# GOVERNMENT OF INDIA
## ATOMIC ENERGY COMMISSION

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## PROGRESS REPORT ON NUCLEAR DATA ACTIVITIES
### IN INDIA – VII

Compiled by
M. Balakrishnan
Nuclear Physics Division
Indian Nuclear Data Group

BHABHA ATOMIC RESEARCH CENTRE
BOMBAY, INDIA
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# INDIAN NUCLEAR DATA GROUP

## Members

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| 1. | M. Balakrishnan (Secretary) | Nuclear Physics Division, BARC |
| 2. | V.C. Deniz | Reactor Engineering Division, BARC |
| 3. | A.S. Divatia (Convener) | Nuclear Physics Division, BARC |
| 4. | S.S. Kapoor | Nuclear Physics Division, BARC |
| 5. | D.N. Kundu | Saha Institute of Nuclear Physics |
| 6. | B.P. Rastogi | Reactor Engineering Division, BARC |
| 7. | N.S. Satyamurthy | Nuclear Physics Division, BARC |
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| 9. | S.B. Garg ( " ) | Reactor Engineering Division, BARC |
| 10. | M.C. Joshi ( " ) | University of Bombay |
| 11. | S.K. Mitra ( " ) | Tata Institute of Fundamental Research |
| 12. | M.P. Navalkar ( " ) | Nuclear Physics Division, BARC |
| 13. | P.K. Patwardhan ( " ) | Electronics Division, BARC |

The seventh progress report on Nuclear Data Activities in India covers the work done during the year 1970. A part of the work outlined in this report has been presented at the Nuclear Physics & Solid State Physics Symposium held at Madurai during December 1970.

The total number of CINDA entries sent to the International Atomic Energy Agency during the period of the report is 20. A progress report on Nuclear Data activities has been compiled and submitted to the International Nuclear Data Committee.

Studies with KEDAK evaluated cross section library and unevaluated point cross section data obtained from IAEA have been carried out. A 26 group cross section set was generated from the basic energy point data to study the large power reactors. This set consists of 20 materials and covers the energy range 0.025 eV - 10.0 MeV.

The progress report on new facilities for research is as follows:

a) Work on the various systems of the 224 cm Variable Energy Cyclotron to be installed at Calcutta is under way. The casting of steel for the 250 tonne magnet at the Heavy Engineering Corporation, Ranchi is nearing completion, and machining is in progress. The process technology for the coils has been finalized at the Heavy Electricals of India Ltd., Bhopal. Work on other systems and further design studies are in progress at the Bhabha Atomic Research Centre. The foundation and the basement of the building

at Calcutta are complete and the superstructure work is in
progress. A User's Committee for Physics has been set up and
meetings have been held to work out plans for utilisation.

b) A repetitively pulsed fast reactor facility is to be
installed at the Reactor Research Centre at Kalpakkam to serve
as an intense neutron source for basic and applied research in
the fields of solid state and nuclear physics, nuclear and
radiation chemistry, radiation biology, etc. The proposed
pulsed reactor is basically similar to the IBR reactor in
operation at Dubna in the USSR since 1960. It is to be plutonium
fuelled, air cooled with an average power dissipation of 30 kW
and provide 50 pulses per second, each of which delivers over
$2 \times 10^{13}$ neutrons.

A zero energy fast critical facility to help optimise the
reflection pulsing mechanism design and other reactor parameters
is under construction at Trombay and is expected to go critical
by the end of 1971. Based on these studies the pulsed fast
reactor design would be carried out. It is expected that the pulsed
facility would be available for use by 1974.

c) The 2 MeV Van de Graaff accelerator at the Indian
Institute of Technology, Kanpur is in operation and an unanalysed
proton beam of 60 microamperes at 2.2 MeV is available. Studies
on proton - capture reactions have started.

d) At the Panjab University, Chandigarh, the sub-systems of the 6 MeV Variable Energy Cyclotron have been assembled and tested. The building to house the cyclotron is nearing completion.


(A.S. Divatia)
Convener
Indian Nuclear Data Group

# INSTITUTION

1. <u>Lowest T=3/2 State in $^{33}$Cl Observed as a Resonance in</u>
<u>$^{32}$S(p,$\gamma$)$^{33}$Cl Reaction</u> - M.A. Eswaran,M.Ismail and N.L.Ragoowansi
- Nuclear Physics Division - The yield of the reaction$^{32}$S(p,$\gamma$)$^{33}$Cl
near the lowest T=3/2 state has been measured by counting the
residual activity between bursts of a mechanically chopped beam.
A natural target of $Sb_2S_3$ was employed and a Ge(Li) detector was
used for counting the positron annihilation radiation from the
decay of $^{33}$Cl. The resonance was found to be at $E_p$=3.371±0.006
MeV in agreement with the elastic scattering experiments. By
comparison of the thick target yield of this resonance with
that of the resonance at $E_p$=2.547 MeV the radiation width $\Gamma_\gamma$
has been determined to be 0.56±0.18 ev for this lowest T=3/2
state. The branching of this state, is found to be $\sim$ 90% to
the 1/2$^+$ first excited state in $^{33}$Cl. This transition is likely
to be from the analogue to the anti-analogue state and its
radiation width corresponds to 0.22 Weisskopf unit.


2. <u>A Doorway State Observed as a resonance in the</u>$^{35}$Cl(p,p$_0$)
<u>Reaction</u> - S.K. Gupta,S.S. Kerekatte,S.Swami[*],M.R. Dwarakanath,
K.K. Sekharan[**] and A.S. Divatia - Nuclear Physics Division - In
the $^{35}$Cl(p,p$_0$) reaction a resonance of 15 KeV width has been
observed with its shape consistent with $l_p$=0 assignment, which
corresponds to a level at 10.901±005 MeV in $^{36}$Ar. This resonance

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does not appear in the $^{32}$S+$\alpha$ channel and therefore, it has been interpreted as an isolated bound doorway state. The observed level is in accordance with the predictions of Payne[1] after taking into account the difference in the penetration factors for protons and neutrons. Our observations also agree with the shell model calculations of Glaudemans et al[2] who predict a level at 10.5 MeV with J = $2^+$, T = 0 in $^{36}$Ar which has a 67% doorway state configuration of $(s_{1/2})^3(d_{3/2})^5$.

1. G.L. Payne, Phys. Rev. 174, 1227(1968)

2. P.W.M. Glaudemans et al, Nucl. Phys. 56, 529 and 548(1964).


3.  A Study of $^{64}$Ni(p,n)$^{64}$Cu Reaction - S.S. Kerekatte, S. K. Gupta and A.S. Divatia - Nuclear Physics Division - The total yield of the $^{64}$Ni(p,n)$^{64}$Cu reaction has been measured using the 4$\pi$ geometry neutron counter, for incident proton energies from 2.475 to 5.500 MeV, in 5 KeV steps. The excitation function exhibits the Ericson fluctuations, with an average level width of $\sim$ 7 KeV. Over the fluctuations strong resonances have been observed at $E_p$=3.895 and 4.620 MeV. These resonances are iso-baric analogs of the 3rd and the 6th excited states of $^{65}$Ni, in the compound nucleus $^{65}$Cu.


4.  Evidence for Doorway States in $^{29}$Si($\alpha$,n)$^{32}$S Reaction - M. Balakrishnan, M.K. Mehta and A.S. Divatia - Nuclear Physics Division - Many evidences are known to exist for doorway states in nuclear reactions interpreted as states of two particle one hole, 2 particles two holes etc. and they are observed prominently

in elastic and inelastic scattering of protons or alphas. In this work evidence for doorway state for a more complicated case like the $^{29}Si(\alpha,n)^{32}S$ reaction is indicated for incident alpha energy from 3.00 to 5.40 MeV, as seen by the averaging of compound nuclear resonances. The widths of structures observed are around 275 keV. Possible significance are discussed. The strength function $\langle \Gamma \rangle / \langle D \rangle$ for the compound resonances in the region of excitation covered is found to be $\sim 0.3$.


5. <u>Isobaric Analogue States in $^{67}Ga$</u> - M.G. Betigeri, C.M. Lamba, N.Sarma, D.K. Sood and N.S. Thampi - Nuclear Physics Division - The isobaric analogue states of $^{67}Zn$ have been observed in the compound nucleus $^{67}Ga$ through the study of elastic scattering of protons on $^{66}Zn$. This study covers the first six levels analogous to $^{67}Zn$. Two of these being high $\ell$ transitions could not be observed. The energy, $\ell$ -value, total width and proton partial width of the other four resonances are determined by a shape fitting procedure and the results are compared with available evidence from $^{66}Zn(d,p)$ reaction.


6. <u>Fragment Angular Distributions in the 14 MeV Neutron-Induced Fission of The $^{232},U^{233},U^{238},Np^{237},Pu^{239}$ and $Am^{241}$ using Solid-State Track Detectors</u> - R.H. Iyer and M.L. Sagu - Radio-Chemistry Division - An efficient and novel experimental set up which allows simultaneous measurement of the angular distribution of fragments from five independently fissioning nuclei at a time has been developed. Laxan polycarbonate plastic was used as the

solid-state track.detector. The data have been analysed in terms of a polynomial of the form $A+B\cos^2\theta+C\cos^4\theta$. From a least square fit of the experimental data with the above relation, the fragment anisotropies, $\sigma_f(0°)/\sigma_f(90°)$, for $Th^{232}, U^{233}, U^{235}, U^{238}, Np^{237}, Pu^{239}$ and $Am^{241}$ were calculated to be $1.82\pm0.12$, $1.34\pm0.12$, $1.67\pm0.14$, $1.66\pm0.13$, $1.28\pm0.13$, ~~1.28±0.08~~, $1.18\pm0.08$ and $1.35\pm0.10$ respectively. Fragment angular distributions in the fission of $Pu^{239}$ and $U^{235}$ induced by thermal neutrons were found to be isotropic within the statistical errors ( $\angle$ 5%) of counting the tracks.

7.  Excitation functions for the Neutron Induced Fission of Heavy Nuclei - K.N. Iyengar[*], R.H. Iyer[**], S.S. Kapoor, D.M. Nadkarni and M.L. Sagu[**] - Nuclear Physics Division - This work is a part of the data of our experiments to measure fission cross-sections of several nuclei namely, $^{232}Th$, $^{233}U$, $^{237}Np$, $^{239}Pu$ and $^{241}Am$ relative to that of $^{235}U$ in the neutron energy region of 0.32 to 2.1 MeV at energy intervals of about 100 keV. Fission events were recorded using Lexan Solid State Track detectors in a 2 geometry. Mono-energetic fast neutrons were generated with $T(p,n)^3He$ reaction using the 5.5 MeV Van de Graaff Accelerator.

8.  Emission of long Range Charged Particles in the Fission of $^{235}U$ by Thermal to 4 MeV Neutrons - D.M. Nadkarni and S.S. Kapoor, - Nuclear Physics Division - The rate of emission of long range charged particles in fission has been determined in the case of fission of $^{235}U$ induced by thermal, 2 MeV and 4 MeV neutrons.

The method used consisted in recording the energy spectrum of these charged particles, using a semiconductor detector, in coincidence with fission fragments detected in a $2\pi$ geometry with a parallel plate ionization counter. Together with our earlier measurements of emission probability of long range alpha particle in 3 MeV neutron induced fission of $^{235}U$, the present results indicate a rather weak dependence of emission probability of charged particles in fission on the excitation energy of the fissioning nucleus. These results, obtained for the case of a single fissioning nucleus, are compared with those obtained by other workers at much higher excitation energies where multiple chance fissions contribute.

9. Kinetic Energy Distribution in Reactor Neutron Induced Fission of $^{241}Am$ - M.V. Ramaniah, Satya Prakash, S.B. Manohar, S.P. Dange, A. Ramaswami, A.G.C. Nair and R.J. Singh - Radiochemistry Division - Recoil ranges in aluminium of fission products from reactor neutron induced fission of $^{241}Am$ have been determined using two different techniques, namely, direct counting of the fission product gammas using a Ge(Li) detector and by radiochemical techniques. Kinetic energy distribution was obtained from recoil range data using semi-empirical range-energy relations. The observed kinetic energy deficit was found to fit well in the correlation of kinetic energy deficit with shells published earlier from this laboratory.[*]

* J. Inorg. Nucl. Chem., 1969, Vol.31, pp.1217 to 1224.

10. <u>Elastic and Inelastic Scattering Cross-sections of Chromium,
Iron and Nickel</u> - S.B. Garg and B.P. Rastogi - Reactor Engineer-
ing Division - Chromium,iron and nickel act as moderators in fast
power reactors as the neutrons suffer elastic and inelastic colli-
sions. The elastic and inelastic scattering cross-sections have
been calculated for the neutron incident energies ranging from
1.0 MeV to 10.0 MeV using the spherical local optical model. The
best values of optical model parameters have been obtained by fitt-
ing the measured elastic angular distributions. Woods-Saxon form
for the imaginary part and the Thomas form for the spin-orbit
coupling term.

11. <u>Triton Knockout From $^7$Li Nucleus</u> - A.K. Jain and N. Sarma
- Nuclear Physics Division - The reaction $^7$Li(p,pt)$^4$He at 55 MeV
incident energy has been studied in the distorted wave impulse
approximation (DWIA) using the properly antisymmetrized $\alpha$ - t
cluster model wave function for $^7$Li nucleus. It is observed that
the inclusion of the distortion of the incoming and the outgoing
waves affects the results significantly. From the study of the
localization of the reaction it is found that the exchange terms
appearing in the antisymmetrization of the cluster model wave
function affect the angular correlation appreciably. Calculated
results are compared with the available experimental data.

12. <u>Further Studies of K X-Rays Emission from $^{252}$Cf Fragments</u>
- S.S. Kapoor, D.M. Nadkarni, S.R.S. Murthy, V.S. Ramamurthy and
P.N. Rama Rao - Nuclear Physics Division - It is known that the
K X-rays emitted in fission result from the internal conversion

process during the $\gamma$ -deexcitation of fission fragments, and
therefore the average yield of the K X-rays from specified frag-
ments is related to the average number of transitions which are
internally converted. In  this work K X-rays emission from $^{252}$Cf
fission fragments has been studied to determine (a) average K
X-ray yields from different fragments upto 110 nsec and 1000 nsec
after fission,(b) the average multiplicity of K X-ray emission from
fragments of specified nuclear charges and (c) whether the X-ray
emission probability from the pair fragments $(Z_H, Z_L)$ is independ-
ent or correlated.  Fission fragments from the $^{252}$Cf source were
detected in a $2\pi$ geometry by a mini ion-chamber, and the X-rays
were detected by two independent cooled Si(Li) detectors,placed
on either side of the chamber and the double and triple coincidence
K X-ray spectra were recorded.  Information has been obtained on
the first moment ( $\langle n \rangle$ ) second moment ( $\langle n^2 \rangle$ ) of to the X-ray
emission distribution function,and the correlation coefficient
$R(Z_H, Z_L)$ and on the intensity of relatively long half life com-
ponents in the X-ray emission from different fragment nuclei.


13.. An Unified Theory on the Structure of Atoms and Nuclei
- R. Ramanna and S. Jyothi - Nuclear Physics Division - Recent
developments in Mathematics concerning differentiable manifolds,
the theory of differential forms and the geometric theory of
partial differential equations have been employed to present an
unified theory on the structure of atoms and nuclei.  The pro-
cedure consists in defining a Schrodinger equation over an Eucli-
dean patch which overlaps with other Euclidean patches in a
specified way to form a manifold.  The invariance of the Schrodinger

equations in the overlapping region leads to a second order non-linear partial differential equation whose solutions are doubly periodic functions. There are only two single-valued solutions to this differential equation giving rise to lattices in the complex space. Of these lattices one consists of corners of an array of equilateral triangles and the other consists of corners of an array of isosceles right-angled triangles. The first solution corresponding to the equilateral triangle lattice was used[1] to derive the shell structure, Coulomb energies and binding energies of spin-less stable systems. In this study it is shown that the second solution corresponding to the isosceles right-angled triangle lattice is used to calculate the binding energies of atoms and these come out to be in agreement of about 3% for the few available experimental values and also in good agreement with those obtained by the perturbation theory. It is also shown that this lattice under certain approximations is equivalent to a pure Coulomb law and the Bohr orbits of the hydrogen atom are correctly predicted.

1. R. Ramanna and S. Jyothi, International Journal of Theoretical Physics, Vol.2,No.4(1969)pp.381-403.

14. <u>Shell Effects on Nuclear Level Densities</u> - V.S. Ramamurthy, S.K. Kataria and S.S. Kapoor - Nuclear Physics Division - On the basis of our microscopic calculation of the nuclear level density versus excitation energy carried out using a realistic shell-model single particle level scheme and BCS formalism to include pairing effects, a simplified prescription for taking into account

shell effects on nuclear level densities has resulted. It has
been shown earlier by us that contrary to general belief even
at moderate excitation energy of 30-40 MeV the shell effects on
the level density disappear. In present work we have shown that
the conclusions of Kahn and Rosenwig and Gilbert showing persi-
stence of shell effects at high excitation energies are based on
a misinterpreation of the ground state shell corrections in the
nuclear masses.


14. On the Production Possibility of Superheavy Nuclei - V.S.
Ramamurthy and S.S. Kapoor - Nuclear Physics Division - The in-
clusion of the shell effects in the liquid drop model deformation
energy of nuclei has led to the now well known prediction of an
island of stability in the doubly magic superheavy region around
$Z = 114$ and $N = 192$. In the attempts currently being made to
produce superheayy nuclei in the laboratory, in particular by
heavy ion bombardment, the nucleus is unavoidaoly formed with an
excitation energy of a few tens of MeV, and the nucleus must
therefore undergo a cascade of neutron emission for the end
product to be a stable superheavy nucleus. On the basis of our
level density calculations we have computed $\Gamma_f/\Gamma_n$ at different
excitation energies for nuclei in the superheavy region. It is
shown that if the fissioning nucleus is "hot" ($E_x \simeq 30-40$ MeV),
the existence of a shell fission barrier in the ground state does
not decrease the otherwise very large $\Gamma_f/\Gamma_n$ expected for the case
of zero liquid drop barrier. Consequently the fraction of com-
pound nuclei surviving fission and reaching the ground state
after a cascade of neutron emission is expected to be very small,
thereby posing a problem for the laboratory production of these superheavy
nuclei.

## B. TATA INSTITUTE OF FUNDAMENTAL RESEARCH,BOMBAY-5.

1. **The Level Structure of $^{75}$Se** - Baldev Sahai, B. Lal - The level structure of $^{75}$Se has been investigated upto an excitation energy of 1500 keV by studying the gamma-gamma coincidence spectra in a reaction $^{75}$As(p,n$\gamma$) $^{75}$Se at incident proton energies 3.0 and 3.5 MeV and also by observing the direct gamma-ray spectra using a 30 c c Ge(Li) detector with incident protons in the energy range 1.5 to 4.0 MeV. A detailed decay sheme for$^{75}$Se levels with branching ratios for some of the levels has been worked out.

2. **Study of Low Lying Levels in $^{51}$Cr and $^{59}$Ni** - B. Lal, Baldev Sahai - The low lying levels in $^{51}$Cr and $^{59}$Ni have been reached by (p,n$\gamma$) reaction on $^{51}$V and $^{59}$Co targets. The angular distributions of some of the ground state transitions have been compared with the statistical model calculations based on Satchler and Sheldon's formalism to extract the information on the spin of the levels and the multipole mixing ratios of the transitions. The spins of the levels of $^{51}$Cr at 749,1165 and 1479 KeV have been confirmed to be 3/2, 9/2 and 11/2 respectively. The spin of 879 KeV level of $^{59}$Ni is found to be 3/2.

3. **Coulomb Excitation of Selenium Isotopes**$^{(74,76,77,78,80,82}$Se$^{)}$ - A.P. Agnihotry, K.P. Gopinathan, M.C. Joshi and K.G. Prasad - A thick target of Selenium natural material was exposed to alpha particles from a 5.5 MeV. Van de Graaff accelerator at Trombay

The $\gamma$-rays emitted from the target were detected by a high resolution (Ge(Li)) detector (20 cc). The gamma-rays corresponding to Coulombe excitation of different isotopes $^{74-82}$Se were identified. From measurements of thick target yields corrected for their natural isotopic abundances, the relative $B(E_2)\uparrow$ values were determined. Using a well known $B(E_2)\uparrow$ value of $2^+$ level of $^{78}$Se, absolute values of $B(E_2)$ in units of $(10^{-50}.e^2.cm^4)$ for all the other gamma-rays were determined. $^{77}$Se:$(23\pm2)$,$(18+6\pm2.0)$, $(1.0\pm0.2)$ for 440-,240 and 250 keV levels respectively. $^{74}$Se : $(48.0\pm15)$ for 635 keV $(2^+)$ level,$^{76}$Se : $(45\pm4)$ for 560 keV $(2^+)$ level, $^{78}$Se: $(38.4\pm.8$ for 612 keV$(2^+)$level,$^{80}$Se:$(27.6\pm2.5)$ for 665 keV$(2^+)$ level and $^{82}$Se: '$20\pm4)$ for 654 keV$(2^+)$ level. The $B(E_2)\uparrow$ value for $^{74}$Se is new. The $B(E_2)\uparrow$ value for 250 keV level in $^{77}$Se is more accurate compared to the earlier value obtained from unresolved gamma-rays 240 and 250 keV using NaI(Tl) scintillation detector. Our improved value is in good agreement with the value obtained from the half life measurements of this level. From the observed $B(E_2)$ values the r.m.s. quadrupole distortion $\beta_{r.m.s.}$ are deduced for the Selenium Isotopes.

4.  <u>g-Factor of the 603 keV Level in $^{124}$Te By Beta-Gamma Perturbed Angular Correlations</u> - A.P. Agnihotry, M.C. Joshi and K.G. Prasad - We have attempted to extend the $\beta-\gamma$ perturned angular correlations to the measurement of nuclear g-factor in the case of 124Sb $\longrightarrow$ 124Te. The active $^{124}$Sb was diffused into a thin (10 mg/cm$^2$) iron foil which was polarized by a small electromagnet. The internal field acting at the site of Te was

used for perturbing the beta-gamma angular correlations. Our
result for $2^+$ level at 603 keV ( $\tau_{1/2} = 4$ PS) in $^{124}$Te indicate
that g-factor extracted (g = 0.45 $\pm$ 0.1) by this method is in
good agreement with that obtained by conventional gamma-gamma
perturbed angulaar correlation technique.

3. <u>Optical Potential for Deuteron</u> - S.K. Samaddar and Suprokash Mukherjee - An analytic expression for the deuteron optical potential given by one of us (Mukherjee) is used to calculate the differential cross-section for the elastic scattering of the deuteron in the energy range 11.8 MeV to 27 MeV from various targets. The nuclear optical potential parameters used are those of Engelbrecht and Fiedeldey for neutron. The results are in fair agreement with experiment.

4. <u>Magnetic Moment of the 280 KeV 5/2⁻ State of As$^{75}$</u> - B.K. Sinha and R. Bhattacharyya - The magnetic moment of the 280 keV 5/2⁻ level of As$^{75}$As has been measured using a modified IRF method. This has resulted in a better accuracy of the measured value 10% compared to an accuracy of 20-30% as found in the published literatures.

5. <u>L/K Capture Ratio From Ge(Li) Spectrum</u> - B.K. Dasmahapatra - A new and simple method has been developed for the measurement of the L/K electron capture ratio for the nuclei whose decay schemes are known. A careful calibration of the Ge(Li) detector in the K-X ray region, together with the accurate determination of the intensity of the cascade gamma-ray, yield the capture ratio in a straight forward way. Using this technique the L/K capture ratio for the $^{133}$Ba decay has been measured.

## C.   SAHA INSTITUTE OF NUCLEAR PHYSICS, CALCUTTA-9.

1.   **Deexcitation Phenomena in Prompt Fission Fragments** - Ratna Sarkar and Aparesh Chatterjee - Improvements on our RGM-PES approach to the fission phenomena are made to study (a) the partition of the excitation energy of the fissioning nucleus into the prompt fragments and (b) the prompt gamma deexcitation processes in the fragments.  While studying (a), a simple RGM saturation condition is used to partition the excess excitation energy of the fissioning nucleus into the conjugate fragments; the predictions are compared with the experimental work on fission of $^{232}$Th by 25.7 and 29.5 MeV $^{4}$He-ions and of $^{226}$Ra by 13.0 MeV protons.  In studying (b), the prompt fragment gamma ray deexcitation energies and yields are compared with the experimental information on the thermal neutron fission of $^{235}$U and spontaneous fission of $^{252}$Cf.  The predictions agree fairly well with observations.

2.   **Study of $(p,p')$ and $(p,n)$ Reactions in Be$^{9}$** - J. Mahalanabis - We have calculated the cross-sections for $(p,p')$ and $(p,n)$ reactions in $^{9}$Be at medium energies, leading to excitation of the 2.43 MeV state (5/2) in Be$^{9}$ and ground state of $^{9}$B (isobaric analouge state), respectively.  The results are compared with the available experimental data.  It is seen that better fit is obtained with Wilkinson's wavefunction rather than the oscillator wave-function.

6.  <u>The Decay of $^{126}$I</u> - K.S.N. Murty, B.P. Pathak and M. L.
Chatterjee - The decay characteristics of 13d $^{126}$I, produced
by the (n,2n) reaction on analytically pure ammonium iodide have
been studied. The gamma rays of energies (relative intensities)
388.4 (100), 491.3 (8.1), 511.0 (5.6), 666.6 (98), 753.9 (12.5),
879.9 (2.2), 1420.1 (0.82) and 2050 (weak) keV have been observed.
The results of beta and gamma measurements have been incorporated
into a decay scheme. The results were found to be consistent
with a recent work.

7.  <u>Decay of $^{68}$Cu(30 sec.) And $^{68m}$Cu(3,75 min)</u> - V.K. Tikku,
H. Singh and B. Sethi - The existence of an isomer of $^{68}$Cu is
confirmed and its half life measured as 3.75±0.05 min. The radio-
active sources of $^{68g\&m}$Cu were produced by the fast neutron
irradiation of enriched samples of $^{68}$Zn and $^{71}$Ga and spec pure
ZnO. A new group of energy (intensity) 4.6 MeV (13%) corres-
ponding to the transition $^{68g}$Cu- $^{68}$Zn is obtained. From the
experimental data the isomeric cross-section ratio ($\sigma_m / \sigma_g$ )
for the production of the metastable and ground state is cal-
culated to be 0.9±0.2. The $\gamma$-spectra were recorded using 2.00.cc
Ge(Li) detector. The $\gamma - \gamma$ and $\beta - \gamma$ coincidences are performed.
Based on the results a decay scheme is proposed for $^{68g}$Cu and
$^{68m}$Cu.

8.  <u>Excited Levels of $^{85}$Sr</u> - S.K. Basu and A.P. Patro - The
decay of $^{85}$Y-isomers (2.9 h. & 4.7 h.) to levels in $^{85}$Sr has been
studied using a high resolution Ge(Li) detector. Several gamma

rays have been identified in the respective decays. On the basis of the energies and relative intensities of the observed gamma rays, a tentative level scheme of $^{85}$Sr has been constructed.

9. <u>Half Life of the 687 KeV Level and the Energy Levels in</u> $^{147}$Pm - H.Singh and B. Sethi - The half-life of the 687.42 KeV level in $^{147}$Pm is measured for the first time using the delayed coincidence technique incorporating a time to amplitude converter. A value of 252±100 psec. is obtained. Using the previous values of the conversion coefficients and the mixing ratios and the branching ratios from this work, transition probabilities $\lambda$(E2) and $\lambda$(M1) are calculated and compared with those of the single particle estimates. The gamma spectra in the decay of $^{147}$Nd was recorded using 2.5 cc Ge(Li) detector. New gamma-rays of energies (intensities) 299.65(0.36),312.57 (0.13), 589.89(0.2), 680.79 KeV (0.19) were observed and assigned to $^{147}$Pm from their decay origin. These new gamma rays are incorporated into the existing decay scheme of $^{147}$Pm with additional levels at 723.48,681.01 KeV. Spins and partities of these levels are deduced.

10. <u>Disintegration of Gallium-65</u> - D. Basu - Disintegration of Gallium-65 has been studied with Ge(Li) detector. Several new gamma rays have been observed. Following are the gamma-ray energies in keV: 54, 61, 115, 153, 207, 654, 660, 703, 715, 752, 769, 795, 813, 856, 867, 910, 932, 983, 1047, 1135, 1227, 1261, 1309, 1342, 1353, 1414, 1468, 1525, 1750, 1870, 1876, 1962, 1969 and 2218. Intensities have been estimated and a suitable level

scheme has been proposed.

11. On the Origin of Hard-Core - Kamales Bhaumik - We have tried to give a theoretical explanation of the origin of re-pulsive-core in N-N interaction. We have been able to form a successful OBEP model which can generate a soft repulsive core. This soft core is, of course, hard enough to account for the observed change in the sign of the $1S_0$ phase-shifts. The con-sistency of this model is being checked in explaining the experimentally observed quantities e.g. scattering lengths, effective ranges, phase-shift parameters etc.

12. M1 Transition Strengths in the Odd-Mass Antimony Isotopes - S. Sen - Different M1 transition rates (particularly $l$-for-bidden cases) in the odd-mass Sb isotopes have been calculated in the framework of the core-particle coupling model. Detailed analysis of the role played by different configurations towards M1 transition strengths have been made. The results are ana-lyzed with reference to the available experimental data and the calculations done by other authors.

## D.   ALIGARH MUSLIM UNIVERSITY,ALIGARH

1.   On the Appearance of Plateau in the Neutron Total Cross Section - A.N. Sanaria and I Ahmad - Occurence of plateau in the neutron total cross section when plotted as a function of the nuclear radius is analysed. It is found that the modified form of the Glauber high-energy potential scattering theory explains quite satisfactorily the existence of the plateau even in the relatively low-energy neutron total cross section data. Expression for the loci of the plateau in the $E-A^{1/3}$ plane is obtained.

2.   Statistical Theory Calculations of Neutron Capture Cross Sections from 200 keV to 800 keV - H.V. Gupta, A.K. Chaubey and M.L. Sehgal - Neutron capture cross sections have been calculated using statistical theory of nuclear reactions in the energy range from 200 keV to 800 keV for $^{75}$As, $^{79}$Br, $^{115}$In and $^{197}$Au. These calculated cross sections were compared with the experimental values of capture cross section to test the validity of statistical theory in the energy range 200 keV to 800 keV. Some excited states in these nuclei have more than one spin. It was tried from the calculations of neutron capture cross-section that which spin is more suitable.

3.   Study of P-Wave Neutron Strength Functions - A.K. Chaubey and M.L. Sehgal - P-wave neutron strength functions ( $\Gamma_n^1$ /D) have been calculated using 24 KeV neutron capture cross sections and low energy resonance parameters. These values of strength

functions were compared with the previous reported values. Some interesting results have been obtained.

4. <u>Statistical Theory Calculations of Neutron Capture Cross</u> Sections at 130 KeV – J. Alam and A. Augusthy – Neutron capture cross-sections have been calculated using statistical theory of nuclear reactions at 130 KeV energy for a large number of cases. These calculated cross-sections are compared with the experimental values to obtain informations about the parameter $\xi_{cal} = \dfrac{D}{2\pi\Gamma}$ These values of $\xi_{cal}$ are then compared with the known experimental values of $\xi_{obs}$ obtained from low energy resonance experiment to check the validity of the statistical theory.

5. 14.8 MeV Neutron Radiative Capture Cross-Section – S.S.Hasan, R. Prasad and M.L. Sehgal – Neutron radiative capture cross-sections have been measured for $^{103}Rh$, $^{127}I$ and $^{175}Lu$. Results of these measurements and those of earlier measurements have been used to check direct-semi-direct theory for radiative capture. A comparison of experimental and theoretical values reveals that for the nuclei near the closed neutron shell these agree well. However, for other nuclei only order of magnitudes agree. Shell effects in $(n,\gamma)$ cross-sections at 14.8 MeV have also been observed.

# B.LABORATORIES FOR NUCLEAR RESEARCH,ANDHRA UNIVERSITY,WALTAIR

1. **New Isomaric Cross-Section Ratios in Neutron Capture Reactions** - A. Lakshmana Rao, K. Parthasaradhi and J.Rama Rao - Experimental Isomer Ratios for neutron capture reactions at 25 KeV leading to the Isomaric pairs Ge-75m,g:Rb-86m,g: Pd-11m,g; Cd-117m,g: Sb-122m,g: Sn-125m,g: Eu-152m,$m_2$: and Pt-197m,g have been measured for the first time. Activation method and absolute gamma counting have been employed, using a calibrated well-type scintillator and a multichannel analyzer. The spin cut-off factors for these cases are being extracted using Huizenga and Vandenbosch formalism for comparison with the predictions of the Shifted Fermi gas model, Superconductormodel and Independent pairing model.

2. **P-Wave Strength Functions in the Mass Region $140 < A < 160$** - B.V. Thirumala Rao, J. Rama Rao and E. Kondaiah - It is well known that there are significant discrepancies between the theoretical and experimental values of the p-wave neutron strength function,s , in the region $140 < A < 160$ corresponding to the valley of the giant resonances. To investigate this point,average neutron capture cross-sections in the isotopes Nd-146,Nd-148, Nd-150 and Gd-158 have been determined at 25 KeV using the activation technique. Employing the recebtly available s-wave resonance parameters (in the KeV region), the s-wave capture contributions are accurately subtracted out to obtain the p-wave cross-sections which were found to be more than 50% in all these cases.

The p-wave strength functions for these isotopes are being extracted for comparison with theoretical predictions.

3.  P-Wave Neutron Capture in Heavy Nuclei at 25 KeV - M. Sriramachandra Murty, K. Siddappa and J. Rama Rao - A systematic investigation of the average neutron capture cross-sections at 25 KeV is undertaken to study the structure of giant resonances in the neutron strength functions. As a part of this programme and to plug the gaps in the existing cross-section data, the radiative capture cross-sections for the following isotopes have been measured: Se-74, Sr-84,Ag-109,Te-122,Tb-159,Yb-168,Tm-169, Yb-174,Yb-176,Hf-178,Hf-179,Ir-191 and Os-192.  Activation method and absolute gamma counting have been employed.

5. **Internal Conversion Coefficients Measurements in $^{133}$Ba Decay** - C. Narasimha Rao, B. Mallik, K.V. Ramanaiah and K.Venkata Reddy - The internal conversion coefficients for six transitions, 161,223,276,302,356 and 385 keV in Cs-133 have been measured by recording the conversion electron lines with a Seigbahm-Slatis beta ray spectrometer and using the published relative photon intensity data. These are calculated relative to the conversion coefficient of the 356 keV E2 transition.

6. **Decay of $^{81m}$Se(57 MIN) and $^{81g}$Se(18 MIN)** - S. Venkataratnam and V. Lakshminarayana - and M.V. Ramanaiah - Radiochemistry Division, Bhabha Atomic Research Centre, Bombay - The gamma rays following the beta decay of $^{81}$Se isomers are investigated with a 2 cm$^3$ Ge(Li) detector. Sixteen gamma transitions are observed confirming several already known gamma rays as well as five new transitions. All these are fitted in a level scheme requiring two new levels at 815 keV and 1323 keV. Energies and relative intensities of the gamma rays and $log$ ft values of the various beta branchings,populating levels in $^{81}$Br are calculated & analysed in relation to their spin and parity assignments.

7. **Angular Correlation Studies in Cobalt-59** - K. Venkata Ramana Rao, D.L. Sastry and V. Lakshminarayana - Angular correlation studies are carried out in Co.59 using a sum-peak coincidence arrangement for three cascades - (190-1100)KeV,(140-1290) KeV, and (330-1100) KeV. Assuming the spins of the ground,1100 and 1290 KeV states to be 7/2,3/2 and 5/2 respectively, the results

of the angular correlation studies are employed to obtain quadrupole contents of the transitions. The 190 keV transition is found to have quadrupole content of 9%. With 1/2 and 3/2 as possible spins for the 1430 keV state, the correlation studies are analysed. For a spin assignment of 1/2 for the state, the 1290 keV transition is found to be a pure M1. For a 3/2 assignment the 330 keV transition is found to have a quadrupole content of 21%, while for a 1/2 assignment the 330 keV transition is a pure M1.

8. **Fission Properties of Super Heavy Nuclei** – S. Rama Murty, M.V. Ramana Murty, C.R. Chandran, K. Partha Sarathy – The fission properties of about 50 super heavy nuclei Z = 110 to 134; A = 288 to 324 have been calculated. The · energy release in binary, ternery and quarternary fission, the surface energy, the coulomb energy and the fissility parameter of the fission nuclei, the terparature, the kinetic energy and the excitation energy of the fission fragments and number of neutrons liberated per binary fission, have been estimated theoretically.

9. **Level Density Parameter and Nuclear Shell Structure** – S. Rama Murty, K. Partha Sarathy, M.V. Ramana Murty and C.R. Chandran – The influence of nuclear shell structure on the level density parameter has been investigated using Lang's formula and modified Newton values of effective angular momenta for about 130 nuclei in the vicinities of magic numbers Z,N=20,28,50 and 82. The numerical values have been explicitly tabulated.

10. <u>Decay of Sr</u>[85m] - K.L. Narasimham, M.N. Seetaramanath and
V. Lakshminarayana and A.P. Patro, Saha Institute of Nuclear
Physics, Calcutta - The electron capture and gamma decay of
Sr-85m (70m) is studied with a calibrated Ge(Li) detector. The
energies and relative intensities of the gamma rays, and the
intensity of the electron capture branch are obtained. The k-
conversion coefficients for the 232 and 237 keV transitions are
calculated from the published conversion electron data and the
presnet results. These are consistant with an M1+E2 nature of
the 232 keV transition and an E3 nature of the 237 keV transition.
The latter is in disagreement with the present 1/2⁻ assignment
for the 237 keV state and supports a 3/2⁻ for its spin. These
results are discussed in relation to the decay scheme of Sr-85m.


11. <u>Beta-Gamma Directional Correlation Measurements in the Decay</u>
of Pr-142 - A Khayyoom, M.L. Narasimha Raju and D.L. Sastry- The
580 keV beta-1570 keV gamma directional correlation was measured
with a slow fast coincidence scintillation spectrometer. The
energy dependence of the angular correlation coefficient, $A_2$ is
studied in the energy range 200 - 500 keV in steps of 100 keV.
The observed $A_2$ coefficient is small and independent of energy
within experimental errors. The results are consistent with the $\xi$
approximation.


12. <u>Gamma-Gamma Angular Correlations in Nd-147</u> - B.R. Sastry,
K.L. Narasimham and D.L. Sastry - The gamma-gamma angular corre-
lations in Nd-147 are investigated for cascades depopulating the

690, 533 and 490 keV levels using a sum-coincidence scinti-
llation spectrometer in order to infer about the spins of these
levels and the multipolarities of the respective gamma transi-
tions.   The results of the present investigation will be dis-
cussed in relation to the level scheme of Pm-147.

# F. BANARAS HINDU UNIVERSITY, VARANASI-5.

1. **Measurement of (n,γ) Cross Section By Activation Technique in the keV Region** - S.N. Chaturvedi, Rajendra Prasad and N.Nath - A specially shielded gamma counting set-up has been designed and fabricated for accounting low level activities employing a well type of NaI(Tl) crystal. A 10-Curie Sb(Be) neutron source was obtained from B.A.R.C., India for irradiation of target nuclei. The low counting,set up was used in measuring the (n,γ) cross section at $E_n$= 24±3 keV for more than ten nuclei. The standard reaction in this study was considered as $^{107}Au(n,γ)^{198}Au$ with $\sigma$ = (640±25)mb. Cross section for almost all the nuclei were also calculated theoretically on the basis of optical model and a comparison has been made with the present experimental values and with those reported in earlier studies. Cross-section in the keV region are helpful in the reactor design,cosmological studies of element formation and in the nuclear reaction studies.

2. **Characteristics of the α-α Interaction** - P.C.Joshi and P.C. Sood - A systematic examination of the binding energies of alpha particle nuclei leads to some interesting features of the inter-alpha binding in these nuclei which can be used to caracterrise the alpha-alpha interaction. We examine these characteristics vis-a-vis the nucleon-nucleon interaction. The saturation properties and the approach to the saturation value is found to be very similar in the two cases. As a first stop towards characterīng the α-α interaction we present an empirical formula for

the binding energies of alpha-particle nuclei.

3. Shell Model Description of $(d_{3/2})^n$ Nuclei - A.N. Mantri and P.C. Sood - A study of the low lying energy levels of nuclei with $(d_{3/2})^n$ configuration of n identical or non-identical particles has been made taking two body interaction as the effective interaction between two nucleons expressed in terms of the seniority, the isospin, and the reduced isospin quantum members. Using the Racah-Talmi approach the matrix elements of this effective interaction in n particle configuration are expressed as linear combinations of the matrix elements in two particle configuration. The interaction parameters are determined from the known energy levels of $^{34}Cl$ and $^{38}K$. The low lying energy levels for several $(d_{3/2})^n$ nuclei are then calculated and compared with experimental data.

4. Shell Model Description of $(d_{3/2})^n$ Nuclei - A.K. Niagam and P.C. Sood - A study of the low lying energy levels of nuclei with $(d_{3/2})^n$ configuration of n identical particles has been made taking two body interaction as the effective interaction between two nucleons in the seniority scheme. Using Racah-Talmi approach the matrix elements of this effective interaction in a particle configurations are expressed as linear combinations of matrix elements in two particle configuration. The interaction parameters are determined from $(d_{3/2})^3$ nuclei and the predicted spectra for $(d_{5/2})^3$ nuclei are compared with the available experimental data.

## G. BOSE INSTITUTE, CALCUTTA-9.

1.  **Analytical Formulation of K-Shell Photoeffect** - M. Biswas, New Alipore College, Calcutta-53, S.C. Roy and A.M. Ghose, Nuclear Physics Laboratory - Theoretical calculation of photoeffect is not available in analytic form and extraction of photoelectric cross-sections for specific element and gamma energy require formidable amount of computation time. To remove this difficulty an analytical formula for K-shell photoeffect was developed semi-empirically valid for any elements of the periiodic table for any energy above 200 keV. The results are in good agreement with the theoretical calculation of Schmickley and Pratt.

2.  **Angular Dependence of Pair annihilation Radiation** -M. Biswas, New Alipore College, Calcutta-53, S.C. Roy and A.M. Ghose - Contrary to the assumption of isotropic angular distribution of annihilated pair with respect to the direction of the incident gamma rays, certain angular variation of annihilation radiation is observed experimentally. This fact necessitates re-evaluation of pair production cross-section near threshold reported by previous workers. The measurement was carried out for lead using a special method of photopeak sharpending in ecintillation spectrometers developed in our laboratory[1]. The nature of the angular dependence of annihilation pairs will be presented.

1.  S.C. Roy, A. Chatterjee and A.M. Ghose-Nucl.Inst.& Methods, 67 (1969),319.

### H.   INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY

1.   **Compton Scattering By K-Shell Electrons at 1.12 MeV**[*] - P.N.
Baba Prasad and P.P. Kane - The differential cross section for
the compton scattering of 1.12 MeV gamma rays by the K-Shell
electrons of gold at a scattering angle of 120° was reported last
year.   Similar measurements were made with a tantalum scatterer.
Further measurements with thin Thorium, lead, gold and tin scatterers
have been performed at 60°, and with the thorium and gold scatterers
at 90°.   The dependence of the ratio $d\sigma_K/d\sigma_{KN}$ on the bias level
in the gamma channel has also been studied.   Measurements of these
cross sections have not been reported by other workers for gamma
energies in excess of 1.01 MeV.

I.  INDIAN INSTITUTE OF TECHNOLOGY,KANPUR-6.

1.  Neutron Distribution in Nuclei From Isobaric Analogue
States - M. Murthy - The displacement energies between isobaric
analogue states have been used to extract information about the
distribution of neutrons in nuclei.

In isobaric analogue states, one of the excess neutrons
in the parent state is converted into a proton nin the analogue
state.  Our method is based on the fact that the radial distribu-
tions of the neutron excess (in the parent state) and that of
the extra proton (in the analogue state) being identical, the
corresponding displacement energy is given by the interaction of
the proton (neutron excess) with the charge distribution of the
protons in the core.  Our calculations include the corrections
due to the exchange term, the electromagnetic spin-orbit term
and the charge dependence of the specifically nuclear forces.

2.  Systematic of Rotational Nuclei on the Basis of Two-Centre
Model - V.R. Irakash, B.M. Bahal and V.K. Deshpande - The
possibility of reproducing rotational levels of deformed even-even
nuclei on the basis of a two-centre model was oreviously investi-
gated[1].  In the present work, the quadrupole moment data has
been correlated with the moment of inertia on the basis of the
model.  The variation of the stiffness with neutron number and
proton number has been studied.  Fits are also obtained to the
lowest beta-vibrational levels.

1.  V.K. Deshpande, V.R. Prakash, B.M. Bahal,Prof.of the
    Nuclear Physics and Solid State Sympoeium, N90, (1969)

I.  **INDIAN INSTITUTE OF TECHNOLOGY, KANPUR-16.**

1.  **Neutron Distribution in Nuclei From Isobaric Analogue States** - M. Murthy - The displacement energies between isobaric analogue states have been used to extract information about the distribution of neutrons in nuclei.

In isobaric analogue states, one of the excess neutrons in the parent state is converted into a proton in the analogue state. Our method is based on the fact that the radial distributions of the neutron excess (in the parent state) and that of the extra proton (in the analogue state) being identical, the corresponding displacement energy is given by the interaction of the proton (neutron excess) with the charge distribution of the protons in the core. Our calculations include the corrections due to the exchange term, the electromagnetic spin-orbit term and the charge dependence of the specifically nuclear forces.

2.  **Systematic of Rotational Nuclei on the Basis of Two-Centre Model** - V.R. Irakash, B.M. Bahal and V.K. Deshpande - The possibility of reproducing rotational levels of deformed even-even nuclei on the basis of a two-centre model was previously investigated[1]. In the present work, the quadrupole moment data has been correlated with the moment of inertia on the basis of the model. The variation of the stiffness with neutron number and proton number has been studied. Fits are also obtained to the lowest beta-vibrational levels.

1. V.K. Deshpande, V.R. Prakash, B.M. Bahal, Proc. of the Nuclear Physics and Solid State Symposium, N90, (1969).

3.  <u>Ge(Li)-Ge(Li) Coincidence Studies in $^{147}$Pm</u> - R. Singh and G.K. Mehta - The decay scheme of $^{147}$Pm has been investigated with Ge(Li)-Ge(Li) fast slow coincidence measurements. Besides the well established levels at 91, 410.1, 489.9, 531 and 685.8 keV, levels at 182 and 319.5 keV have been confirmed from coincidence studies. Indications of levels at 275, 680 and 725 keV are found only from singles spectra. No evidences are found for the existence of the levels at 120.5, 211, 231, 398.2, 471, 552 and 763 keV which were proposed by Bashandy et al. (E. Bashandy et al. Zeits Fur Nat. <u>22A</u>, 154 (1967)).

4.  <u>On the Decay of $^{115m}$Cd</u> - S.N. Chaturvedi[+],C.Rangacharyulu[*], G.K. Mehta[*] and N. Nath[++], '+'B.H.U.,Varansi,'*' Indian Institute of Technology, Kanpur, '++' Kurukshetra University,Kurukshetra - The decay scheme of $^{115m}$Cd has been studied using a Ge(Li) detector and a NaI(Tl) sum coincidence spectrometer with fast-slow condition. We confirm the existence of levels at 336,650, 828,864,934,1078,1133,1290,1420 and 1450 KeV with an indication of a level at 970 KeV. In all twenty five transitions have been observed in the present study. The existence of 106 and 492 KeV gamma transitions between the 934 and 336 KeV states reported earlier[1] has been confirmed. In addition to the well established gamma transitions following new gamma components have been observed: 144, 214, 250, 320, 355, 462, 528, 592, 597 and 970 KeV. A decay scheme hasbbeen constrcuted with the help of these observations. Relative intensities of most of the gamma transitions have been determined and compared with the earlier reported values.

1.  G.E. Gordon et al P.R. <u>149</u>,(67)884

5. <u>Sum Coincidence studies on</u> $^{131}$Ba - C. Rangacharyulu and
G.K. Mehta - A study of the energies of gamma rays in the decay
of $^{131}$Ba was carried out. A Ge(Li) detector of depletion depth
7mm was used to assign the energies of gamma rays. A sum coin-
cidence spectrometer with slow-fast coincidence was employed to
study the different cascade modes of various levels in $^{131}$Cs.
In addition to the already well established levels, there is
evidence of a new level at 528 KeV and new gamma rays of energies
169, 312, 506 and 528 are observed. There is no evidence what-
soever for 323.9 KeV reported by Karlsson[1] and the existence of
82.4 and 137.2 KeV transitions is doubtful. A decay scheme is
constructed to fit in all the observed gamma rays.

1. K. Karlsoon Arkiv For Fysik <u>33</u>, 47(67).

## J.  INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR-2.

1.  Photodisintegration of the Alpha Particle - H. L. Yadav,
D. Mahanti and B.K. Srivastava - We use Sum rules of Levinger
and Bethe to calculate the Bremsstrahlung weighted cross-section
and the integrated cross-section for the photodisintegration
of the alpha particle.  In our calculation the alpha particle
is described by the Irving wave function whose parameters are
determined by variational calculation of the binding energy of
the alpha particle using the velocity dependent potential of
Nestor et al.  Our values agree reasonably well with experiments
and with those given by earlier calculations.

## K. OSMANIA UNIVERSITY, HYDERABAD-7.

1. **Compton Scattering By K-Shell Electrons at Large Scattering Angle** - V. Govinda Reddy, D.V. Krishna Reddy and D. S. R. Murty - The differential cross-section for the compton scattered gamma rays of energy 662 keV from a 6.0 curie source of Caesium-137 by the K-shell electrons of Plantinum, Bismuth and Thorium to the free electrons was experimentally studied at a scattering angle of 125°. The scattered energy spectrum was studied on a twenty channel analyser. NaI(Tl) scintillation spectrometers and fast-slow coincidence system have been used for the above studies. The effect of the target thickness on the differential cross-section ratio and energy spectrum has also been studied. The results have been compared with available theoretical results.

2. **Inelastic Scattering of Gamma Rays by K-Shell Electrons** - D.V. Krishna Reddy, E. Narasimhacharyulu and D.S.R. Murty - The differential cross-section $d\bar{\sigma}_K$ for the inelastically scattered gamma rays of energy 662 K-Shell electrons of platinum, Bismuth and Thorium was studied at 70° and 105° by experiment. The energy spectrum of the scattered gammas was also studied on a 20 channel analyser. The scattered gamma rays were selected in coincidence with the accompanying K X-rays from the scatterer using the NaI(Tl) scintillation detectors and fast-slow coincidence method. The differential cross-section $d\bar{\sigma}_K$ is compared with that of the Klein-Nishina cross-section $d\bar{\sigma}_F$ for free and stationary electrons. The experimental results are analyzed in the light of existing theories.

## L. PANJAB UNIVERSITY, CHANDIGARH

1. __Configuration Mixing vs Effective-Shell Model__ - Raj K. Gupta and R.K. Bansal - The ARNL group has reported that many nuclear properties, in addition to the energy spectra, are highly insensitive to the configuration mixing. This claim has not been found to be true in general and calculations using electron scattering probe, on the se called pseudo-nuclei having non-mixed parity states, in particular, have disputed this claim.

In the present study we investigate the problem of mixed confirugation v.s. effective shell model, for pseudo nuclei having mixed parity states.

2. __The Decay of $^{131}$I__ - K.K. Suri[*] and P.N. Trehan - The level structure of $^{131}$I has been investigated emplying scintillation spectrometers in $4\pi$ sum-peak coincidence and sum-coincidence modes. On the basis of these investigations, the existence of the weak gamma transitions of energy 318, 325, 358, 405 and 643 keV and a weakly populated level at 405 keV is verified. It has, however, not been possible to confirm the existence of 272 keV gamma ray as reported earlier. Further from the sum-coincidence spectrum with the gata set at 503 keV and the result of Graeffe et al., it is inferred that 503 keV gamma ray and 326-177 keV cascade arise in the decay of a level at 667 keV. The K-conversion coefficient for the 80 keV transition has been measured to be 1.31±0.08, which ahows the transition to be pure

[*] Department of Applied Sciences, Panjab Engineering College, Chandigarh.

M1 in cnaracter. Also on the basis of gamma gamma angular correlation measurements for the 284-80 keV cascade an assignment of character $1/2^+$ nas been confirmed for the level at 80 keV.


3.   The Decay of $^{160}$Tb to Levels in $^{160}$Dy - K.K. Suri[*] and P.N. Trehan - In the decay of $^{160}$Tb a level at 1538 keV and its decay modes have been established by fast-slow coincidence and sum-coincidence spectrum studies. Also from the coincidence data, the positions of weak gamma transitions of energy 1005, 1115 and 1251 keV have been verified. The directional correlation measurements on seven gamma ray cascades: 299-966, 299-879, 879-87, 962-87, 1178-87, 1272-87 and 216-962 keV have been performed. As a consequence of these measurements, spin-parity assignments $3^+$ and $2^-$ have been confirmed for the levels at 1049 and 1359 keV respectively and the multipole characters of the 299, 879, 962, 1178, 1272 and 216 keV gamma transitions determined.

[*] Department of Applied Sciences, Punjab Engineering College, Chandigarh.

## M.  SHIVAJI UNIVERSITY, KOLHAPUR

1.  The Binding Energy of $^{10}$B Nucleus - K.L. Narayana and
Shamrao B. Desai - A correlated nuclear wave function of the type

$$\Psi = \sum_i C_i \, \phi_i \, (1,2) \, [1 + P_{12}]$$

with the property of optimum convergency has been used to cal-
culate the ground state energy of Boron nucleus, with $P_{12}$ as the
space exchange operator of the two outermost nucleons, and in-
cluding the spin and isospin function based on a dual core model.
A $\delta$-force of strength about  -10 MeV to furnish the experimentally
observed binding energy of the boron nucleus indicates either a
predominantly 1p-character or a highly correlated motion of the
two nucleons.  An important result of the present calculations
is the predication of a low % analogous 1s-shell orbital for both
the cases in conformity with the studies on Quasi-free (p,2p)
reaction cross-sections.

## N. UNIVERSITY OF ROORKEE, ROORKEE.

1. The Dependence of Nuclear Matter Binding Energy of the High Energy Phase Shifts - M.K. Srivastava - The dependence of the binding energy per particle in nuclear matter on the phase shift, beyond 350 MeV laboratory energy, is investigated by using the reference spectrum method. Self-consistency with respect to the reference spectrum gap parameter and the effective mass for the occupied spectrum is achieved by interation. Second rank separable potentials are used. These have been obtained by solving the inverse scattering problem as suggested by Fiedeldey[1] It is found that the results are rather insensitive to the form of the phase shifts in the high energy region in agreement with the findings of Elliott et al[2].

References:

1. H. Fiedeldey, Nuc.Phys. A135(1969)353

2. J.P. Elliott, A.D. Jackson, H.A. Mavromatis, H.A. Sanderson and B. Singh, Nucl Phys.A121 (1968)241.

2. Triple Gamma Coincidence and Angular Correlation Studies in $Cd^{110}$ From the Decay of $Ag^{110m}$ - U.S. Pande and B.P. Singh - The gamma-gamma-gamma coincidence studies are done in $Cd^{110}$ from the decay of $Ag^{110m}$. The two triple gamma cascades thus studied are 1384 keV  884 keV-658 keV and 937 keV-884 keV-658 keV.

For the coincidence and also for angular correlation studies, three NaI(Tl) detectors have been used. The mounting of these detectors have been done in the two geometries (i) Putting all the three detectors in the plane of the table, equidistant

from the source. Two of them are fixed and one is movable.
(ii) Two detectors are in the plane of the table and one per-
pendicular to the plane of the table. All the three are equi-
distant from the source. Two detectors,one in the plane of the
table and other perpendicular to the plane of the table are
fixed and one in the plane of the table is movable.

The triple gamma angular correlation coefficients $A_2$ and
$A_4$ are given. The spin values for 2925 keV and 2479 keV levels
are discussed. The multipole mixture for 1384 keV gamma tran-
sition is given.

3.  Gamma-gamma-gamma Directional Angular Correlation Studies
in Dy$^{160}$ From the Decay of Tb$^{160}$ - U.S. Pande and B.P. Singh
- Triple gamma angular correlation studies are one in Dy$^{160}$
from the decay of Tb$^{160}$ using three NaI(Tl) detectors. For
these studies pulses from one of the detectors detecting 87 keV
in 2 volts channel width (2 volts-20 keV) and pulses from other
detector detecting high energy gamma rays using as integral
spectrum above 500 keV are fed to a double coincidence unit.
The output of this coincidence unit forms as gate for one of
the input of second coincidence unit and the pulses for the second
input of the second coincidence unit are taken from the third
detector which scans the spectrum in one volt channel width.
The triple gamma coincidence spectrum is given which predominently
gives 298 keV-879 keV-87 keV triple cascade. The triple gamma
angular correlation studies are made in two geometrical considerat-
ions of these three detectors (spectrometers). The angular
correlation coefficients are given. The multipole mixture for

879 keV gamma transition and spin of excited levels are considered.

4. <u>Beta-Gamma-Gamma Directional Correlation Studies in Ba$^{134}$ from the Decay of Cs$^{134}$ and Cd$^{110}$ from the Decay of Ag$^{110m}$</u>
- H.S. Dahiya and B.P. Singh - An experimental set up for the study of Beta-gamma-gamma directional correlation studies is described. The beta-gamma-gamma coincidence studies are done in Ba$^{134}$ from the decay of Cs$^{134}$ for the following (i) The beta group of 410 keV and gamma rays of 1038 keV and 605 keV (ii) The beta group of 660 keV and gamma rays of 796 keV and 605 keV. Beta-gamma-gamma coincidence studies are done in Cd$^{110}$ from the decay of Ag$^{110m}$ for the following: (i) Beta group of 87 keV and gamma rays of 1384 keV and 884 keV (ii) Beta group of 529 keV and gamma rays of 937 keV and 884 keV.

The angular correlation studies are done for these cascade. The angular correlation coefficients 'A$_2$' and 'A$_4$' for these cascades are given and the results are discussed.

## O. CALCUTTA UNIVERSITY

1. Internal Bremsstrahlung Spectrum From $^{32}$P - M. Nath,
S. Mitra, A.K. De, A.K. Das and P.C. Bhattacharya - An experi-
mental study of internal bremsstrahlung accompanying beta decay
of $^{32}$P has been carried out for the clarification of the con-
tradictions among the various experimental investigations.
Bremsstrahlung spectrum is measured by a sodium iodide scintilla-
tion spectrometer with a modified geometrical arrangement. The
experimental results in the energy region 60-1200 keV are com-
pared with the experimental results of other authors and with
theoretical calculations from KUB-Lewis and Ford-Nilsson theory.

## P. PANJABI UNIVERSITY, PATIALA

1. Internal Bremsstrahlung From $^{32}$P - M.S. Pawar and M.Singh
- The experimental results of earlier workers on the Internal
Bremsstrahlung energy spectrum and photon yield for $^{32}$P disagree
among themselves as also with the KUB theory corrected for Nuclear
Coulomb effects. A study of the energy spectrum and photon yield
due to internal bremsstrahlung from the allowed beta decay of $^{32}$P,
with different methods of measurements to investigate the reasons
for the disagreement of earlier measurements, is in progress.

2. Measurement of the (82L-212$\gamma$) Angular Correlation in $^{121}$Te
- Measurement of the angular correlation of 11/2 - 3/2 - 1/2 cascade
in $^{121}$Te has been performed with L-conversion electrons and $\gamma$ rays.
The measured value of the correlation $A_{22} = -0.020\pm0.03$ agrees
with the findings of Marelius et al[1] but differs very much from
the result $A_{22} = 0.007\pm0.007$ of Goldberg and Frankel[2] using a
thin lens beta spectrometer as a fixed detector for electrons and
a scintillation counter for the movable detector. The L-subshell
particle parameter for the 82 keV $M_4$ transition has been evaluated
and compared with the theory of Hager and Seltzer.

1. A. Marelius,H.Pettersson, S. Turnkvist,S.E. Hagglund and
   R. Dumitrescu, Arkiv fur Fysik, 37,435,(1968).

2 N. Goldberg and S. Frankel, Phys.Rev.100,1350,(1955).

Previous reports published by the Indian Nuclear Data Group (INDG) :-

1.  A.E.E.T./NP/10    Progress report on Nuclear
                      data activities in India-I        1964

2.  A.E.E.T. -227     Nuclear Data measuring
                      facilities in India               1965

3.  A.E.E.T. -228     Progress report on nuclear
                      data activities in India-II       1965

4.  A.E.E.T. -267     Progress report on nuclear
                      data activities in India-III      1966

5.  B.A.R.C. -305     Progress report on Nuclear
                      data activities in India-IV       1967

6.  B.A.R.C. -401     Progress report on Nuclear
                      data activities in India-V        1969

7.  B.A.R.C. -474     Progress report on Nuclear
                      data activities in India-VI       1970

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