

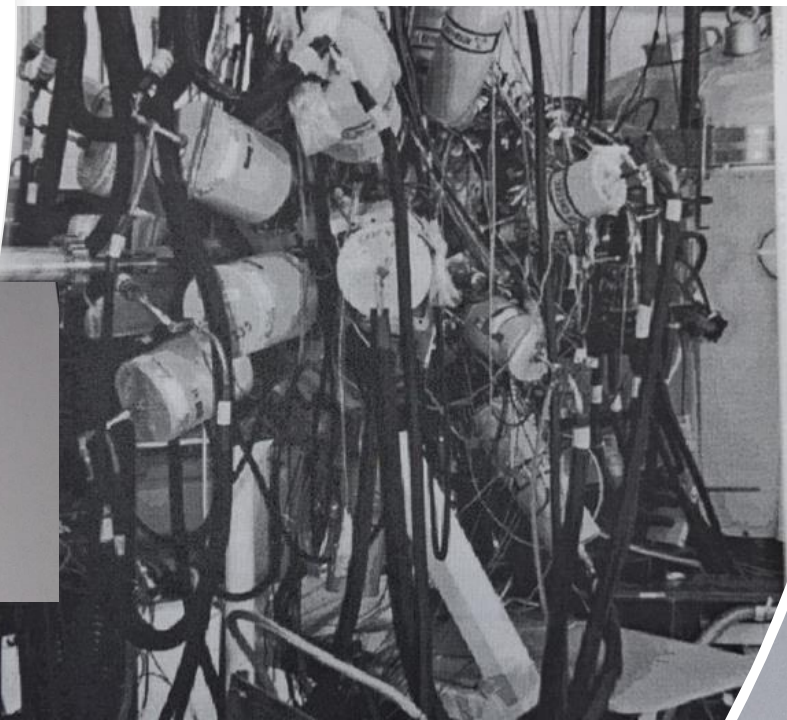
Exotic Nuclear Structure under the Microscope - Seeing 'AYEBALL to AYEBALL' with Robert

Paddy Regan

University of Surrey & National Physical Laboratory, UK

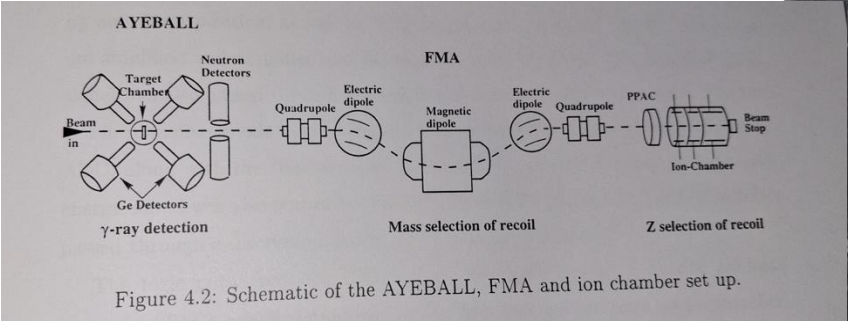
*Presented at: Nuclear Physics Over The Years: From the high spin era to rare isotopes,
CELEBRATING THE CAREER AND CONTRIBUTIONS OF ROBERT V. F. JANSSENS
University of North Carolina, Chapel Hill, 19-20 September 2025*

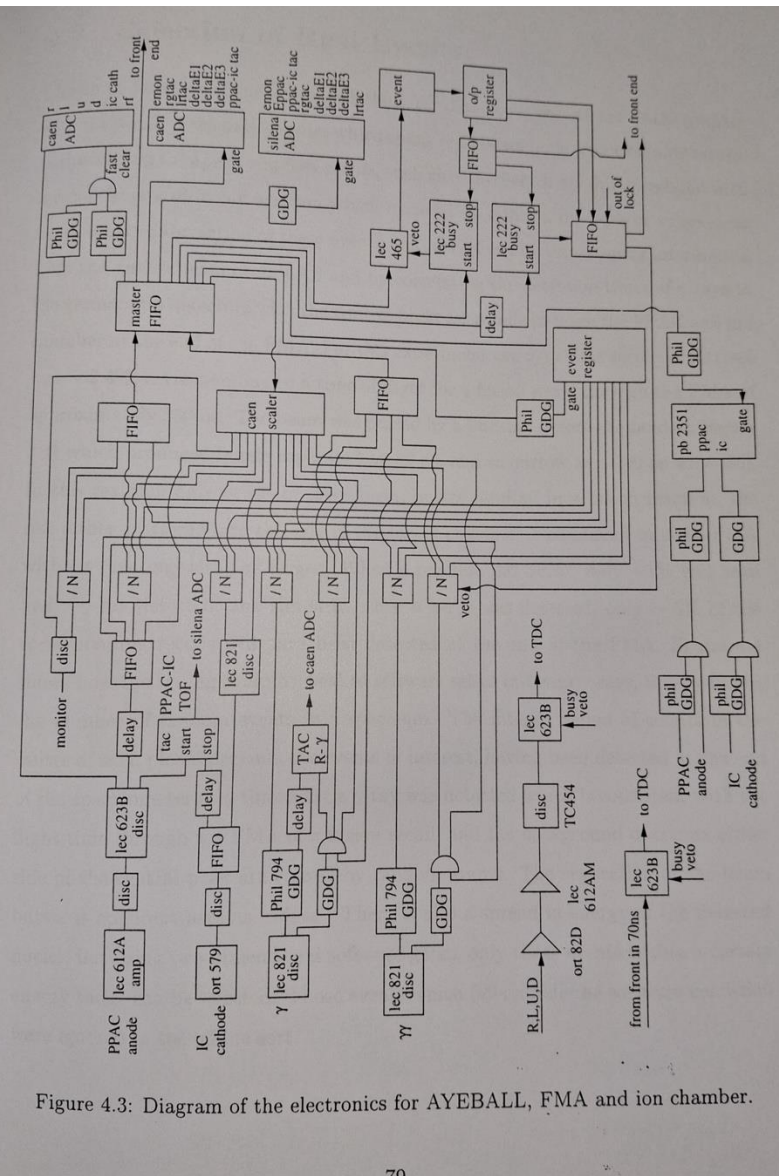
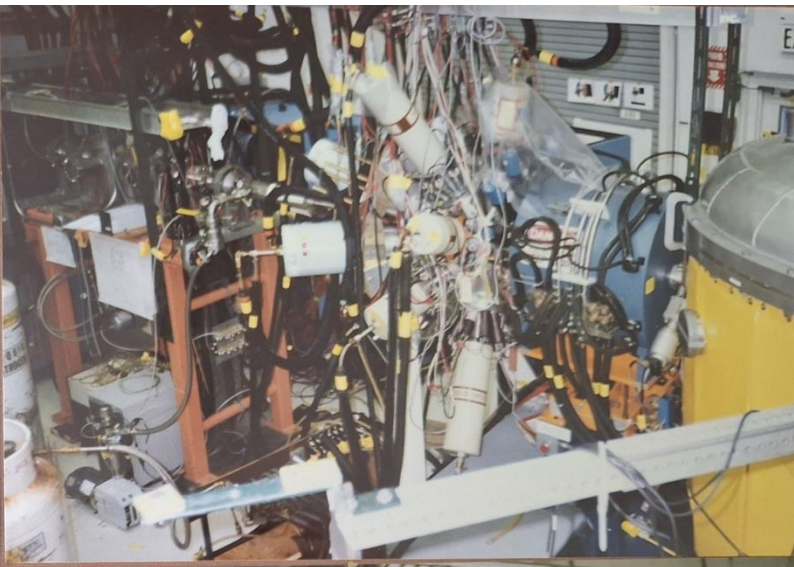
- Argonne – Yale – European Ball = **AYEBALL**.
- First set up over the summer of 1996 at ANL.
- **Represented first coupling of HPGe detectors at the target position used in conjunction with the FMA at ANL.**
- Precursor for GAMMASPHERE + FMA



Positions of the various germanium detectors in the AYEBALL array.

Ring	Type	θ	ϕ
1	EUROGAM	157.6	36
1	EUROGAM	157.6	108
1	EUROGAM	157.6	180
1	EUROGAM	157.6	252
1	EUROGAM	157.6	324
2	GAMMASPHERE	133.6	54
2	EUROGAM	133.6	90
2	EUROGAM	133.6	270
2	TESSA	133.6	306
3	YALE	101	36
3	TESSA	101	108
3	YALE	101	180
3	TESSA	101	252
3	TESSA	101	324
4	TESSA	79	0
4	TESSA	79	144
4	YALE	79	216
4	TESSA	79	288





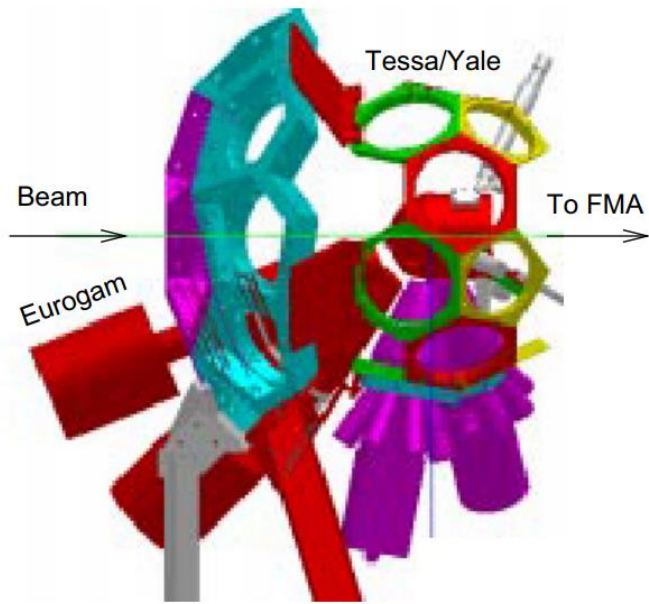


Fig. 2. Diagram of the support frame for AYE-Ball



1. Carpenter, M. P. "Study of nuclei far from stability with the AYE-Ball array." *Zeitschrift für Physik A Hadrons and nuclei* 358, no. 2 (1997): 261-265.
2. Taylor, R. B. E., S. J. Freeman, J. L. Durell, M. J. Leddy, A. G. Smith, D. J. Blumenthal, M. P. Carpenter et al. "γ decay from states at low excitation energy in the neutron-deficient isotope, Rn 200, identified by correlated radioactive decay." *Physical Review C* 54, no. 6 (1996): 2926.
3. Seweryniak, D., C. N. Davids, W. B. Walters, P. J. Woods, I. Ahmad, H. Amro, D. J. Blumenthal et al. "In-beam γ-ray spectroscopy of the proton emitter 69 147 Tm using recoil-decay tagging." *Physical Review C* 55, no. 5 (1997): R2137.
4. Carpenter, M. P., R. V. F. Janssens, H. Amro, D. J. Blumenthal, L. T. Brown, D. Seweryniak, P. J. Woods et al. "Excited States in 176, 178Hg and Shape Coexistence in Very Neutron-Deficient Hg Isotopes." *Physical review letters* 78, no. 19 (1997): 3650.
5. Vincent, S. M., P. H. Regan, D. D. Warner, R. A. Bark, D. Blumenthal, M. P. Carpenter, C. N. Davids et al. "Competing T= 0 and T= 1 structures in the N= Z nucleus 6231Ga." *Physics Letters B* 437, no. 3-4 (1998): 264-272.
6. Vincent, S. M., P. H. Regan, S. Mohammadi, D. Blumenthal, M. Carpenter, C. N. Davids, W. Gelletly et al. "Near yrast study of the fp shell nuclei 58 Ni, 61 Cu, and 61 Zn." *Physical Review C* 60, no. 6 (1999): 064308.

Four of the experiments performed with AYE-Ball were directed at the study of N=Z nuclei. Three were led by groups from Surrey and Daresbury utilizing the reactions: (a) $^{54}\text{Fe} + ^{36}\text{Ar}$ at 120 MeV; (b) $^{58}\text{Ni} + ^{36}\text{Ar}$ at 120 MeV; and (c) $^{40}\text{Ca} + ^{24}\text{Mg}$ at 65 MeV in order to identify for the first time excited states in the N=Z nuclei ^{88}Ru , ^{92}Pd and ^{62}Ga , respectively. The fourth experiment was led by C.J. Lister at Argonne and attempted to confirm and extend the level structure of ^{68}Se using the reaction $^{12}\text{C} + ^{58}\text{Ni}$ at 200 MeV. One other experiment on nuclei in this region was led by D. Seweryniak (ANL) and attempted to identify states in ^{103}Sn .

For all these experiments both the neutron detectors and ionization chamber were in place. The ionization chamber provided Z-identification to the mass identified ions. While the data from these experiments are still under analysis, an example of the Z-selectivity is given in Fig. 3 where it is shown that Z=30 (^{61}Zn) lines from the 2pn channel can be cleanly separated from the dominating 3p lines associated with ^{61}Cu in the A=61 gated spectrum.

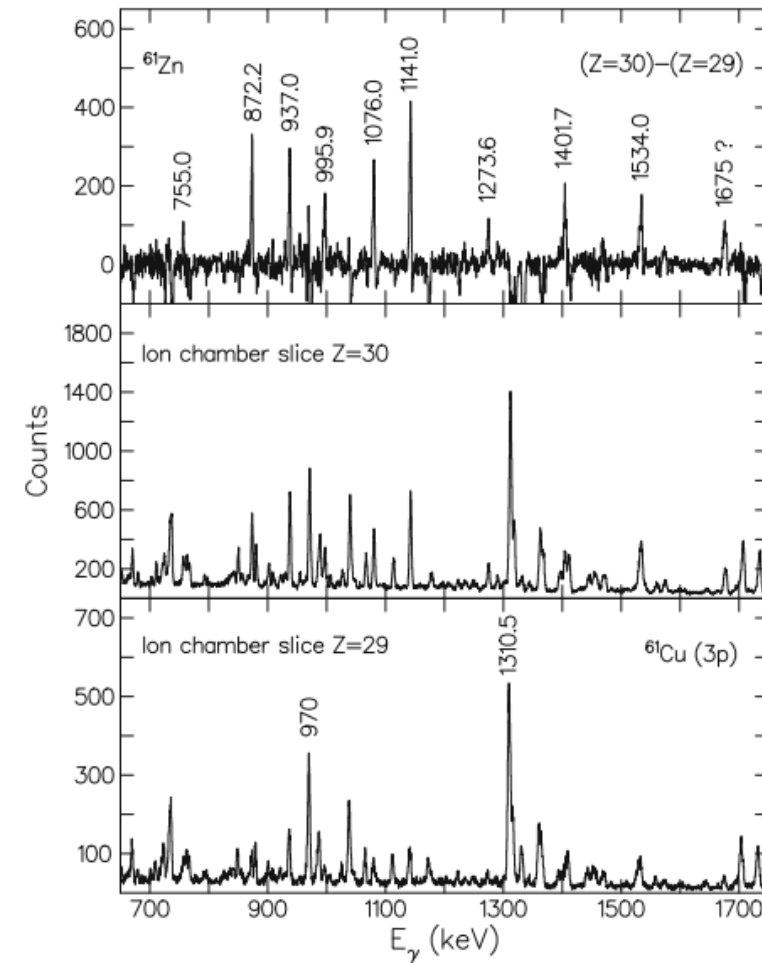


Fig. 3. Spectrum showing the Z discrimination from the ionization chamber for A=61 recoils in the $^{24}\text{Mg}+^{40}\text{Ca}$ experiment. The ^{61}Zn (2pn) lines can be cleanly separated from the dominant ^{61}Cu (3p) lines

Spectroscopy of $N \simeq Z$ Nuclei around $A=60$ Using AYEBALL and PEX.

By

S.M. Vincent

Supervisors

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Prof. W. Gelletly.

A PhD Thesis submitted to the School of Physical Sciences,
University of Surrey, Guildford, GU2 5XH, UK.

Department of Physics

July 31, 1998

Acknowledgements

This thesis has only been made possible thanks to the EXCELLENT supervision of Dr. Paddy Regan and Prof. Bill Gelletly. Paddy has been a great supervisor, a collaborator and a mentor. Bill has been an inspiration ever since my undergraduate course, and is really the reason I started this PhD. My unofficial supervisor Prof. Dave Warner at Daresbury has also been a great influence and tutor, being able to teach me the finer points of $n - p$ pairing is no mean feat.

I would also like to thank Kim Lister at the Argonne National Laboratory, Chicago, for his time and guidance during my two month visit in 1997. Also Jazmin Schwartz, Cary Davids, Darek Seweryniak, Robert Janssens and Dale Henderson at Argonne, and Ani Aprahamian at Notre Dame University, Indiana for inviting me to present a seminar. Chris O'Leary at Staffordshire and Chris Pearson at Surrey for helping me stumble my way through MIDAS-session and 'Janet-sort'. Mike Bently, John Simpson, Alison Bruce, Dave, Paddy, Luke and Chris for making the experiments such a success as well as great fun! Also, the experimental successes were in no small part due to the excellent in-house expertise of all the people at the Argonne National Laboratory, the Niels Bohr Institute Tandem Accelerator Laboratory, Copenhagen, and the Oak Ridge Laboratory, Tennessee. I want to thank all the members of the group at Surrey for making my three years not seem like a sentence, and everyone I have worked with, at the summer school or on experiment. Also my great mates outside the field who keep me from turning into a physicist.

I owe a great deal to the EPSRC for funding my PhD, and for the opportunity to be involved in numerous experiments, despite the need for overseas travel. Also, The

Studies of $N \sim Z \sim 28$ Nuclei with Stable and Radioactive Heavy Ion Beams

By

Saeed Mohammadi

A thesis submitted to the Faculty of Science of
the University of Surrey for the degree of
Doctor of Philosophy

Department of Physics

January, 1997

**2 U. Surrey PhD theses based on AYEBALL experiments / campaign, focussed on
1) fpq SM above ^{56}Ni (^{58}Ni , ^{61}Zn , ^{61}Cu) and 2) $T=0,1$ Pairing competition in $N=Z=31$ ^{62}Ga**

FIG. 10. Partial decay scheme for ^{61}Cu deduced in the present work.

Near yrast study of the *fpg* shell nuclei ^{58}Ni , ^{61}Cu , and ^{61}Zn

S. M. Vincent,^{1,*} P. H. Regan,¹ S. Mohammadi,^{1,†} D. Blumenthal,² M. Carpenter,² C. N. Davids,² W. Gelletly,¹
S. Ghugre,³ D. J. Henderson,² R. V. F. Janssens,² M. Hjorth-Jensen,⁴ B. Kharraja,⁵ C. J. Lister,² C. J. Pearson,¹
D. Seweryniak,² J. Schwartz,^{2,6} J. Simpson,⁷ and D. D. Warner⁷

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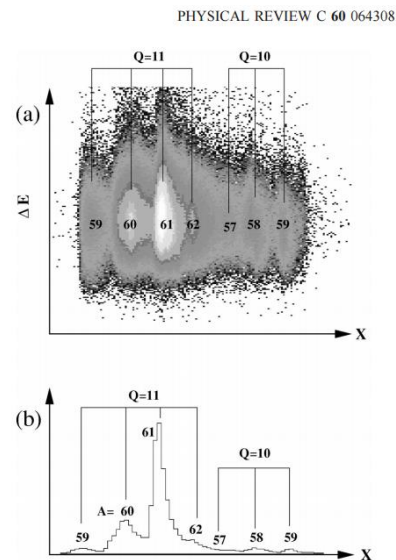


FIG. 1. (a) Recoil position X at the PGAC versus deposited energy; (b) projection on the X axis, showing the dispersion in the PGAC X direction of recoils in A/Q state ratio.

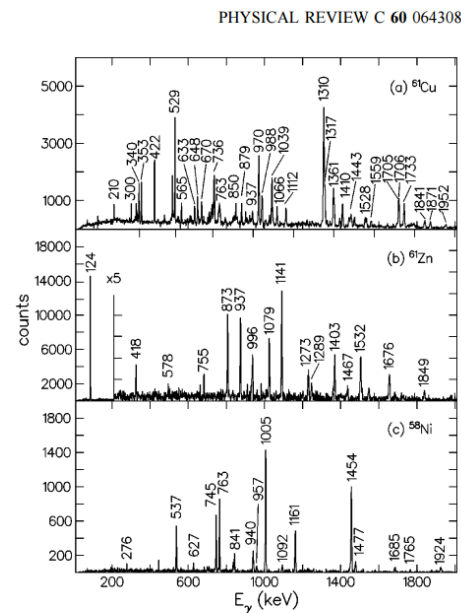


FIG. 5. Isotopically pure identification spectra for (a) ^{61}Cu , (b) ^{61}Zn , and (c) ^{58}Ni .

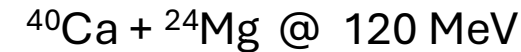
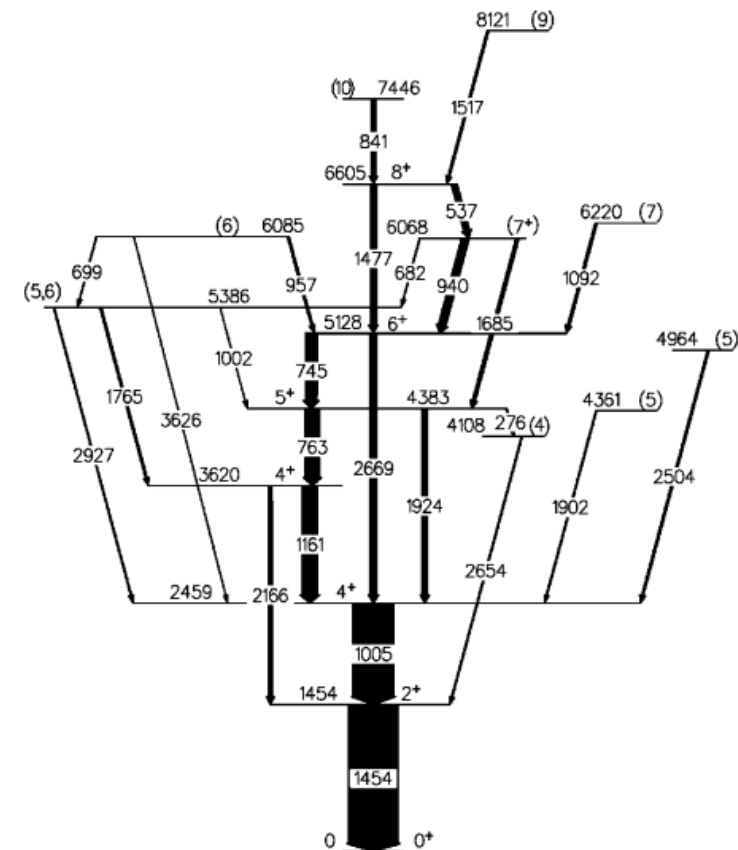
NEAR YRAST STUDY OF THE fpg SHELL NUCLEI . . .

FIG. 12. Partial decay scheme for ^{58}Ni deduced in this work.

Near yrast study of the *fpg* shell nuclei ^{58}Ni , ^{61}Cu , and ^{61}Zn

S. M. Vincent,^{1,*} P. H. Regan,¹ S. Mohammadi,^{1,†} D. Blumenthal,² M. Carpenter,² C. N. Davids,² W. Gelletly,¹
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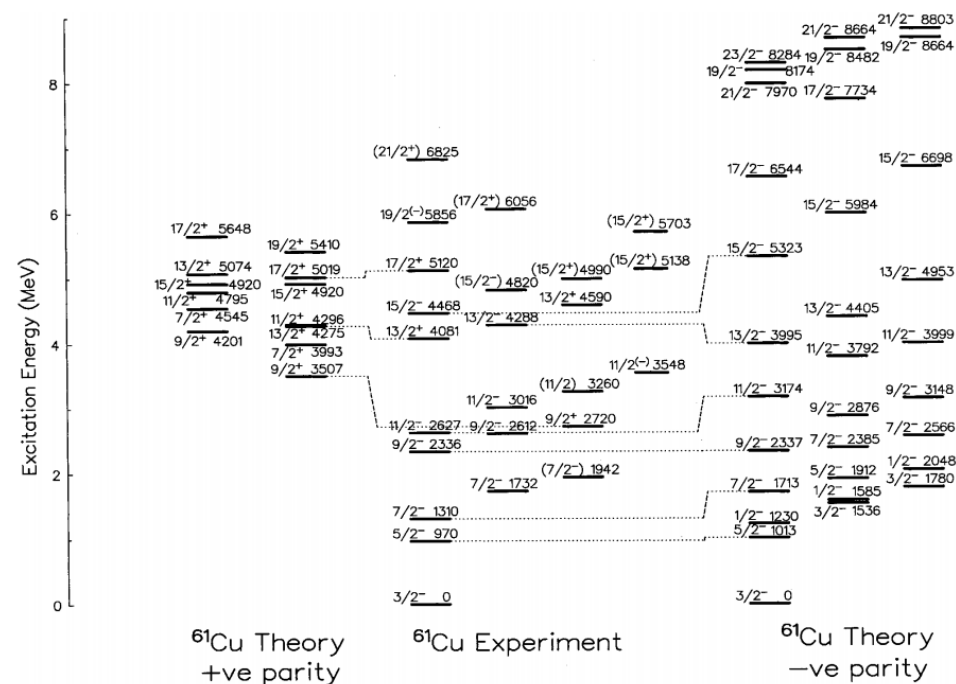


FIG. 13. Comparison of experimental data and *fpg*-shell theoretical calculations for ^{61}Cu . The highly nonyrast calculated levels are not shown.

NEAR YRAST STUDY OF THE *fpg* SHELL NUCLEI ...

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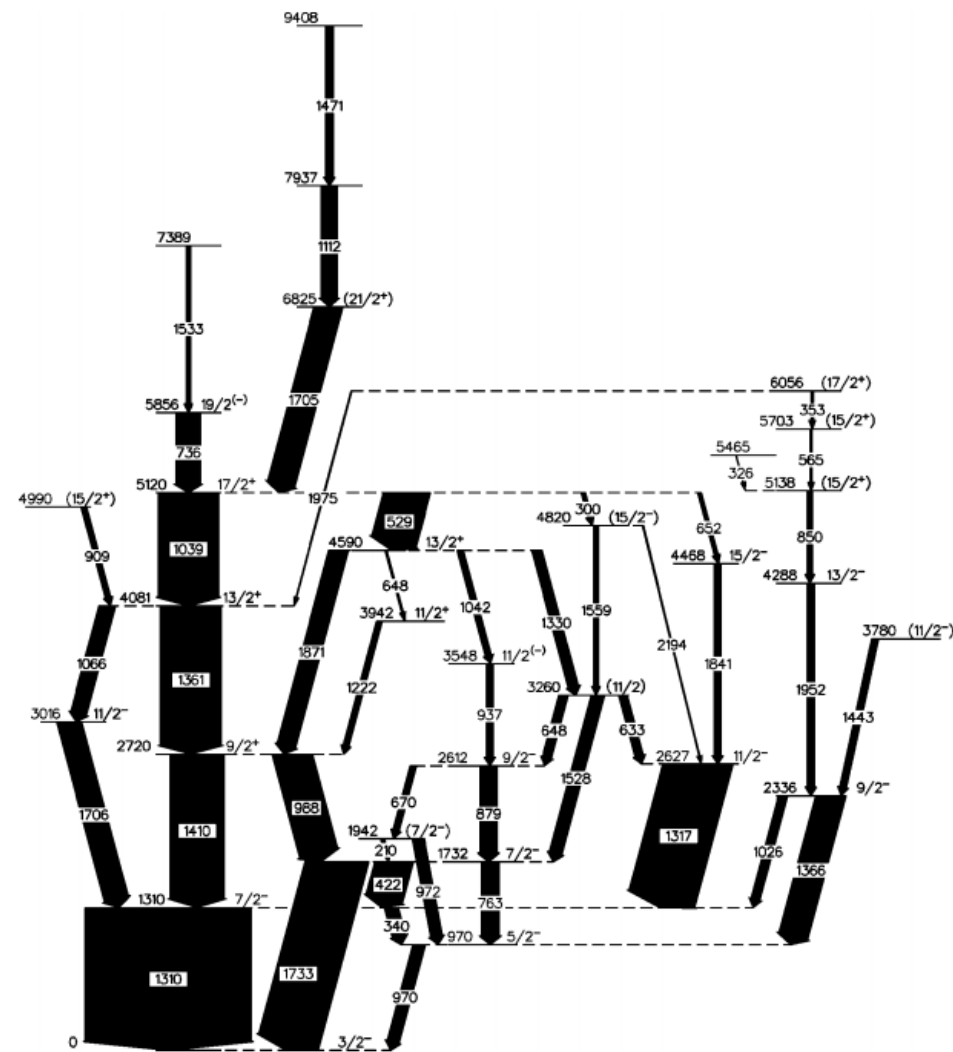


FIG. 10. Partial decay scheme for ^{61}Cu deduced in the present work.

Discrete line spectroscopy of $^{62}_{31}\text{Ga}$ with AYEBALL

S M Vincent†, P H Regan†, D Blumenthal‡, M Carpenter‡, C N Davids‡, W Gelletly†, R V F Janssens‡, C J Lister‡, D Seweryniak‡, J Schwartz‡, J Simpson§ and D D Warner§

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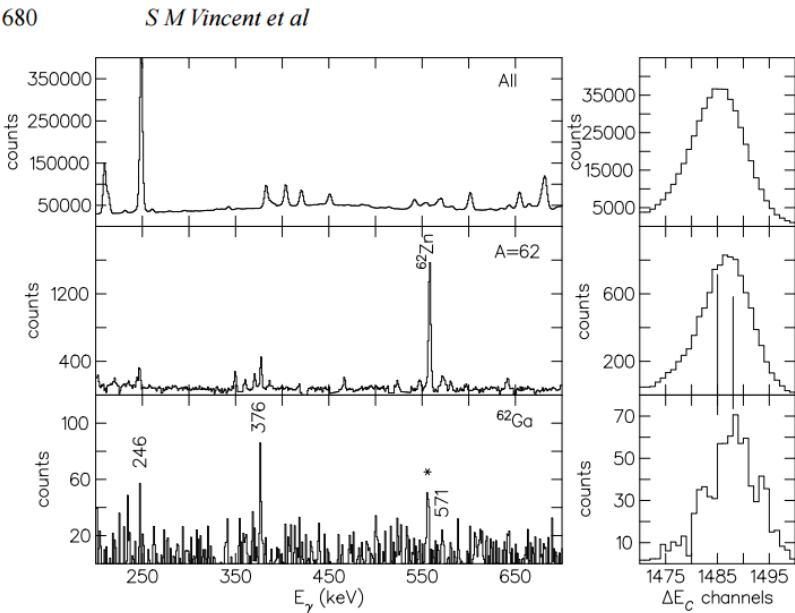


Figure 1. γ -ray identification spectra and their associated ion chamber energy loss signals for the thin target AYEBALL data.

$^{40}\text{Ca} + ^{24}\text{Mg}$ @ 120 MeV $\rightarrow$ pn channel to $N=Z=31$ ^{62}Ga

Discrete line spectroscopy of $^{62}_{31}\text{Ga}$ with AYEBALL

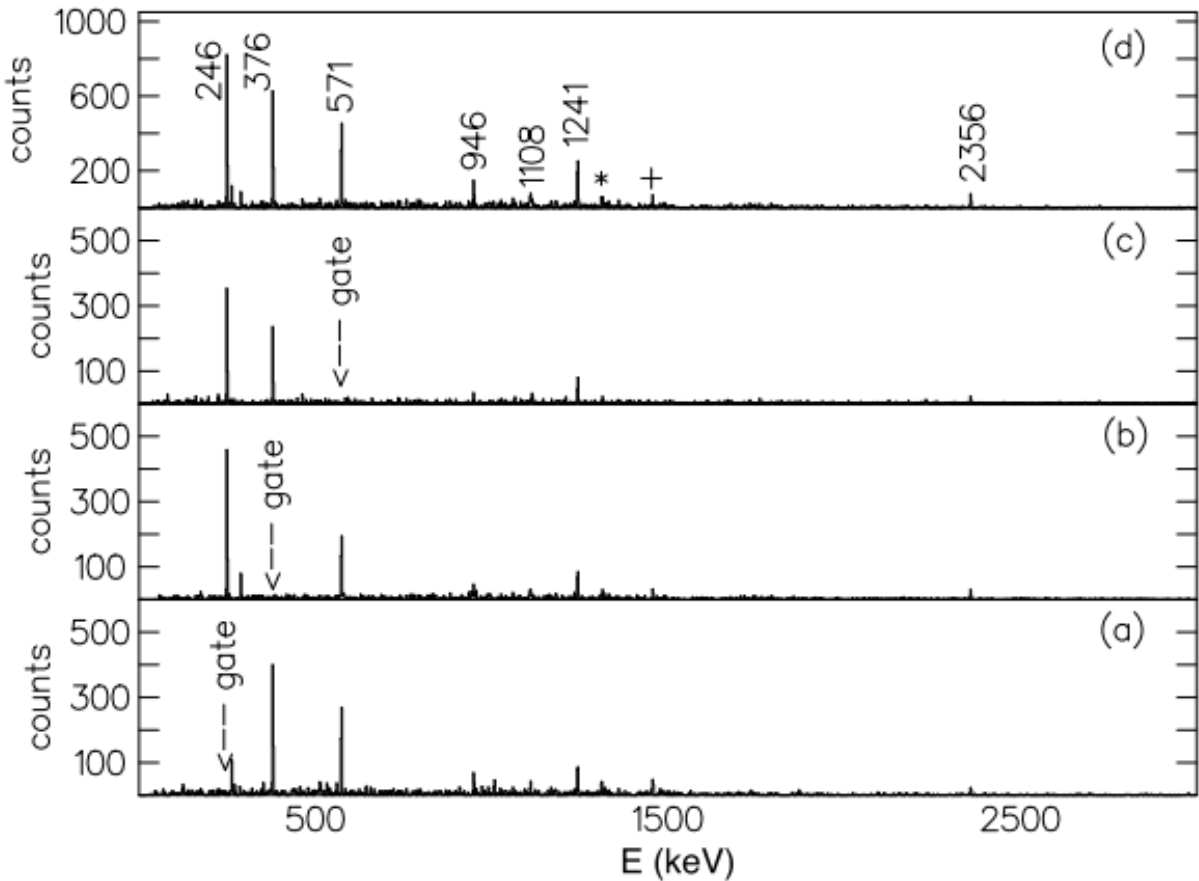


Figure 2. γ - γ coincidence gates for transitions identified in ^{62}Ga . (a) 246 keV gate; (b) 376 keV gate; (c) 571 keV gate; (d) sum of these three gates. These data are from the backed target experiment. Contaminant lines from ^{61}Cu (*) and ^{58}Ni (+) are also weakly evident.

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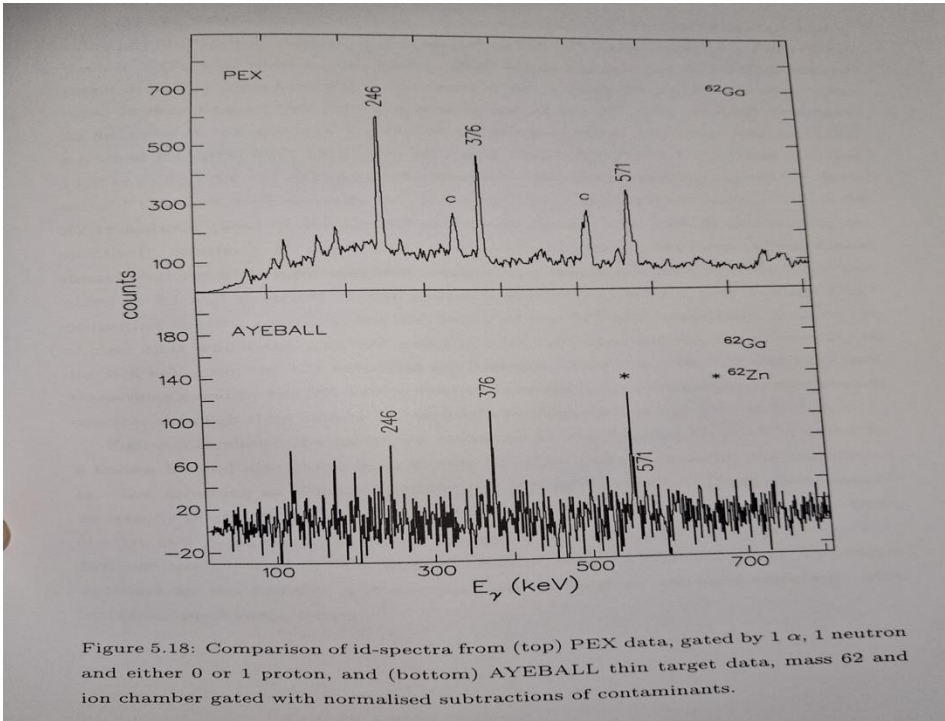


Figure 5.18: Comparison of id-spectra from (top) PEX data, gated by 1 α , 1 neutron and either 0 or 1 proton, and (bottom) AYEBALL thin target data, mass 62 and ion chamber gated with normalised subtractions of contaminants.

Discrete line spectroscopy of $^{62}_{31}\text{Ga}$ with AYEBALL

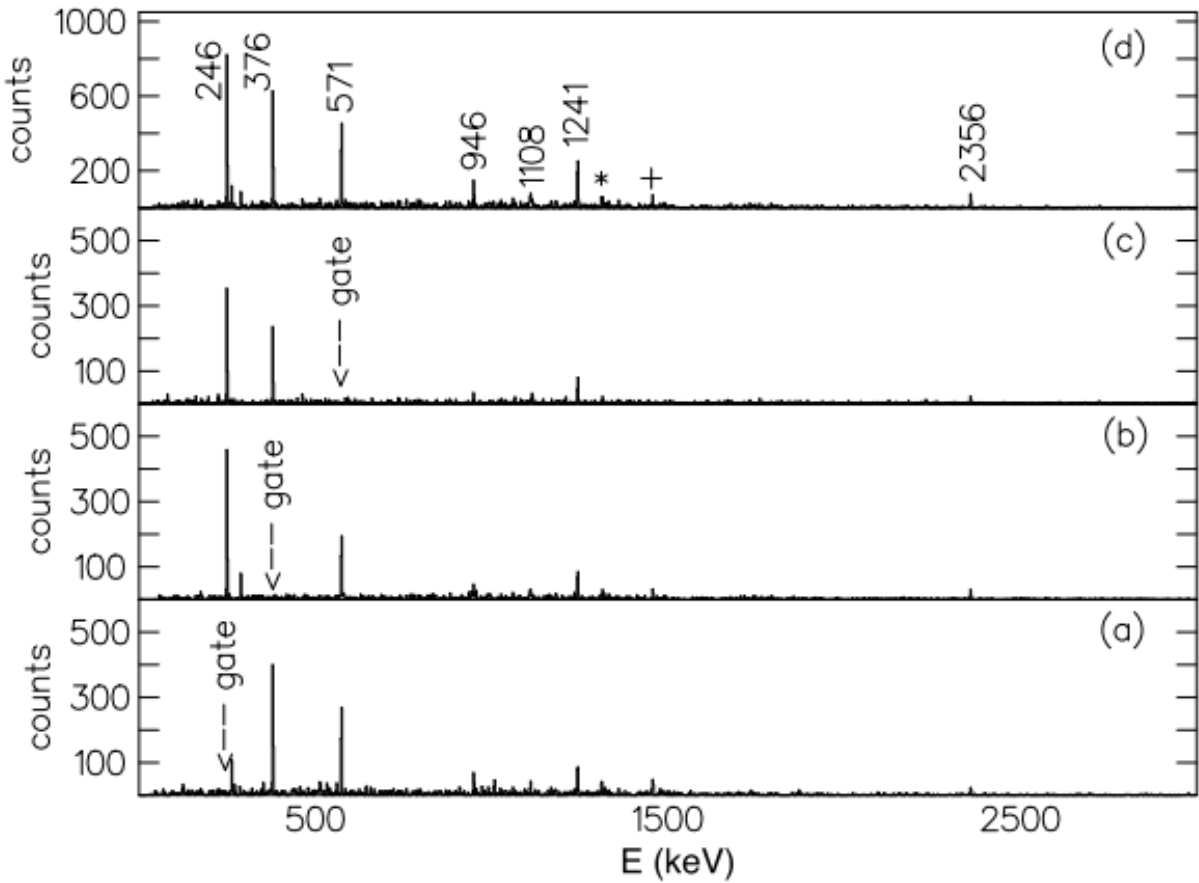


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Competing $T = 0$ and $T = 1$ structures in the $N = Z$ nucleus ^{62}Ga

S.M. Vincent ^a, P.H. Regan ^a, D.D. Warner ^b, R.A. Bark ^{c,1}, D. Blumenthal ^d,
M.P. Carpenter ^d, C.N. Davids ^d, W. Gelletly ^a, R.V.F. Janssens ^d, C.D. O’Leary ^e,
C.J. Lister ^d, J. Simpson ^b, D. Seweryniak ^d, T. Saitoh ^e, J. Schwartz ^{d,f},
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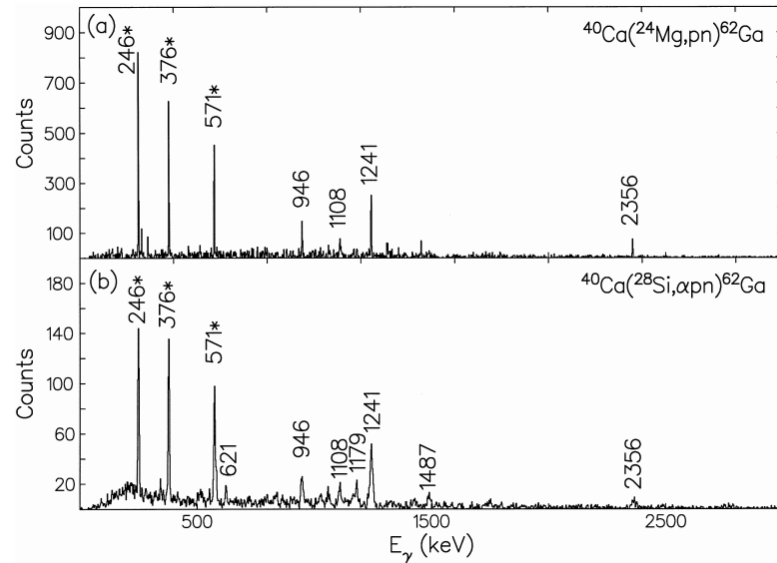


Fig. 2. Transitions in coincidence with the 246, 376 and 571 keV γ rays in ^{62}Ga (marked *) from (a) the AYEBALL gold-backed target data and (b) the α pn-gated PEX data.

$^{40}\text{Ca} + ^{24}\text{Mg}$ @ 120 MeV $\rightarrow$ pn channel to $N=Z=31$ ^{62}Ga

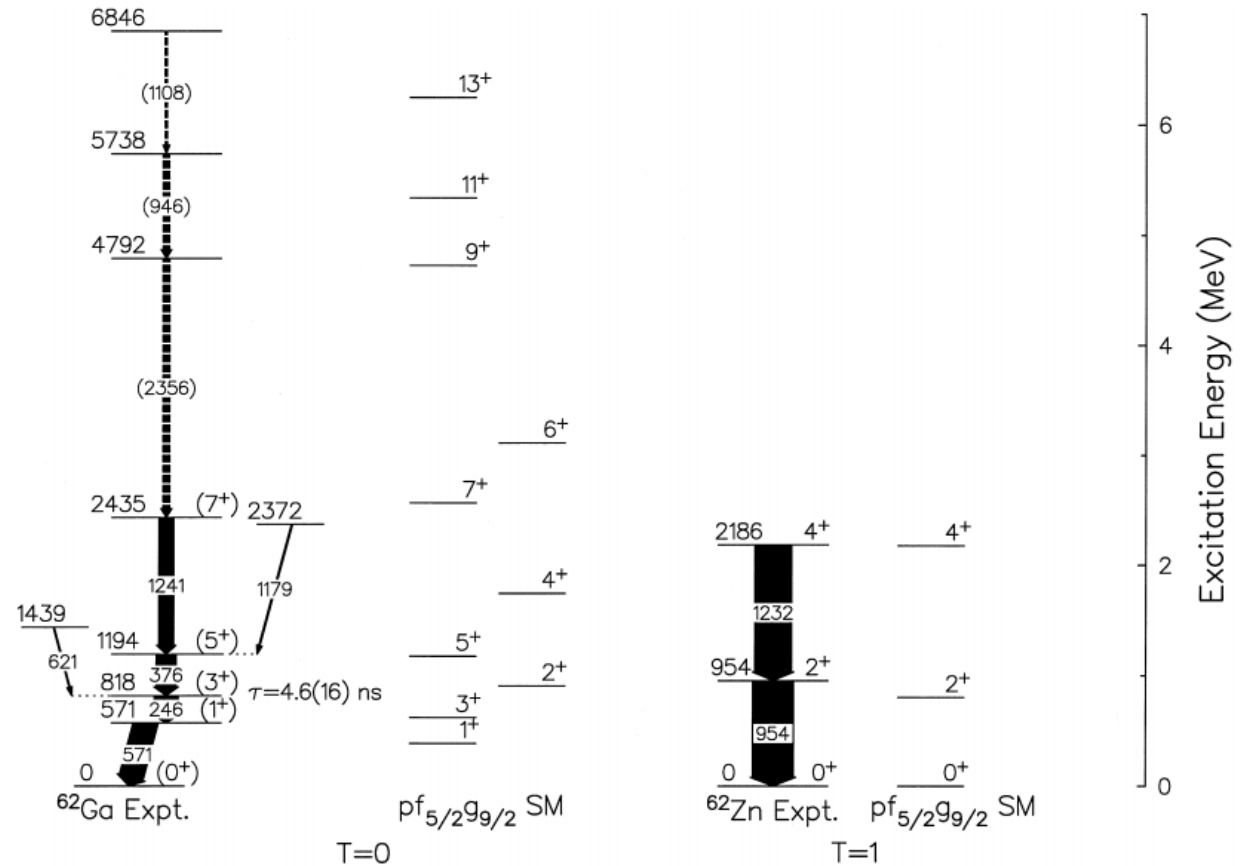


Fig. 3. Decay scheme derived for ^{62}Ga compared to the predictions of the $pf_{5/2}g_{9/2}$ basis shell model. $T = 0$ states are shown on the left, and $T = 1$ states are on the right. The low lying levels in the $T_z = 1$ isobar, ^{62}Zn are included for comparison. Tentative experimental assignments are denoted by dashed lines and parentheses.

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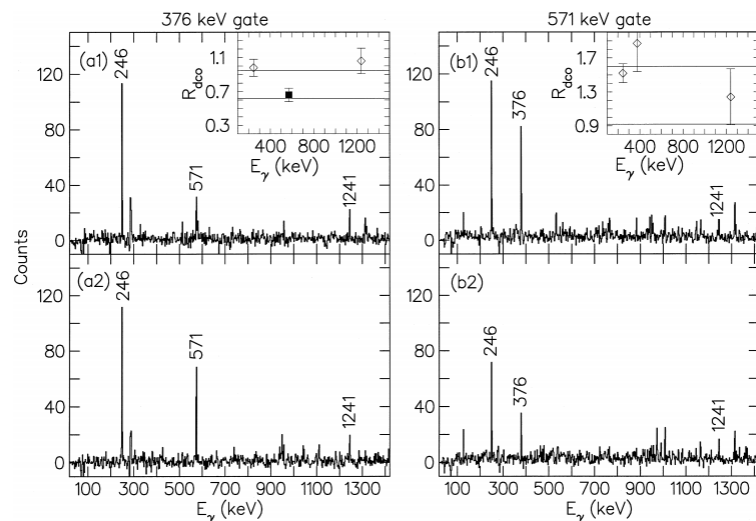


Fig. 5. DCO projections from the gold-backed target AYEBALL data, efficiency corrected for gate and projection energy. Projected from the $A = 62$ gated DCO matrix, gated by: (a) the 376 keV transition and (b) the 571 keV transition. (1) gated at $79^\circ + 101^\circ + 134^\circ$, and projected onto the 158° axis; (2) gated at 158° , and projected onto the $79^\circ + 101^\circ + 134^\circ$ axis. The insets show the DCO values of the projected transitions in the 376 keV and the 571 keV gate, with weighted averages of transitions of known multipolarity indicated as lines (see text). Open diamonds are assigned as quadrupoles, the filled square is assigned as a dipole. This data is tabulated in Table 1.

$^{40}\text{Ca} + ^{24}\text{Mg}$ @ 120 MeV $\rightarrow$ pn channel to $N=Z=31$ ^{62}Ga

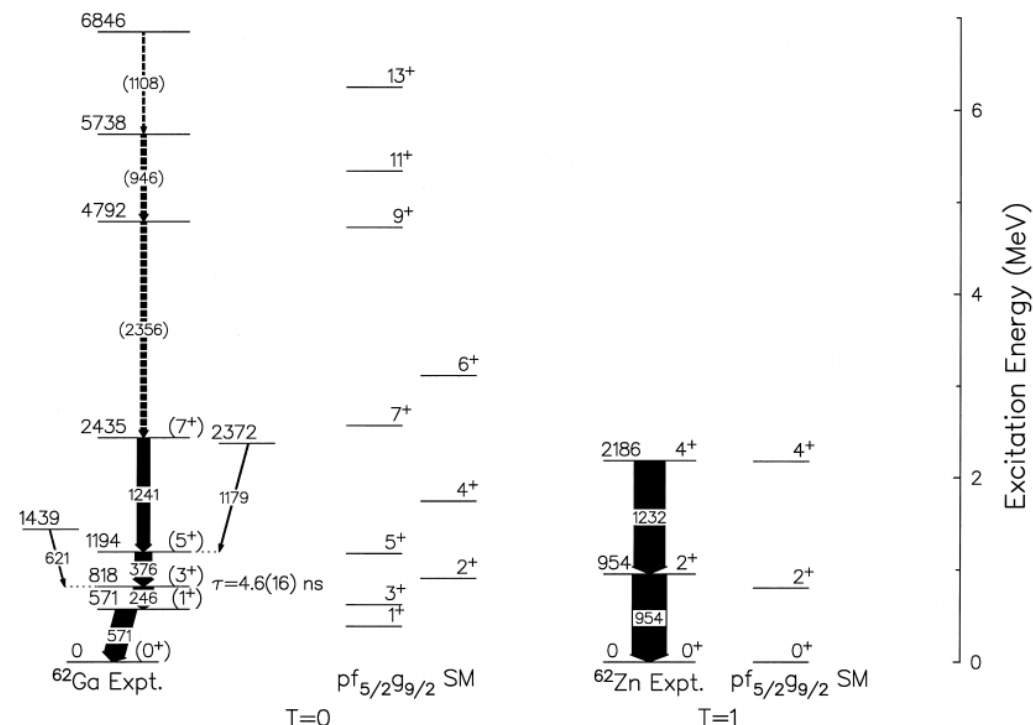


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Discrete line spectroscopy of $^{62}_{31}\text{Ga}$ with AYEBALL

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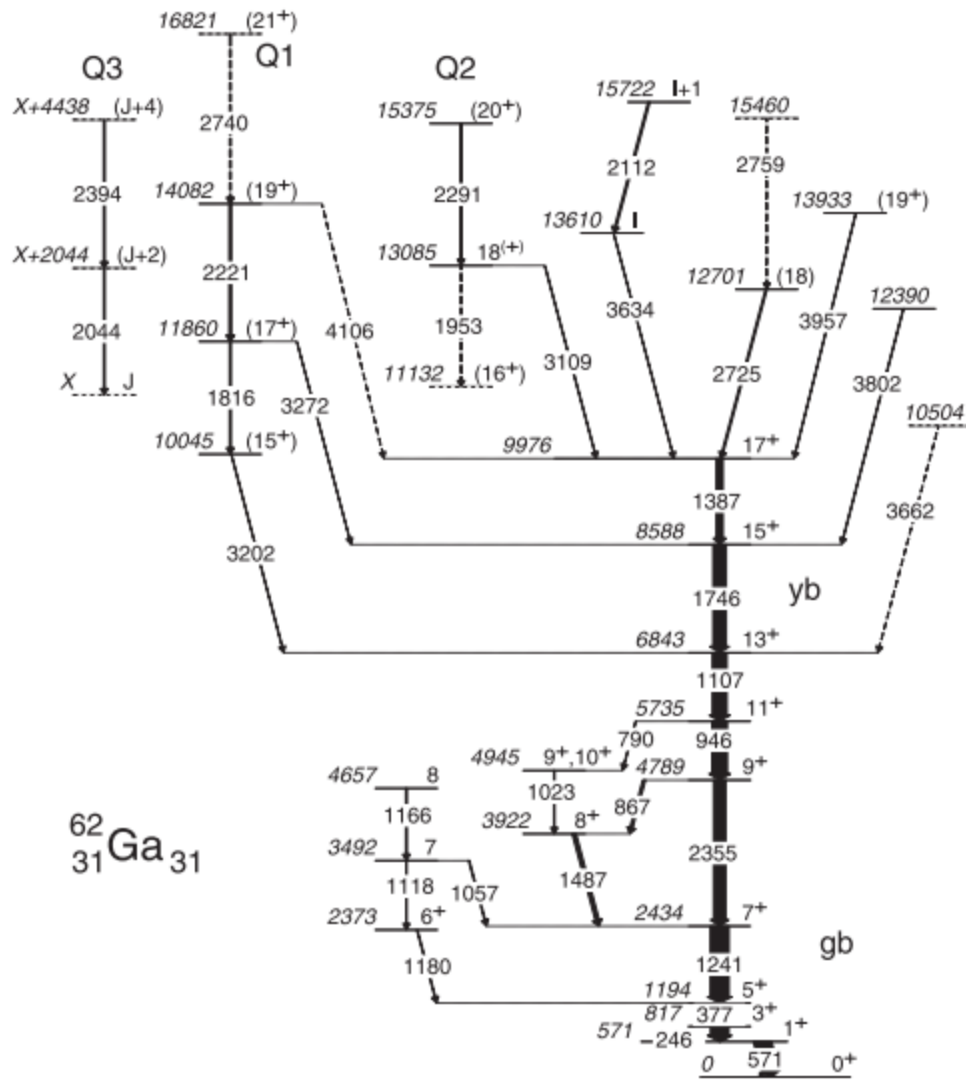


FIG. 1. Proposed level scheme of ^{62}Ga from the present study. Energy labels are in keV. Tentative transitions and levels are dashed. The widths of the arrows correspond to the relative intensities of the γ rays. In the figure, $X = 11$ MeV.

Onset of high-spin rotational bands in the $N = Z$ nucleus ^{62}Ga

D. Rudolph^{1,*}, I. Ragnarsson², S. Åberg¹, C. Andreoiu^{1,2}, M. P. Carpenter³, R. M. Clark⁴, J. Ekman^{1,5}, C. Fahlander¹, R. V. F. Janssens^{3,6}, F. G. Kondev³, T. Lauritsen³, D. G. Sarantites⁷, D. Seweryniak³, and C. E. Svensson⁸

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The fusion-evaporation reaction $^{28}\text{Si} + ^{40}\text{Ca}$ at 122 MeV beam energy was used to populate high-spin states in the odd-odd $N = Z$ nucleus ^{62}Ga . With the combination of the Gammasphere spectrometer and the Microball CsI(Tl) charged-particle detector array the decay scheme of ^{62}Ga was extended beyond 10 MeV excitation energy. The onset of band structures was observed. These high-spin rotational states are interpreted and classified by means of cranked Nilsson-Strutinsky calculations.

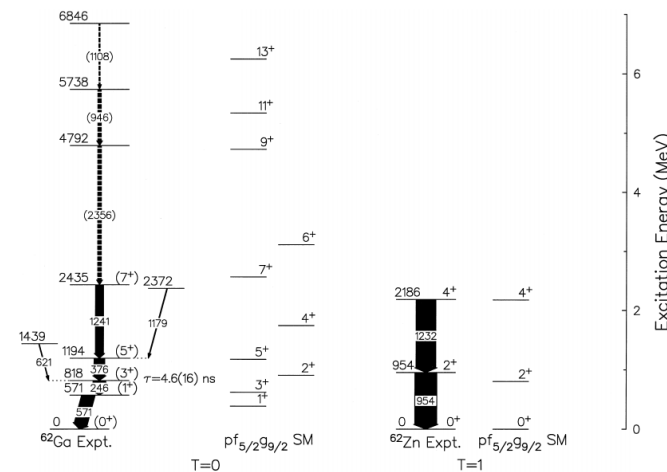


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School cum Workshop on Nuclear Yrast and Near-Yrast Spectroscopy

October 26-30, 2009 at IIT, Roorkee

jointly organized by the

Department of Physics, Indian Institute of Technology, Roorkee &
UGC-DAE Consortium for Scientific Research, Kolkata Centre



The rapidly rotating atomic nucleus provides a unique laboratory to investigate the two extreme modes of excitations, viz. the single-particle and the collective, which manifest in the observed yrast and near yrast gamma-ray spectrum. In the Indian context, research in experimental in-beam gamma ray spectroscopy has been rejuvenated with the successful operation of the Indian National Gamma Array (INGA) facility, a national collaboration between the Universities and the Research Institutes and funded in part by the DST, India. As a result many young research scholars in the country have been attracted to this field of nuclear structure with a large number of research groups successfully exploiting the research potential offered by the facility.

School October 26 - 28, 2009

Besides advanced instrumentation involving accelerators, detector systems and targets, studies in the field of nuclear high spin states incur a good amount of number crunching and computational efforts of various kinds. Simulations of gamma-ray detectors, escape suppression, detector-arrays, advanced pulse processing, data acquisition and data analysis etc. demand high speed digital processing. Large scale computations are needed for understanding the underlying nuclear dynamics through detailed microscopic calculations which are critical for the interpretation of data and for guiding new directions of research. The school will comprise of series of lectures by practicing physicists on these topics. Besides, school will provide actual hands-on experience in using the associated computer codes.

Research scholars and young faculty members from universities/ colleges and institutes may apply (through email or on plain paper) giving the name, address, fax, telephone/mobile phone number along with a brief bio-data. Applications for the school should be sent as soon as possible (not later than Sept 21, 2009). Limited support towards travel and local hospitality is available to the participants.

Workshop October 29 - 30, 2009

The workshop will follow the school and will be held during the period Oct 29-30, 2009. It will consist of presentations in the form of invited talks and contributed posters/talks in the field of nuclear yrast and near-yrast spectroscopy. Contributions may also be sent towards novel physics ideas feasible with a next generation INGA set up. A two page writeup of your contribution may be sent by Sept 21, 2009 through e-mail or post.

The school program will consist of nearly 24 hours of lectures/ demonstrations on the Experimental techniques (gamma arrays, channel selection, lifetime measurements), Gamma Emission (transition probabilities, angular correlation, polarisation, spin parity assignment, isomers), nuclear models (shell model, deformed shell model, geometrical models), computer codes (RADWARE, NuShell, LISE++).

The list of proposed/confirmed speakers for the school and workshop include RK Bhowmik, SK Basu, K Kar, S Pal, SC Pancholi, AK Jain, R Janssens, P Walker, P Regan, Y Sun, U Garg, A Macchiavelli, S Muralithar, N Madhavan, RP Singh, M SahaSarkar, R Sahu, R Palit, D Mehta, Suresh Kumar, SS Ghugre, AK Sinha, A Goswami, Sharmishtha Bhattacharya, P Arumugam, DC Biswas...

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School cum Workshop on Nuclear Yrast and Near-Yrast Spectroscopy

October 26-30, 2009 at IIT, Roorkee
jointly organized by Department of Physics, IIT, Roorkee & UGC-DAE CSR, Kolkata Centre

Programme: October 26, 2009

0900-0930	REGISTRATION
0930-1005	INAUGURATION
1005-1100	Plenary talk: “Experimental techniques for yrast and near yrast spectroscopy” – S K Basu (formerly VECC)
1100-1130	HIGH TEA
1130-1230	“Modern gamma arrays and coincidence spectroscopy” – S Muralithar , IUAC, N Delhi
1230-1330	“Nuclear models: many facets of the atomic nucleus” – S Pal , VECC, Kolkata
1330-1430	LUNCH
1430-1530	“Spectroscopy techniques for the study of neutron-rich nuclei” – R Janssens , ANL, USA
1530-1630	“Triaxial strong deformation” – S C Pancholi , Delhi Univ.
1630-1700	TEA
1800-1830	REFRESHMENTS
1830-2000	Kathakali, the ancient sign language of India , Multipurpose Hall, DOMS
2000-2100	DINNER
2100-2200	Lecture with hands on practice: “Data analysis” – A Chatterjee , NPD, BARC

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Programme: October 28, 2009

9000-1000	“Lifetime Studies” – A K Sinha , UDCSR, Kolkata
1000-1100	“Isomeric decay physics : near spherical nuclei” – P Regan , Surrey Univ.
1100-1130	TEA
1130-1230	“Isomeric decay physics : deformed nuclei” – P Walker , Surrey Univ.
1230-1330	“Modern Shell Model” – VKB Kota , PRL, Ahmedabad
1330-1430	LUNCH
1430-1530	“Gamma Spectroscopy of fast moving exotic nuclei” – S K Mandal , Delhi Univ.
1530-1830	“Discussions with students” – U Garg , Notre Dame Univ. , P Regan , Surrey Univ (Bose Block, 1530 -)
1630-1700	INGA – PICC Meeting, (Committee Room, II Floor, Physics Dept)
1800-1830	TEA
1830-1930	REFRESHMENTS
1930-2030	Pre Dinner Talk : Choosing an idea : Devising the experiment” – A Roy , IUAC, N Delhi
2030-2200	DINNER
	Lecture with hands on practice: “Data Analysis contd....” – A Chatterjee , NPD, BARC

School cum Workshop on Nuclear Yrast and Near-Yrast Spectroscopy

October 26-30, 2009 at IIT, Roorkee
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Programme: October 27, 2009

9000-1000	“Channel Selection and Gamma Spectroscopy of Exotic Nuclei” – N Madhavan , IUAC, Delhi
1000-1100	“Shell Model: A Perspective” – K Kar , SINP, Kolkata
1100-1130	TEA
1130-1230	“B(E/M), lifetimes, W.U., mixing ratios & spin parity assignment” – R Palit , TIFR, Mumbai
1230-1330	“Lifetime-measurements/ DSAM-analysis with computer program demo” – P Joshi , HBCSE, TIFR, Mumbai
1330-1430	LUNCH
1430-1530	“Geometrical symmetries and level structure” – A K Jain , IIT Roorkee
1530-1630	“Open access codes and theory support at Roorkee” – P Arumugam , IIT-Roorkee
1630-1700	TEA
1800-1830	REFRESHMENTS
1830-1930	Pre-dinner talk with students: “Aspects of pairing correlations in nuclei” – A Macchiavelli , LBNL, USA
1930-2030	DINNER
2030-2130	Lecture with hands on practice: “Data Analysis contd....” – A Chatterjee , NPD, BARC



Spectroscopy Techniques for the Study of Neutron-Rich Nuclei

Robert V. F. Janssens

School cum Workshop on Nuclear Yrast and Near-Yrast Spectroscopy
October 26 – 30, 2009
IIT Roorkee

School cum Workshop on Nuclear Yrast and Near-Yrast Spectroscopy

October 26-30, 2009 at IIT, Roorkee
jointly organized by Department of Physics, IIT, Roorkee & UGC-DAE CSR, Kolkata Centre

Programme: October 29, 2009

1130-1200	P Regan : "Nuclear decay spectroscopy of very exotic nuclei"	SESSION I
1200-1230	S Tandel : "Spectroscopy of shell-stabilized trans-plutonium nuclei"	
1230-1245	S Chamoli : "Transient field g-factor measurements in ^{125}Te "	
1245-1300	R Chakravarti : "Spectroscopic studies of nuclei in the vicinity of the island of inversion in the mass $A \sim 30$ "	
1300-1400	LUNCH	
1400-1500		
1400-1430	R Janssens : "Highlights of the Recent Nuclear High Spin Studies"	SESSION II
1430-1500	A Macchiavelli : "Nuclear structure physics with GRETINA".	
1515-1900	SESSION III	
	Advanced Experiments with a Next Generation INGA+Particle (n-p-alpha-ER-FF,e) Detector Setup	
	Speakers - R Palit, DC Biswas, SS Ghugre, G Mukherjee, Suresh Kumar, R P Singh, SC Pancholi	
1600-1630	TEA	
2000-2100	WORKSHOP DINNER	

School cum Workshop on Nuclear Yrast and Near-Yrast Spectroscopy

Programme: October 30, 2009

0930-1100	SESSION IV
0930-1000	P Walker : "Nuclear isomers as probes of unusual structure"
1000-1015	S Ray : "Spectroscopy of ^{37}Ar , ^{36}Cl and role of fp orbitals"
1015-1030	K Raja : "High spin spectroscopy of ^{73}As "
1030-1045	A Dhal : "Study of high spin states: Role of intruder orbitals"
1045-1100	T Trivedi : "Shape evolution at high spin in 70-80 mass region"
1100-1130	TEA
1130-1300	SESSION V
1130-1200	U Garg : "Chirality, tidal waves, and other exotic quantal rotations"
1200-1230	R Palit : "Experimental investigation of exotic shapes, correlations and
1230-1245	D Choudhury : "Role of neutrons/protons in Magnetic and Anti-magnetic Rotation Phenomena"
1245-1300	D Negi : "High spin structures in ^{107}In "
1300-1400	LUNCH
1400-1500	SESSION VI
1400-1430	D C Biswas : "Role of nuclear shell closure in fission fragment mass distribution"
1430-1500	S Bhattacharya : "Yrast and near-yrast spectroscopy of nuclei around shell closure using INGA"
1515-1630	SESSION VII
1515-1545	I Govil : "Gamma softness and a new aligned band in OS-178 nucleus"
1545-1600	N Guleria : "Effective Λ - Λ and Λ -N interaction within Skyrme-Hartree-Fock approach
1600-1630	SB Patel : Conclusion
1630-1700	TEA



Highlights of Recent Nuclear High-Spin Studies

Robert V. F. Janssens

School cum Workshop on Nuclear Yrast and Near-Yrast Spectroscopy
October 26 – 30, 2009
IIT Roorkee

Conclusions & Outlook

- Much progress has been made over the decades in understanding
 - The interplay between collective and single-particle degrees of freedom
 - The large variety of collective modes the nucleus can adopt & the interplay between them
 - The dependence of these effects on angular momentum & energy, neutron and proton number
- Yet, the nucleus continues to surprise us and new questions continue to arise. This presentation tried to illustrate this by
 - Returning to the impact of Octupole correlations
 - Wondering about possible new shapes
 - Questioning how well we understand triaxial shapes
 - Probing how well nuclei at extreme angular momenta are described
- Progress is forthcoming:
 - new detectors (γ -ray tracking)
 - input from exotic nuclei
 - new theory developments





The Beatles at Rishikesh 1967

Thanks Robert ☺ From all your friends at U. Surrey over the last 30 years. From Bill Gelletly, Phil Walker, Paddy Regan, Zsolt Podolyak, Gavin Lotay, Dan Doherty & Jack Henderson et al.,

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PHYSICAL REVIEW C 105, L042801 (2022)

Letter

Revised decay properties of the key 93-keV resonance in the $^{25}\text{Mg}(p, \gamma)$ reaction and its influence on the MgAl cycle in astrophysical environments

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PHYSICAL REVIEW C, VOLUME 60, 064308



Near yrast study of the $f_{7/2}$ shell nuclei ^{58}Ni , ^{61}Cu , and ^{61}Zn

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Physics Letters B 437 (1998) 264–272

Competing $T = 0$ and $T = 1$ structures in the $N = Z$ nucleus ^{62}Ga

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ACTA PHYSICA POLONICA B

No 3

FAST TIMING MEASUREMENT USING AN $\text{LaBr}_3(\text{Ce})$ SCINTILLATOR DETECTOR ARRAY COUPLED WITH GAMMASPHERE²

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23 April 1998

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Opening up the $A \approx 180$ K-isomer landscape: inelastic excitation of new multi-quasiparticle yrast traps

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A High-Resolution Study of the $^{110}\text{Tc} \rightarrow ^{110}\text{Ru} \rightarrow ^{110}\text{Rh} \rightarrow ^{110}\text{Pd}$ Decay Chain with the GRETINA

Array

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PHYSICAL REVIEW LETTERS 134, 062502 (2025)

Deformation and Collectivity in Doubly Magic ^{208}Pb

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PHYSICAL REVIEW LETTERS 127, 202501 (2021)

Editors' Suggestion

Solving the Puzzles of the Decay of the Heaviest Known Proton-Emitting Nucleus ^{185}Bi

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PHYSICAL REVIEW C 108, 035807 (2023)

Confirmation of a new resonance in ^{26}Si and contribution of classical novae to the galactic abundance of ^{26}Al

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