freiburg** - H. Fischer, J. Franz, K. Konisgmann, H. Schmitt
- **INR-Russia** - M. Prohvatilov, V. Rasin
- **Kyoto University** - K. Imai, K. Yamamoto, M. Yosoi
- **Kyoto-Sangyo University** - K. Okada, F. Takeuchi
- **Rutgers University** - R. D. Ransome
- **TRIUMF** - D. R. Gill
- **University of Manitoba**
J. Birchall, C. A. Davis, L. Gan, L. Lee, S. A. Page, W. D. Ramsay, W. T. H. van Oers
- **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 spectroscopy of double- Λ hypernuclei.

Double- Λ hypernuclei will be produced at the (K^- , K^+) reaction point through multi-step processes and 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), will be used for this experiment.

EXPERIMENT 907

Home Page • <http://bart.phys.uh.edu/~mep.hype907.html>

Schematic layout of the experimental setup.

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, J. Gerald, M. May, P. H. Pile, A. Rusek, R. Sutter, W. B. Tippens
- **University of California at Los Angeles** - B. Nefkens
- **Carnegie-Mellon University** - G. B. Franklin, B. Quinn
- **CEBAF** - L. Tang
- **University of Colorado** - G. A. Peterson
- **George Washington University** - W. Briscoe
- **University of Houston**
M. Ahmed, X. Cui, A. Empl, E. V. Hungerford, A. Lan, B. Mayes, L. Pinsky
- **University of Kentucky** - V. Zeps
- **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
- **University of Maryland** - P. G. Roos
- **University of Minnesota** - D. Dehnhard
- **North Carolina A&T** - R. Sawafta
- **R. Boskovic Institute** - I. Supek
- **University of Texas at Austin** - G. Glass, C. Fred Moore, H. Ward
- **Tohoku University** - O. Hashimoto
- **University of Zagreb** - D. Androic, M. Furic, T. Petkovic, M. Planinic

The experimenters propose to use 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 to be used is (K_{stop}^- , π^0), with stopping K^- obtained from the LESB-II(C) beam line at the AGS. The NMS will be moved from LAMPF to BNL for this experiment.

EXPERIMENT 909

Home Page • [http:](http://)

E890 Layout

Experimental setup for E890 including changes necessary for using a kaon beam.

EXPERIMENT 909 - η TA PRODUCTION AT THRESHOLD IN THE REACTIONS

$$\pi^- p \rightarrow \eta n \text{ and } K^- p \rightarrow \Lambda \eta$$

Spokesmen: W. J. Briscoe and W. B. Tippens

- **George Washington University**
C. Bennhold, W. J. Briscoe, T. W. Morrison, Z. Papandreou, S. Philips, J. Prokop, R. Pratt
- **University of California-Los Angeles**
M. Clajus, S. McDonald, T. Moriwaki, B. M. K. Nefkens, W. B. Tippens, D. White
- **Brookhaven National Laboratory** - S. Bart, R. E. Chrien, R. Sawafta, D. Sutter
- **Abilene Christian University** - L. D. Isenhowe, M. E. Sadler
- **Rudjer Boskovic Institute** - A. Marusic, I. Šlaus
- **Joint Institute for Nuclear Research-Dubna** - A. Efendiev
- **PNPI, Gatchina** - V. Abaev, V. Bekrenev, N. Koslenko, S. Kruglov

The threshold for η production in the reactions $\pi^- p \rightarrow \eta n$ and $K^- p \rightarrow \Lambda \eta$ is close to the mass of the $S_{11}(N^*(1535))$ and $S_{01}(\Lambda^*(1670))$ resonances, respectively. The cross section for η production in both reactions is unexpectedly large as are other η threshold production cross sections. Better quality data, particularly angular distributions which are currently lacking, in both the $K^- p$ and $\pi^- p$ reactions are needed to understand the role of these resonances near the η threshold. There is a factor of four discrepancy in the determination of the ηN scattering length and the $\eta \Lambda$ scattering length is unknown due to a lack of precise threshold cross section data. New, precision data at threshold would allow better determinations of these scattering lengths.

The experimenters propose to measure total cross section, as well as angular distributions for η production in both of these reactions from threshold ($P_\pi = 685 \text{ MeV}/c$, and $P_K = 723 \text{ MeV}/c$) up to $760 \text{ MeV}/c$. The η particles are detected via the 2γ decay mode using the improved η spectrometer currently in operation on the C8 beam line.

EXPERIMENT 910

Home Page • <http://nevis1.nevis.columbia.edu/heavyion/e910/>

EOS - pA Plan View

Plan view of the proposed experiment

**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
- **University of Tennessee**
S. Mioduszewski, D. Morrison, K. Read, S. Sorensen
- **University of Tsukuba- Institute of Physics** - K. Kurita, Y. Miake
- **Yonsei University** - J. H. Kang, Y. H. Shin

The experimenters are studying proton-nucleus (p-A) and heavy ion collisions at the AGS using a large-acceptance detector. The main focus of the experiment is measurement of strange particle production and a search for H^0 dibaryon formation in p-A collisions. The strange-particle production measurements will provide data for comparison to recent measurements in heavy-ion collisions and also allow more detailed studies of the mechanisms that are responsible for strangeness enhancement in p-A and heavy-ion collisions. The main component of the proposed detector is the EOS TPC, a part of Exp. 895. The TPC will be 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 will provide a dedicated facility for the EOS TPC which would allow the detector to be employed during all modes of AGS running.

EXPERIMENT 913

Home Page • http://ucla5.phy.bnl.gov/htdocs/e913-914_new/e913-914.html

Crystal Ball Floor Layout - Plan View

EXPERIMENT 913 - BARYON SPECTROSCOPY WITH THE CRYSTAL BALL
Spokesmen: M. E. Sadler and W. B. Tippens

- **Abilene Christian University** - L. D. Isenhower, M. E. Sadler and students
- **University of California-Los Angeles**
M. Clajus, S. McDonald, T. Moriwaki, B.M.K. Nefkens, W. B. Tippens, D.B. White and students
- **George Washington University** - W. J. Briscoe, T. W. Morrison, Z. Papandreou and students
- **Joint Institute for Nuclear Research-Dubna** - A. Efendiev and others
- **Kent State University** - D. M. Manley and students
- **Petersburg Nuclear Physics Institute-Gatchina**
V. Abaev, V. Bekrenev, N. Koslenko, S. Kruglov, I. Lopatin, A. Starostin
- **Rudjer Boskovic Institute** - M. Bartinic, A. Marušič, I. Šlaus, I. Supek, A. Švarc

A comprehensive experimental program is proposed to measure absolute differential cross sections for $\pi^- \rightarrow \gamma n$, $\pi^- p \rightarrow \pi^0$ and $\pi^- \rightarrow \eta n$ in the momentum region 0.4-1.9 GeV/c. The large acceptance, high energy resolution and spatial segmentation of the Crystal Ball detector are necessary to identify the various reaction channels by reconstructing the invariant mass of the produced γ rays.

EXPERIMENT 914

Home Page • <http://ucla5.phy.bnl.gov/htdocs/e913-914/e913-914.html>

Crystal Ball Floor Layout - Plan View

EXPERIMENT 914 - NEUTRAL HYPERON SPECTROSCOPY
Spokesmen: B.M.K. Nefkens, T. Kycia, S.P. Kruglov

- **Abilene Christian University** - L. D. Isenhower, M. E. Sadler and students
- **University of California-Los Angeles**
 M. Clajus, S. McDonald, T. Moriwaki, B.M.K. Nefkens, W. B. Tippens, D.B. White and students
- **George Washington University** - W. J. Briscoe, T. W. Morrison, Z. Papandreou and students
- **Joint Institute for Nuclear Research-Dubna** - A. Efendiev and others
- **Kent State University** - D. M. Manley and students
- **Petersburg Nuclear Physics Institute-Gatchina**
 V. Abaev, V. Bekrenev, N. Koslenko, S. Kruglov, I. Lopatin, A. Starostin
- **Rudjer Boskovic Institute** - M. Bartinic, A. Marušić, I. Šlaus, I. Supek, A. Švarc

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})
$K^- p \rightarrow \Sigma^0 \pi^0$	"
$K^- p \rightarrow \Sigma^0 2^0$	"
$K^- p \rightarrow \Sigma^0 \eta$	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. The incident beam momentum is varied in steps of 25-50 MeV/c from 600 MeV/c in the C-line to the maximum momentum of 1.8 GeV/c in the D-line.

EXPERIMENT 915

Home Page • [http:](#)

EXPERIMENT 915 - Proposal for 11.4 A GeV Au Exposure at the AGS
The Trek Collaboration
Spokesman: A. Westphal

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

The Trek Collaboration proposes to use 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 is 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 to two cosmonauts in an EVA in June 1991. The goals of the large Trek collector are 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 to search for transuranic nuclei and exotic particles such as strangelets. The experimenters propose to calibrate the detectors with a highly relativistic gold beam at the AGS at the first opportunity after recovery.

EXPERIMENT 916

Home Page • [http:](#)

**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 is 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 (see figure). 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 will study 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 will measure 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 hope to establish the energy dependence of these cross sections, which may enable 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 expect to study the dependence of the detector response on β for a given Z . This set of data will permit an interesting examination of the dependence of restricted energy loss on γ in addition to $(Z/\beta)^2$ term.

EXPERIMENT 917

Home Page • <http://cnas.ucr.edu/~physics/hvyion/e917.html>

EXPERIMENT 917- Studies of High Density Baryon Matter Using Rare Probes
Spokesmen: R. Seto and A. Mignerey

- **Brookhaven National Laboratory** - Y. Y. Chu, J. Cumming
- **University of California-Riverside**
J. Chang, W. Elderege, K. Fleming, S. Y. Fung, R. Seto, H. Xiang
- **Columbia University (Nevis Labs.)** - C. Y. Chi
- **Institute of Nuclear Study-Tokyo University** - Y. Akiba, H. Hamagaki, S. Homma
- **Lawrence Berkeley Laboratory** - H. J. Crawford, J. Engelage
- **Lawrence Livermore National Laboratory**
- **University of Maryland** - E. Garcia, A. Mignerey, J. Shea
- **Massachusetts Institute of Technology**
J. Dunlop, G. Heintzelman, C. Ogilvie, G. Stephans, H. Yao
- **University of Tokyo** - R. S. Hayano, T. Ishikawa, K. Oyama, H. Tamura
- **Yonsei University** - J. H. Kang, E-J. Kim

The proposed experiment will study 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.

Home Page • http://bnlstb.bio.bnl.gov/www_root/webdocs/nasa/nasapage.html

Home Page • http://bnlstb.bio.bnl.gov/www_root/webdocs/nasa/nasapage.html

**EXPERIMENT 919 - A STUDY OF THE GENETIC AND EPIGENIC EFFECTS
PRODUCED BY HIGH ENERGY HEAVY IONS
Spokesman: M. Vazquez**

- Brookhaven National Laboratory - J. Bullis, J. Gatley, M. Vazquez
- Lawrence Berkeley National Laboratory - J. Miller, A. Kronenberg
- Colorado State University - G. Mariano
- USAF Armstrong Laboratory - A. Cox
- University of Maryland Baltimore County - B. Rabin
- University of Maryland Baltimore - E. Balcer-Kubiczek
- Georgetown University Medical Center - T. Jorgensen

This is a NASA effort in the AGS to study the genetic and epigenetic effects produced by high energy heavy ions. There will be two runs labeled BNL-3,4 (E919) for the period of October 1, 1996 to September 31, 1998. Each run provides 150 hours of 1 GeV/nucleon Fe ions.

Schematic of a MCS radiographic detector system. The beam is first prepared with a diffuser and matching lens to meet optics requirements. It then passes through the object to be radiographed. The transmitted beam passes through an iris, or aperture, is focused on the first detector, then passes through a smaller diameter iris and is focused on a second detector. The ratio of the first and second detector intensities provides both the density profile and material composition of the object.

Beam: A1
Status: Complete 1996
Hours Charged/Approved: 197

EXPERIMENT 920 - LENS TEST 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 is 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 will be directly compared with X-ray measurements on the same set of objects.

EXPERIMENT 922

Home Page • <http://>

**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 International 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 is 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 scheduled at the AGS in the fall/winter of 1996 is the only American resource known that can accomplish this special testing.

EXPERIMENT 923

Home Page • <http://www.phy.bnl.gov/edg/~edg.html>

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

- **Brookhaven National Laboratory**
M. V. Diwan, J. Frank, A. Gordeev, S. Kettell, L. Leipuner, L. Littenberg, H. Ma,
V. Polychronakas
- **Institute for Nuclear Research, Moscow, Russia**
G. Atoyan, V. Issakov, O. Karavichev, S. Laptev, A. Poblaguev, A. Proskuryakov
- **Louisiana Tech University** - B. Barakat, 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 $K^+ \rightarrow \mu^+ \pi^0 \nu$ 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 $Im\xi$, an improvement by approximately 40 over the previous best limit.

EXPERIMENT 924

Home Page • <http>

2GeV Beam Line and Experimental Area for P924

**EXPERIMENT 924 - STUDY OF THE $\xi(2220)$ IN $\bar{p}p$ - 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
- University of Colorado - R. J. Peterson
- University of Connecticut - R. T. Jones
- George Washington University - C. Bennhold, W. J. Briscoe
- 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
- Kent State University - D. M. Manley
- University of Maryland - D. Peaslee
- 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
- University of Regina - G. J. Lolos, Z. Papandreou
- University of California at Los Angeles
M. Clajus, S. C. McDonald, A. Marušić, B. M. K. Nefkens, W. B. Tipples
- Valparaiso University - D. Grosnick, D. D. Koetke, R. W. Manweiler, S. Stanislaus
- College of William and Mary in Virginia - M. Eckhause, J. Kane, R. Welsh

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>

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
SPOKESMEN: Y. MAKDISI AND A. YOKOSAWA**

- **Argonne National Laboratory**
K. Krueger, T. LeCompte, H. Spinka, D. Underwood, A. Yokosawa
- **Brookhaven National Laboratory**
L. Ahrens, J. G. Alessi, G. Bunce, H. Huang, A. U. Luccio, Y. Makdisi, F. Mariam, L. Ratner, T. Roser, M. Syphers
- **IHEP, Institute for High Energy Physics, Protvino**
N. I. Belikov, A. M. Davidenko, A. A. Dervschikov, S. V. Erin, Yu. A. Matulenko, S. B. Nurushev, A. I. Pavlinov, A. N. Vasiliev
- **Institute for Theoretical and Experimental Physics (ITEP), Moscow**
I. G. Alekseev, V. P. Kanavets, D. N. Svirida
- **Indiana University**
M. Bai, S. Y. Lee

The experimenters propose to measure asymmetries in the inclusive reactions,

$$p \uparrow p \rightarrow \pi^+ \text{ anything}, p \uparrow C \rightarrow \pi^+ \text{ anything},$$

$$p \uparrow p \rightarrow \pi^- \text{ anything}, p \uparrow C \rightarrow \pi^- \text{ anything}$$

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 $x_F = p_L^*/p_{\max}^* \approx 0.5 \text{ to } 0.8$.

The purpose of this proposal 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.

EXPERIMENT 926
 Home Page • <http>

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

EXPERIMENT 926 - MEASUREMENT OF $K_L^0 \rightarrow \pi^0 \nu \bar{\nu}$
SPOKESMEN: D. BRYMAN, L. LITTENBERG, M. ZELLER

- **Brookhaven National Laboratory**
I-H. Chiang, J. W. Glenn, D. Lazarus, L. Littenberg, R. Strand, C. Woody
- **INR-Moscow**
D. Dementyev, A. Ivashkin, A. Khotjanzev, Y. Kudenko, O. Mineev
- **Kyoto University** - H. Kurashige, N. Sasao
- **University of New Mexico** - J. Lowe, B. Bassalleck
- **Thomas Jefferson National Accelerator Facility** - M. Ito
- **TRIUMF**
E. Blackmore, D. Bryman, P. Gumplinger, M. Hasinoff, A. Konaka, J. Macdonald,
T. Numao, R. Poutissou, G. Smith
- **Virginia Polytechnic Institute** - M. Blecher, K. Kinoshita
- **Yale University**
S. Dhawan, H. Kaspar, W. Majid, M. Zeller

This experiment will be a measurement of 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 $3 \pm 2 \times 10^{-11}$.

EXPERIMENT 929

Home Page • <http>

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

EXPERIMENT 929 SPIN-ORBIT SPLITTING OF SINGLE Λ STATE STUDIED BY THE $^{13}\text{C}(K^-, \pi^-\gamma)$ REACTION
SPOKESMAN: T. KISHIMOTO

- **Osaka University - Department of Physics**
S. Ajimura, H. Hayakawa, R. Hazama, T. Kishimoto, K. Morikubo, E. Saji, R. Sato
- **Osaka University - Research Center for Nuclear Physics**
N. Kudomi, K. Kume, Y. Mizuno, M. Nomachi, K. Tamura
- **University of Tokyo - Department of Physics - H. Tamura**
- **University of Tokyo - Institute for Nuclear Study**
T. Fukuda, T. Nagae, J. Nakano, H. Outa, T. Tamagawa
- **Tohoku University - K. Maeda, T. Suda**
- **National Laboratory of High Energy Physics - H. Noumi**
- **Brookhaven National Laboratory**
R. E. Chrien, M. May, P. Pile, A. Rusek, R. Sutter
- **University of Houston**
M. Ahmed, R. Barber, T. Empl, E. V. Hungerford, K. J. Lan, B. W. Mayes, M. Muerleilier,
L. S. Pinsky, M. Youn
- **North Carolina A&T State University - R. Sawafta**
- **Hampton University - L. Tang**
- **Manitoba University - L. Lee**

The experimenters propose to measure the spin-orbit (ls) splitting of single Λ particle states in a hypernucleus.

EXPERIMENT 930

Home Page • <http>

**EXPERIMENT 930 - HIGH-RESOLUTION γ SPECTROSCOPY OF HYPERNUCLEI
USING LARGE-ACCEPTANCE GERMANIUM DETECTOR
SPOKESMAN: H. TAMURA**

- University of Tokyo - Department of Physics - T. Ishikawa, H. Tamura, K. Tanida
- INS, University of Tokyo - T. Fukuda, T. Nagae, H. Outa
- Osaka University - S. Ajimura, T. Kishimoto
- KEK - H. Noumi
- Tohoku University - O. Hashimoto, T. Takehashi
- Brookhaven National Laboratory - R. E. Chrien, M. May, P. Pile, A. Rusek
- North Carolina A&T University - R. Sawafita
- Hampton University - L. Tang

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 0.75 GeV/c K^- beam at C6 beam line together with the Moby Dick spectrometer. The aim is to determine ΛN spin-dependent interactions through γ spectroscopy of some light hypernuclei. Data will be taken with ^{16}O , ^9Be , and ^{20}Ne targets and to study γ transitions of $^{15}_{\Lambda}\text{N}$, $^{16}_{\Lambda}\text{O}$, $^9_{\Lambda}\text{Be}$, $^{20}_{\Lambda}\text{Ne}$, which will give information on the spin-spin, spin-orbit, and tensor interactions between Λ and nucleon.

An option is also proposed to use 1.8 GeV/c (and 1.1 GeV/c) K^- beam at D6 beam line together with the present spectrometer to study $^7_{\Lambda}\text{Li}$, $^9_{\Lambda}\text{Be}$, $^{12}_{\Lambda}\text{C}$, and $^{16}_{\Lambda}\text{O}$.

Beam: AGS
Status: Approved
Hours Charged/Approved: 0/0

EXPERIMENT 932 - STUDY OF RF BUNCHING TECHNIQUES
SPOKESMAN: J. H. NOREM

- Argonne National Laboratory - J. H. Norem

This experiment proposes to study rf bunching techniques that would be relevant to the operating modes for a muon collider driver.

EXPERIMENT 934

Home Page • <http://>

**EXPERIMENT 934 - PROPOSAL FOR BROOKHAVEN CALIBRATION OF DETECTORS
FOR USE ON ACCESS
Spokesman: W. R. Binns**

- Washington University in St. Louis - W. R. Binns, P. L. Hink, M. H. Israel
- Caltech - T. L. Garrard, R. A. Leske, R. A. Mewaldt, S. M. Schindler, M. E. Wiedenbeck
- University of Minnesota - C. J. Waddington
- Goddard Space Flight Center
L. M. Barbier, E. R. Christian, J. W. Mitchell, J. F. Ormes, R. E. Streitmatter
- Pennsylvania State University - J. J. Beatty, M. Douvernois

The purpose of this proposed calibration run at Brookhaven is 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 FIP or volatility; test whether galactic cosmic rays originate from interstellar dust grains, mass loss from main sequence star, 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 are Li-drifted silicon wafer detectors for dE/dx , waveshifter readout plastic scintillators for dE/dx , scintillating fibers for time-of-flight, and waveshifter readout Cerenkov counters.

EXPERIMENT 935

Home Page • <http://wmhegl.physics.wm.edu/e935>

EXPERIMENT 935 - A DECAY SEARCH FOR A LIGHT GLUINO BOUND STATE IN THE B5 LINE
Spokesman: Y. Kuang

- **University of California, Irvine** - M. Bachman, R. Lee, T. Liu, W. Molzon
- **College of William and Mary**
M. Eckhause, D. Hancock, K. Hern, C. Hoff, J. Kane, Y. Kuang, R. Martin, A. Norman,
R. Welsh
- **Rensselaer Polytechnic Institute** - M. Witkowski
- **University of Richmond** - P. Rubin

The experimenters propose to search 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 R^0 -hadron. The E871 detector in its present configuration would be 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.

List of publications of AGS experiments begins here.

Publications - AGS Experiments 1982 - 1996

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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