Unveiling the excitation modes of ^{28}Si in interpreting the barrier distribution data

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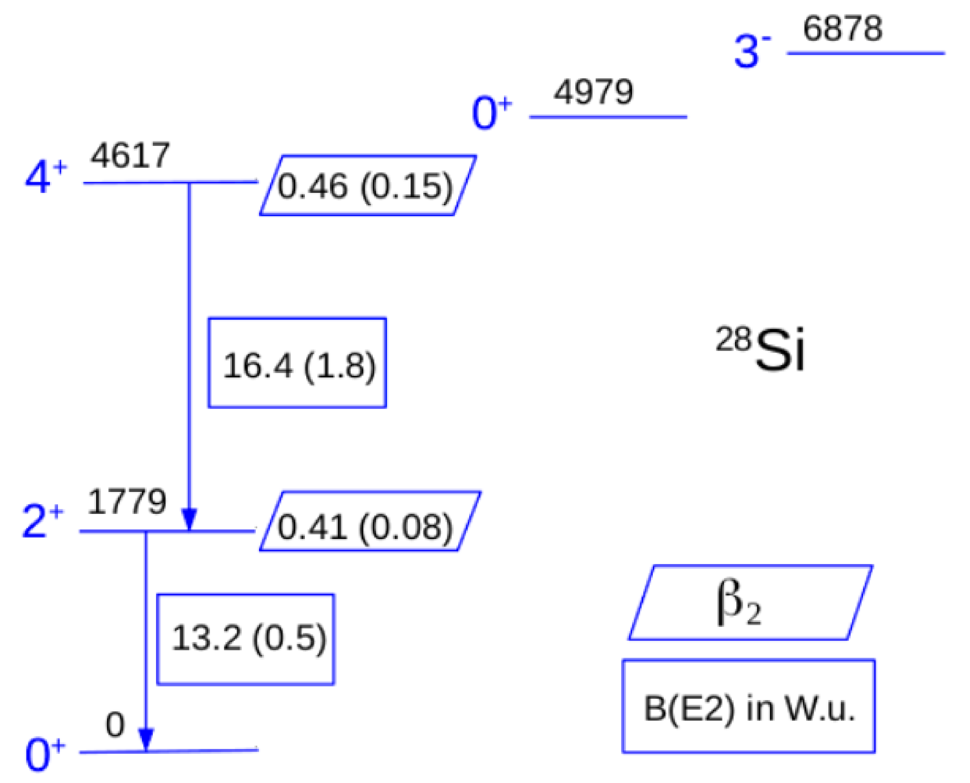
Figure has been taken from Ref. [4]

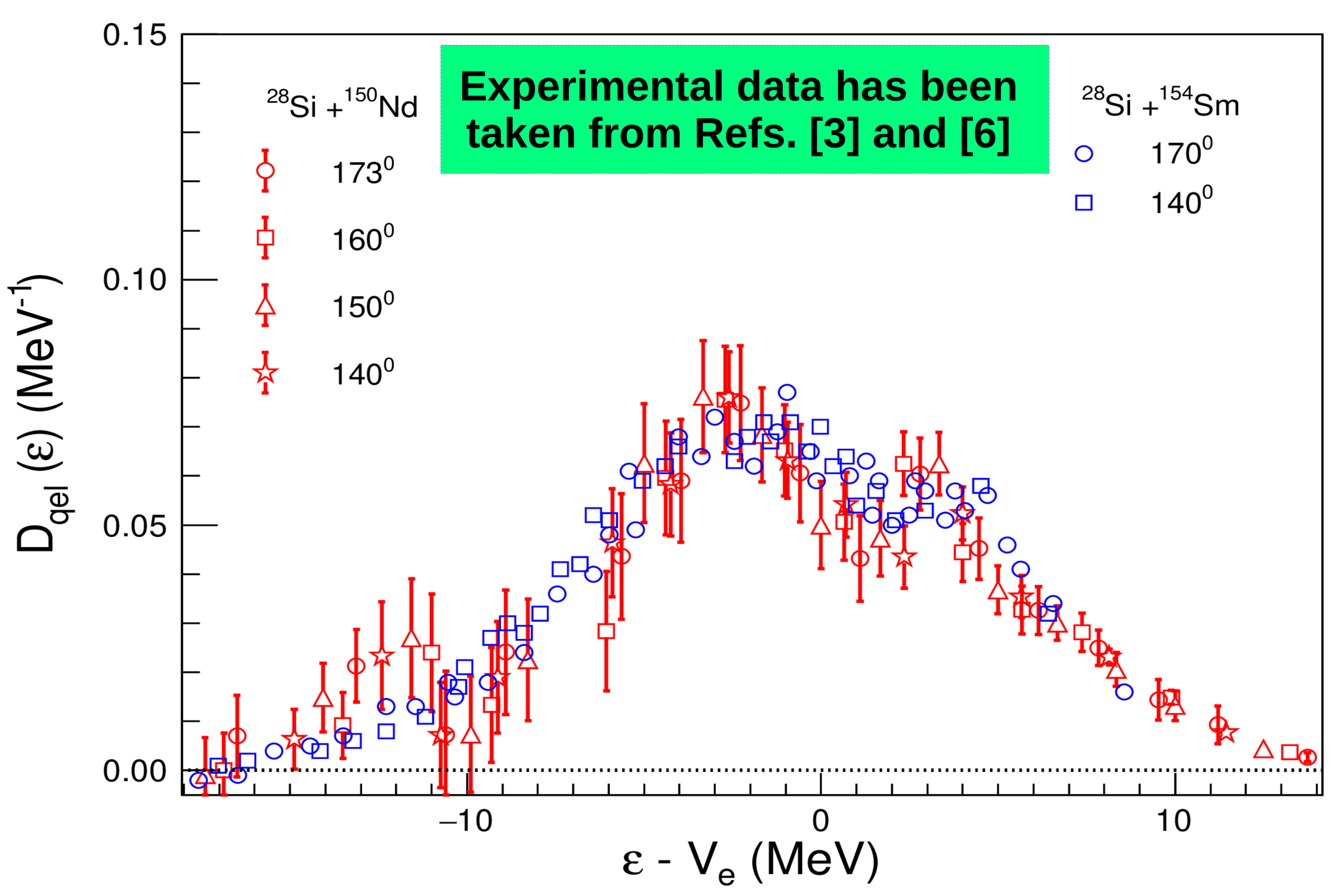


	Pure Vibrator	Pure Rotor	^{28}Si
$\frac{E_x(4^+)}{E_x(2^+)}$	2.0	3.33	2.59
$\frac{B(E2:4^+\rightarrow 2^+)}{B(E2:2^+\rightarrow 0^+)}$	2.0	1.43	1.24

The low-lying level scheme of ^{28}Si highlighting the quadrupole deformations and the transition strengths. The position of 3^- state is not according to the energy scale.

In heavy ion reactions, the interplay between the intrinsic structure and the reaction dynamics of the interacting nuclei is very important at energies near the Coulomb barrier. Measurement of barrier distribution is a very powerful tool to understand this effect. There exist two experimental methods for investigating barrier distributions: (i) by the measurement of fusion excitation function and (ii) by the measurement of quasi-elastic excitation function. Among the two methods of measurements, the measurement involving category (ii) is relatively easier to carry out in the laboratory and provides additional advantages over the measurement under category (i). The analysis of the experimentally measured data within coupled channel model (CCFULL) using Woods-Saxon potential give better understanding of the role of projectile and target deformations on fusion mechanism. Systematic study of the reactions involving spherical and deformed targets with the same projectile ^{28}Si unveils the role of different excitation modes of the projectile (^{28}Si) on fusion process .

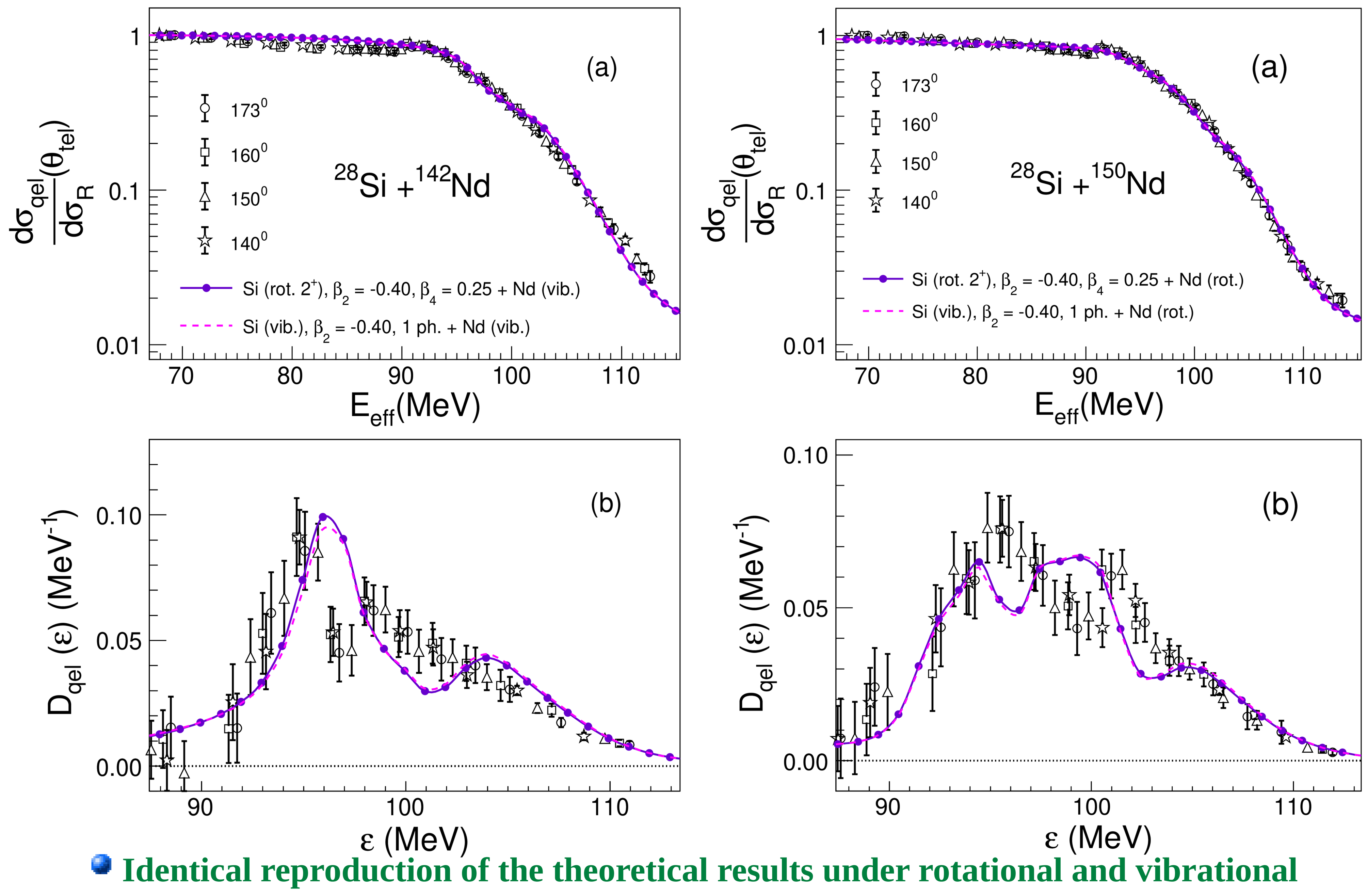
Dependency of Barrier Width on Coupling Strength



System	Coupling Strength
^{28}Si + ^{150}Nd	288.54
^{28}Si + ^{154}Sm	330.27

Reorientation Effect

Experimental data has been taken from Ref. [3]

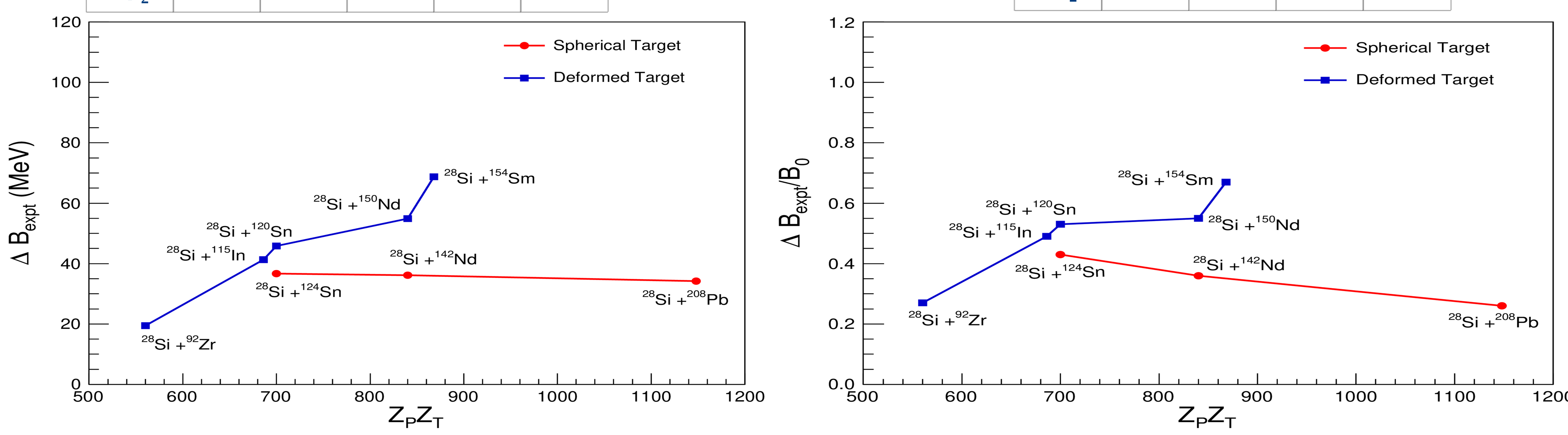


- Identical reproduction of the theoretical results under rotational and vibrational coupling in CCFULL calculation.
- Reorientation term in the coupling matrix becomes zero for β_4/β_2 = - 0.745
- Rotational and vibrational coupling matrices become identical due to cancellation of reorientation term.

Structure effect

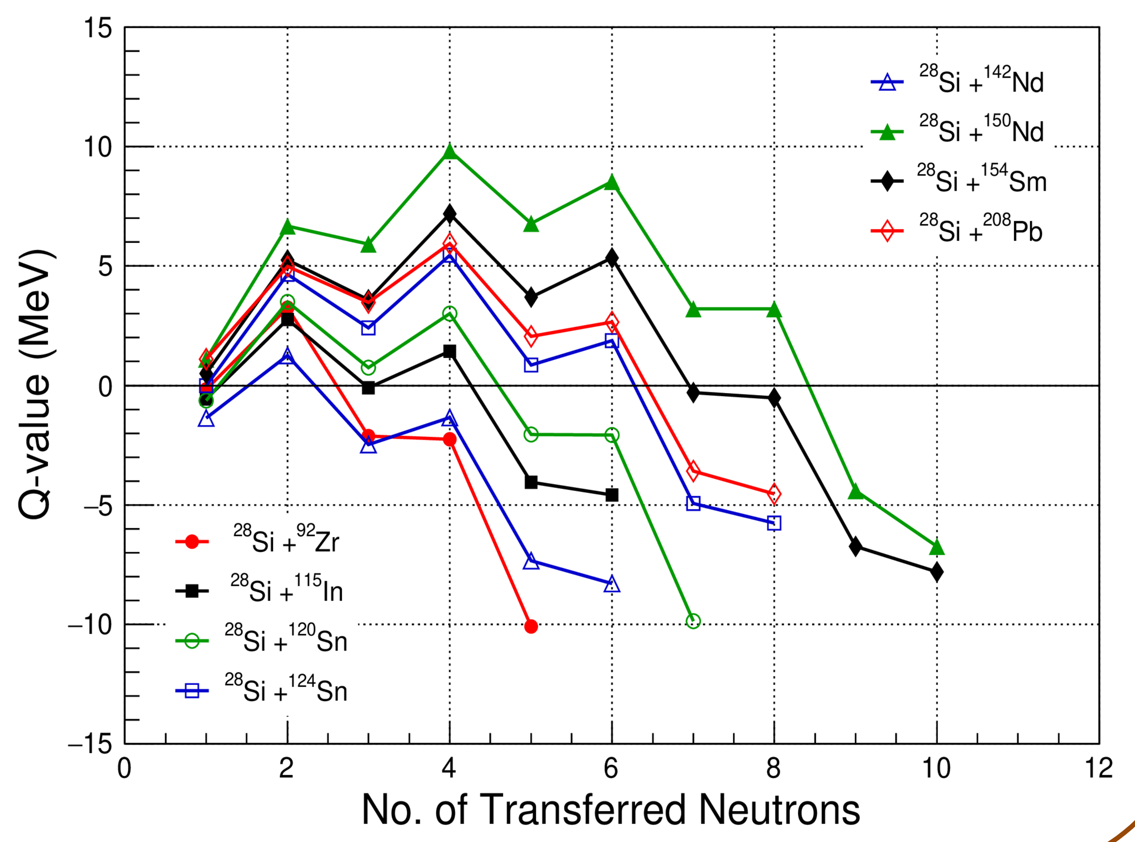
	^{28}Si	^{92}Zr	^{115}In	^{120}Sn	^{124}Sn
β_2	- 0.412	0.101	- 0.115	0.107	0.0952

	^{142}Nd	^{150}Nd	^{154}Sm	^{208}Pb
β_2	0.0916	0.285	0.339	0.0563

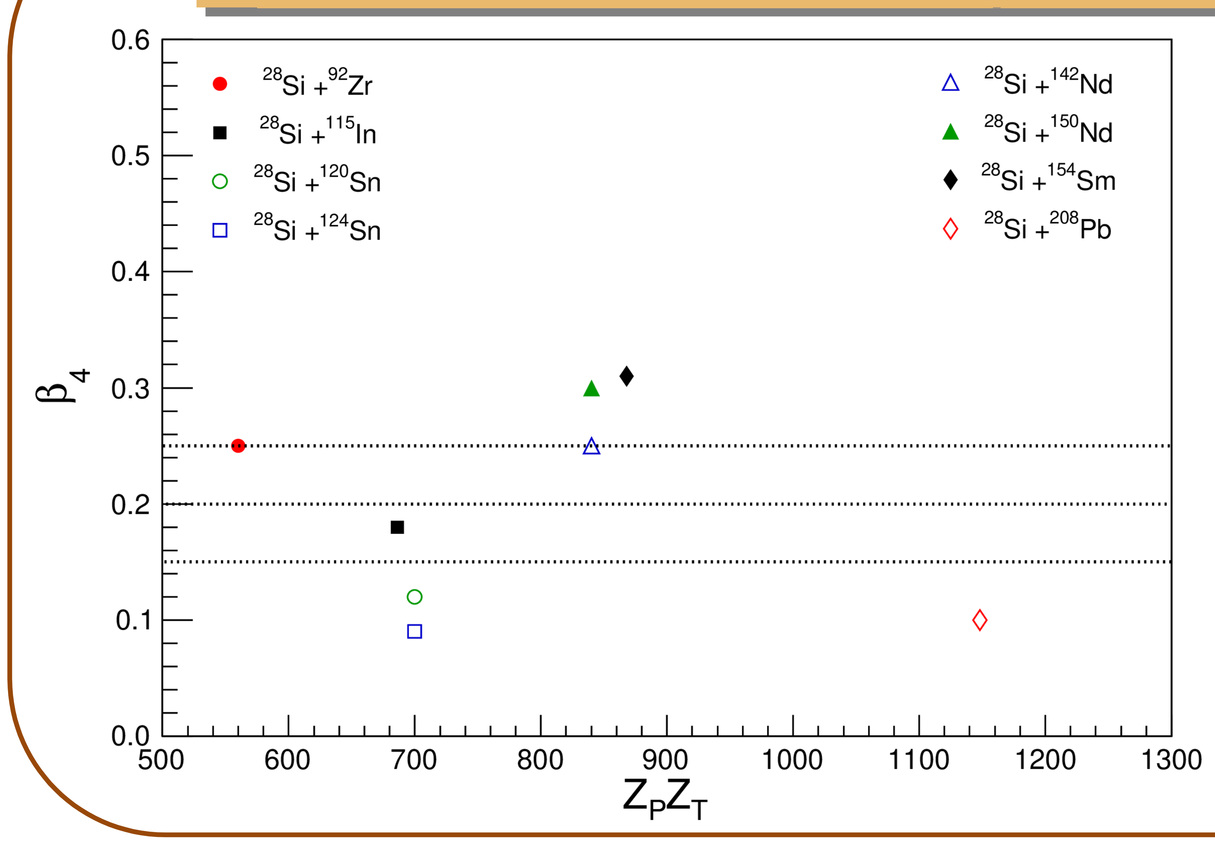


- ΔB_{expt} has been extracted following the procedure described in Ref. [7].
- Structure effect of the participating nuclei plays an important role.
- Positive Q-value neutron transfer channel effects the fusion process.

Q-value



Determination of Hexadecapole Deformation of ^{28}Si



Hexadecapole deformation for ^{28}Si has been obtained for different systems by fitting the experimental barrier distribution data with the predicted results from CCFULL calculations.

References

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