New results concerning the wobbling properties of $^{183,187}Au$

Robert Poenaru

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1 Introduction

Two wobbling sequences have been identified in ^{183}Au by Nandi et. al. [1]. One sequence has two bands with states of negative parity (built on top of the odd $h_{9/2}$ proton) and two bands with states of positive parity (built on top of the odd $i_{13/2}$ proton). Both sequences are considered to have $n_w = 0$ for the *yrast* band and $n_w = 1$ for the one-phonon wobbling band.

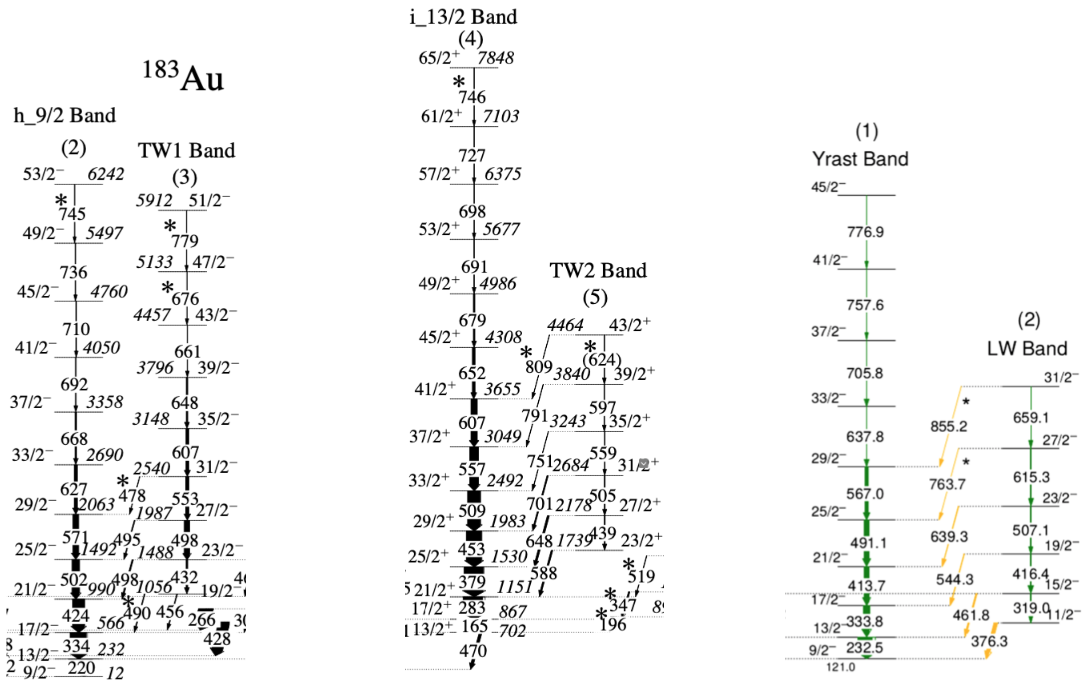

Figure 1: **Left:** ^{183}Au: negative parity states based on $j = 9/2$.**Middle:** ^{183}Au: positive parity states based on $j = 13/2$. **Right:** The wobbling structure in ^{187}Au.

On the other hand, Sensharma et. al. [2] has confirmed wobbling motion in ^{187}Au, with the identification of two such bands, show in figure 1.

2 Numerical application

By using the same formalism as the one applied for ^{163}Lu in [3]. Namely, the both positive and negative wobbling sequences from ^{183}Au were described with the same analytical expressions for the *excitation energies*.

$$E_{\mathrm{exc}}(I) = \varepsilon_j + \mathscr{H}_{\mathrm{min}}(I) + \Omega_1^I\,(n_{w_1}+1) + \Omega_2^I\,(n_{w_2}+1)\ , \tag{1}$$

such that $E_{\mathrm{exc}}(I) = \mathscr{F}(I, j; \mathscr{P})$, where $\mathscr{P} = [\mathscr{I}_1, \mathscr{I}_2, \mathscr{I}_3, V, \gamma]$ is the **free parameter set**.

The wobbling frequencies Ω_1 and Ω_2 are the solutions of the algebraic equation:

$$\Omega^4 + B\Omega^2 + C = 0 \tag{2}$$

and

$$\Omega_1 = \sqrt{\frac{1}{2}\left(-B + \sqrt{B^2 - 4C}\right)} \tag{3}$$

$$\Omega_2 = \sqrt{\frac{1}{2}\left(-B - \sqrt{B^2 - 4C}\right)}. \tag{4}$$

3 Coupling schemes

3.1 ^{183}Au - positive parity

The spin states with positive parity are created by the coupling of the even-even rotor $\vec{R}$ with the odd-proton $i_{j=13/2}$. As such, the yrast band emerges from a rotor with even angular momentum $\vec{R} = 0, 2, 4, \ldots$, while the first excited wobbling band emerges from the coupling of the same j but with a rotor with odd spin sequence $\vec{R} = 1, 3, 5 \ldots$.

Within Eq. 1, the two wobbling phonon numbers (i.e., n_{w_1} and n_{w_2}) are $(0, 0)$ and $(1, 0)$ for the yrast and excited bands, respectively.

3.2 ^{183}Au - negative parity

For the negative sequences, the wobbling states are obtained via the coupling of $j = 9/2$ proton with the even-rotor sequence $\vec{R} = 0, 2, 4, \ldots$ for the yrast band, and odd-rotor sequence $\vec{R} = 1, 3, 5, \ldots$ for the first excited wobbling band.

4 Data fit

Concerning the actual fitting procedure, the wobbling spectrum for the isotopes was calculated by fitting Eq. 1 using the parameter set $\mathscr{P}$. The excitation energies are obtained by subtracting the **band-head** of yrast band from every other spin state.

In ^{183}Au, the band-head for the negative wobbling sequence is the $I^\pi = 9/2^-$ state, and the band-head for the positive sequence is the $I^\pi = 13/2^+$ state. For ^{187}Au, the band-head energy state is $I^\pi = 9/2^-$.

References

[1] S Nandi, G Mukherjee, QB Chen, S Frauendorf, R Banik, Soumik Bhattacharya, Shabir Dar, S Bhattacharyya, C Bhattacharya, S Chatterjee, and et al. First observation of multiple transverse wobbling bands of different kinds in au 183. *Physical Review Letters*, 125(13):132501, 2020.

[2] N Sensharma, U Garg, QB Chen, S Frauendorf, DP Burdette, JL Cozzi, KB Howard, S Zhu, MP Carpenter, P Copp, and et al. Longitudinal wobbling motion in au 187. *Physical review letters*, 124(5):052501, 2020.

[3] R Poenaru and AA Raduta. Parity partner bands in 1 6 3 lu: A novel approach for describing the negative parity states from a triaxial super-deformed band. *International Journal of Modern Physics E*, page 2150033, 2021.