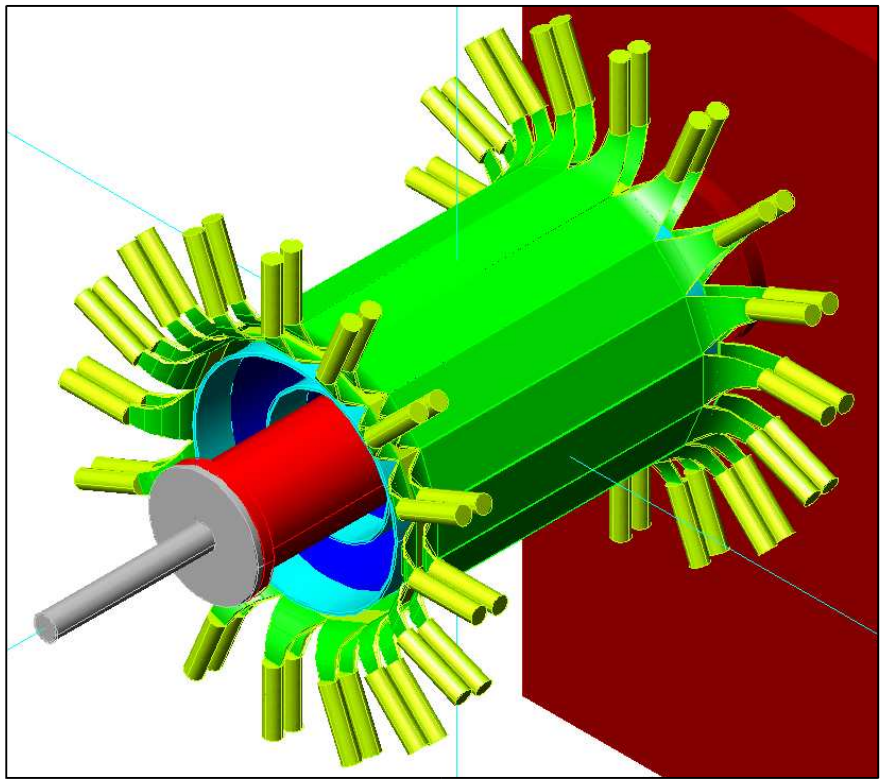
MuCap Run8 Systematics "Report"



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UC Berkeley Physics

MuCap Analysis Meeting
UIUC, Illinois
May 2-3, 2005

Overview

All of the following have the potential to generate distortions to the muon lifetime:

- Impurities
  - Deuterium
  - High-Z
- Molecular formation effects (lambda_op)
- Electronics misbehavior (CAENs!)
- MuStop (mis)identification
- Electron (mis)identification
- mu+SR

Impurity Correction: Deuterium

Peter's descriptions of deuterium correction methods:

1. "Deuterium Effects in MuCap," MuCap Note #29 (2003)
   http://www.npl.uiuc.edu/exp/mucapture/notes/deuterium03.pdf

2. "Deuterium Effects in MuCap, Update04." (2004)
   http://kaon.physics.berkeley.edu:8080/run8/1014
   http://kaon.physics.berkeley.edu:8080/analysis-run8/1

3. "Deuterium Correction." (2004)
   http://kaon.physics.berkeley.edu:8080/run8/876
   (Note: Peter handwrote a "Rosetta Stone" to explain this "Deuterium Correction" document, but I can't find it online anywhere.)

4. See also some of Peter's presentations (e.g. Gatchina talk).

5. Location of the "Deuterium Studies" mathematica notebook?

Impurity Correction: Deuterium

We need to study impact cut effects for both mu- and mu+ lifetimes, and compare. Help from MC (Brendan and Peter) would be tremendously appreciated.

Impurity Correction: High-Z

Peter's descriptions of impurity correction methods (along with some other relevant items):

1. “Simple Purity Estimates.” (Sept. 3, 2003)
   http://kaon.physics.berkeley.edu:8080/run7/380 & 384

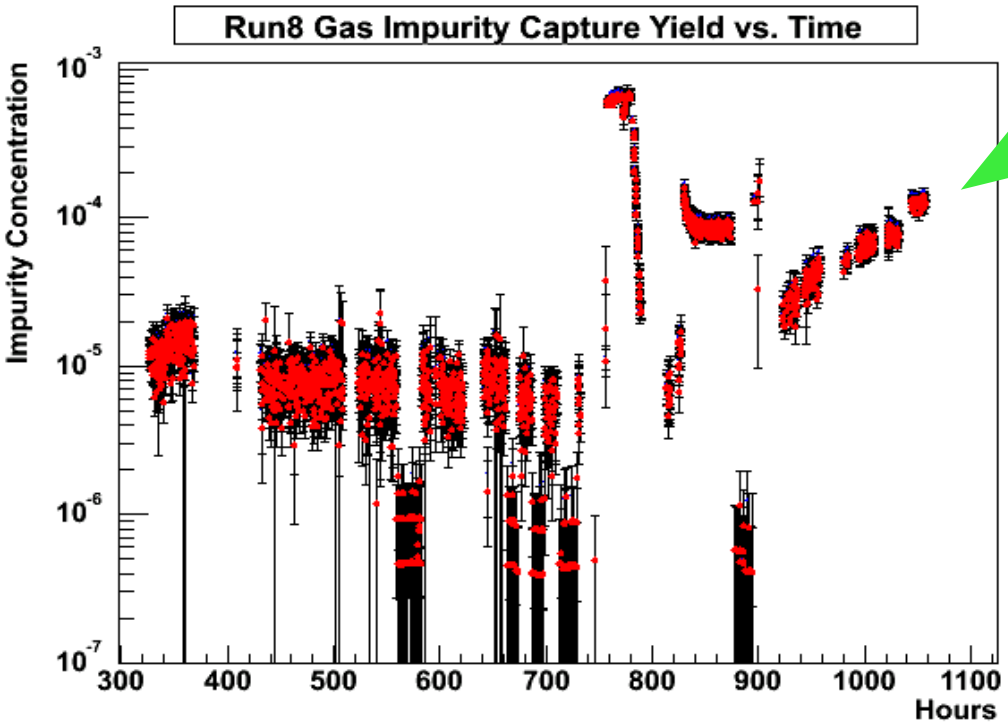
2. “Hydrogen Impurities in MuCap.” (Oct. 6, 2003)
   http://kaon.physics.berkeley.edu:8080/run7/591

3. “Hydrogen Impurities in MuCap 04” (Oct. 20, 2004)
   http://kaon.physics.berkeley.edu:8080/run8/613

3. “Dubious Event Classes.” (March 9, 2005)
   http://kaon.physics.berkeley.edu:8080/analysis-run8/31

Impurity Correction: High-Z

In order to apply the appropriate high-Z impurity correction, we need to reach some decisions about the impurity content during Run8. Existing measurements are inconsistent (see the impurity presentation).

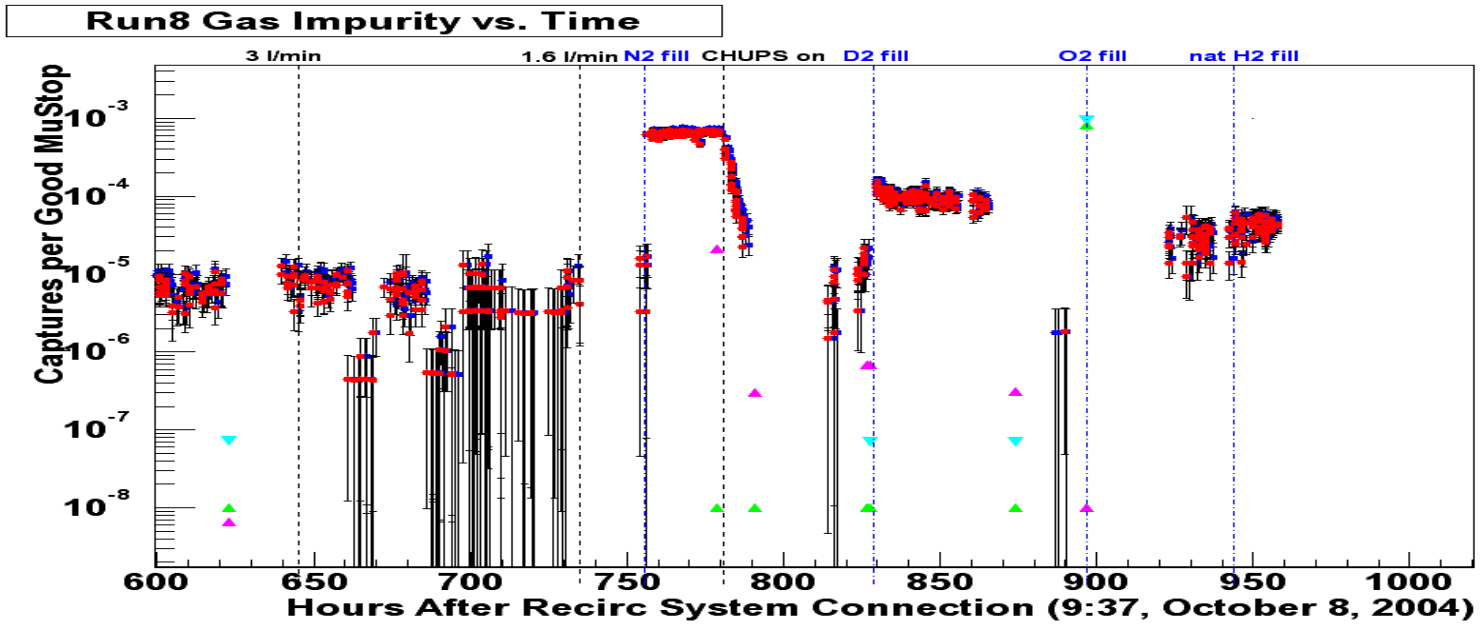


Incidentally, we now have impurity points from the H20 fill. I don't think these were available before.

Impurity Correction Concerns

- Validity of these correction techniques in general, and for the Run8 conditions in particular? For the high-deuterium concentration in the Run8 nat. H2 fill (> 100 ppm?), is it acceptable to fit for an effective lifetime?

- Are the impurity and deuterium corrections “orthogonal”? Both the D2 and nat. H2 run8 calibration fills had elevated high-Z concentrations—could that hamper deuterium correction efforts?



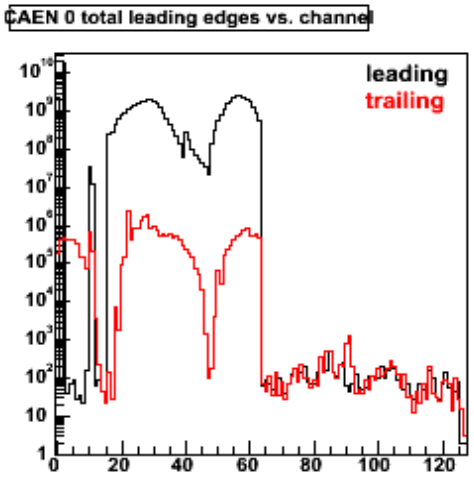
Molecular Formation Effects

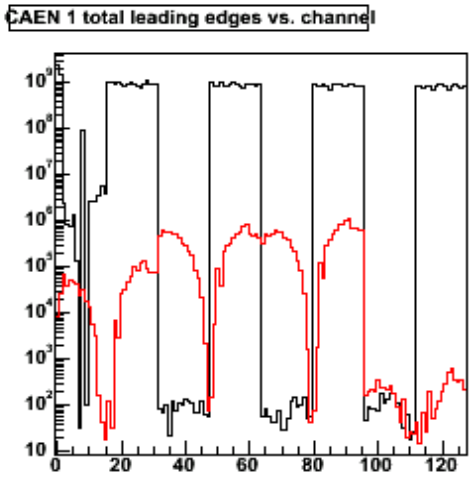
MuCap's 1996 proposal discusses lambda_op effects in detail, and mentions that it might be necessary to fit over the limited interval 0-10 microseconds in order to avoid distortions. Subsequent MuCap documents only mention that molecular formation is suppressed under the MuCap operating conditions—note that the 2001 TP's systematics table lacks a pp-mu entry. So how significant are the molecular effects? Is a correction necessary?

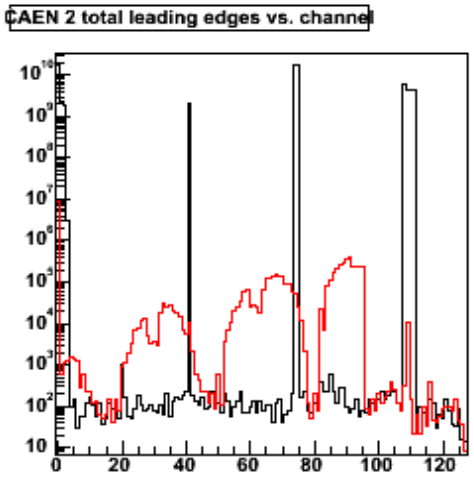
This is new territory for me and I haven't spent much time working on it yet.

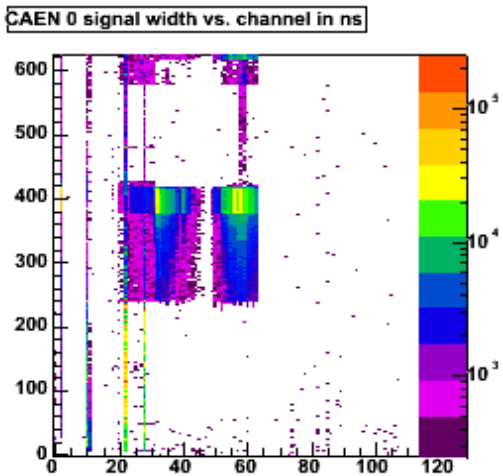
Electronics

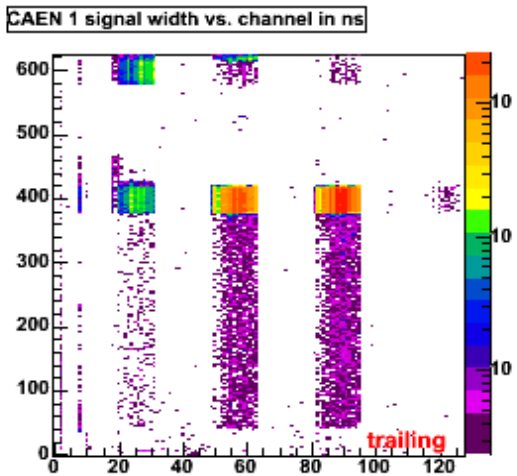
CAEN stability? We need to eliminate blocks which contain trailing edges. How much of the data is affected? Does it happen in spurts?

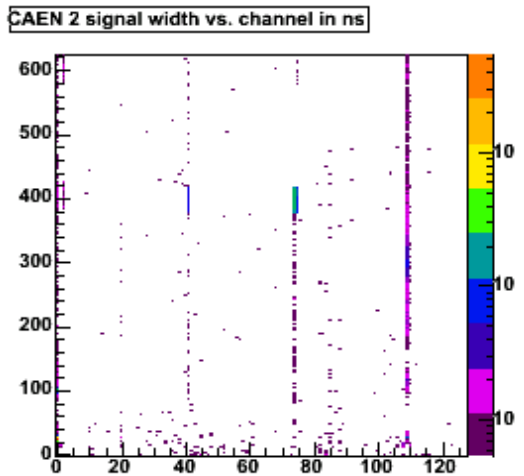






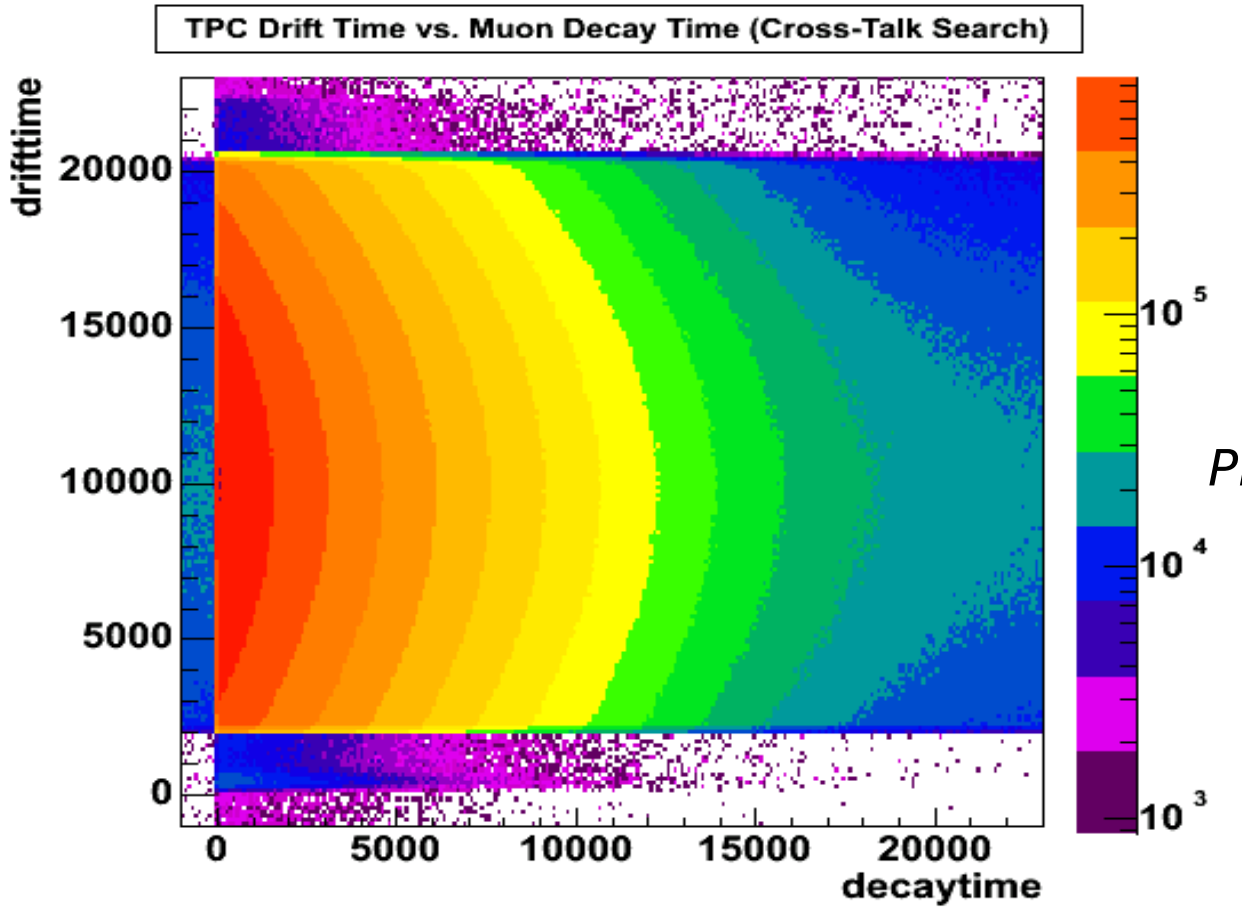






Electronics

Some good news: No evidence of any cross-talk between the TPC and electron detectors, which would show up as a diagonal enhancement in the plot below:



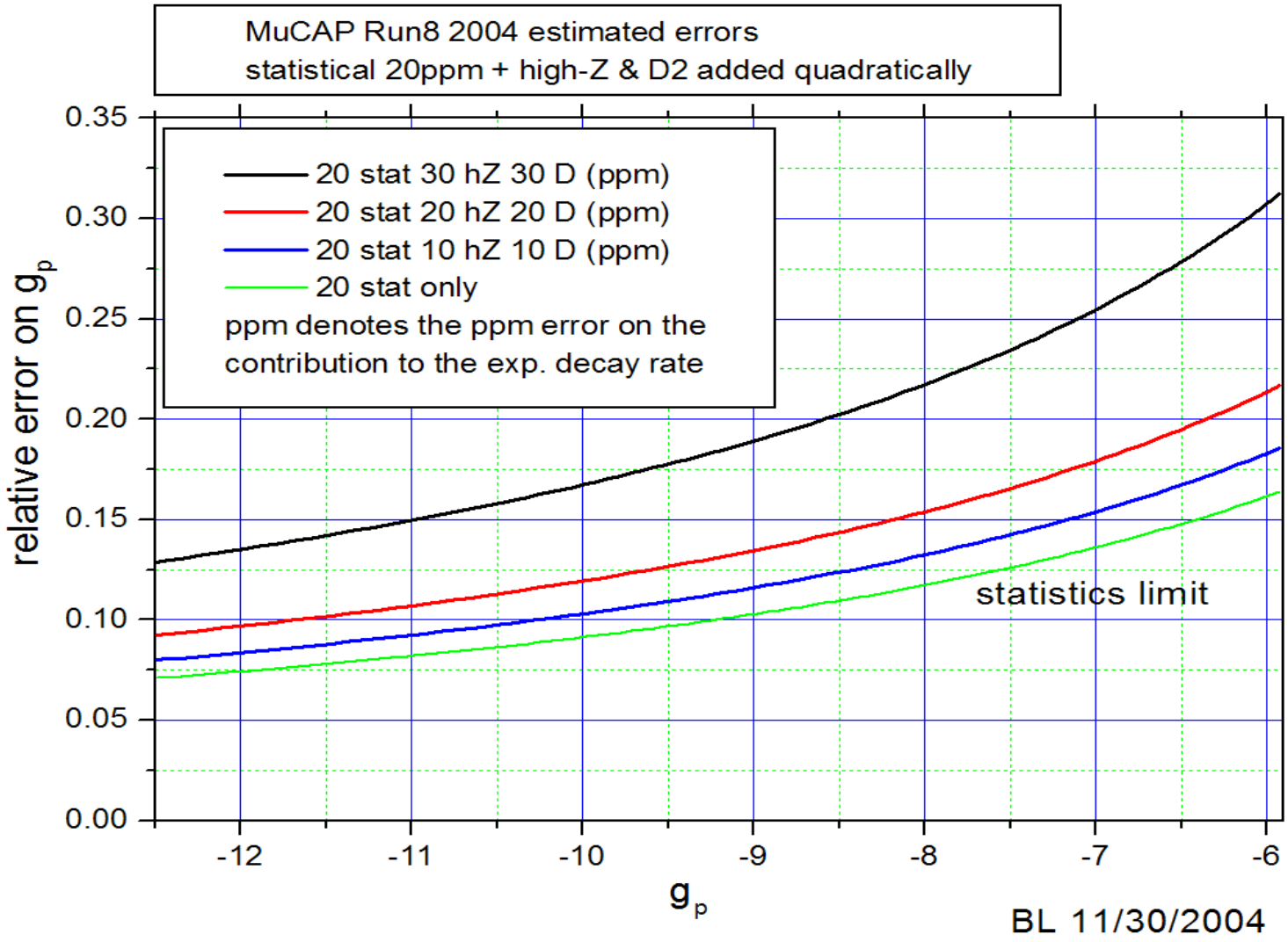
(From Run8 analysis pass0 Prod-50-mu-.root)

Mustop Identification

- We need to better understand the TPC drift distribution = more accurate spatial mustop reconstructions.
- Lifetime histograms for different fiducial cuts, in order to study mu-p drift effects?
- 50 MHz beamline RF: just avoid by rebinning?

Electron Identification

- We need to study the newly-discovered decay electron showers: what's responsible, how does it affect our lifetime distribution, and what should we do about it?
- Deadtime effects, especially for ePCs: How do they affect the lifetime? Can they be reduced? Would it help to use different detector combinations (say, ePC anodes + one cathode plane only)?

Impurity Errors

Run8 error estimates, courtesy of Bernhard: