Angular Correlations for Triaxial Nuclear Molecule ^{28}Si-^{28}Si in Resonances

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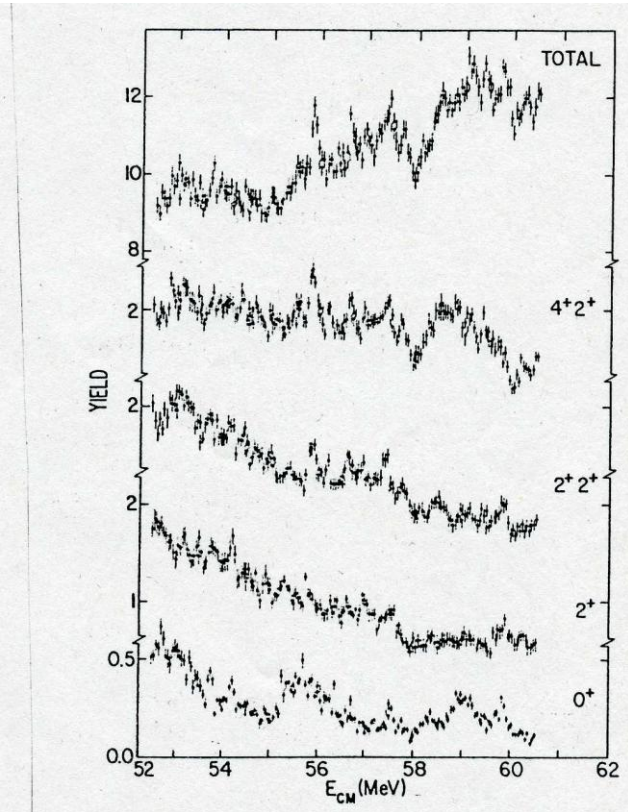
- Intermediate resonances in heavy-ion collisions ^{28}Si+^{28}Si

  R. Betts et al., PRL43(1979)253; PRL47(1981)23

- Angular correlation measurements: Strasbourg at E_{cm}=55.8MeV

  R. Nouicer et al., Phys. Rev. C60(1999) 041303
  C. Beck et al., Phys. Rev. C63(2000) 014607

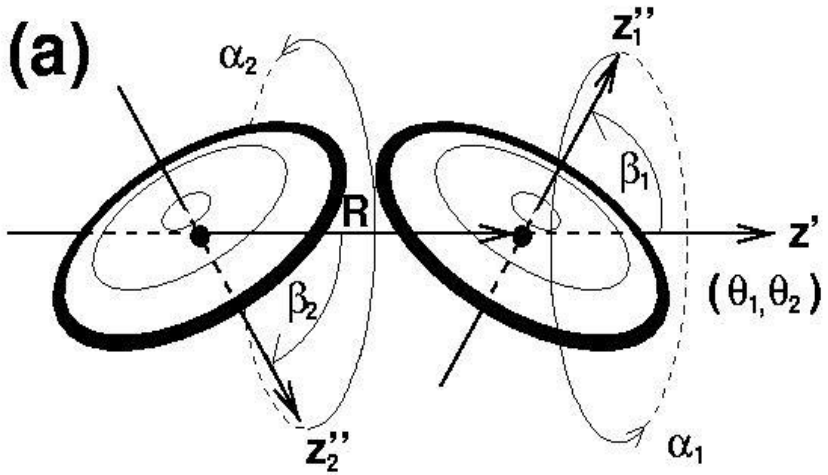
- To clarify the structure of the resonances, normal modes of dinuclear molecule,i.e.,Internal degrees of freedom are investigated. E. Uegaki and Y. Abe, Int. J. Mod. Phys.17(2008)2034

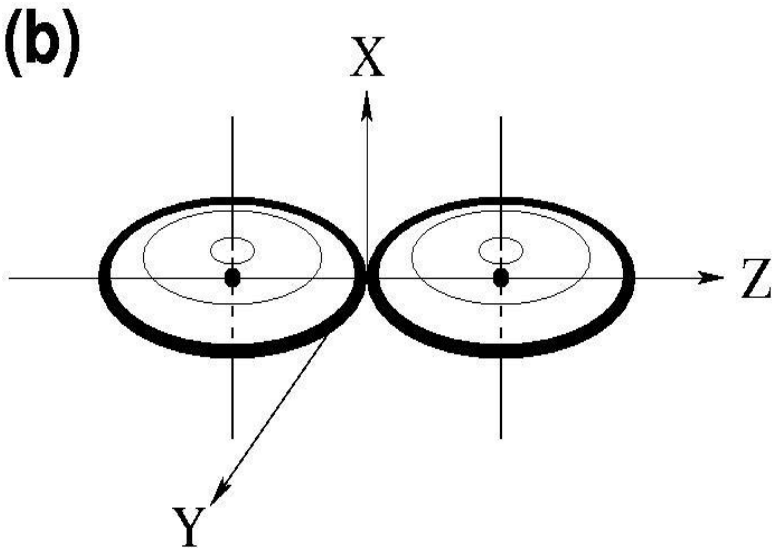


2. Angle-integrated yields of the elas
2^+, mutual 2^+, and mutual $(4^+, 2^+)$ ex
as a function of $E_{c.m.}$. The top part o
ıows the total yield in the spectrum.

^{28}Si-^{28}Si molecular model

- Four internal degrees of freedom: Euler angles
  referring to molecular axis z' and R
- Stable configurations: E-E one
- Wave function by Harmonic Approx.



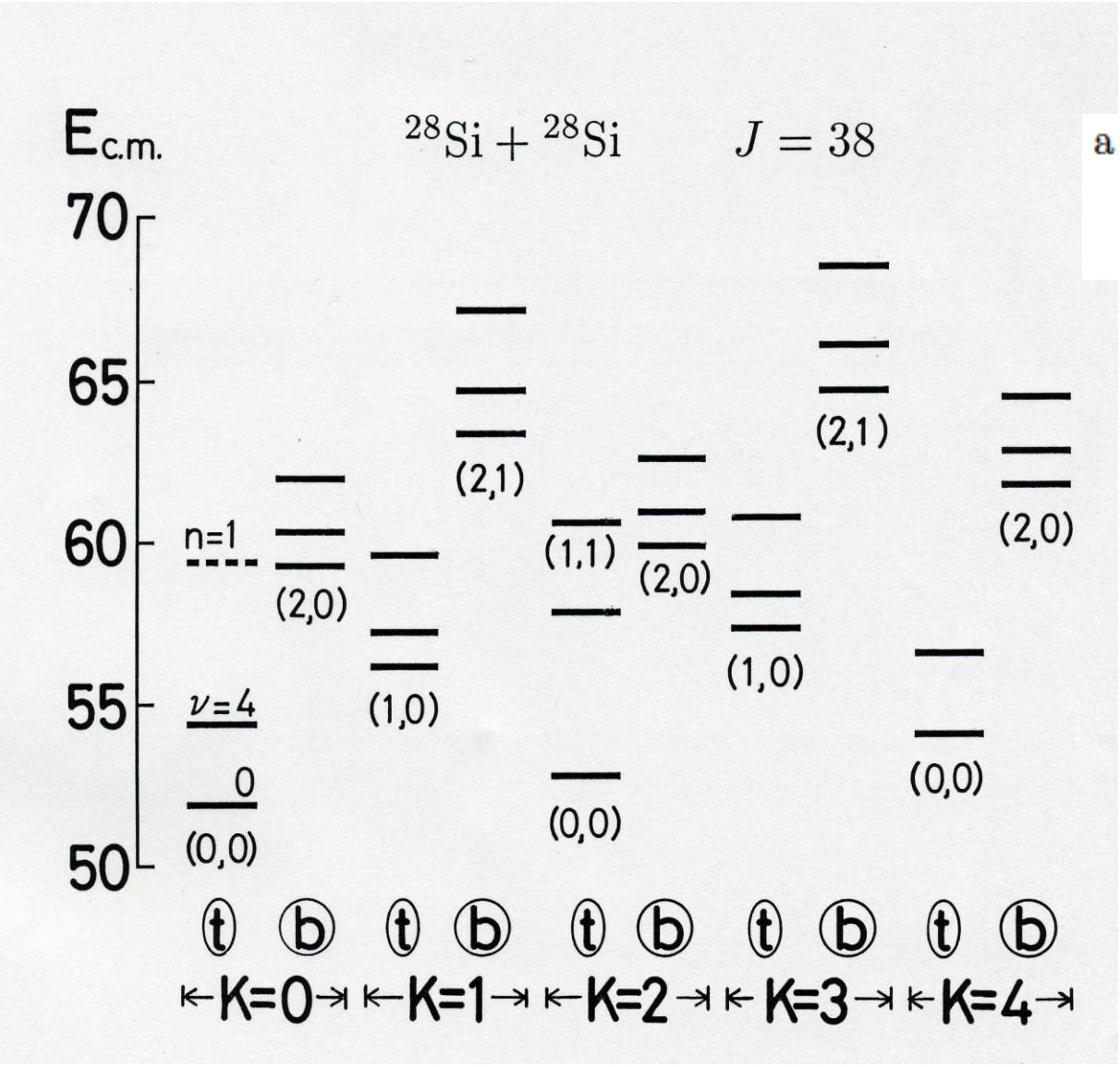


$$\theta_3 = (\alpha_1 + \alpha_2)/2$$

$$\alpha = (\alpha_1 - \alpha_2)/2$$

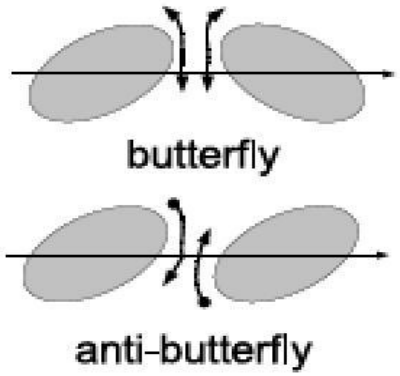
Normal mode spectrum

twisting, butterfly

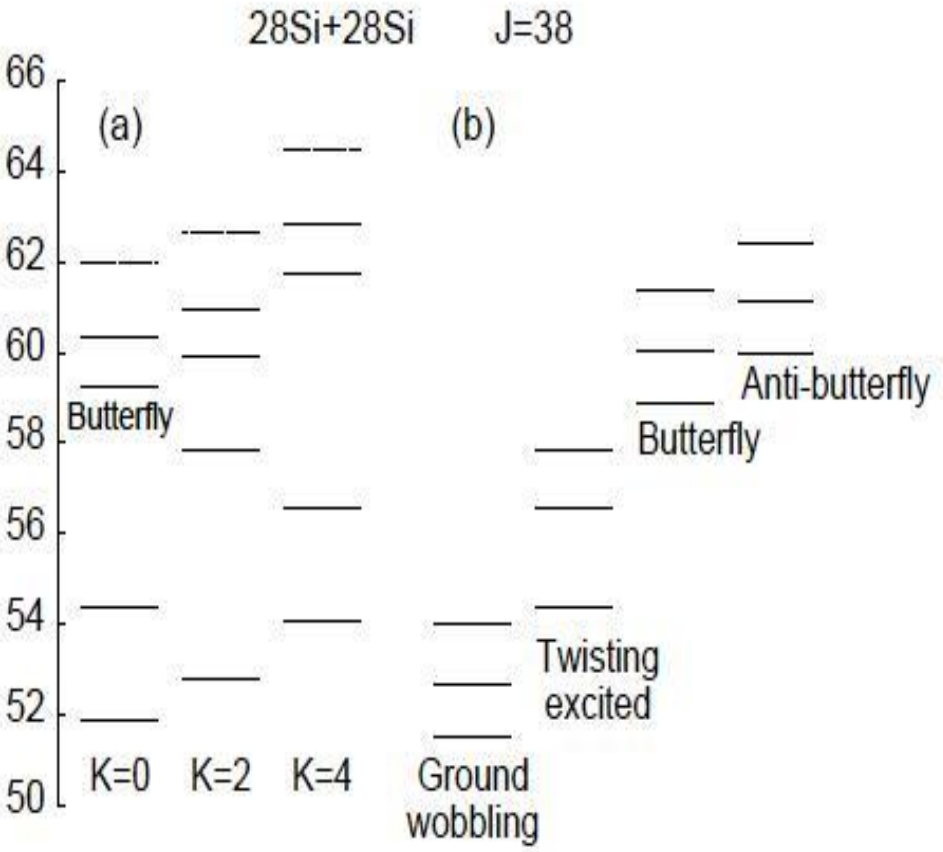


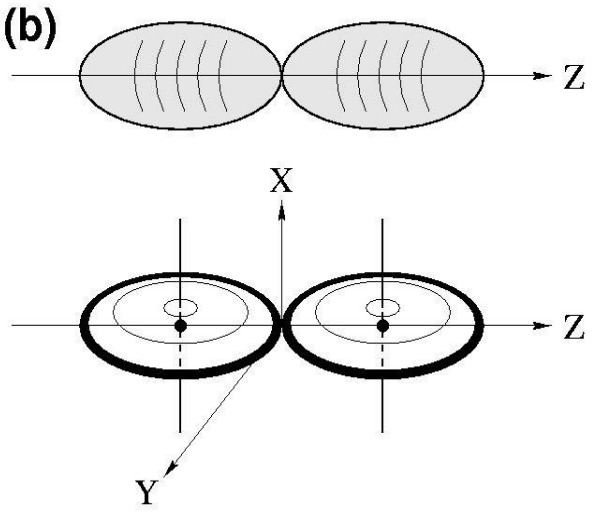
a rotation-vibration type,

$$\Psi_\lambda \sim D^J_{MK}(\theta_i)\chi_K(R,\alpha,\beta_1,\beta_2).$$



Wobbling motion (K-mixing)



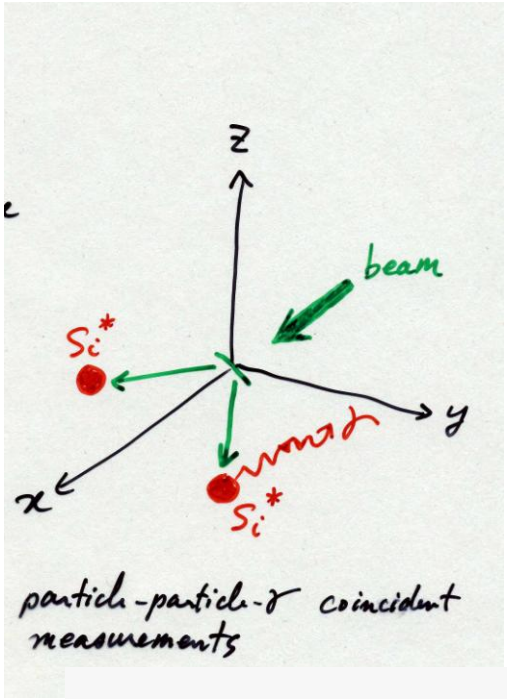


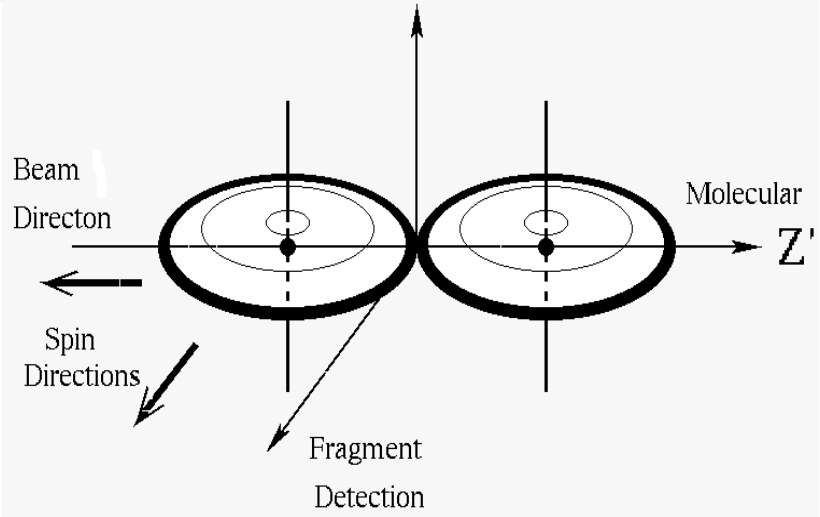
Asymmetric shape
of E-E configuration

Fig. 3. Energy spectra of the $^{28}Si + ^{28}Si$ system for $J = 38$. (a) Molecular normal modes without K-mixing. (b) After K-mixing, with indications of the modes under the levels.

Fragment-fragment-γ angular correlations

4πdata => z-axis of the quantization



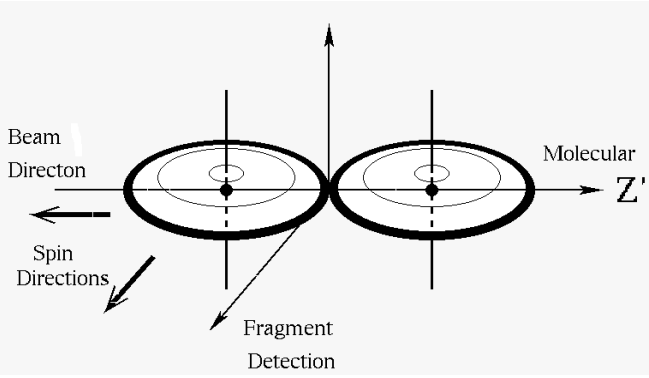


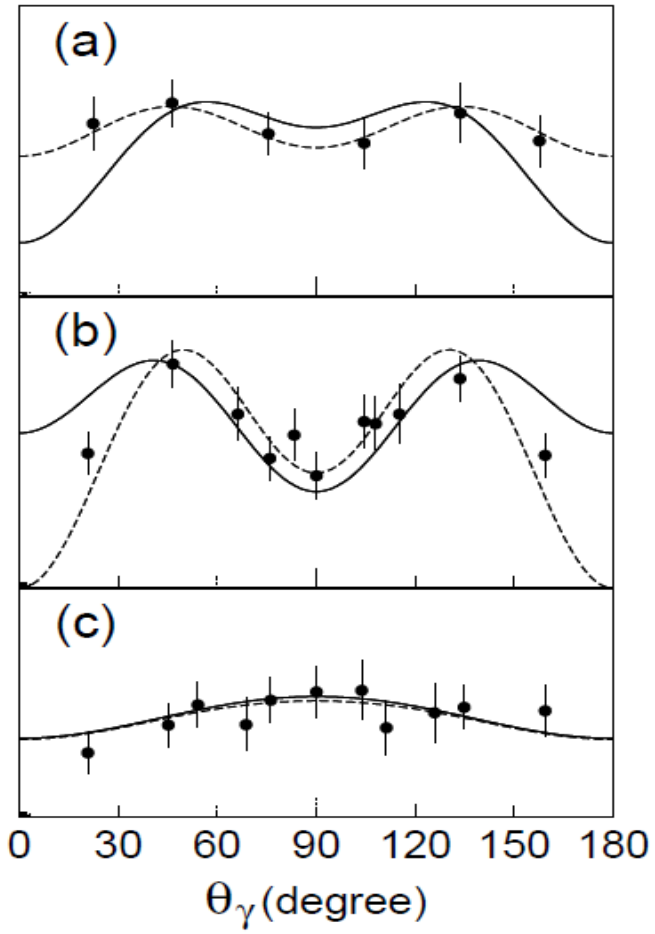
- One photon be averaged
- Directions of z-axis :
  a) beam
  b) normal
  c) fragments
- Integration on φ

Angular correlations for Mutual 2^+ decay

Theory: Molecular ground state
with wobbling
J=38
Solid lines

Data by Strasbourg Group:
dashed lines : data plot
and x^2-fit
at E_{cm}=55.8MeV





Angular correlations for Mutual 2^+ decay

Twisting

Butterfly

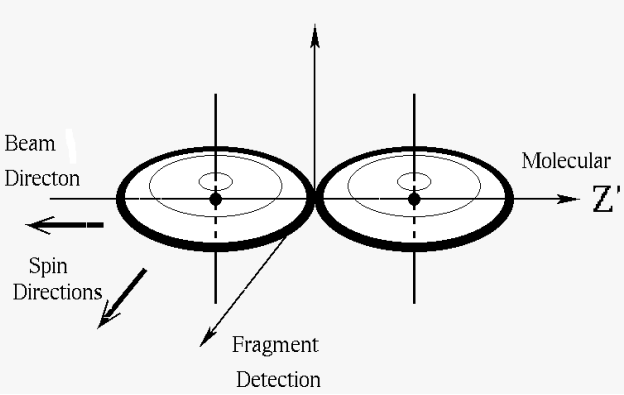
m∼2 in (a)

m∼2 in (c)

(a)

(b)

(c)



Conclusions

- States of the normal modes
  ==> the origin of the narrow resonances.
- The molecular ground state with J=38 is a candidate for Ecm=55.8MeV resonance.
- Structure is asymmetric ^{28}Si-^{28}Si molecule.
- Since the angular correlations indicate different characteristics among the normal modes, we are able to identify their excitations.
  Experimental information on the other ^{28}Si+^{28}Si resonances is strongly called for.