Measurement of $\Delta\sigma_L$ in the $\vec{n}$ - $\vec{d}$ System

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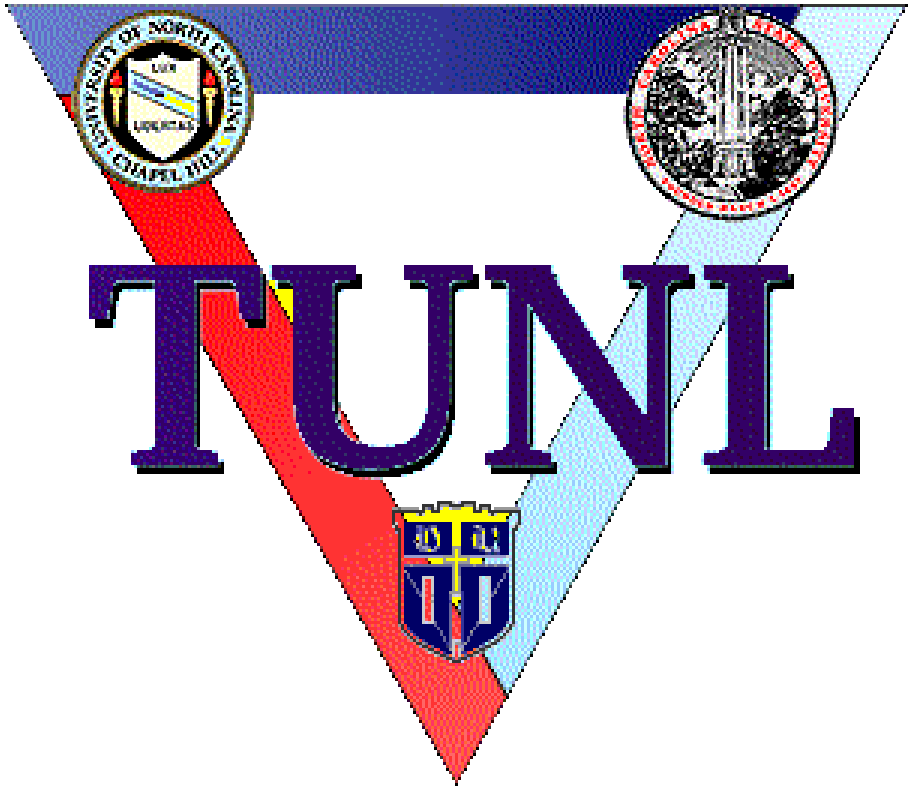


Supported by the US Dept. of Energy

Overview

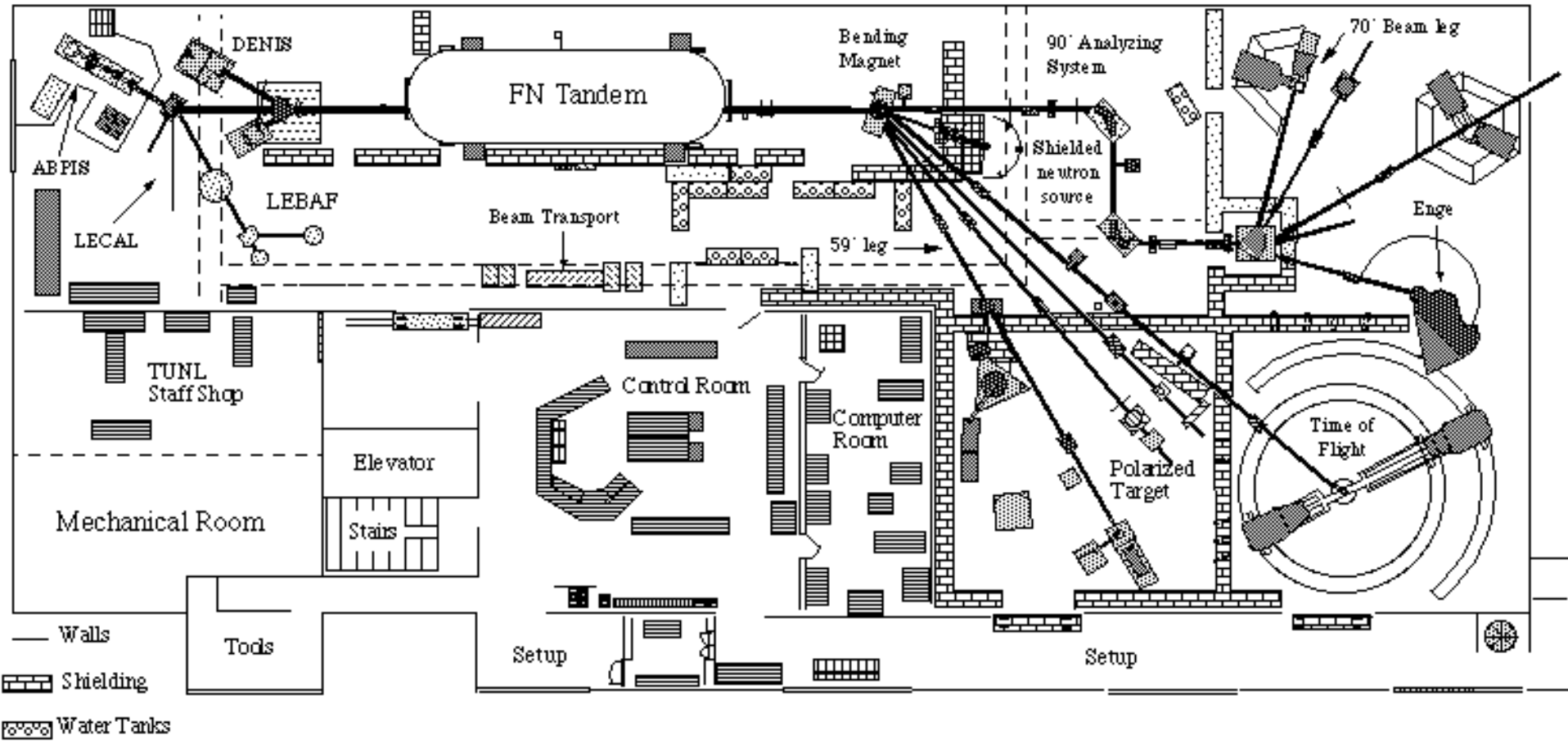
- Motivation and Theory
- Overview of the Experiment
- Dynamically Polarized Deuteron Target
- Results
- Summary

Motivation and Theory

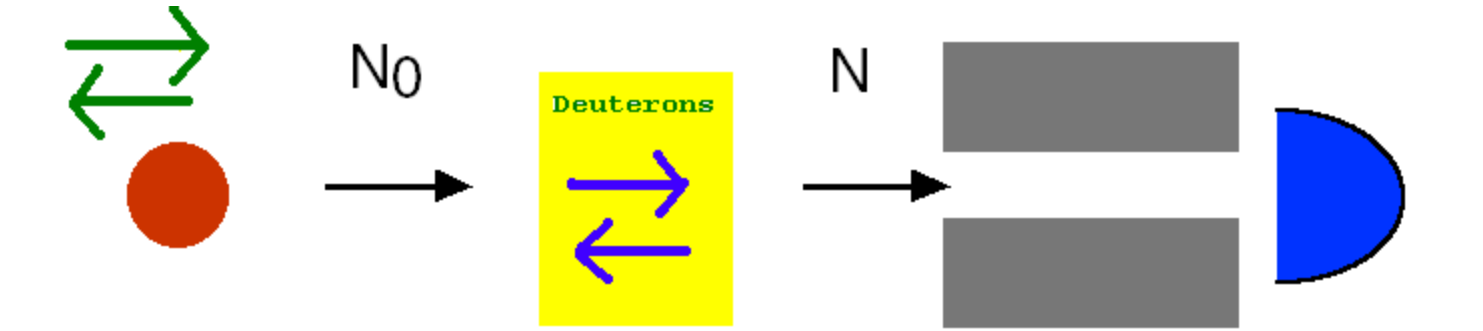
- Investigate the spin dependence of the nucleon-nucleon (NN) interaction in the $\vec{n} - \vec{d}$ system
- Determine the contribution of three-nucleon force (3NF) term to NN potential
- Longitudinal total cross section difference is sensitive to the same 3NF terms which are added to the NN potential models to reproduce the triton binding energy

$$\Delta\sigma_L \equiv \sigma\left(\rightleftarrows\right) - \sigma\left(\rightrightarrows\right)$$

Triangle Universities Nuclear Laboratory



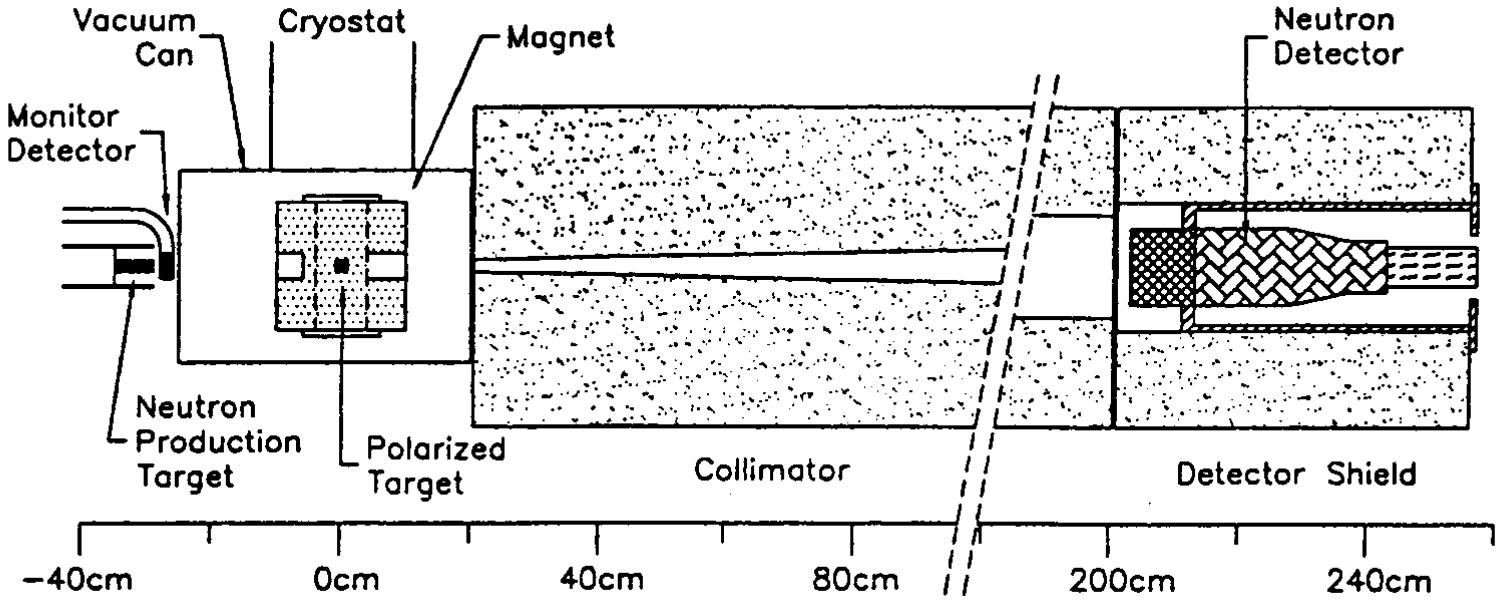
n-d Scattering Experiment



$$\varepsilon = \frac{N^+ - N^-}{N^+ + N^-}$$

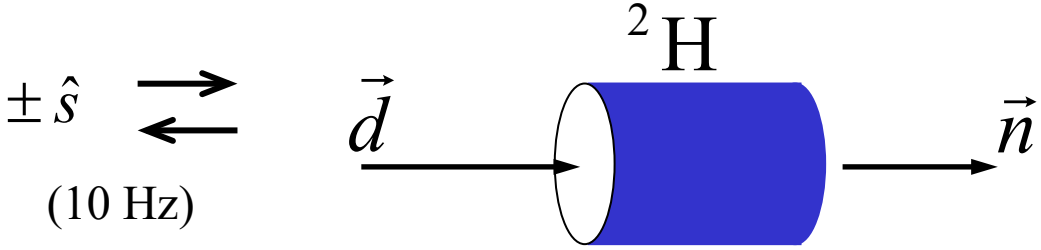
$$\Delta\sigma_L = \frac{2\varepsilon}{\mathrm{P}_T x \mathrm{P}_n}$$

Schematic of the Experiment



Polarized Neutron Beam

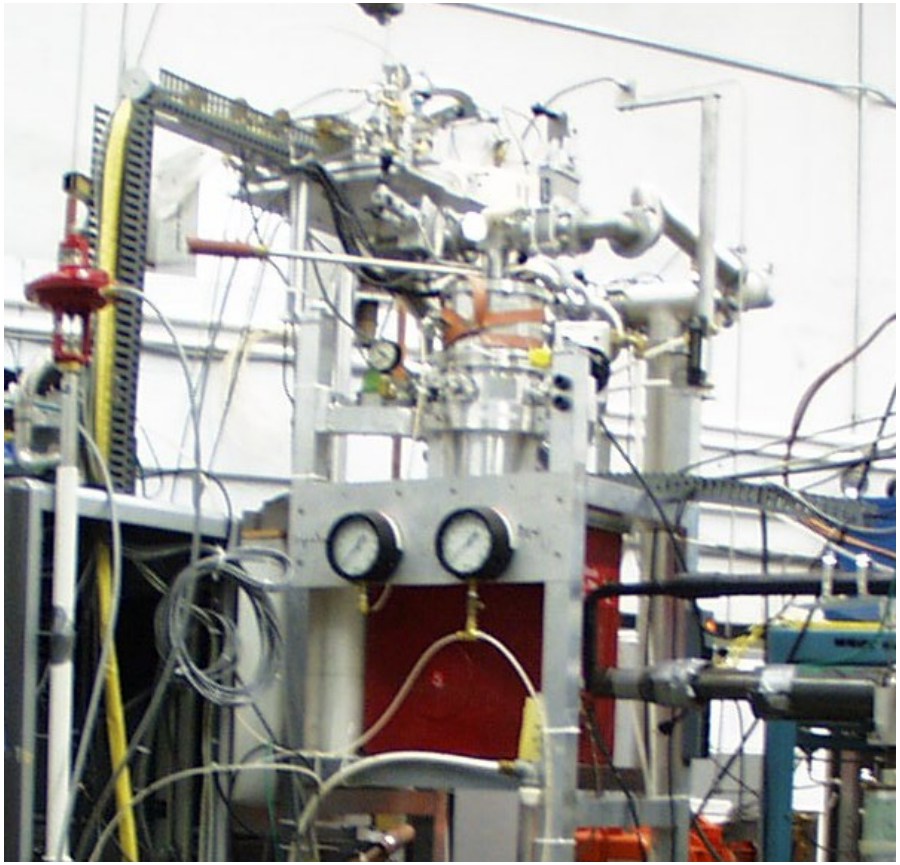
Neutron production reaction: $\vec{d}(^2\mathrm{H},^3\mathrm{He})\vec{n}$



P_n calculated from d polarization using polarization transfer coeff.

$$P_n = ((30-50)\pm 4)\%$$

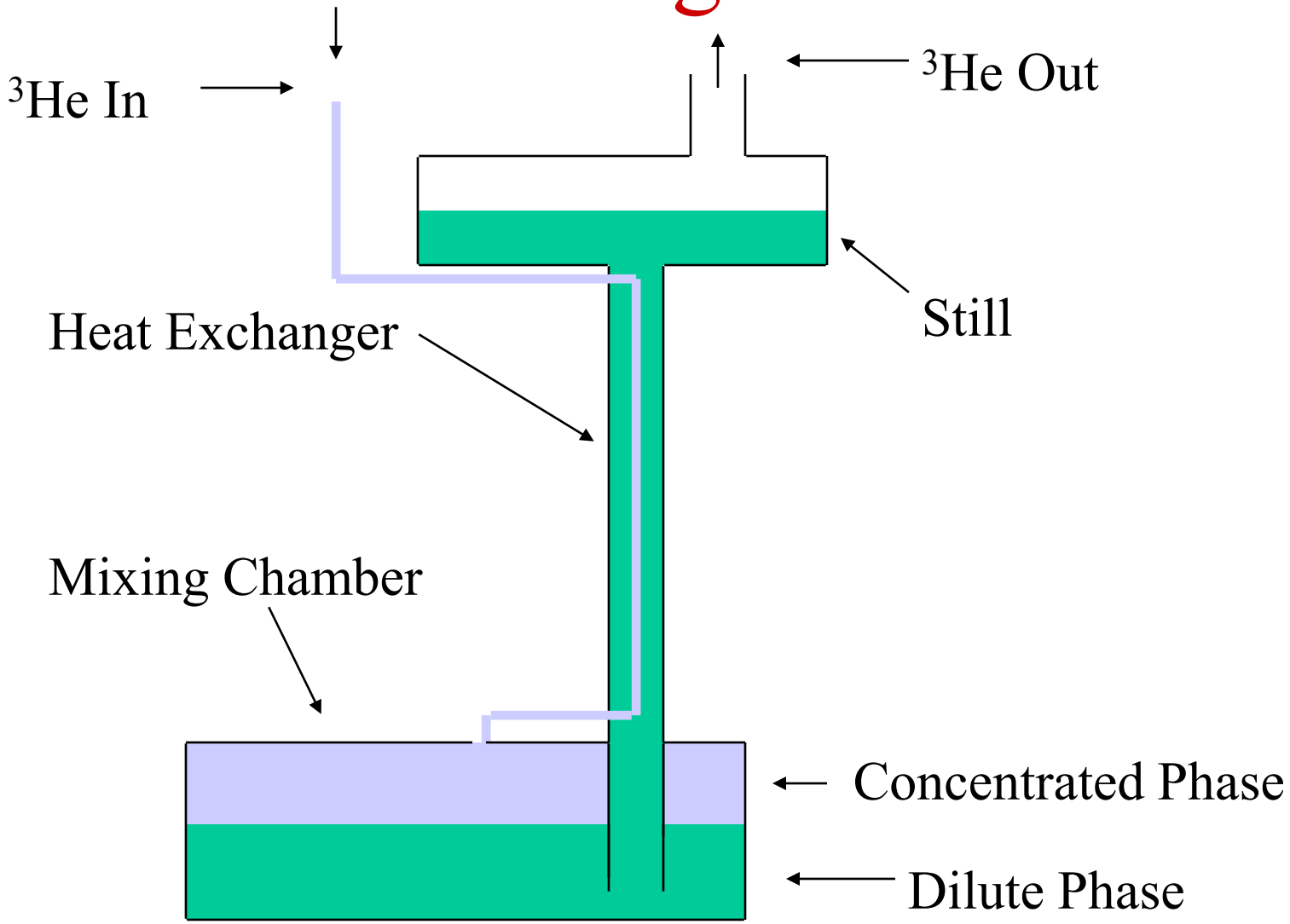
TUNL Polarized Target Facility



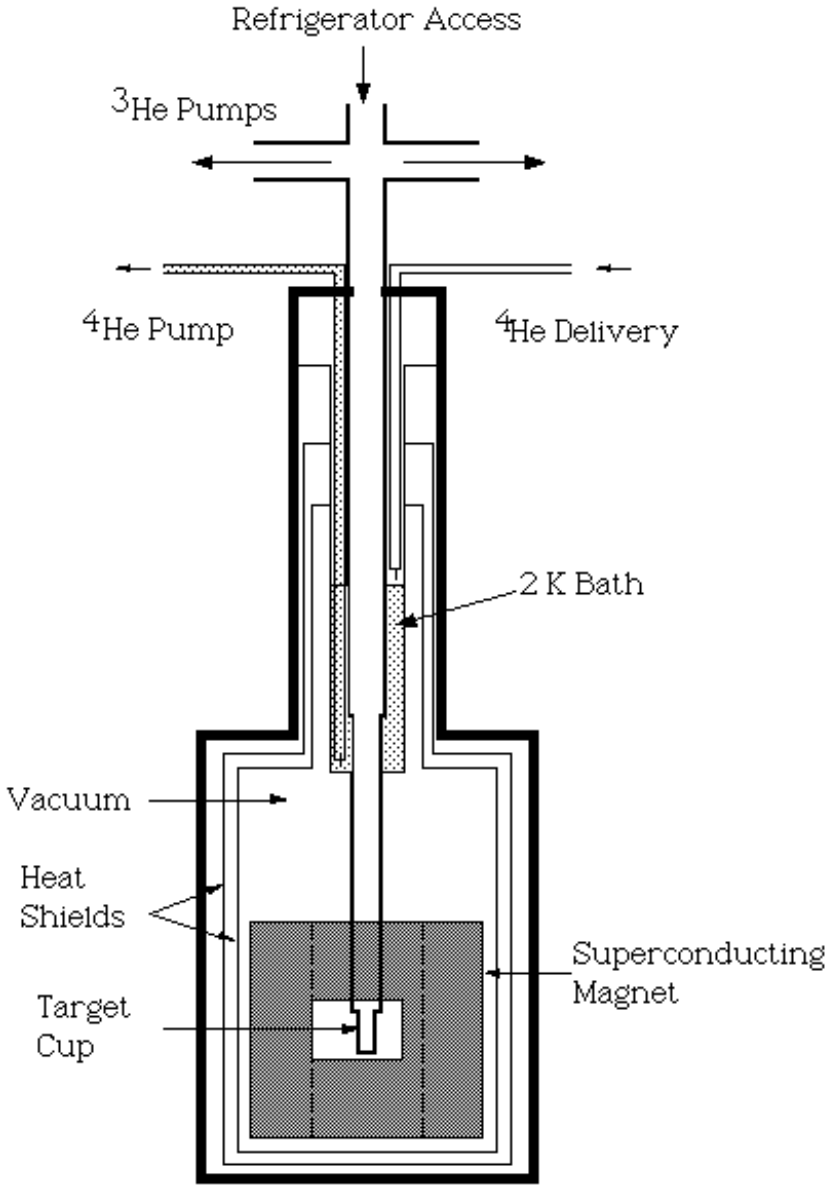
Dynamic Nuclear Polarization

- Low temperature (200 mK) and high magnetic field (2.5 T) polarize electrons
- Drive transitions with 70 GHz microwaves to produce nuclear polarized target
- DNP provides a method to quickly flip target polarization and it can absorb external heating
- Target material is 1 mm diameter beads of frozen 1,2-propandiol in which all 8 hydrogens have been replaced by deuterons

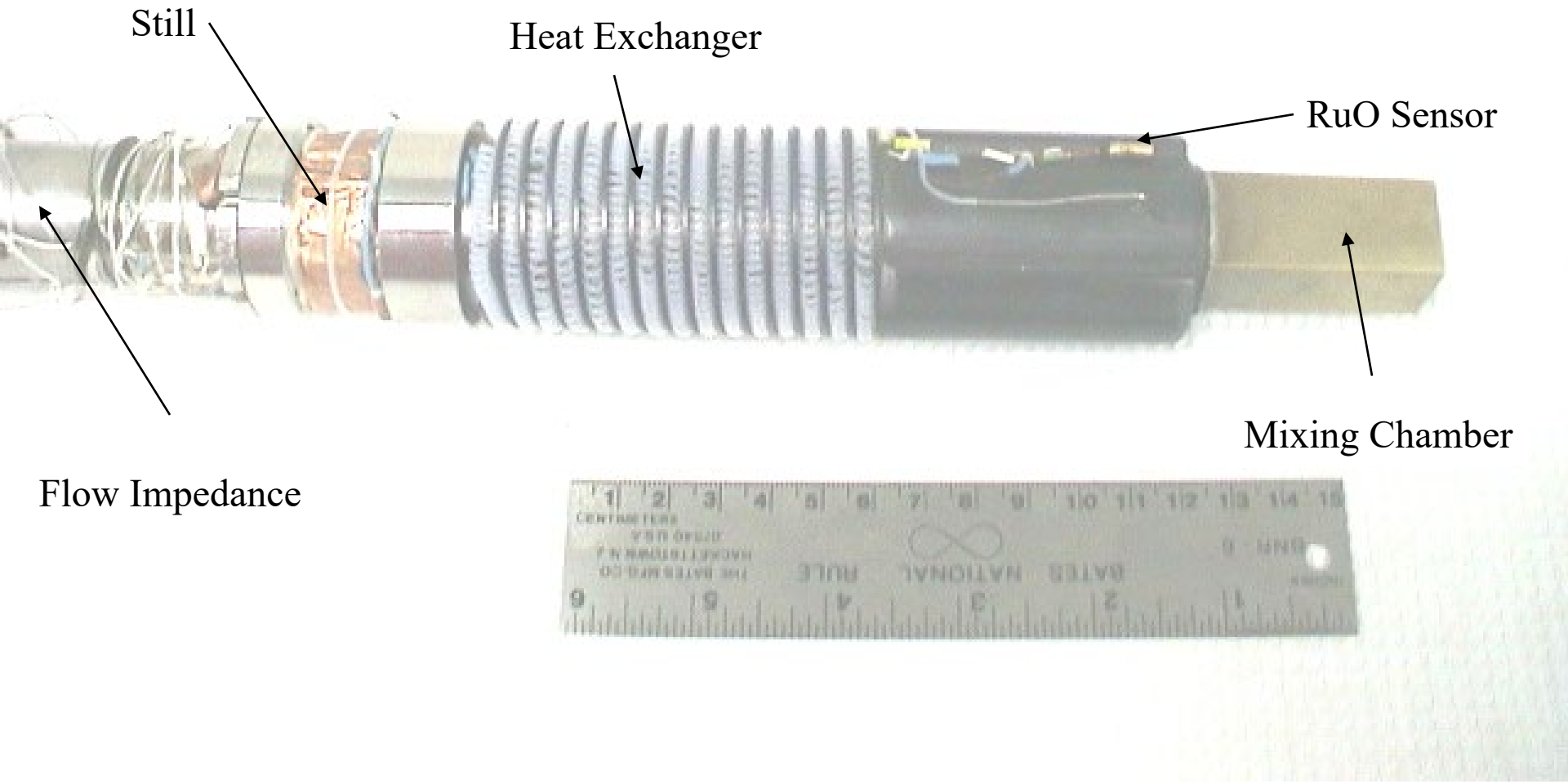
Dilution Refrigeration



TUNL Dynamically Polarized Deuteron Target



Dilution Refrigerator



Target Insert

May 2003 Results

	$\Delta\sigma_L$ (mb)		
Neutron Energy (MeV)	CDBonn	CDBonn+TM	May 2003 Experiment
6.88	-382.4	-413.6	-390 ± 60

- Very small data set
- Error is too large to resolve 3NF effects
- Were not able to take multiple sets of data for each target polarization state

Summary

- We have made a preliminary measurement of $\Delta\sigma_L$ at 6.88 MeV
- Try to reduce uncertainty to ~8% to see the separation of NN and 3NF model calculations
- Take more data at this energy and also take data at 5 MeV in the fall
- Take an 800 keV point for calibration of $P_t x$