

Level Densities and γ -ray Strength Functions

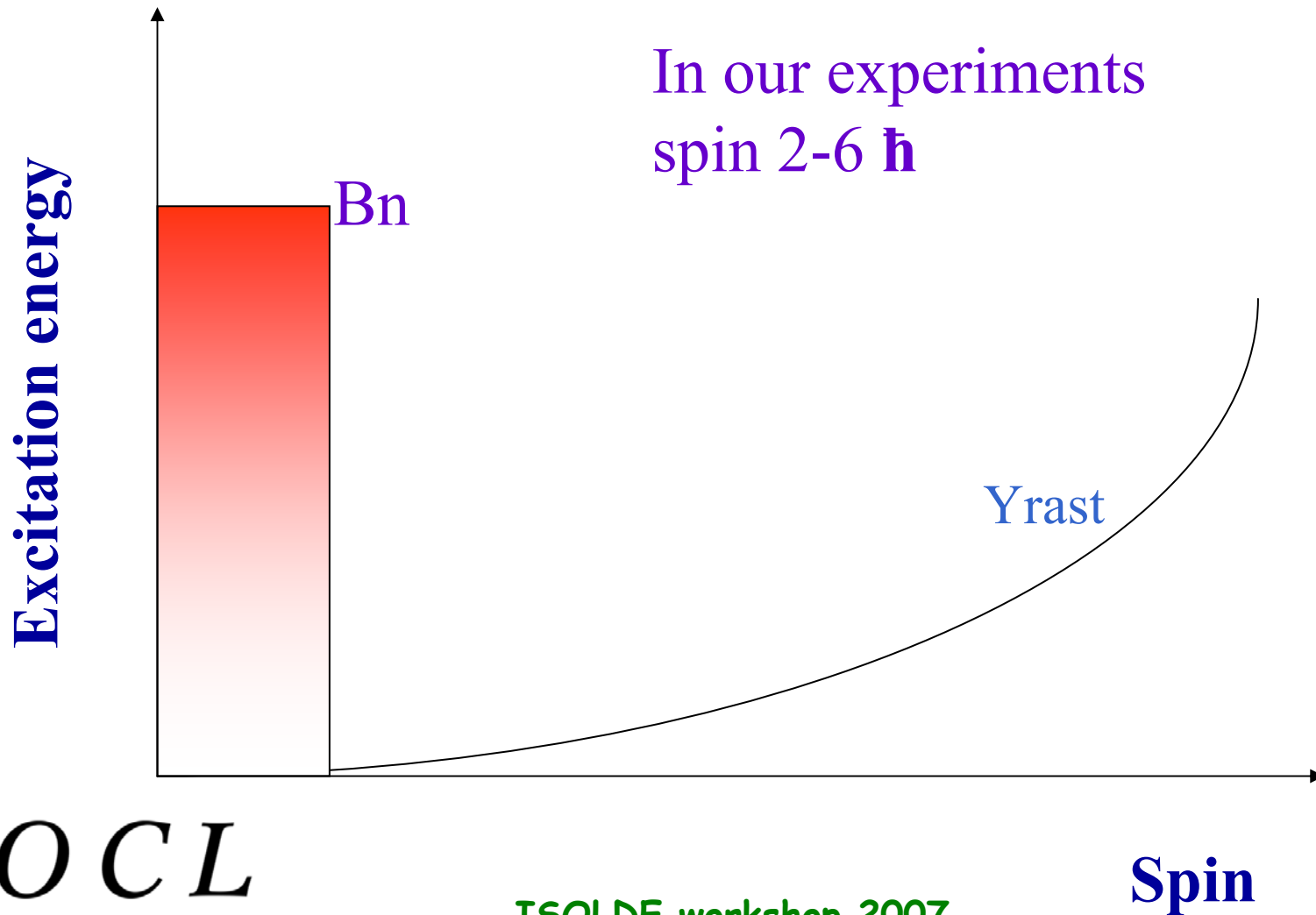
Sunniva Siem

University of Oslo



ISOLDE workshop 2007

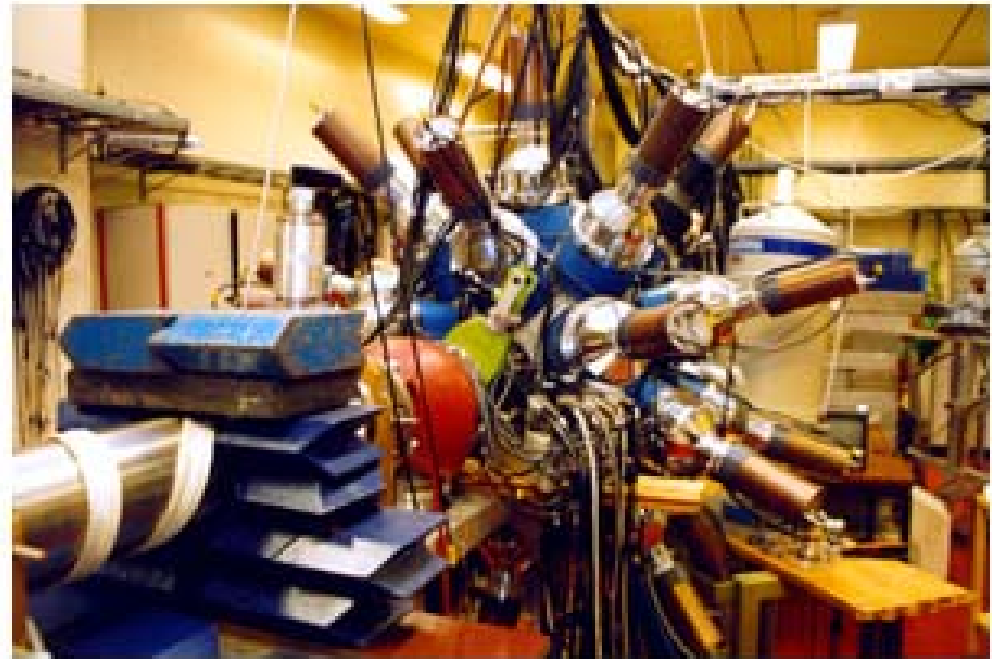
Spin energy diagram



CACTUS- experimental setup

- Reactions: (${}^3\text{He},\alpha$) and (${}^3\text{He},{}^3\text{He}'$)
- Beam: 30-45 MeV
- Targets: Yb, Dy, Er, Sm, Nd, Si, Mo, Fe, Sn, V, Pb, Ti, Ni
- 8 Si particle telescopes at $\Theta = 45^\circ$

• Spin 2-6 \hbar



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

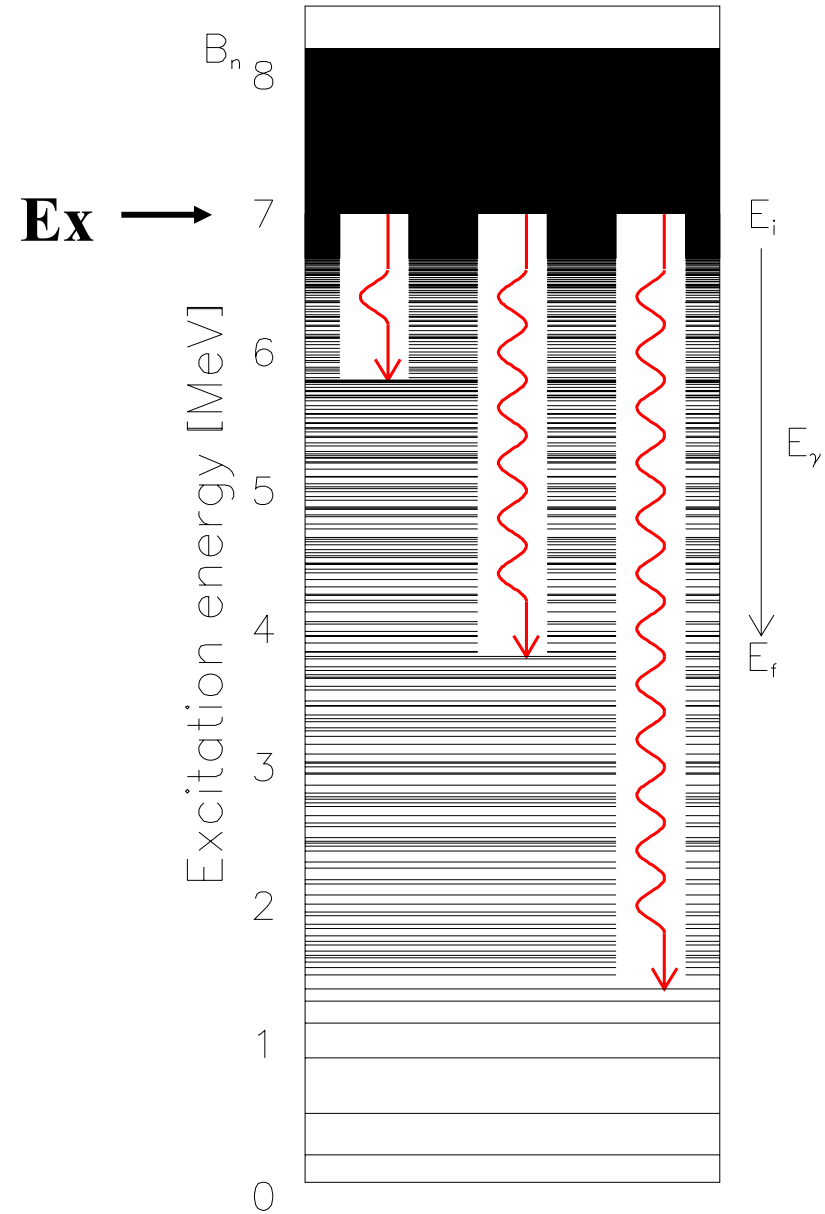
Energy distribution of primary γ rays contains info on:

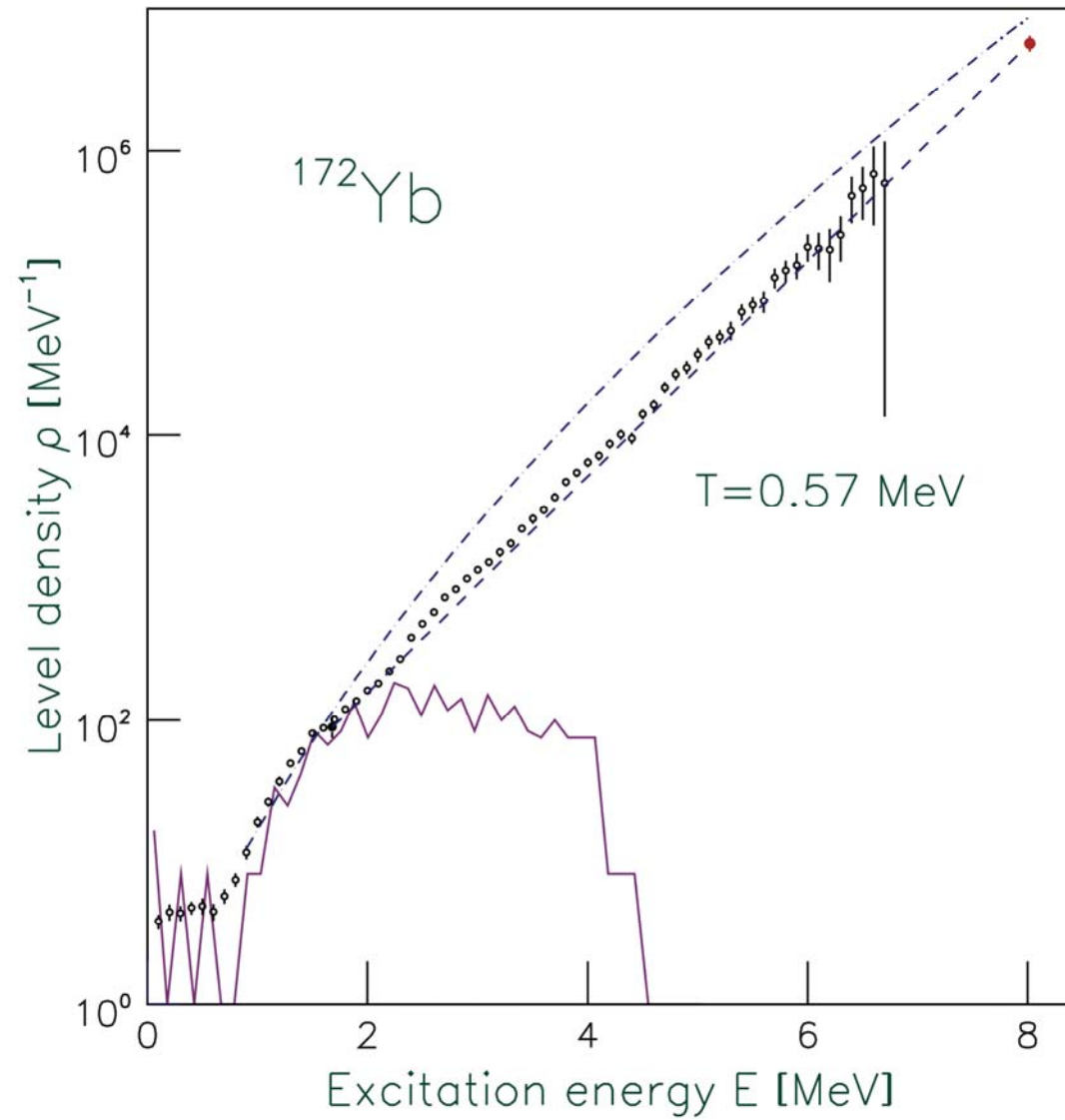
level density $\rho(E_f)$

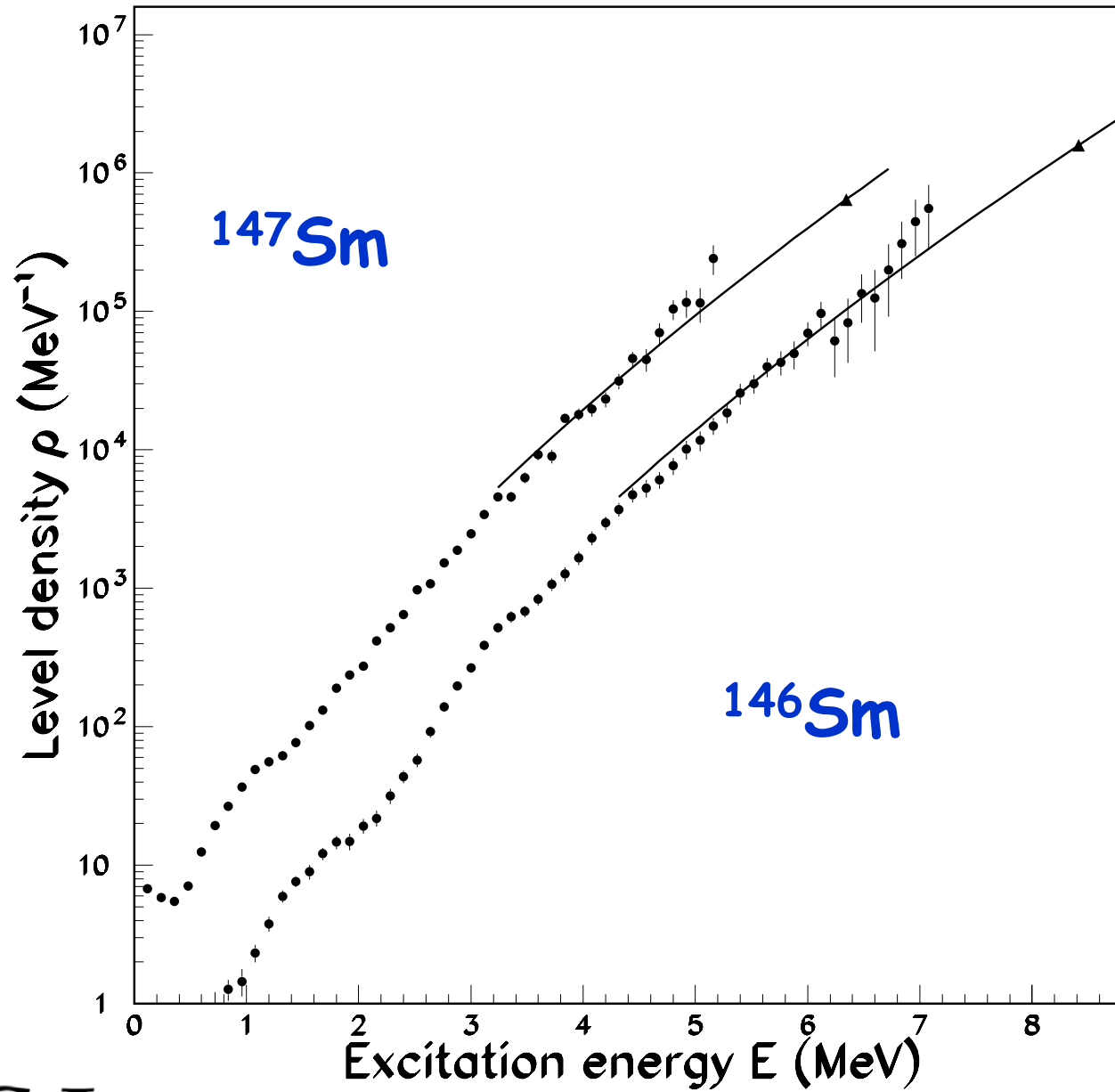
γ -ray transmission coefficient $T(E_\gamma)$

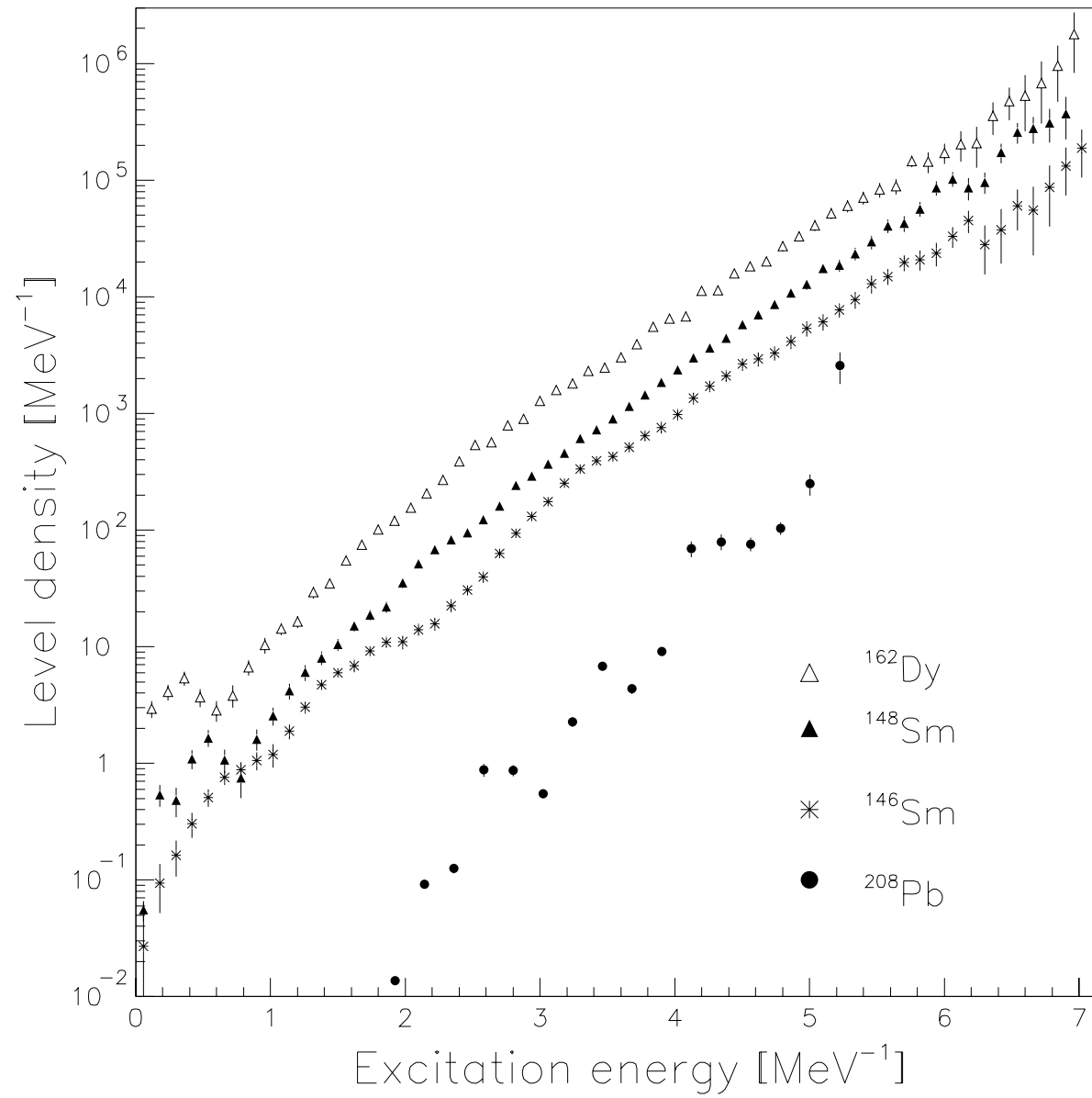
Brink-Axel:

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









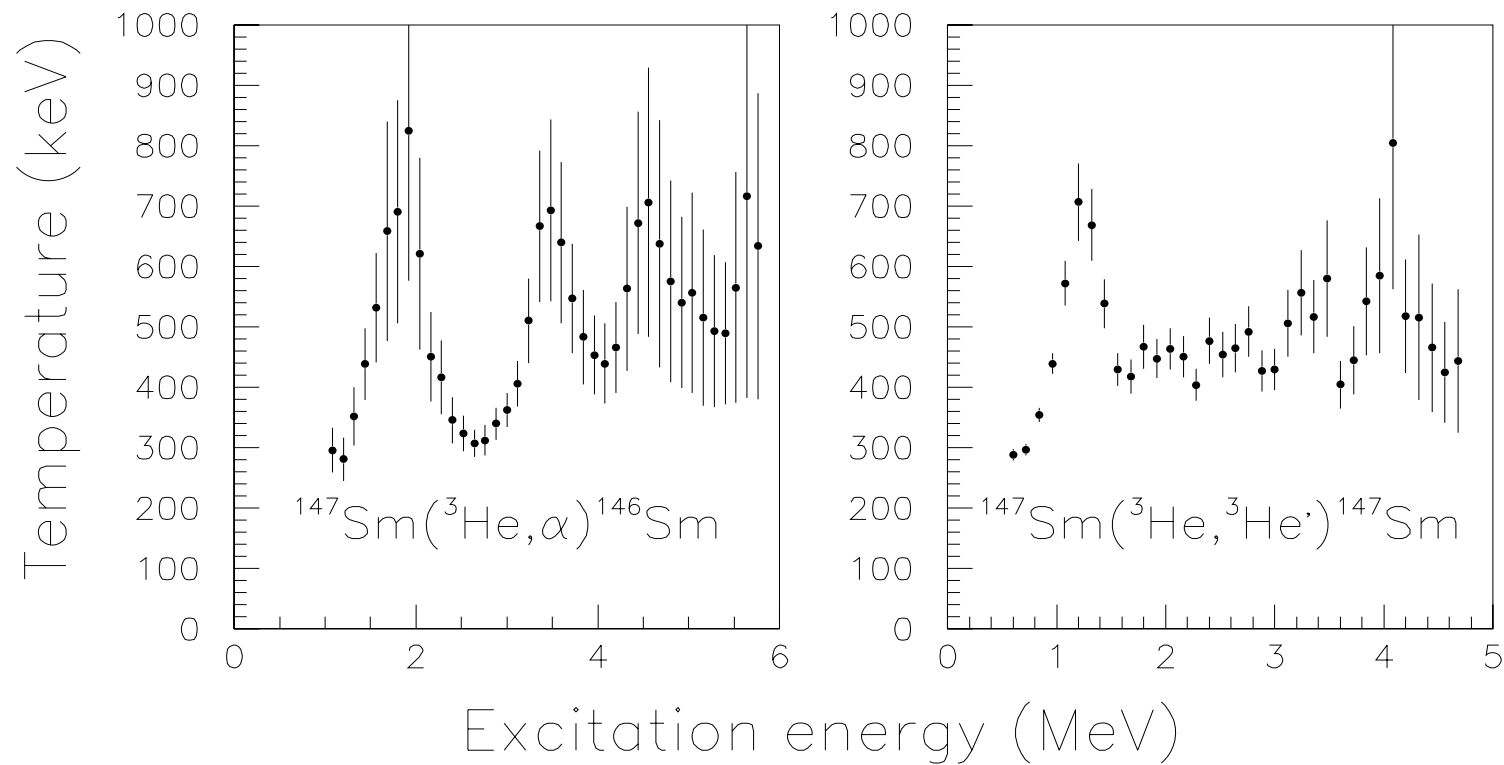
Microcanonical ensemble

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

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

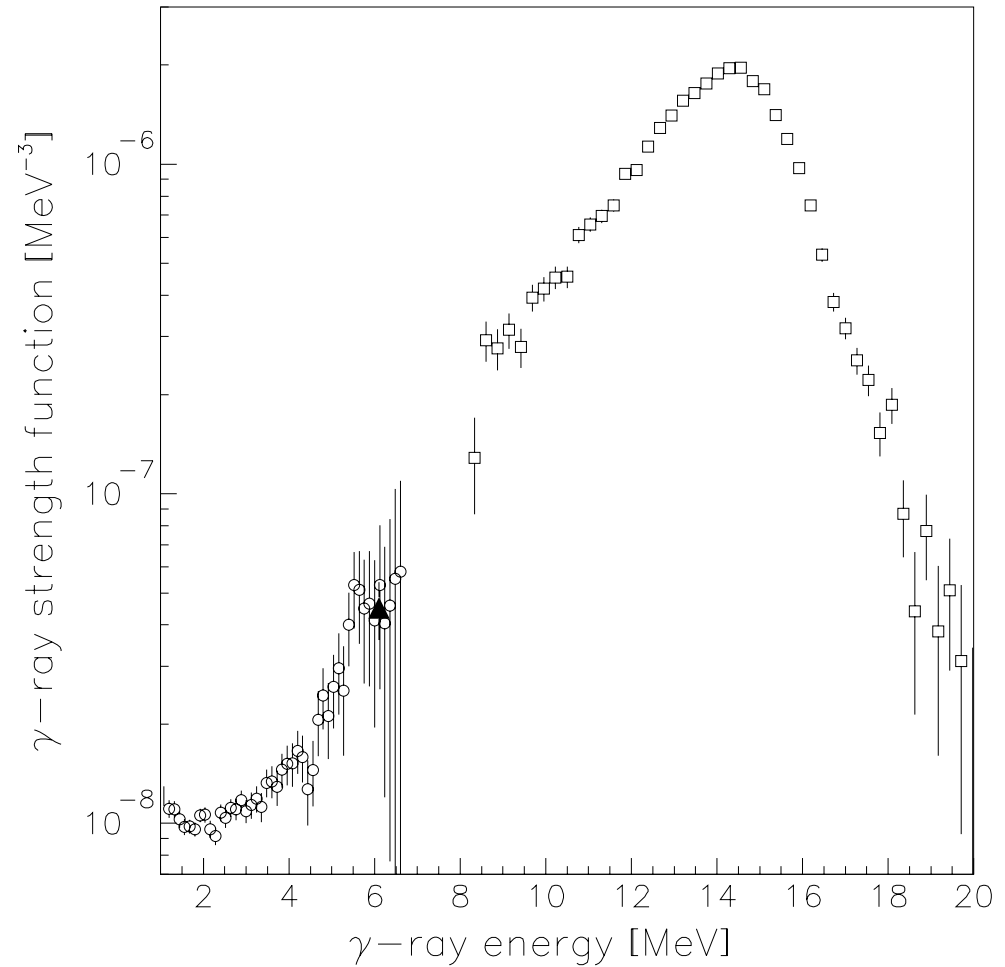
$$C_V(E) = \left(\frac{\partial T(E)}{\partial E} \right)^{-1}$$

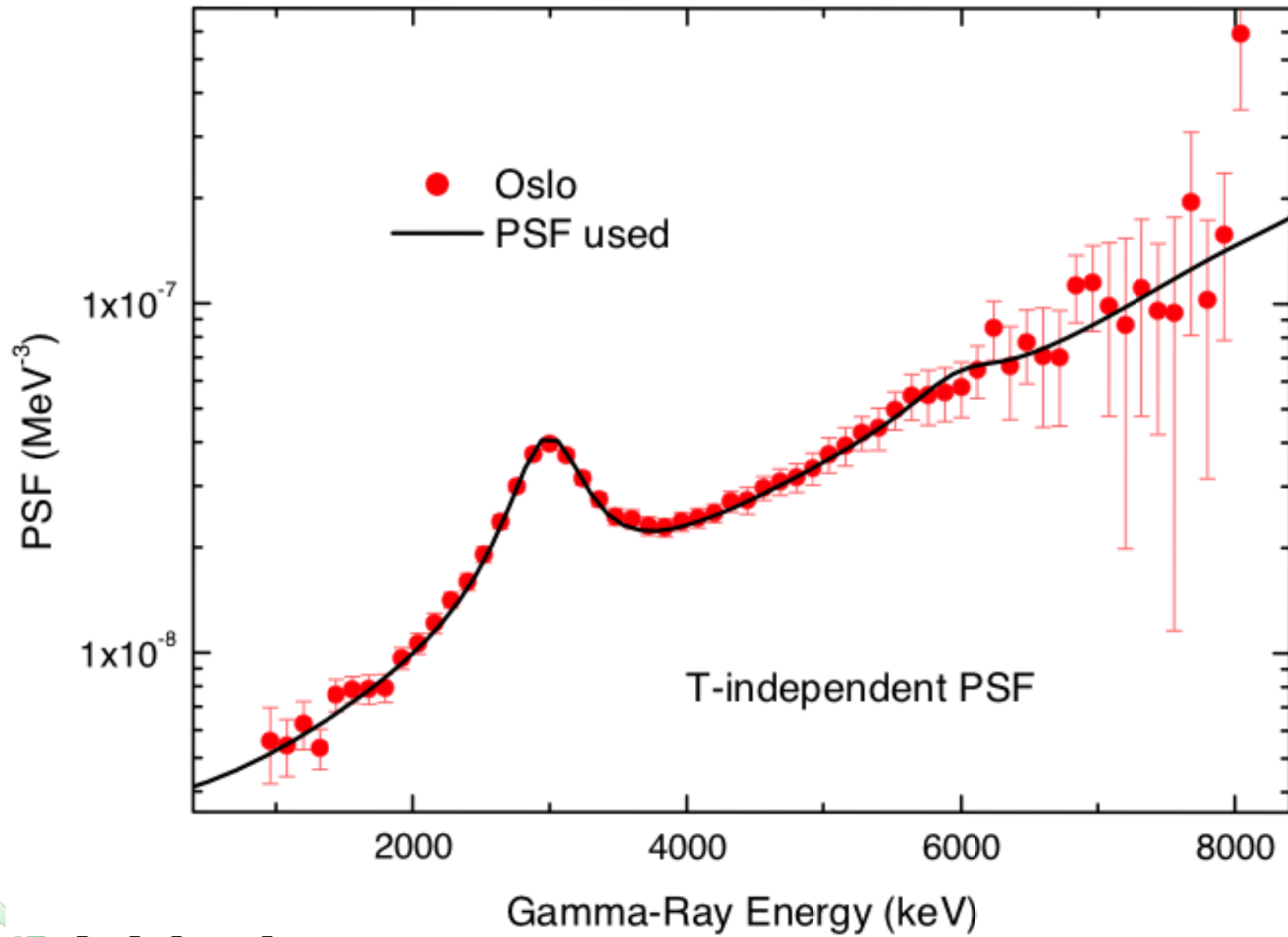
Microcanonical Temperature

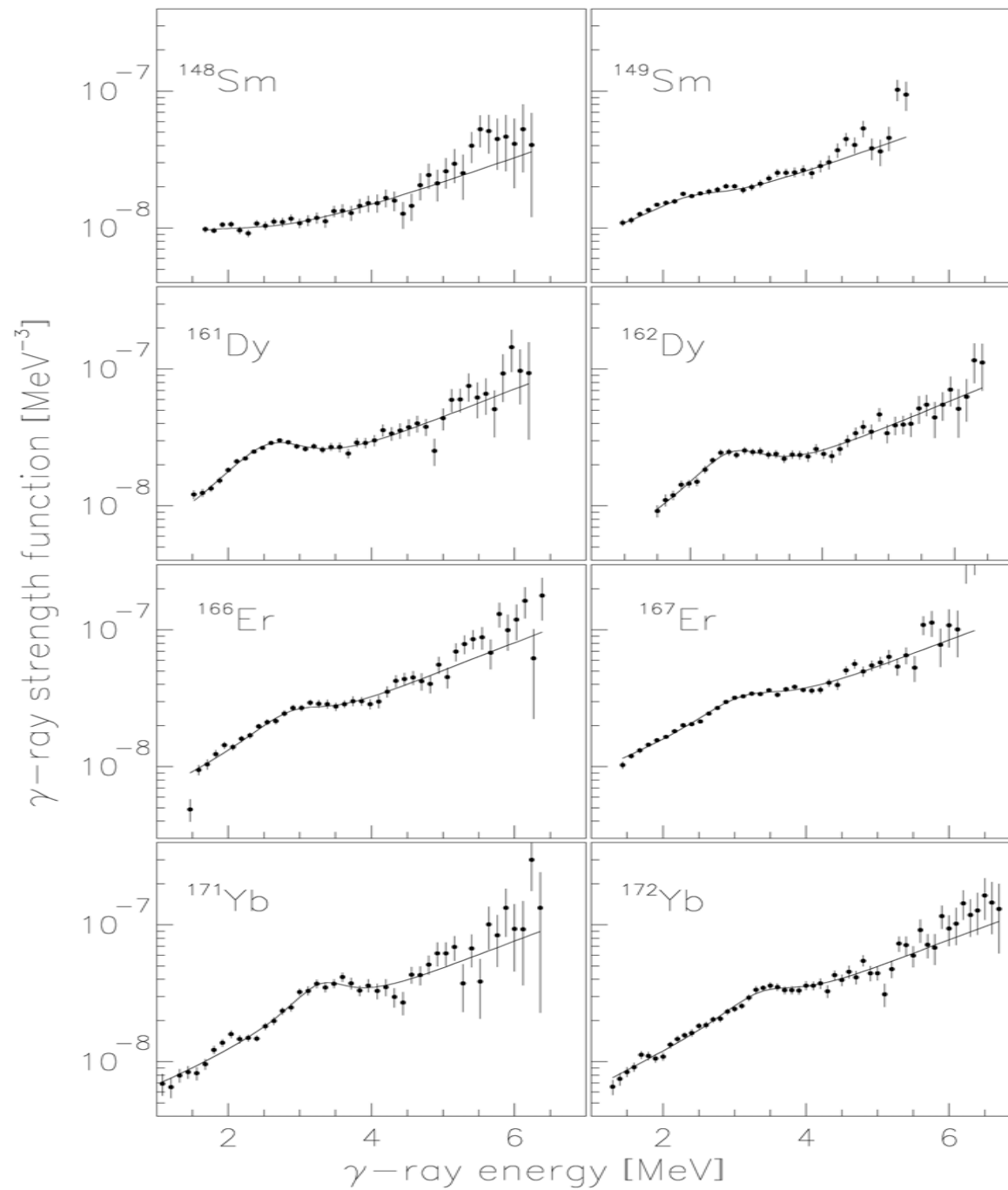


^{148}Sm strength function

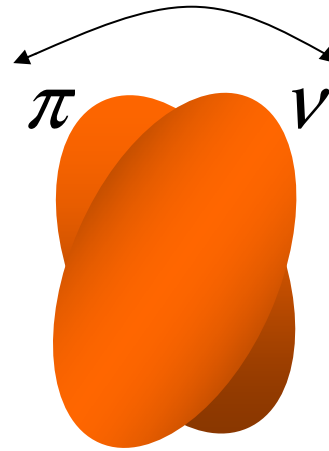
- Circles our data
- Squares from photoabsorption cross sections P.Carlos et al. NPA 225 (1974)
- Filled triangle is based on neutron capture in ^{147}Sm





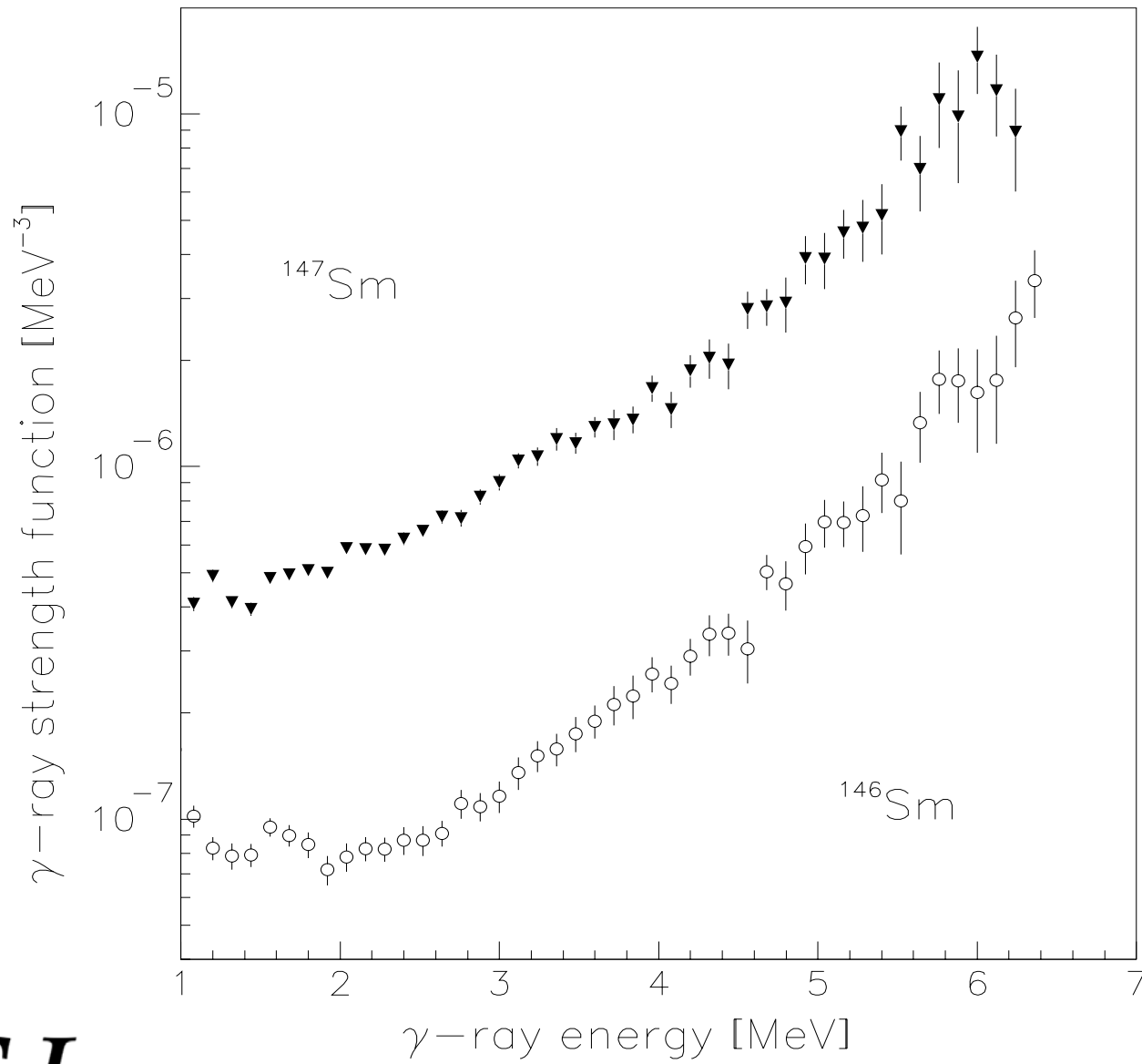


Scissors mode

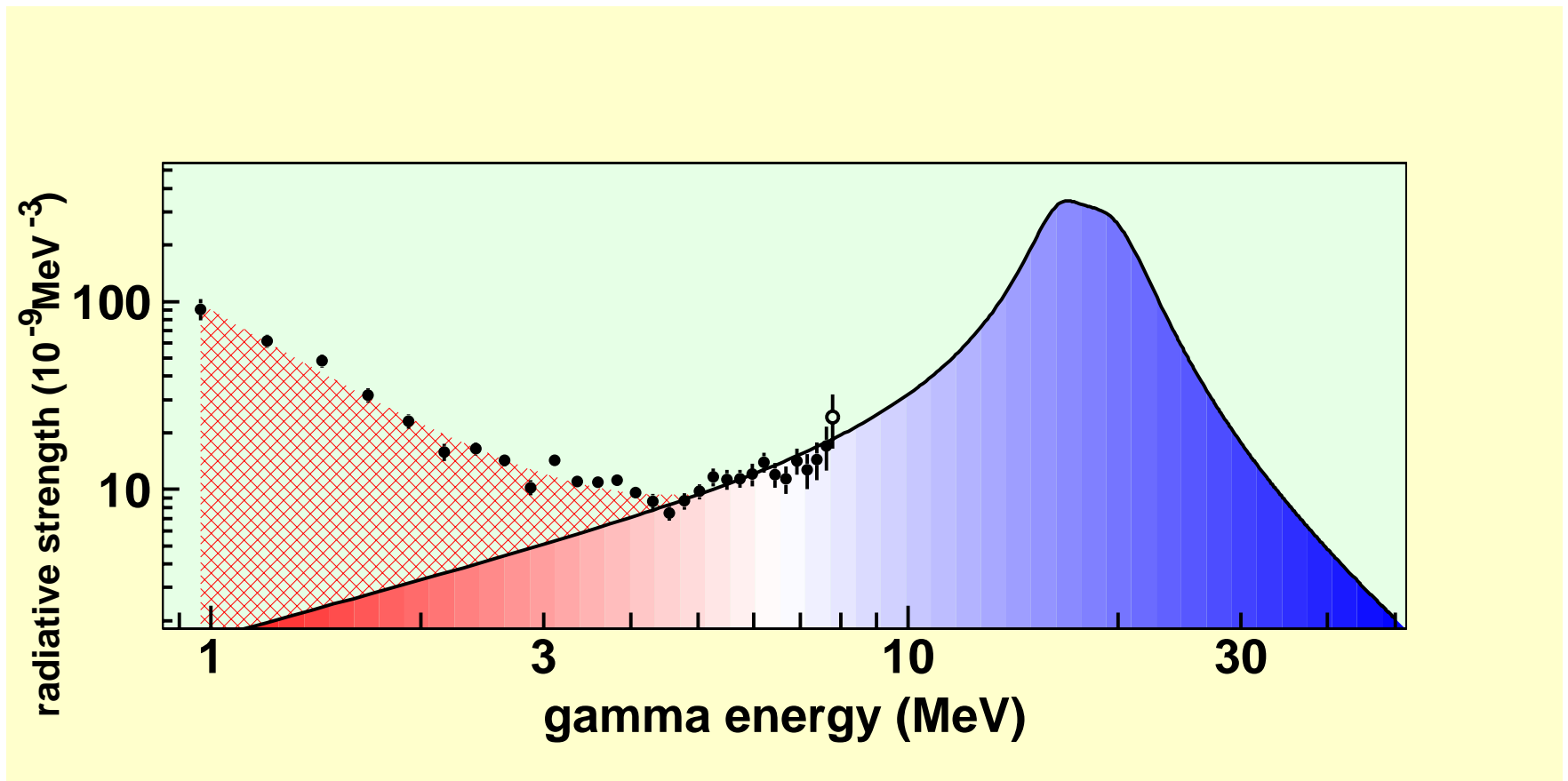


Established M1 multipolarity of a pygmy resonance in ^{172}Yb at $E_\gamma = 3.3$ MeV

$$B(M1 \uparrow) = \frac{9\hbar c}{32\pi^2} \left(\frac{\sigma\Gamma}{E} \right)_{py} = 6.5(15)\mu_N^2$$



Radiative strength function of ^{57}Fe

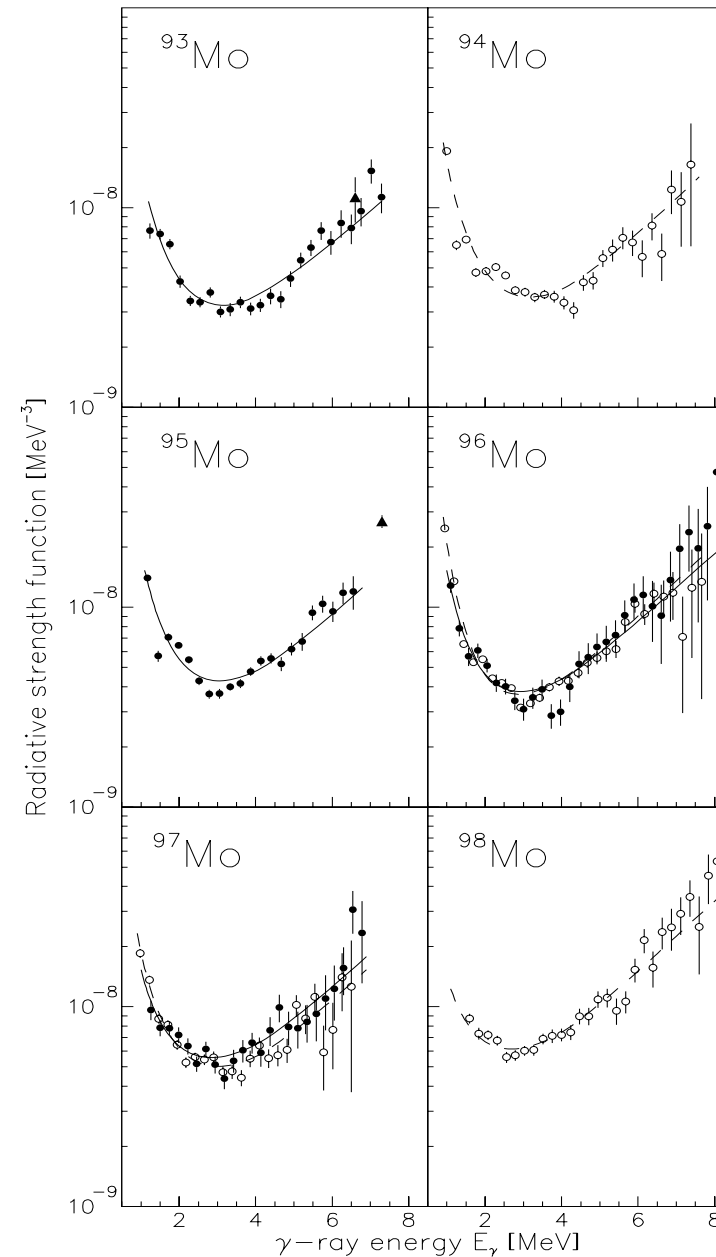


A.Voinov et al. Phys.Rev.Lett.93, 142504 (2004)

γ -strength functions in Mo isotopes

Filled circles:
($3\text{He},\alpha$)
Open circles:
($3\text{He},3\text{He}'$)

M.Guttormsen et al.
Phys.Rev.C 71,044307(2005)



Summary

- Unique technique to extract level densities and γ -strength function experimentally
- New Sm data show that the level density continues to decrease as one approaches the N=82 closed shell
- The M1 pygmy resonance observed in deformed nuclei vanishes in the Sm nuclei as one approaches N=82
- We still don't understand the large enhancement in the strength function for low E_γ in Fe, Mo and V isotopes

Future outlook

- New particle detector system, which will increase the efficiency 5-10 times
- Polarization measurements of the upbend in the strength function at low E_γ , maybe with GRETINA or AGATA
- Study level density as a function of spin
- Investigate/test possibility of using inverse reactions

Collaborators

- R.Chankova, M.Guttormsen, F.Ingebretsen, S. Messelt, J.Rekstad, A.C.Larsen, N.U.H.Syed, S.Ødegård, University of Oslo
- A.Voinov, Dubna, Russia
- U.Agvaanluvsan, 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, Turkey

Workshop on Level Density and Gamma Strength in Continuum

Oslo, May 21 - 24, 2007

Experimental and theoretical topics on:

- Level density
- Radiative strength
- Phase transitions in mesoscopic systems
- Applications in astrophysics
- Other related topics

DEADLINES

Abstract submission: March 1st 2007

Confirmed speakers:

E. Algin
Y. Alhassid
F. Becvar
A. Bracco
F. Camera
P. Chomaz
T. Døssing
T. von Egidy
S. Frauendorf
S. Grimes
S. Harrisopulos
K. Kaneko

M. Krticka
A. Lopez-Martens
T. Lönnroth
A. Maj
G. Mitchell
R. Pezer
A. Richter
A. Schiller
A. Voinov
J.-P. Wieleczko
V. Zelevinsky
S. Åberg

<http://ocl.uio.no/workshop07/>


Oslo Cyclotron Laboratory

