^{3}He target tests

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June 15, 2018

Status

- Oven Installation
- change of EPR
- Water NMR
- Beam compensation

Installation of oven

- The new oven is installed in target lab in EEL building(the size is bigger than old one.)

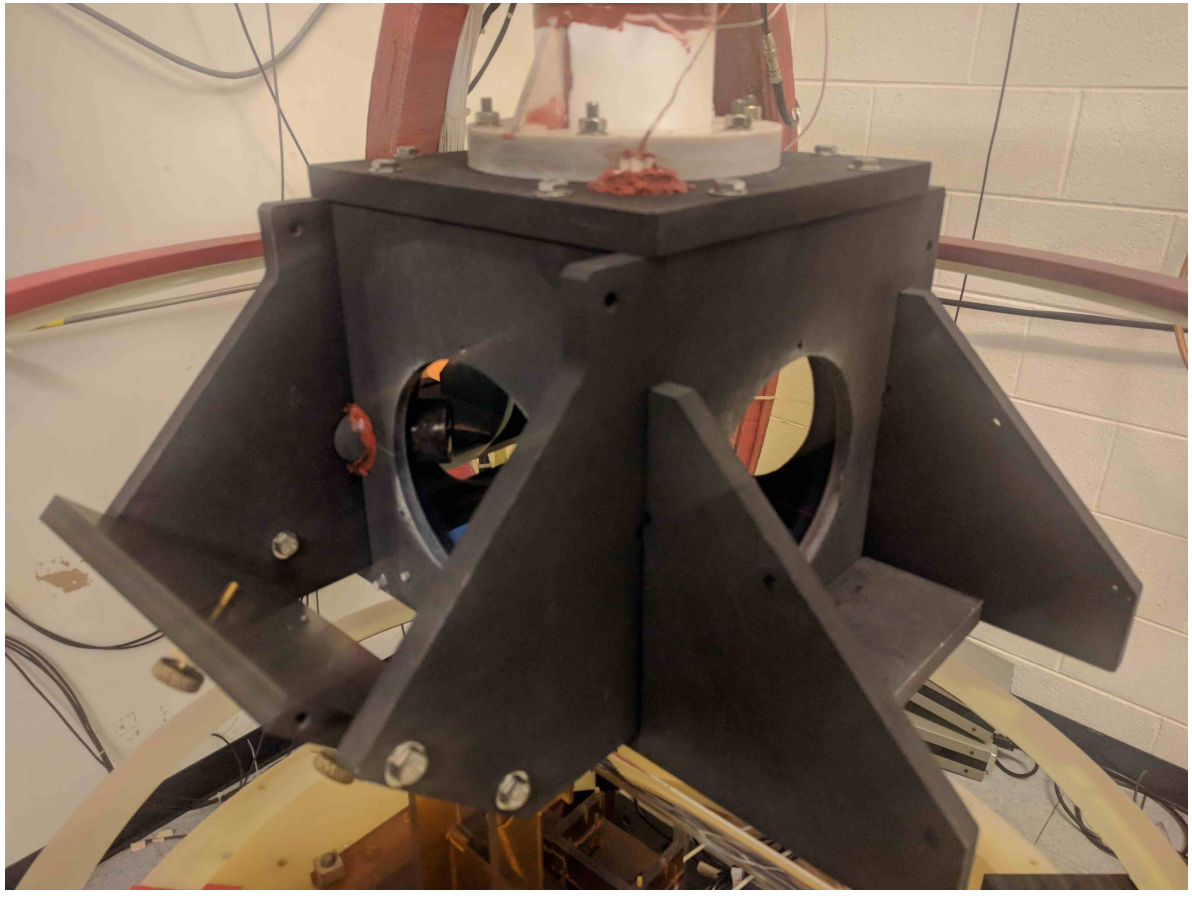


Figure 1 : oven

change of EPR system

- EPR RF coil move from inside oven to outside oven: longer distance between RF coil and pumping chamber;
- Use lens to focus D_2 signal to fibers, then use thick fiber transport to photodiode: need to improve light collection efficiency to ensure signal-to-noise ratio.

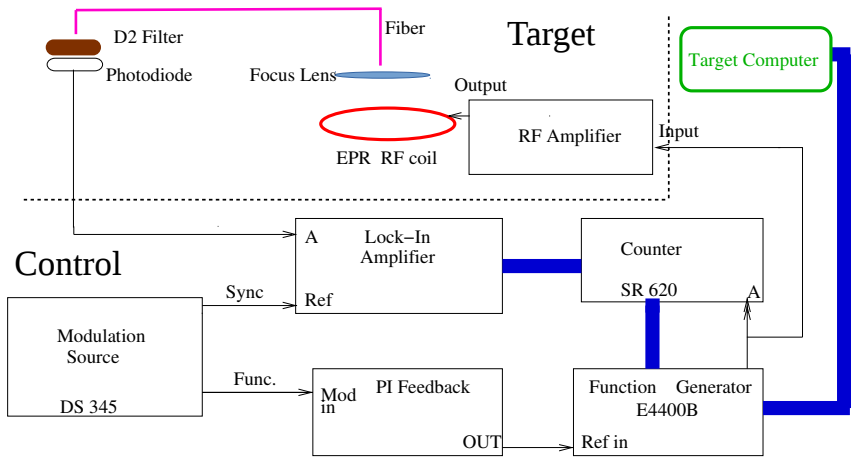
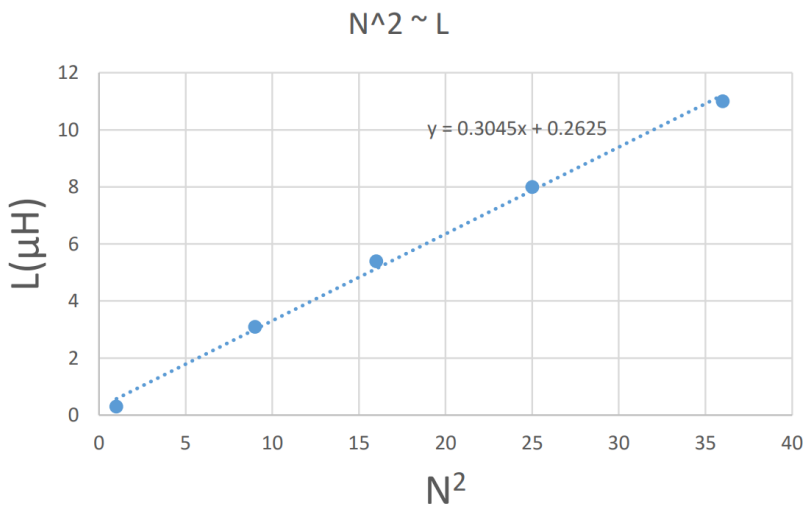


Figure 2 : EPR system

EPR coil optimization

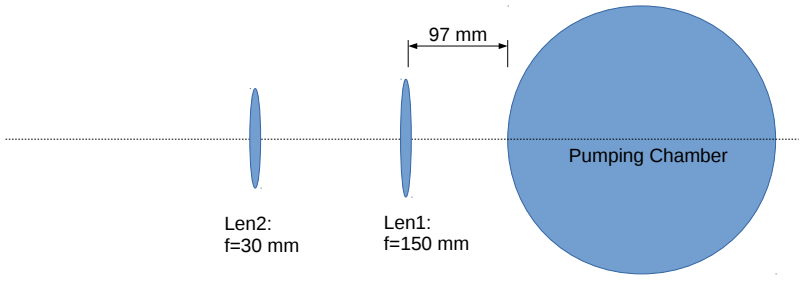
By change turns of EPR coil, can optimize coil impedance, and reach maximum RF signal at pumping chamber.
test condition: wire gauge 24 awg. RF generator give -4 dBm RF signal, Lockin sensitivity 1mV.

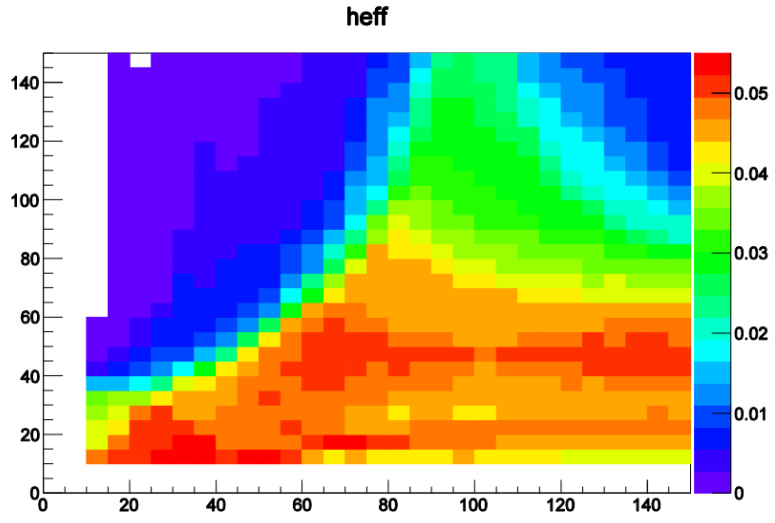


coil turns (N)	R(Ω)	L(μH)	signal Vpp (μV) at a RF gain			
			20% RF gain	40% RF gain	60% RF gain	80% RF gain
1	0.10	0.3	14	43	90	160
3	0.20	3.1	17	49	101	180
4	0.23	5.4	150	450	830	1650
5?	0.26	8.1	130	380	770	1250
6	0.30	11.0	110	320	625	1000

EPR light collection

Combine simulation with tests, find the configuration: Len1: focal length=150 mm, Len2: focal length=30 mm can optimize the light collection efficiency. Still need to test with fiber-bundle in the new oven setup.

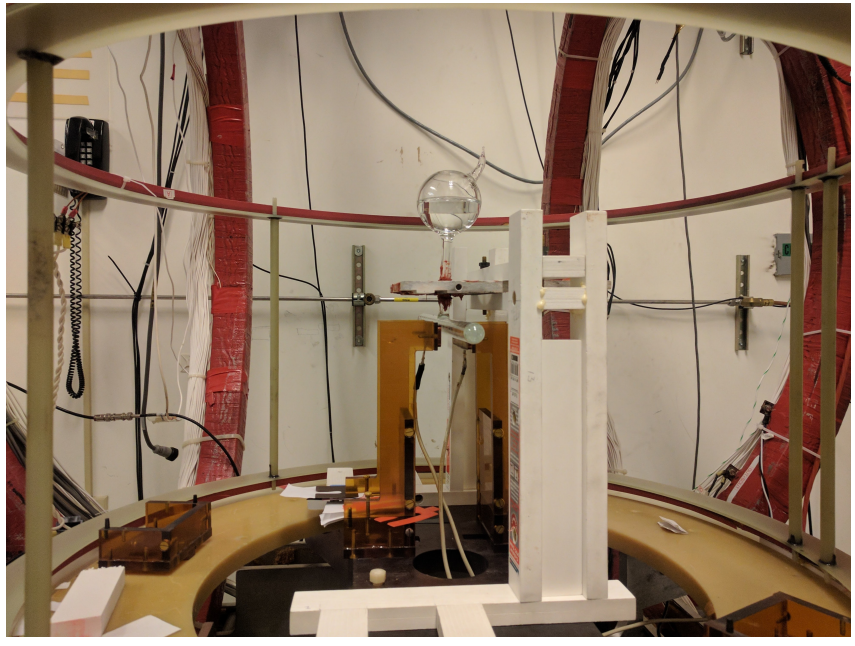




x-axis: Len1 focal length, 10mm-150mm, step 5mm;
y-axis: Len2 focal length, 10mm-150mm, step 5mm.

water NMR

- To calibrate ^{3}He NMR, need to measure thermal polarization of proton in deionized water, $P_{thermal} = \tanh(\frac{\mu_p B}{k_B T})$. For a holding field B = 18 Gauss, T = 395 K, $P_{thermal} = 6.23 \times 10^{-9}$.
- resonance field for RF frequency 91 kHz is 21.27 G;
- RF generator: 500 mV (rms), 90.7 kHz;
- RF amplifier: 10% of max gain;
- Preamplifier: 10k-100k bandpass filter, x100 amplification;



Spin up and spin down sweep

Still need to reduce noise to finish the water calibration.

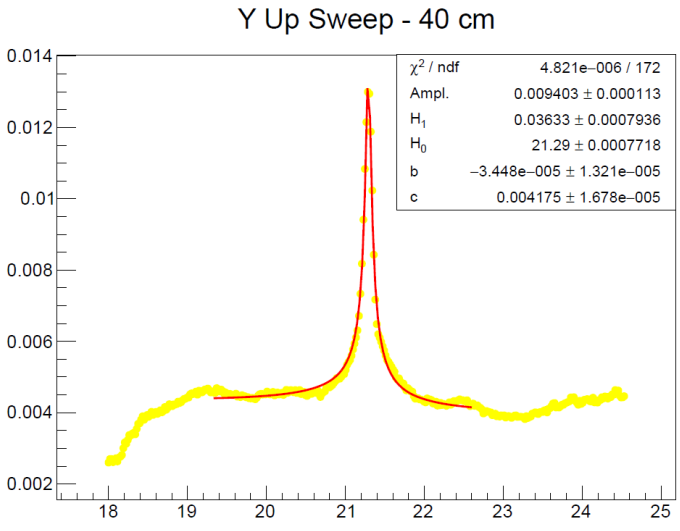


Figure 5 : Sweep up fit

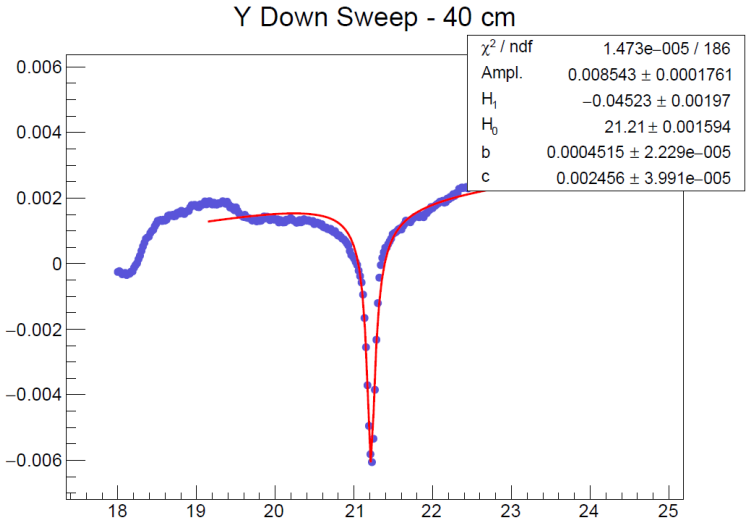


Figure 6 : Sweep down fit

Beam compensation

- Unpolarized laser gets polarized after optics first;
- Finally send laser to pumping chamber by mirrors:
- Dielectric mirrors conserve power but not phase;
- Different phase shift for S and P waves;
- Circular $\rightarrow$ elliptical polarization;
- By add an another 1/4 wave plate into setup: have an extra degree of freedom.