Possibility to measure level densities as a function of spin using AGATA

Sunniva Siem

University of Oslo

AGATA Physics week 2004
Today’s Menu

- Physics motivation
- Level densities
- $\gamma$-strength functions
- How AGATA opens for exiting future experiments
Spin energy diagram

New region to explore using AGATA?

I ~ 6 h

Spin

OSLO

Bn

Excitation energy

Yrast

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CACTUS- experimental setup

- Reactions: \( (^3\text{He},\alpha) \) and \( (^3\text{He},^3\text{He}^*) \)

- Beam: 45 MeV

- Targets: Yb, Dy, Er, Sm, Nd, Si, Mo, V,++

- 8 Si particle telescopes at \( \Theta = 45^\circ \)

- Spin 0-6

- CACTUS detector array (28 NaI + 2Ge) has 15% efficiency

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S. Siem et al. PRC65(2002)

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Energy distribution of primary $\gamma$ rays contains info on:

level density $\rho(E_f)$

$\gamma$ ray strength function

$= T(E_\gamma)/E_\gamma^{2L+1}$

Brink-Axel:

$P(Ex,E_\gamma) \sim T(E_\gamma) \rho(E_f)$

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Normalization of level density
Level densities for even and odd rare earth nuclei

The Sm nuclei (triangles) are closer to a closed shell and have smaller level density

S. Siem et al. PRC65(2002)  AGATA Physics week 2004
Microcanonical ensemble

\[ S(E) = \ln \rho_{\text{exp}}(E) + S_0 \]

\[ T(E) = \left( \frac{\partial S(E)}{\partial E} \right)^{-1} \]

\[ C_v(E) = \left( \frac{\partial T(E)}{\partial E} \right)^{-1} \]
Microcanonical Temperature

S.Siem et al. PRC65(2002)

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$^{148}\text{Sm}$ strength function

- Circles our data
- Squares from photoabsorption cross sections P.Carlos et al. NPA 225 (1974)
- Filled triangle is based on neutron capture in $^{147}\text{Sm}$

S.Siem et al. PRC65(2002)

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Total $\gamma$–spectrum from $E_x = B_n$

Data points from (n,$\gamma$)-experiments B.Duamet, M. Igashira et al. Nucl.Sci.Tec.36 (1999). Solid line is calculated from our level densities and strength functions.

S.Siem et al. PRC65(2002)
$\gamma$-strength functions

Filled circles: (3He,α)  
Open circles: (3He,3He$^*$)

R. Chankova PhD thesis  AGATA Physics week 2004
Level density above neutron binding energy $B_n$

Above $B_n$ competition between neutron and $\gamma$ emission. Gates on yrast transitions to select $\gamma$ events.
Level density as a function of spin

gating on yrast transitions to select spin
Why we would like to do experiments with AGATA

- Combination of high efficiency, highly segmented and excellent energy resolution
- Possibility to gate on yrast transition of different spin and still have enough statistics to do our analysis
- Study level density as a function of spin
- Study level density 1-2MeV above Bn
- Polarization measurements of the upbend in the strength function at low $E_\gamma$

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Collaborators

- R.Chankova, M.Guttormsen, F.Ingebretsen, J.Rekstad, C.Sunde, S.Ødegård, University of Oslo
- A.Voinov, Dubna, Russia
- U.Agvaanluvysan, G.Mitchell, TUNL, USA
- J.A.Becker, L.Bernstein, LLNL, USA
- A.Schiller, MSU, USA
- T.Lønnroth, Åbo, Finland
- T.Belgya, Budapest, Hungary
- E.Algin, Tyrkia