DF 17. Energy Levels and Coriolis Coupling in the Odd Tungsten Isotopes. R.F. CASTEN,* P. KLEINHEINZ, P.J. DALY,† and B. ELBEK, Niels Bohr Inst., Copenhagen.--Single particle neutron states and their associated rotational bands have been studied in the odd W isotopes from $^{179-187}W$ using the (d,p), (d,t), and (^3He,α) reactions. Level energies and cross sections were generally obtained up to 2 MeV. Assignment of states to rotational bands built on intrinsic Nilsson orbitals were made for most states below 700 keV in $^{179,187}W$, 1000 keV in ^{181}W, 1400 keV in $^{183,185}W$. Several even parity levels at higher energies were assigned in $^{183,185}W$ using the (^3He,α) to single out the ℓ=6 orbital angular momentum transfers. A study of Coriolis coupling showed that calculated energies and cross sections were often significantly altered by this interaction and that many deviations between the data and the simple Nilsson model could be eliminated with its inclusion. The mixing also offered an explanation for many of the extreme changes in cross section to a given level as a function of neutron number. The coupling strength was studied as a function of neutron number, quantum number and excitation energy; evidence was found for a reduction of many matrix elements below the Nilsson predictions.

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TUESDAY MORNING, 28 APRIL 1970 — FREDERICK ROOM AT 9:00 A.M.

(C. A. LEVINSON presiding)

Nuclear Theory I

DG 1. Is Nuclear Matter Gaseous or Liquid?. M. de LLANO, Instituto de Física, Univ. de México, México, D.F. and V. V. TOLMACHEV, Moscow State University, Moscow-B234.--The Brueckner-Bethe-Goldstone density-power-expansion perturbation series for the total energy per particle of infinite nuclear matter is critically analyzed as a low-density, non-ideal Fermi gas theory. A rough calculation based on the particle-hole Green function shows that a gas of nucleons interacting with a "realistic" N-N potential condenses to the liquid phase at about 0.03 times the empirical saturation density: a liquid theory is thus required for the understanding of both infinite and finite nuclear matter. Analogies between the BBG theory and the Mayer cluster-expansion theory of an imperfect gas with its failure at and beyond the condensation point seem to lead to the conclusion that the BBG theory of nuclear matter requires drastic modification.

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DG 2. The Tensor Force and Nuclear Matter.* I.R. AFNAN, F.J.D. SERDUKE and D.M. CLEMENT, Univ. of Calif., Davis--Separable potentials which have been fit to the nucleon-nucleon scattering data have also had tensor forces that are unacceptably weak: they predict deuteron D- state probabilities (P_D) of less than 3%. This has led to overbinding and too large a saturation density in nuclear matter[1]. To study this phenomenon in a systematic manner we have constructed separable potentials with Yamaguchi form factors in the $^3S_1$-$^3D_1$ channel. We first consider a set of potentials that are one term separable and are fit to the triplet scattering length, deuteron binding energy and quadrupole moment; P_D is allowed to vary from 1% to 9%. In contrast to Phillips'[2] potentials, they contain the repulsion needed to approximate the $^3D_1$ phases. These potentials lead to drastically different saturation curves in infinite nuclear matter with the P_D=1% potential yielding the largest binding energy per particle and saturation density. Binding energy results in nuclear matter and finite nuclei are presented using more realistic potentials whose P_D is in the range 4% to 7%.

*Work supported in part by the U.S. Atomic Energy Comm.
[1]D.M. Clement, et. al., Nucl. Phys. A139, 407 (1969)
[2]A.C. Phillips, Nucl. Phys. A107, 209 (1968)

DG 3. Off-Shell Nucleon-Nucleon Amplitudes from Pion Production.* D.A. ZOLLMAN, M.K. BANERJEE, C.A. LEVINSON and M.D. SHUSTER, University of Maryland.--The mass dispersion approach of Fubini and Furlan[1] has been applied to single pion production in nucleon-nucleon collisions. By considering the leading correction to the soft pion limit, a connection between the relativistic theory and the non-relativistic distorted wave approximation has been established[2]. The pion production amplitude depends on the off energy shell nucleon-nucleon scattering amplitude. This dependence is discussed for some nucleon-nucleon potentials.

*Work supported in part by the U. S. Atomic Energy Comm. under contract 40-1(3765)
[1]S. Fubini and G. Furlan, Ann. Phys.(N.Y.)48, 322(1968)
[2]M. K. Banerjee, C. A. Levinson, M. D. Shuster, and D. A Zollman (to be published)

DG 4. Pion Production in Nuclear Collisions.* M. D. SHUSTER, M. K. BANERJEE, C. A. LEVINSON, AND D.A. ZOLLMAN, University of Maryland.--PCAC and Current Algebra are applied to the calculation of "hard" pion production cross-sections for collisions of protons, He^3, and alpha-particles with complex nuclei. When the final nuclear state is not observed a closed expression is obtained relating $\partial^2\sigma^{\pi^+}/\partial\epsilon_\pi\,\partial\Omega_\pi$ to off-energy-shell matrix elements of the projectile-target optical potential. Comparison with known data is made for several standard potentials for the reaction $p + C^{12} \to \pi^+ + X$. Predictions are made for pion production in reactions involving complex projectiles.

*Work supported in part by the U. S. Atomic Energy Comm. under Contract 40-1(3765)

DG 5. The Relation Between the off shell N-N Scattering Amplitudes and Nuclear Binding Energies. MICHAEL I. HAFTEL,* Naval Research Laboratory--The relation between the off shell scattering amplitude and the binding energy of nuclear matter is discussed. Both phenomenological and exactly phase-shift equivalent potentials are treated. Exactly phase-shift equivalent potentials are generated by the rank two unitary transformation described by Coester, et. al.[1] It is found that the binding energy of nuclear matter is quite sensitive to the central and tensor T matrix elements for which the off shell variable is less than

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