High Resolution $(\vec{d},t)$ Study of ^{196}Au and IBM Supersymmetry ◇

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1. Introduction

The interacting boson model (IBM) proposed by Arima and Iachello [1,2] allows for simultaneous description of even and odd mass nuclei. Spectroscopic properties of a quartet of nuclei, an even-even, even-odd, odd-even and an odd-odd one, are correlated. The IBM has been successfull in the Pt region with ^{196}Pt as the best known realization of the O(6) supersymmetry limit. In the supersymmetry model the odd Z even N, the even Z odd N and the odd odd members of the quartett of nuclei are described by the groups $U_\pi(6/4)$, $U_\nu(6/12)$ and $U_\nu(6/12) \otimes U_\pi(6/4)$, with an O(6) core, respectively. Another quartet of interest with respect to the supersymmetry model is ^{194}Pt, ^{195}Pt, ^{195}Au and ^{196}Au [3].

Even the lowest part of the level scheme of odd-odd ^{196}Au is not known completely [4,5], thus it is essential to provide more information to compare with IBM prediction. In collaboration with Bonn and Fribourg e^--singles, $e^-\gamma$-coincidence, and γ-γ- coincidence decays using the ^{196}Pt(d,2n)^{196}Au reaction are presently studied and compared with the present ^{197}Au$(\vec{d},t)^{196}$Au transfer experiment to establish a complete level scheme.

2. The ^{197}Au$(\vec{d},t)^{196}$Au experiment and first results

The ^{197}Au$(\vec{d},t)^{196}$Au reaction was studied using a 25MeV polarized deuteron beam from the Munich MP tandem accelerator with an intensity of 250nA on target. The outgoing tritons have been analyzed in the Q3D magnetic spectrograph using an array of single wire proportional detectors with additional cathode readout, followed by a plastic scintillator for particle detection. Angular distributions from 8 to 48 degree scattering angle in steps of 3 degrees had been measured. For improved energy resolution we also studied ^{197}Au(p,d)^{196}Au. The FWHM line width in the $(\vec{d},t)$ measurements was 7keV, in (p,d) less than 5keV. From the (p,d) data we have an energy calibration with an error of about 1keV [6]. Using this calibration the polarized data have been analyzed. To the observed neutron transfer the orbits $3p_{1/2}$, $3p_{3/2}$, $2f_{5/2}$, $2f_{7/2}$ or $1i_{13/2}$ may contribute depending on spin, parity and structure of the excited state. Because of the ground state spin $3/2^+$ of ^{197}Au up to four different values of j transfer have to be distinguished. They add incoherently to the (polarized) differential cross sections. Restricting the analysis to the orbits listed above we expect either mixed contributions from l=1 and 3 transfer or pure j=13/2 transfer. The theoretical cross sections and asymmetries are calculated as

$$\frac{d\sigma}{d\Omega}(\Theta) \;=\; \sum_{l,j} S_{l,j} \frac{2J_f+1}{(2J_i+1)(2j+1)} \sigma^{DWBA}_{l,j}(\Theta)$$

and

$$A(\Theta) \;=\; \sum_{l,j} S_{l,j} \frac{d\sigma}{d\Omega}(\Theta)\, A^{DWBA}_{l,j}(\Theta)$$

Here J_i and J_f are the initial and final spins of the target nucleus, j the transfered angular momentum, $\sigma^{DWBA}_{l,j}(\Theta)$ and $A^{DWBA}_{l,j}(\Theta)$ the results of calculations in the distorted wave Born approximation performed with the code CHUCK3 and $S_{l,j}$ the spectroscopic factors. To resolve mixing of j=1/2, 3/2, 5/2 and 7/2 transitions DWBA calculations which reproduce the angular dependences of pure j transitions are needed. We used a numerical program (MINUIT [7]) to fit the input parameter set of the DWBA calculations to reproduce strong lines in the spectra and to determine mixing of the j transfers. The resulting spectroscopic factors are compared with older IBM calculations of Jolie [4,5]. The input of these calculations was the knowledge about the three other members of the IBM quartett without an adaption to ^{196}Au. The results for l=1 are displayed in fig. 1. Comparing theory with experiment allows to assign a 0^- state at 41keV or two 4^- states at 213keV and 233keV, but this is preliminary. Next steps are improvements in the IBM calculations, in the evaluation of the spectroscopic factors and as a major topic a cross check with the above mentioned γ spectroscopic data.

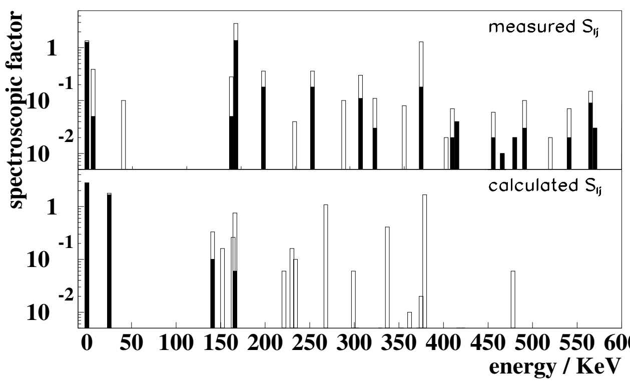

Fig. 1: Preliminary values of measured and calculated spectroscopic factors for j=1/2 (black bars) and for j=3/2 (white bars) transfer strength

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