Measurements of magnetic moments of ps states of nuclei far from stability

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I will not talk about everything, namely:

Intermediate Coulomb excitation experiments at MSU with the TF technique

Recoil in vacuum (RIV) at ORNL, ANL

β-NMR, etc...

These require more instrumentation than the experiments I would like to start with, as well as complex calibrations although they are a good option for future experiments.

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I will mention possible Transient Field (TF) measurements with CARIBU beams.

Measurements of magnetic moments of ps states with radioactive beams

Motivation : Microscopic structure of individual low-lying states in nuclei far from stability, with TF techniques and Coulomb excitation in inverse kinematics.

Needs: Beams: intensity ~ 10^5 ions/sec
isobaric purity

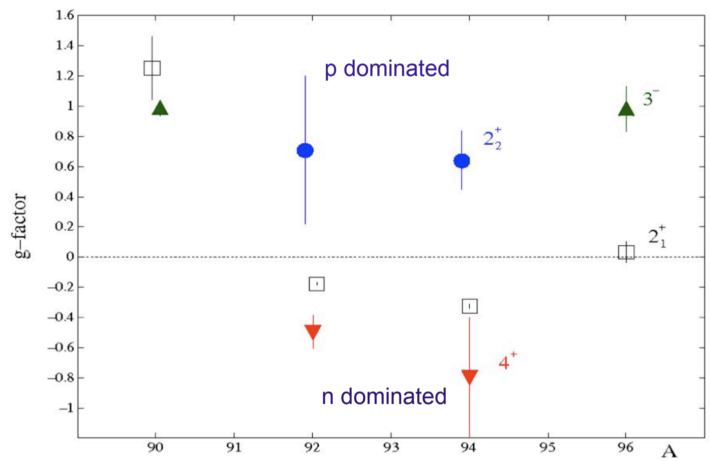
Instrumentation: four Clovers + one Ge
solar cells or PIPS particle detectors
digital electronics

Cooled **targets**

Caveats: every nucleus has its own challenges stemming from its spectroscopy

Mixed-symmetry states in Zr isotopes

g factors of 2^+, 3^- and 4^+ states in Zr isotopes



Neutron holes in the $g_{9/2}$ orbital

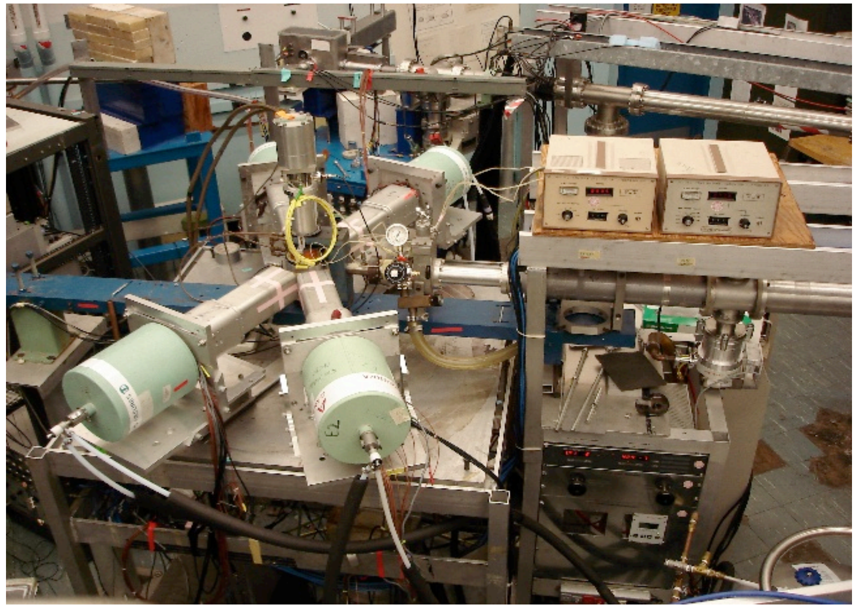
What's new?

New DAQ techniques

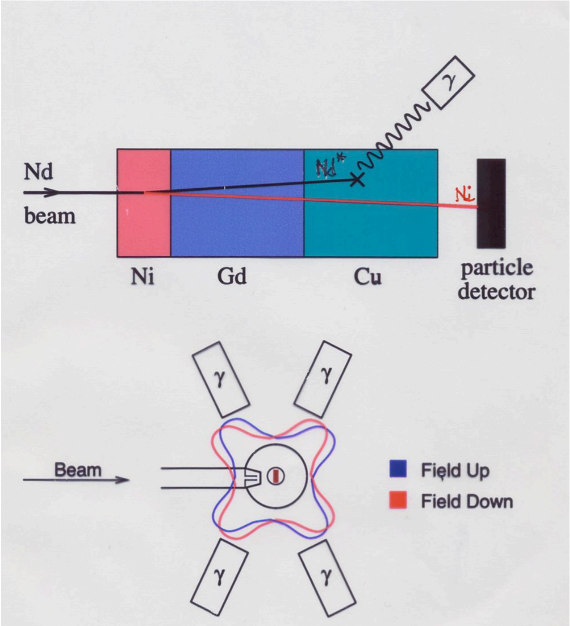
Digital electronics + Clovers

Angular correlations measured directly from the split Clover detectors simultaneously with precession measurements

YALE:WNSL

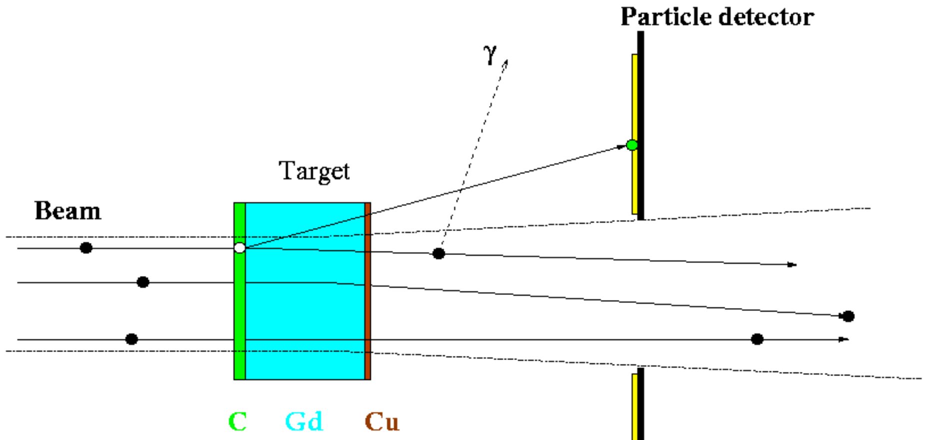


Transient field technique in inverse kinematics



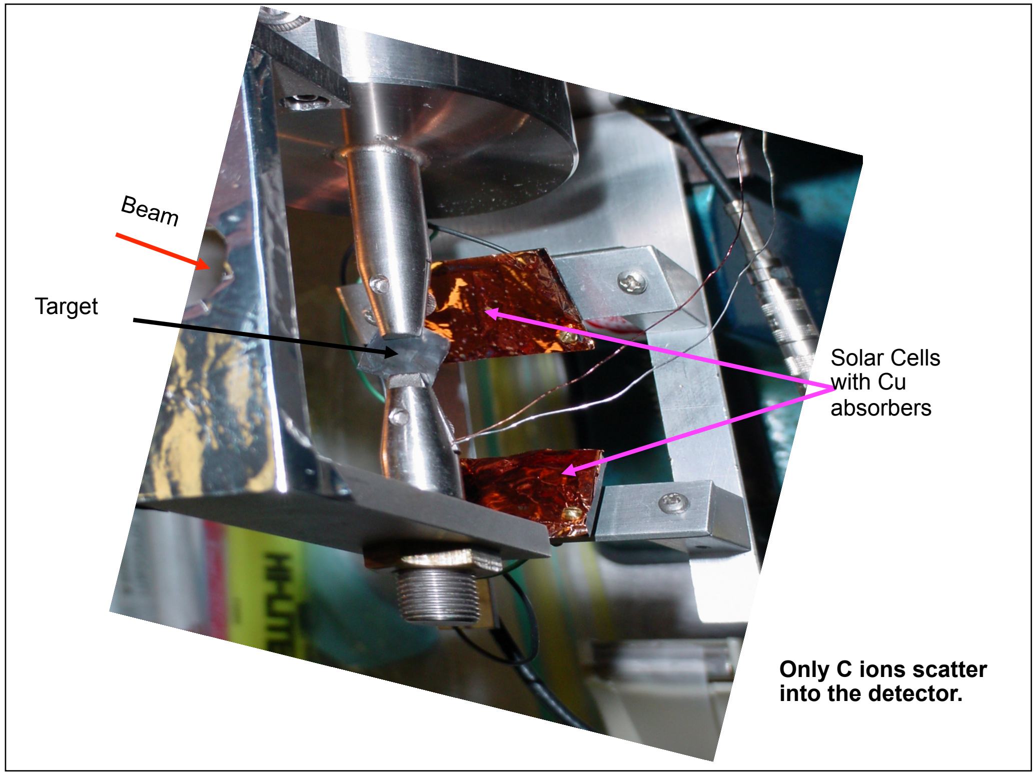
Particle – gamma coincidence mode

^{132}Te transient field setup: ORNL

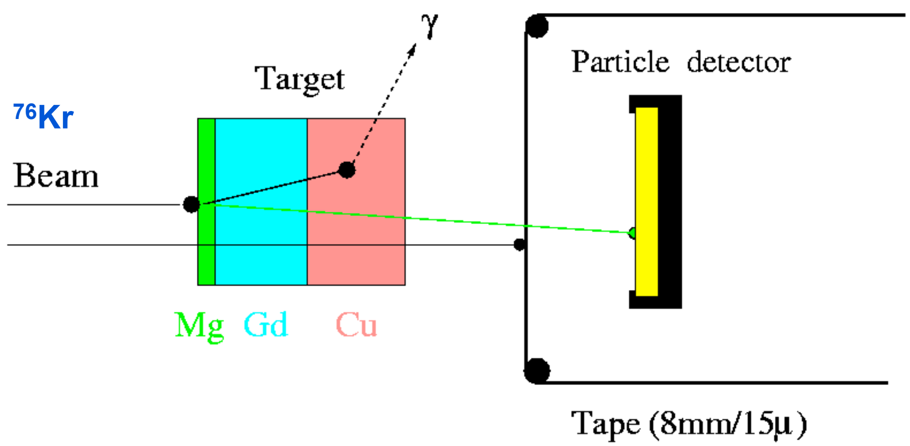


THIN Cu backing.
<u>Disadvantage</u>: probe ions decay in flight, i.e reduction of the anisotropy, an important ingredient in the analysis.
<u>Advantage</u>: target is thinner, less scattering of beam.

Solid angle subtended by detectors: 19° – 47°
Hole diameter: 20 mm
Tgt-det distance30 mm


Beam
Target
Solar Cells
with Cu
absorbers
Only C ions scatter
into the detector.

^{76}Kr setup: LBNL



Coincidence between gamma rays and scattering nuclei

Examples:

^{76}Kr	LBNL	Recyclotron technique
$^{132,134,136}Te$	ORNL	ISOL production
$^{38,40}S$	MSU	Fragmentation
$^{38,40,42}Ar$	MSU	Fragmentation
^{126}Sn	*ORNL*	ISOL production:coming attraction

Beam intensity considerations:

Stable :1 pnA = 0.6 x 10^{10} p/s

^{132}Te	4 x 10^{7}	^{126}Sn	1 x 10^{7}
^{134}Te	2 x 10^{6}	^{128}Sn	3 x 10^{6}
^{136}Te	5 x 10^{5}	^{132}Sn	9 x 10^{5}
		^{134}Sn	3 x 10^{3}
^{38}S	2 x 10^{5}		

Future at ORNL: ^{126}Sn

MSU campaign: **Fe**

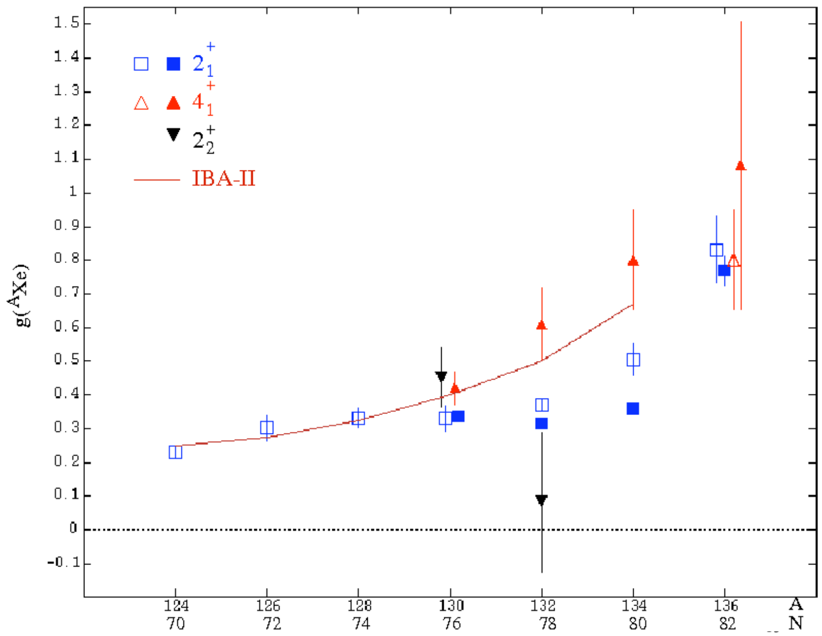
CARIBU Beam Yields for Representative Species

Updated July, 2009

2.5 mCi - summer 09 80 mCi - fall 09 1 Ci - early 10

	Isotope	Half-Life (s)	Low-Energy Beam Yield (ions/sec)	Accelerated Beam Yield (ions/sec)
*	^{104}Zr	1.2	1.5×10^{3} / 4.8×10^{4} / 6.0×10^{5}	5.3×10^{1} / 1.7×10^{3} / 2.1×10^{4}
	^{143}Ba	14.3	3.0×10^{4} / 9.6×10^{5} / 1.2×10^{7}	1.1×10^{3} / 3.4×10^{4} / 4.3×10^{5}
	^{145}Ba	4.0	1.4×10^{4} / 4.4×10^{5} / 5.5×10^{6}	5.0×10^{2} / 1.6×10^{4} / 2.0×10^{5}
*	^{130}Sn	222	2.5×10^{3} / 7.8×10^{4} / 9.8×10^{5}	9.0×10^{1} / 2.9×10^{3} / 3.6×10^{4}
*	^{132}Sn	40	9.3×10^{2} / 3.0×10^{4} / 3.7×10^{5}	3.5×10^{1} / 1.1×10^{3} / 1.4×10^{4}
*	^{138}Xe	846	2.5×10^{4} / 7.8×10^{5} / 9.8×10^{6}	1.8×10^{3} / 5.8×10^{4} / 7.2×10^{5}
	^{110}Mo	2.8	1.6×10^{2} / 5.0×10^{3} / 6.2×10^{4}	5.8×10^{0} / 1.8×10^{2} / 2.3×10^{3}
	^{111}Mo	0.5	8.3×10^{0} / 2.6×10^{2} / 3.3×10^{3}	0.3×10^{0} / 9.6×10^{0} / 1.2×10^{2}

g factors of low-lying states in stable Xe isotopes



Jakob et *al.*, PRC **65**,024316(2002)