



IS682 – Add1 Laser-assisted decay spectroscopy of $^{75m}, ^{79m}\text{Zn}$

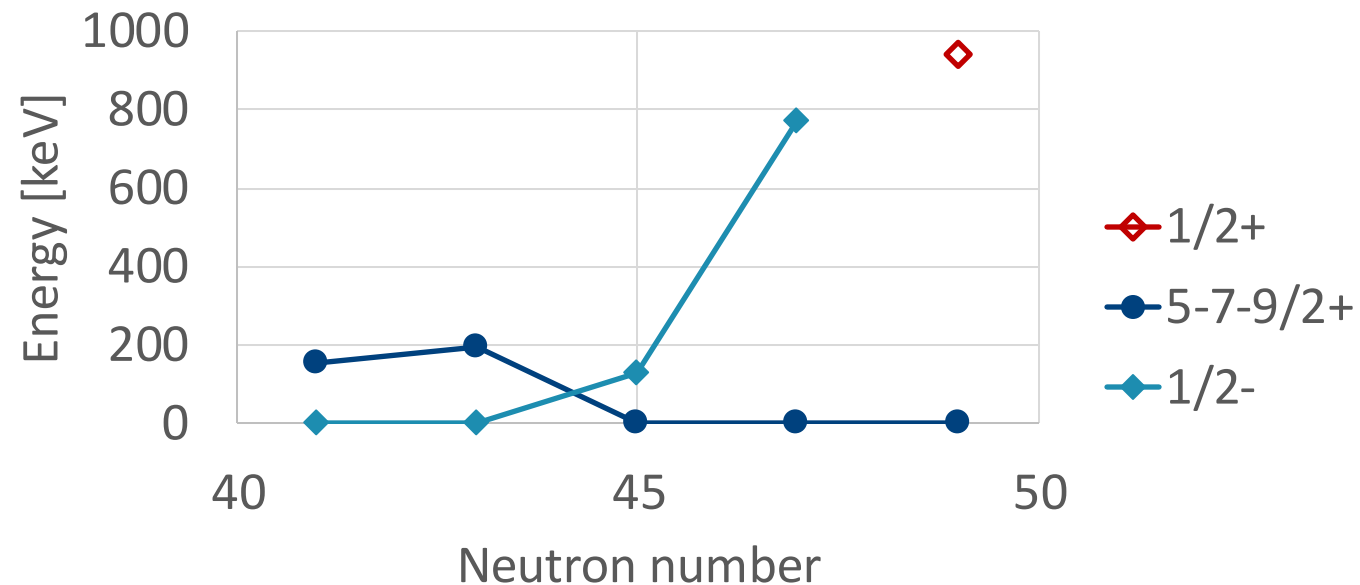
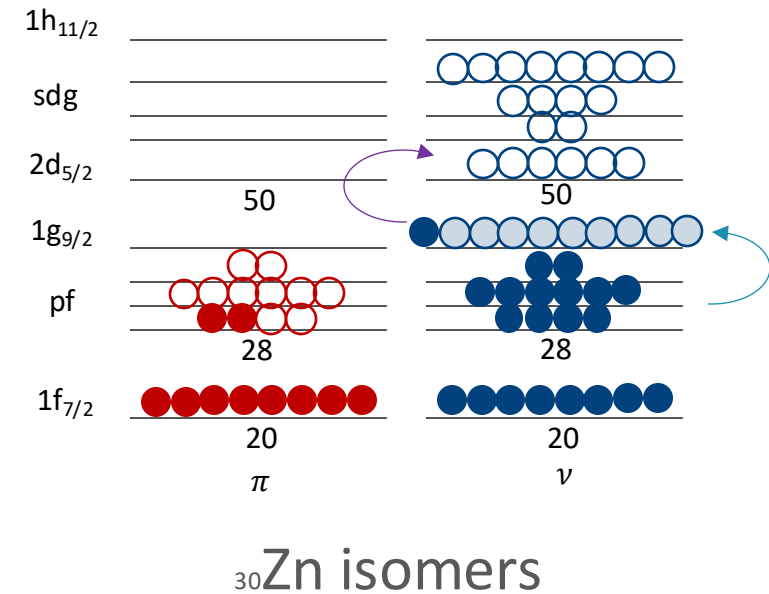


Addendum

Laser-assisted decay spectroscopy of $^{75m,79m}\text{Zn}$

Isomers in ${}_{30}\text{Zn}_{40-50}$

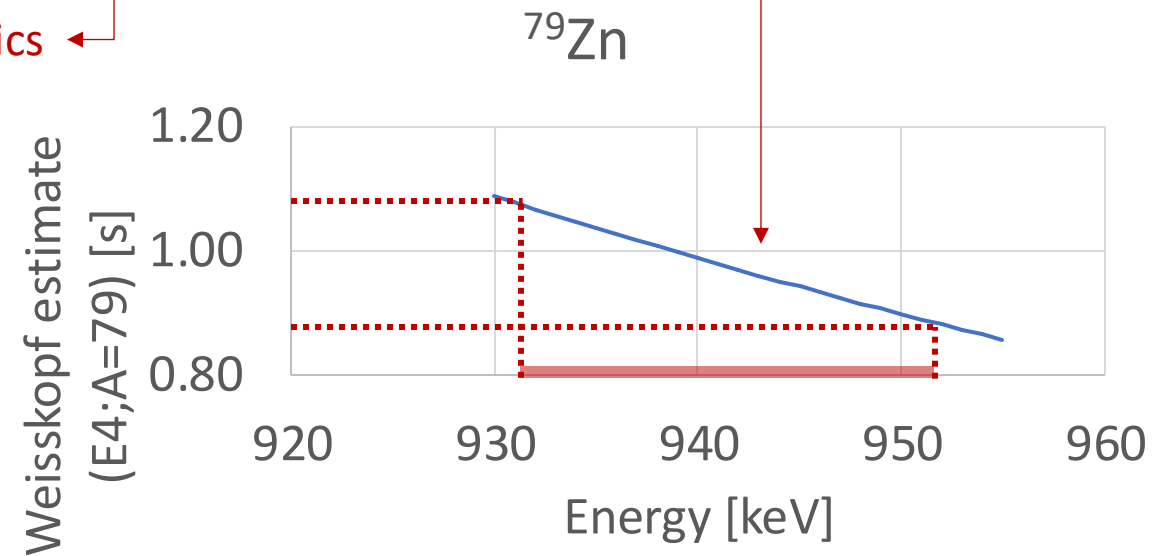
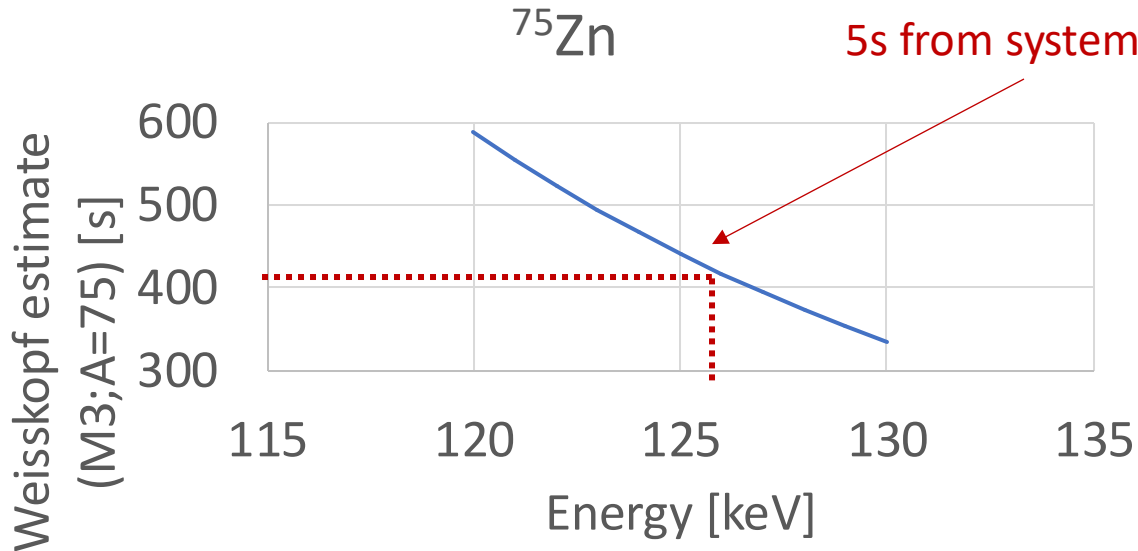
- The $g_{9/2}$ orbital, with its different parity and high orbital angular momentum, is an ideal ground for isomerism.
- Excitations from the pf shell give rise to opposite-parity isomers, like $1/2^-$, even becoming the ground state for some isotopes.
- In ${}^{79}\text{Zn}$, the nature of the isomer is different, interpreted as an excitation across the $N=50$ shell gap.



Isomers in ${}_{30}\text{Zn}_{40-50}$

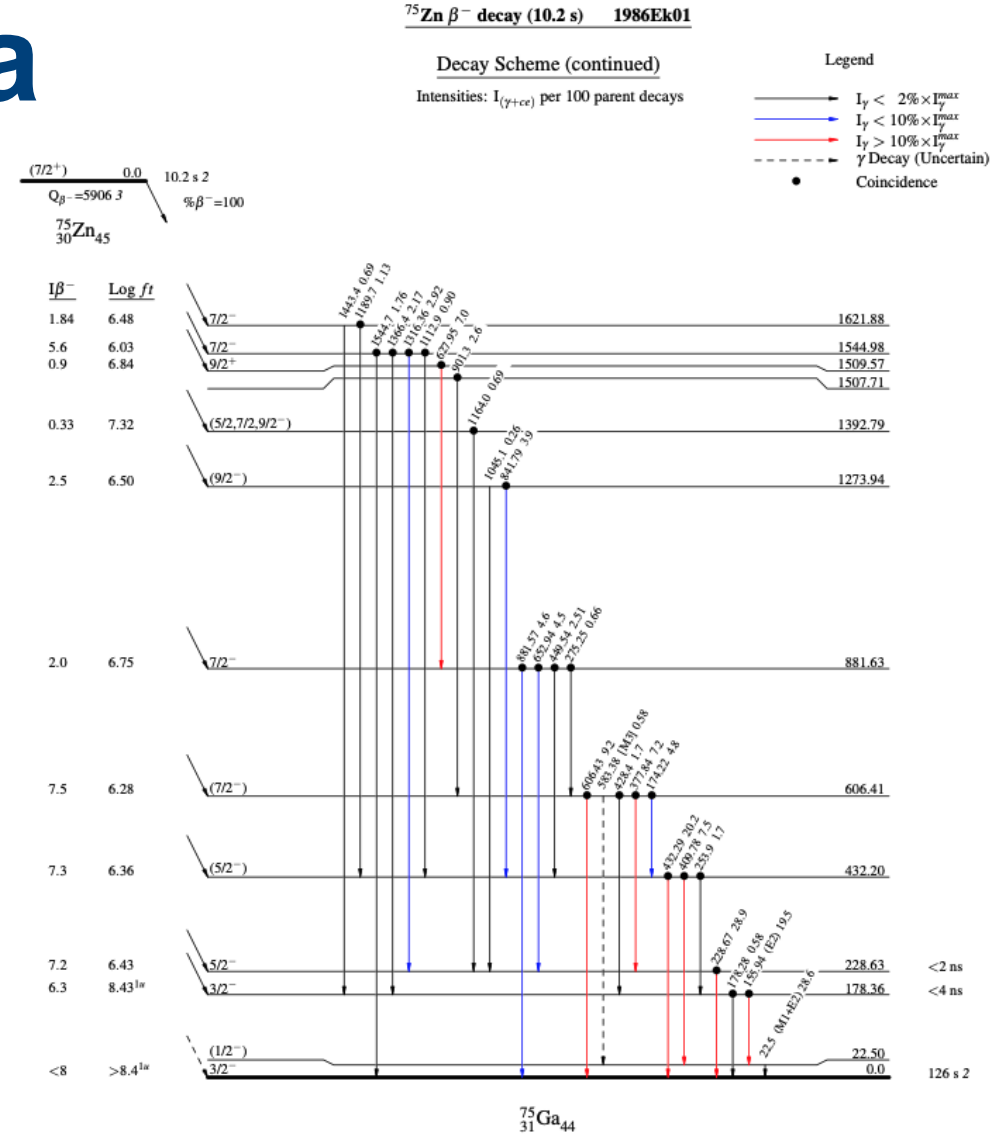
Table 1: Overview of the spin and half-life of the neutron-rich zinc isotopes between $N = 40$ and $N = 50$.

Isotope	${}^{71}\text{Zn}$	${}^{73}\text{Zn}$	${}^{75}\text{Zn}$	${}^{77}\text{Zn}$	${}^{79}\text{Zn}$
g.s. spin	$1/2^-$	$1/2^-$	$7/2^+$	$7/2^+$	$9/2^+$
g.s. half-life	2.42 min	24.5 s	10.2 s	2.08 s	0.746 s
isomer spin	$9/2^+$	$5/2^+$	$1/2^-$	$1/2^-$	$1/2^+$
isomer half-life	4.14 h	13 ms	-	1.05 s	> 200 ms

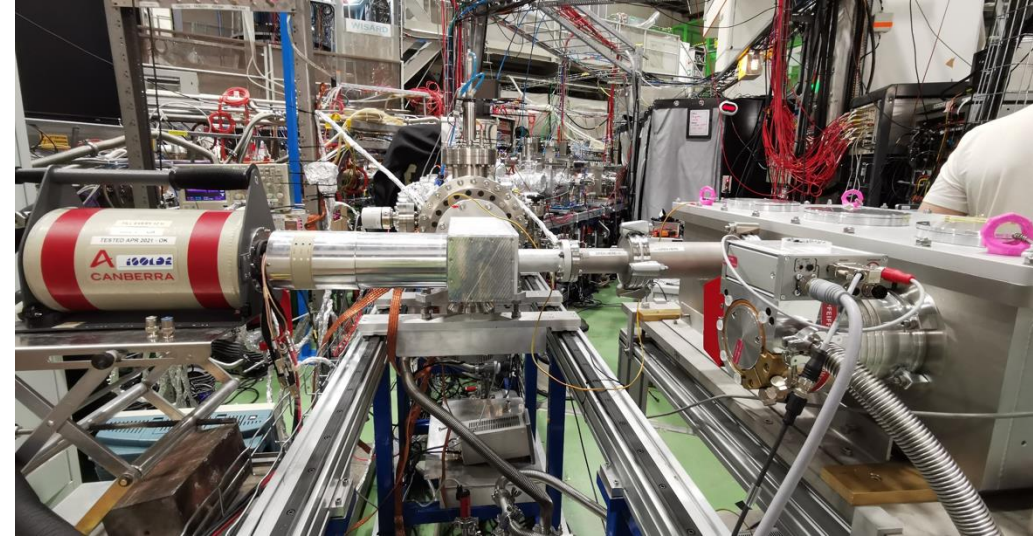
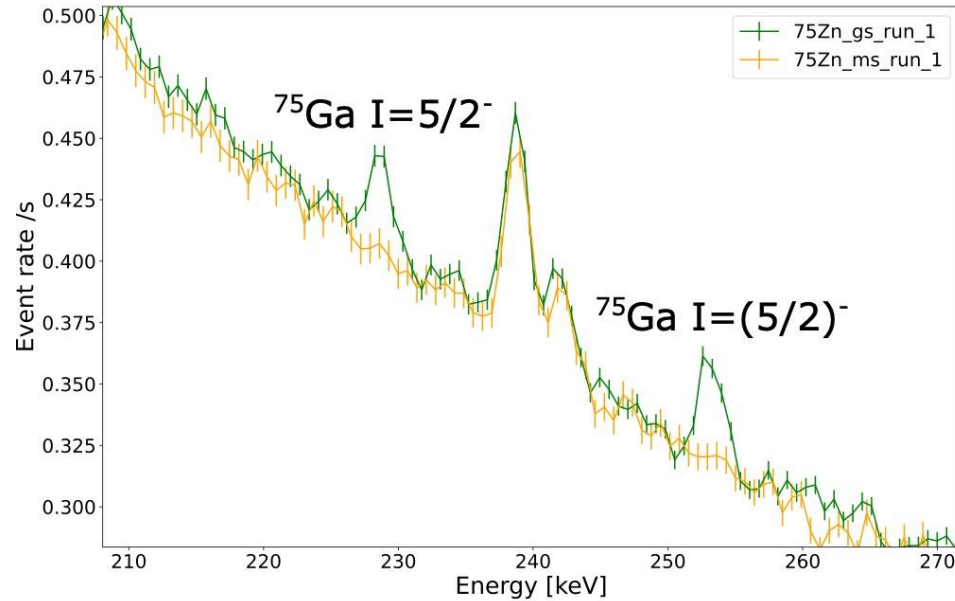
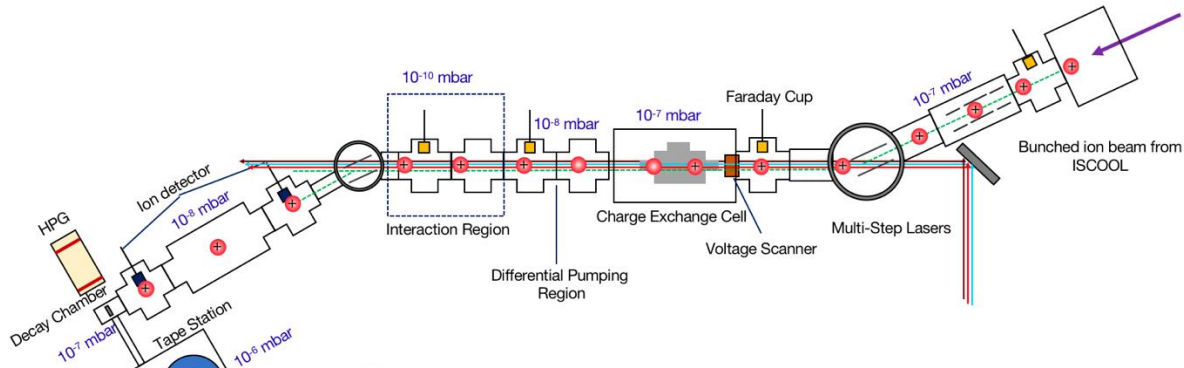


Populating states in ^{75}Ga

- The decay of this isotope already shows a rich level scheme, though one may assume that it represents an average of both decays.
- Beta decay is selective, which will result in different starting populations in ^{75}Ga , towards higher spins from the $7/2^+$ ground state and lower spins from the $1/2^-$ isomer.
- Our preliminary tests have shown that the decay of the $(5/2^-)$ low-lying levels proceed indeed from the decay of the high-spin ground state.
- We now request to acquire high statistics to fully deconvolute the scheme between those two states.

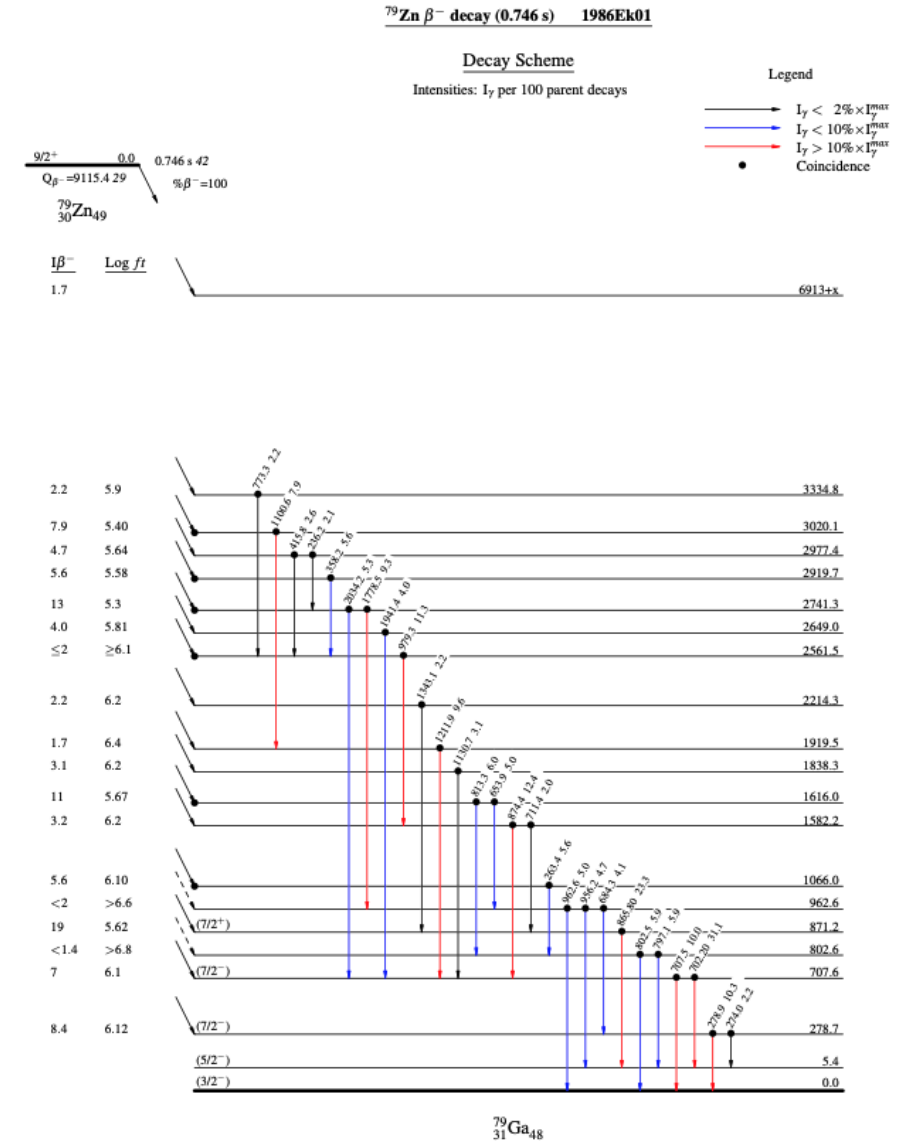


Preliminary test on ^{75m}Zn



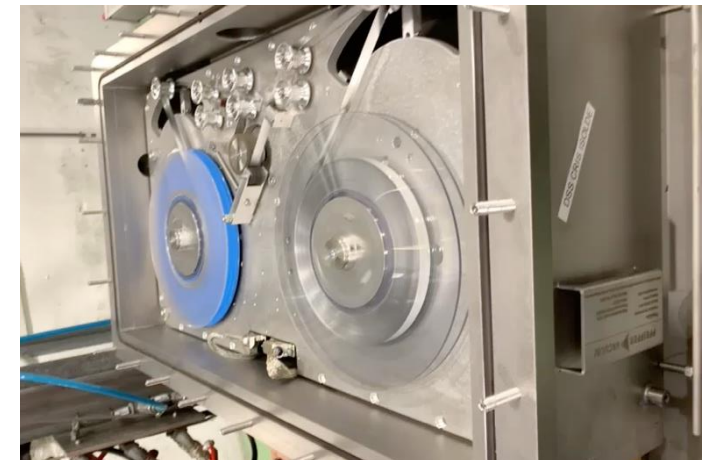
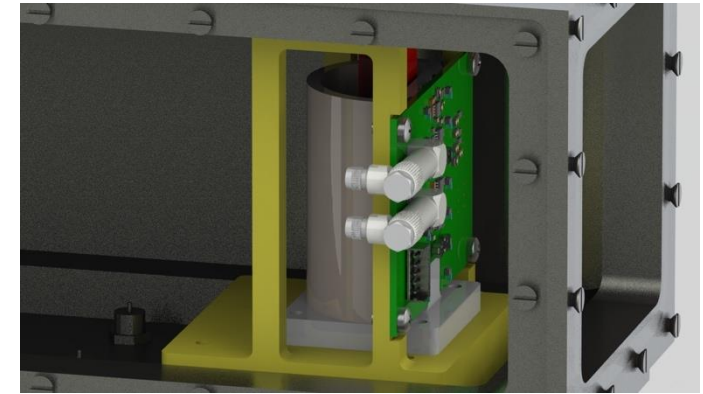
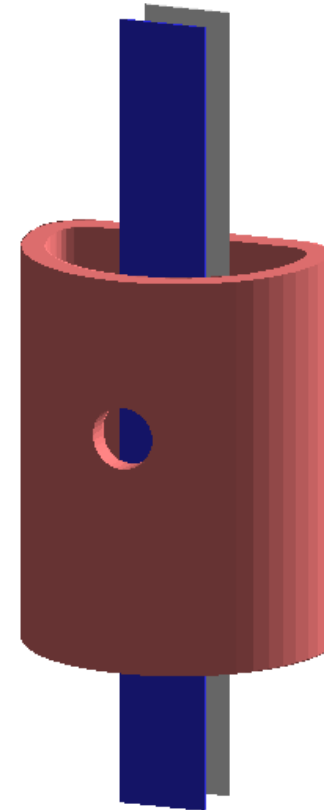
Populating states in ^{79}Ga

- Also a rich decay scheme, though less information is known, given the more exotic isotope.
- The different spins but also the high excitation energy of the isomer may lead to a very different population.
- There is a known βn branch from the ground state (1.8%) that populates ^{78}Ga . This might also be observed from the isomer decay.



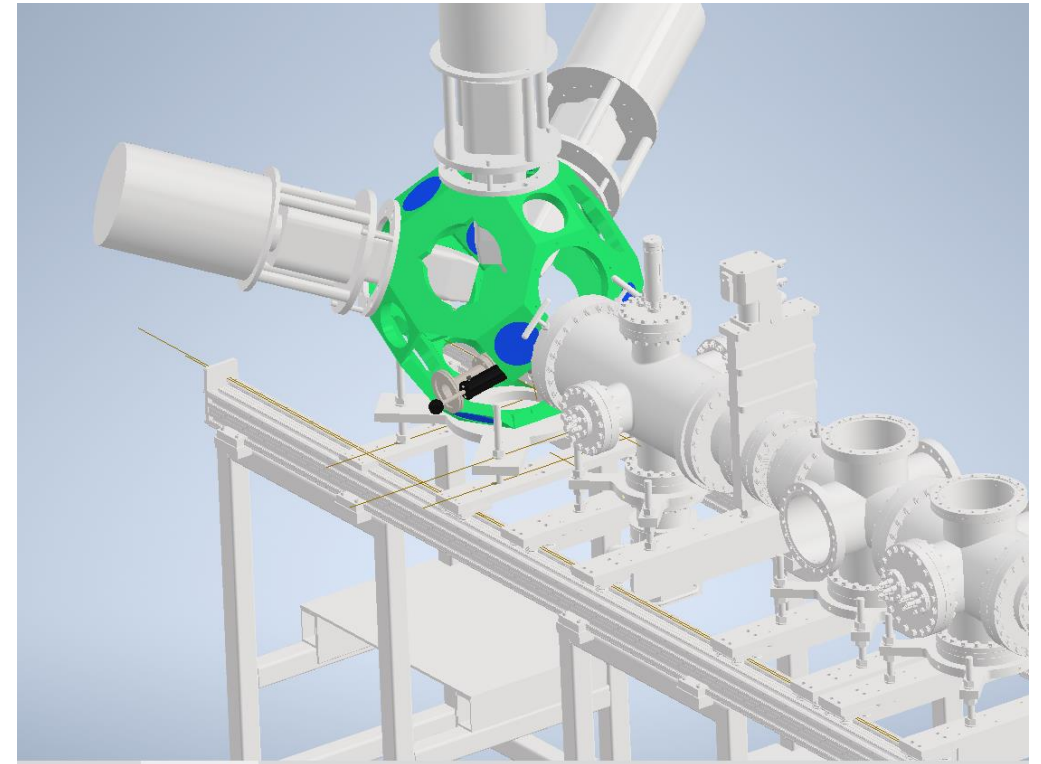
New CRIS Decay Spectroscopy Station

- CRIS has recently upgraded its beam line to improve the ion beam transport towards this end of its beamline. This has been fully commissioned in 2023 and is now fully under control.
- The CRIS DSS is now equipped with the same tape system as IDS for the efficient removal of activity build up.
- A new scintillator has been designed for β detection, with a simulated efficiency of 85% (^{75}Zn) and 90% (^{79}Zn).



New CRIS Decay Spectroscopy Station

- Outside the vacuum chamber, we foresee to install 4 HPGe - ideally 4 clovers.
- Configuration similar to the earlier version of IDS → using their known efficiency curve for estimates.
- Aiming for ~10k counts in γ -singles a ‘weak’ transition in order to ensure reasonable statistics in $\gamma\gamma$ -coincidences, as a guide for the shift request.
 - 178.3 keV in ^{75}Zn , with 0.58% absolute intensity and 8% efficiency → 10 hrs at a rate of 600/s
 - 802.5 keV in ^{79}Zn , with 5.9% absolute intensity and 3% efficiency → 50 hours at a rate of 30/s



Summary of request

Table 2: Measured rates and requested shifts for the study of the decay of $^{75,79}\text{Zn}$ with the CRIS DSS.

Isotope	Rate	Shifts ground-state	Shifts isomer	Total
^{75}Zn	600 per s	1	1	2
^{79}Zn	30 per s	6	6	12
			Setup	3
			TOTAL	17

- Request rounded down with respect to the indicative 10k counts in the reference γ rays. However, sufficient statistics should still be available globally to reach the scientific goal.
- Half-life measurements with beam on/off sequences will further reduce the statistics, but still allowing the scientific goals to be reached.

TAC

Probing the magicity and shell evolution in the vicinity of N = 50 with high-resolution laser spectroscopy of 81,82Zn isotopes: Addendum: Laser-assisted decay spectroscopy of 75m,79mZn					
CDS#	Proposal #	IS #	Setup	Shifts	Isotopes
CERN-INTC-2024-059	INTC-P-579-ADD-1		CRIS	17	75Zn, 79Zn
Beam intensity/purity, targets-ion sources	<p>For future reference:</p> <ul style="list-style-type: none"> - 75Zn - 1.7E6 /uC https://logbook.cern.ch/elogbook-server/GET/showEventInLogbook/3580516 - 79Zn - 3E5 /uC https://logbook.cern.ch/elogbook-server/GET/showEventInLogbook/4136850 <p>--> Ok with request</p> <ul style="list-style-type: none"> - 75Ga should be suppressed contamination suppressed due to quartz line. -> good from RP point of view 				
General implantation and setup					
General Comments					
Safety					
TAC recommendation	The TAC does not see any feasibility issues with this proposal.				



Kennis kent
geen einde



Knowledge
knows no end