1 POLARIZED TARGETS for E159 and E161

- Proposals had the same target system (dilution fridge + 7T magnet) for both experiments.
- 7T magnet design changed due to corporate change at Oxford Instruments.
- Standard 7T NMR magnet under consideration and study (see E161 Web site)

2 E161

- Dilution refrigerator for E161 shown in Fig. 1
- Two pronged approach:
  1) Modify old CERN fridge and assemble at UVA and test
  2) Modify test and run Los Alamos fridge (similar design to above CERN fridge)
- $^6\text{LiD}$ will be target material
- Fig. 2 shows world data on deuteron polarization vs magnetic field
  The fits are to $\frac{1}{\tau}$ where $T_s$ is the spin temperature and related to the lattice temperature
- Recent data from COMPASS shows $P_D = +56\%$ and $-48\%$ at 2.5T
and ∼300mK
A $\frac{1}{T_2}$ fit implies $P_D \sim 90\%$ at 6.5T!
But COMPASS fridge (from SMC) is more powerful than ours and we expect $> 60\%$

Two EIO tubes with frequency $\sim 185$ GHz have been ordered by SLAC
UVA has frequency and power measuring components at this frequency
Magnet purchase is on hold until FY2003

3 E159

Proposed E159 system shown in Fig. 3
Same as used in E143/E155/E155X and more recently in GeN at JLAB
Material probably $^{15}\text{NH}_3$ and $^{15}\text{ND}_3$
95\% proton and 48\% deuteron polarizations achieved in GeN
Deuteron signal at 46\% shown in Fig. 4
Fig. 5 shows radiation damage to ND$_3$ at 100nA
There will be radiation damage from the photon beam
Will study this with EGS4
Fig. 6 shows data from eg1b at JLAB where the rastering did not cover the complete face of the target.
The NMR coils were outside the target material and the figure
shows the deviation between polarization measured with NMR and a scattering reaction.

Studies of the differential rad. damage with a photon beam have been made by G. Court et al., NIM 177, 281 (1980)

We will study this further

Finally, the Bochum group have discovered that d-butanol irradiated with $10^{15}$ e cm$^{-2}$ gave 70% polarization at 5T and 300mK. This opens up the possibility of using a dilution fridge with the E159 5T magnet.
Figure 1: Dilution fridge for E161
Inverse Spin Temperatures of the $^7$LiD World Pol. Data

$$P = \frac{4 \tanh \left( \frac{g \mu_B B}{2kT} \right)}{3 + \tanh \left( \frac{g \mu_B B}{2kT} \right)}$$

Figure 2: World LiD Polarization
Figure 3: Target system for E159
Figure 4: NMR signal at 46% polarization
Figure 5: ND3 NMR signal
Figure 6: Polarization for eg1b target as a function of Run number (Dose) as measured by a scattering reaction and NMR.