Structure of nuclei near the 0ν2β candidate ^{76}Ge*

C. J. Chiara[1,2], Y. Toh[3,2], E. A. McCutchan[2], W. B. Walters[1], R. V. F. Janssens[2], M. P. Carpenter[2], S. Zhu[2], M. Alcorta[2], R. Broda[4], B. Fornal[4], G. Gürdal[5], C. R. Hoffman[2], B. P. Kay[2], F. G. Kondev[5], W. Królas[4], T. Lauritsen[2], C. J. Lister[2], T. Pawłat[4], A. M. Rogers[2], D. Seweryniak[2], N. Sharp[1], I. Stefanescu[1,2], N. J. Stone[6,7], J. Wrzesiński[4], K. Higashiyama[8], and N. Yoshinaga[9]

[1]Department of Chemistry and Biochemistry, University of Maryland, College Park, MD 20742, USA
[2]Physics Division, Argonne National Laboratory, Argonne, IL 60439, USA
[3]Japan Atomic Energy Agency, Tokai, Ibaraki 319-1195, Japan
[4]Niewodniczański Institute of Nuclear Physics PAN, PL-31-342, Kraków, Poland
[5]Nuclear Engineering Division, Argonne National Laboratory, Argonne, IL 60439, USA
[6]Department of Physics, University of Oxford, Oxford OX1 3PU, UK
[7]Department of Physics and Astronomy, University of Tennessee, Knoxville, TN 37996, USA
[8]Department of Physics, Chiba Institute of Technology, Narashino, Chiba 275-0023, Japan
[9]Department of Physics, Saitama University, Saitama City 338-8570, Japan

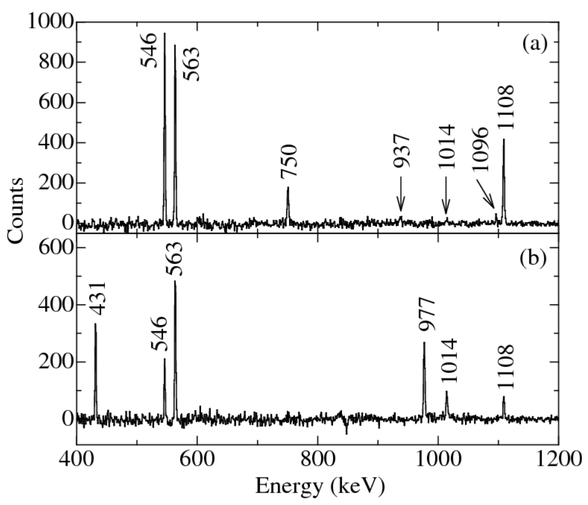
Motivation for studying $^{75\text{-}77}$Ge 1

The nucleus ^{76}Ge is a candidate for neutrinoless double β decay. For theoretical models to accurately calculate the relevant nuclear matrix element for this decay mode, it is important to have a firm understanding of the properties of the nuclei. Extending the level schemes of this and neighboring nuclei to higher spins can provide a robust test of various models, fine-tuning the single-particle energies and effective interactions in large-scale shell-model calculations involving the $p_{3/2}p_{1/2}f_{5/2}g_{9/2}$ proton and neutron subspace. In addition, ^{76}Ge provides an opportunity to explore triaxiality for low-lying states in this region.

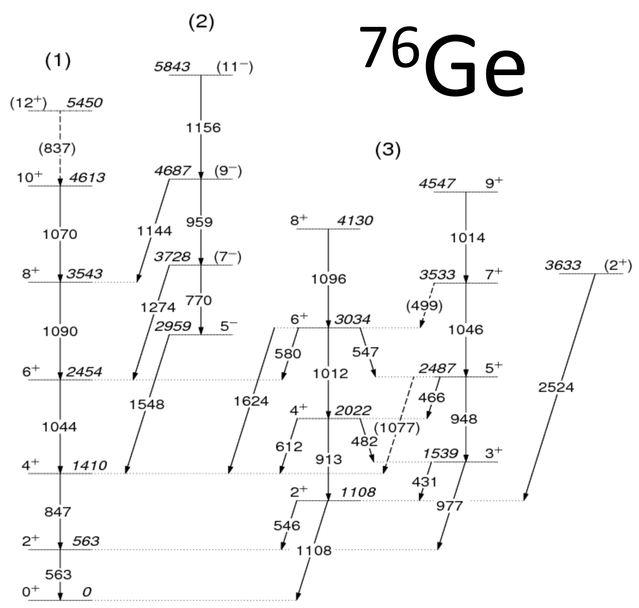
Experimental details 2

Excited states in $^{75\text{-}77}$Ge were populated in 530-MeV ^{76}Ge + ^{238}U and 450-MeV ^{76}Ge + ^{208}Pb,^{198}Pt reactions at the ATLAS facility at Argonne National Lab. Reaction products were stopped in the thick targets at the center of the Gammasphere array of 100 Compton-suppressed HPGe detectors, which was used to detect γ rays emitted following the reactions.

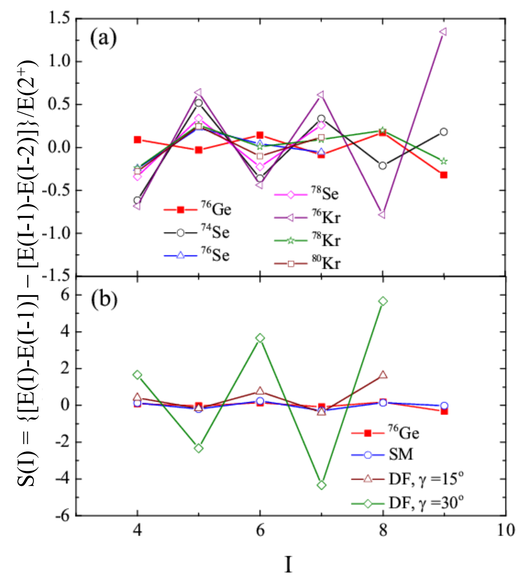
Properties of the γ band in ^{76}Ge 3



Spectra double gated on (a) 913/1012 keV and (b) 948/1046 keV in the γ band (3) of ^{76}Ge.



Partial level scheme of ^{76}Ge deduced in the present work. Spins and parities were determined through angular-correlation measurements.



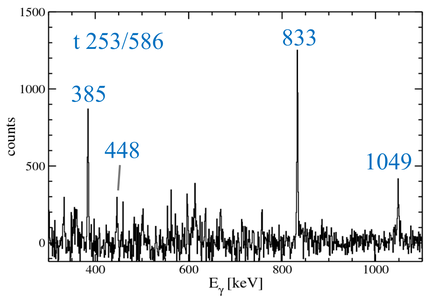
Staggering S(I) for ^{76}Ge compared to (a) neighboring nuclei and (b) predictions of the shell model (SM) and Davydov-Filippov (DF) rigid-triaxiality model.

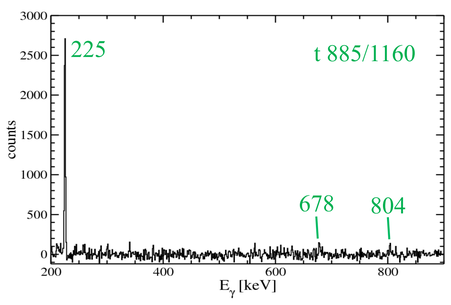
E_{exp}	I_i^π	I_{f1}^π	I_{f2}^π	R_{exp}	R_{DF}	R_{SM}
1108	2_2^+	0_1^+	2_1^+	0.027(3)	0	0.045
1539	3_1^+	2_1^+	2_2^+	$0.029(^{+6}_{-4})$ [a]	0	0.064
2022	4_2^+	4_1^+	2_2^+	1.3(4)	0.46	0.93
2487	5_1^+	4_2^+	3_1^+	2.7(22), 0.42(37) [b]	1.00	1.29
3034	6_2^+	4_1^+	4_2^+	0.038(14)	0	0.48

Ratio R = B(E2,I_i→I_{f1})/B(E2,I_i→I_{f2}) for the experimental data compared to the DF and SM models.

<u>Observations in ^{76}Ge:</u>
- First observation of γ band above I=4.
- $E(2_2^+)/E(2_1^+)$=2.0, as in DF model.
- Staggering has phase expected for a rigid triaxial potential, unlike its neighbors, but oscillation has smaller magnitude than DF model predicts.
- SM does surprisingly well in reproducing this seemingly collective structure: energy ratio, B(E2) ratio, and both the phase and magnitude of the staggering agree well with data.

Structure of ^{75,77}Ge 4

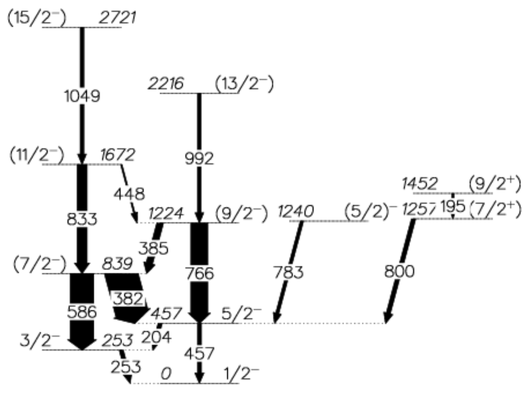




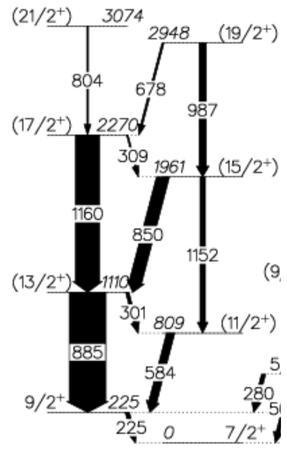
Spectra double gated on transitions in ^{75}Ge (far left) and ^{77}Ge (left), revealing members of the strongly coupled bands built upon the 1/2- and 7/2+ ground states, respectively.

<u>Observations in ^{75,77}Ge:</u>
- First observation of levels with spin >9/2 in both isotopes.
- Strongly coupled bands identified, built upon the 1/2- ground state in ^{75}Ge and 7/2+ ground state in ^{77}Ge.
- Comparison of somewhat pure $\nu[(g_{9/2})^2p_{1/2}]$ and $\nu[(g_{9/2})^3]$ configurations at high spin could provide information on $g_{9/2}g_{9/2}$ and $g_{9/2}p_{1/2}$ residual interactions. Unfortunately, only one in each isotope (so far)!

^{75}Ge



^{77}Ge



Partial level schemes of ^{75,77}Ge deduced in this work. Angular correlations support I^π assignments up to the 9/2- level in ^{75}Ge. This band is likely $\nu p_{1/2}$ coupled to the prolate-deformed ^{74}Ge core; similar bands are known in the N=43 isotones ^{77}Se, ^{79}Kr, ^{81}Sr, and ^{83}Zr.
The band in ^{77}Ge is interpreted as the $\nu g_{9/2}$ configuration, given its positive parity.

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