OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.
POST OFFICE BOX 2008, OAK RIDGE, TENNESSEE 37831-6285

ORNL/FTR--3516

DE90 006325

ORNL

FOREIGN TRIP REPORT

ORNL/FTR-3516

DATE: January 9, 1990

SUBJECT: Report of Foreign Travel of Edward E. Gross, Physics Division, December 30, 1989 - January 7, 1990

TO: Alvin W. Trivelpiece

FROM: Edward E. Gross

Purpose

To present an invited talk at the XIII Symposium on Nuclear Physics at Oaxtepec, Mexico.

Sites Visited

Jan. 3-6, 1990	XIII Symposium on Nuclear Physics Oaxtepec, Mexico	E. R. Chavez

Abstract

The traveler attended the XIII Symposium on Nuclear Physics at Oaxtepec, Mexico, January 3-6, 1990, and presented an invited talk on "Heavy Ion Inelastic Scattering With a 4π γ-Ray Detector." A brief account of some results presented at the Symposium is given.

The XIII Symposium on Nuclear Physics at Oaxtepec, Mexico, represents the latest in the series of the longest extant meeting devoted to nuclear physics. The series is a testimonial to the determination of the small band of Mexican nuclear physicists who have had to conduct their experimental research programs as users at foreign research facilities. They have been the forerunners for the user mode of operation, which has been the usual one for high energy physics and which is now becoming the general mode in nuclear physics. The purpose of the Oaxtepec Symposium is to stimulate this small, but talented, group and to keep them current with the latest developments. Attending the Symposium were about 15 Mexican physicists, 12 visiting scientists, and 13 Mexican graduate students who benefited both from the formal sessions and from informal contacts with the visiting scientists.

The primary focus of the meeting was on fragmentation processes in heavy-ion reactions. Gomez del Campo (ORNL) reviewed the status of temperature measurements in heavy-ion-reaction zones based on the yields of fragments in excited states relative to the yield of the same fragment in its ground state. Original use of this method, by Benenson *et al.*, reported temperatures that were almost a factor of ten lower than expected. It is important to account for multiple steps and decay paths in the emission process, and it is therefore difficult to extract a "temperature" from such experiments. A similar measurement has been carried out at ORNL using the Spin Spectrometer to measure excited states of ^{12}C, ^{15}N, and ^{16}O, relative to their ground state yields, resulting from $^{58}Ni + ^{58}Ni$ collisions at 11 MeV/nucleon. In this work, Hauser-Feshbach calculations reproduce the measured cross sections and the effective temperatures very well. Peaslee (LBL) reviewed the heavy fragment emission program at Berkeley using 50 MeV/nucleon ^{197}Au beams incident on ^{12}C, ^{27}Al, and ^{nat}Cu targets. Clear evidence for 3- and 4-body final states was obtained. Monte Carlo simulation appears to be quite successful in accounting for fragment yields. Mondragon (UNAM) assembled information on the behavior of shock waves in liquids and showed that shock waves in nuclear matter followed the same systematics. Friedman (Wisconsin) discussed his model for the disassembly of hot nuclear matter into large fragments and contrasted it with other models. According to his model, more than 1 GeV of excitation energy is required before multifragmentation can occur.

Heavy ion fusion was the subject for a number of presentations. Aguilera (ININ) presented subbarrier fusion results for ^{27}Al fusing with ^{70,72,73,74,76}Ge. The subbarrier cross sections clearly reveal a different behavior for ^{70,72}Ge relative to ^{73,74,76}Ge targets. He can account for these data by assuming an oblate shape for ^{27}Al, a spherical shape for ^{70,72}Ge, and a prolate shape for ^{73,74,76}Ge. Stefanini (Legnaro) presented careful work from his laboratory on ^{58}Ni+^{58,60}Ni elastic scattering in the subbarrier region to complement prior fusion measurements. The theory of Landowne and Esbenson can account for the fusion data on these systems. Schmitt (Texas A&M) presented his work on neutron and γ-multiplicities following fusion of 120 MeV ^{16}O on various targets. Incomplete fusion can be separated from fusion-fission reactions by the behavior of the angular yield of n and γ multiplicities. The Transition State Model gives a good account of the data.

Heavy-ion peripheral reactions were also represented. The traveler discussed a new technique for doing inelastic scattering using a segmented 4π γ-detector (the "Spin Spectrometer") in coincidence with charged particle detectors. The method is particularly sensitive to reorientation matrix elements through the particle-γ angular correlation. Brandon (UNAM) presented a painstaking global optical-model analysis of ^{12}C + ^{12}C and ^{16}O + ^{12}C elastic scattering. Since coupling to the 4.4 MeV state of ^{12}C is neglected in this analysis, the traveler doubts that the extracted potential parameters are very meaningful. McVoy (Wisconsin) gave his usual talk on rainbow scattering and his decomposition of the scattering process into "nearside" and "farside" scattering amplitudes. Menchaca-Rocha (UNAM) discussed his neutron transfer work on light heavy-ion systems. The neutron transfer yield for ^{13}C + ^{32}S is not enhanced relative to ^{12}C + ^{32}S. This is puzzling since Rehm *et al.* at ANL found a large enhancement for ^{13}C + ^{12}C relative to ^{12}C + ^{12}C. Massmann (U. Chile) described a poor man's coupled channels method where a series of spherical waves scattering from different nuclear radii (to simulate a deformed radius) replaces scattering from a deformed surface. He is able to incorporate mutual excitation and transfer reactions into his calculation. Unfortunately, he has no reliable way of relating β deformation parameters to ME2's and ME4's.

Nuclear structure theory was represented by Draayer (LSU) and Castanos (UNAM). Draayer, using group theory methods, showed how the shell model could give collective model behavior. Castanos discussed his work on the "Nuclear Pseudo-Symplectic Model." Balantekin (Wisconsin) reviewed the solar neutrino problem and showed how a neutrino magnetic moment could influence neutrino oscillations. Moshinsky (UNAM) discussed his work on harmonic oscillator solutions to the Dirac equation and obtained a relativistic many-body mass formula for baryons. He is struggling with the problem that the ground state has an infinite degeneracy.

Doll (Karlsruhe) presented precision n,p scattering cross section and polarization data with 20-60 MeV polarized neutrons as well as new precision measurements on $n + p \Rightarrow d + \gamma$. The new data have some disagreements with the Paris potential. He finds significant breaking of charge symmetry for the p,p and n,p $^3P_1$ phase shifts in the 20-40 MeV energy range. Wiescher (Notre Dame) reviewed primordial element production in the Standard Big Bang Model. The model can account for observed abundances up to ^{7}Li, but not beyond. Beyond about 20 sec after time zero, the neutron density, assumed to be uniform in the Standard Model, is too small to contribute to element synthesis by neutron capture. By relaxing the uniform hadron-density assumption, it is easy to extend the influence of neutron capture up to 800 sec and thereby generate primordial abundances well past neon. Hadronization out of a quark-gluon process can produce a nonuniform hadron distribution, the properties of which could conceivably be studied with RHIC.

The Symposium was well run and was successful in its goals. The continued existence of this Symposium is evidence for its importance to Mexico. The collaboration of Mexican nuclear physicists is also important to a number of U.S. research institutions, including ORNL.

DISTRIBUTION

1. David B. Waller, Assistant Secretary for International Affairs and Energy Emergencies (IE-1), DOE, Washington
2. Wilmot N. Hess, Associate Director for High Energy and Nuclear Physics, Office of Energy Research, DOE, Washington
3. D. L. Hendrie, Director of Nuclear Physics, Office of High Energy and Nuclear Physics, Office of Energy Research, DOE, Washington
4. Elizabeth Q. Ten Eyck, Director, Division of Safeguards and Security (DP-34), DOE, Washington
5. A. Bryan Siebert, Director, Office of Classification and Technology Policy (DP-323.2), DOE, Washington
6. Richard L. Egli, Assistant Manager, Energy Research and Development, DOE/ORO
7. D. J. Cook, Director, Safeguards and Security Division, DOE/ORO

8-9. Office of Scientific and Technical Information, Post Office Box 62, Oak Ridge, Tennesse 37831

10. E. E. Gross
11. B. R. Appleton
12. R. L. Auble
13. C. Baktash
14. J. B. Ball
15. J. R. Beene
16. F. E. Bertrand
17. J. D. Garrett
18. J. Gomez del Campo
19. M. L. Halbert
20. D. C. Hensley
21. D. J. Horen
22. I. Y. Lee
23. N. R. Johnson
24. C. M. Jones
25. J. B. McGrory
26. F. E. Obenshain
27. F. Plasil
28. R. L. Robinson
29. G. R. Satchler
30. D. Shapira
31. P. H. Stelson
32. A. W. Trivelpiece
33. G. R. Young

34-35. Laboratory Records Department

36. Laboratory Records Department - RC
37. Laboratory Protection Division
38. ORNL Patent Section
39. ORNL Public Relations Office