Coulomb-excitation measurements in nuclei around ^{132}Sn

Letter of Intent for SPES

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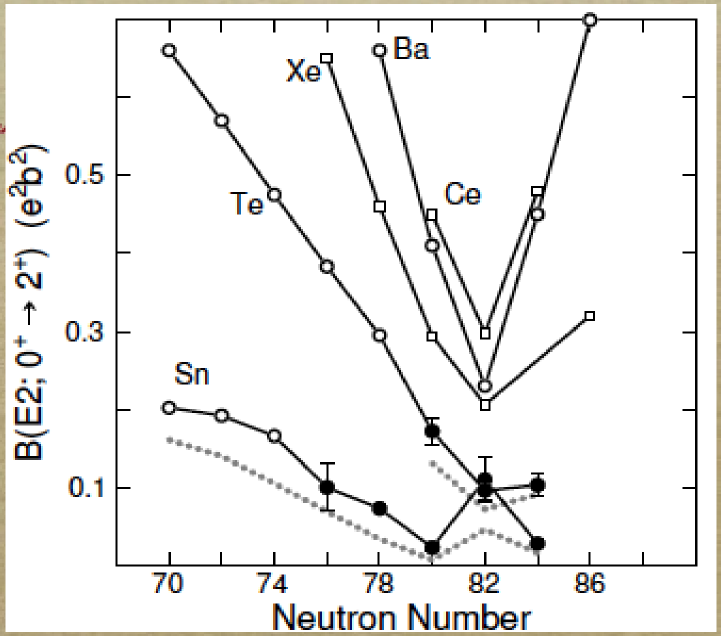
Measurements in nuclei around ^{132}Sn

The study of exotic nuclei in the regions of shell closures is drawing much attention. It offers the opportunity to explore possible changes in nuclear structure.

Great attention is currently focused on nuclei beyond the N=82 shell closure motivated by the fact that some of the data that recently became available appear to be at variance with what expected by extrapolating the existing results for N<82 nuclei.



- ^{134}Sn: 2_1^+ at 726keV the lowest 2^+ observed in a semi-magical even-even nuclei
- ^{136}Te: the B(E2, 2_1^+-> 0_1^+) value is significantly smaller
- ^{135}Sb: significant drop in the energy of the lowest 5/2+ state in comparison to the isotopes with N≤82

These properties may suggest the onset of a shell-structure modification

New data needed to clarify this point →

Radford et al, Eur. Phys. J A 25, s01,383-387 (2005)

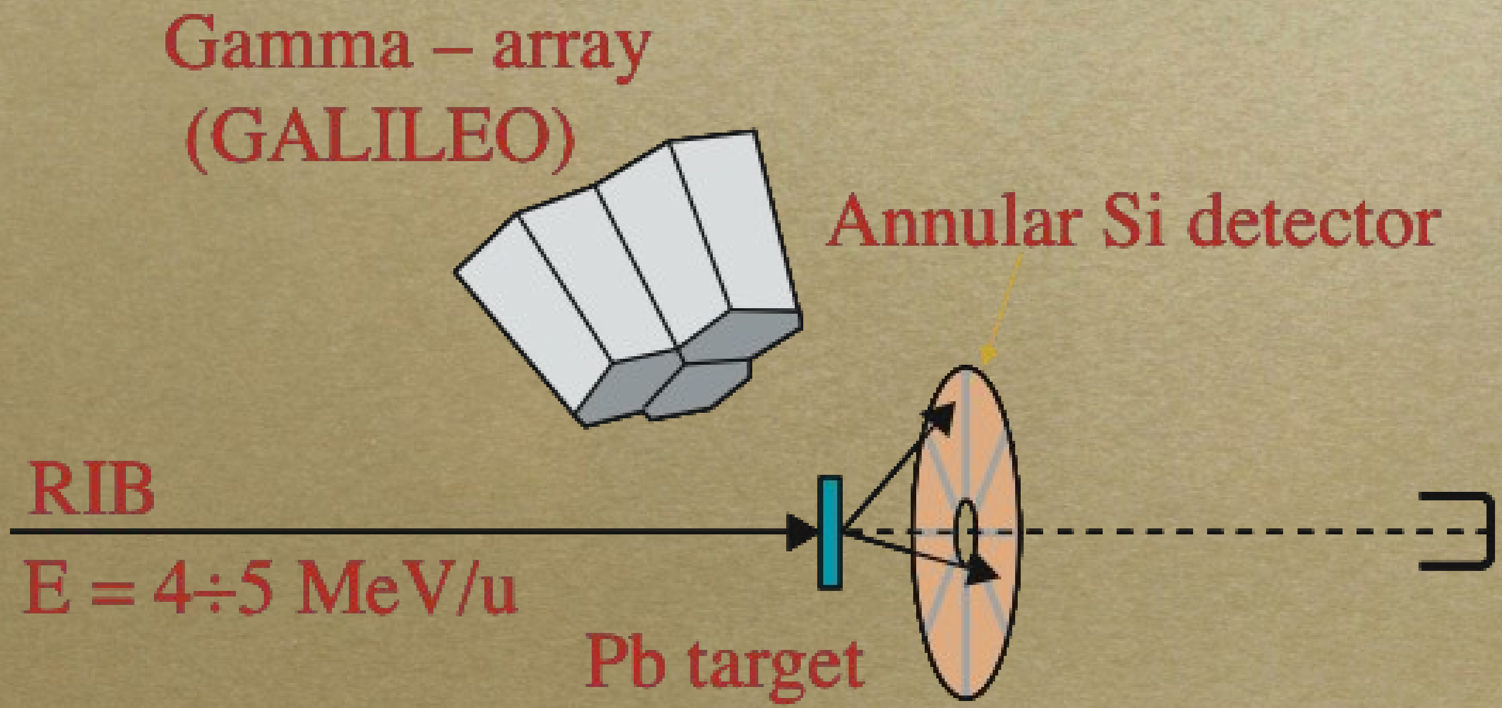
may be provided by the next generation of RIB's facilities →

Neutron rich beams @ SPES

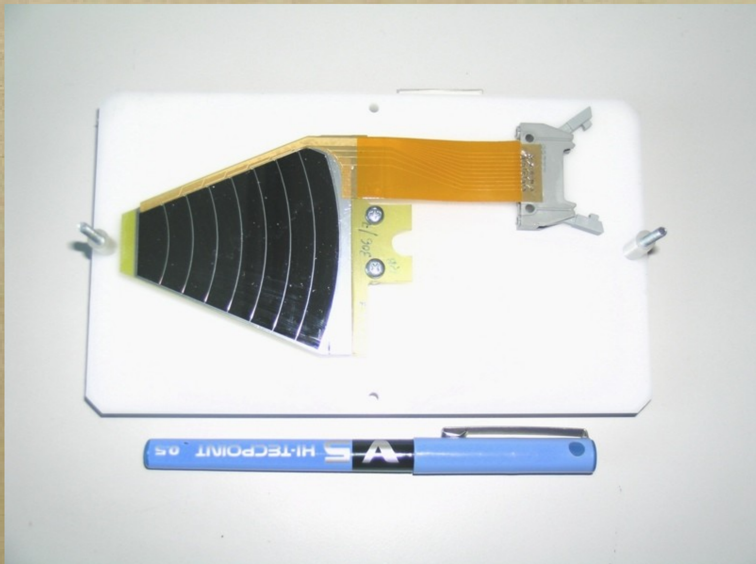
CoulEx measurements with RIBs

Coulomb excitation measurements represent the most general and simple technique to provide information on low-lying excited state and electromagnetic transition probabilities among them.

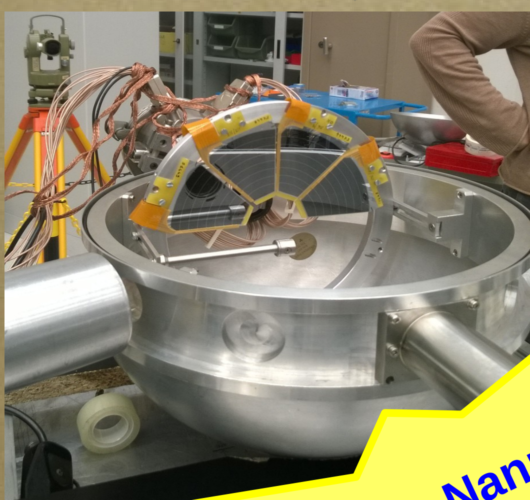
CoulEx with RIBs requires the detection of the scattered projectile and/or the recoil target nuclei for selecting gamma rays coming from the excited beam ions.



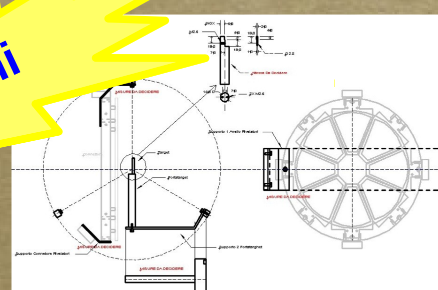
SPIDER: **S**ilicon **PI**e **DE**tecto**R**



- 8 Si detectors of trapezoidal shape arranged to form an annular disc.
- Each sector is segmented into eight independent annular strips on the front surface (junction side).
- The rear surface (ohmic side) consists of a unique electrode
- The thickness of the Si detector is around 300µm with a 50nm dead layer



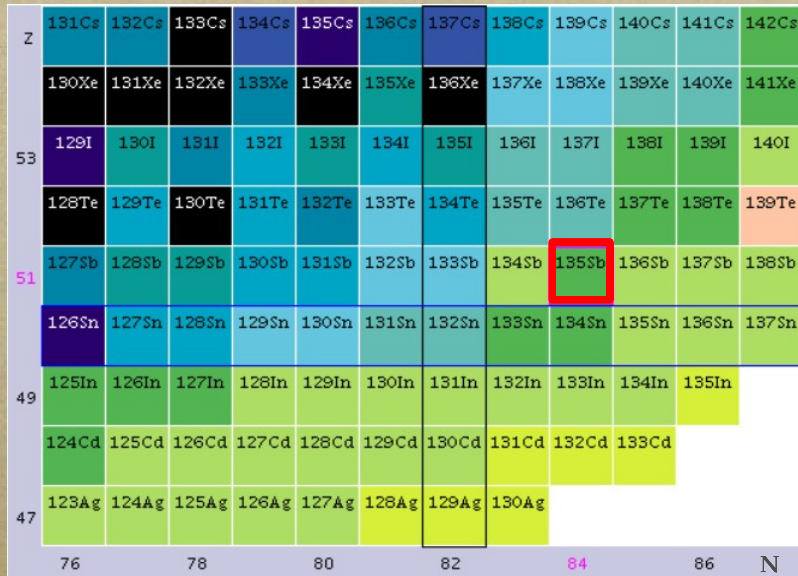
TALK of A. Nannini

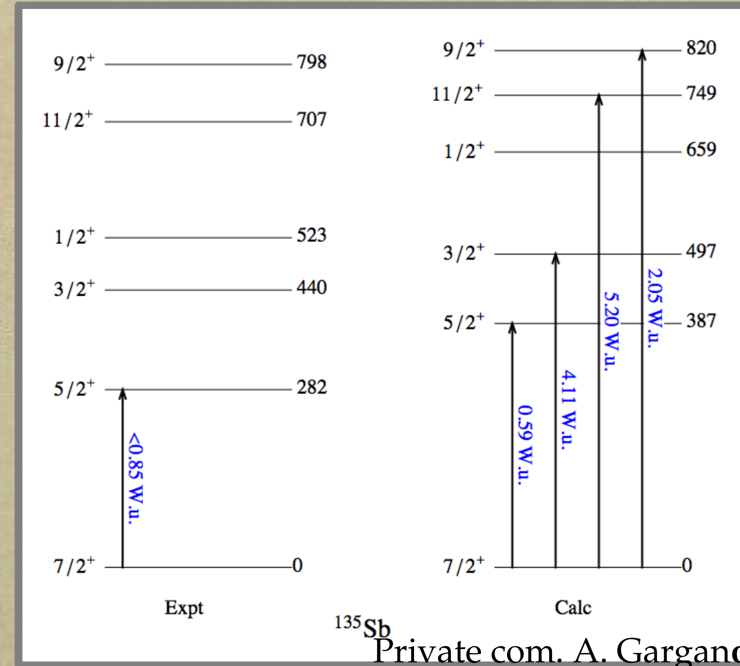


Courtesy of M. Ottanelli

Strip no.	Inner radius (mm)	Outer radius (mm)	θ_{min} (deg)	θ_{max} (deg)
1	76.7	85.0	56.9	59.5
2	68.1	76.4	53.7	56.7
3	59.5	67.9	50.0	53.6
4	50.9	59.3	45.5	49.9
5	42.4	50.7	40.3	45.4
6	33.8	42.1	34.1	40.1
7	25.2	33.6	26.7	33.9
8	16.6	25.0	18.4	26.6

CoulEx of ^{135}Sb





	Target	Yield (p/s)	Source
^{135}Sb	UCx	$2.88 \cdot 10^5$	LIS ***

May be attributed to a downshift of the $d_{5/2}$ proton level relative to the $g_{7/2}$ one, caused by a more diffuse nuclear surface produced by the two neutrons beyond the 82 shell closure.

^{135}Sb	Energy [keV]	Y [mb·mg/cm²/sr]	counts /day
11/2+ → 7/2+	707	33	290
3/2+ → 7/2+	440	36	316
5/2+ → 7/2+	282	11	97

output of GOSIA for ^{135}Sb:

beam intensity: $2.88 \cdot 10^5$ ion/sec

beam energy: 540 MeV

Covello et al, Eur Phys J Special Topics 150 93-96 (2007)
Coraggio *et al*, Nucl. Phys C80, 044320 (2009)
Coraggio *et al*, Nucl. Phys A805 (2009)424c-420c

The electromagnetic matrix elements utilized in the computation were taken from a realistic shell-model calculation

CoulEx of ^{126,128}Cd

Scarce information on ^{126,128}Cd, two proton holes and two or four neutron holes inside ^{132}Sn core, respectively

When approaching N=82 → anomalous behavior of the energies of the 2_1^+ is observed,the energy of the 2_1^+state in ^{128}Cd is lower than the one in ^{126,}Cd

Jungclaus et al propose that the anomaly is caused by the presence of quadrupole collectivity close to the N = 82 shell closure.

They predict that the cadmium isotopes are weakly deformed

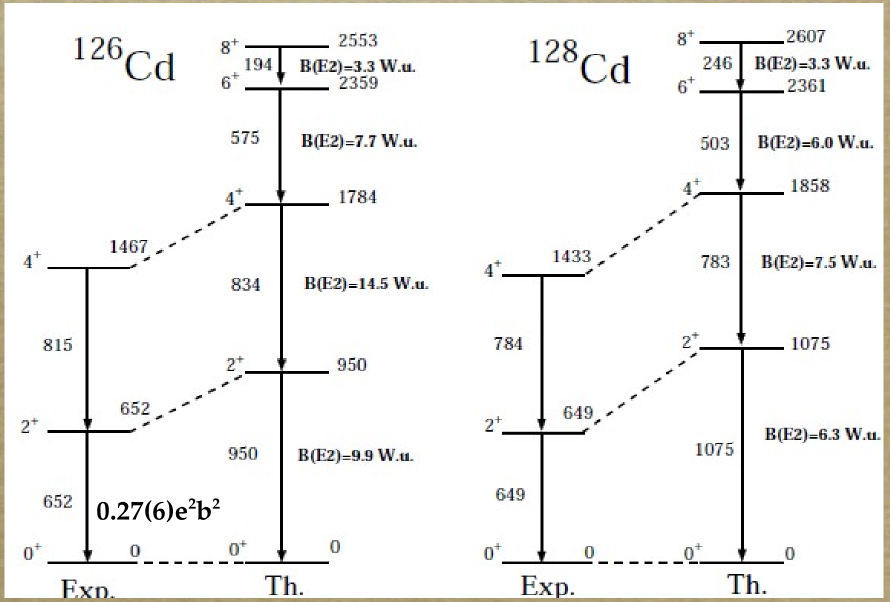
Jungclaus et al, Phys Rev.Lett 99, 132501(2007)

Very recently CoulEx and DSAM measurements have been performed to determine B(E2) rates and Q in $^{122\text{-}126}$Cd

Ileva et al, Phys Rev. C 89, 014313 (2014)

We propose: CoulEx on $^{126,\ 128}$Cd

	Target	Yield (p/s)	Source
^{126}Cd	UCx	$8,68 \cdot 10^4$	LIS **
^{128}Cd	UCx	$2.87 \cdot 10^3$	LIS **



Scherillo et al, Phys Rev. C 70, 054318 (2004)

output of GOSIA for $^{126-128}Cd$:

beam intensity: 8,68 · 10^4 ion/sec
beam energy: 485 MeV

^{126}Cd	Energy [keV]	Y [mb·mg/cm²/sr]	Counts/day
$2_1 \rightarrow 0_1$	652	435	1000
$4_1 \rightarrow 2_1$	815	34	90

beam intensity: 2.87 · 10^3 ion/sec
beam energy: 485 MeV

^{128}Cd	Energy [keV]	Y [mb·mg/cm²/sr]	Counts/day
$2_1 \rightarrow 0_1$	645	864	72
$4_1 \rightarrow 2_1$	784	38	4

Conclusions

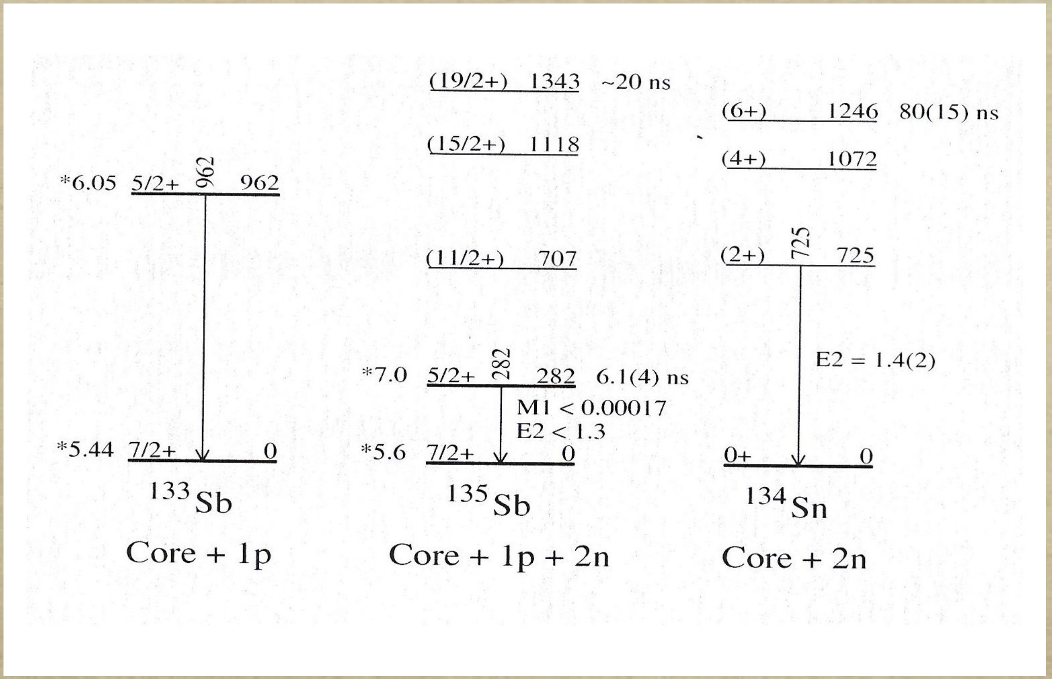
- CoulEx is one of the most general and simple method (at least in principle) capable to provide crucial information on nuclei off the valley of stability. Multi-step excitation will become common with the increase of the RIB intensities

- We propose to investigate ^{135}Sb and ^{126,128}Cd nuclei for which we have performed Gosia calculation to estimate the yields

Thank You

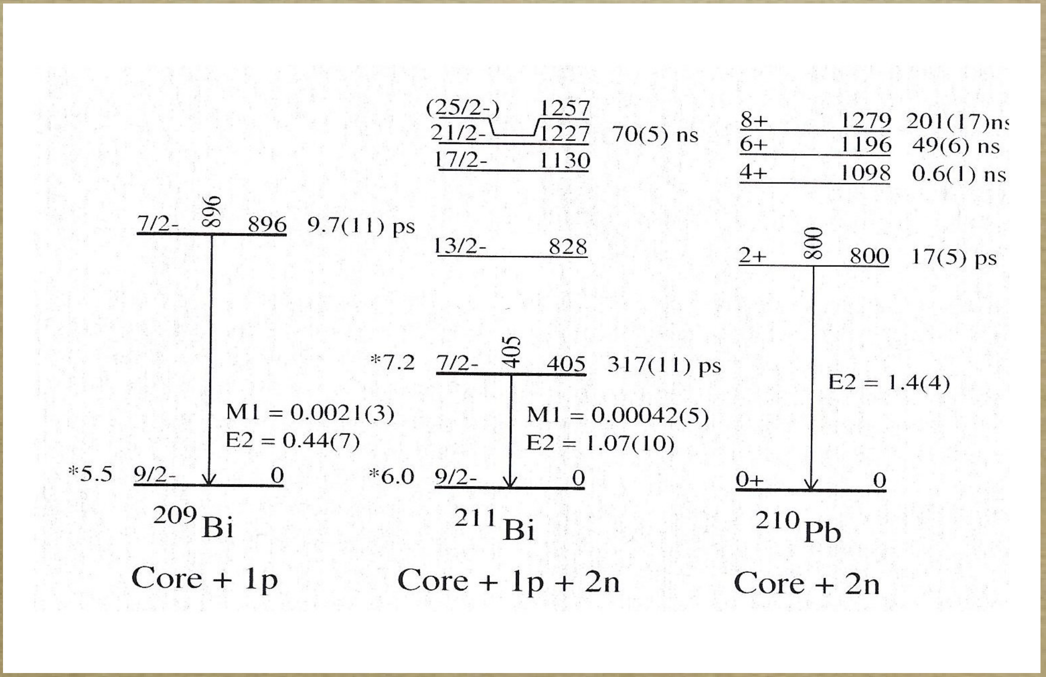
^{135}Sb

downshift of the $d_{5/2}$ proton level relative to the $g_{7/2}$ one, caused by a more diffuse nuclear surface produced by the two neutrons beyond the 82 shell closure.



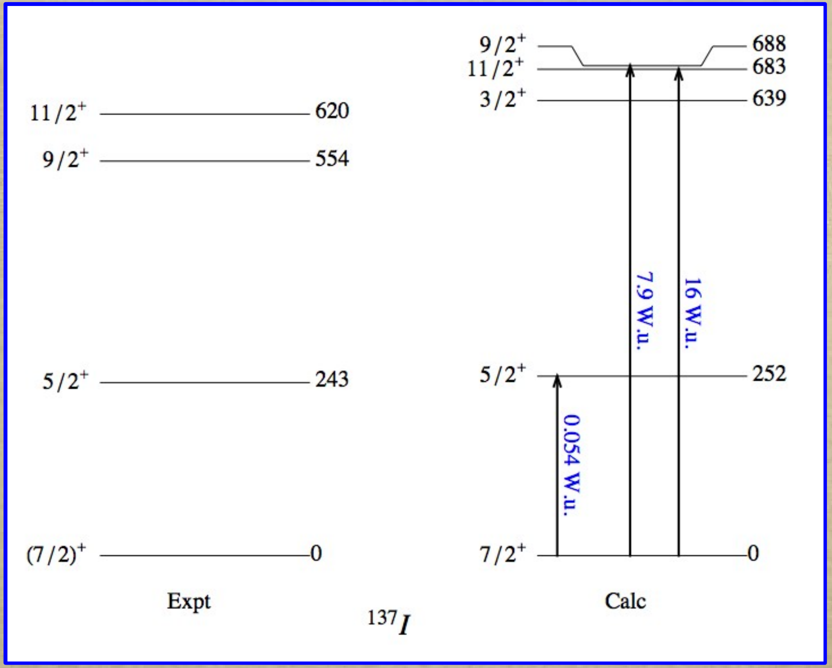
Korgul et al, Eur Phys J A15, 181 (2002)
Shergur et al, Phys Rev C 6, 021302 (2005)

^{211}Bi



Korgul et al, Eur Phys J A15, 181 (2002)

CoulEx of ^{137}I



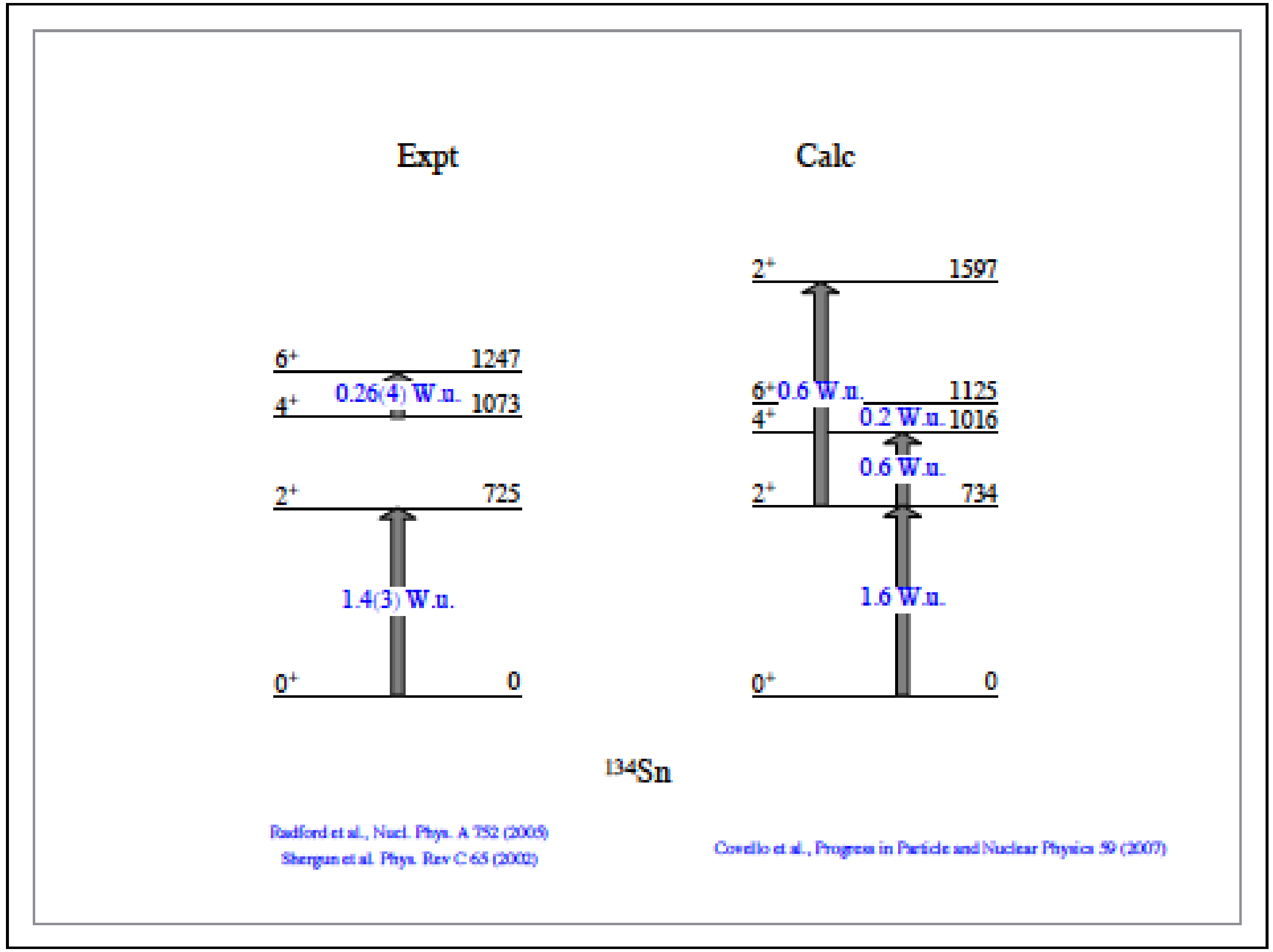
Private com. A. Gargano

	Target	Yield (p/s)
^{137}I	CeS	$2.18 \cdot 10^9$

output of GOSIA for ^{137}I:

^{137}I	Energy [keV]	Y [mb•mg/cm²/sr]	counts/day
11/2+→7/2+	683	93	300
9/2+ →7/2+	688	11	30

Coulex of ^{134}Sn



output of GOSIA code:

beam intensity: 5·10[5] ion/sec
beam energy: 570 MeV

ε_γ : 8% @ 1 MeV
θ coverage: 18 to 60 degrees

^{134}Sn	Energy [keV]	Y [mb•mg/cm²/sr]	counts/hour
$2_1 \rightarrow 0_1$	726	35	16
$4_1 \rightarrow 2_1$	348	0.32	0.1
$2_2 \rightarrow 2_1$	863	0.44	0.2