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ORNL

FOREIGN TRIP REPORT

ORNL/FTR-3481

DATE: November 17, 1989

SUBJECT: Report of Foreign Travel of James R. Beene, Group Leader, Physics Division, October 30 - November 13, 1989

TO: Alvin W. Trivelpiece

FROM: James R. Beene

ORNL/FTR--3481

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PURPOSE

To present a series of invited lectures at the Workshop on Nuclear Physics with Large Arrays (Section C of the Nuclear Structure in the Era of New Spectroscopy Workshop), held at the Niels Bohr Institute, Copenhagen, Denmark, October 30-November 24, 1989.

SITE VISITED

Oct. 31-Nov. 12, 1989	Workshop Copenhagen, Denmark	A. Holm

ABSTRACT

The traveler attended the third and final part of the three-month-long Workshop on Nuclear Structure in the Era of New Spectroscopy, held from September through November at the Niels Bohr Institute in Copenhagen, Denmark. The third or C part of this ambitious series of workshops was titled "Nuclear Physics with Large Arrays." The author presented four talks over a two-week period, at the invitation of the organizers.

The Niels Bohr Institute has organized and executed an ambitious series of workshops and symposia lasting, with short breaks, from September 11 to November 24, 1989, known collectively as the Workshop on Nuclear Structure in the Era of New Spectroscopy. The underlying theme of the entire workshop was intended to be physics that might be explored with the new generation of high resolution, large solid angle, Ge arrays such as the GAMMASPHERE to be built in the US, and the proposed EUROBALL. The workshop was divided into three segments. The first two (A and B) parts of the workshop dealt with array design, instrumentation and data analysis (A), and high-spin spectroscopy (B), respectively. Both were attended by scientists from the ORNL Physics Division. The traveler attended the C workshop, which was titled "Nuclear Physics with Large Arrays." It was much less focused and much broader in subject matter than the A and B workshops. The format of the workshop called for 2½ weeks of lectures, talks, and discussions attended by about 20 invited participants and local scientists, followed by a one-week symposium with a larger attendance, at which additional talks as well as summaries of the findings of study groups of the workshop were presented. The C workshop was nominally divided into five working groups: Collective Excitations, Chaos, Reactions, Symmetry/Dynamics, and Far from Stability. However, in practice, there were no separate discussion sessions on these topics; all discussions held during normal working hours were attended by all participants. The traveler was scheduled to attend the entire C workshop, including the symposium week; however, it was necessary to leave prior to the symposium because of a death in the family. As a result, it is only possible to report on the lectures and discussion of the first two weeks.

The principal lecturers and discussion coordinators included J. J. Gaardhoje (NBI), R. Broglia (Milan and NBI), H. Niefenecker (Grenoble), and the traveler, for Collective Excitations; P. Arve (Lund), B. Mottelson (Nordita), and O. Bohigas (Orsay), for Chaos; C. Dasso (NBI), A. Winther (NBI), J. Bondorf (NBI), D. Schwalm (Heidelberg), and R. Betts (Argonne), for Reactions; D. Bes (Buenos Aires), V. Zelevenski (Novosibirsk), P. Ring (Munich), and F. Iachello (Yale), for Symmetry and Dynamics; R. Broglia, P. Gregers Hansen (CERN), D. Schwalm, and P. Armbruster (GSI), for Far From Stability. In addition to the lecturers, there were a large number of additional talks presented by the lecturers and other attendees. Among the most interesting were those by K. Snover (Seattle) on the Giant Dipole Resonance (GDR) in moderately hot nuclei, P. F. Bortignon (Milan) on damping of giant resonances, E. Ormand (Milan) on motional narrowing, C. Baktash (ORNL) on heavy-ion transfer reactions studied in the Spin Spectrometer, S. Aberg (Lund) on large amplitude motion, and H. Emling (GSI) on excitation of multiphonon states in relativistic heavy-ion collisions. The level of discussion during the lectures and talks was very high. Typically, lecturers (including the traveler) were surprised by how little of the originally planned ground, and how much unexpected territory, was covered in an hour lecture. This unusual level of discussion, the regular contributions and criticisms by Mottelson and others, and the unplanned change of direction and emphasis

in talks made this one of the most interesting (and exhausting) meetings the traveler has attended. The traveler presented four talks during his two weeks of attendance. Two were invited lectures on the experimental status of giant resonances at zero temperature and on recent resonance decay experiments. In addition, at the request of the coordinators of the Reactions and Collective Excitations study groups, the traveler presented talks on angular momentum distributions in subbarrier fusion and on problems in the study of GDR strength at very high temperature.

The quality of the lectures and talks was unusually high, enhanced by constant comments, questions, and criticism from the floor. Rather than attempt a broad summary of talks and discussions, which were in many cases far from settled when it was necessary for me to leave, I will give a few brief observations on a few, almost randomly selected talks which were of particular interest to me.

D. Schwalm presented very good talks on several experiments done with the Heidelberg Crystal Ball. All the data presented was impressive, reflecting the high quality of experimental technique and analysis for which this group is known. Some rather old data on angular momentum resolved studies of the decay of compound nuclei, produced at the same excitation energies in asymmetric (C + Sm and O + Nd) and nearly symmetric (Ni + Zr) fusion reactions, provoked some of the liveliest discussion. This included a disagreement between the traveler and Schwalm which carried over into the traveler's talk on subbarrier fusion. This discussion ended unresolved, with each convinced that the other was attempting to obtain more detailed information from the gamma-ray multiplicity data provided by the Crystal Ball or Spin Spectrometer than was possible ... or at least prudent. The most impressive work presented by Schwalm was a detailed study of the gamma decay of states in the second or superdeformed potential well to normally deformed states in the first well of the fission isomer in ^{236}U.

K. Snover presented a good comprehensive review of studies of collective dipole strength in excited nuclei. The most interesting part of his talk, however, was new data on isospin mixing in nuclei as a function of temperature. These studies rely on the suppression of GDR strength in systems with N = Z due to isospin symmetry. He presented a comparison of GDR strength in $^{28}Si + ^{28}Si$ and $^{28}Si + ^{30}Si$ over a range of compound nucleus excitation energies from 35 to 65 MeV, from which he deduced the isospin mixing in the $t_z = 0$ system. The result was a rapid increase in mixing above 35 MeV of excitation, leading to a much larger mixing than anticipated theoretically. This result was discussed extensively with no clear conclusion.

P. Ring gave an impressive presentation of work his group has done on developing a phenomenological relativistic mean field theory of nuclear structure. His subtitle, "...from Nuclear Matter to Superdeformation," gives a feeling for progress already made by this group. The specific motivation for developing a phenomenological theory

of this sort was not made clear in the introduction to the lecture, i.e., what sort of things he expected to calculate better or more elegantly than the corresponding non-relativistic theory. It was also disappointing that he had not attempted to calculate spin observables, which are obvious candidates for exercising a relativistic theory. Ring did make a very clear presentation of the structure and status of the theory, and he presented an impressive range of results (moments, masses, level schemes, deformations, etc.). He also made the claim that the relativistic theory was computationally much simpler than the corresponding non-relativistic theory, because of the complicated non-local interaction required by the latter.

O. Bohigas presented an elegant review of selected topics in chaos and their relation to nuclear physics; however, the highlight of the meeting for the traveler was a lecture on chaos by B. Mottelson and a subsequent afternoon-long discussion. Mottelson's emphasis was quite different from usual discussions of this sort in which data from nuclear physics on distributions of level spacings or spectral rigidity are introduced as illustrations of results from the theory of chaotic systems without any discussion of what this might be telling us about nuclei, or for that matter, about chaos. Mottelson insisted on relating the discussion to things we know about nuclear physics, for example, pointing out what it means in terms of the structure of underlying wavefunctions to say the statistical properties of a group of levels are described in terms of random matrices. He presented a very good critical review of one of the most extensive studies of "chaotic behavior" at low excitation energy in nuclei (an analysis of extensive data on ^{26}Al carried out by Mitchel et al.). The underlying theme of these talks was "what does all this have to do with nuclei?" His answer was he doesn't really know yet. He clearly had no interest in trying to impress the audience with a slick presentation, or with his own erudition, but gave the very refreshing impression of someone who really was interested in his subject and was in the midst of trying to find out what it was all about.

APPENDICES

A. Itinerary

1989

Oct. 30-31	Travel from Oak Ridge, TN, to Copenhagen, Denmark, via plane
Oct. 31- Nov. 12*	Workshop at Niels Bohr Institute, Copenhagen
Nov. 13	Travel from Copenhagen to Oak Ridge, via plane

*Please note: Traveler returned earlier than originally scheduled due to a death in his family.

B. Persons Contacted

R. Broglia	Niels Bohr Institute (Denmark) and Milan (Italy)
C. Dasso	Niels Bohr Institute (Denmark)
J. Gaardhoje	" " " "
B. Herskind	" " " "
A. Holm	" " " "
D. Schwalm	Heidelberg (West Germany)
G. Sletten	Niels Bohr Institute (Denmark)
K. Snover	Seattle, Washington (USA)
A. Winther	Niels Bohr Institute (Denmark)

C. Literature Acquired

None