

Duality Water Analysis

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Pol. ^3He Collaboration Meeting

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Calibration Summary

- Pre-experiment no good water calibrations!
- Post-experiment 6 water calibrations
 - First three, target lifting motor caused significant background noise
 - Last three, lifting motor unplugged
 - For the last two, A- ϕ box was used
 - A- ϕ box down sweep signals appear systematically smaller than non A- ϕ signals

A- ϕ Signal comparison

Date	Sweep	Signal (μV)
02-16-03-2 without A- ϕ	Up	5.89
	Down	-6.99
02-17-03-1 with A- ϕ	Up	-6.07
	Down	6.53
02-17-03-2 with A- ϕ	Up	-6.01
	Down	6.81

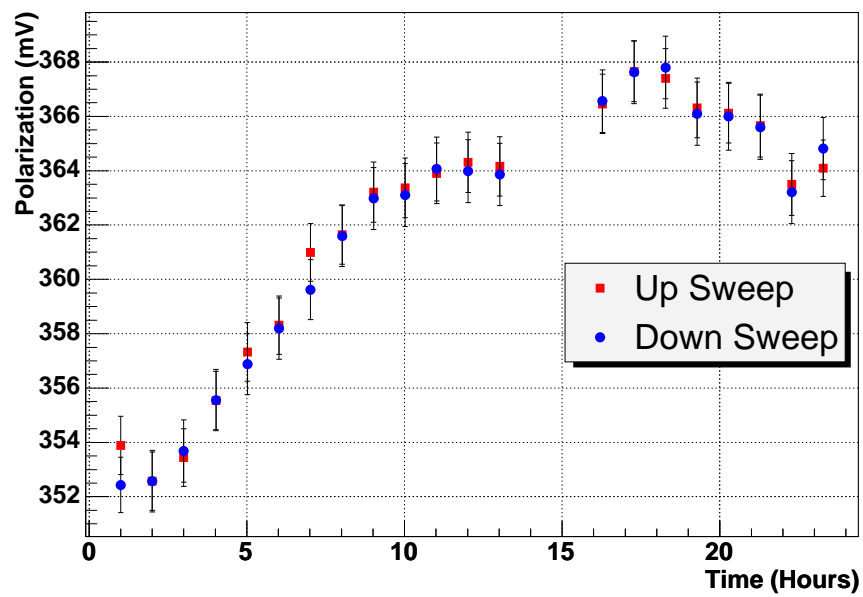
- Clear that tests were needed to understand the signal effects from the A- ϕ box

A- ϕ Box Tests

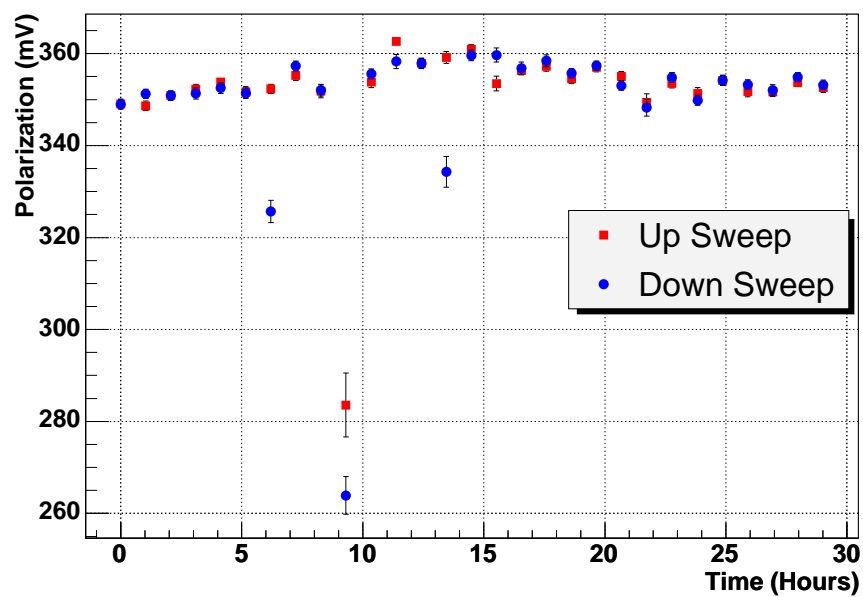
- Test Setup:
 - Polarized ^3He target
 - Amplifier Power = 18 Watts
 - H1 \sim 92 mG
 - Checked electronic components (resistors, op amps, etc.)
- Signal gain from Adder circuit:
 - Checked pick-up signal and arbitrary signal from RF function generator with and without circuit
 - $\langle \text{Ratio} \rangle = -1.02343$ (ratio of pure signal to circuit signal)
 - Compare with results from Feb. 17, 2003, $-1.02666 \pm 1.5\%$
- Cancel RF background from pick-up coils using A- ϕ box

A- ϕ Box Test Results

Queen Mary without A-Phi box

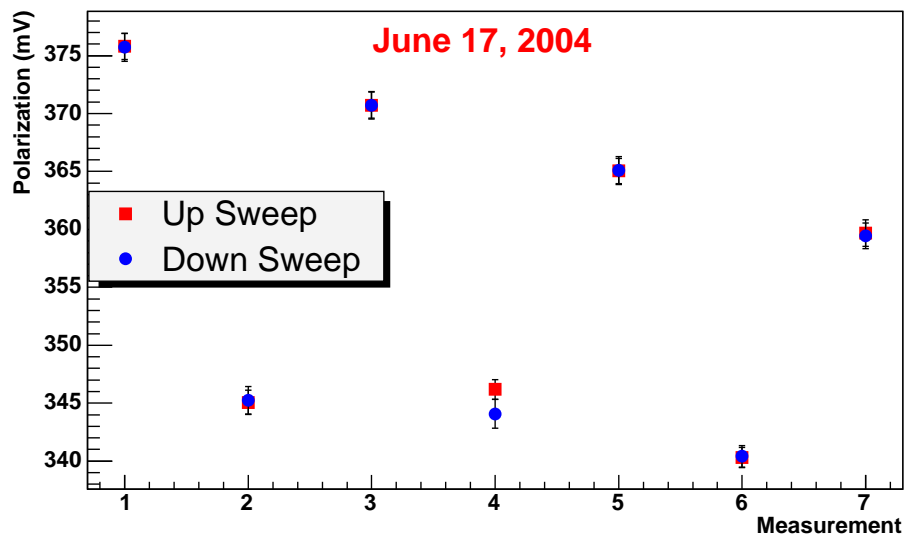


Queen Mary with A-Phi box



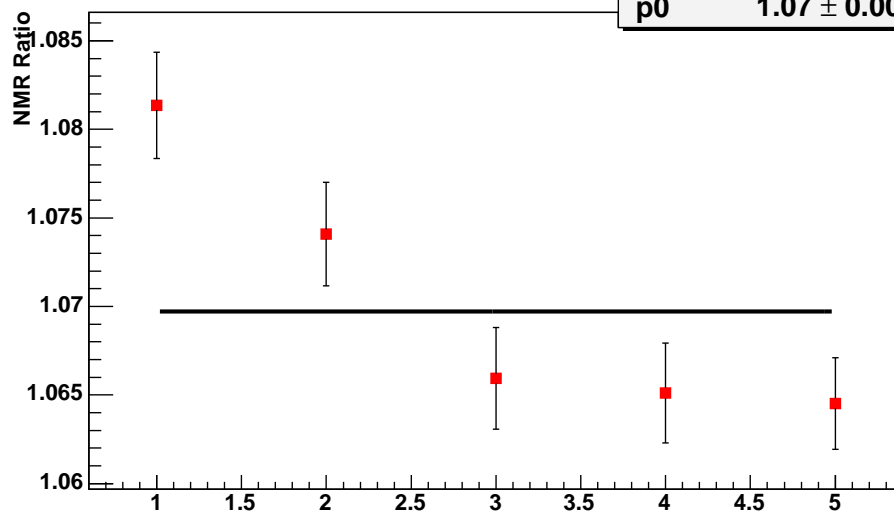
- With and without A- ϕ Box NMR “calibration”
- Compare with 1.023 or 1.027

NMR without and with A-Phi box

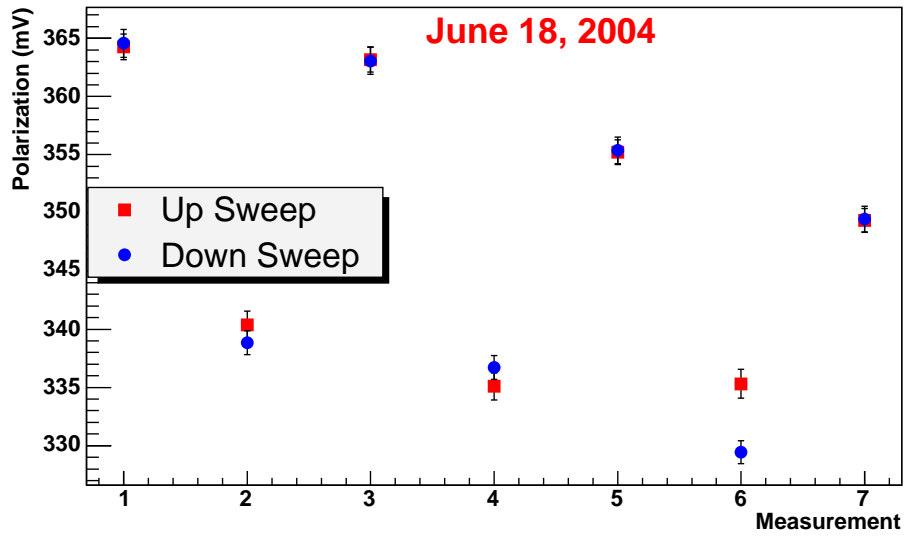


NMR Ratio without/with A-Phi box

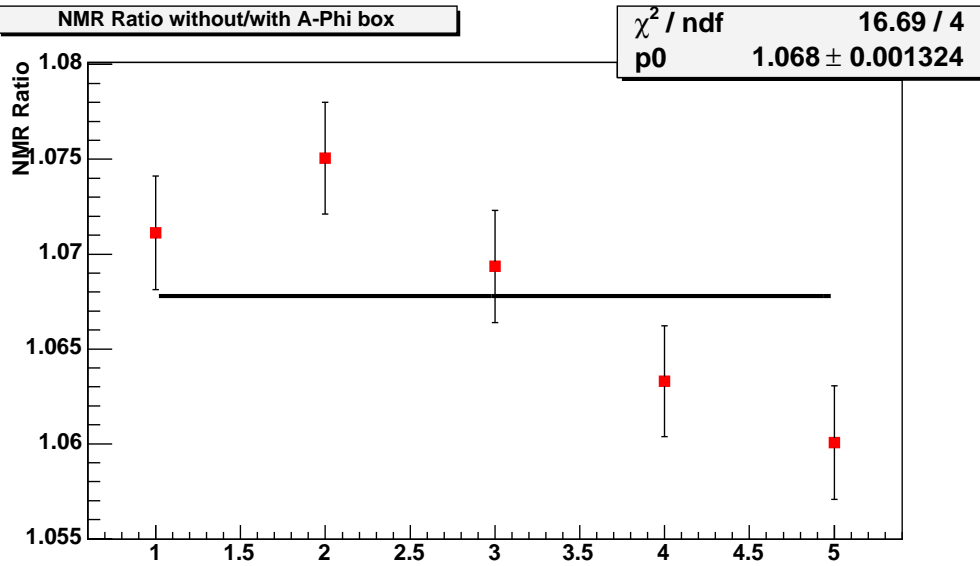
χ^2 / ndf 25.76 / 4
 p_0 1.07 \pm 0.001265



NMR without and with A-Phi box

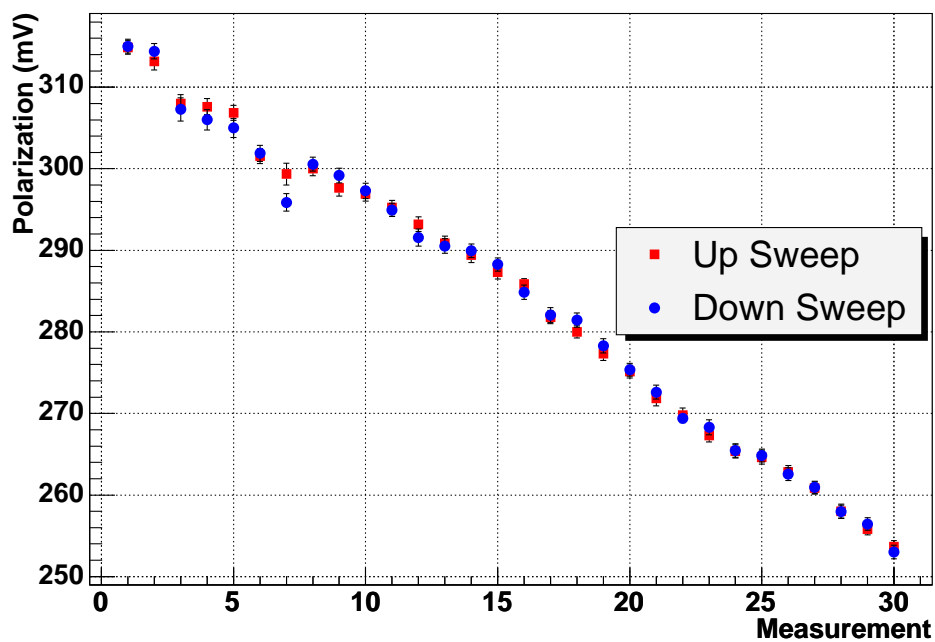


NMR Ratio without/with A-Phi box



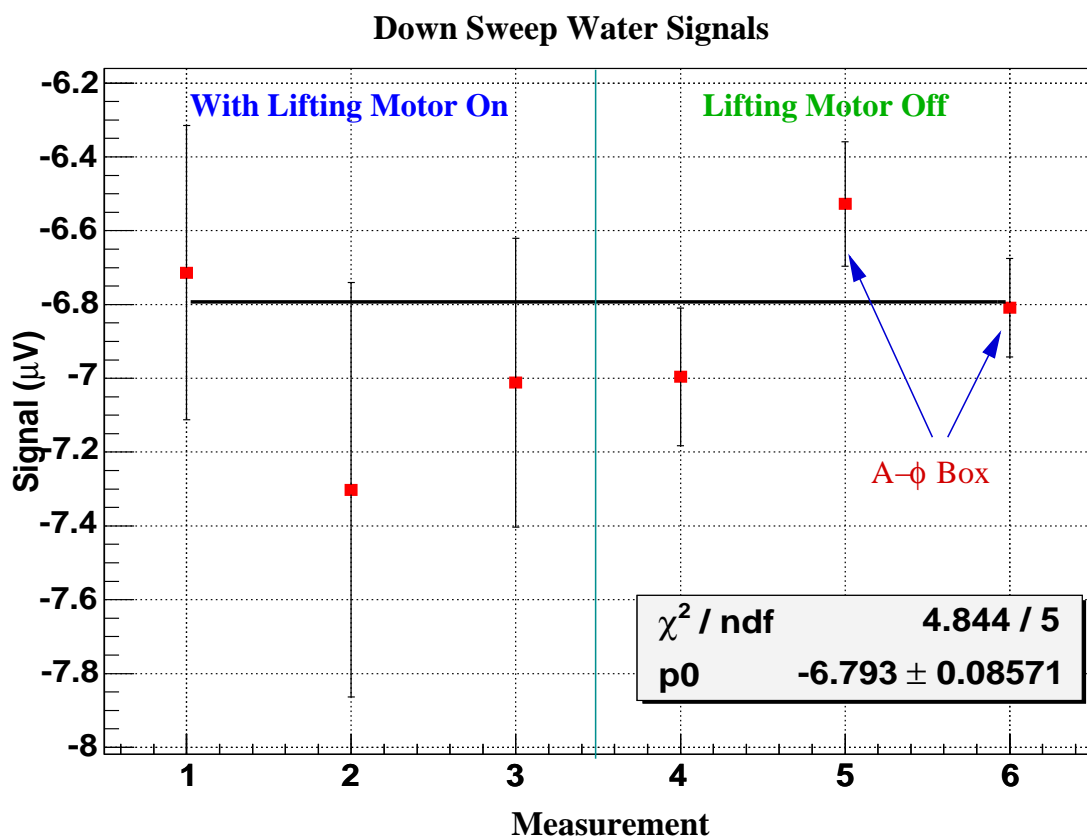
A- ϕ Box Test Conclusions

Queen Mary with A-Phi box, every two minutes



- With the A- ϕ box, there are some measurements where the down sweep is systematically smaller than the up sweep.
- A- ϕ signal drifts over time, so cancellation of the background changes.
- Inconsistency of A- ϕ gain factor:
 - Raw signal tests show $R \approx -1.025$
 - Earlier estimate of Ratio ≈ -1.035

- Last two tests show $R \approx -1.07$
- How does this affect the water calibrations?
 - From ^3He results, both up and down sweeps should be corrected
 - Water only shows a problem for the down sweep(?)
 - Which ratio is the correct one, or more importantly does the ratio changing over time?
- Should the $A-\phi$ box calibrations be thrown out or just add a large systematic uncertainty?



Summary

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- Tests to understand the signal effects from the A- ϕ box
- Some down sweep signals are smaller than the up sweeps
- Inconsistency of A- ϕ gain factor
- Computer readout problems of lock-in (readout hanging and 1 minute to read each channel)

Plan (1-1.5 months)

- Decide how to use A- ϕ calibrations
- Finalize water signal uncertainty
- Study NMR signal shape (lock-in time constant, gradients, etc.)
- Finalize flux error bars
- Compare NMR and EPR calibrations