Spectroscopic studies in $^{152\text{-}154}$Gd

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Motivation The rare-earth region has been a main point of interest due to the strong degrees of deformation that are present.

Why Gd? The Gd isotopes exhibit a sudden change in collectivity between 152<A<155, but still lack necessary spectroscopic information like cross-sections or branching ratios of deformed states.

Solution In this work, the $^{152\text{-}154}$Gd were studied by a fusion-evaporation reaction in the energy range of 61-67 MeV.

Experimental Setup

The Gd isotopes were populated at the 9 MV Tandem at IFIN-HH in Romania, employing the ROSPHERE array mounted with 15 HPGe.

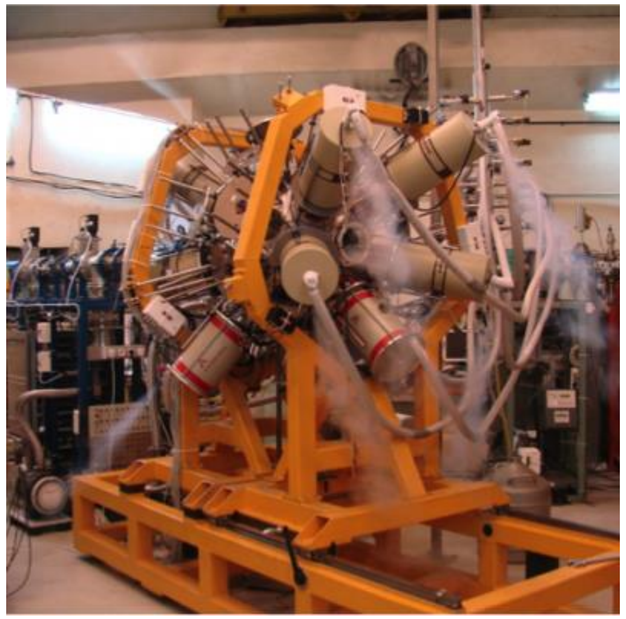

Fig. 1: The ROSPHERE array.

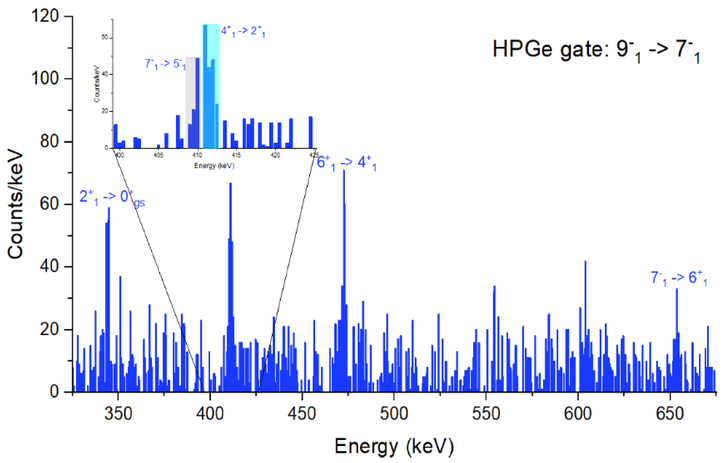

Fig. 2: Projection of the γ-γ spectrum gated at 451.1 keV. The zoomed region depicts the partially overlapped peaks at 410 keV.

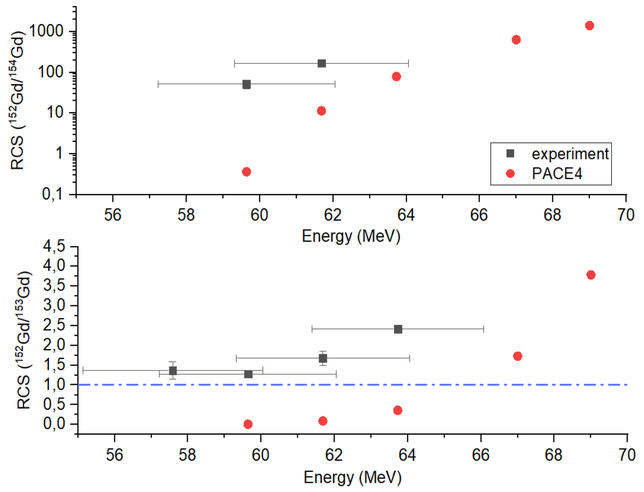

Fig. 3: Relative Cross-Sections for the studied Gd isotopes. Some errors are smaller than the accompanied symbols.

Table 1: Branching Ratios for ^{153}Gd.

Transition	E_γ (keV)	Exp.	Lit.	Multipolarity
$\left(\frac{23^+}{2}\right) \rightarrow \left(\frac{19^+}{2}\right)$	460.0(2)	0.59(22)	0.53(4)	E2
$\left(\frac{23^+}{2}\right) \rightarrow \left(\frac{21^+}{2}\right)$	708.7(2)	0.41(25)	0.36(3)	D, Q
$\left(\frac{23^+}{2}\right) \rightarrow \left(\frac{25^+}{2}\right)$	241.7(5)	-	0.111(8)	(M1 + E2)

Table 2: Branching Ratios for ^{152}Gd.

Transition	E_γ (keV)	Exp.	Lit.	Multipolarity
$4_2^+ \rightarrow 4_1^+$	526.88(5)	0.47(5)	0.512(15)	E0 + M1 + E2
$4_2^+ \rightarrow 2_2^+$	351.69(4)	0.53(7)	0.452(14)	E2
$4_2^+ \rightarrow 2_3^+$	172.1(4)	-	0.017(8)	[E2]
$4_2^+ \rightarrow 3_1^-$	159.16(16)	-	0.0184(21)	[E1]
$2_2^+ \rightarrow 2_1^+$	586.2648(26)	0.70(9)	0.800(9)	E0 + M1 + E2
$2_2^+ \rightarrow 0_{gs}^+$	930.50(4)	0.15(4)	0.128(3)	(E2)
$2_2^+ \rightarrow 0_2^+$	315.11(3)	0.15(5)	0.0703(15)	E2
$2_2^+ \rightarrow 4_1^+$	175.09(3)	-	0.0022(5)	[E2]
$11_1^- \rightarrow 10_1^+$	514.3	0.65(10)	0.65	D
$11_1^- \rightarrow 9_1^-$	483.1	0.35(7)	0.35	E2
$10_1^- \rightarrow 10_1^+$	589.9	0.65(19)	0.62	-
$10_1^- \rightarrow 8_1^-$	353.6	0.35(15)	0.38	-
$10_1^- \rightarrow 9_1^-$	558.0	-	-	-
$9_1^- \rightarrow 7_1^-$	451.1	0.86(14)	0.78	E2
$9_1^- \rightarrow 8_1^+$	584.6	0.14(4)	0.22	D
$6_2^+ \rightarrow 4_2^+$	385.9(1)	0.50(7)	0.83(5)	E2
$6_2^+ \rightarrow 6_1^+$	440.8(2)	0.22(6)	0.10(4)	(M1 + E2)
$6_2^+ \rightarrow 5_1^-$	197.4(3)	0.28(8)	0.07(1)	[E1]
$7_1^- \rightarrow 5_1^-$	410.0	0.44(12)	-	-
$7_1^- \rightarrow 6_1^+$	652.9(3)	0.56(15)	-	E1

Conclusions

- A good agreement between present results and previous data has been established
- The PACE4 results significantly deviate from the experimental values below the Coulomb barrier
- The present work reports on the first values for relative cross-sections in $^{152\text{-}154}$Gd
- New results have been established for the branching ratios in ^{152}Gd

References

[1] A. Khaliel et al., EPL **128** 62001
[2] S. Pelonis et al., (in prep)
[3] S. R. Lesher et al., Phys. Rev. C **66** 051305
[4] S. Leoni et al., Phys. Rev. Lett. **118** 162502

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