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Extended Spectroscopy in the Superdeformed Well of ^{148,149}Gd Nuclei

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Superdeformed (SD) bands in ^{118,149}Gd nuclei were investigated using EUROGAM II array following the ^{124}Sn + ^{30}Si fusion-evaporation reaction at a beam energy of 158 MeV. A high statistics experiment was performed and resulted in the discovery of twelve new SD bands. Three of them have been assigned to ^{148}Gd and seven to ^{149}Gd giving a total of thirteen SD bands now known in this nucleus. Six bands were previously observed respectively in ^{148}Gd[1)] and ^{149}Gd[2)]. The yrast SD bands of the $^{145\text{-}149}$Gd chain of isotopes are all considered to have the same $\pi 6^2$ (i 13/2)$\nu 7^1$(j15/2) intruder configuration with the neutron orbitals [651]1/2 and [642]5/2 $\alpha = \pm$ 1/2 lying just below the N = 86 neutron SD shell gap, completely filled in the ^{149}Gd case. Concerning the three new excited SD bands (7, 8 and 9) in ^{148}Gd, two of them (7, 8) are signature partners and their dynamical moments of inertia $J^{(2)}$ display a well-pronounced bump at the same critical frequency as for ^{145}Gd(2)[3)], ^{146}Gd(1)[4)] and ^{147}Gd(1)[5)] bands. This strong interaction crossing is explained as due to the interaction between the ν[651]1/2 and ν[642]5/2 α = - 1/2 orbitals when the blocking effect is removed. Between the two irregularities observed respectively at low and high rotational frequencies, the moment $J^{(2)}$ of the third band is very similar to that of ^{152}Dy(1) suggesting the same intruder configuration ($\pi 6^4 \nu 7^2$). Up to now, in the A ~ 150 mass region, the $J^{(2)}$ moment of many bands based on this configuration and involving natural parity particle-hole excitations with insignificant alignment, present one or two small discontinuities, the first one located at low rotational frequencies ($\hbar\omega$ ~ 0.4 - 0.5 MeV) and the second one at higher ones ($\hbar\omega$ ~ 0.6 - 0.7 MeV). The new ^{149}Gd(7) band with a $J^{(2)}$ moment similar to those of all bands having the high-N intruder $\pi 6^3 \nu 7^1$ configuration is based on a proton excitation involving the unfavored [301]1/2 α = +1/2 orbital; a small discontinuity at $\hbar\omega$ ~ 0.5 MeV disturbs the transition energies relationship between this band and ^{150}Tb(1)[6)] band. The $J^{(2)}$ moment of ^{149}Gd(8) shows a smooth rise with a pronounced increase at very high rotational frequency; its behaviour suggest the $\pi 6^4$ {[301]1/2}$^{-2}$ $\nu 7^1$ configuration. The ^{149}Gd(9,10,11,13) bands have $J^{(2)}$ moments very close to each other and similar to that of ^{148}Gd(1) band; these data indicate single neutron excitations from the ^{149}Gd core into orbitals with no significant alignments. The $J^{(2)}$ moment of ^{149}Gd(12) based on a two neutron excitation displays a similar bump as those above-mentioned. It is noteworthy, that all these bumps are similar and located at the same rotational frequencies, suggesting that changes in mass, deformation and/or alignment are weak or act in a compensatory manner.

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