Antiproton Source Department

Unfilling Collection Lenses

Tony Leveling

1/01

The Path To a High Gradient Collection Lens

- Where are we now and where are we going?
  - T. Leveling
  - 12/12/00

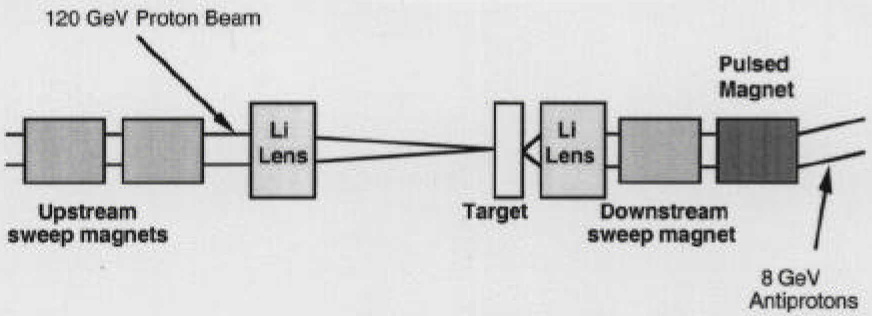
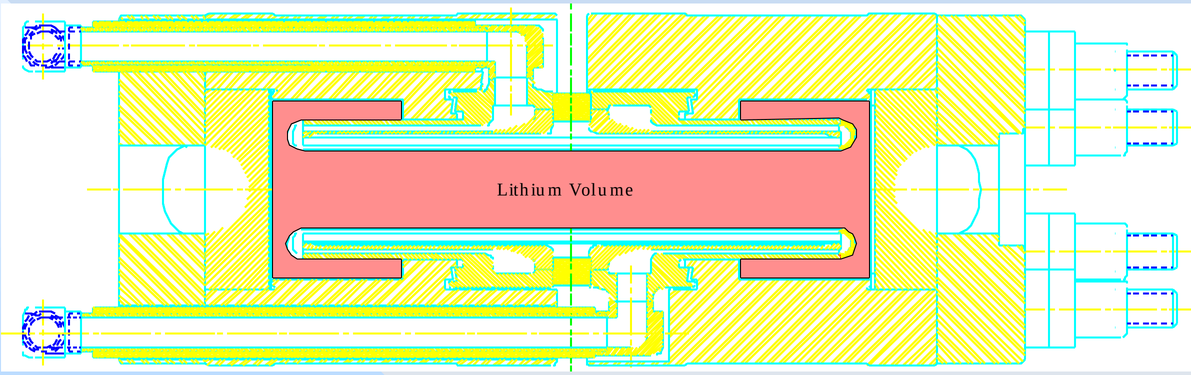


Figure 3.5. Components in the target vault of the upgraded target station. The pre-target SEM and the beam dump are not shown.


Lithium Volume

Run II Goal for Target Station

Increase surface gradient of collection lens from 7.5 to 10 Tesla

What does Gradient Improvement buy us?

- 35% increase in pbars making it into the AP2 line
  - assuming increase from 7.5 T to 10 T
  - based upon measurement!

What do we have to gain?

pbar yield increases linearly with gradient

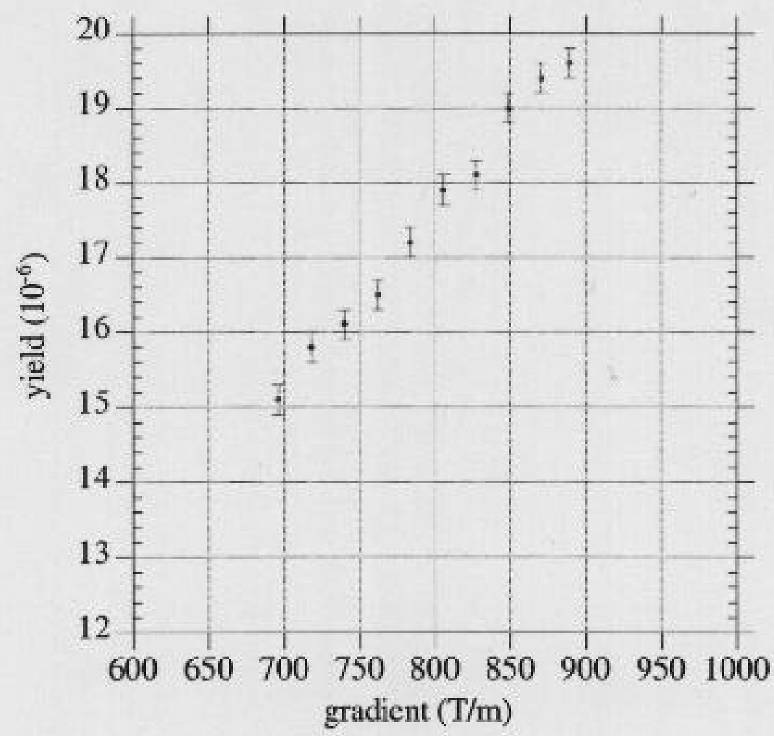


Figure 3.7. Measured yield vs. lithium lens gradient

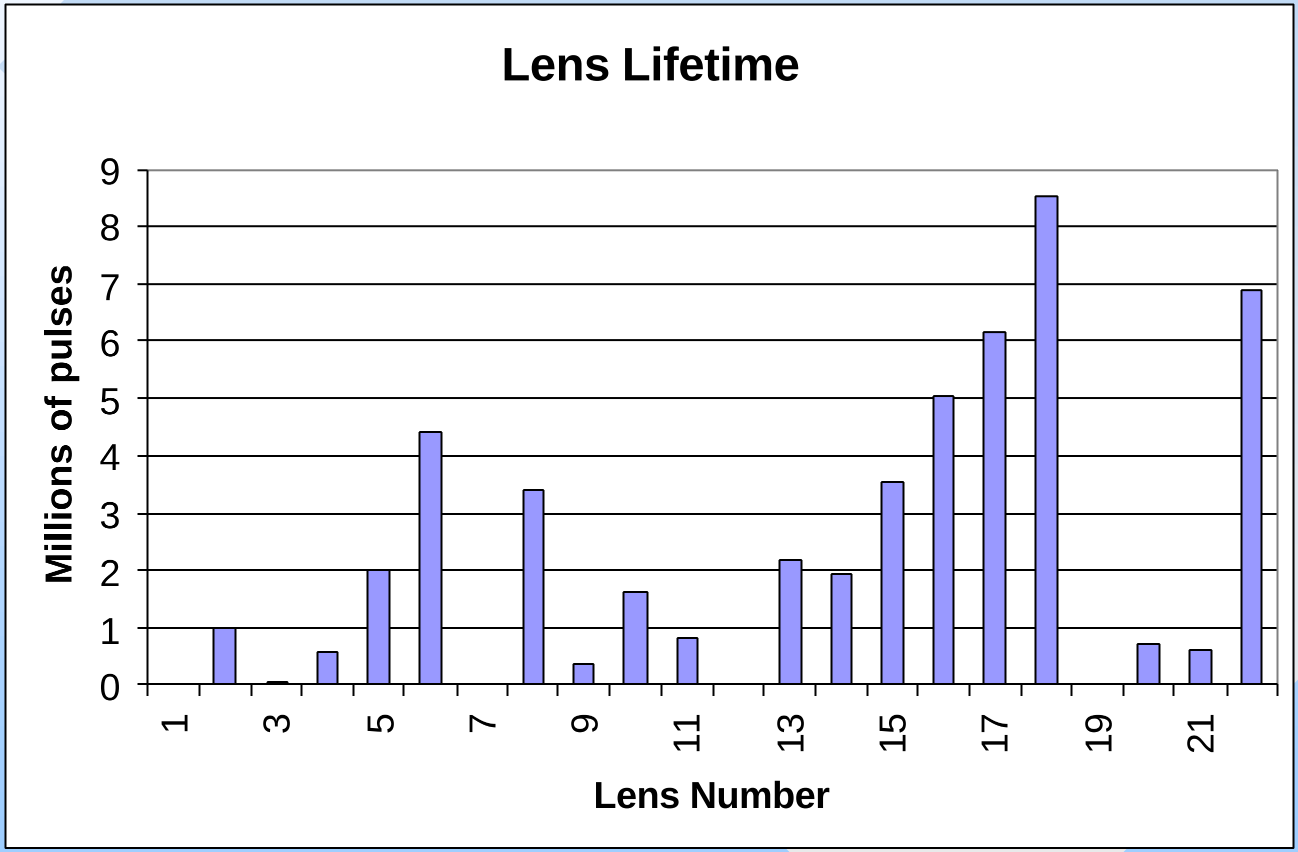
Research in two directions

- Solid Lens Gradient Improvement
  - Work being done by Fermilab
- Liquid Lens R&D
  - A collaboration between FNAL and BINP
  - Work primarily by scientists at Novosibirsk
  - Funding and oversight by FNAL (DOE)

Solid Lens Technology

- Initial Design was for 10 Tesla
- Reliable at about 7.5 Tesla
  - Some of the time (test stand operation at higher gradient is probable lens killer)
- Reasonable operating life for 1 in 3

Lens History



Solid Lens Improvement Goals

- Short term goal (1st quarter 2001)
  - produce reliable 7.5 Tesla Lenses
  - target is 5E6 pulses per lens
  - sufficient number of them for 3E7 pulses
- Long term goal (2nd quarter 2002)
  - produce reliable “10 Tesla Lens”
  - In time for Run IIb (2003)
  - target is 5E6 pulses per lens
  - sufficient number of them for 3E7 pulses

Solid Lens Improvement Efforts

- Reengineer Current Lens Building Process
- R&D of New High Gradient Lens
- Investigation of Current Design
  - FEA of current lens design
  - Failed lens autopsy

Failures during fill or on test stand (non-radioactive)

- Postmortems are done on these lenses
- Types of failures noted
  - axial tube splitting (high gradient testing)
  - end region welds (questionable weld quality)
  - arcing (fill procedure)

Failures after short or long service life (radioactive)

- Titanium breach between Li and water
- Examinations have never been pursued
- We intend to do postmortems on four of these in 2001
  - two with short service life
  - two with long service life

Candidate Lenses

Lens number	Removed from service	Total beam pulses	Average intensity per pulse	Total beam intensity (protons)	Tritium inventory (Ci) [ref 1]	Tritium inventory (Ci) [ref 2]
16	10/92	3,200,000	2E12	6.4E18	4	0.9
17	3/93	5,146,131	2E12	1E19	6.25	1.4
18	4/94	7,870,738	2E12	1.6E19	10	2.3
21	6/95	299,000	3E12	9E17	0.56	0.13
22	11/95	194,484	3E12	6E17	0.38	0.09

Unfilling Methodology

Procedure documented in draft pbar note

- Phase 1 - melt/remove lithium from lens body
- Phase 2 - remove/react remaining lithium in lens body
- Phase 3 - burn hydrogen gas and collect water vapor

Safety Considerations

- Lithium metal handling (hi temp liquid)
- Reactive metal (Li/water)
- Hydrogen gas production (8 to 9 liters)
- Environmental Releases (tritium)

Trial Operation Ongoing at Materials Lab

- Test Phase 2 gas collection apparatus
- Test Phase 3 hydrogen burn and water vapor collection

ES&H Equipment Support

- Tritium gas analyzer (Triton) calibration
  - in air
  - in argon

Unfilling Project Schedule