SYMMETRY BREAKING, RMT AND NUCLEI

A -- USE NUCLEUS AS TEST LABORATORY FOR RMT PREDICTIONS

B -- ASSUME RMT TO INTERPRET NUCLEAR PHENOMENA

A -- ISOSPIN SYMMETRY BREAKING
EFFECT ON LEVEL STATISTICS
EFFECT ON TRANSITIONS

B -- PARITY VIOLATION
ENHANCEMENT IN COMPOUND NUCLEUS
EFFECT OF SYMMETRY BREAKING
ON LEVEL STATISTICS

ISOSPIN

REQUIREMENTS

LEVELS WITH KNOWN QUANTUM NUMBERS

COEXISTENCE OF LEVELS WITH DIFFERENT ISOSPIN

FROM GROUND STATE COEXISTENCE
ONLY FOR N = Z = ODD

SUCH NUCLEI ACCESSIBLE
WITH SUFFICIENT # OF LEVELS
IN S-D SHELL

26Al AND 30P
\[ H = H_{sc} + \alpha H_{sb} \]

\[ H = \begin{bmatrix} T=0 & 0 \\ 0 & T=1 \end{bmatrix} + \alpha \begin{bmatrix} 0 & V \\ V & 0 \end{bmatrix} \]

REDIAGONALIZE, EIGENVALUES CHANGE

EFFECT ON STATISTICAL OBSERVABLES

DEPENDS ON \( \lambda = \alpha / D \), NOT JUST \( \alpha \)

SMALL SYMMETRY BREAKING CAN LEAD TO LARGE EFFECT
### $^{30}$P Level Statistics

<table>
<thead>
<tr>
<th>Levels</th>
<th>Brody Parameter $\omega$</th>
</tr>
</thead>
<tbody>
<tr>
<td>All States (T Ignored)</td>
<td>0.54 ± 0.17</td>
</tr>
<tr>
<td>All States (T Separated)</td>
<td>0.60 ± 0.22</td>
</tr>
</tbody>
</table>

### $^{26}$Al Level Statistics

<table>
<thead>
<tr>
<th>Levels</th>
<th>Brody Parameter $\omega$</th>
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</thead>
<tbody>
<tr>
<td>All States (T Ignored)</td>
<td>0.54 ± 0.11</td>
</tr>
<tr>
<td>All States (T Separated)</td>
<td>0.54 ± 0.14</td>
</tr>
</tbody>
</table>
IN 26AI AND 30P
EIGENVALUE DISTRIBUTIONS
STRONGLY AFFECTED
BY ISOSPIN SYMMETRY BREAKING

PREDICTED BY DYSON, PANDEY
EXPLAINED BY
GUHR AND WEIDENMUELLER
(HEIDELBERG)
HUSSEIN AND PATO
(SAO PAULO)

CONFIRMED IN
COUPLED MICROWAVE CAVITIES
A. RICHTER
(DARMSTADT)

CONFIRMED IN
QUARTZ BLOCKS
C. ELLEGAARD
(COPENHAGEN)

EFFECT OF SYMMETRY BREAKING
ON EIGENVALUES
UNDERSTOOD
GOE

AMPLITUDES GAUSSIAN DISTRIBUTED

DISTRIBUTION OF STRENGTHS
(AMPLITUDES SQUARED)

CHI-SQUARED OF ONE DEGREE OF FREEDOM

PORTER THOMAS

REDUCED MATRIX ELEMENTS $B(XL)$

NORMAlIZED TO LOCAL AVERAGE $B(XL)$

$Y = B(XL) / <B(XL)>$

LARGE RANGE OF $B$ (AND $Y$) VALUES

INTRODUCE NEW VARIABLE

$Z = \ln(\text{BASE10}) Y$
$\chi^2$ Distribution Function for Different $\nu$ Values
\[
\langle \tilde{u} | 0 | \tilde{u} \rangle \text{ TRANSITIONS}
\]

\[
\text{WAVEFUNCTIONS CHANGE}
\]

\[
\text{EIGENVALUES CHANGE}
\]

\[
\text{REDIAGONALIZE}
\]

\[D \text{ DEPENDS ON \( \gamma = a / D \)}
\]

\[
\text{STATISTICAL OBSERVABLES EFFECT ON}
\]

\[
\begin{bmatrix}
0 & 0 \\
0 & 0
\end{bmatrix}^\gamma + \begin{bmatrix}
0 & T = 1 \\
T = 0 & 0
\end{bmatrix} = H
\]

\[H = H_{SC} + a H_{SP}
\]
FOLLOWING

WU—AMBLER, GARWIN—LEDERMAN

MANY STUDIES OF PARITY VIOLATION IN STRONG INTERACTION PROCESSES

CONFLICTING RESULTS (MAINLY RUSSIAN) IN NEUTRON-INDUCED REACTIONS LOOKING AT GAMMA RAYS

FINALLY AT ILL VERY LARGE NEUTRON SPIN ROTATION

CONFUSION EXTREME EXAMPLE RESORT TO FIFTH FORCE

EXPLANATION SUSHKOV—FLAMBAUM

OBSERVATION OF LARGE PARITY VIOLATION IN NEUTRON RESONANCES IN 139LA FRANK LABORATORY, DUBNA

THEN WE STARTED TRIPLE COLLABORATION
1. PNC asymmetry for mixing with several s-levels

The observed asymmetry for a given $p$-wave level $\mu$ has contributions from many $s$-wave levels $\nu$, and the PNC asymmetry is

$$p_\mu = 2 \sum_\nu \frac{V_{\nu\mu}}{E_\nu - E_\mu} \frac{\Gamma_{\nu\mu}^{1/2}}{\Gamma_{\mu\mu}^{1/2}},$$

(1)

which can be rewritten as

$$p_\mu = \sum_\nu A_{\nu\mu} V_{\nu\mu},$$

(2)

with $A_{\nu\mu} = 2(\Gamma_{\nu\nu}/\Gamma_{\mu\mu})^{1/2}/(E_\nu - E_\mu)$, where $(\Gamma_{\mu\mu})^{1/2} \equiv g_\mu$ and $(\Gamma_{\nu\nu})^{1/2} \equiv g_\nu$ are the neutron decay amplitudes of levels $\mu$ and $\nu$, $E_\mu$ and $E_\nu$ are the corresponding resonance energies, and $V_{\nu\mu}$ is the matrix element of the PNC interaction between levels $\mu$ and $\nu$. The $A_{\nu\mu}$ are known since they are functions of the known neutron widths and the resonance energies. There are many more unknown $V_{\nu\mu}$ than there are equations and therefore the individual mixing matrix elements $V_{\nu\mu}$ cannot be determined.

We assumed that the $V_{\nu\mu}$ were independent Gaussian random variables with mean zero and variance $M_2^2$. The variance $M_2^2$ is the weak interaction mean-squared matrix element. Since each $p_\mu$ is the sum of the variables $V_{\nu\mu}$ with constant coefficients, each $p_\mu$ is a Gaussian random variable with variance $M_2^2 A_\mu^2$, where $A_\mu^2 = \sum_\nu A_{\nu\mu}^2$. 