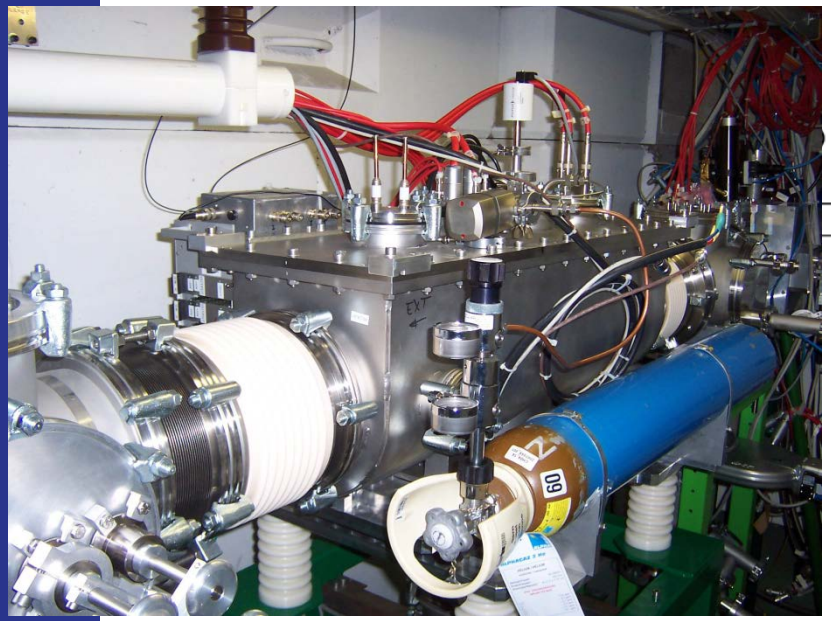
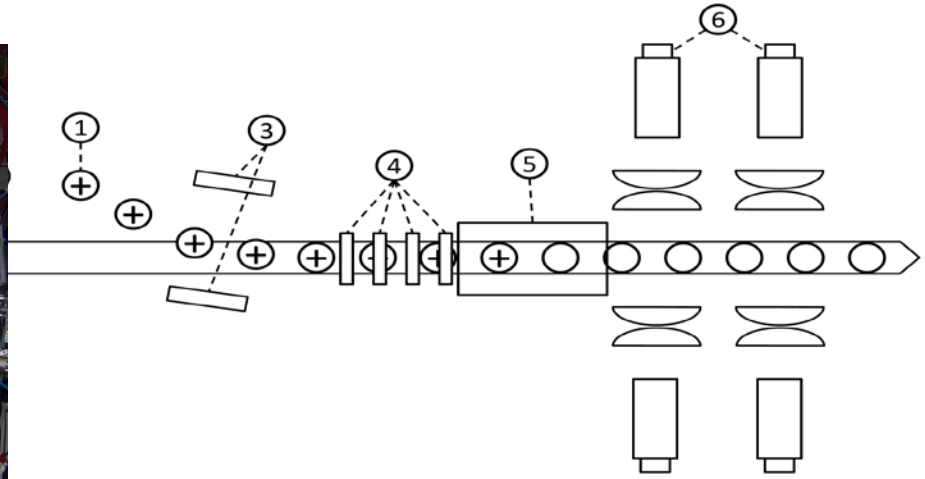
Collinear laser spectroscopy with the COLLAPS setup

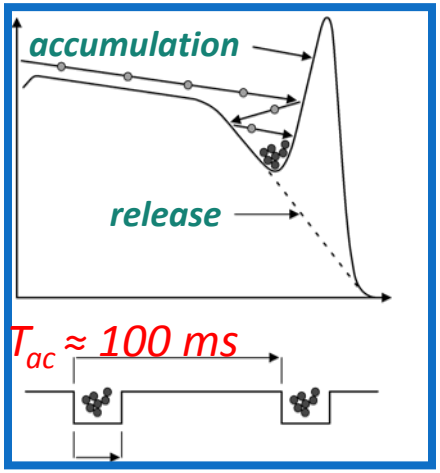
IS508: Mn
IS519: Zn
IS529: Ca

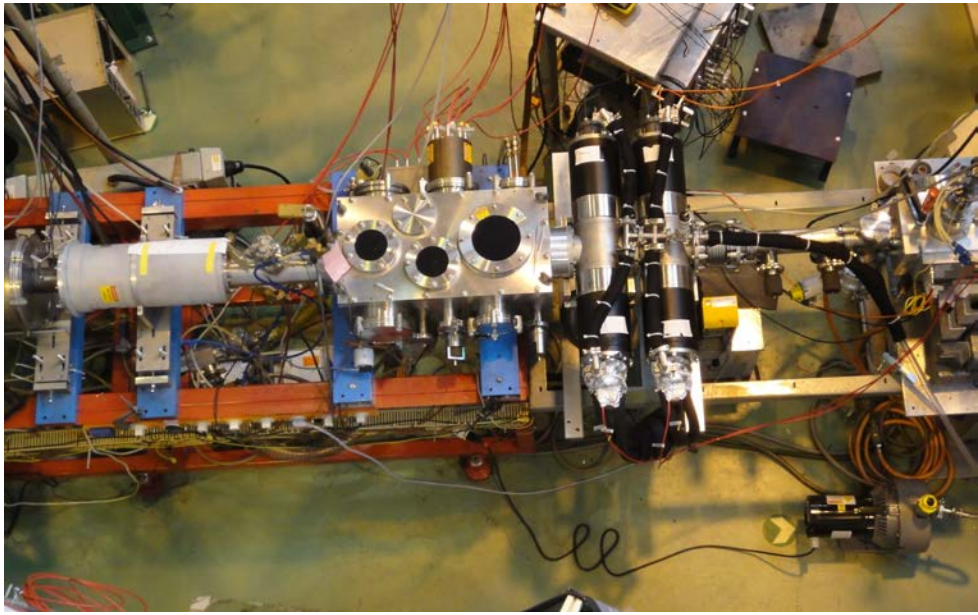
M. L. Bissell on behalf of the COLLAPS collaboraion

BUNCHED BEAM COLLINEAR LASER SPECTROSCOPY





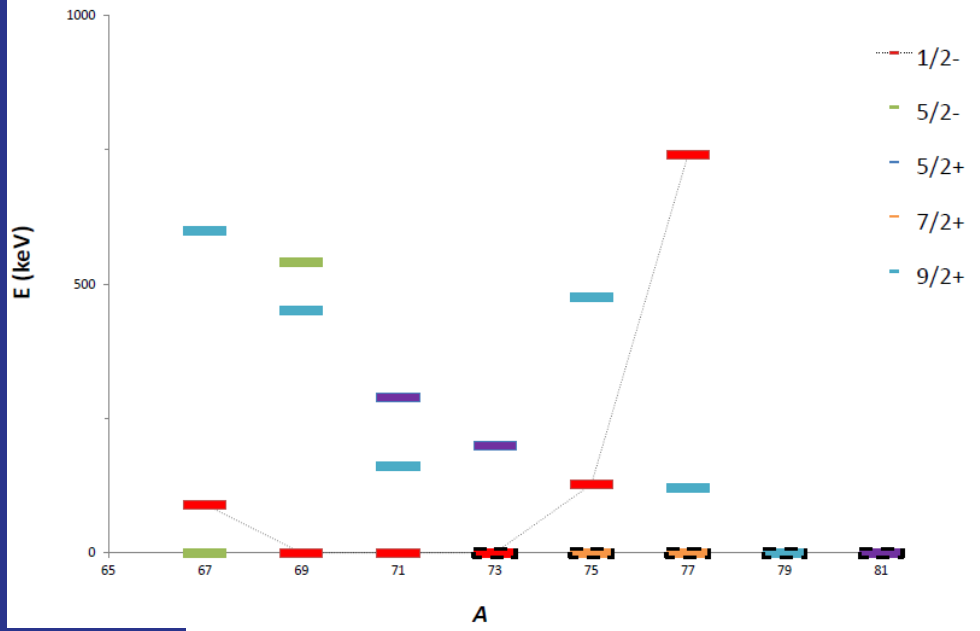


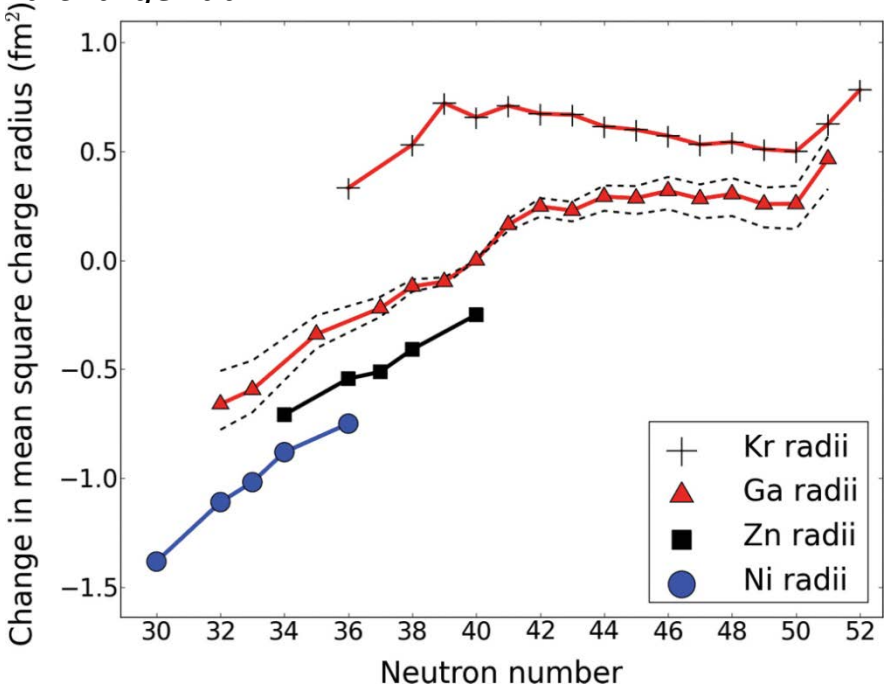


IS519: Shell structure and level migrations in zinc studied using collinear laser spectroscopy

Shifts: *21 awarded in 2011, 21 remaining.*

Physics Case: *$^{60-81}$Zn: Spins, moments and charge radii.*





$\pi 2p_{3/2}$ and $\pi 1f_{5/2}$ level inversions in Cu (N=44→46) and Ga(N=46 → 50)
Phys. Rev. Lett. **103** 142501 (2009), Phys. Rev. Lett. **104** 252502 (2010):
But what is happening with the neutrons?

Feasibility: UC_x with RILIS + quartz line + n-converter.
Yield predictions remain unchanged.
Shift estimates not strongly correlated with yield.

IS508: Collinear laser spectroscopy of manganese isotopes using optical pumping in ISCOOL

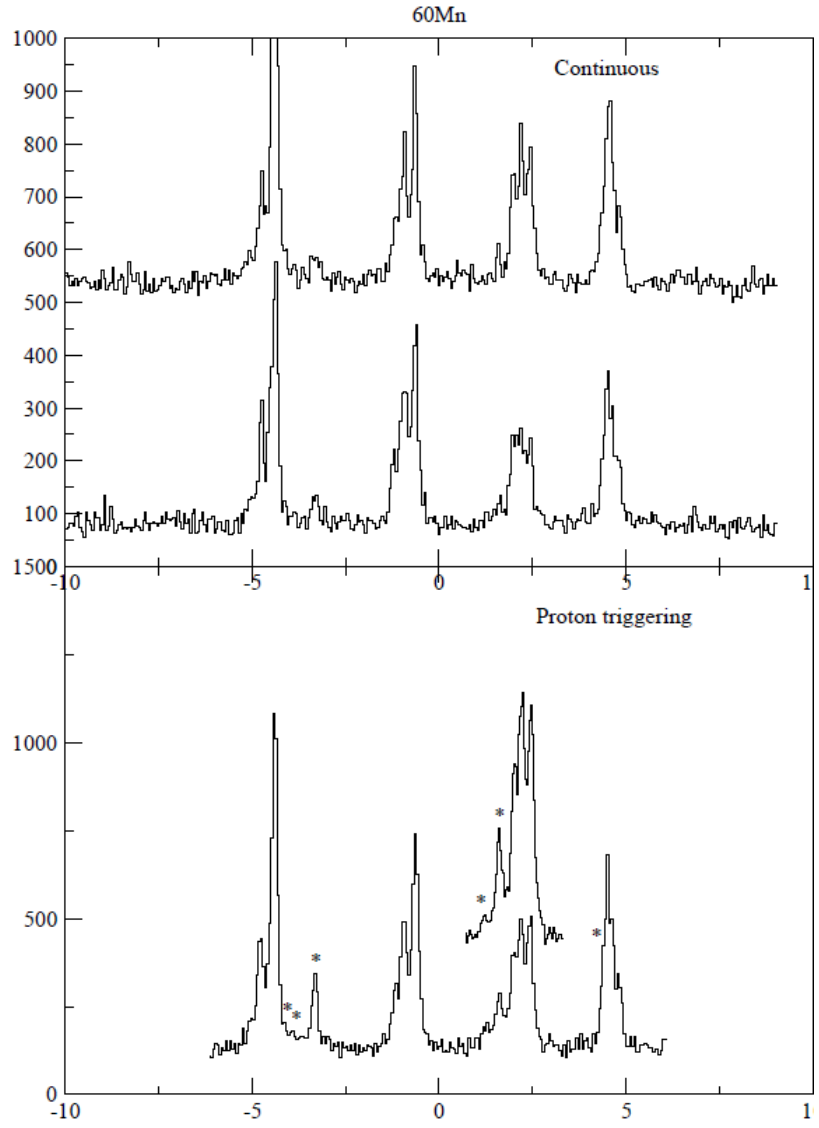
Shifts: *18 awarded, 7 remaining.*

Performed Studies: *Initial offline testing of optical pumping in ISCOOL (December 2011) unsuccessful. ☹*

Realignment of ISCOOL scheduled for LS1 so started on-line studies with less efficient atomic transition.

November 2012 took 11 shifts to measure $^{51-64}$Mn.

IS508: Collinear laser spectroscopy of manganese isotopes using optical pumping in ISCOOL



J=5/2 - 3/2 atomic transition with high spins and isomers
= Difficult

<u>But</u> all spins, magnetic moments and charger radii obtained.☺

Transition rather insensitive to Q.

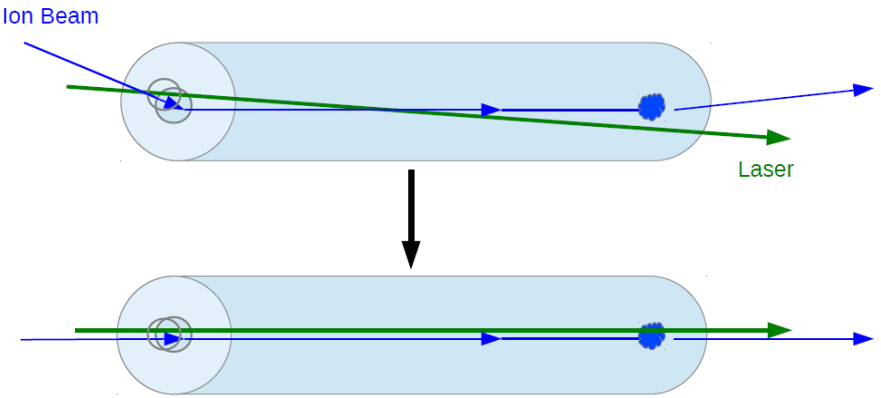
-A few cases (58,60,62 I=1 states) would benefit from further study in the ionic system.

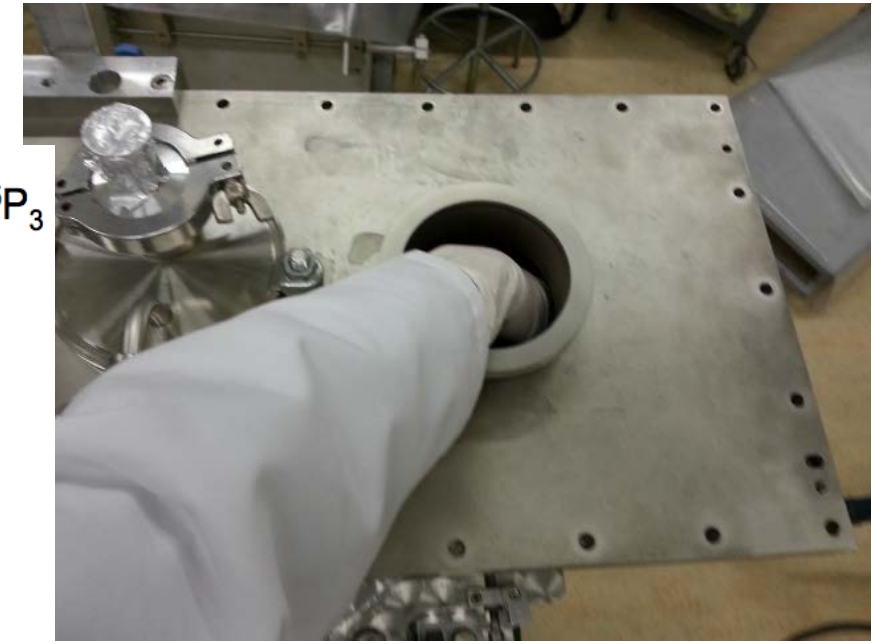
HFS components linked to $t_{1/2}$ of state by accepting counts for different time periods after proton impact.

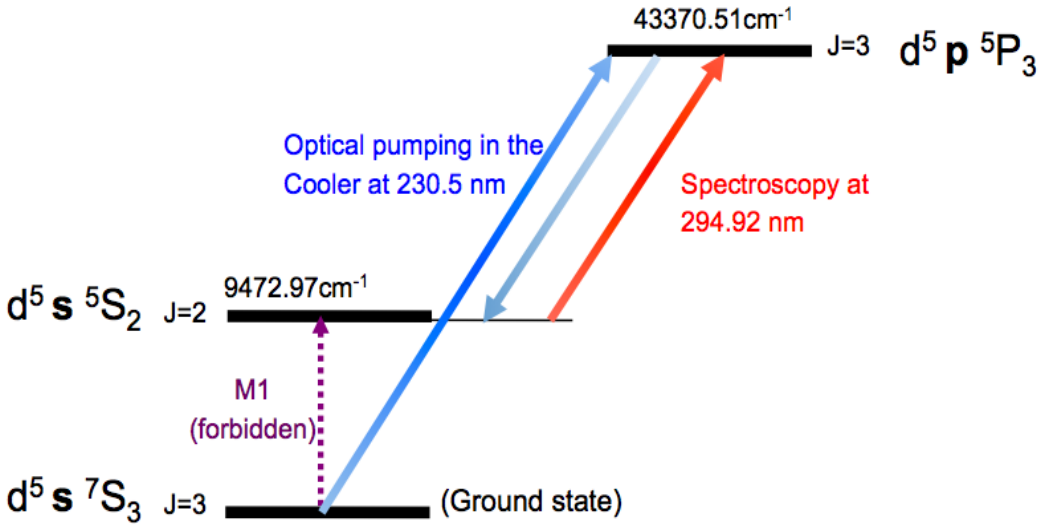
IS508: Collinear laser spectroscopy of manganese isotopes using optical pumping in ISCOOL

Future Plans with remaining shifts:

1) Repeat offline testing after reinstallation of ISCOOL.
2) Use optical pumping in the cooler with the 294.92nm ionic transition.
    - Cross *N*=40 (^{65,66}Mn)
    - Improve Q's of difficult cases.





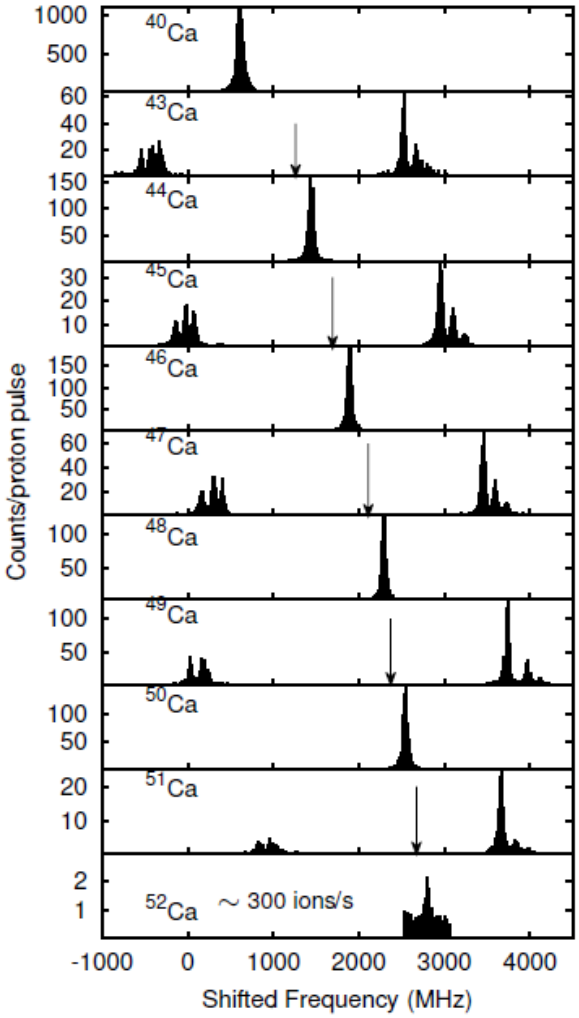


IS529: Spins, Moments and Charge Radii Beyond ^{48}Ca

Shifts: *18 awarded in 2011, 0 remaining.*

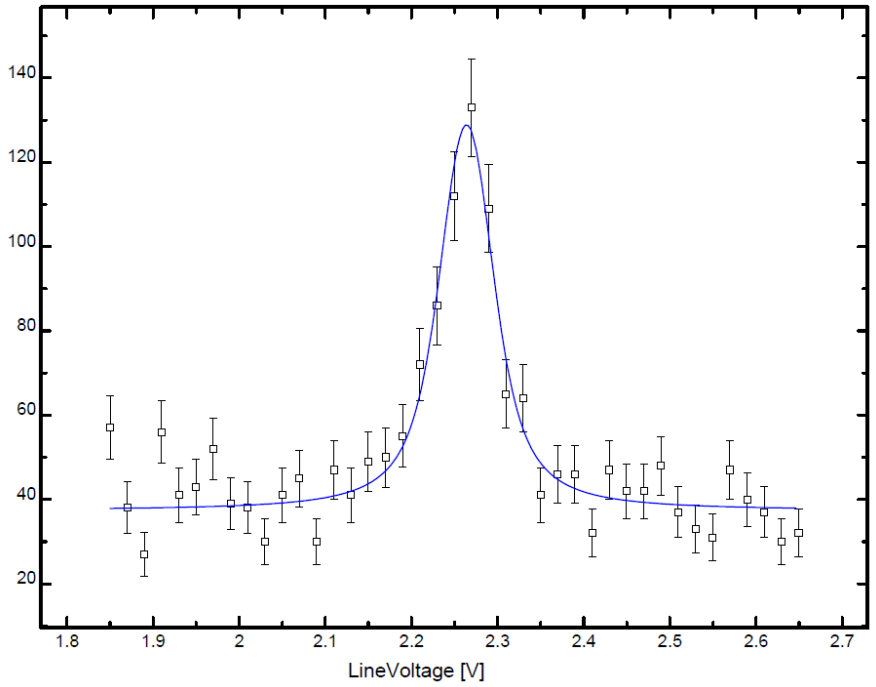
Physics Case: *$^{49-54}$Ca: Spins, moments and charge radii.*

Shifts awarded for measurements up to ^{52}Ca ***used successfully.***



^{52}Ca measured with ≈300 ions/s in 4 hours.

New sensitivity record for BBCLS at COLLAPS

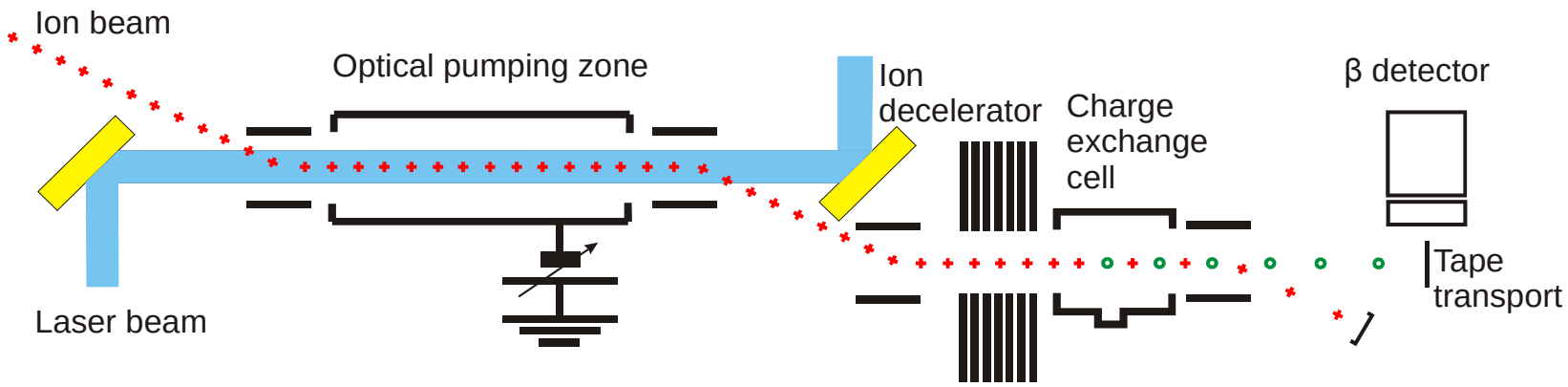


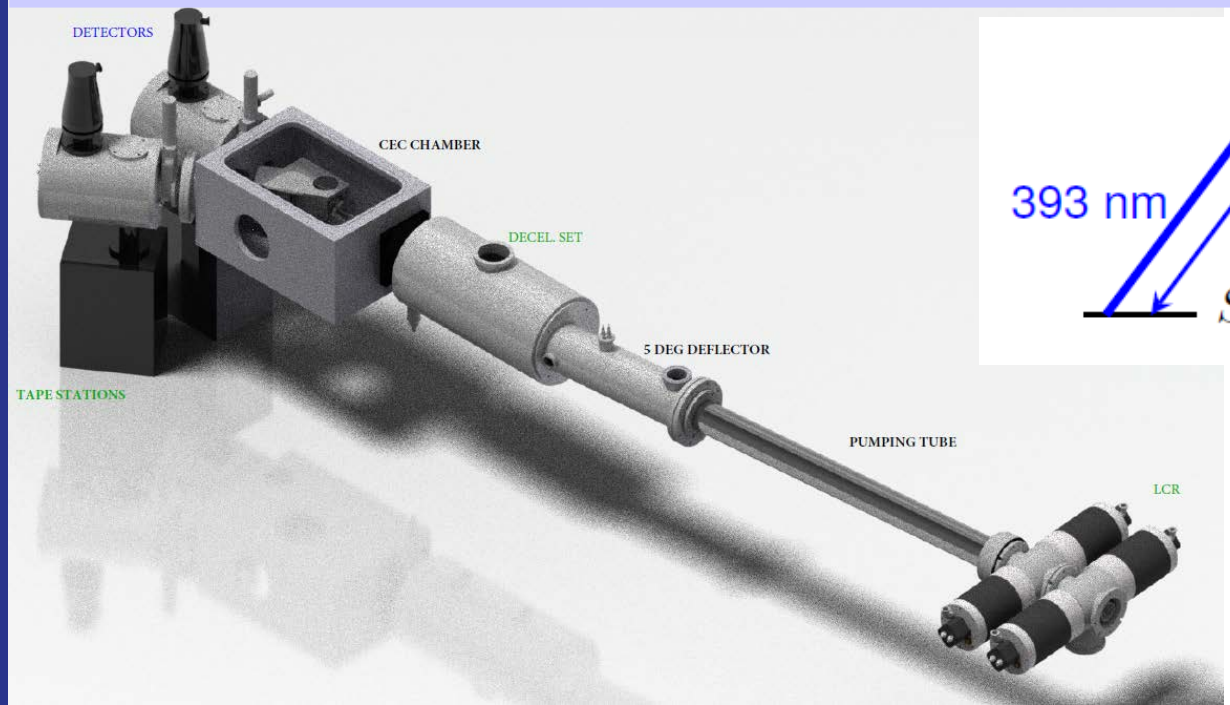
Addendum to IS529: Spins, Moments and Charge Radii Beyond ^{48}Ca

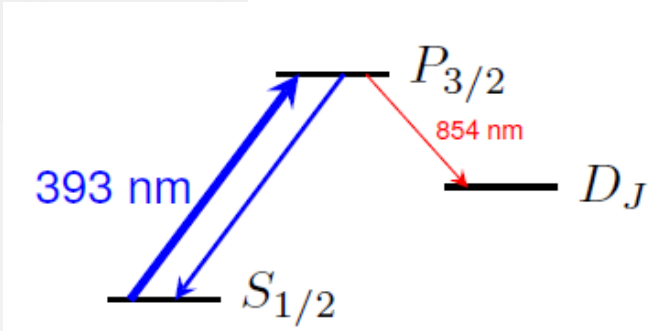
M. L. Bissell on behalf of the COLLAPS collaboraion

The ROC Technique

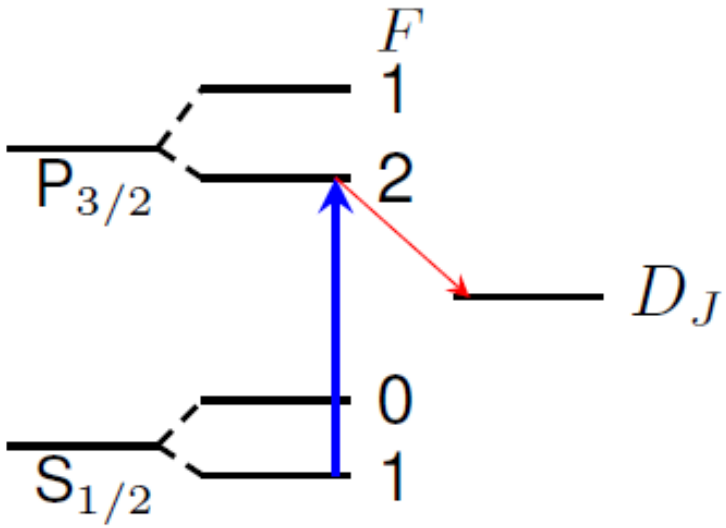
Radioactive detection of Optically pumped ions after state selective Charge exchange (ROC)

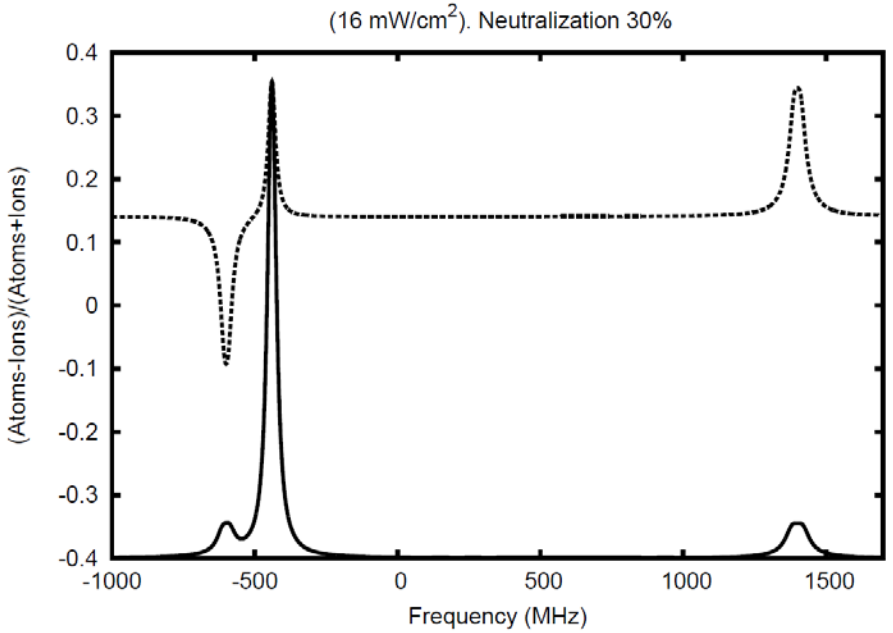






^{53}Ca Multi-step optical pumping

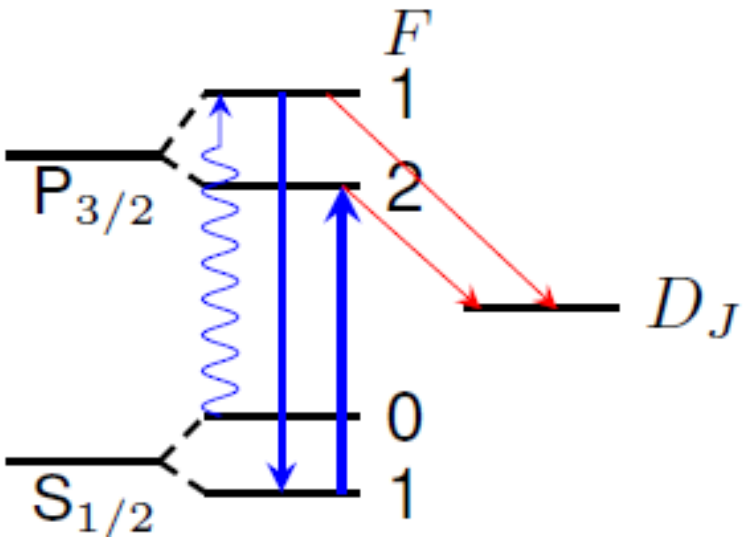


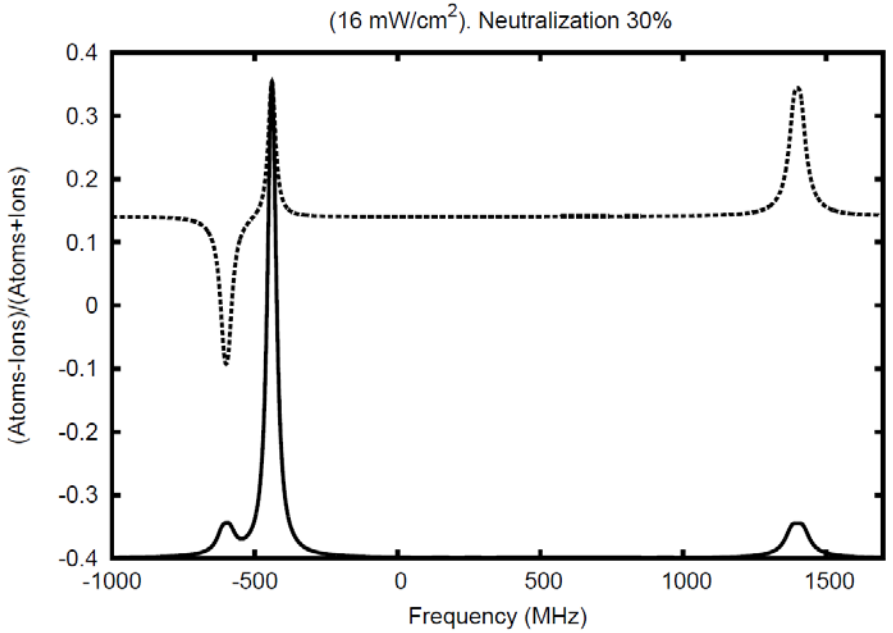


Shifts required for ^{53}Ca similar to ^{54}Ca.

Smaller components enhanced from ≈1/20th. of I=0 intensity to ≈1/5th.

^{53}Ca Multi-step optical pumping



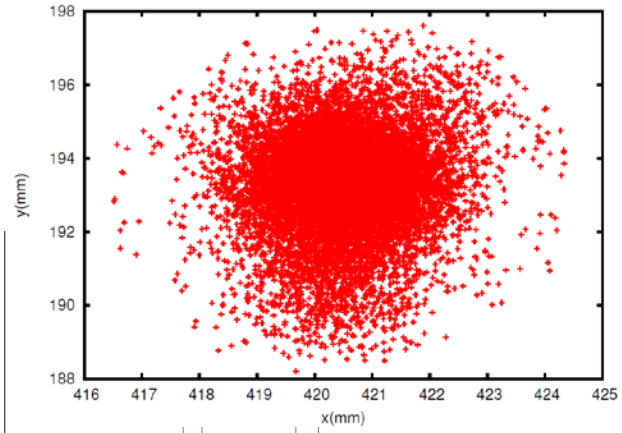


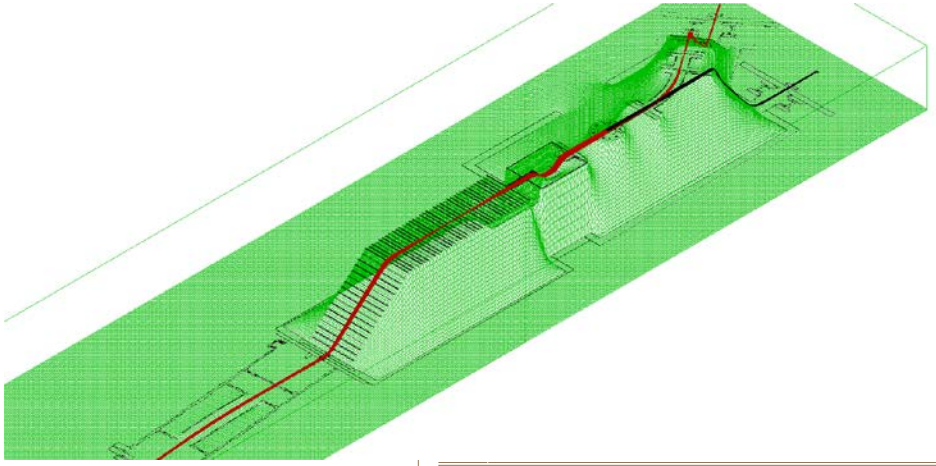
Shifts required for ^{53}Ca similar to ^{54}Ca.

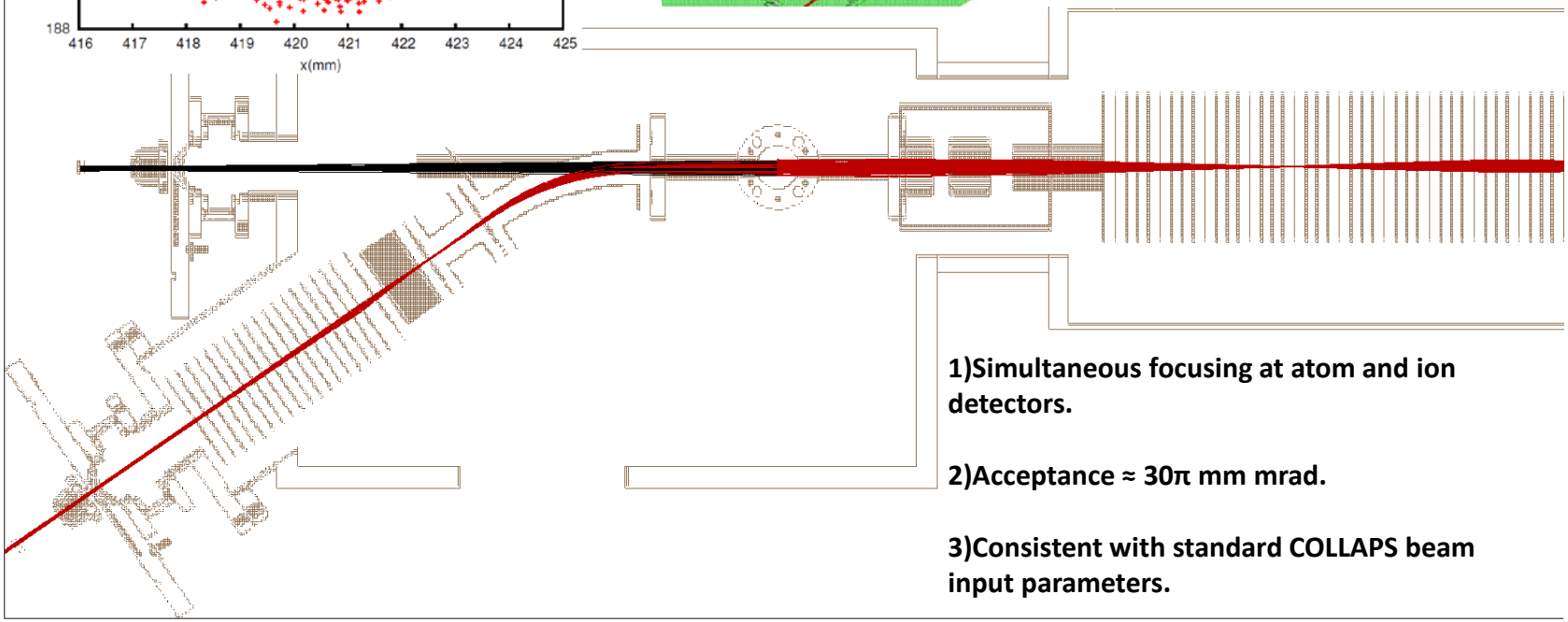
Smaller components enhanced from ≈1/20th. of I=0 intensity to ≈1/5th.

Ion optical design

Full SIMION validation completed





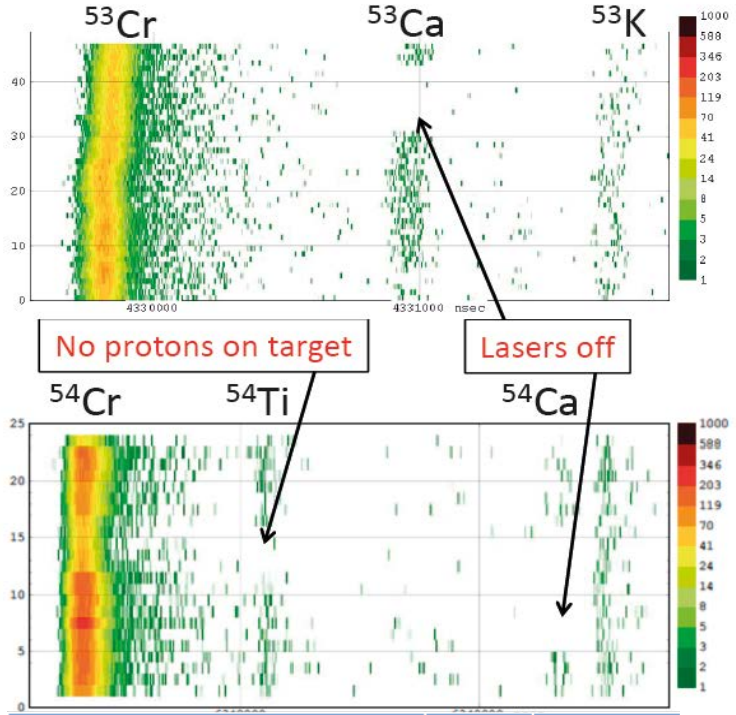


1)Simultaneous focusing at atom and ion detectors.

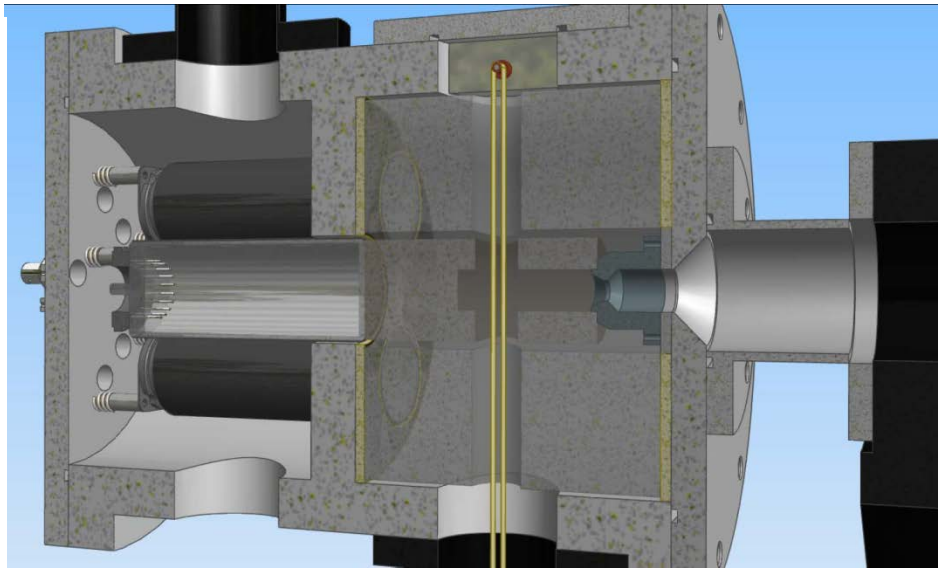
2)Acceptance ≈ 30π mm mrad.

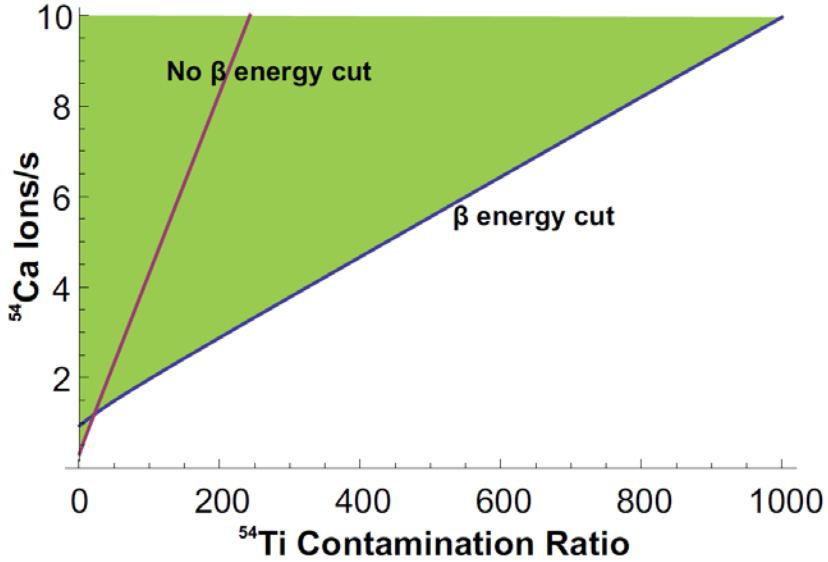
3)Consistent with standard COLLAPS beam input parameters.

Detector design



Contamination ratio	^{54}Ca	^{53}Ca
54Cr (Stable)	928	
54Ti(1.5s)	3	
54 Stable (Molecule?)	2	
53Cr (Stable)		300
53Ti(33s)		~0
53K(30ms)		>0.3





Shift requirements

Shift requirements highly sensitive to both ^{54}Ca yield and contamination.
Estimated based on 2 scenarios-

1) ^{54}Ca yield 1/20th of that observed by ISOLTRAP and contamination equal.

2) ^{54}Ca yield equal to ISOLTRAP and contamination close to saturating the detectors.

- Based on 5 scans of 5σ

	Shifts
^{54}Ca	5
^{53}Ca	9
Calibration scans	2
Scintillator setup/ optimisation	1
	17

The Collaborations

IS529

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With: IS508

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