Decay Spectroscopy of odd-Ag isotopes - INTC-P-383

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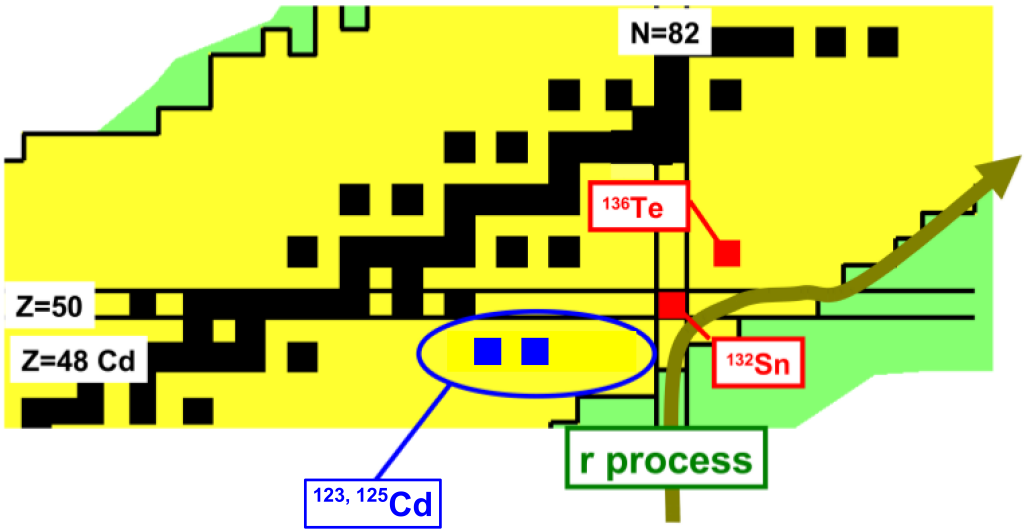
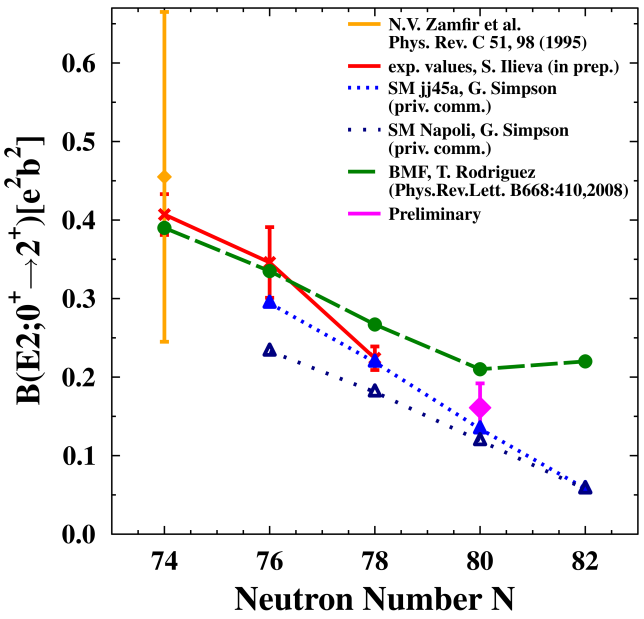
INTC meeting CERN, October 23rd 2013

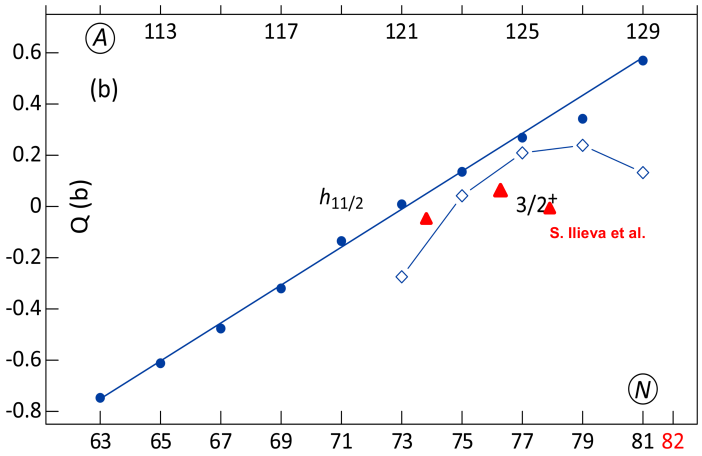
Interesting region



- Very far away from stability
- Only one of a few experimentally accessible doubly-magic regions
- Close to shell closures at Z = 50 and N = 82
  $\rightarrow$ perfect test for SM interactions
- Close to r-process-path: Which theoretical extrapolation can we believe?

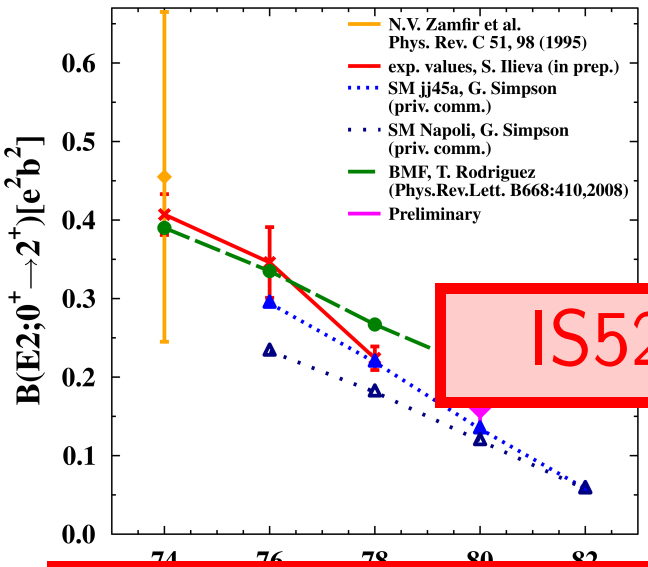
Neutron-rich Cd - Newly known facts





- $^{122-126}$Cd: IS411 → *S. Ilieva et al., Phys. Rev. C, (nearly) submitted*
- ^{128}Cd: IS477 → *PhD Thesis S.B.*
- SM prediction too low for ^{124}Cd
  ⇒ Additional collectivity or problem with SM interactions?
- Small quadrupole moments for 2_1^+ state
- COLLAPS: IS497 → *D. T. Yordanov et al., Phys. Rev. Lett. 110, 192501 (2013)*
- Small quadrupole moments in heavy odd Cd for ground and isomeric state
- Laser spectroscopy not possible for short living states → Role of orbitals for generation of collectivity?

Neutron-rich Cd - Newly known facts



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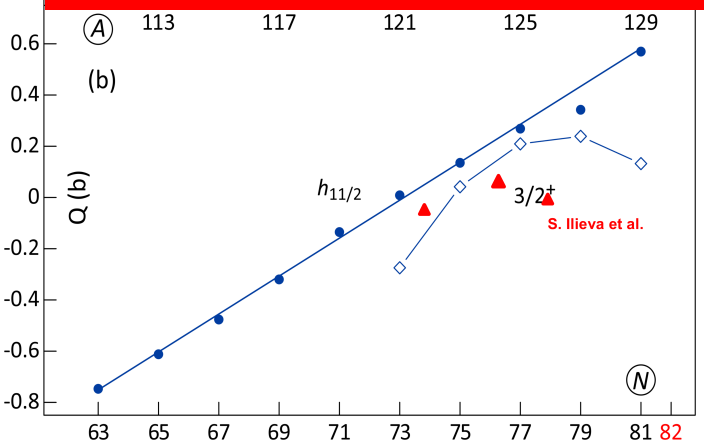
- Small quadrupole moments for 2_1^+ state

IS524: Physics case approved

So far: ^{123}Cd measured as the level scheme was known



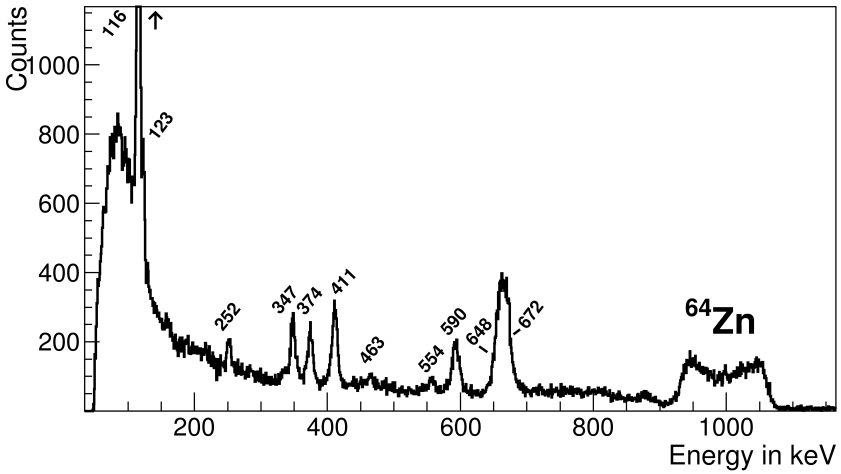
Phys. Rev. Lett. 110, 192501 (2013)

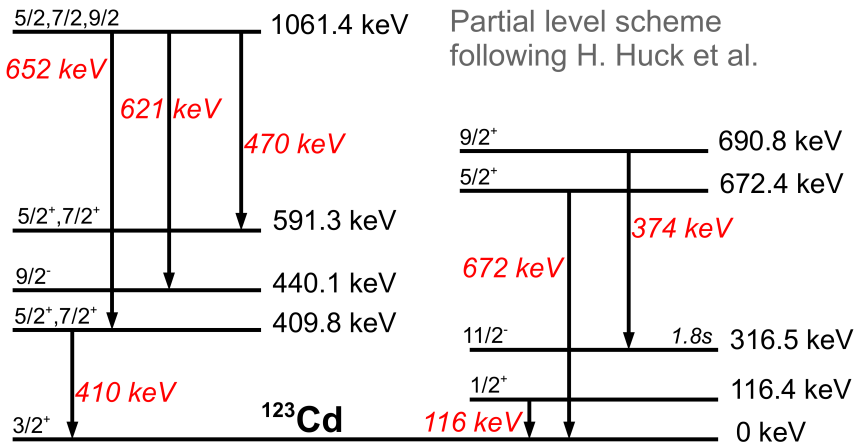
- Small quadrupole moments in heavy odd isomeric state

BUT...

- Laser spectroscopy not possible for short living states → Role of orbitals for generation of collectivity?

^{123}Cd: COULEX

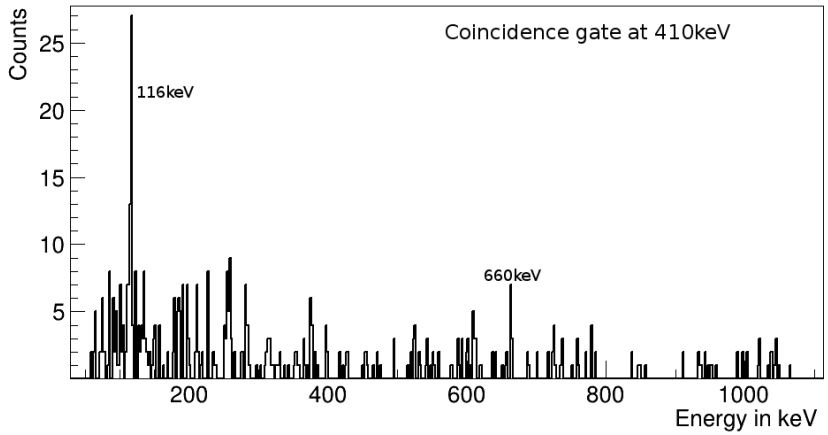




Example for disagreement with *H. Huck et al., Phys. Rev. C 40, 1384 (1989)*:

- Multiplet @660keV: could contain two transitions (652keV and 672 keV), BUT: coincident transitions not observed
  $\rightarrow$ Either state at 1061keV not populated $\rightarrow$ ~~652keV~~ $\Rightarrow$ Unknown transitions!
  $\rightarrow$ Or Level scheme wrong!
- *A. Kankainen et al., Phys. Rev. C 87, 024307 (2013)*: $\frac{11}{2}^-$ isomeric state at 144keV

^{123}Cd: COULEX



- IS524 $\rightarrow$ *Master Thesis of A.-L. Hartig, TU Darmstadt*
- Low statistics for $\gamma\gamma-$coincidences

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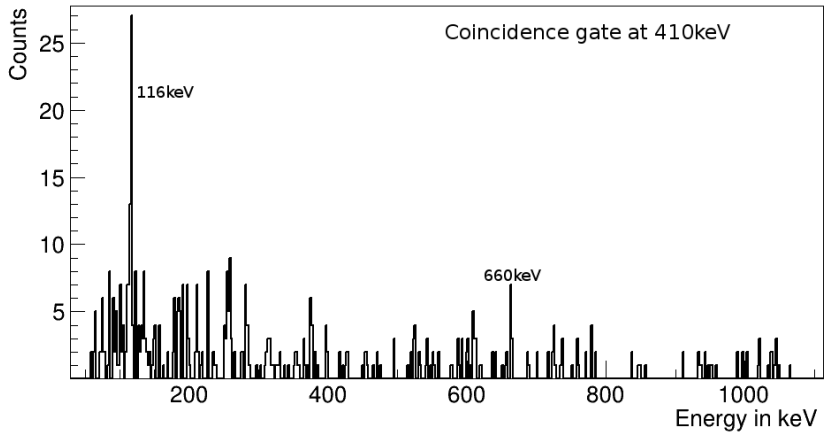

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Example for disagreement with *H. Huck et al., Phys. Rev. C 40, 1384 (1989)*:

- M[illegible] 660keV and [illegible] transitions (650keV and 670 keV); BUT: coincident transitions not observed

  NEW INVESTIGATION OF LEVEL SCHEME NEEDED!

  $\rightarrow$ Either state at 1061keV not populated $\rightarrow$ ~~652keV~~ $\Rightarrow$ Unknown transitions!

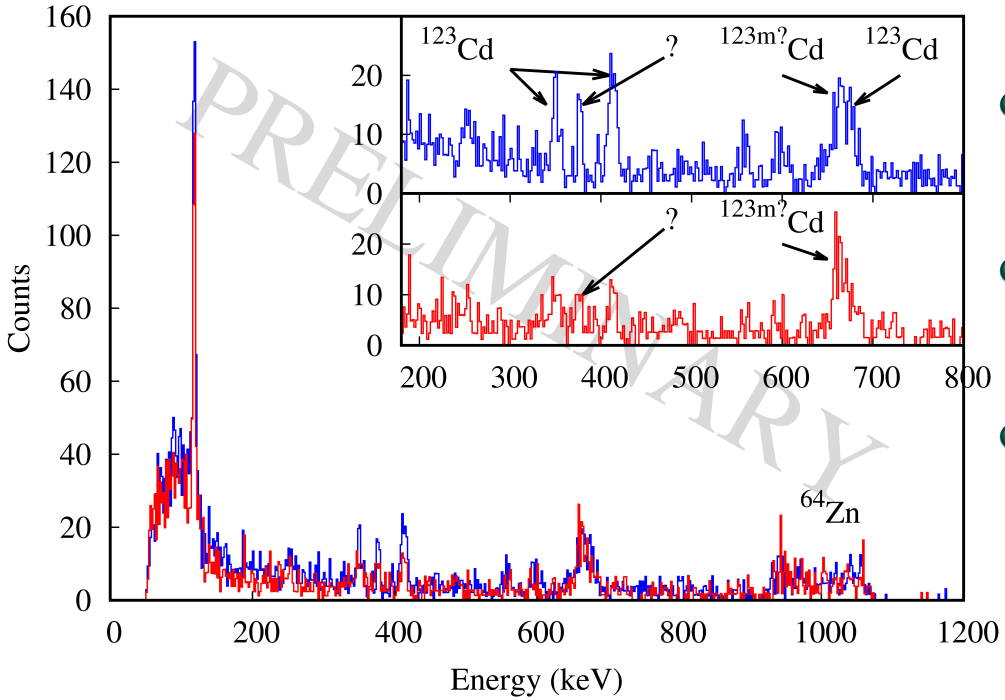
  $\rightarrow$ Or Level scheme wrong!
- *A. Kankainen et al., Phys. Rev. C 87, 024307 (2013)*: $\frac{11}{2}^-$ isomeric state at 144keV

^{123}Cd: COULEX

With RILIS:

- Rough test with broadband laser (not enough time for narrowband laser scan)

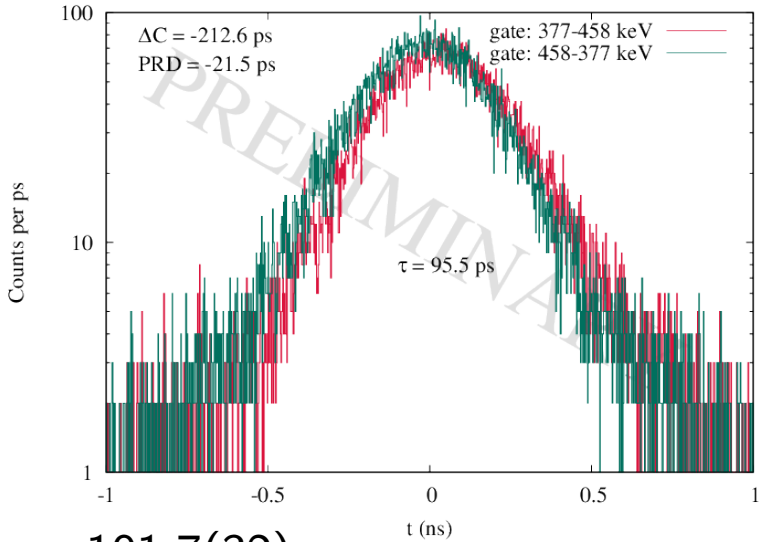
Two different settings found:



- Change of intensity in 116keV-line
- Change of structure in 660keV mulitplet
- 374keV transition previously assigned to feed isomer, here rather gs

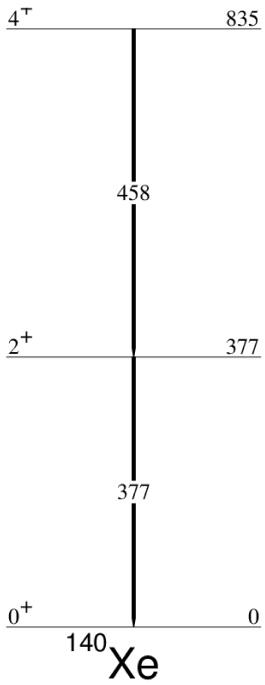
Lifetime measurements

- Lifetimes of excited states in (sub-)nanosecond range
- Combination with coulex data → additional constraints to matrix elements → *Th. Kröll et al., INTC-P-342*
- Use generalised centroid difference method → *J.-M. Régis et al., Nucl. Instr. Meth. Phys. Res. A 726, 191 (2013)*
- Method already applied by S. Ilieva on ILL data

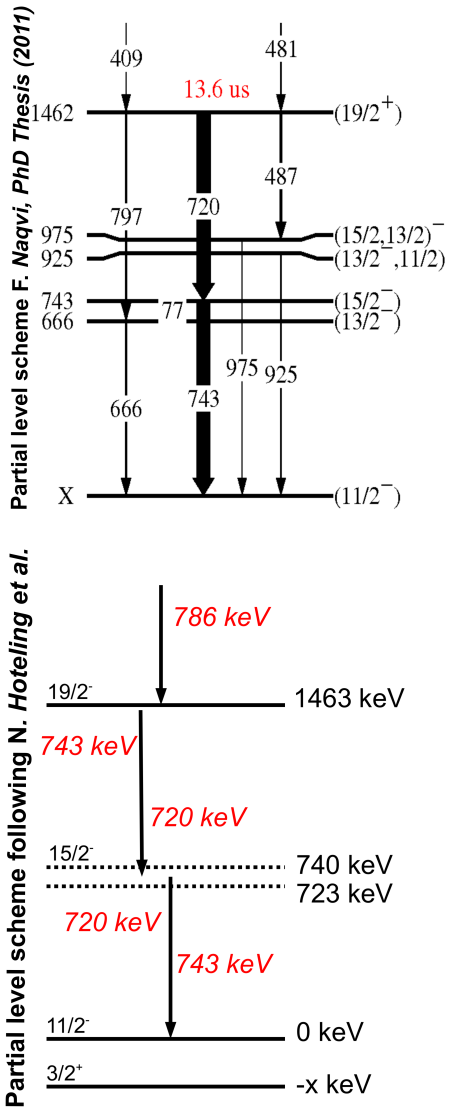


Literature: 101.7(32)ps *A. Lindroth, Phys. Rev. Lett. 82 (1999) 4783*

Coulex: 90.1(108)ps *Th. Behrens, PhD Thesis (2009)*



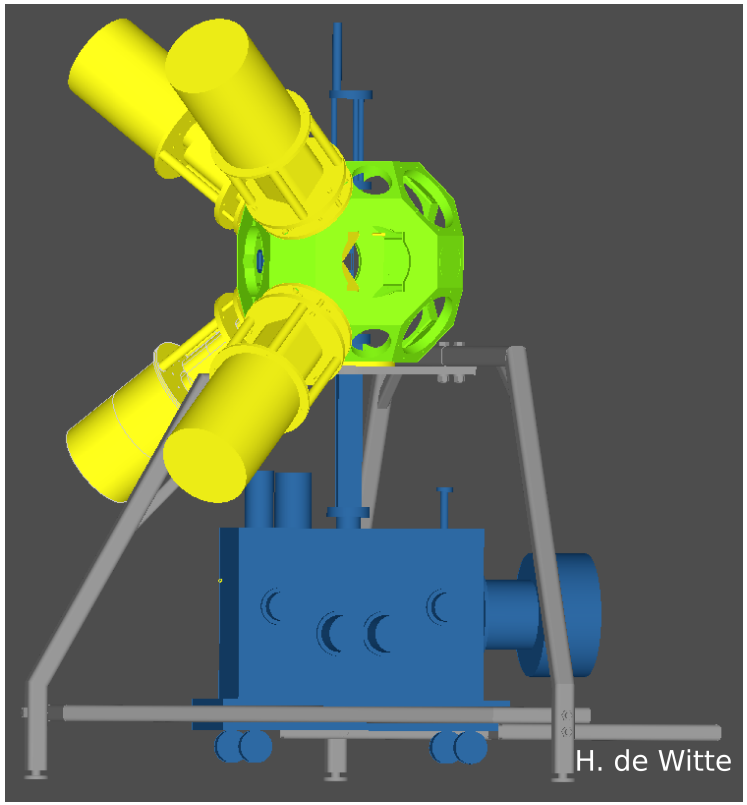
^{125}Cd: Not much is known



- $\gamma-$spectroscopy after fragmentation
  $\rightarrow$*F. Naqvi, PhD Thesis (2011)*
  $\rightarrow$*N. Hoteling et al., Phys. Rev. C 76, 044324 (2007)*
- Relative order of transitions (720keV and 743keV) not known
- Energy of the $\frac{11}{2}^-$ isomer only poorly known:
  - 50(70)keV $\rightarrow$ ground state?
    $\rightarrow$*J. Katakura, Nucl. Data Sheets 86, 855 (1999)*
  - 186(5)keV
    $\rightarrow$*A. Kankainen et al., Phys. Rev. C 87, 024307 (2013)*
- So far no transitions to the ground state found

Decay station (IDS) at ISOLDE

- Four Ge Clover detectors (16 crystals á 20% rel. eff.) (compare Huck et al.: 2 detectors á 30% and 40% rel. eff.)
  $\Rightarrow$ better coincidence efficiency
- + four $LaBr_3(Ce)$ fast scintillators ($\sim$ 0.5% @ 500keV and 10cm distance)
- + plastic scintillator for beta measurement (high time resolution
  $\rightarrow$ ultra fast timing method, see *M. Moszyński and H. Mach, Nucl. Instr. and Meth. in Phys. Res. A 277, 407 (1989)*)



- Implantation of the nuclei on a movable tape

Estimation and request

- ^{123}Ag
  - Expected Yield: $10^4/\mu$C
    - 5 $\gamma\gamma$ coincidences per min for a state with 1% feeding
      $\Rightarrow$ 1200 counts in 7 shifts
    - Lifetime measurement: state with 5% feeding doable
    - Possible In contamination not an issue
- ^{125}Ag
  - Expected Yield: $10^2/\mu$C
    - 70 $\gamma\gamma$ coincidences per day for a state with 1% feeding
      $\Rightarrow$ 210 counts in 9 shifts
    - Lifetime measurement: state with 50% feeding doable
    - Possible In contamination not an issue

+ 2 shifts for beam preparation

In total: 18 shifts