

Intruder band structures in neutron deficient odd-odd Tl nuclei

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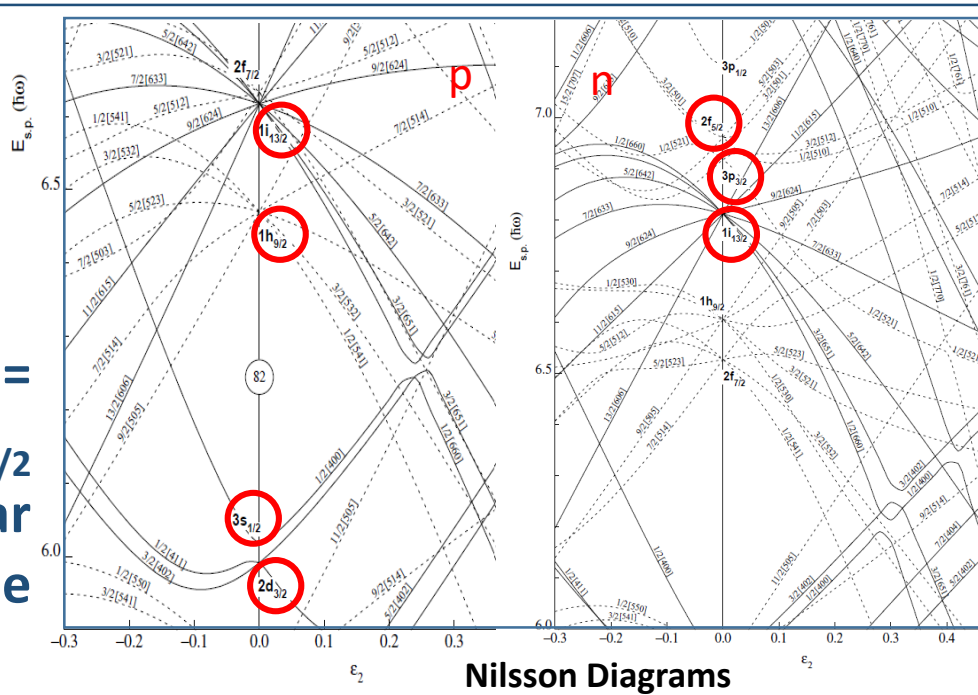
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Introduction:

- ❖ Tl nuclei lies near Z=82 shell closure. The isotopes of Tl show evolution of shapes with neutron number.
- ❖ In Tl isotopes, proton Fermi level lies near Z = 82 shell closure. In addition to the $s_{1/2}$ and $d_{3/2}$ orbitals below Z = 82, $h_{9/2}$ orbital intrudes near proton Fermi level. High-j $i_{13/2}$ orbital also lie near the neutron Fermi level.
- ❖ Large angular momentum vectors j_p and j_n would form shears blades and so, it is possible to form **Magnetic Rotational (MR) band**. However, MR bands are not known in Tl isotopes lighter than ¹⁹⁴Tl. Moreover, the presence of $h_{9/2}$ and $d_{3/2}$ orbitals would induce **octupole correlation**.
- ❖ So our aim is to look for the MR band and octupole correlations in odd-odd Tl isotopes. We have studied ¹⁹⁰Tl and ¹⁹²Tl.



Experimental Details:

TIFR EXPT



- Beam Energy = 157 MeV
- Target thickness = 7.3 mg/cm²
- Experiment was performed with INGA collaboration at TIFR, Mumbai
- 17 HPGe clover detectors were placed at 6 different angles ($\pm 40^\circ, \pm 65^\circ, 90^\circ, -23^\circ$).

INGA, TIFR



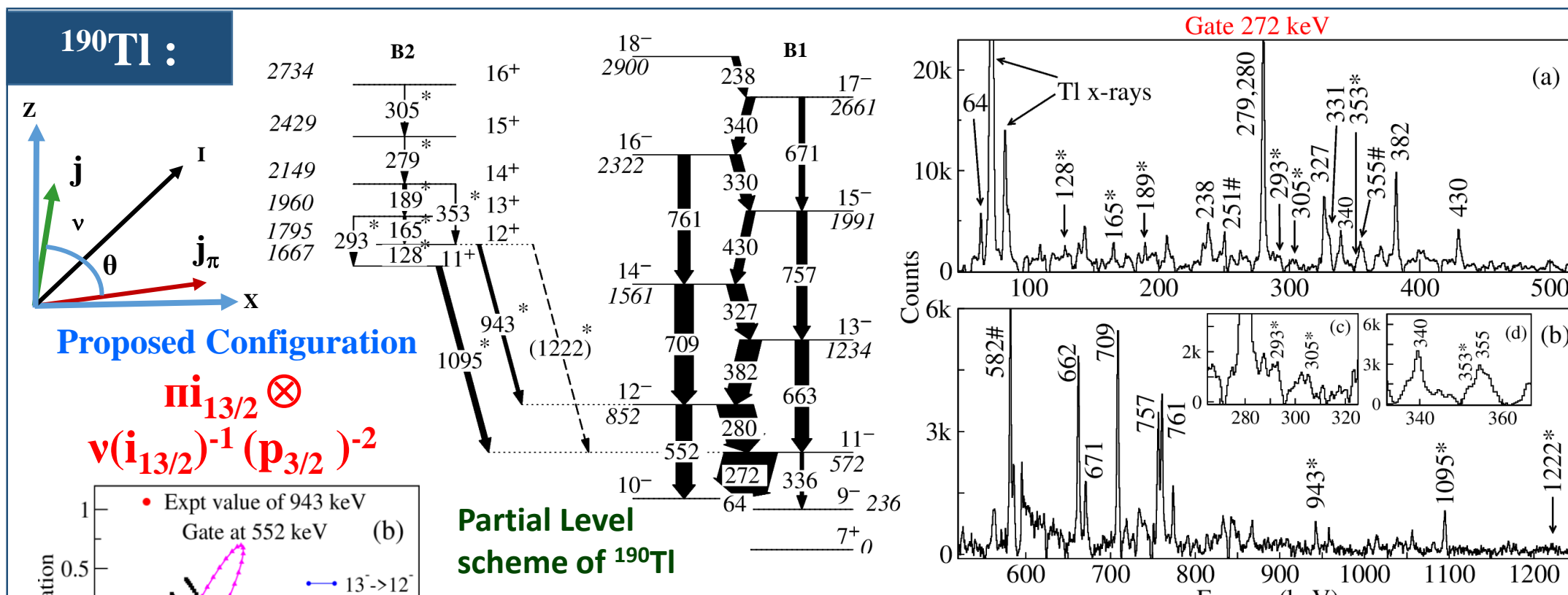
INGA, VECC



VECC EXPT



- Beam Energy = 142 MeV
- Target thickness = 25 mg/cm²
- Experiment was performed with INGA collaboration at VECC, Kolkata
- 1 LEPS and 11 HPGe clover detectors were placed at 3 different angles ($40^\circ, 90^\circ, 125^\circ$).



❖ A New band, B2 has been identified that decays to the g. s. band B1 by 1095, 943 and 1222 keV transitions.

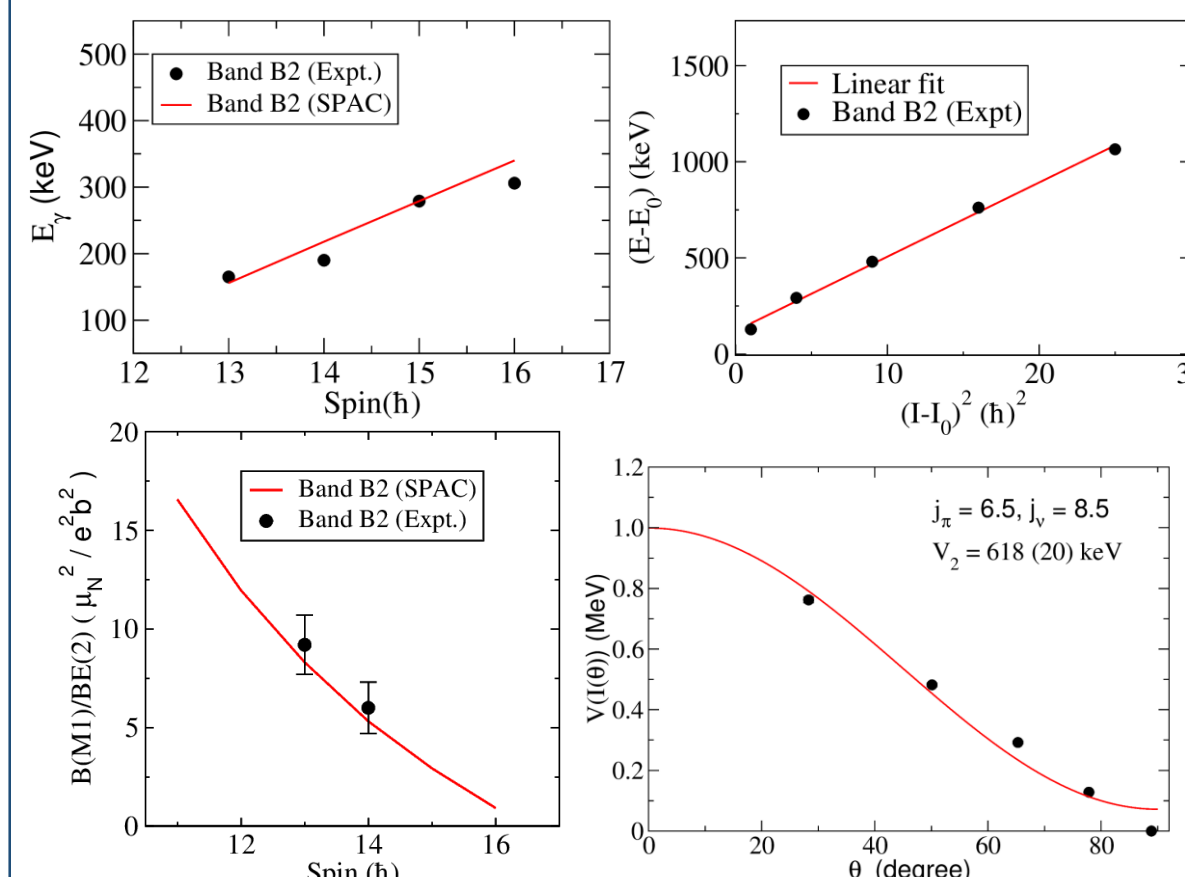
❖ The J^π of the band B2 was established from the R_{dco} and P measurements of the 1095 and 943 keV γ rays.

SPAC and Semiclassical Model calculation

❑ $(E-E_0)$ vs $(I-I_0)^2$ plot for B2 band is in good agreement with the experimental points.

❑ From Semi-classical Model: $j_\pi = 6.5$ and $j_v = 8.5$,

➔ Bandhead and maximum spins corroborate well with shears mechanism



❑ From SPAC calculation, ➔ E_γ vs. Spin curve and the decreasing nature of $B(M1)/B(E2)$ values match well with the experimental observation.

❑ Interaction strength, $V_2 = 618$ (20) keV

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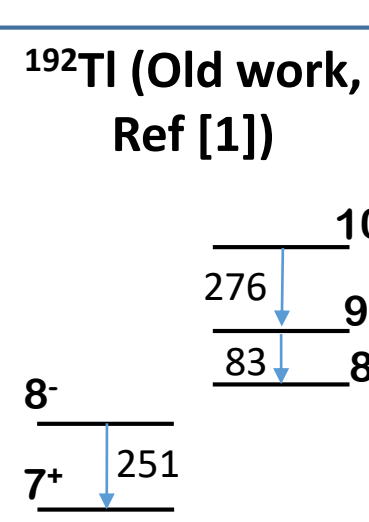
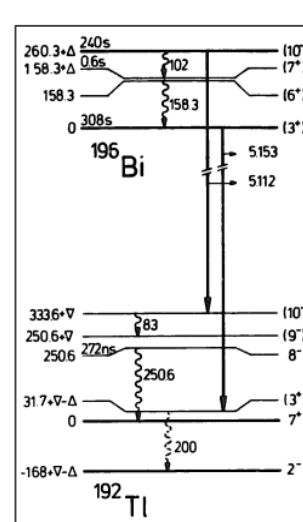
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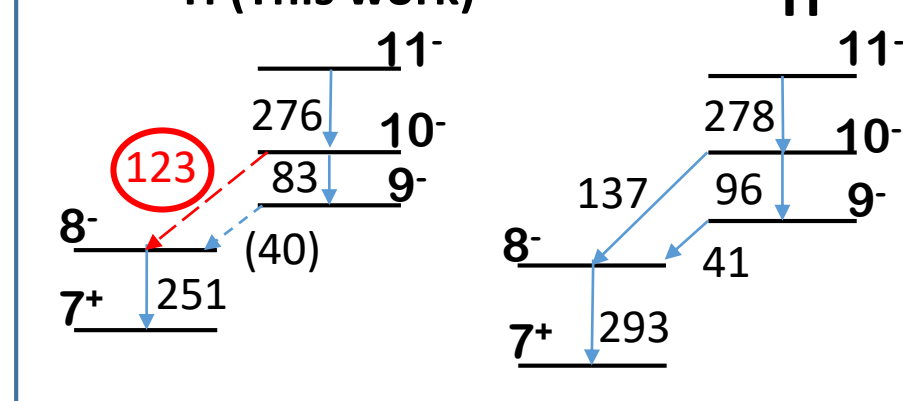
¹⁹²Tl :

J^π assignment of different levels

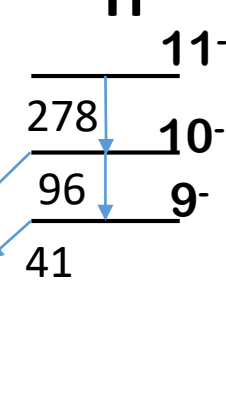
¹⁹⁶Bi (α -decay)



¹⁹²Tl (This work)

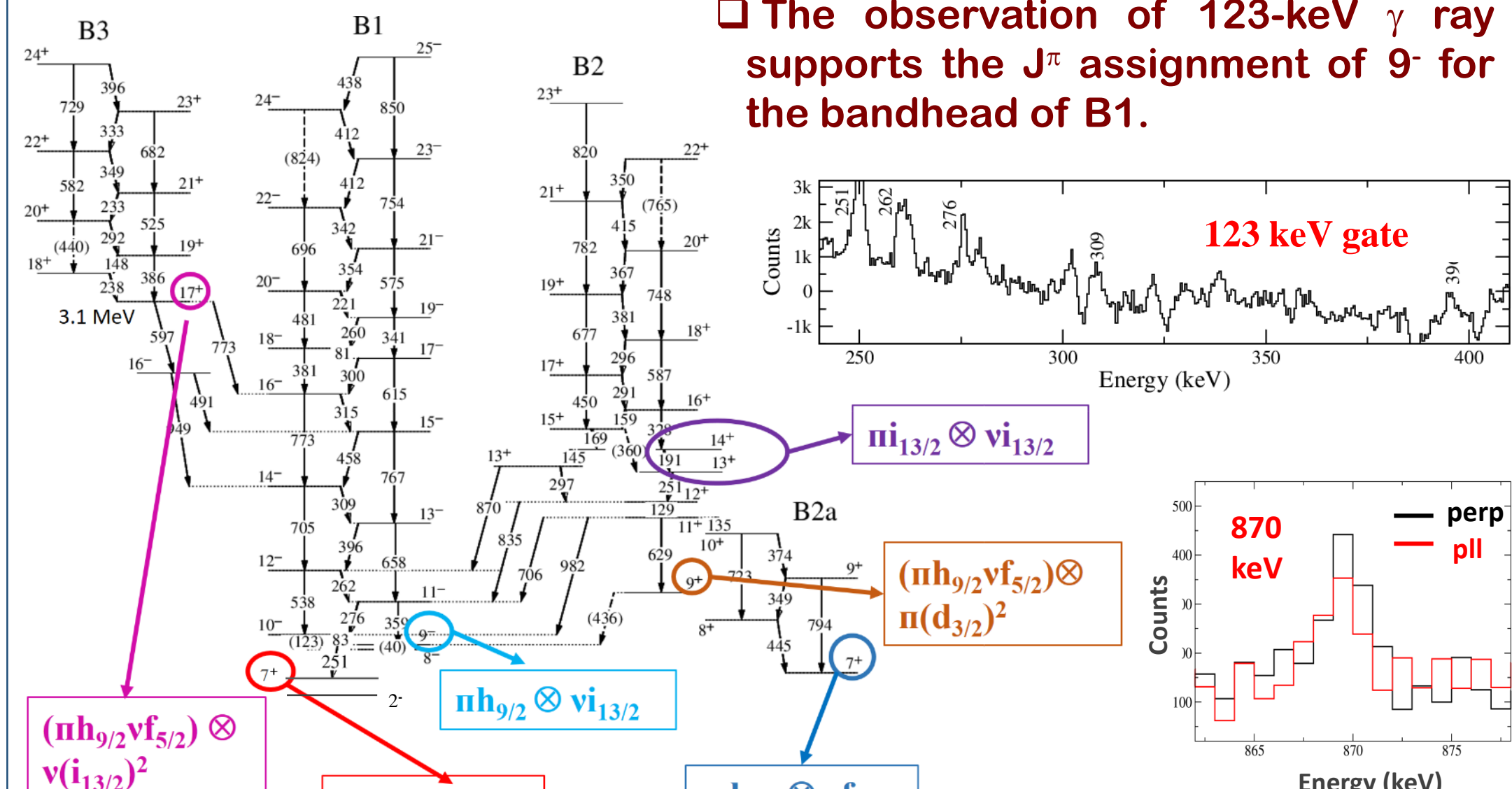


¹⁹⁴Tl



❑ 9⁻ assignment fits nicely the energy-spin systematics of the first three states of B1 with ¹⁹⁴Tl.

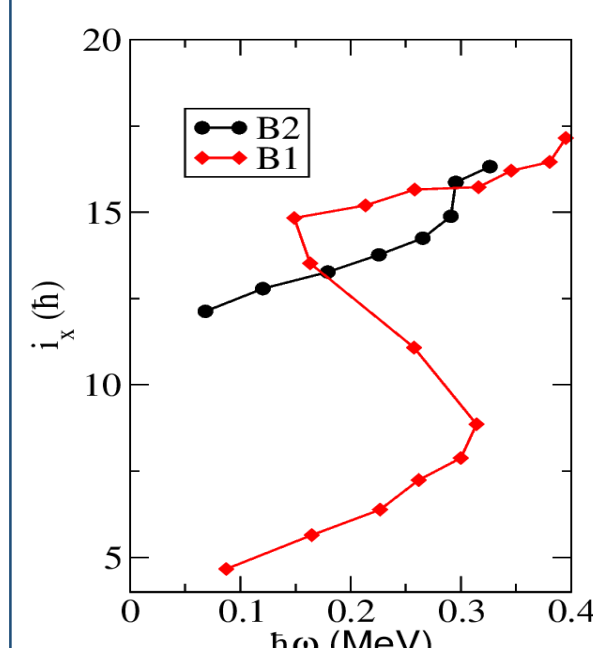
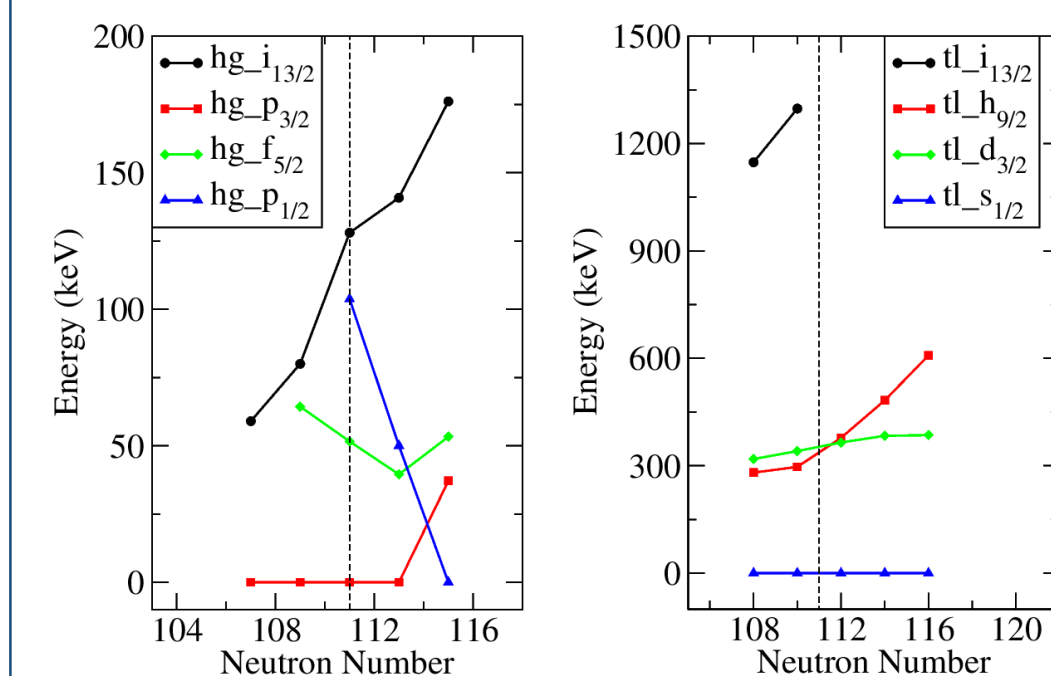
❑ The observation of 123-keV γ ray supports the J^π assignment of 9⁻ for the bandhead of B1.



GS of ¹⁹²Tl: 2⁻ $\rightarrow \pi s_{1/2} \otimes \nu p_{3/2}$

Configuration assignment of different bands

Experimental quasiparticle energies in the odd-N and odd-Z nuclei



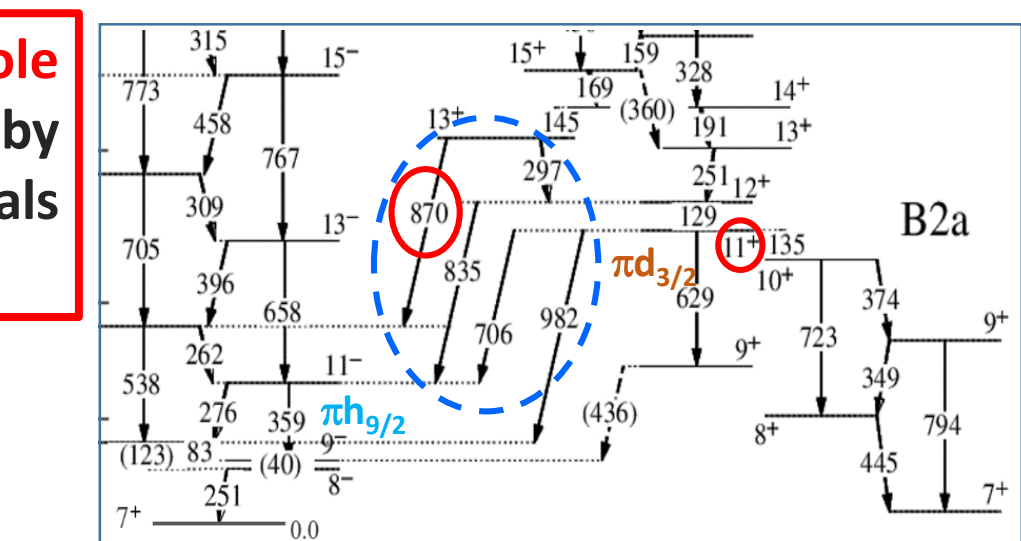
Alignment plot for Band B2

Indication of **Octupole correlation** in ¹⁹²Tl by $\nu d_{3/2}$ and $\nu h_{9/2}$ orbitals with E1 transitions.

❑ 135 keV γ ray is a $\Delta_J = 1$ dipole transition and spin of the initial level is changed to 11⁺ from 10⁺

❑ This confirms the J^π assignment of band B2

❑ R_{dco} and P of 835, 870 keV confirms them to be E1 and fix the bandhead of band B1 to be 9⁻ and confirms the J^π of band B1.



Summary :

- ✓ A new band B2 has been found in ¹⁹⁰Tl and interpreted as MR band with $\nu i_{13/2} \otimes \nu(i_{13/2})^{-1} (p_{3/2})^{-2}$ configuration.
- ✓ Semi-classical Model and SPAC calculations establish the band as Magnetic Rotational band.
- ✓ TRS calculations suggest low deformation with near non-collective oblate shape for the 4-qp configuration of this band, which is conducive to generate MR bands.
- ✓ The level scheme for ¹⁹²Tl has been constructed and previously reported bands have been confirmed with firm spin-parity assignments. Configurations of the bands have been suggested.
- ✓ Indication of octupole correlation has been found in ¹⁹²Tl through the observation of E1 transitions between bands involving $h_{9/2}$ and $d_{3/2}$ orbitals.