ABSTRACTS FOR PAPERS SUBMITTED
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Mid-rapidity Λ and $\overline{\Lambda}$ Production in Au+Au Collisions at $\sqrt{S_{NN}}$ = 103 GeV

STAR Collaboration
Phys. Rev. Lett. (submitted)

We report the first measurement of strange (Λ) and anti-strange $(\overline{\Lambda})$ baryon production from $\sqrt{S_{NN}}$ = 130 GeV Au + Au collisions at the Relativistic Heavy Ion Collider (RHIC). Rapidity density and transverse mass distributions at mid-rapidity are presented as a function of centrality. The yield of (Λ) and $(\overline{\Lambda})$ hyperons is found to be approximately proportional to the number of negative hadrons. The production of $(\overline{\Lambda})$ hyperons relative to negative hadrons increases very rapidly with transverse momentum. The magnitude of the increase cannot be described by existing hadronic string fragmentation models.

Asymptotic Normalization Coefficients and Astrophysical Direct Capture Rates

C. A. Gagliardi, A. Azhari, V. Burjan,
F. Carstoiu, V. Kroha, A. M. Mukhamedzhanov,
A. Sattarov, X. Tang, L. Trache, and
R. E. Tribble
Eur. Phys. J. A (submitted)

The asymptotic normalization coefficient (ANC) for a nuclear system specifies the normalization of the tail of the nuclear overlap function. ANCs may be determined experimentally by measuring peripheral nuclear reactions. They may be used to calculate the astrophysical *S* factors for radiative capture reactions at stellar energies and to determine the halo structure of loosely bound nuclei. A brief introduction to ANCs is given and applications to the $^{7}\mathrm{Be}(\rho,\gamma)^{8}\mathrm{B}$ and $^{ll}\mathrm{C}(\rho,\gamma)^{12}\mathrm{N}$ reactions and the halo structure of ^{8}B are described.

The STAR Endcap Electromagnetic Calorimeter

C E. Allgower, B. D. Anderson, A. R. Baldwin,
J. Balewski, M. Belt-Tonjes, L. C. Bland,
R. L. Brown, R. V. Cadman, W. Christie,
I. Cyliax, V. Dunin, L. Efimov, G. Eppley,
C. A. Gagliardi, N. Gagunashvili, T. Hallman,
W. Hunt, W. W. Jacobs, A. Klyachko,
K. Krueger, A. Kulikov, A. Ogawa,
Y. Panebratsev, M. Planinic, J. Puskar-Pasewicz,
G. Rakness, S. Razin, 0. Rogachevski,
S. Shimansky, K. A. Solberg, J. Sowinski,
H. Spinka, E. J. Stephenson, V. Tikhomirov,
M. Tokarev, R. E. Tribble,
D. Underwood, A. M. Vander Molen,
S. E. Vigdor, J. W. Watson,
G. Westfall, S. W. Wissink, A. Yokosawa,
V. Yurevich, W. –M. Zhang, and A. Zubarev
Nucl. Instrum. Meth. (submitted)

The STAR endcap electromagnetic calorimeter will provide full azimuthal coverage for high-p_T photons, electrons and electromagnetically decaying mesons over the pseudorapidity range $1.086 \leq \eta \leq 2.00$. It includes a scintillating-strip shower-maximum detector to provide 11"0/ '"Y discrimination and preshower and postshower layers to aid in distinguishing between electrons and charged hadrons. The triggering capabilities and coverage it offers are crucial for much of the spin physics program to be carried out in polarized proton-proton collisions.

Tests of the Standard Model from Superallowed Fermi Beta-Decay Studies: The ^{74}Rb Beta Decay

E. F. Zganjar, A. Piechaczek, G. C. Ball,
P. Bricault, J. M. D'Auria, J. C. Hardy,
D. F. Hodgson, V. Iacob, P. Klages, W. D. Kulp,
J. R. Leslie, M. Lipoglavsek, J. A. Macdonald,
H. -B. Mak, D. M. Moltz, G. Savard,
J. von Schwarzenberg, C. E. Svenson,
I. S. Towner, and J. L. Wood
Eur. Phys. J. (in press)

Precise measurements of the intensities of superallowed Fermi $0^{+}\rightarrow 0^{+}\beta$-decays have provided a powerful test of the CVC hypothesis at the level of 3×10^{-4} and also led to a result in disagreement with unitarity for the CKM matrix at the 98% confidence level. It is essential to

address possible trivial explanations for the apparent non-unitarity such as uncertainties in the isospin symmetry-breaking corrections. We have carefully studied the $^{74}Rb \rightarrow {}^{74}Kr$ β-decay in order to measure the non-analog β-decay branching to the 0^+ state at 508 keV in ^{74}Kr. We have determined that this branching is $< 3 \times 10^{-4}$, far smaller than any published theoretical estimate. We also show that high-precision, complete spectroscopy, measuring the major β-branches to excited 0^+ and 1^+ states, must be performed if one is to obtain a meaningful branching ratio to the excited 0^+ state and concomitantly deal, in a substantial way, with the possibility of β-feeding to an array of 1^+ states.

Superallowed Beta Decay of Nuclei with A > 62: The Limiting Effect of Weak Gamow-Teller Branches

J. C. Hardy and I. S. Towner
Phys. Rev. Lett. (in press)

The most precise value of V_{ud}, which is obtained from superallowed nuclear β decay, leads to a violation of CKM unitarity by 2.2σ. Experiments are underway on two continents to test and improve this result through decay studies of odd-odd $N = Z$ nuclei with A≥62. We show, in a series of illustrative shell-model calculations, that numerous weak Gamow-Teller branches are expected to compete with the superallowed branch in each of these nuclei. Though the total Gamow-Teller strength is significant, many of the individual branches will be unobservably weak. Thus, new techniques must be developed if reliable *ft*-values are to be obtained with 0.1% precision for the superallowed branches.

Superallowed $0^+ \rightarrow 0^+$ Beta Decay and CKM Unitarity: Recent Results and Future Prospects

J. C. Hardy and I. S. Towner
Eur. Phys. J. (in press)

Precise measurements of the *ft*-values for superallowed nuclear β-decay yield results that support conservation of the weak vector current but violate the unitarity of the Cabibbo-Kobayashi-Maskawa matrix by more than two standard deviations. This apparent violation of the Standard Model has led to considerable theoretical activity largely focused on reducing uncertainties in the small correction terms that account for charge-dependent nuclear effects. This activity is outlined and the prospects for future sharpening of the unitarity test are assessed.

The Michel Parameters From μ^+ Decay

N. L. Rodning, W. Anderson, Y. Davydov, P. Depommier, J. Doornbos, W. Faszer, C .A. Gagliardi, A. Gaponenko, D. R. Gill, P. Green, P. Gumplinger, J. C. Hardy, M. Hasinoff, R. Helmer, R. Henderson, P. Kitching, D. D. Koetke, E. Korkmaz, A. Khruchinsky, D. Maas, J. A. Macdonald, R. MacDonald, R. Manweiler, G. Marshall, T. Mathie, J. R. Musser, P. Nord, A. Olin, R. Openshaw, D. Ottewell, T. Porcelli, J. -M. Poutissou, R. Poutissou, G. Price, M. Quraan, J. Schaapman, V. Selivanov, G. Sheffer, B. Shin, F. Sobratee, J. Soukup, T. D. S. Stanislaus, G. Stinson, R. Tacik, V. Torokhov, R. E. Tribble, M. A. Vasiliev, H -C. Walter, S-C. Wang, and D. Wright
Proceedings of Tau2000, Victoria, B.C. (September 2000) (in press)

We propose to make the first high precision measurements of nearly the entire differential spectrum (in energy and angle) of positrons from the decay of polarized muons. The main goal of the experiment is the precise testing of the (V-A) structure of the electroweak interactions in the framework of the $SU(2)_L \times U(1)$ model. Highly polarized "surface" μ^+ from the TRIUMF M13 beamline will enter a large volume, high field superconducting magnet on axis and will stop in a thin target at its center. The e^+ from the muon decay will be precisely tracked in the magnetic field using small-cell planar drift chambers. This spectrometer has been simulated with GEANT and EGS4 and has been demonstrated to meet the precision requirements.

Enhanced Production of Neutron-rich Isotopes in the Reaction of (25 MeV/nucleon) ^{86}Kr on ^{64}Ni

G. A. Souliotis, M. Veselsky, G. Chubarian, L. Trache, A. Keksis, E. Martin, A. Ruangma, E. Winchester, and S. J. Yennello
Phys. Lett. B (submitted)

The cross sections and velocity distributions of projectile-like fragments from the reaction of 25 MeV/nucleon ^{86}Kr + ^{64}Ni have been measured using the MARS recoil separator at Texas A&M, with special emphasis on the neutron rich isotopes. Proton-removal and neutron pick-up isotopes have been observed with large cross sections. A model of deep-inelastic transfer (DIT) for the primary interaction stage and the statistical evaporation code GEMINI for the deexcitation stage have been used to describe the properties of the product distributions. The results have also been compared with the EPAX parametrization of high-energy fragmentation yields. The experimental data show an enhancement in the production of neutron-rich isotopes close to the projectile, relative to the predictions of DIT/GEMINI and the expectations of EPAX. We attribute this enhancement mainly to the effect of the extended neutron distribution (neutron skin) of the ^{64}Ni target in peripheral interactions of ^{86}Kr with ^{64}Ni. The large cross sections of such reactions near the Fermi energy, involving peripheral nucleon exchange, suggest that, not only the N/Z of the projectile and the target, but also the N/Z distribution at the nuclear surface may properly be exploited in the production of neutron-rich rare isotopes. This synthesis approach may offer a fruitful pathway to extremely neutron-rich nuclei, towards the neutron-drip line.

Production Mechanism of Hot Nuclei in Violent Collisions in the Fermi Energy Domain

M. Veselsky
Nucl. Phys. A (accepted for publication)

A production mechanism of highly excited nuclei formed in violent collisions in the Fermi energy domain is investigated. The collision of two nuclei is decomposed into several stages which are treated separately. Simplified exciton concept is used for the description of pre-equilibrium emission. A modified spectator-participant scenario is used where motion along classical Coulomb trajectories is assumed. The participant and one of the spectator zones undergo incomplete fusion. Excitation energies of both cold and hot fragment are determined. Results of the calculation are compared to recent experimental data in the Fermi energy domain. Data on hot projectile-like, mid-velocity and fusion-like sources are described consistently. Geometric aspects of pre-equilibrium emission are revealed. Explanations to previously unexplained experimental phenomena are given. Energy deposited into non-thermal degrees of freedom is estimated.

Studies of Reaction Dynamics in the Fermi Energy Domain

M. Veselsky, G. A. Souliotis, S. J. Yennello
In *Proceedings of 5the Fifth International Conference on Dynamical Aspects Of Nuclear Fission*, Casta-Papiernicka Slovak Republic, (October 2001) (in press)

An overview of recent results on reaction dynamics in the energy region 20 - 50 A MeV is given. The results of the study of projectile multifragmentation using the detector array FAUST are presented. Reaction mechanism is determined and thermodynamical properties of the hot quasiprojectile are investigated. Preliminary results on fragment isospin asymmetry obtained using the 4π detector array NIMROD are given. Procedure for selecting centrality in two-dimensional multiplicity histograms is described. Possibility to extract thermodynamical temperature from systematics of isotope ratios is investigated. Reaction mechanism leading to production of hot sources is discussed. Furthermore, the possibilities for production of rare isotopes are discussed and recent experimental results obtained using recoil separator MARS are presented.

Excitation Energy Thermalization and Partitioning in 30 AMeV ^{16}O-Induced Breakup Reactions

R. P. Schmitt, D. O'Kelly, T. Botting, L. Cooke, B. Hurst, Y. -W. Lui, B. K. Srivastava, W. Turmel, and H. Utsunomiya
Eur. Phys. J. A (submitted)

Breakup reactions of 30 AMeV ^{16}O + ^{58}Ni, ^{120}Sn, and ^{208}Pb have been studied using a magnetic spectrograph. Sequential breakup is the dominant reaction mechanism for $^{16}O^{*}$ decay up to apparent energy losses of about 70 MeV. Nearly elastic breakup reactions exhibit excited state populations that are far from their expected equilibrium distributions. At energy losses as small as 30 MeV, the distributions of states in the projectile approach a thermal distribution. However, the apparent temperatures are far larger than expected for thermal equilibrium between projectile and target.

Projectile and Target Ionization in MeV/u Collisions of Xe ions with N_2

R. E. Olson, R. L. Watson, V. Horvat, and K. E. Zaharakis
J. Phys. B (submitted)

Experimental cross sections are presented for single and multiple electron stripping from Xe^{18+} projectiles in collisions with N_2 at energies 2.0 - 9.3 MeV/u. The data are compared to 2 - 30 MeV/u *n*-body classical trajectory Monte Carlo calculations that explicitly include electrons on both centers. Two-center electron-electron (e-e) and electron-screened nuclear interactions contribute to the ionization reactions. The computations are in reasonable accord for the total stripping cross section but underestimate the higher stages of multiple electron loss. An energy deposition model gives improved agreement with experiment. The energy dependence of the total stripping cross section is close to $E^{!0.5}$. Calculations are also presented for target ionization by Xe^{+}, Xe^{8+}, and Xe^{18+} at 10 and 20 MeV/u. Projectile and target ionization cross sections are found to be comparable. Cross sections for projectile stripping by ionized targets are also calculated and found to be relatively insensitive to the

ionization stage of the target. This latter observation is attributed to the compensating contributions between the two-center e-e and electrons-screened nuclear interactions.

Modeling Heavy Ion Collisions at RHIC

C. M. Ko
In *Proceedings of the International Workshop on Nuclear Many Body Problems and Subnucleonic Degrees of Freedom, Heavy Ion Collider*, Changchun, China, eds. T. T. S. Kuo, H. T. S. Lee, and C. S. Wu (2001) (in press)

Heavy ion collisions at the Relativistic Heavy Ion Collider (RHIC) provides the possibility of producing a quark-gluon plasma during the initial stage. In recent experiments, the rapidity and transverse momentum distributions of various charged particles, their elliptic flows, ratios of multistrange antibaryons to baryons, and the HBT correlations have been measured. To understand these experimental results and to see if they carry any information on the initial quark-gluon plasma, we have developed a multiphase transport model (AMPT), which includes both initial partonic and final hadronic interactions. Comparing the theoretical results with the experimental data allows us to extract the partonic effects on these observables and other signals for the quark-gluon plasma

Multiphase Transport Model for Heavy Ion Collisions at RHIC

C. M. Ko, B. A. Li, Z. W. Lin, S. Pal, and B. Zhang
In *Proceedings of the International Workshop on the Physics of the Quark-Gluon Plasma*, Paris, ed. M. Gonin (2001) (in press)

Using a multiphase transport model (AMPT), which includes both initial partonic and final hadronic interactions, we have studied heavy ion collisions at the Relativistic Heavy Ion Collider (RHIC). Results on the rapidity distributions of various charged particles and their elliptic flow will be compared with the experimental data. We have further studied multistrange baryons production and charmonium suppression in these

collisions. Effects due to the partonic matter on these observables are discussed.

Partonic Effects in Heavy Ion Collisions at RHIC

C. M. Ko, Z. W. Lin, and S. Pal

In *Proceedings of the International Workshop on Quark and Hadron Dynamics in Relativistic Heavy Ion Collisions*, Budapest, Hungary, ed. P. L\'evai (2002) (in press)

Effects of partonic interactions in heavy ion collisions at RHIC are studied in a multiphase transport model (AMPT), which includes both initial partonic and final hadronic interactions. It is found that the partonic effects are important for understanding the observed large elliptic flow and measured two-pion correlation function as well as for determining the yield of charmoniums in these collisions.

Charm Meson Production from Meson-Nucleon Scattering

W. Liu and C. M. Ko

Phys. Lett. **B** (in press)

Using an effective hadronic Lagrangian with physical hadron masses and coupling constants determined either empirically or from SU(4) flavor symmetry, we study the production cross sections of charm mesons from pion and rho meson interactions with nucleons. With a cutoff parameter of 1 GeV at interaction vertices as usually used in studying the cross sections for J/ψ absorption and charm meson scattering by hadrons, we find that the cross sections for charm meson production have values of a few tenth of mb and are dominated by the *s* channel nucleon pole diagram. Relevance of these reactions to charm meson production in relativistic heavy ion collisions is discussed.

Phi Meson Production in Relativistic Heavy Ion Collisions

S. Pal, C. M. Ko, and Z. W. Lin

Nucl. Phys. A (in press)

Within a multiphase transport model we study phi meson production in relativistic heavy ion collisions from both superposition of initial multiple proton-proton interactions and the secondary collisions in the produced hadronic matter. The yield of phi mesons is then reconstructed from their decaying product of either the kaon-antikaon pairs or the dimuon pairs. Since the kaon-antikaon pairs at midrapidity with low transverse momenta are predominantly rescattered or absorbed in the hadronic medium, they can not be used to reconstruct the phi meson and lead thus to a smaller reconstructed phi meson yield than that reconstructed from the dimuon channel. With in-medium mass modifications of kaons and phi mesons, the phi yield from dimuons is further enhanced compared to that from the kaon-antikaon pairs. The model result is compared with the experimental data at the CERN/SPS and RHIC energies and its implications to quark-gluon plasma formation are discussed.

Multistrange Baryon Production in Relativistic Heavy Ion Collisions

S. Pal, C. M. Ko, Z. W. Lin

Phys. Rev. C (submitted)

Using a multiphase transport model, we study the production of multistrange baryons from the hadronic matter formed in relativistic heavy ion collisions. The mechanism we introduce is the strangeness-exchange reactions between antikaons and hyperons. We find that these reactions contribute significantly to the production of multistrange baryons in heavy ion collisions at SPS energies, which has been found to be appreciably enhanced. We have also made predictions for multistrange baryon production in heavy ion collisions at RHIC and found a similar enhancement.

Partonic Effects on Pion Interferometry in Relativistic Heavy Ion Collisions

Z. W. Lin, C. M. Ko, and S. Pal

Phys. Rev. Lett. (submitted)

Using a multiphase transport (AMPT) model that includes both initial partonic and final hadronic interactions, we study the pion interferometry at the Relativistic Heavy Ion Collider (RHIC). We find that the two-pion correlation function is sensitive to the magnitude of the parton scatttering cross section, and a value of about 10 mb is needed to reproduce the

measured correlation function in central Au+Au collisions at $\sqrt{s}$ =130A GeV. The emission source of pions from the AMPT model is non-Gaussian, leading to source radii that can be more than twice larger than the radius parameters extracted from a Gaussian fit to the correlation function.

Diomega Production in Relativistic Heavy Ion Collisions

S. Pal, C. M. Ko, and Z. Y. Zhang
Phys. Lett. B (submitted)

Using a multiphase transport model, we study the production of a new strange dibaryon $(\Omega\Omega)_{0+}$ in dense hadronic matter formed in relativistic heavy ion collisions. The (multi-) strange baryons (Ξ and Ω) are produced by strangeness-exchange reactions between antikaons and hyperons in the pure hadronic phase. The rescattering between the omegas at midrapidity leads to a production probability of $\simeq 3\times 10^{-7}$ $(\Omega\Omega)_{0+}$ per event at the RHIC energy of $\sqrt{s}$ =130A GeV. The production probability would be enhanced by two orders of magnitude if $(\Omega\Omega)_{0+}$ and omega reach chemical equilibrium during heavy ion collisions. We further find that the yield of $(\Omega\Omega)_{0+}$ increases continuously from SPS to the highest RHIC energy.

Proton–Deuteron Elastic Scattering from 2.5 to 22.5 MeV

E. O. Alt, A. M. Mukhamedzhanov,
M. M. Nishonov, and A. I. Sattarov
Phys. Rev. A (submitted)

We present the results of a calculation of differential cross sections and polarization observables for proton-deuteron elastic scattering, for proton laboratory energies from 2.5 to 22.5 MeV. The Paris potential parametrisation of the nuclear force is used. As solution method for the charged-composite particle equations the screening and renormalisation approach' is adopted which allows to correctly take into account the Coulomb repulsion between the two protons. Comparison is made with the precise experimental data of Sagara *et al.*

Astrophysical S Factor for $^{13}C(p,\gamma)^{14}N$ and Asymptotic Normalization Coefficients

A. M. Mukhamedzhanov, A. Azhari, V. Burjan,
C. A. Gagliardi, V. Kroha, A. Sattarov, X. Tang,
L. Trache, and R. E. Tribble
Phys. Rev. C (submitted)

We re-analyze the $^{13}C(p,\gamma)^{14}N$ radiative capture reaction within the R-matrix approach. The low-energy astrophysical S factor has important contributions from both resonant and nonresonant captures. The normalization of the nonresonant component of the transition to a Particular N bound state is expressed in terms of the asymptotic normalization coefficient (ANC). In the analysis we use the experimental ANCs inferred from the $^{13}C(^{14}N,\ ^{13}C)^{14}N$ and $^{13}C(^{3}He,\ d)^{14}N$ reactions. The fits of the calculated S factors to the experimental data are sensitive to the ANC values and are used to test the extracted ANC's. We find that for transitions to all the states in ^{14}N, except for the third excited state, the ANC's determined from the transfer reactions provide the best fit. The astrophysical factor we obtain, S(0)=7.7 ± 1.1 keVb, is in excellent agreement with the value obtained by King *et al*.

Low Energy Behavior of the Astrophysical S-factor for Radiative Captures to Loosely Bound Final States

A. Mukhamedzhanov and F. Nunes
Nucl. Phys. (submitted)

The low-energy behavior of the astrophysical S-factor for E1 direct radiative captures leading to loosely bound final states is investigated. We show that not the pole corresponding to the bound state governs the behavior of the S (E)-factor at E \to 0. We derive a first-order integral representation of the astrophysical factor and show that the remnant Coulomb barrier, initial and final centrifugal barriers, binding energy define the behavior of the S(E)-factor. The increase of the centrifugal barriers increases the derivative S(0) while the increase of the charge

of the target increases the impact of the Coulomb remnant barrier and decreases the derivative S'(0). For $l_i = l_f + 1$ the increase of the binding energy of the final nucleus increases the derivative S'(0) while for $l_f = l_i + 1$ the effect is opposite. We explain the behavior of the astrophysical factors for some notorious cases: $^{7}Be(p,\gamma)^{8}B$, $^{14}N(p,\gamma)^{15}O(3/2^{+})$, $^{16}O(p,\gamma)^{17}F(5/2^{+})$, $^{20}Ne(p,\gamma)^{21}Na$ and $^{22}Mg(p,\gamma)^{23}Al$.

Coulomb Breakup of Light Nuclei in the Field of Heavy-ion at Relativistic Collision Energies

B. F. Irgaziev, Sh. Kalandarov, and A. M. Mukhamedzhanov
Russian J. of Nucl. Phys. (submitted)

A simple method of calculation of the amplitude and cross section of the Coulomb breakup of relativistic light nucleus into two fragments in the field of a heavy target is suggested within the framework of time-dependent perturbation theory. It is shown that the amplitude of the process has correct nonrelativistic effect. In the ultrarelativistic limit the contribution of the longitudinal component Of the Coulomb field of the heavy target goes to zero. Practical realization of the method is demonstrated for the $^{208}Pb(^{8}B,^{7}Be\,p)^{208}Pb$ at different relativistic collision energies. A good agreement with the available experimental data is obtained.

Nuclear Equation of State and Compression Modes

S. Shlomo and A.I. Sanzhur
Heavy Ion Phys. (in press)

The nuclear matter (N = Z and no Coulomb interaction) incompressibility coefficient, K_{nm}, which is directly related to the curvature of the nuclear matter equation of state, is a very important physical quantity in the study of properties of nuclei, supernova collapse, neutron stars and heavy-ion collisions. We review the current status of K_{nm} and the experimental and theoretical methods used to determine the value of K_{nm} from the excitation cross-sections $\sigma(E)$ and the transition strength distributions $S(E)$ of compression modes in nuclei. In particular, we will consider the isoscalar giant monopole resonance (ISGMR) and the isoscalar giant dipole resonance (ISGDR) and provide a simple explanation to the long standing problem of the conflicting results obtained for K_{nm}, deduced from experimental data on excitation cross sections for the ISGMR and data for the ISGDR.