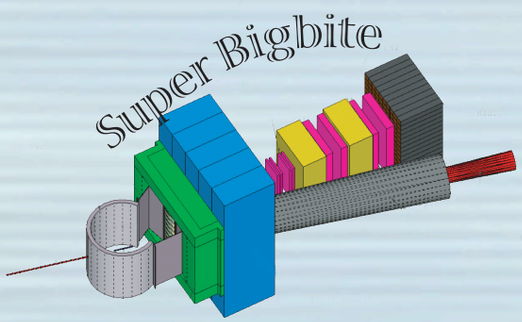
Polarized ^{3}He target update

- Status of the target for A1n
- Status of the target development for GEn
- Issues



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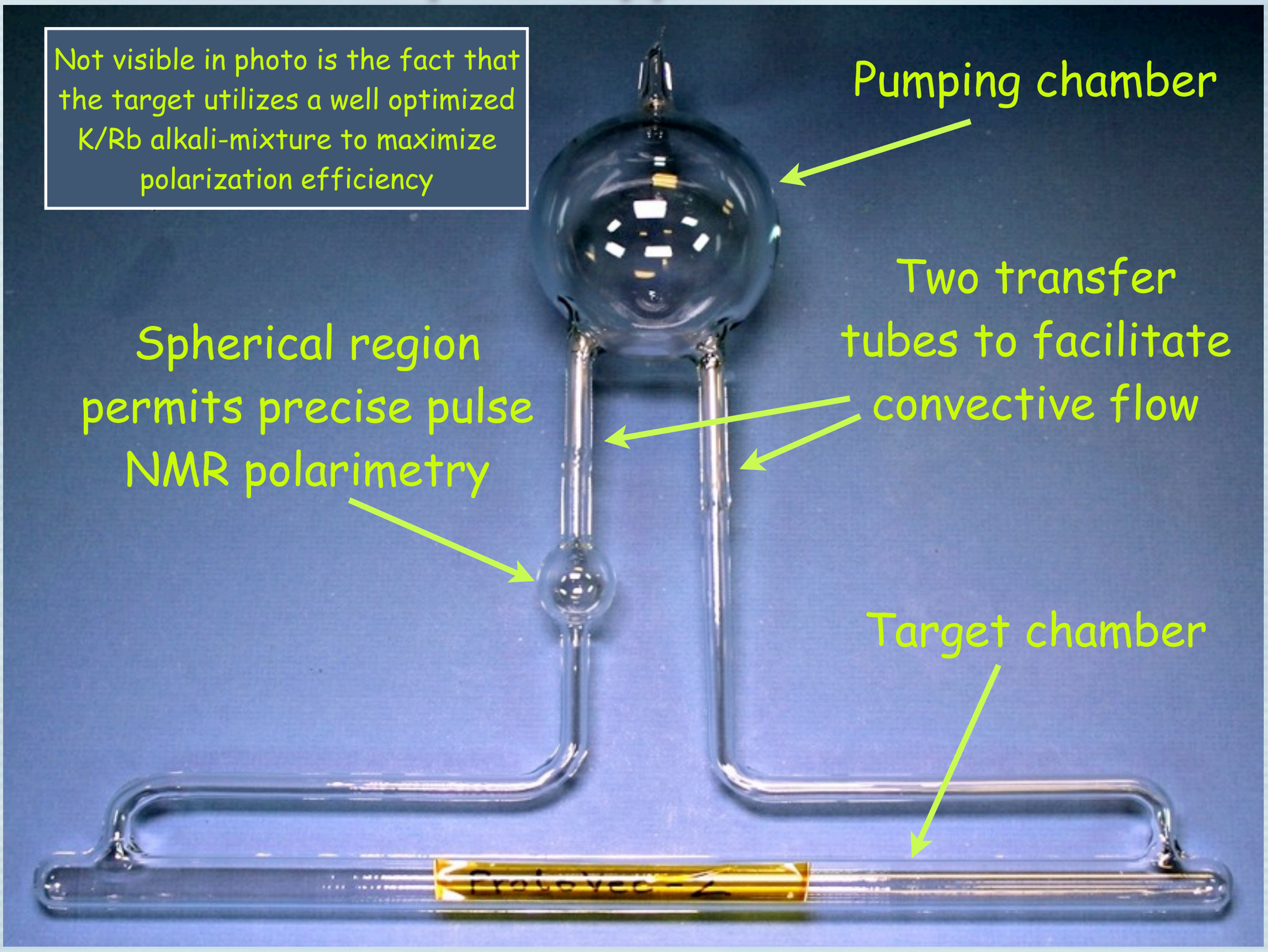
February 19, 2014

Jefferson Lab
EXPLORING THE NATURE OF MATTER

Status of the ^{3}He target for A_1^n

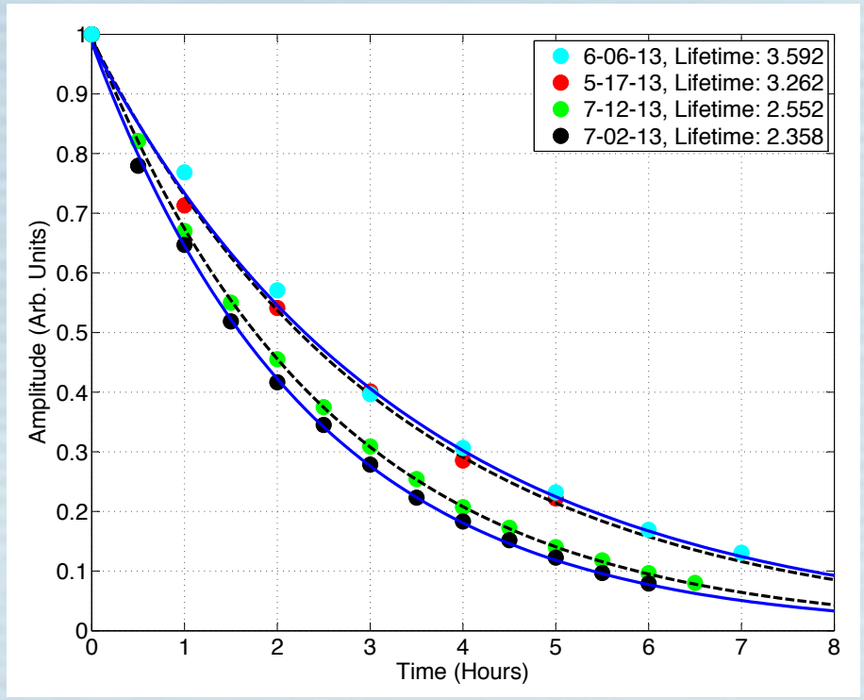
- Decision was made to use as much of the hardware from Transversity as possible.
- This approach can accomodate the "Protovec" cell design
  - Includes Convection
  - Size is slightly larger than the GEn-I cells
  - Target-chamber length of 40cm instead of 60cm as in the proposal.
  - Early bench tests suggest polarization should be at least 55-60% with planned beam current of 30 μ A
- Outstanding Concerns:
  - Using a glass end window with 30 μ A beam current is largely untested.
  - Some concerns remain regarding the magnetic field inhomogeneities of the Transversity Coils when using the larger Protovec design.
- Design of modification to the Transversity hardware are currently on hold.

Half-scale SBS prototype
full-scale prototype for Hall A A_1^n

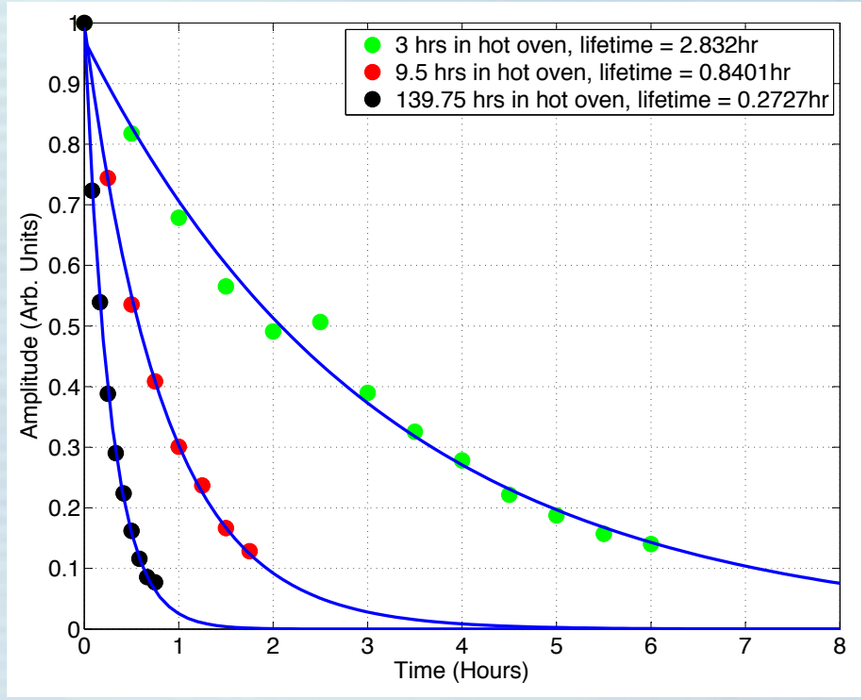


Previous end-cap development

Photo is actually of Goldfinger

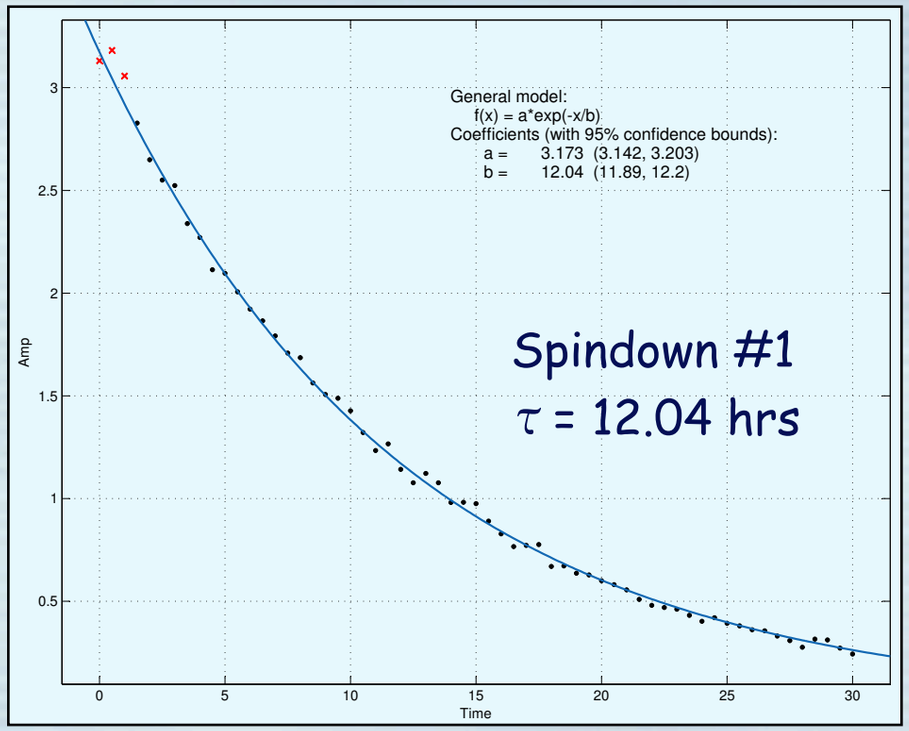


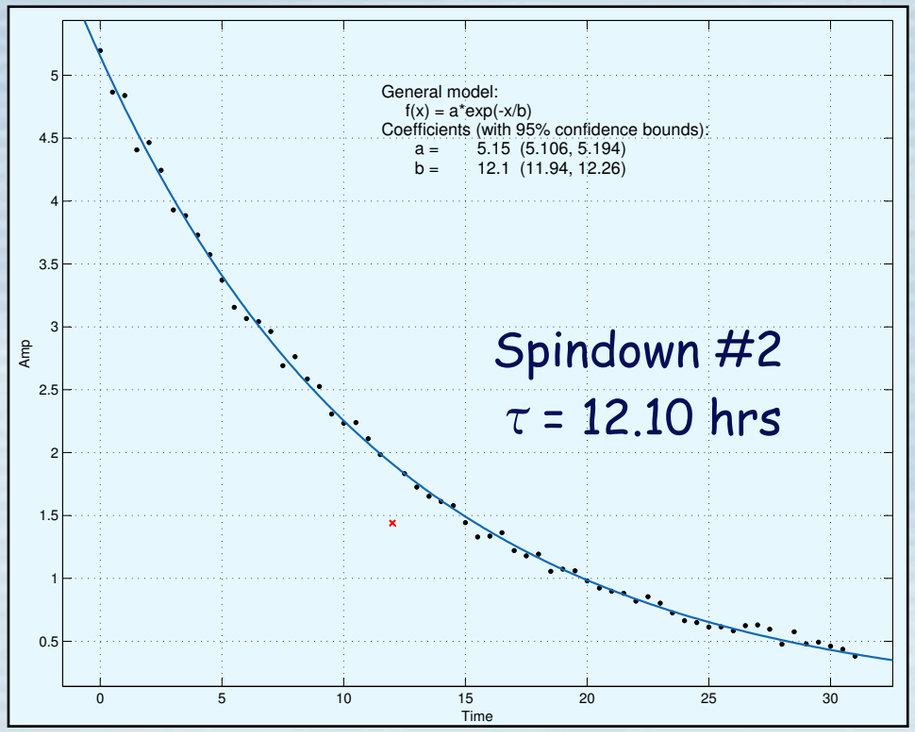
Goldfinger, gold-coated copper, showed lifetimes degrade from 3.6 hrs to 2.4 hours, but we suspected that it started out much longer

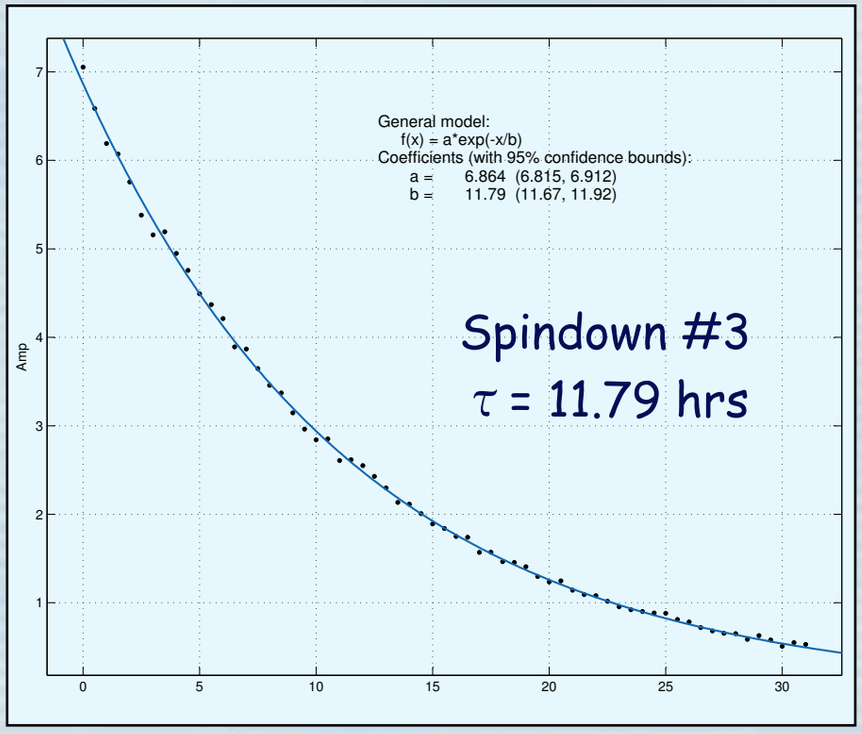


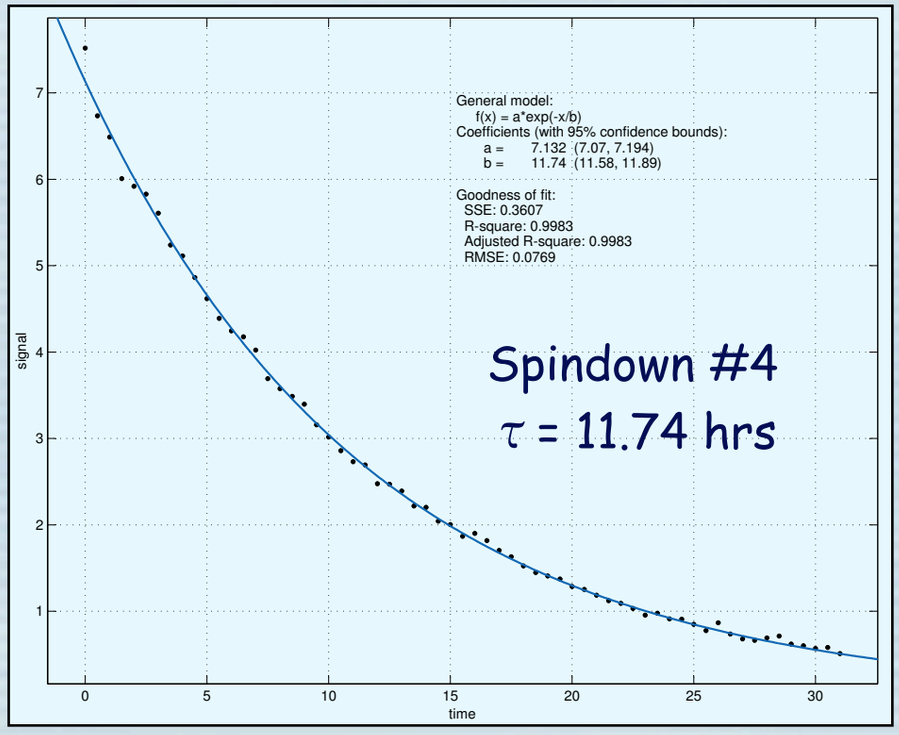
Cupid, copper-only, showed lifetimes degrade from 2.8 hrs to 0.3 hours. This test reinforced our belief that Rb exposure was seriously degrading our surfaces.

Tests of "GoldRush"



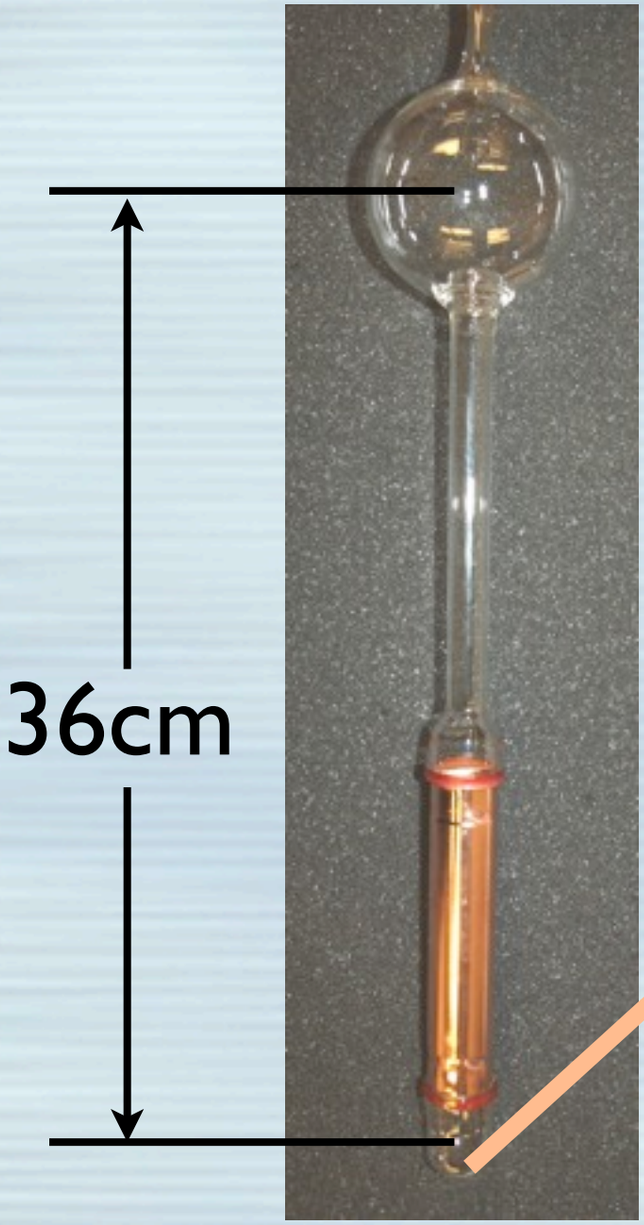


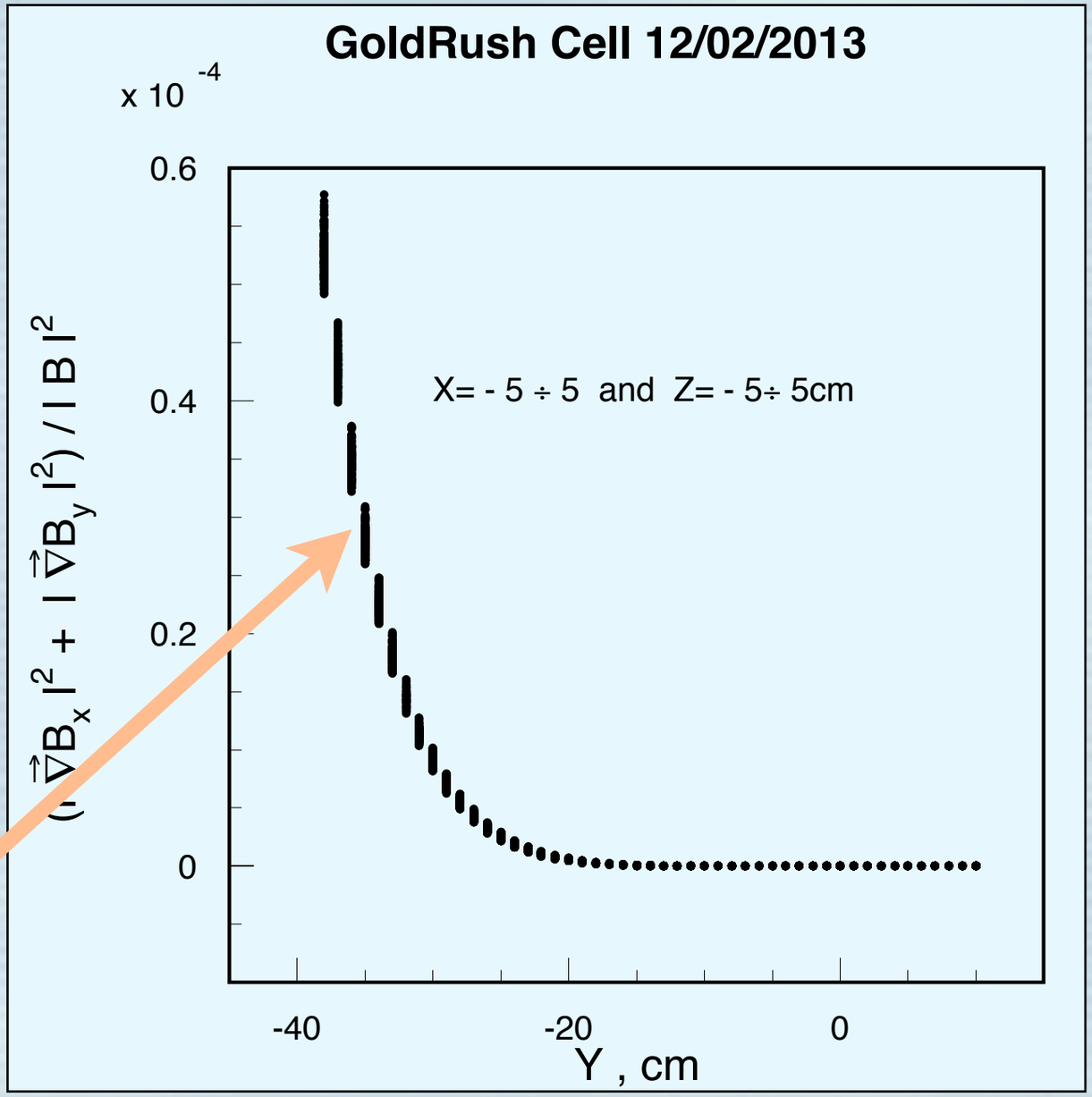




No serious degradation of lifetime was observed over four spin downs

Calculations indicated lifetime of "GoldRush" was at least partially limited by magnetic field inhomogeneities

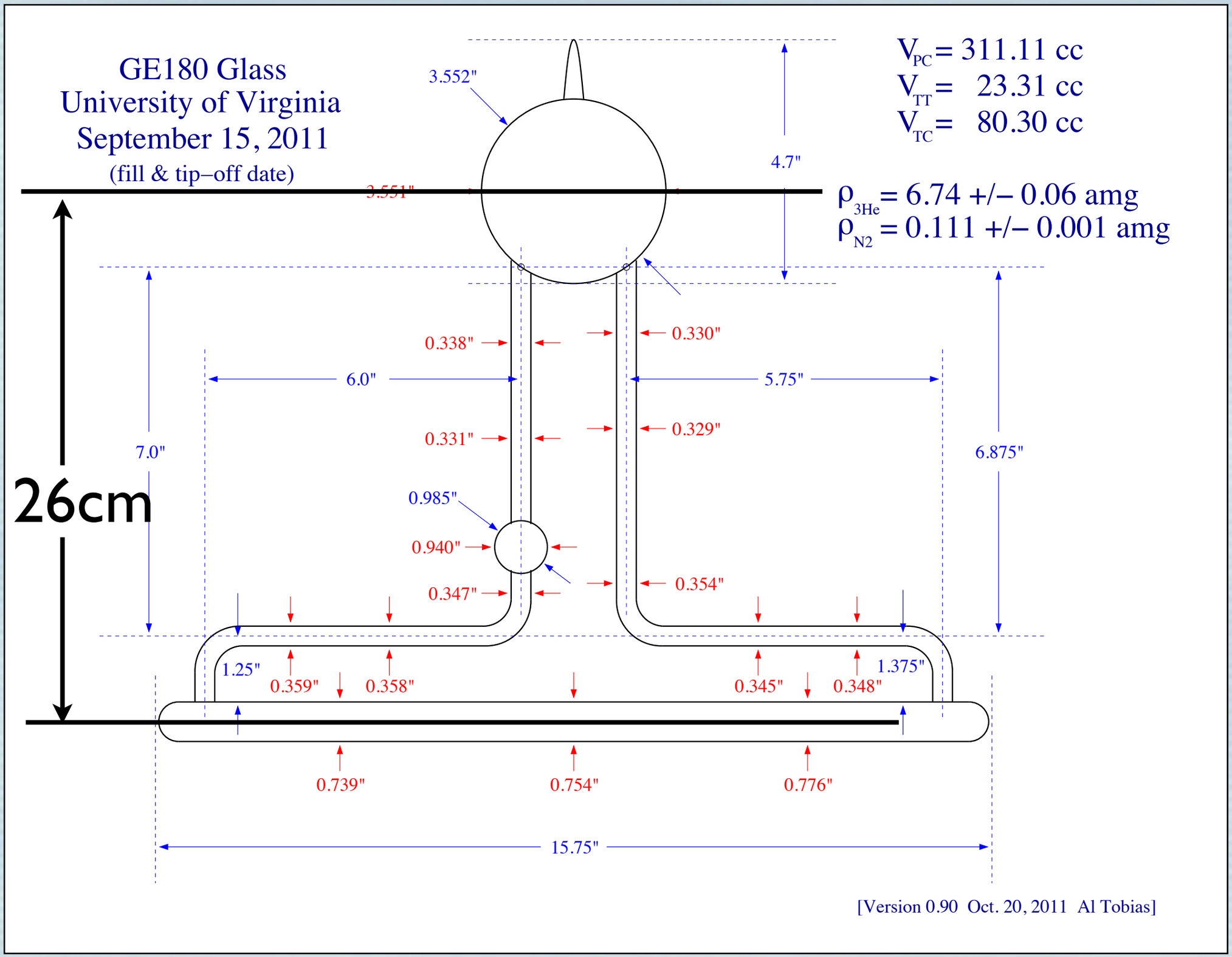




Lifetime at bottom of cell is around 4.6 hours (note, pressure is much lower than a target cell).

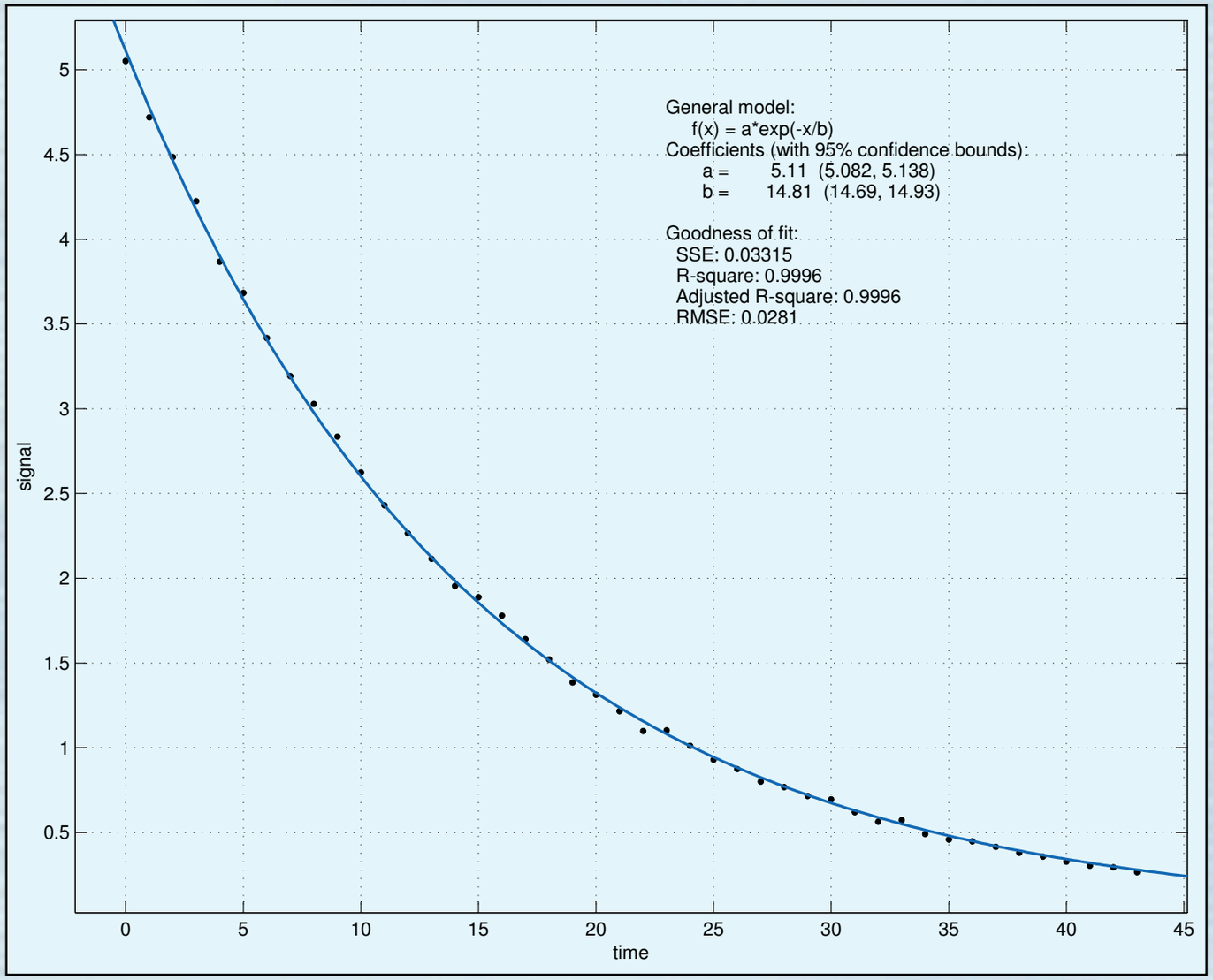
While a serious limitation for our metal-cell tests, the effect will be ~10 times less severe in targets. Still, it is not negligible

Existing, tested prototype: Protovec I



If we extended Protovec's height by as little as 10cm, the target chamber lifetime would suffer ~1/40hr relaxation from inhomogeneities.

Repositioning "GoldRush" improved the lifetime!



- Repostioned cell upwards by ~7 cm
- Lifetme improved from around 11 to roughly 15 hours.
- When adjusted for polarimetry losses, τ = 17 hrs .
- Intrinsic lifetime is probably better!
- What does this imply?
  - Assume ALL relaxation is due to metal surface.
  - Assume endcaps would have cumulative area half that of existing metal surface.
  - Protovec I would experiencr a contribution to wall relaxation of Γ = 1/49 hrs
  - G_E^n-style cell (double chambered) would experience a contribution to wall relaxation of Γ = 1/100 hrs.

GoldRush provides a proof of principle for incorporating metal end caps.
Also, note the clean polarimetry achieved using pulse-NMR.

Status of the ^{3}He target for G_E^n

- Basic target-cell technology appears to be shaping up.
  - Need double-chamber cells, not yet demonstrated.
  - Need metal end caps, not yet demonstrated.
  - Need 60cm target-chamber length.
  - Will need pulse-NMR polarimetry, already routine in our lab.
- Clearly need to start building and testing prototypes.
- Recent magnetic field calculations show significant field in the target area.
- Lots of work remains on both the target-cell and hardware side.