



NC STATE UNIVERSITY

The status of ^3He Relaxation Time Measurement at 300~500mK

Q. Ye, D. Dutta, H. Gao, W. Zheng, X. Zhu
Duke University

R. Golub, P. Huffman, F. Dubose
NC State University

Feb. 8th, 2008

Experimental

Schematics

Detachable cell

Detachable cell mount

Distance between the top polarized ^3He cell and the bottom acrylic cell ~ 218.4cm

293.4 cm

Dilution Refrigerator

IVC

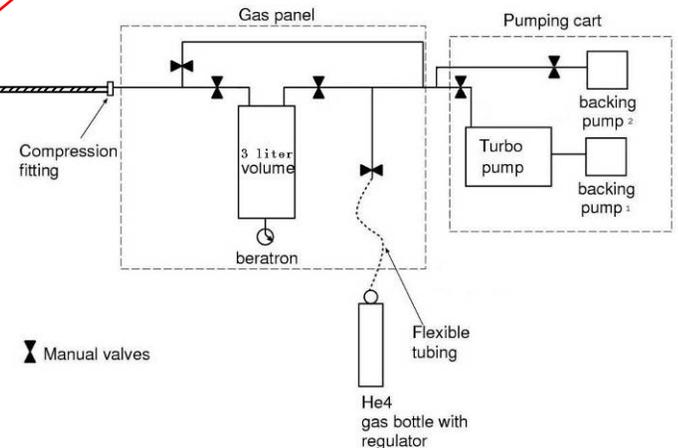
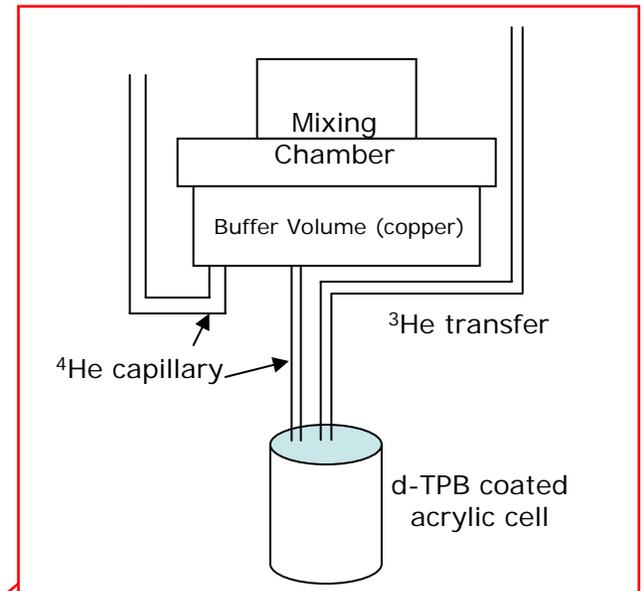
d-TPB coated acrylic cell

RF coils

2/6/2008

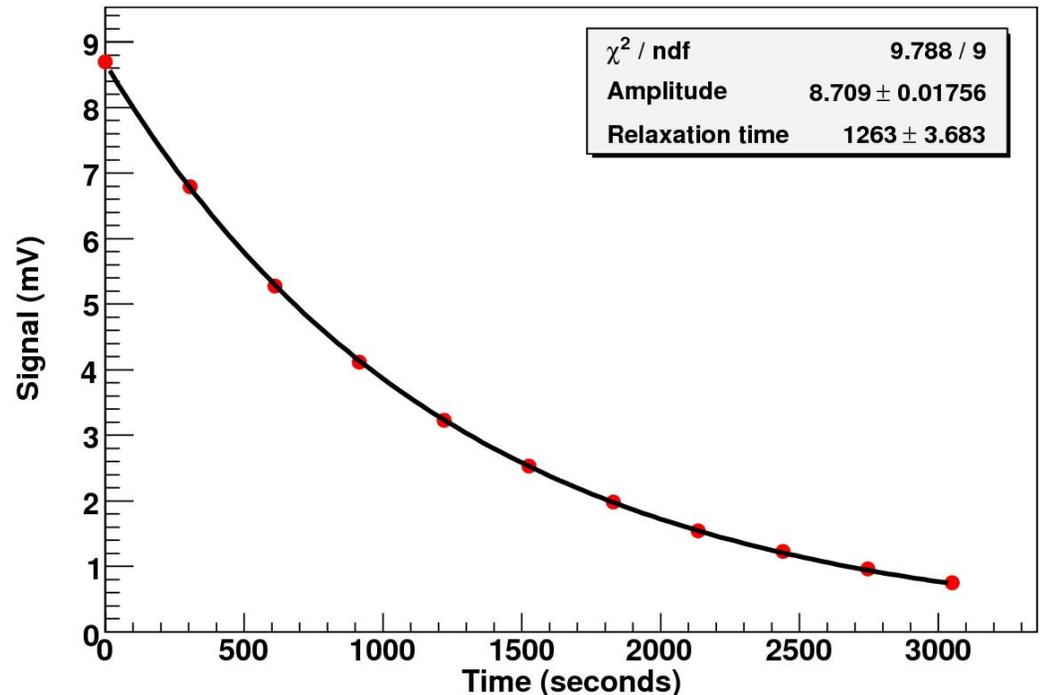
pickup coil

Filled with polarized ^3He

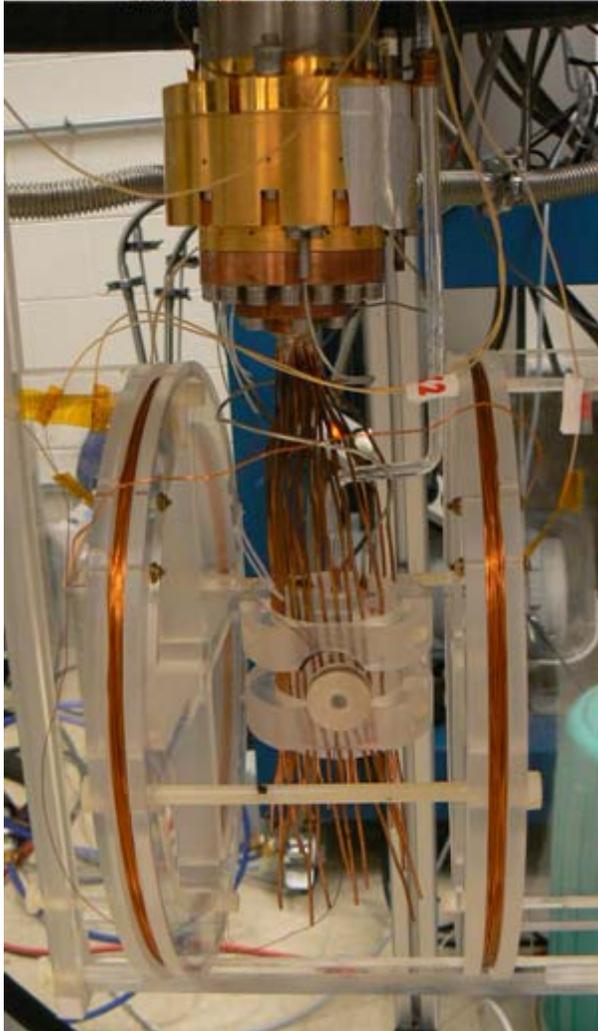


Preliminary Results

- Cell filled with 1.23mol super-fluid ^4He (~63% full), cooled down to 0.530K
- Total amount of ^3He in the cell was 0.00092 mol (polarization~5%)
- ^3He relaxation time (~1263 seconds with an AFP loss of 0.5%) at 7.5G holding field
- Hard to cool down the cell filled with super-fluid ^4He



Problem of cooling down

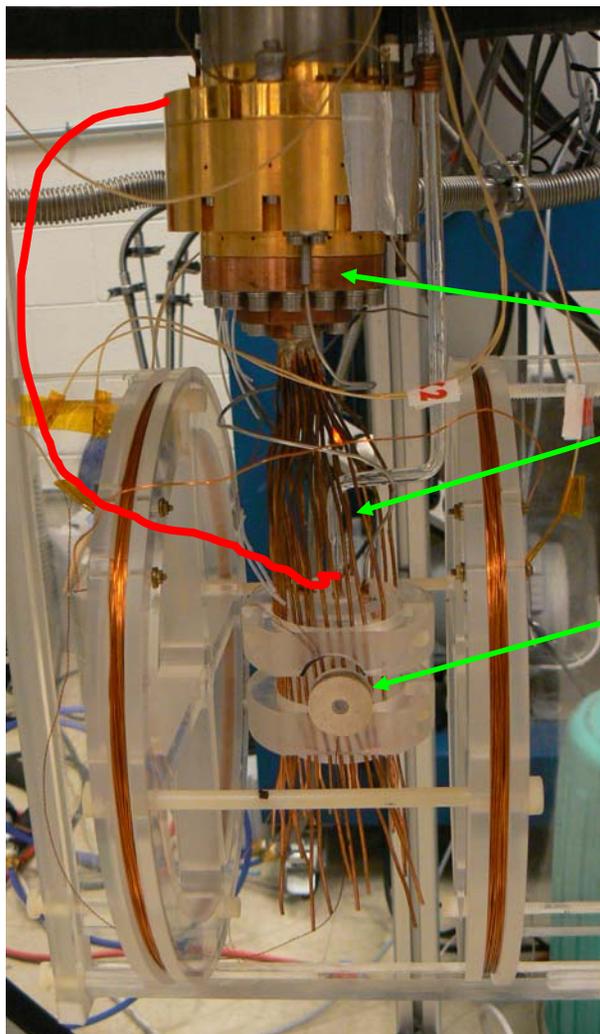


- Cool down \rightarrow 200mK with the empty cell
- Cool down \rightarrow 500mK with the cell half full of super-fluid ^4He
- Cool down \rightarrow 800mK with the cell full of super-fluid ^4He (system unstable)

Outline

- Modifications to the MC & acrylic cell
- More dTPB-dPS made for coating
- Cs coating test in the injection test cell
- Future plan

Modifications needed



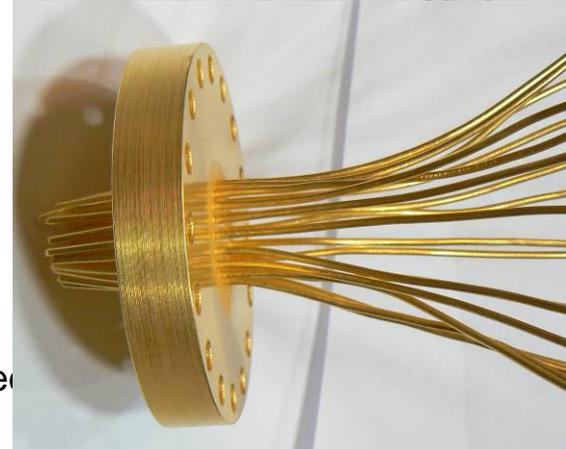
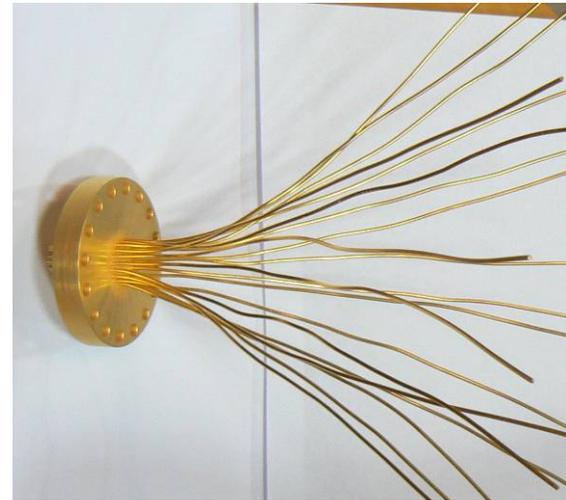
- Better thermal contact from MC to acrylic cell
 - Gold plate the copper part and wires (five 9's)
 - Grooves on the acrylic cell for housing gold-plated copper wires
 - Thermal link from MC to the glass-copper seal

Gold plated copper parts for better thermal contact

Before brazing & gold plating

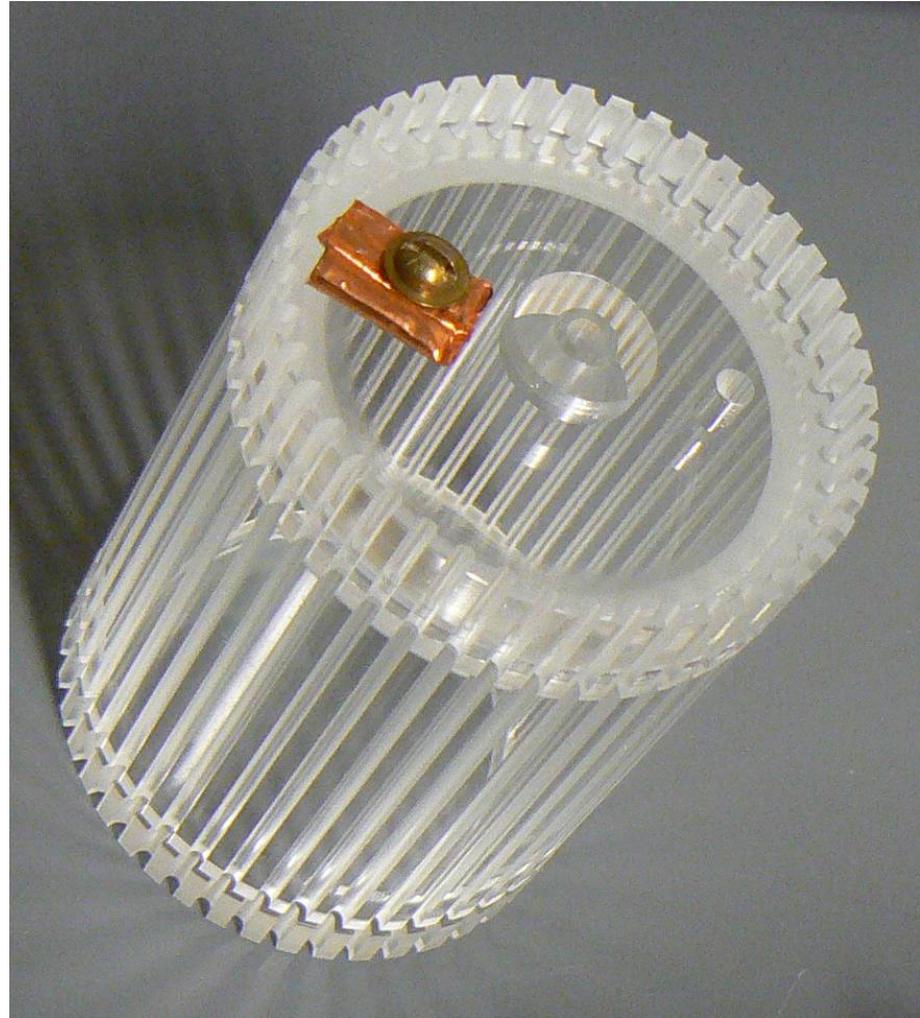


After brazing & gold plating
(99.999% pure copper wires)



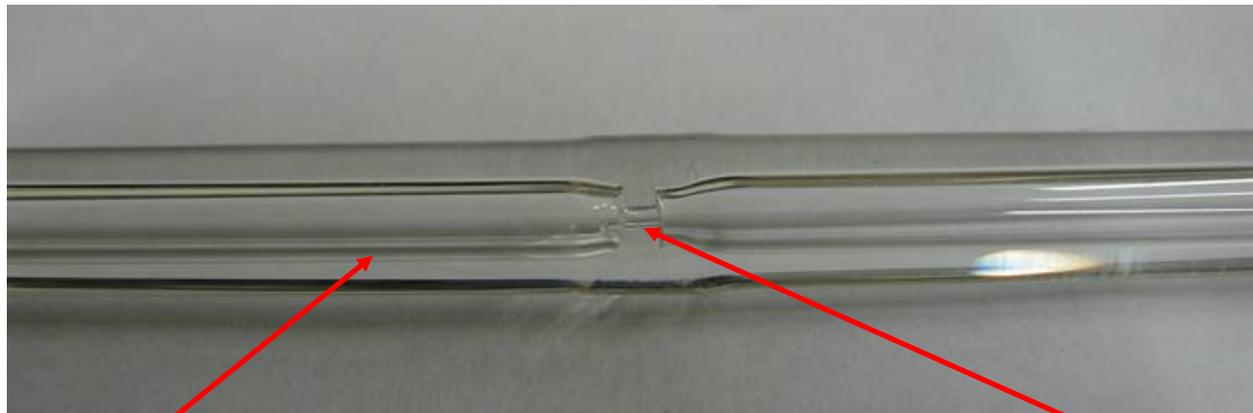
Grooves on the acrylic cell

- Grooves for the copper wires to go thru
 - Better thermal contact



Restrict ^4He film flow

- Thin capillary tube to stop film flow
- Positioned above the buffer volume

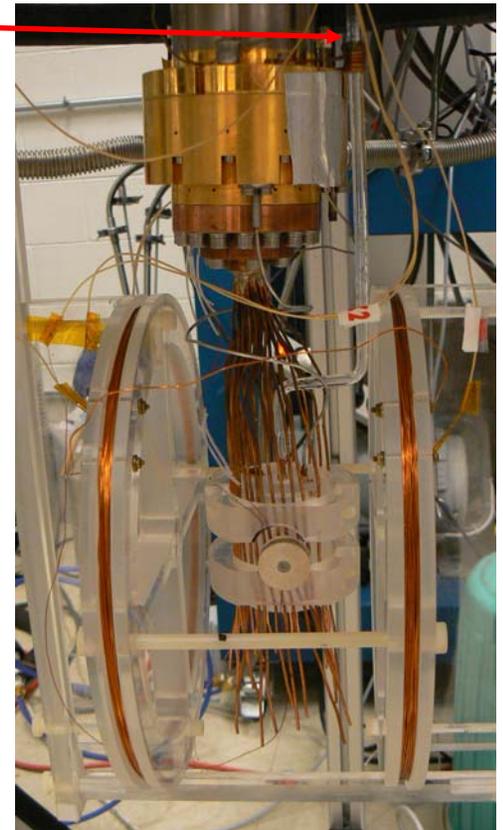


6x2 mm capillary

2/6/2008

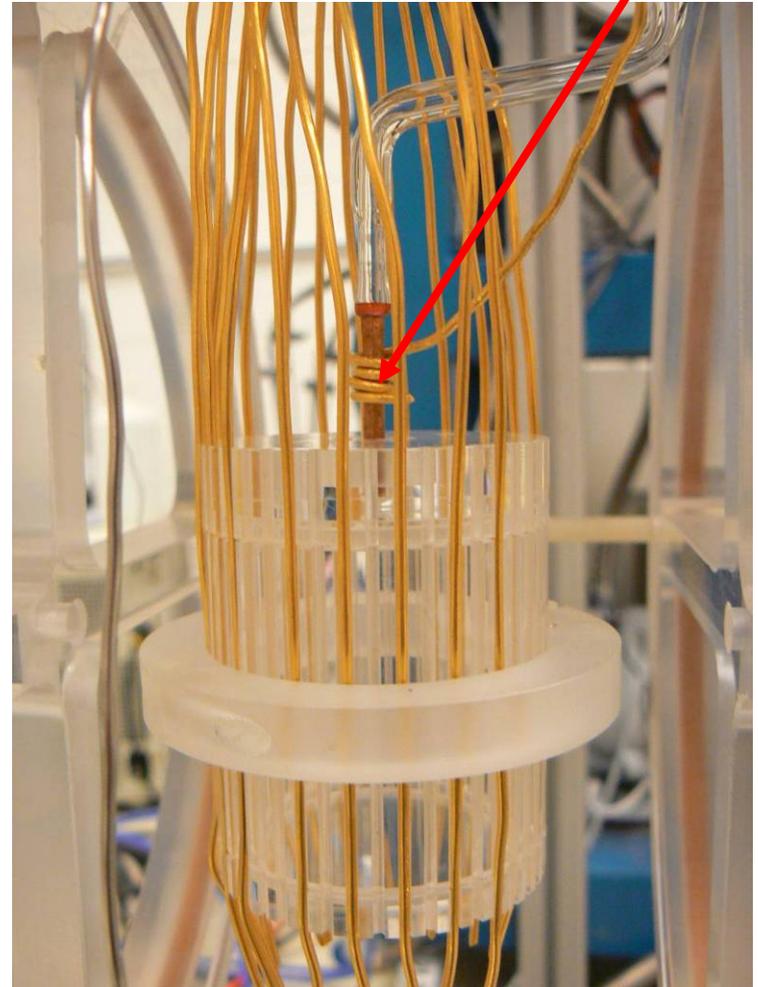
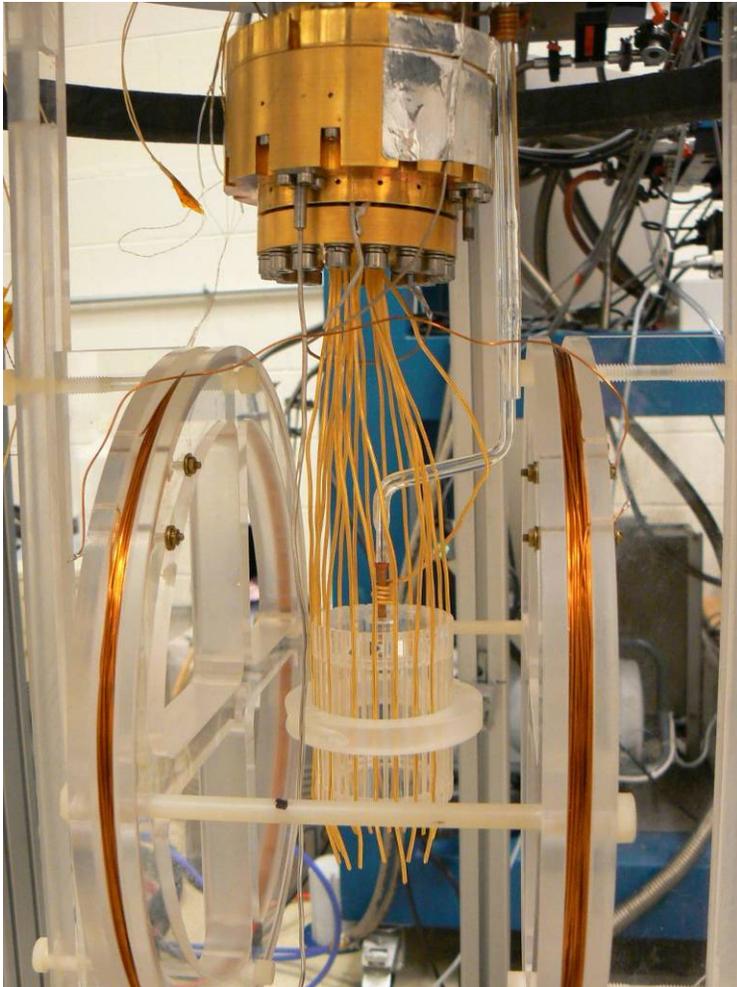
0.25mm diameter, 1mm long

nEDM Collaboration Meeting



After putting together

Modifications



2/6/2008

nEDM Collaboration Meeting

1/8" copper tubing

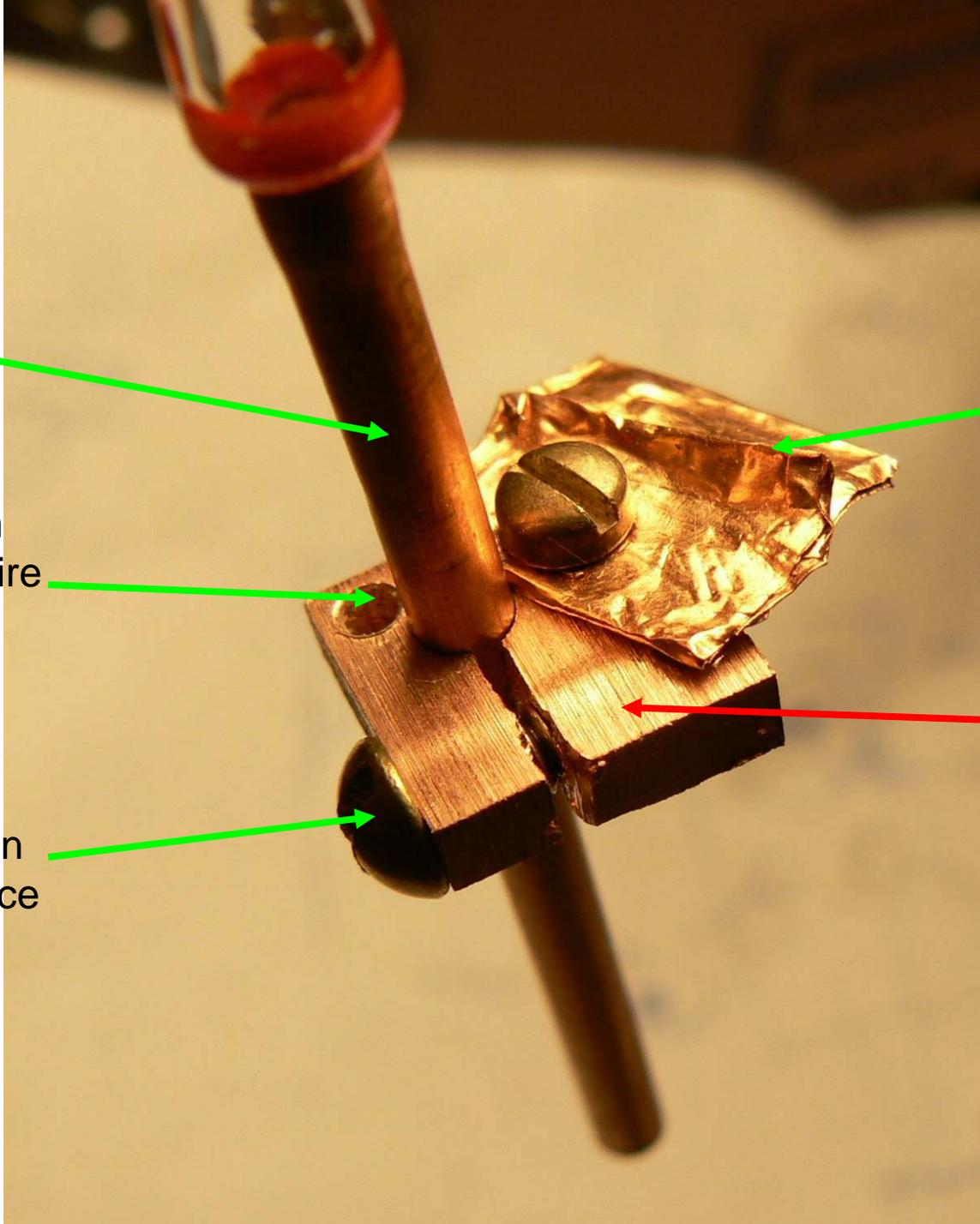
For the 1.5mm pure copper wire to go through

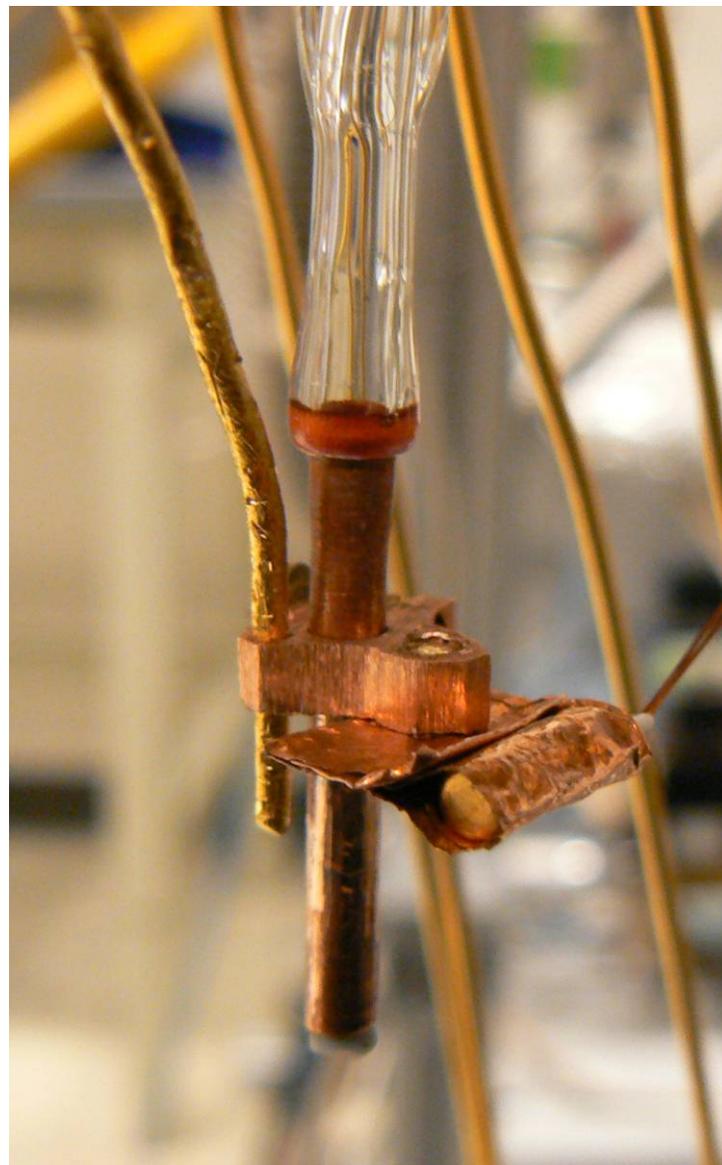
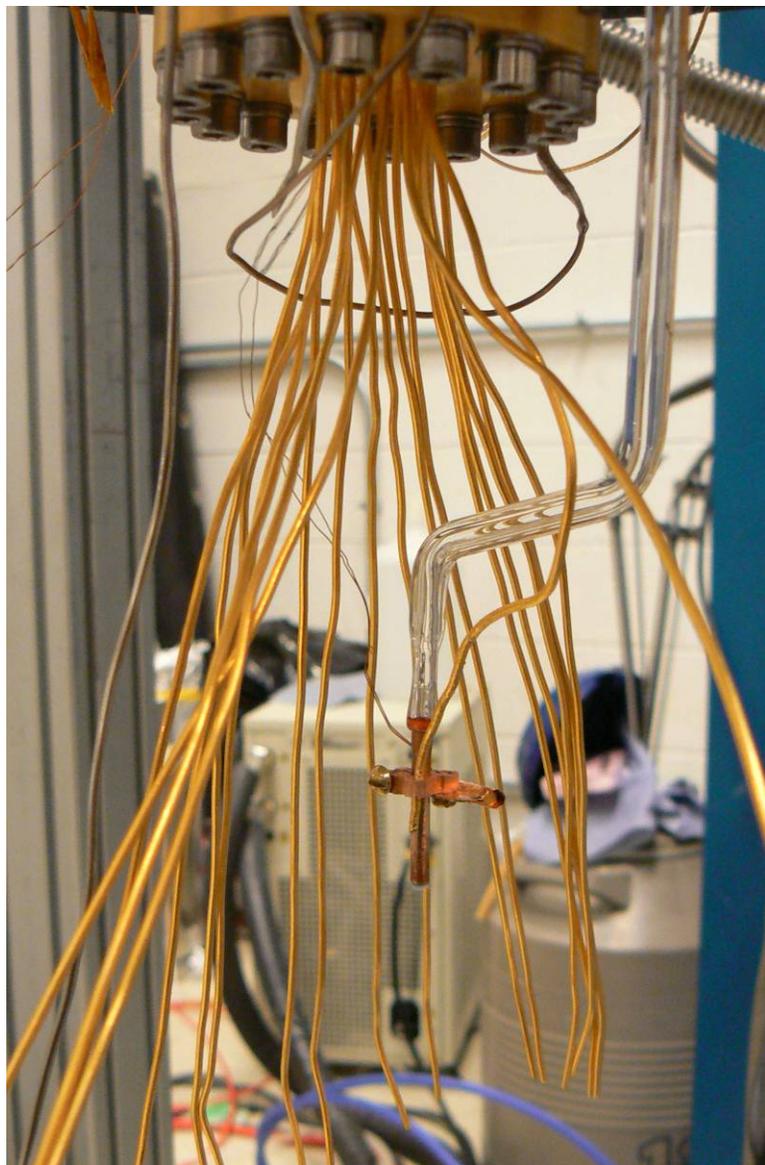
4-40 plastic screw to tighten the copper piece to the tube

Temperature sensor holder

Small copper part

2/6/2008





2/6/2008

nEDM Collaboration Meeting

dTPB-dPS making

- Make more dTPB-dPS material for coating
 - Distill d-styrene
 - Polymerization -> d-Polystyrene
 - Dissolve in Toluene
 - Dripping in d-methanol
 - Dissolve in Toluene (final d-PS solution)
 - Mixed with d-TPB

Next steps

- Coat the acrylic cell with dTPB-dPS
 - Done!
- Attach the cell onto the DR
 - Unlucky! One of the holes blocked by the glue
- Will repeat these steps and carry on (acrylic cells already made)

Cs coating test under vacuum



Glass covered magnet
Sealed Rb ampule

2/6/2008

nEDM Collaboration Meeting

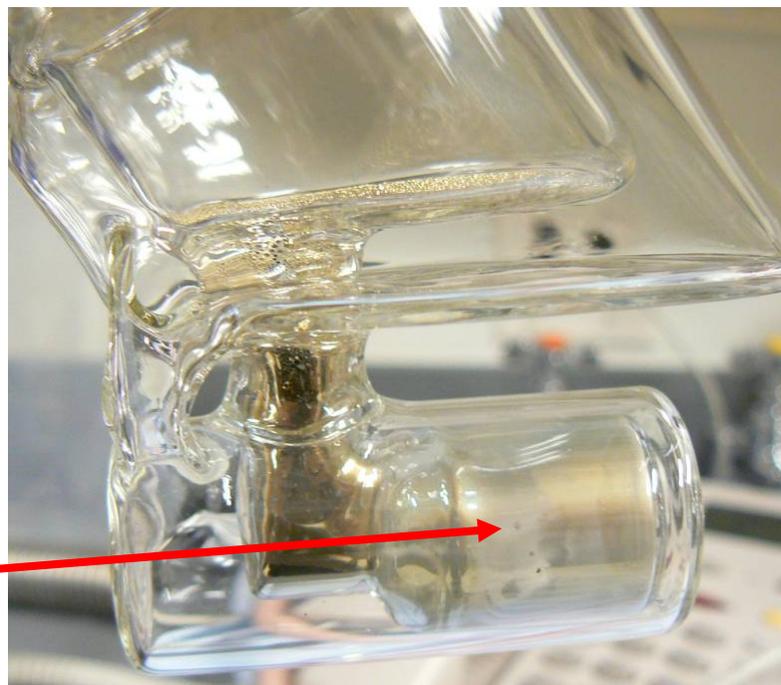
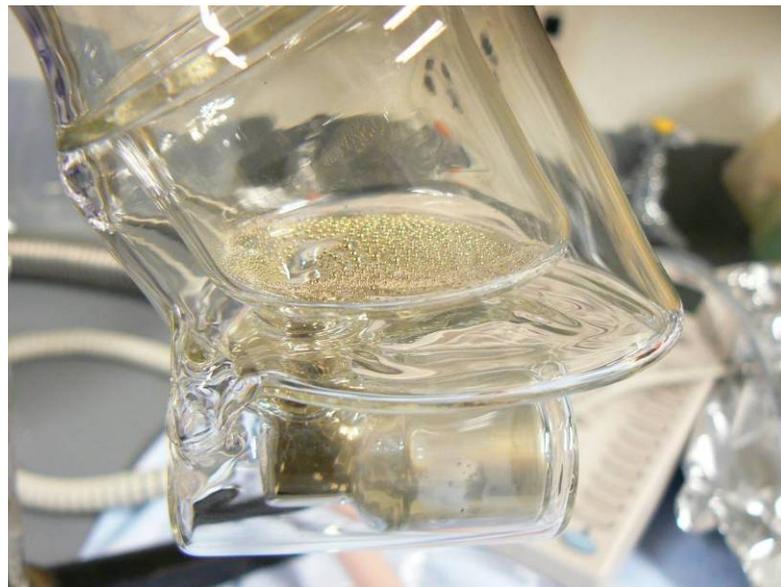
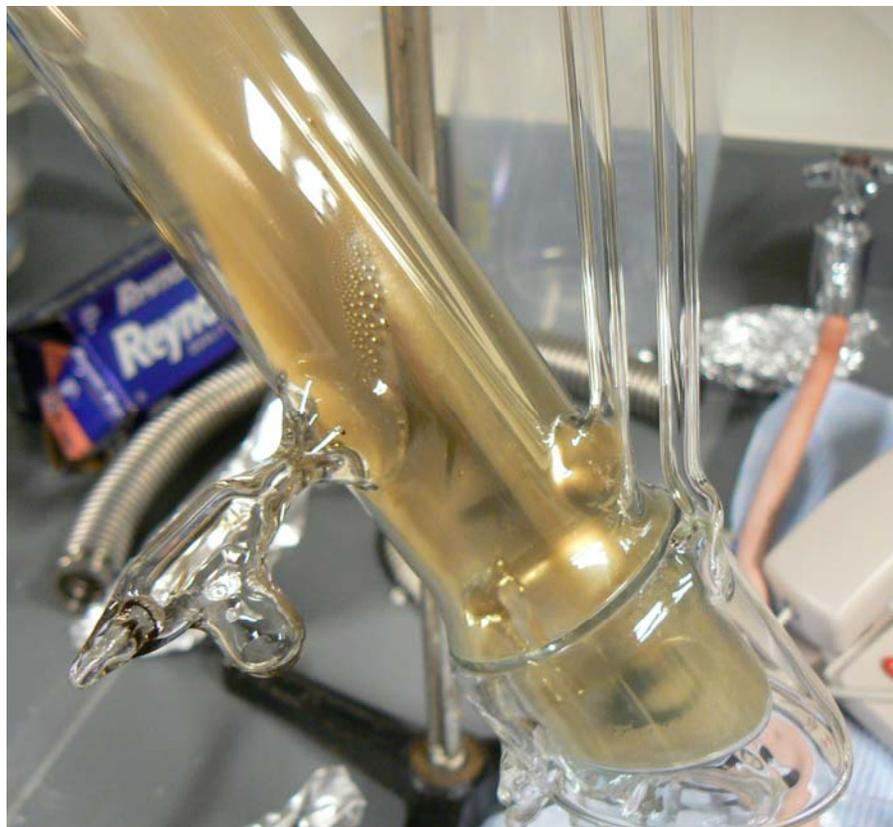
Chase Cs to the sink



2/6/2008

nEDM Collaboration Meeting

Coating result



**Collection volume
coated with Cs**

Future Plan

- Assemble apparatus
- Carry out relaxation time measurements over temperature range of 300-500 mK with the cell full of super-fluid ^4He
- Improve the NMR system
- Add gradient coils to study geometric phase effect

Thank you!