Journey with Fulla

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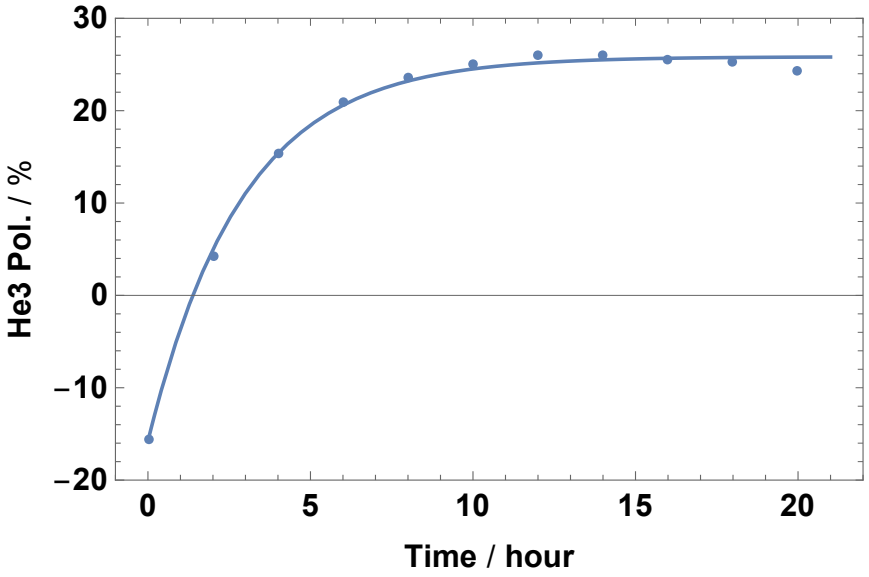
Fulla Characterization Timeline

Phase 1: Change Coils 08/10/19– 08/13/19	Phase 2: Temperature Scan 08/14/19 – 08/15/19	Phase 3: UVa Optics 08/16/19 – 08/17/19
General Test Condition JLab Optics EPR Test Only NMR RF Coils lifted 3" NMR Pickup coils dismounted no Convection 200 °C Oven	**General Test Condition** JLab Optics EPR Test Only NMR RF Coils lifted 3" NMR Pickup Coils Dismounted Upstream Convection No Gradient Coils	**General Test Condition** UVa Optics EPR Test Only NMR RF Coils lifted 3" NMR Pickup Coils Dismounted No Convection No Gradient Coils
	Instruments Test Laser polarisation and polarisation directions checked with Huong's Method, they are fine	**Instruments Test** Huong checked the Jlab optics's polarization, they are fine
Polarizing Test no gradient, 24 hour max pol. 3 A gradient, 20 h spin-up curve	**Polarizing Test** 200 °C Oven 188 °C Oven 194 °C Oven 194 °C Oven, EPR AFP Loss Test	**Polarizing Test** 200 °C Oven, 14 h spin-up 205 °C Oven, 14 h spin up 205 °C Oven, 11 h max Pol. 205 °C Oven, EPR AFP Loss Test

Phase 1: Change Coils

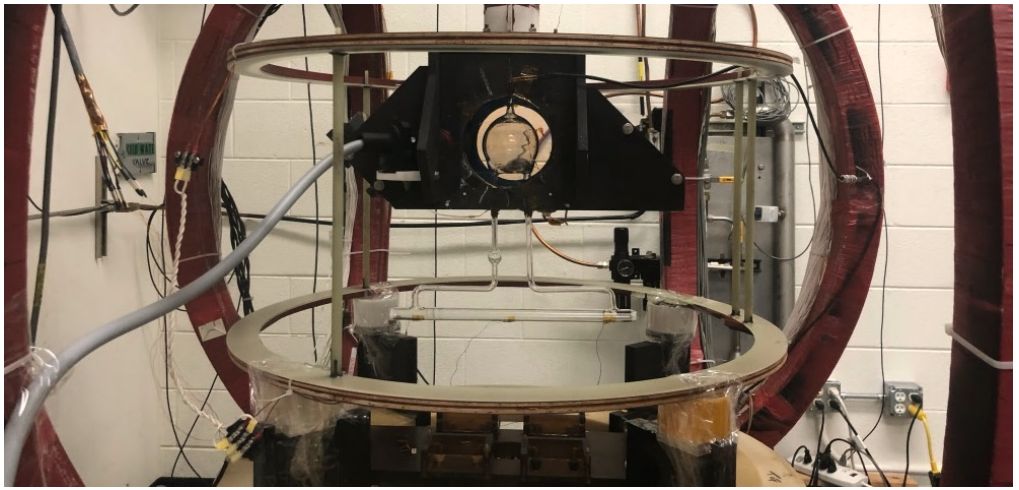
08/10/19– 08/13/19

- No gradient: Max Pol. 32%
- 3 A gradient:



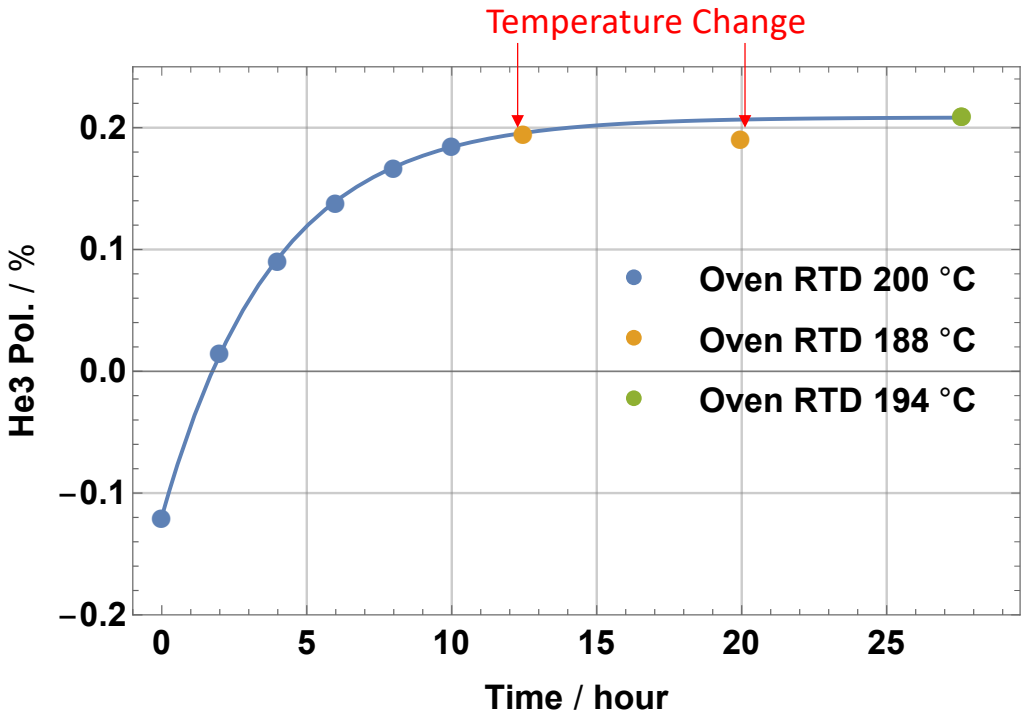
Main Change:

- Lift up NMR RF coils
- Dismounted pickup coils



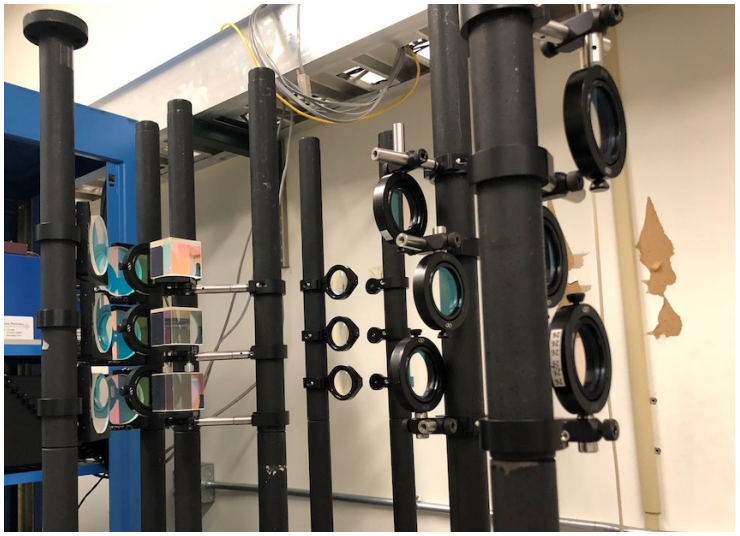
Phase 2: Temperature Scan

08/14/19_02am– 08/15/19_06am



Main Change:

- Up Stream Convection

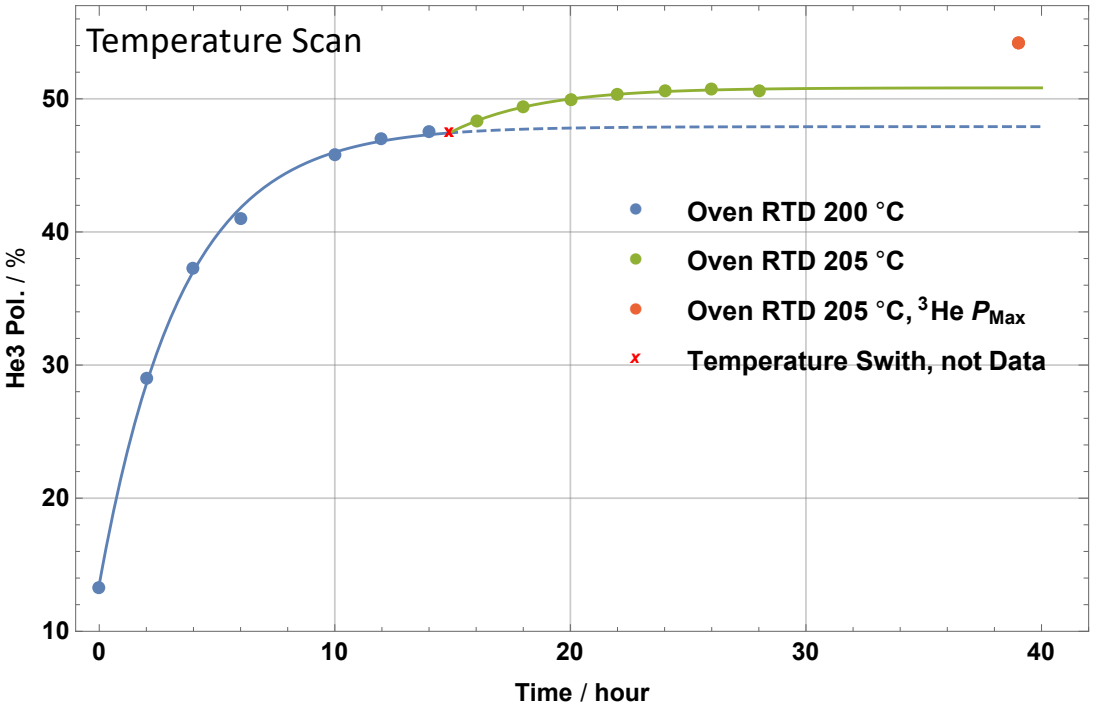


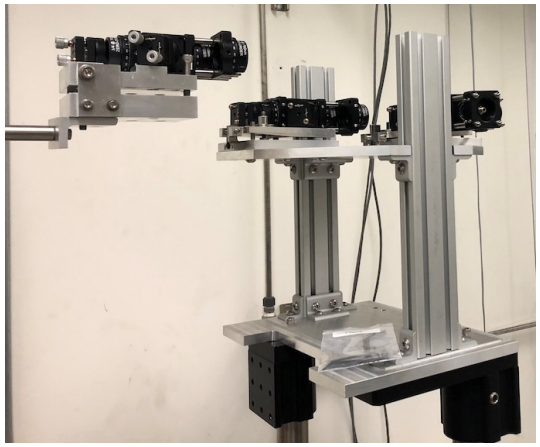
★Phase 3-1: UVa Optics

08/16/19_06am– 08/17/19_09pm

Main Change:

- UVa Optics



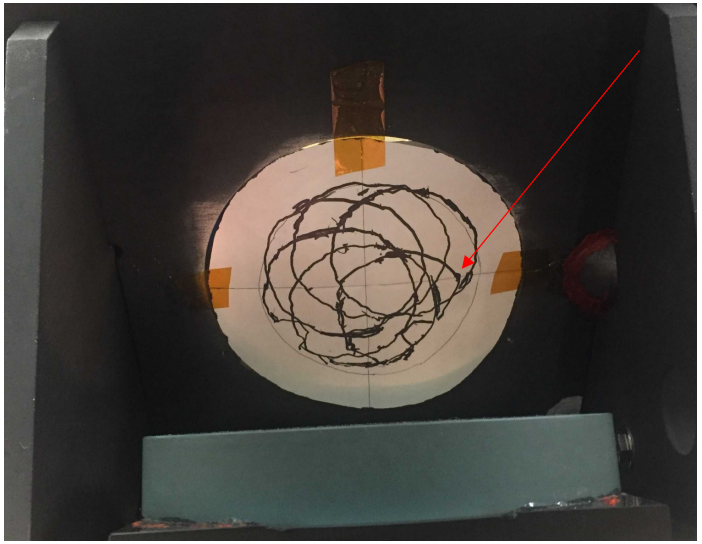


★Phase 3-1: UVa Optics

08/16/19_06am– 08/17/19_09pm

What is done differently?

- Laser spots size and spots spatial arrangement

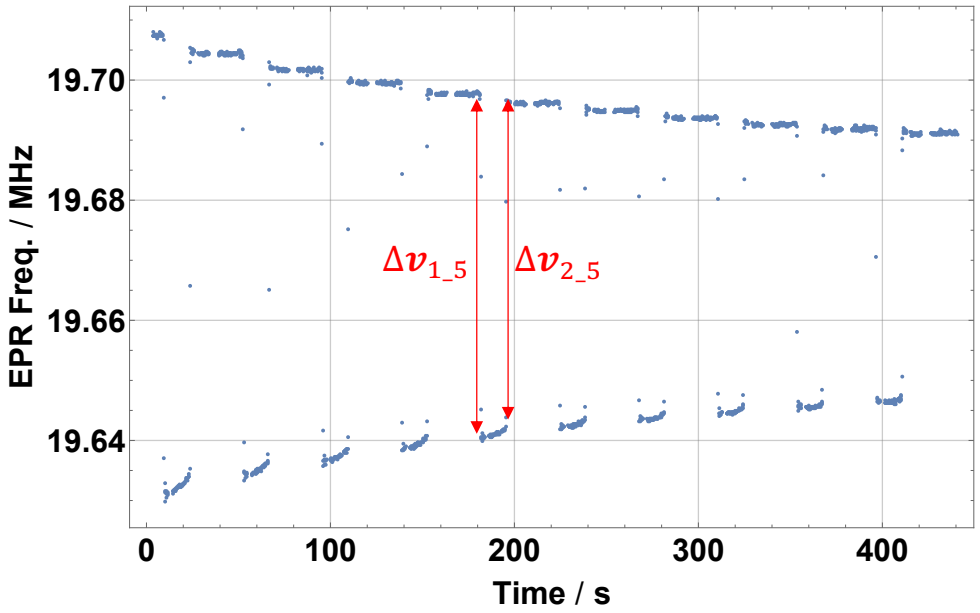


JLab Optics: Six small spots, ~2.5” diameter each, separated to cover 3.5” pumping chamber

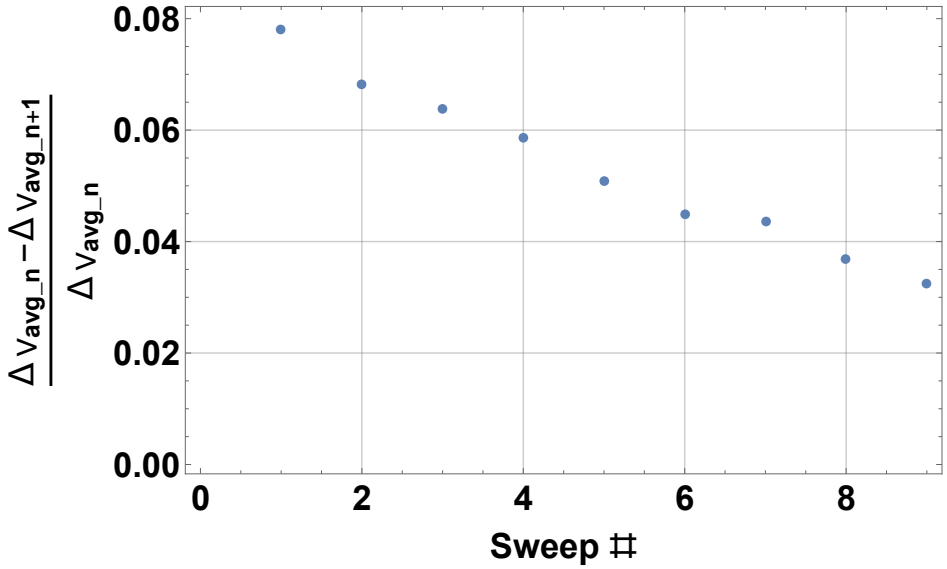
UVa Optics: Six spots, ~3.5” diameter each, all centered at same point (no picture)

Phase 3-2: EPR-AFP Loss

08/16/19_06am– 08/17/19_09pm

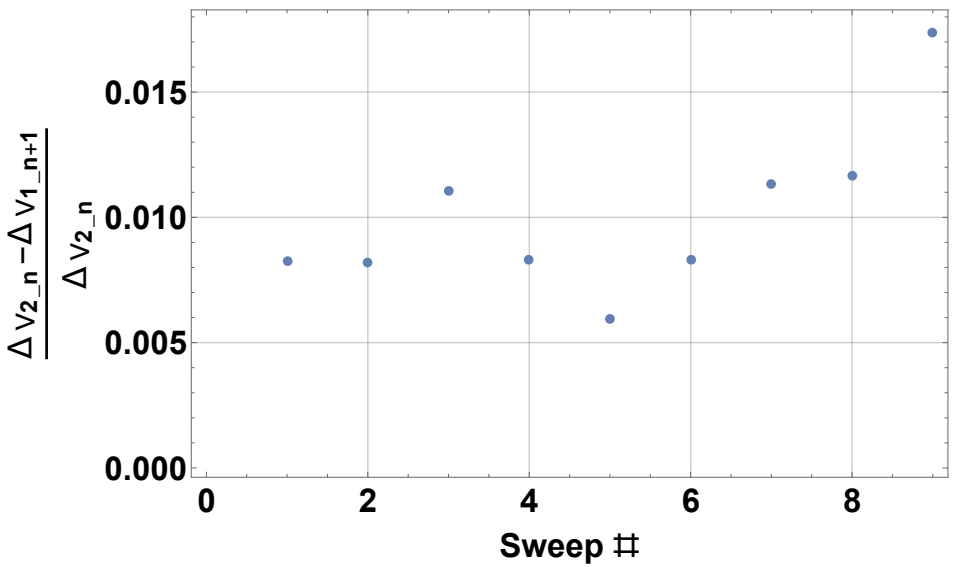


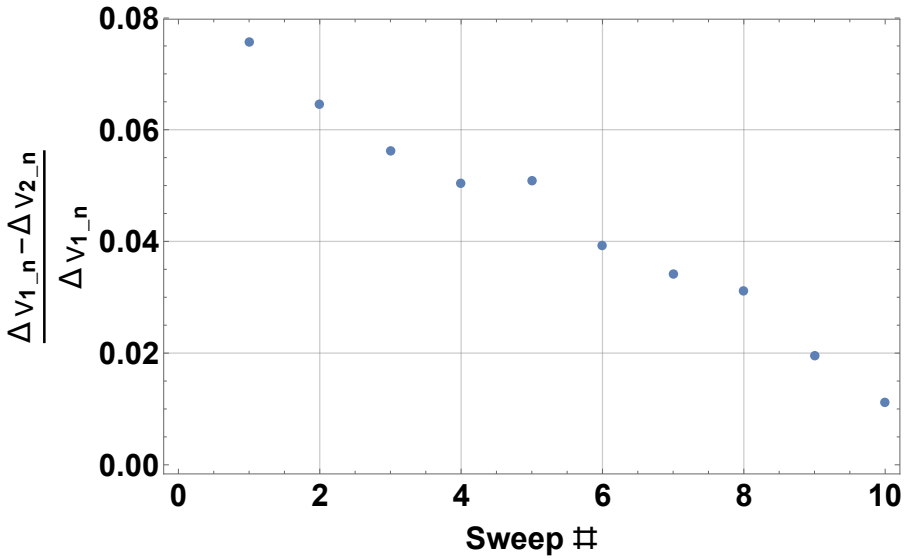
$\Delta\nu_{avg\_5} = (\Delta\nu_{1\_5} + \Delta\nu_{2\_5})/2$



Phase 3-2: EPR-AFP Loss

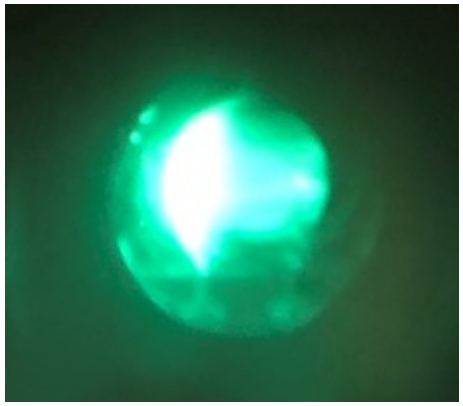
08/16/19_06am– 08/17/19_09pm

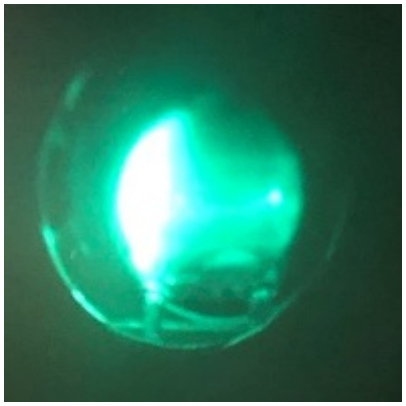




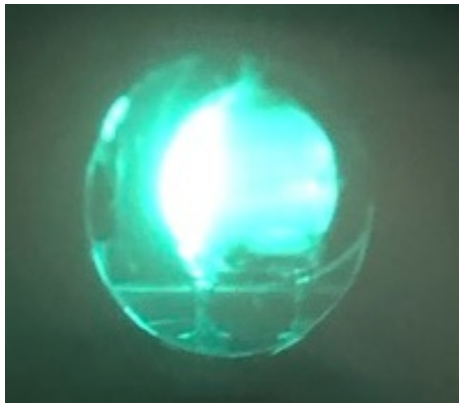
Side Oven D2 Filtered IR View 1

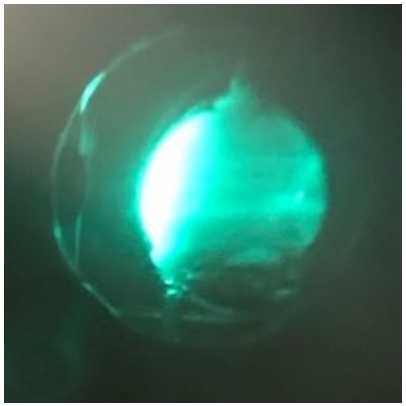
Laser

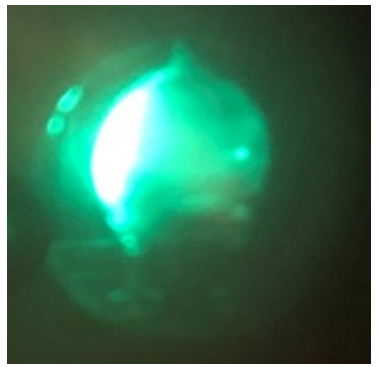




Laser







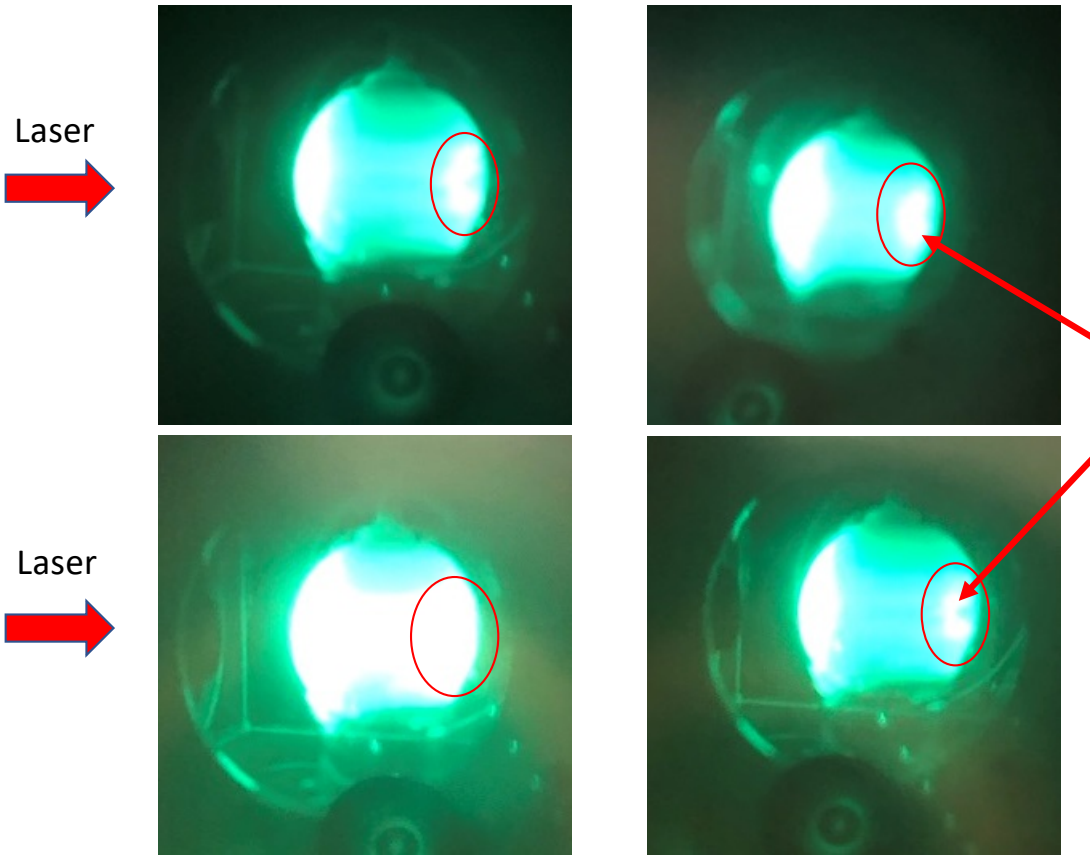
Back Oven View

JLab Optics, 200 ℃ Oven

JLab Optics, 188 ℃ Oven

JLab Optics, 194 ℃ Oven

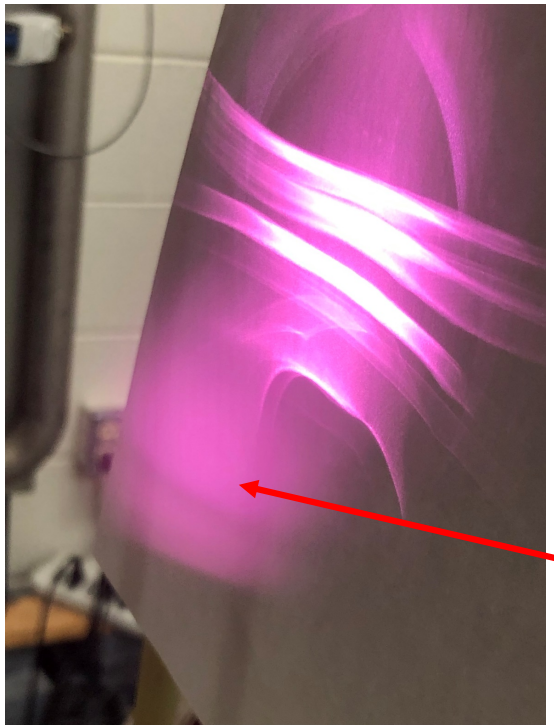
Side Oven D2 Filtered IR View 2



The white spots on the back of the cell are new after switching to UVa optics. Maybe the white spots are D1 on glass somehow saturated the D2 filter and/or camera.

UVa Optics, 200 ℃ Oven

Laser Transmission After Oven: iPhone X

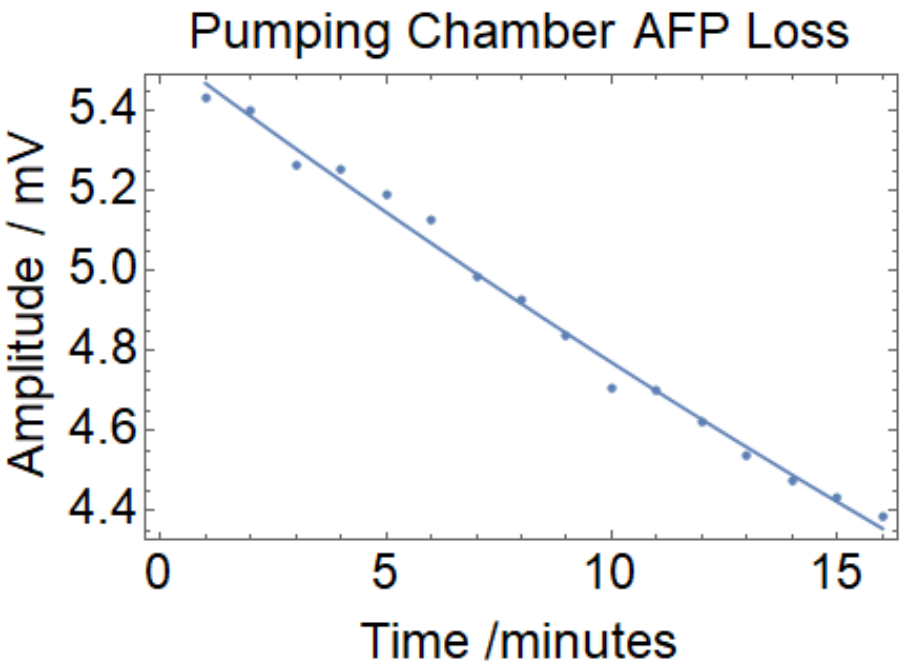


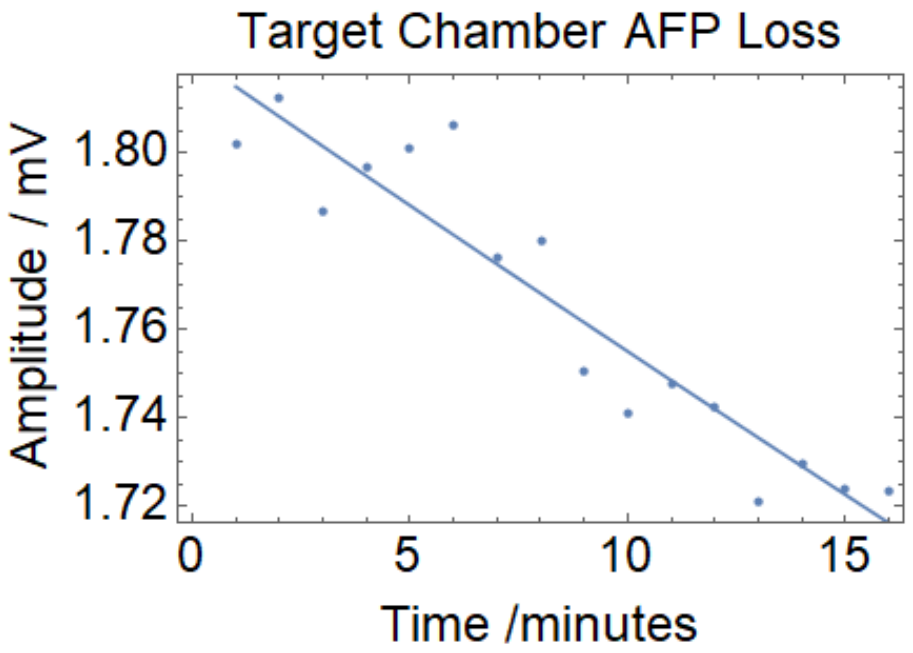
200 ℃ oven JLab optics

Camera Window Effect

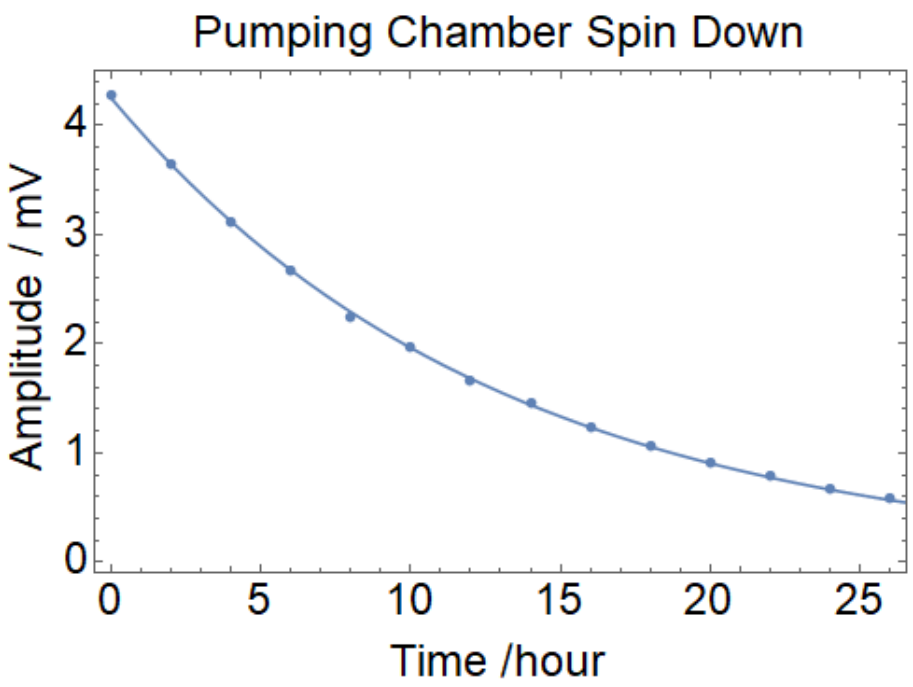
200 ℃ oven UVa optics

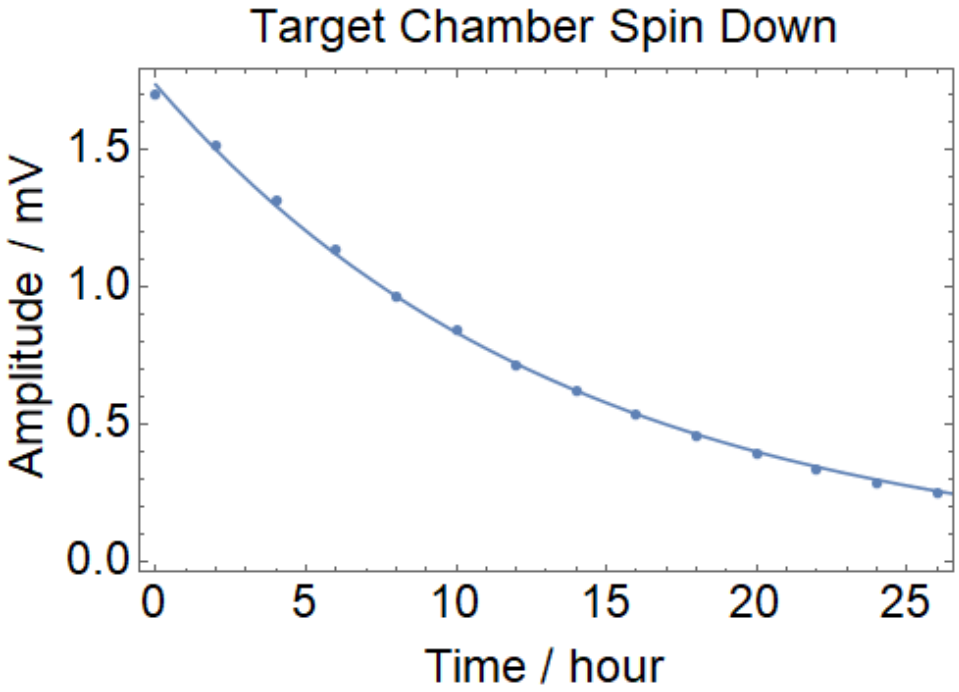
Fulla Cold AFP Loss





Fulla Cold Spin Down





Fulla Cold AFP Loss & Lifetime

	Spin Down / h	AFP Loss per sweep
Pumping Chamber	14.23	0.8%
Target Chamber	13.92	0.13%

- Time constant and AFP loss are derived from fitting points of $\{1\ min, A[1\ min]\}$, $\{2\ hour, A[2\ hour]\}$, where $A[dt]$ is defined as:

$$A[dt] = e^{-\frac{dt}{\tau}}(1-\alpha)^2$$

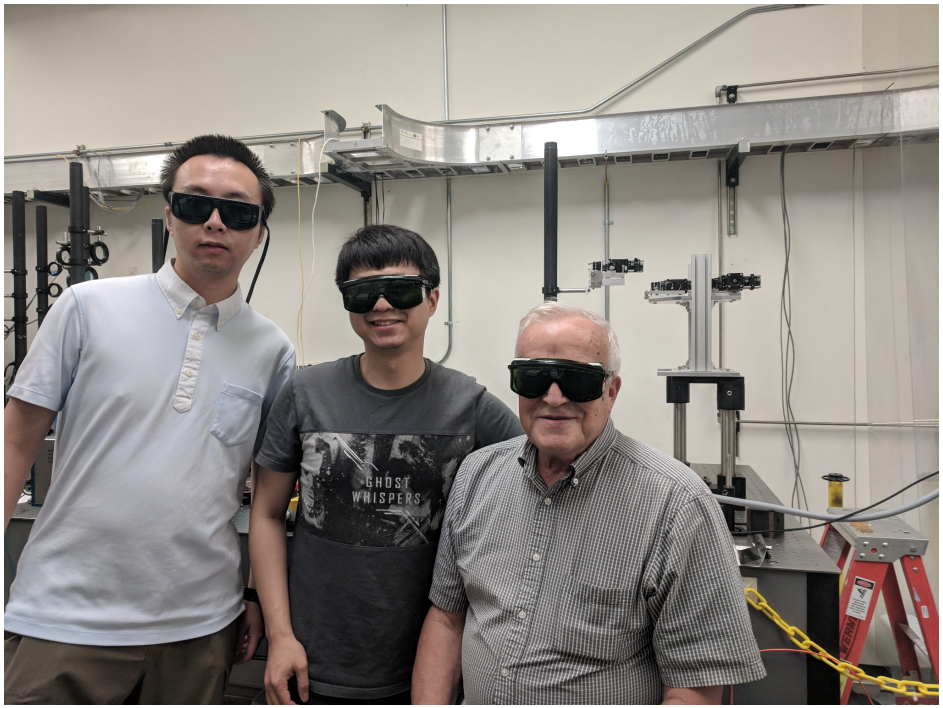
  dt: measurement interval
  τ: time constant
  α: AFP loss per sweep.

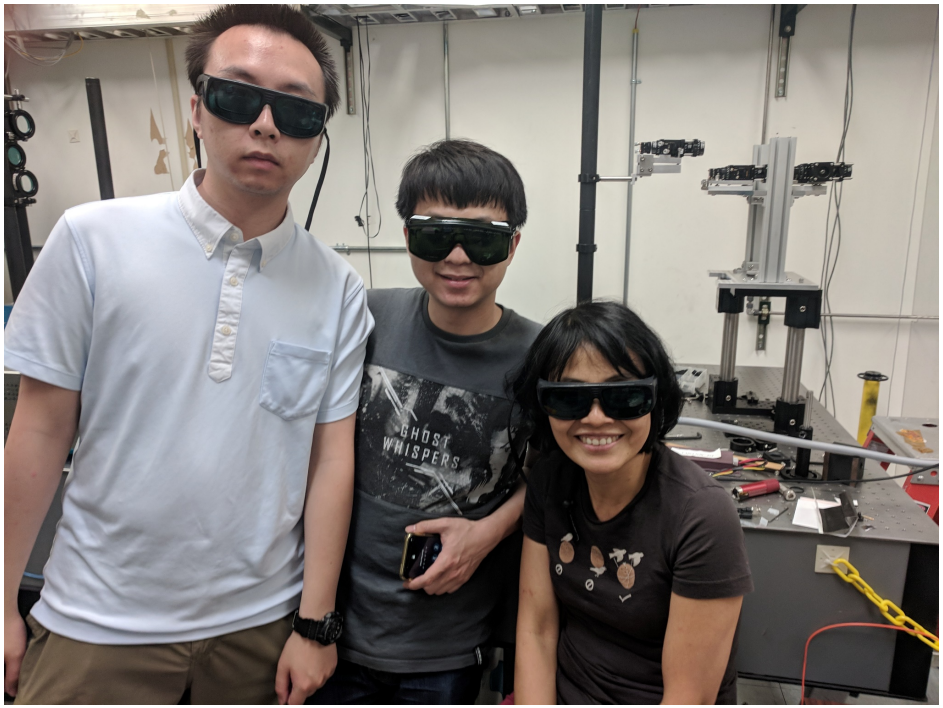
- And $A[dt]$ are derived from fitting nmr_signal[n]=nmr_signal[0]*$A[dt]$^(n-1)

Mystery

- Large Epr/Afp loss for high polarization, masing?
- Strips in the transmitted laser after oven

Special Thanks for Vladimir and Huong!!!





Also thanks for everyone: Dr. Xiaochao Zheng, Dr. Gordon Gates, Dr. Todd Averett, Dr. Jian-ping Chen, Dr. Arun Tadepalli, Dr. Alexandre Camsonne, Junhao Chen, Mingyu Chen

See you!