Rotating Target Raster

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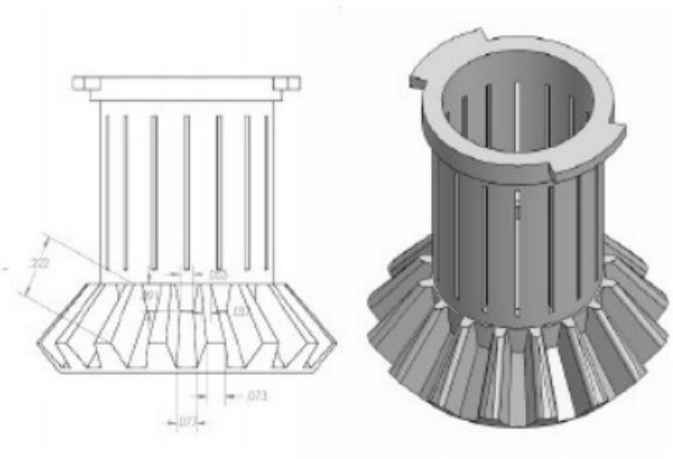
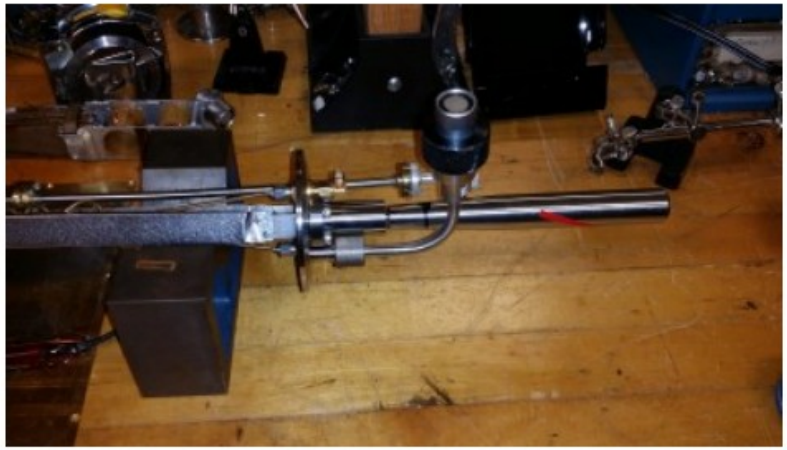
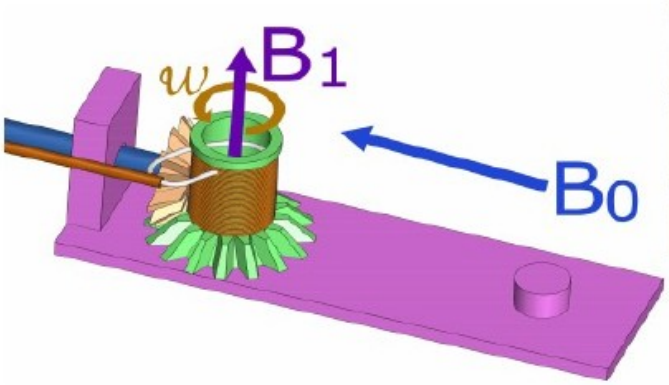
UVA

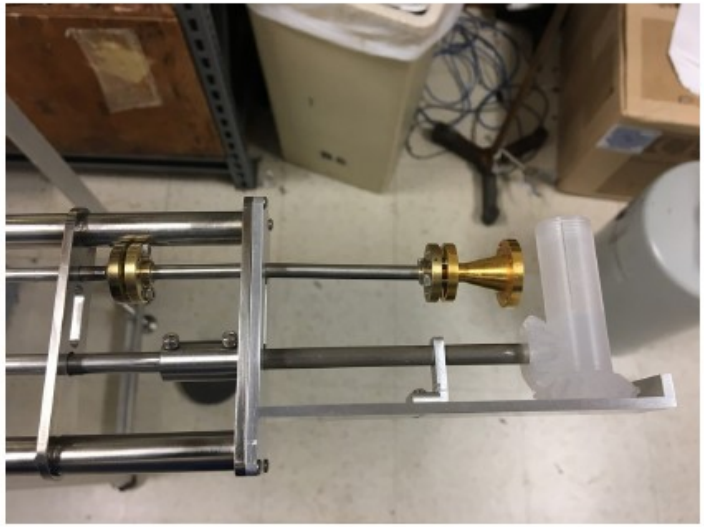
Raster Over Faces of Target

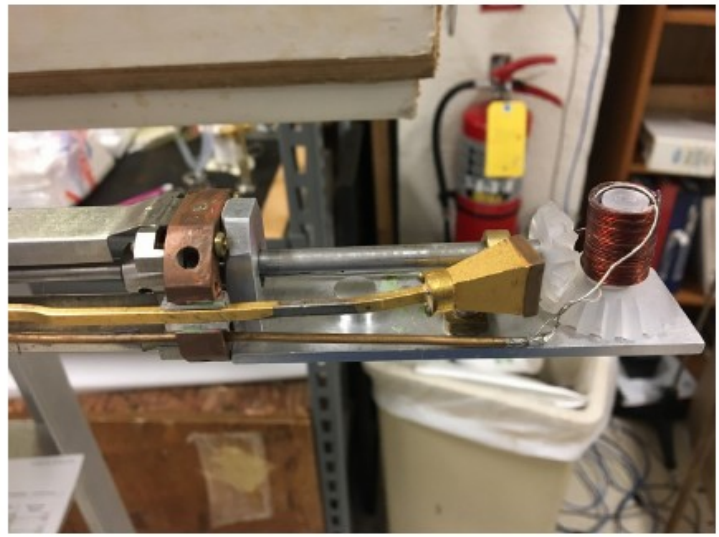




- Kel-F $(C_2ClF_3)_n$ cup and driving gear
- Motor outside cryostat
- NMR coil around cup
- Already used with several designs at UVA
- 1 Hz achieved with no problem
- Fixed beam spot







Why are we doing this

- Depolarization due to radiation damage

  - Photons at the several GeV scale can easily brake up NH3

  - Especially with high energy (IPs) we get significant production of NH2, Atomic H, Atomic N, and recombination to hydrazine and others

  - This radiation damage causes either different polarization mechanisms and/or depleted DNP

  - The production of these free radicals is the leading cause of target maintenance and overhead time required to anneal and replace target material

  - EGS and Geant indicate we will get some of these processes with a high energy photon but the primary production of centers is still NH2, Atomic H from the IPs created by the photon source

  - Secondary scattering of ionizing radiation inside the target using 10^{11} gamma/sec with RMS~1 mm leads to 20 nA of e+/e- in an area of 4.5 mm^2

  - If this dose can be spread out over the surface of the target (570 mm^2) we start to approach the radiation damage seen in CLAS6 type running

- Depolarization due to localized beam heating

  - Local hot-spots caused by interfacial thermal heating can create loss of polarization at the beam location in the target

  - Additional heating issue arise from thermal conductivity of the material and the Kapitza resistance

  - All of this is easily handled by keeping the beam to target position moving (fix only a couple of seconds)

Its worth Noting

- Even with e-beam we know what some of the radiation damage processes are but not all of them
- The manifestation of these processes into 'bad' paramagnetic centers is beam energy and target temperature dependent with rate effects involved as well
- The photon beam production of paramagnetic centers may not be directly proportional to heat load as the 'bad' centers are less likely to be produced in the front of the target and almost only comes from pair production and e-Compton scattering at lower energy further in the target
- We should expect many more lower energy processes to terminate in the target that are not producing as many 'bad' centers as seen in electron beams
- But still mostly an open question when trying to consider numbers, a more sophisticated MC-effort maybe worthwhile to understand the profile of radiation damage in needed dimensions of this type of target (at least down the road)

What is Not New

- No change to NMR system
- No change to NMR coil, we have used outside coils before for different experiments
- No change to Microwave system, there can be less space on the top cryostat flange but thats it
- At 1K there is absolutely no effect to the NMR signal, this is widely known and understood (Not frozen-spin system)

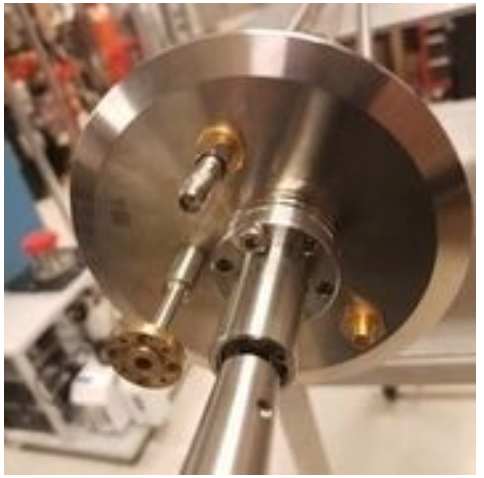
What is New

- Mechanical Rotary Vacuum Feed Through
- Geared Cups, size of cup can change but not necessary
- Use combination of already used target position actuator and rotation
- Connected Motor at the top of cryostat
- NMR coil must be on outside of cup (but this is actually not new)

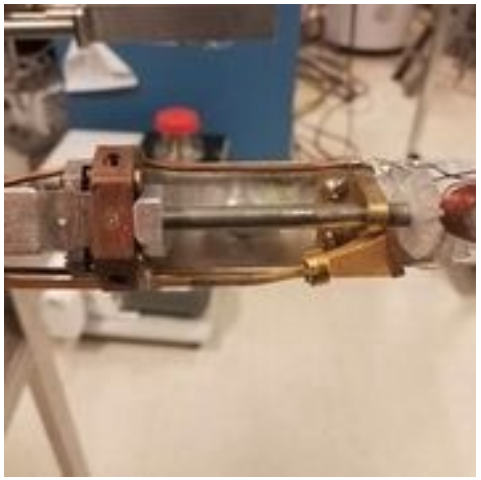
Rotating System Currently Used

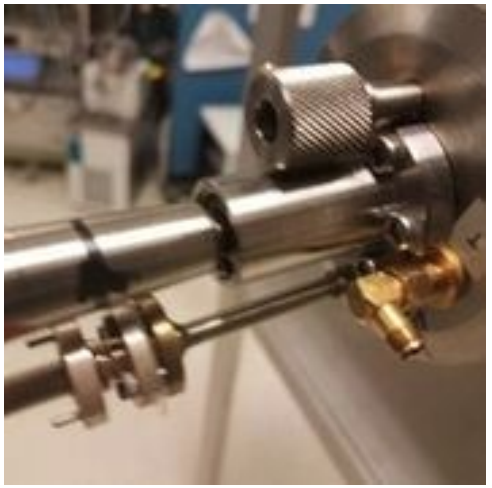
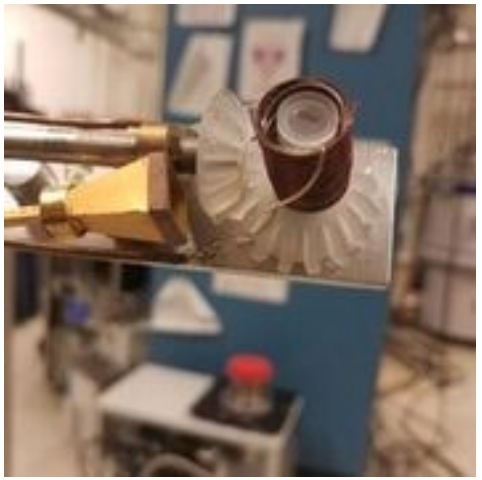




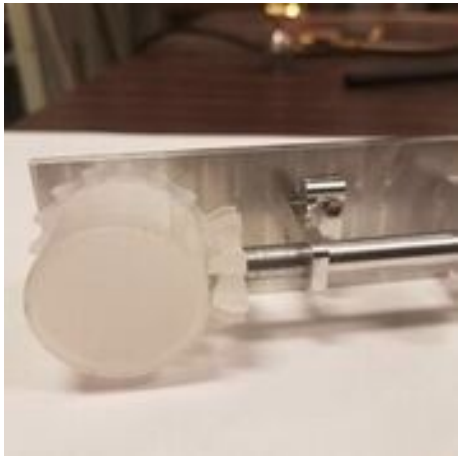




System Currently Used



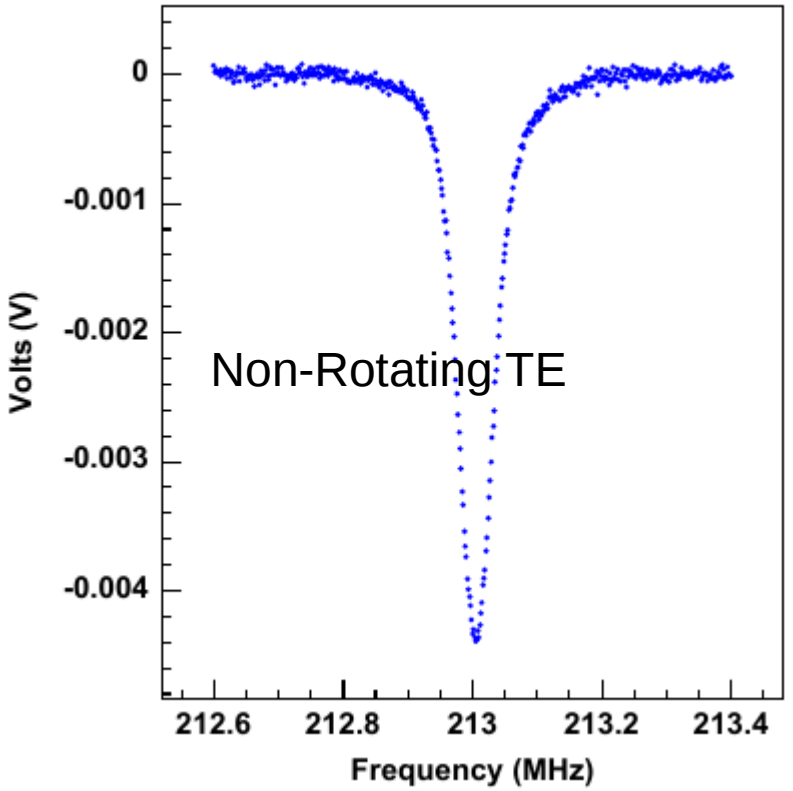




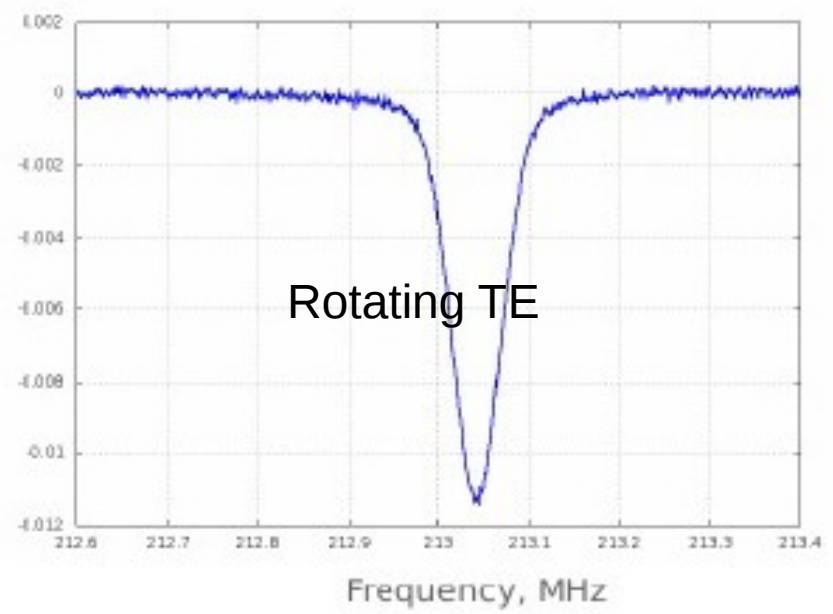

A Likely WACS Version



NMR signal

- No Change to NMR signal





Other Questions?

- Let me know what other questions
- Things people would like to see
- Up coming cooldown
- Can present more at meeting