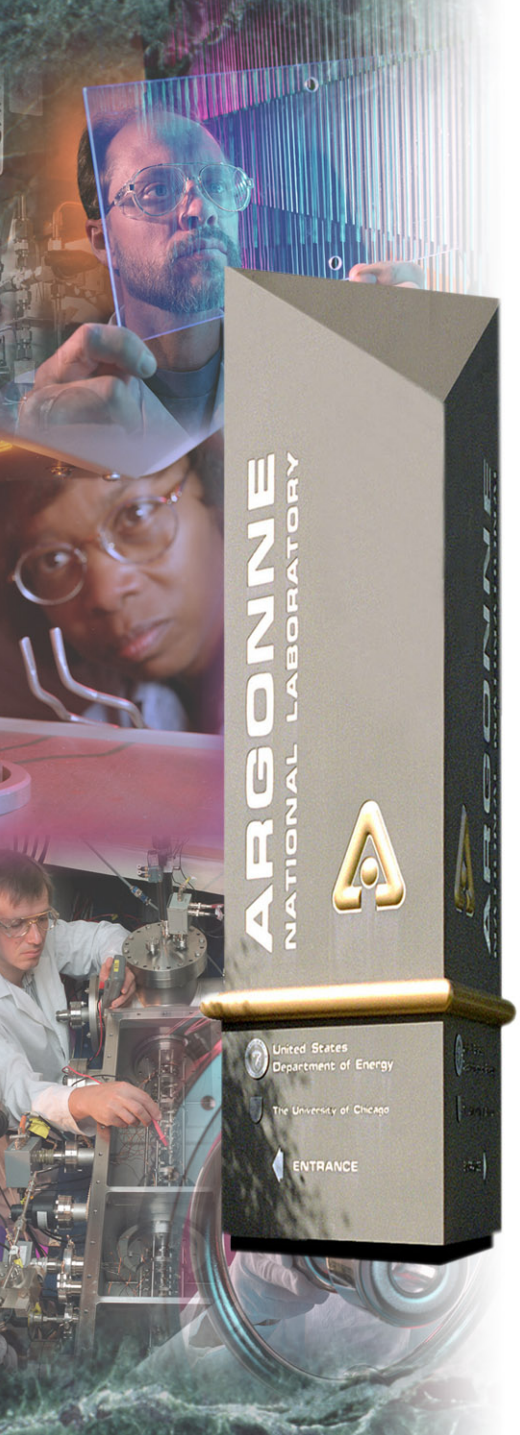


Decay Rate of Triaxially Deformed Proton Emitters

Proton Emitters - their decay and level structure

Cary N. Davids

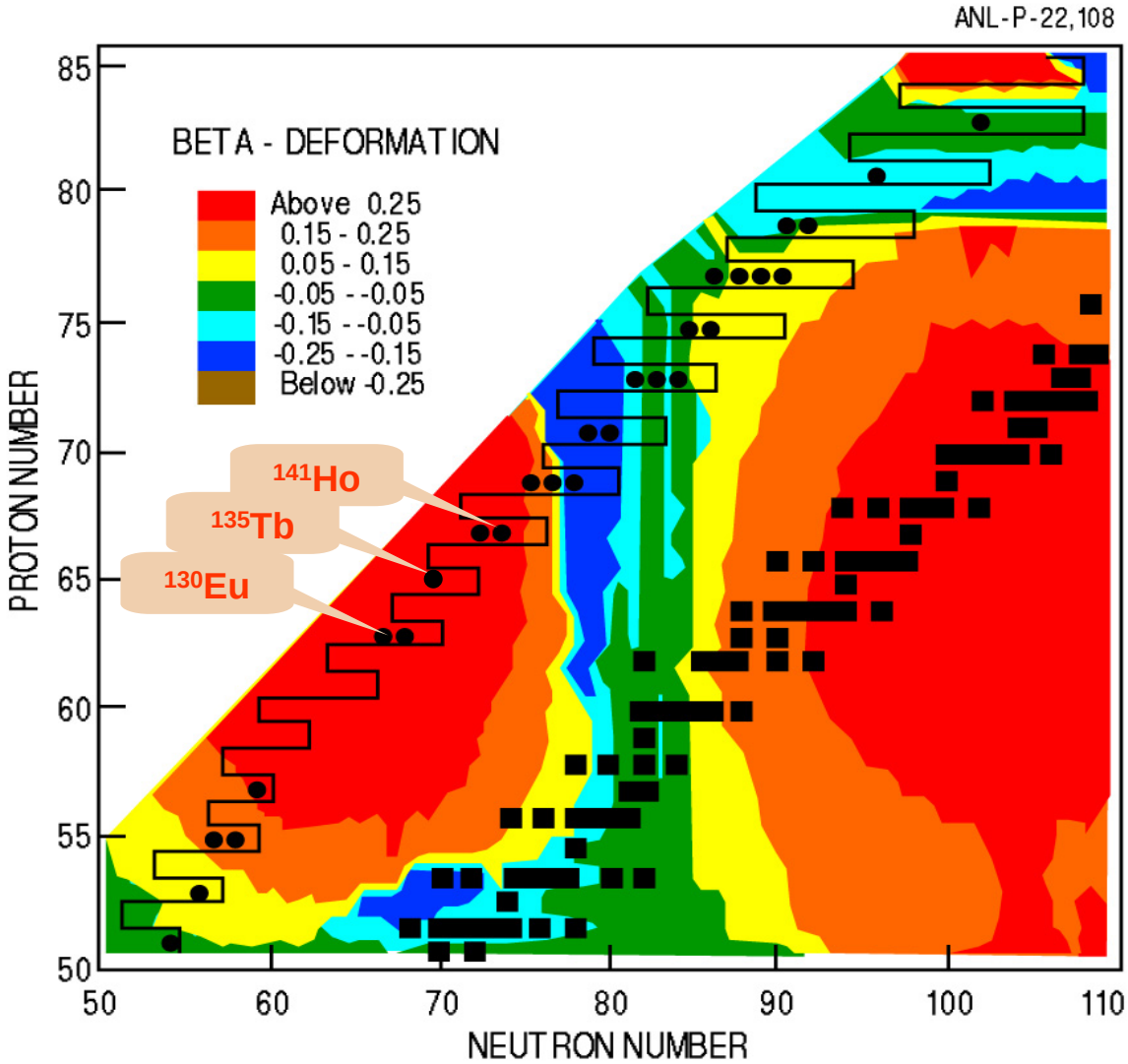
Conference on "Nuclei at the Limits"July 26-30, 2004

Argonne National Laboratory

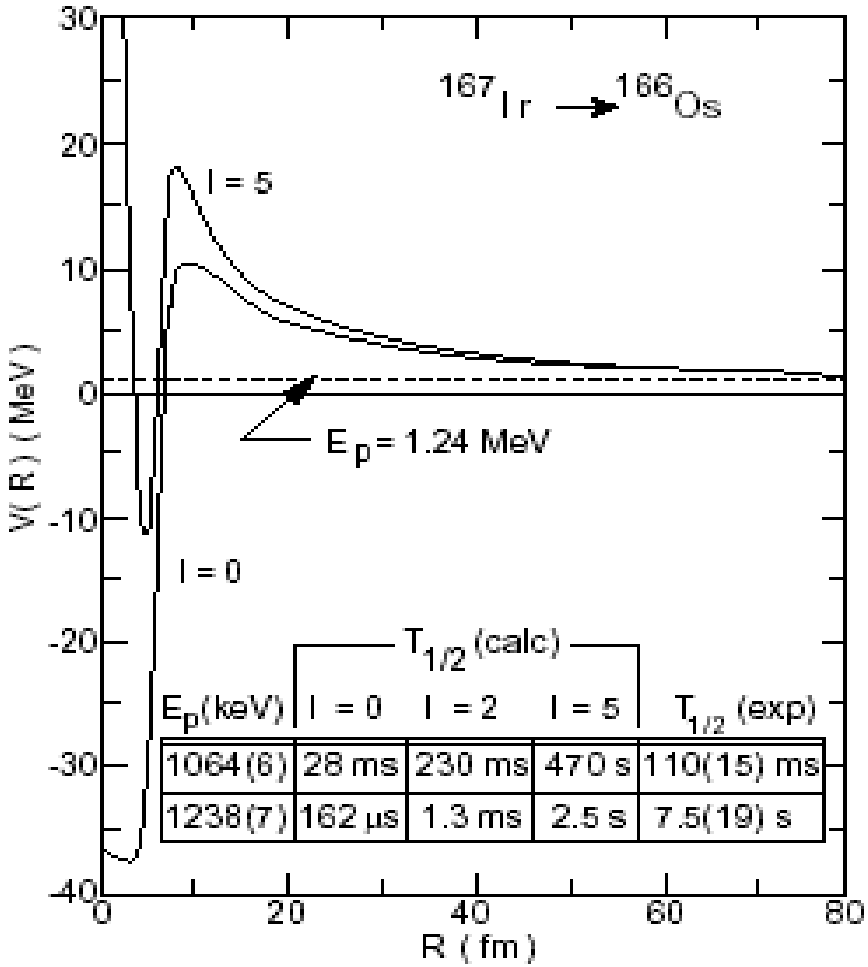
Office of Science
U.S. Department of Energy

A U.S. Department of Energy
Office of Science Laboratory
Operated by The University of Chicago

The Proton Drip-Line for 50 < Z < 85



Proton-nucleus Potential for ^{167}Ir



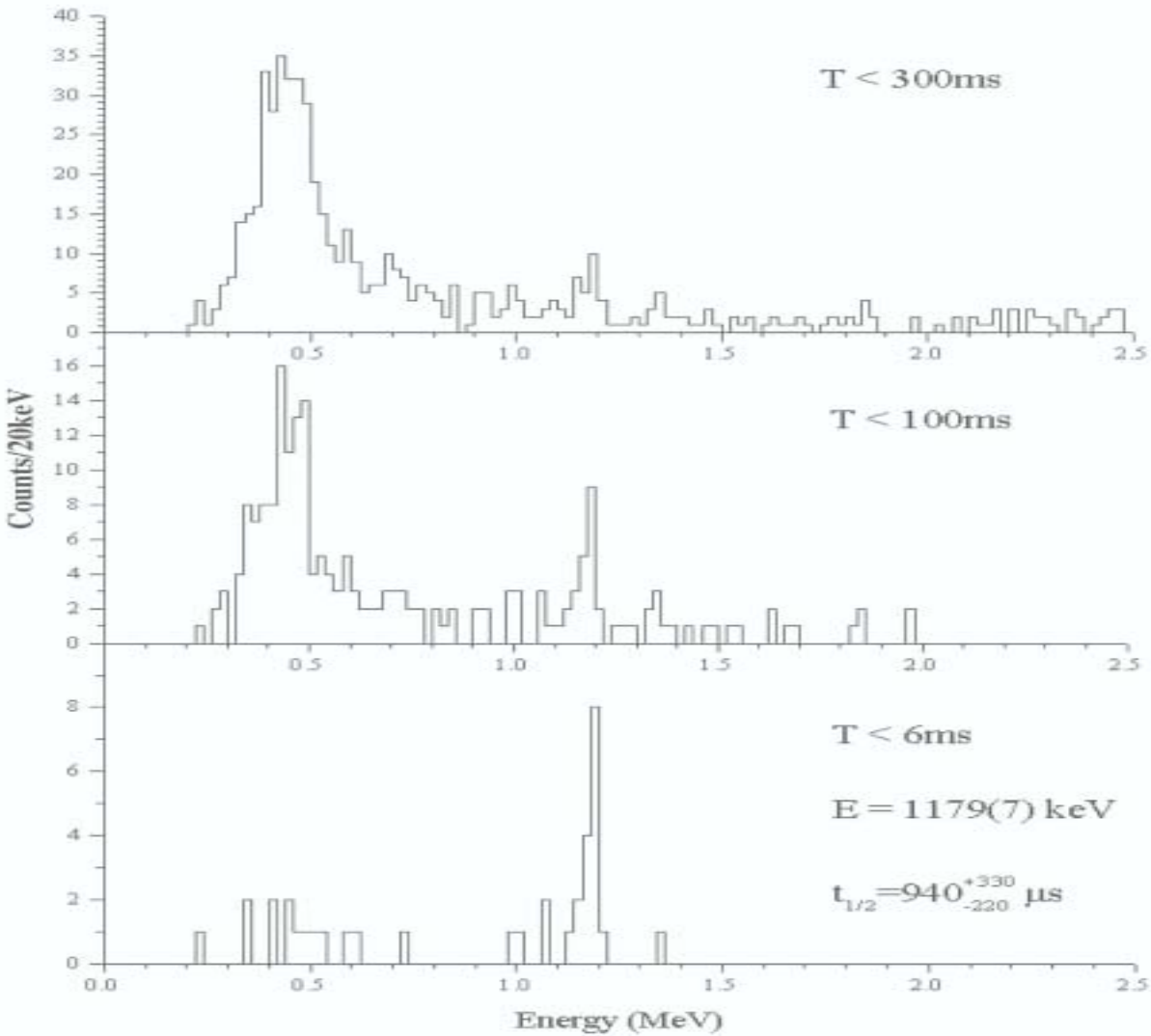
E_p(keV)	$T_{1/2}$ (calc) l = 0	l = 2	l = 5	$T_{1/2}$ (exp)
1064(6)	28 ms	230 ms	470 s	110(15) ms
1238(7)	162 μs	1.3 ms	2.5 s	7.5(19) s

Proton Radioactivity Research at the FMA

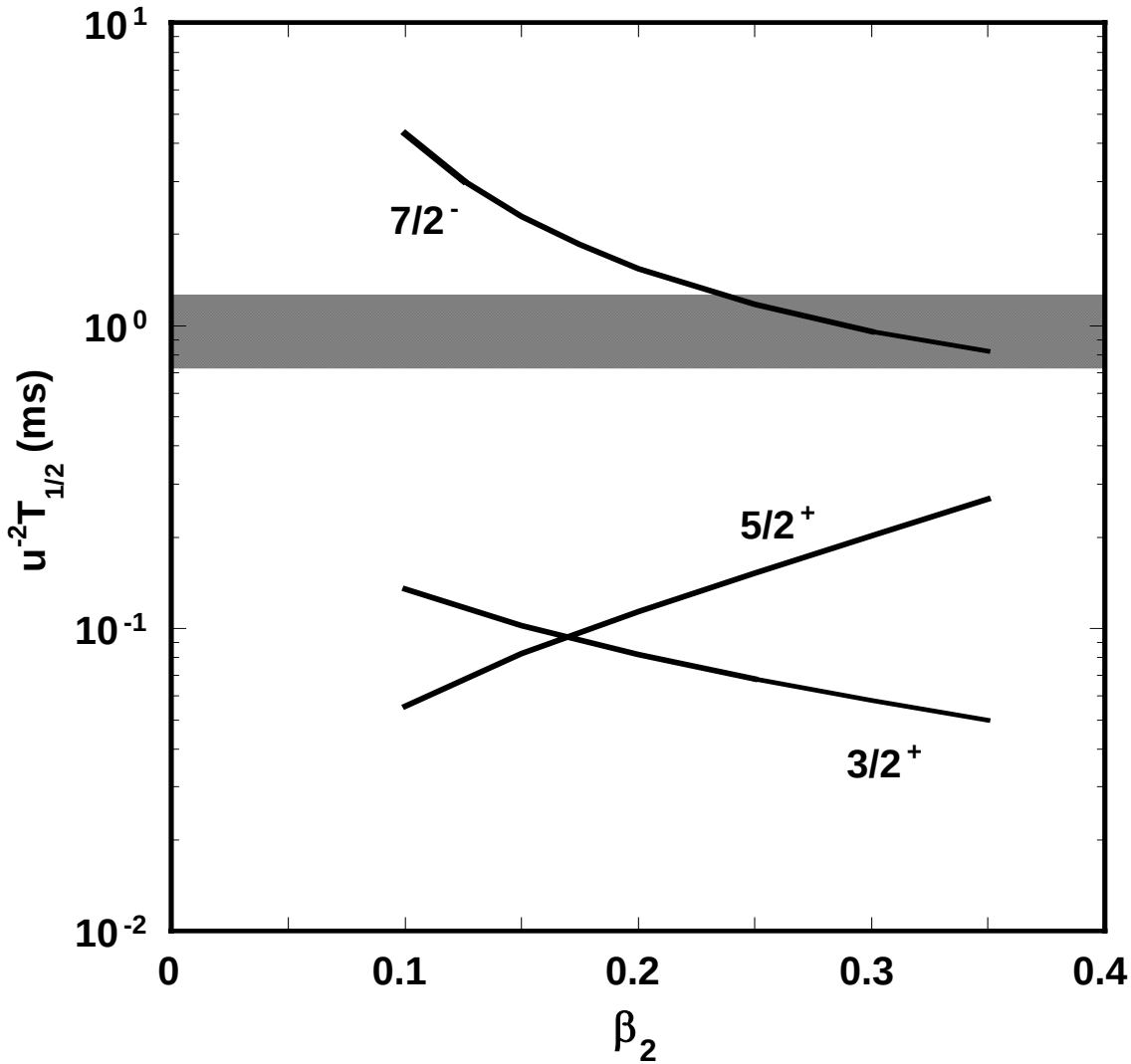
C. N. Davids	Argonne National Laboratory
D. Seweryniak	"
S. Sinha	"
R. V. F. Janssens	"
M. P. Carpenter	"
P. J. Woods	University of Edinburgh, UK
T. Davinson	"
Z. Liu	"
P. Munro*	"
A. Robinson*	"
W. B. Walters	University of Maryland
N. Hoteling*	"
J. Shergur*	"
A. Woehr	"
A. Sonzogni	Brookhaven National Laboratory

* Graduate student

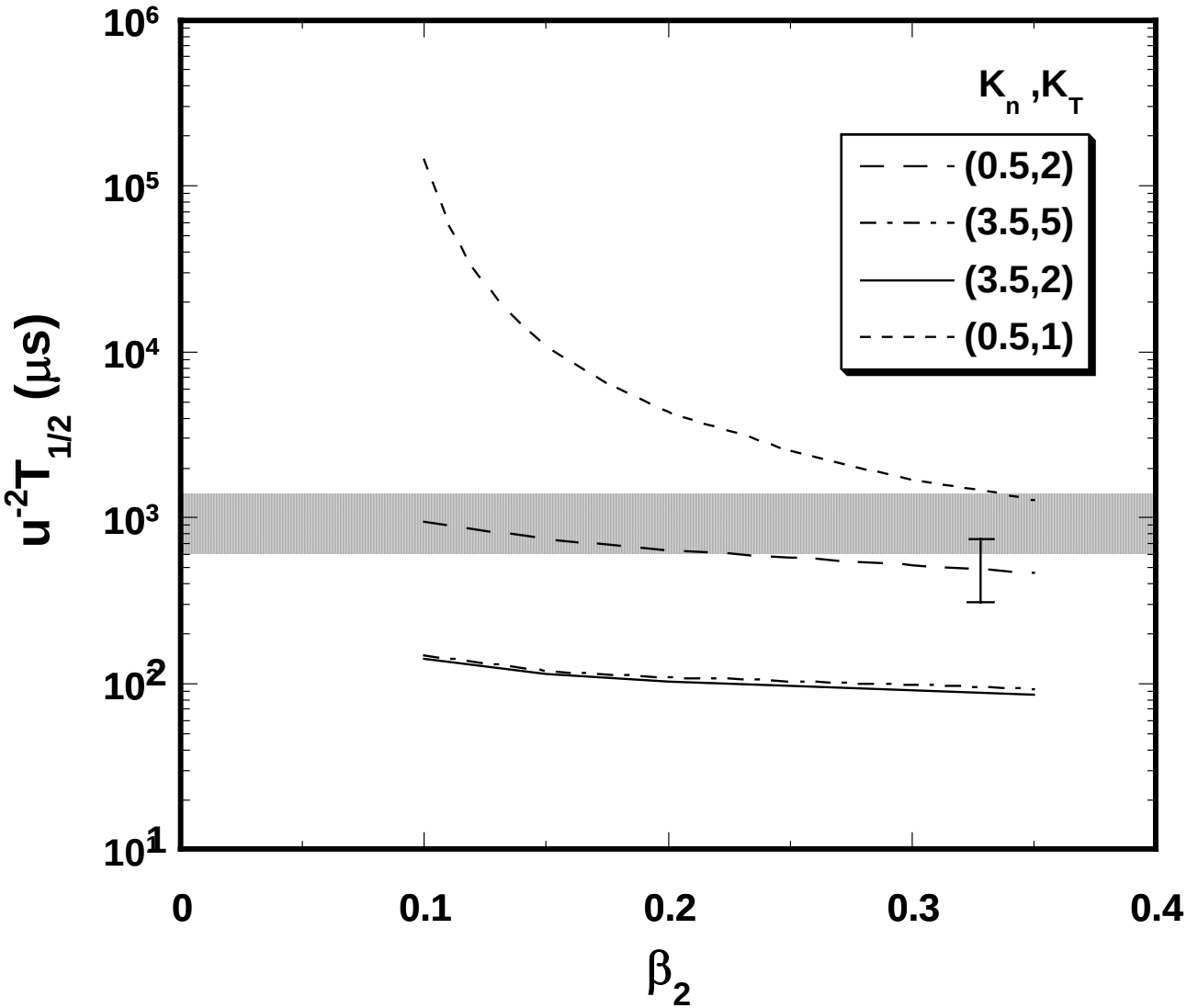
Protons from the Decay of Highly-Deformed ^{135}Tb



Calculated and Experimental $T_{1/2}$ for ^{135}Tb

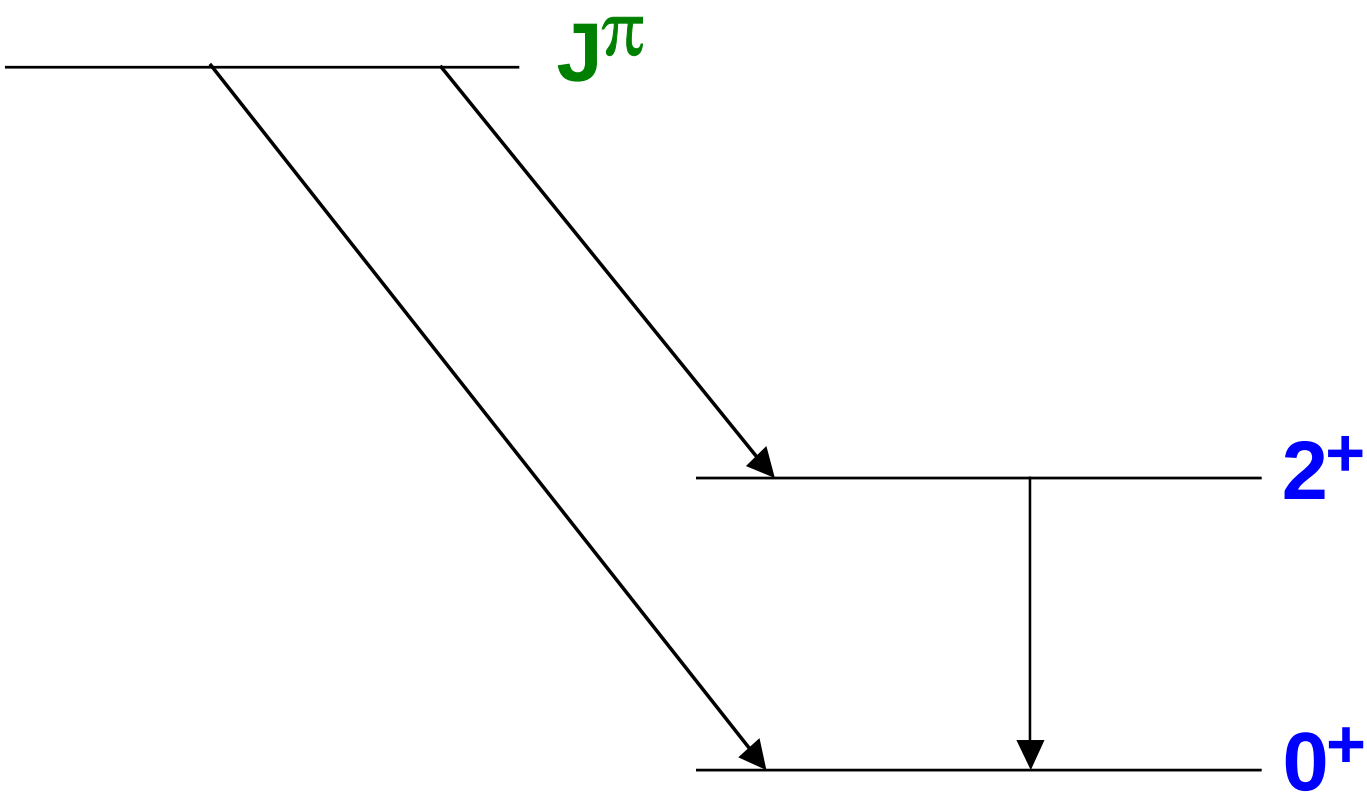


Calculated and Experimental $T_{1/2}$ for ^{130}Eu

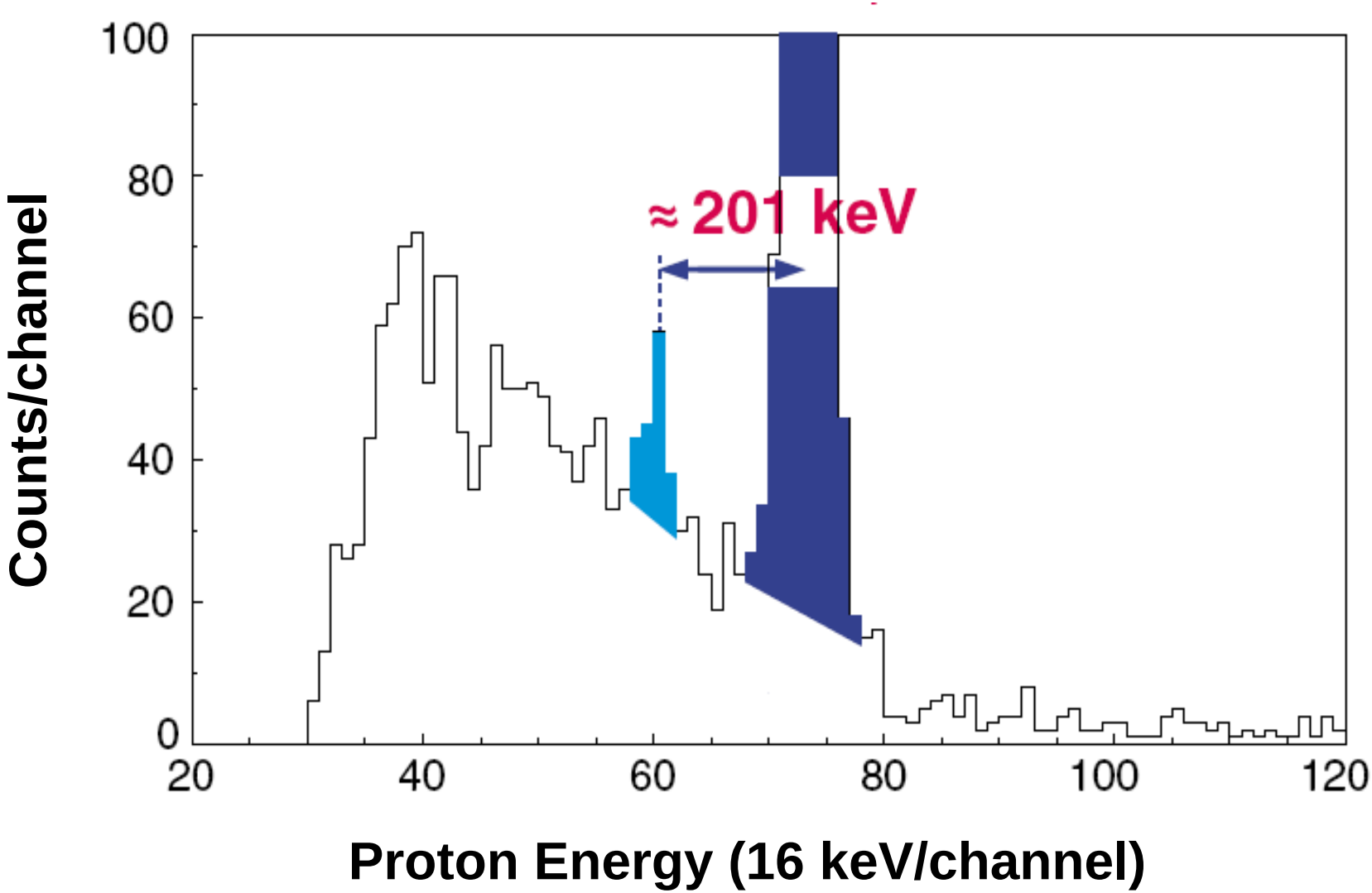


Fine Structure in Proton Decay

Parent **Daughter**



Fine Structure in ^{141}Ho Decay (Rykaczewski et al.)



Proton Decay Rate Calculations (with Henning Esbensen)

- **Solve the Schroedinger equation in the adiabatic limit, for a unbound proton interacting with an inert core. Use a Woods-Saxon form-factor for the Coulomb, nuclear, and spin-orbit potentials.**

- **For deformed emitters, expand the intrinsic wave function in spherical components. All potentials are deformed, with axial symmetry assumed. $\Omega = K$, where Ω is the projection of the proton angular momentum on the Z-axis of the nucleus, and K is the total angular momentum projection.**

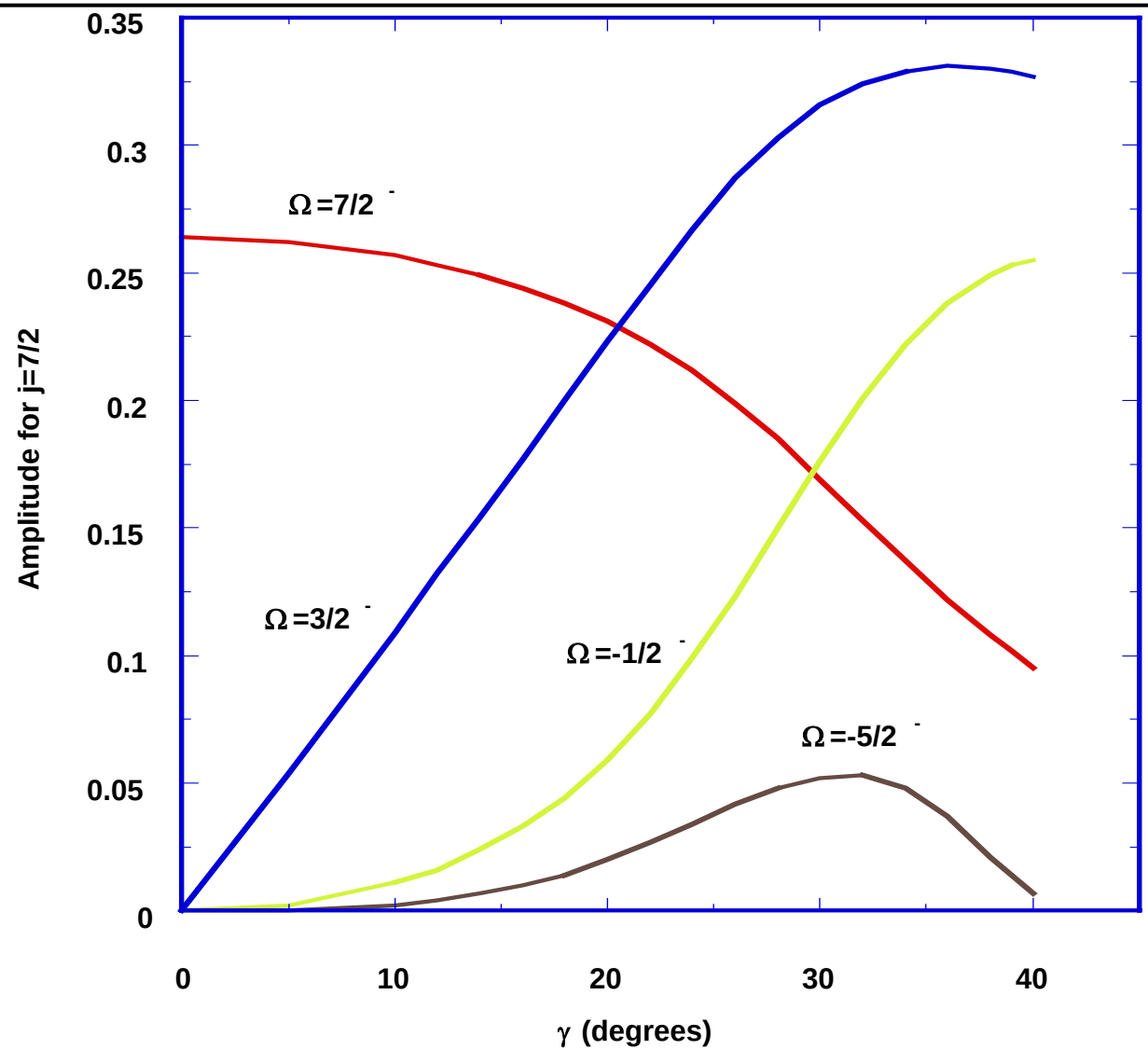
- **The Green's function technique compensates for the long-range Coulomb coupling.**

What Happens if the Axial Symmetry Requirement is Relaxed?

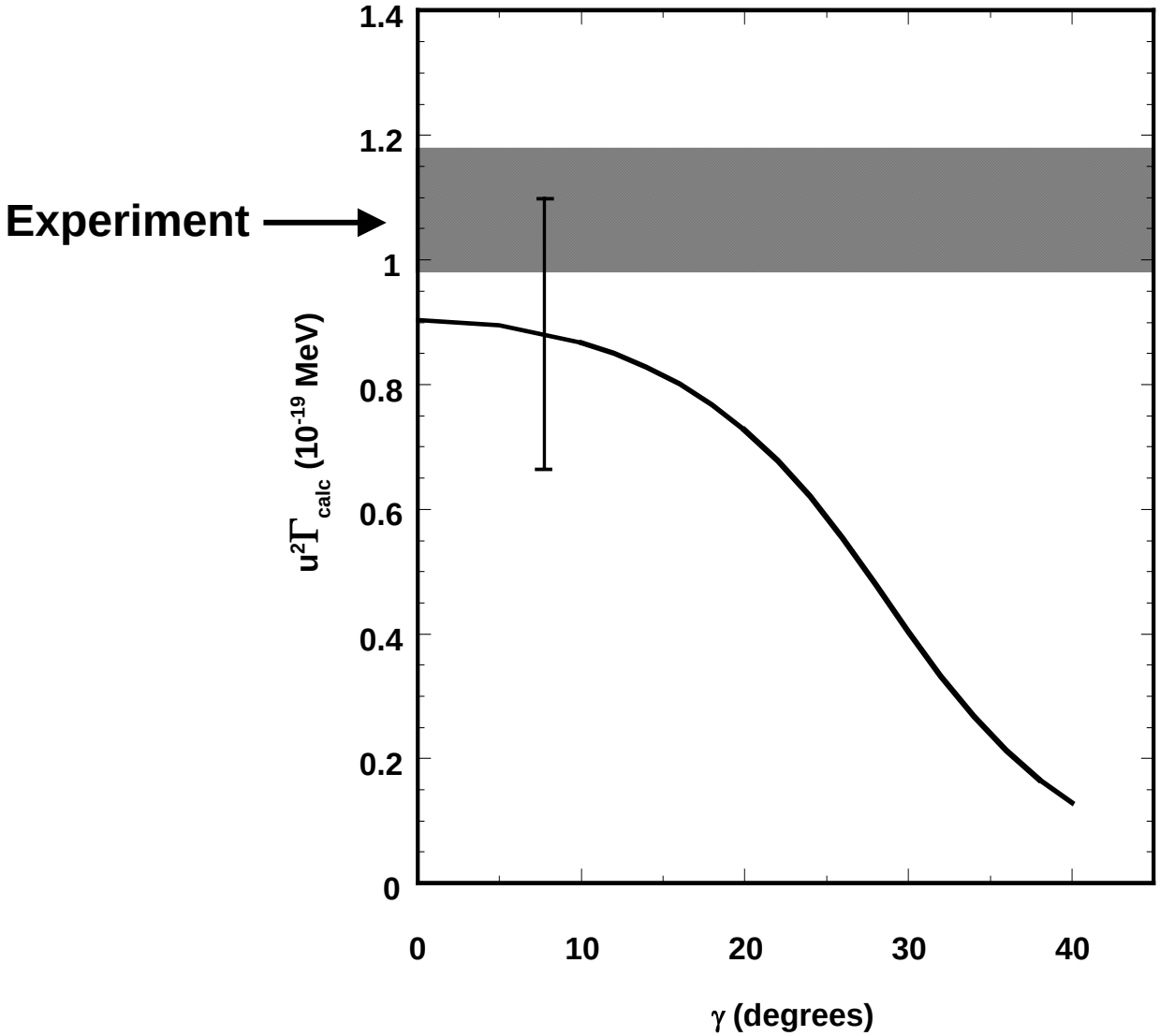
- **Introduce a non axially-symmetric Woods-Saxon form-factor for the Coulomb, nuclear, and spin-orbit potentials. The triaxiality parameter is the angle γ, which varies from 0º- 60º.**

- **Ω is no longer a good quantum number. The wave function will have good K, but with Ω-mixing. This mixing will influence the overall decay rate and the fine structure branching ratio.**

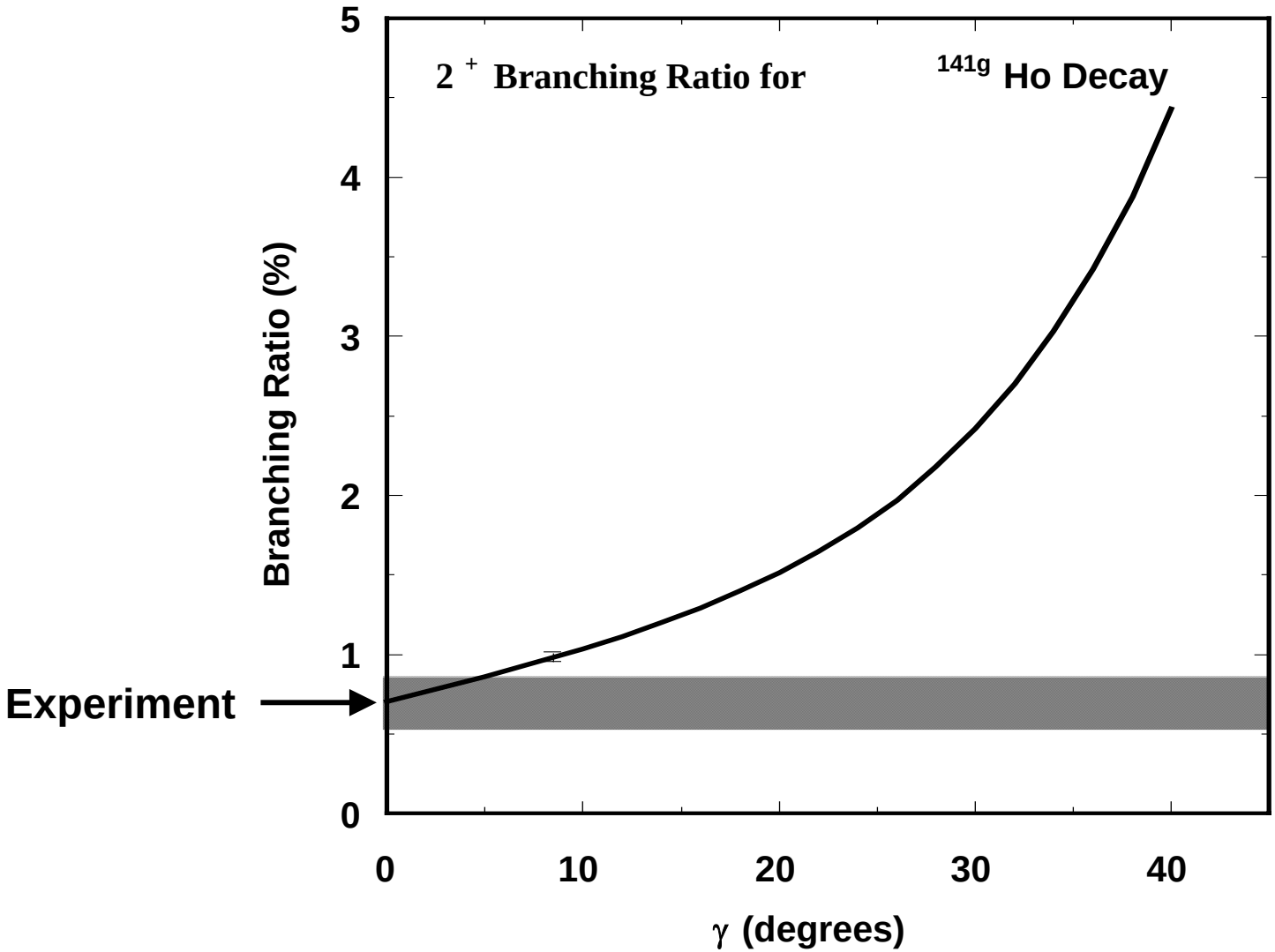
Ω-Amplitudes for j=7/2 Spherical Wave Function Component



Decay Width for ^{141}Ho vs. Triaxial Angle γ



^{141}Ho Fine-Structure Branching Ratio



Conclusions

- **The Green's function technique in the adiabatic limit has had excellent success in describing the decay rates and fine structure branching ratios for a number of well-deformed odd-A and odd-odd proton emitters.**

- **In the case of ^{141}Ho, non axially-symmetric potentials spoil the agreement between experiment and calculation for triaxial angles $\gamma > 5^{o}$.**

- **Odd-odd proton emitters present the opportunity to study the residual n-p interaction, which has so far not been included in decay rate calculations. It is also desirable to include pairing microscopically.**