Rapid evolution of collectivity at N=Z
- recent results from level lifetime measurements with GRETINA

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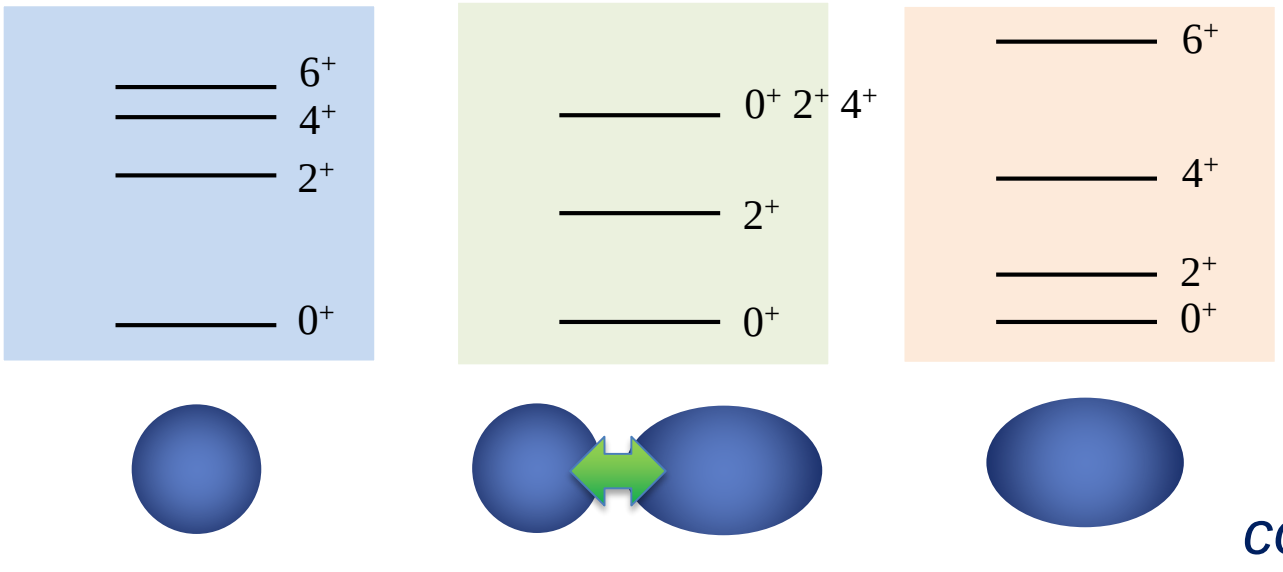
Collective modes in atomic nuclei

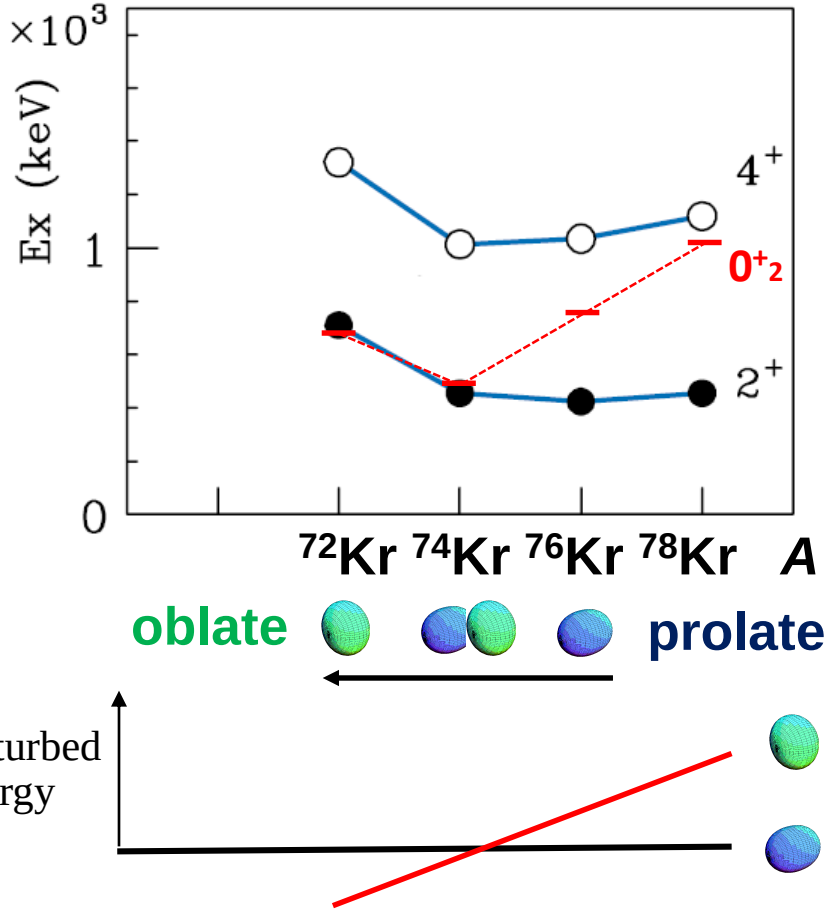
- characterized by the ground-state shape as a single basis



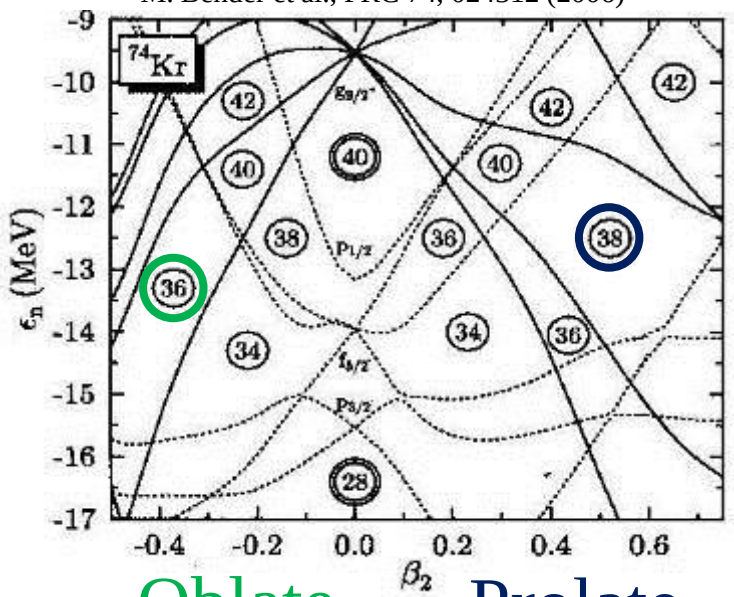
	spherical	vibration	deformed
$E(4^+)/E(2^+)$ =	$\approx$1.2	2	3.3
$\frac{B(E2;4^+\rightarrow2^+)}{B(E2;2^+\rightarrow0^+)}$ =	1-10	2	1.43

What will happen if two different shapes coexist ?

Shape transition in the Kr ground states



M. Bender et al., PRC 74, 024312 (2006)

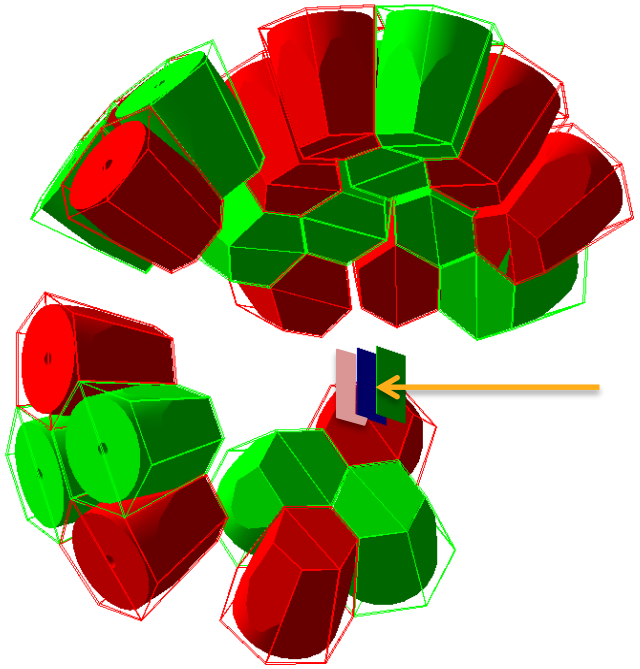


Oblate Prolate

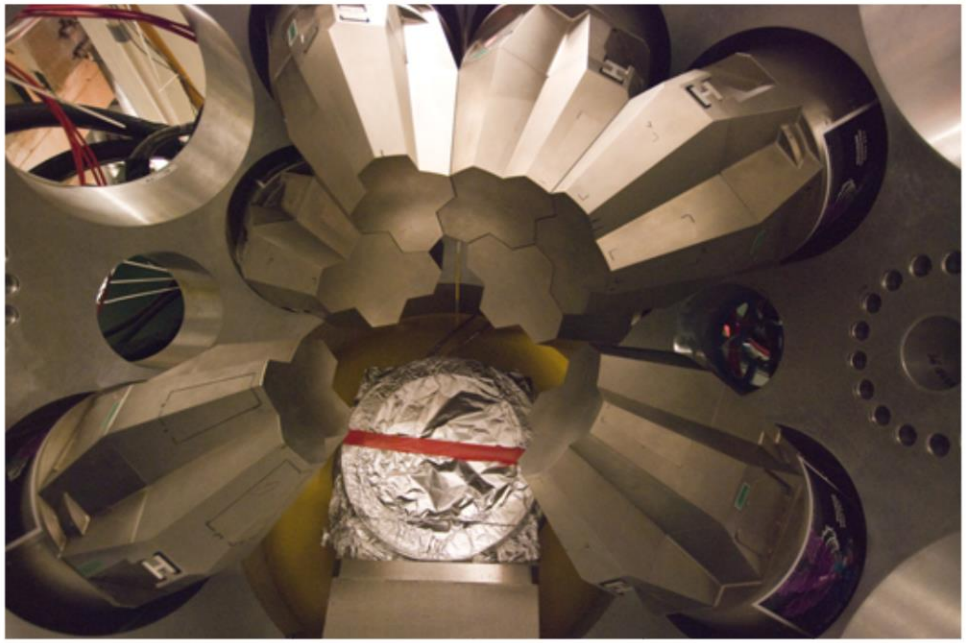
Nilsson orbitals for ^{74}Kr (Z=36, N=38)

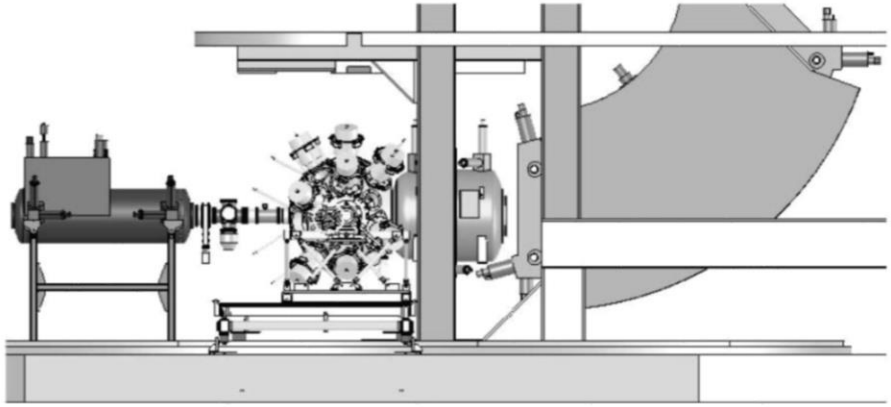
How about excited states (2^+ and 4^+) in ^{72}Kr ? → B(E2) measurement

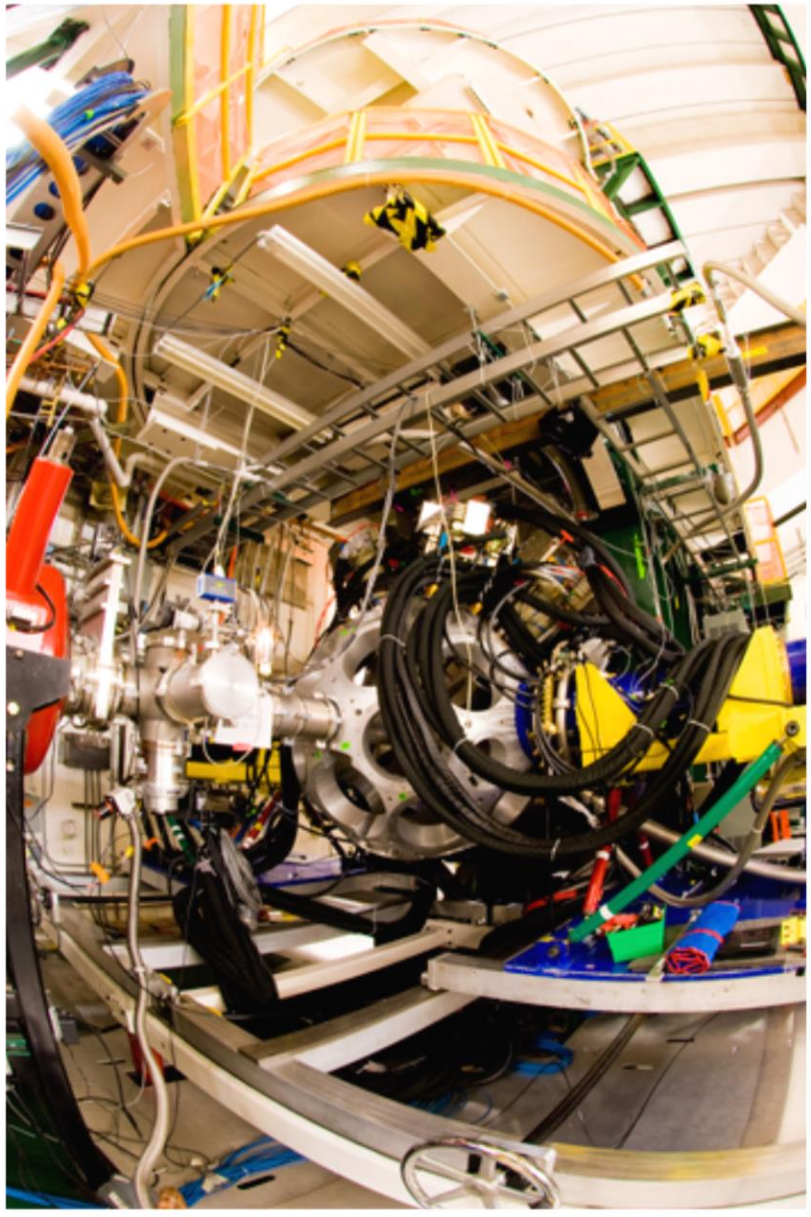
Challenges with GRETINA



GRETINA at NSCL



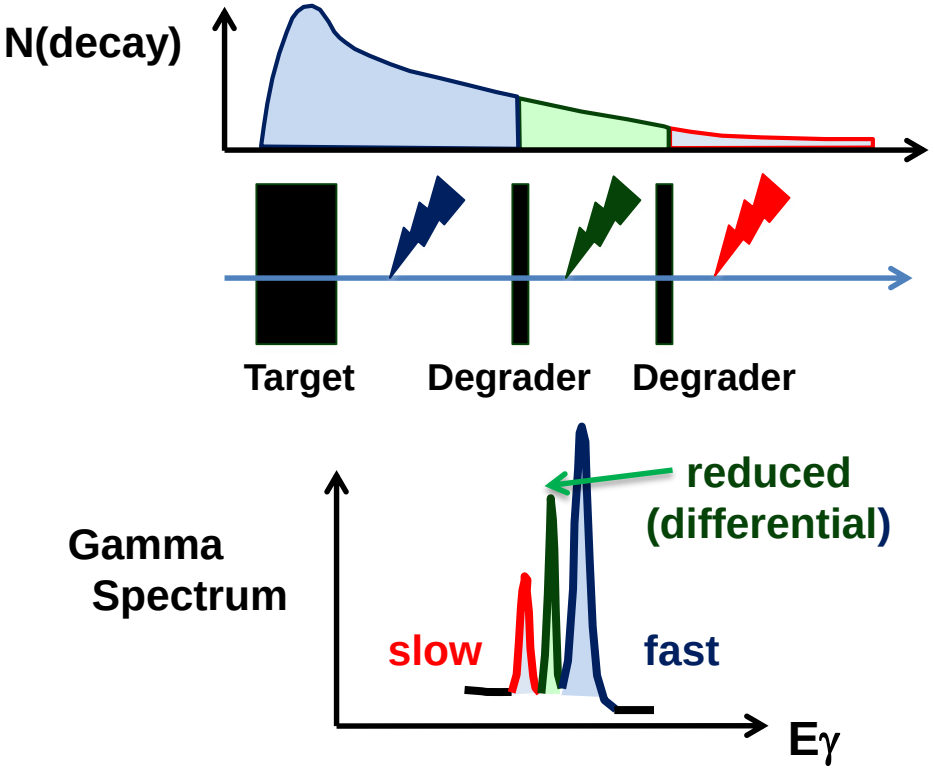


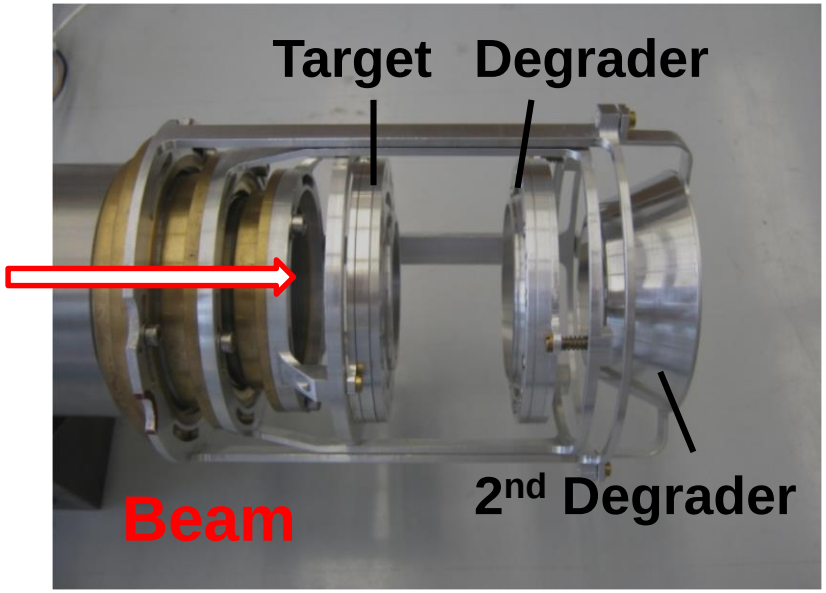


TRIPLEX

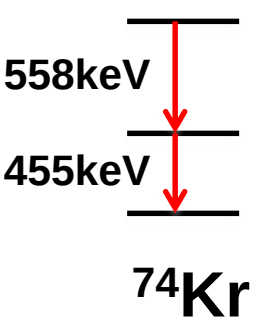
(TRIple PLUNGER for EXOTIC BEAMS)

New approaches in lifetime studies with TRIPLEX and GRETINA

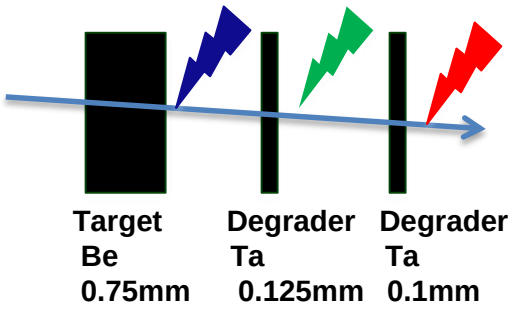




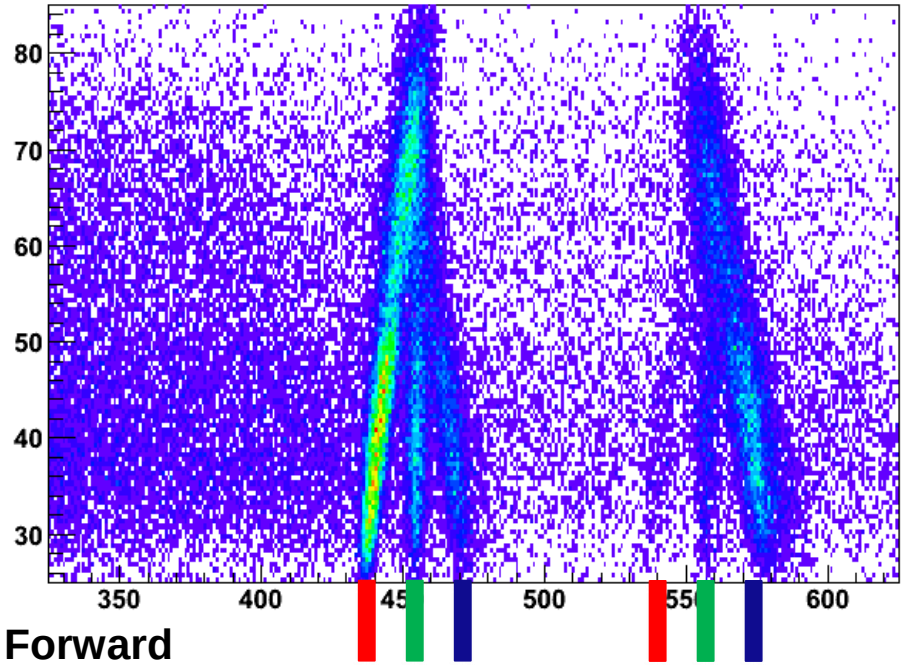
Simulated spectra

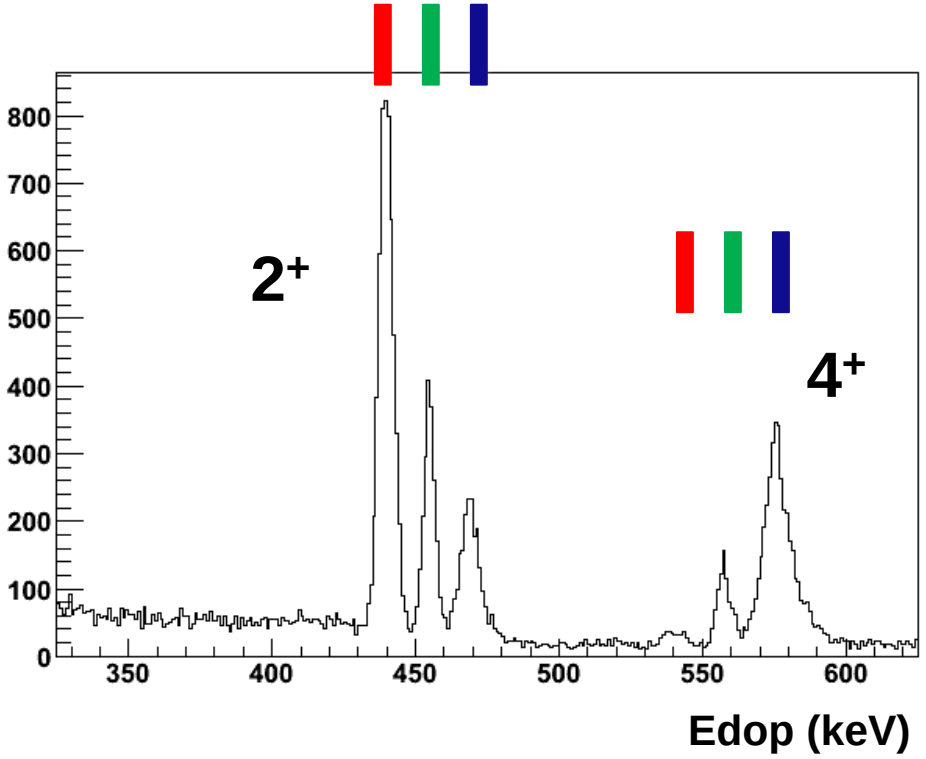


A.Gorgen et al.
EPJA26(05)153

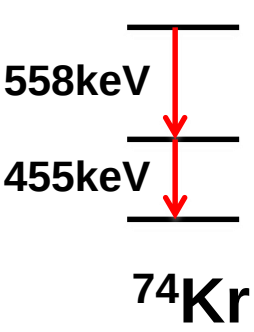


90 deg

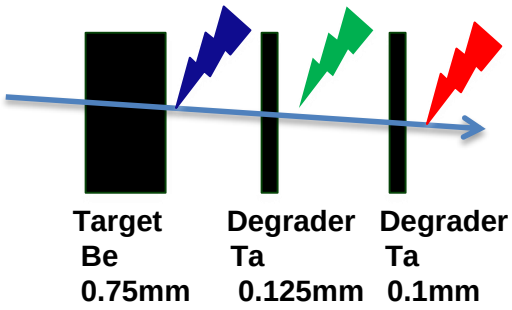


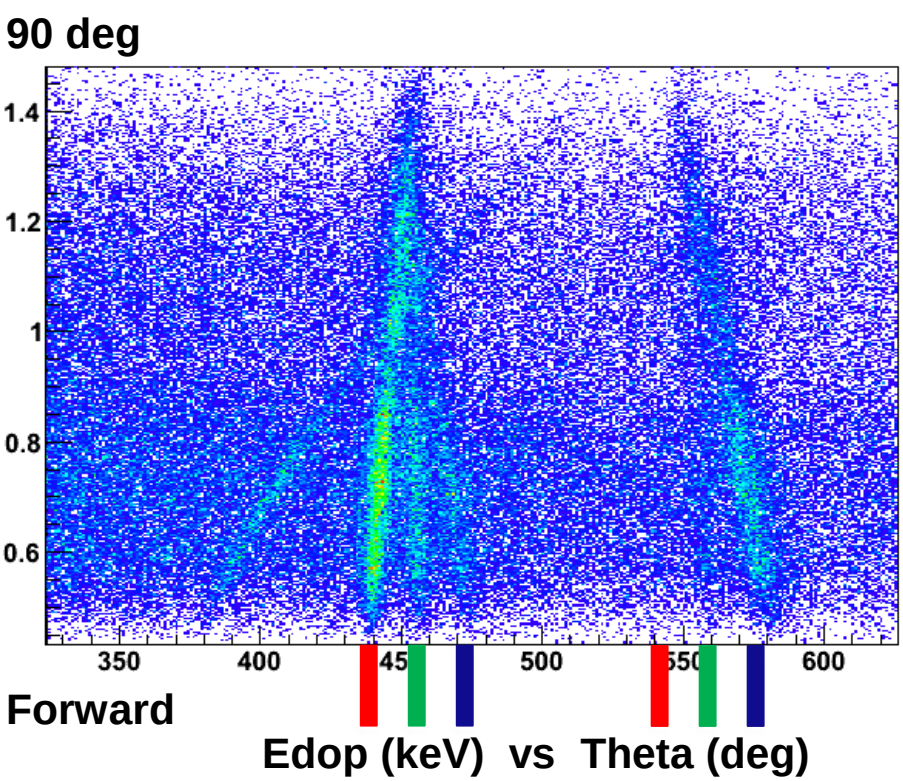


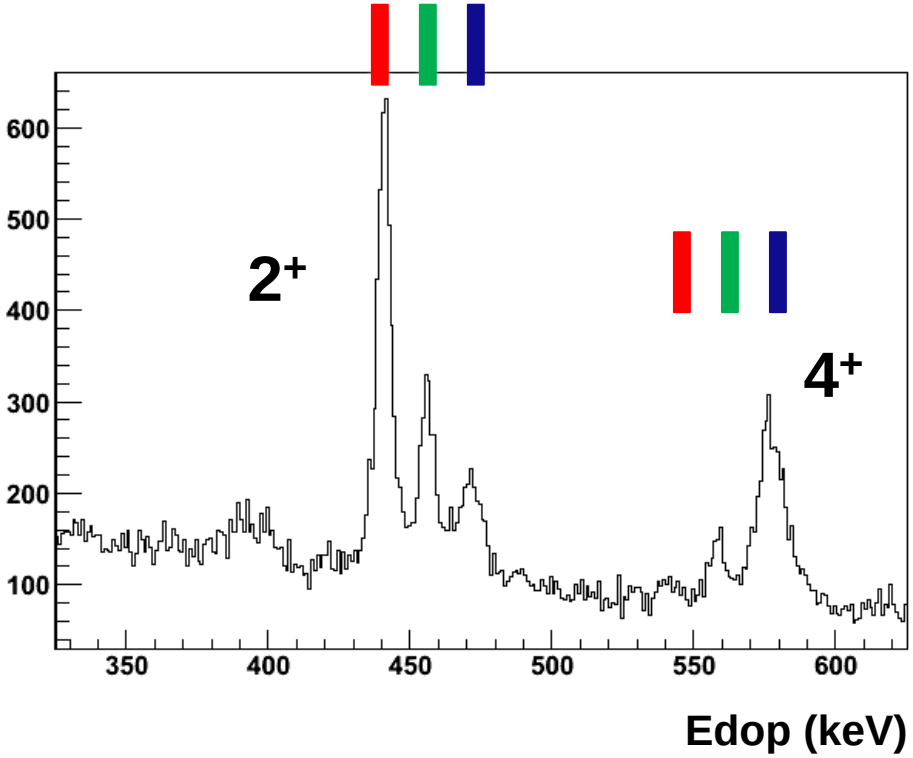
Measured spectra



A.Gorgen et al.
EPJA26(05)153

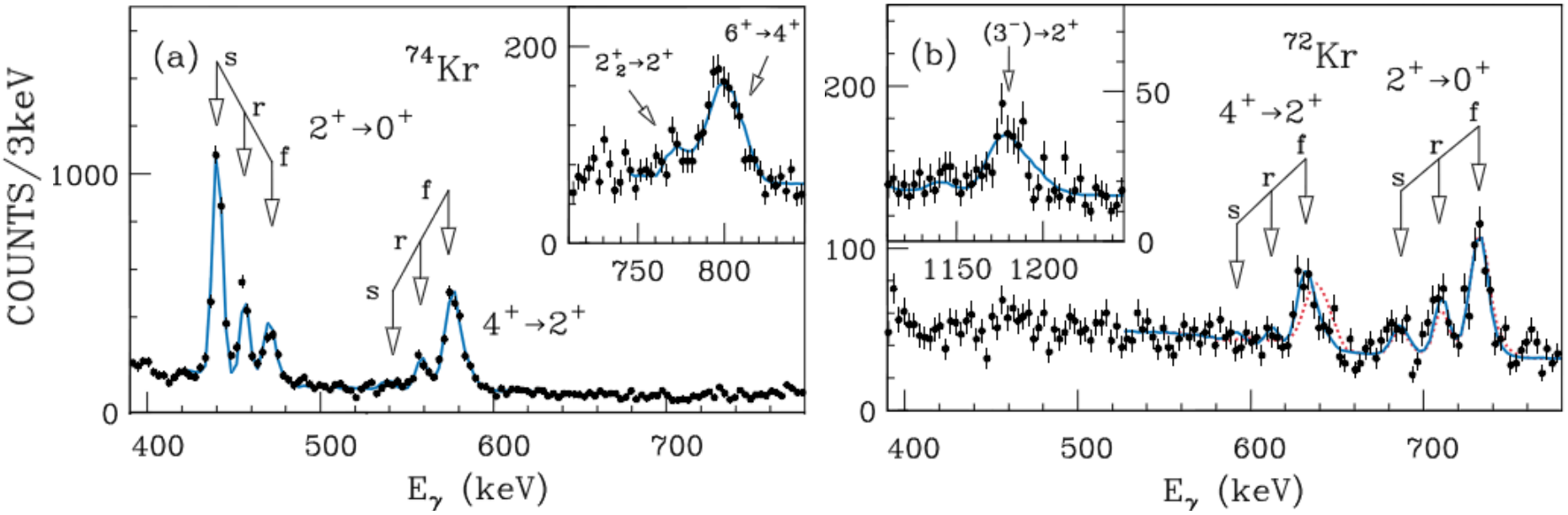






Results for ^{74}Kr and ^{72}Kr

Model independent B(E2) determination

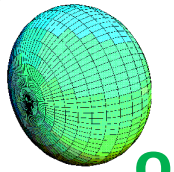
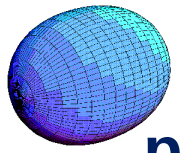


A	Transition	E_γ (keV)	τ_{exp} (ps)	$B(E2)$ present	$B(E2)$ previous
^{74}Kr	$2^+ \rightarrow 0^+$	455.6	32.2(22)	1290(90)	1223(22) [1]
	$4^+ \rightarrow 2^+$	557.7	5.9(6)	2560(260)	2895(111) [1]
^{72}Kr	$2^+ \rightarrow 0^+$	709.7	5.6(10)	810(150)	999(129) [2]
	$4^+ \rightarrow 2^+$	611.7	3.5(7)	2720(550)	…

H.Iwasaki et al., PRL112 (2014) 142502

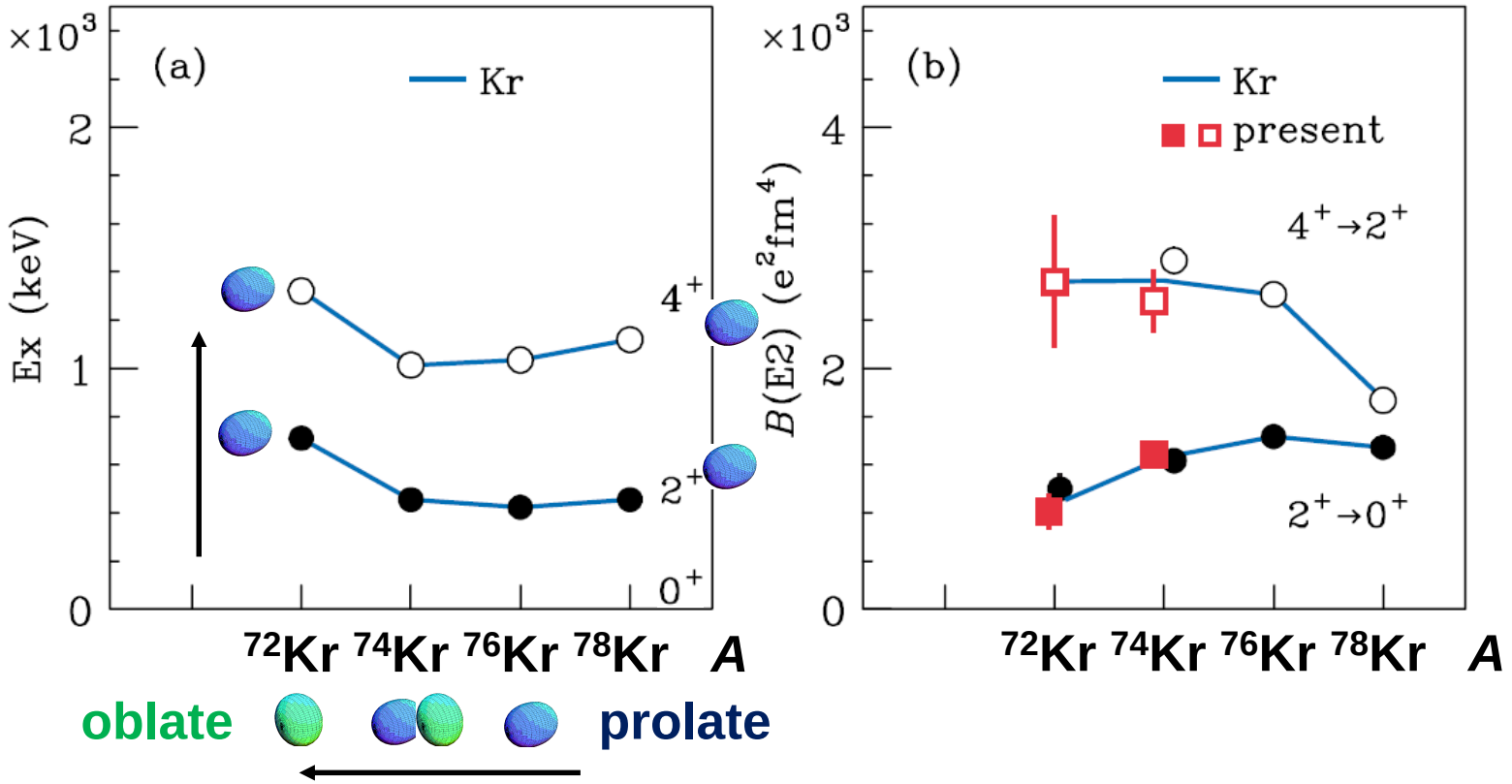
[1] A.Gorgen et al., EPJ A 26 (2005) 153
[2] A.Gade et al., PRL95 (2005) 022502

E(2⁺), E(4⁺) and B(E2) systematics

Shape evolution between  and 

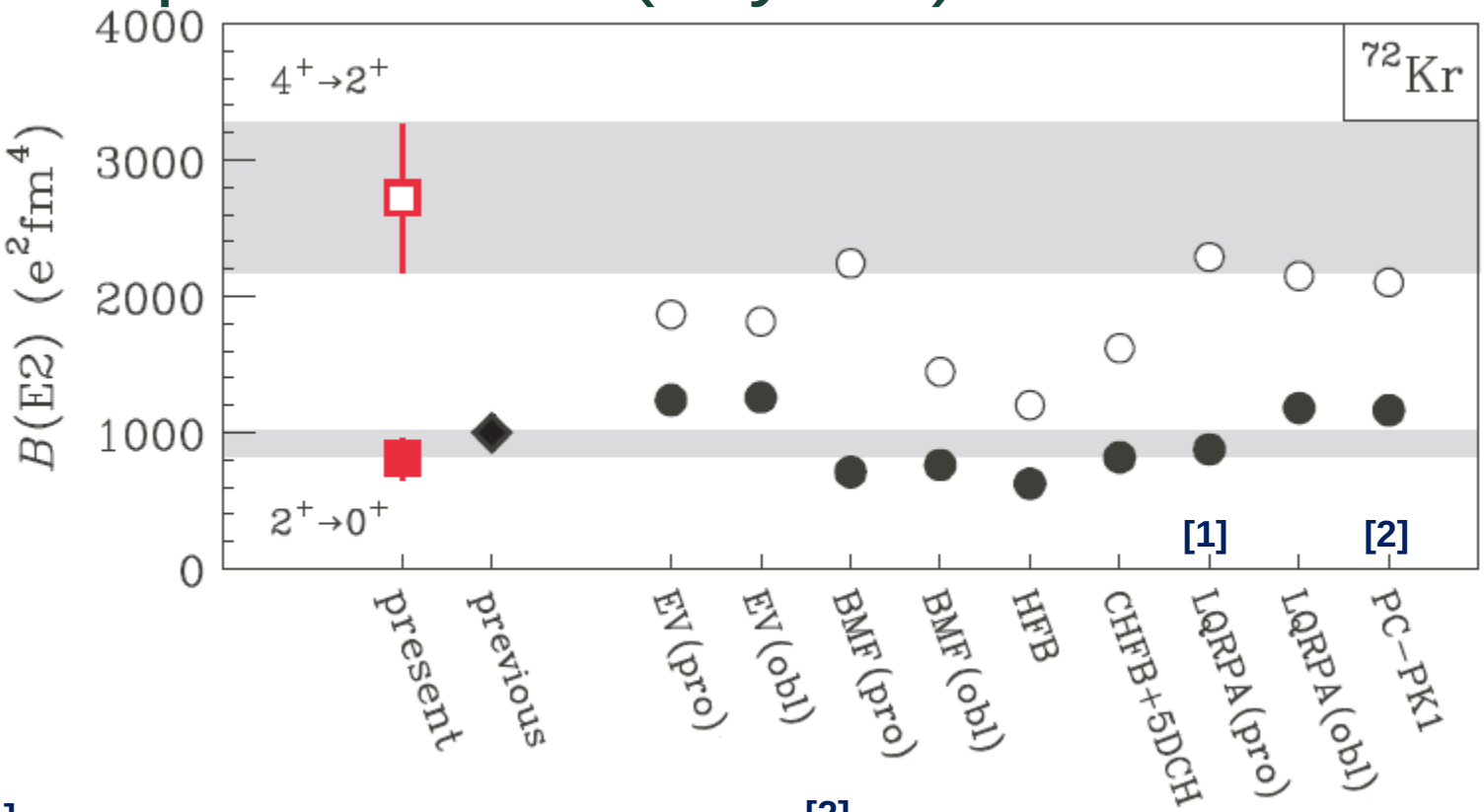
oblate **prolate**

Rapid evolution of collectivity in ^{72}Kr
with $E(4^+)/E(2^+)$ =1.86 and $B(E2;4^+\rightarrow2^+)/B(E2;2^+\rightarrow0^+)$ = 3.4

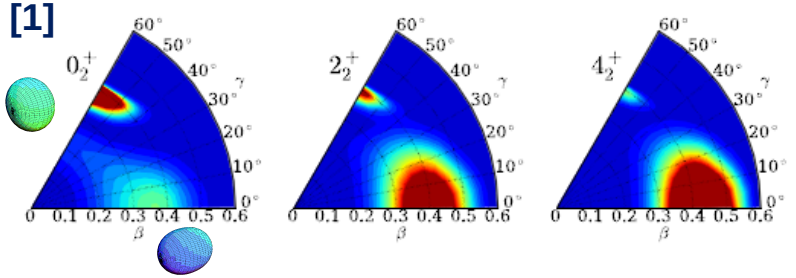


*) e.g. ^{72}Kr : H.Dejbakhsh et al., PLB249(1987)463, ^{74,76}Kr : E.Clement et al., PRC 75 (07) 054313

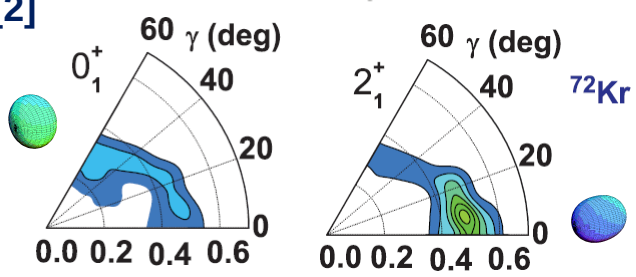
Comparison with (beyond) mean-field theory



[1]



[2]



A.Petrovici et al., NPA665 (00) 333, M.Bender et al., PRC74 (06) 024312
M.Girod et al., PLB676 (09) 39, J.-P.Delaroche et al., PRC 81 (10) 014303

[1] K.Sato et al., NPA 849 (2011) 53
[2] Y.Fu et al., PRC87 (2013) 054305

Summary

· Lifetime measurement of the yrast 2^+ and 4^+ states in ^{72}Kr at N=Z has been performed at NSCL using the advanced gamma-ray array GRETINA.

· A new plunger system (TRIPLEX) was developed, which extends the sensitive range of lifetime that can be covered with a single setup and thus enables us to study several states simultaneously.

· System and methodology have been established for future GRETINA campaigns with fast rare isotope beams.

· A rapid shape transition in low-spin yrast states in the self-conjugate nucleus ^{72}Kr have been discussed based on the measured rapid evolution of collectivity.

Collaborators

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TU Darmstaft : C.Walz

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Thank you