Muon System Production Monitoring and Quality Assurance

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Motivation

In the process of constructing the muon detector, we want to be able to determine, at a much later date, what was done

Of course we need to make sure the detector is built properly too, so we need to measure and archive lots of variables:

- ASDQ properties (supplied by vendor)
- Sources and specs. of all materials
- Measurements of tubes
  - Tension of wire
  - Current draw
  - Efficiency (cosmic rays)
- Interrelation of building blocks (which tubes are in which plank, octant, etc.)

Also, provide easy access to data (often overlooked)

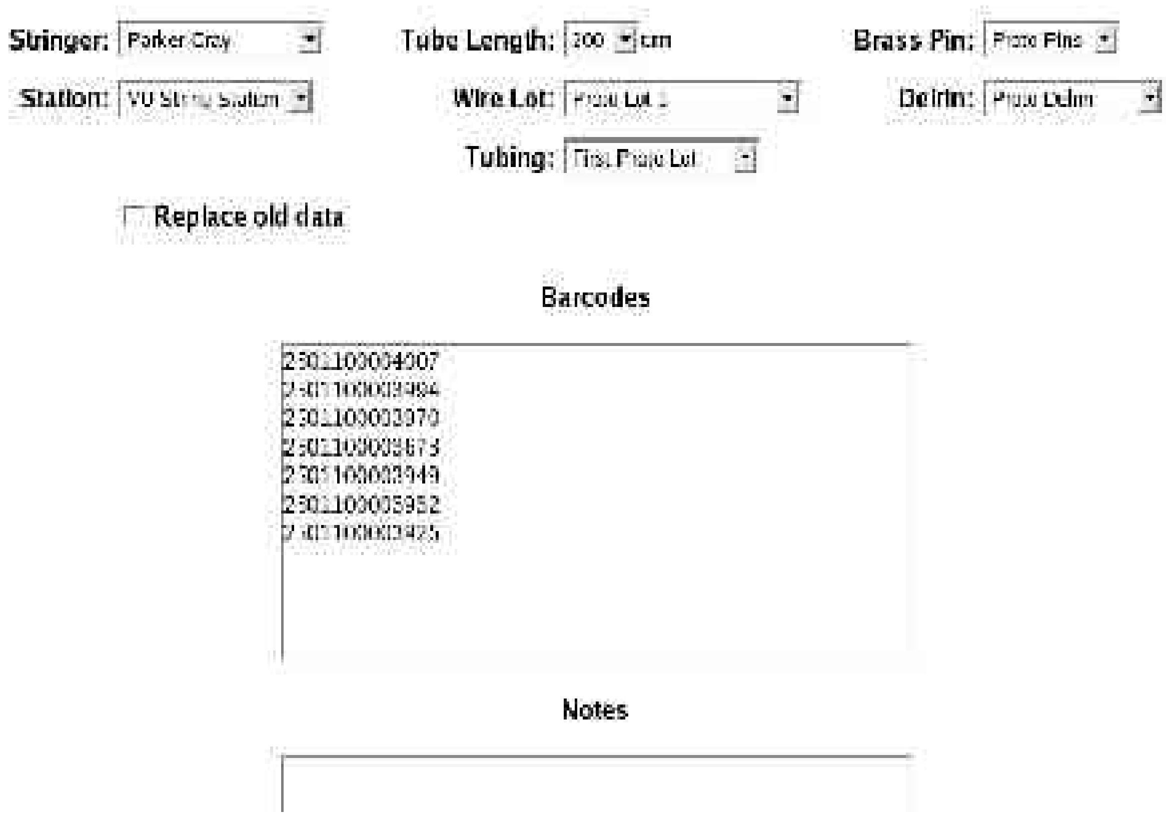
Production Database

We've constructed and are still working on a data management system to do this

- All information stored in a central database (from all 3 construction sites)
- WWW access to view (plus Perl/C++ access for analysis and calibration code)
- Entry of data via:
  - GUI for test stands with DAQ
  - WWW forms for construction data
  - Text file processing (*e. g.*, ASDQ)
- Every element will be barcoded

Major progress was made this summer by Vaandering and undergraduate Parker Gray

Web Form for Stringing



Can see we are tracking sources of materials and individuals doing the work

Web Form for Plank Assembly

Plank Serial Number: 25011000039[illegible] **Assembler:** John Fellenstein **Station:** Test Station

☐ Replace old data

Tube Serial Numbers

0	2501100003918	1		2	2501100003925	3	
4	2501100003932	5		6	2501100003949	7	
8	2501100003956	9		10	2501100003994	11	
12	2501100003987	13		14	2501100003970	15	
16	2501100003963	17		18		19	
20		21		22		23	
24		25		26		27	
28		29		30		31	

Notes

Tension Measurement

We measure the tension of each wire, both to make sure it is constructed properly before assembly into a plank and again to make sure the wire is not slipping.

- Oscillate wire in magnetic field, look for feedback at resonant frequency. Tension calculated from *f*, L, and mass.
- Have rebuilt our old test stand.
  - Better, faster DAQ. Still tuning speed for production.
- Will be able to do a single tube, a batch of tubes, or a complete plank
- Same test stand measures current draw vs. for each tube before assembly

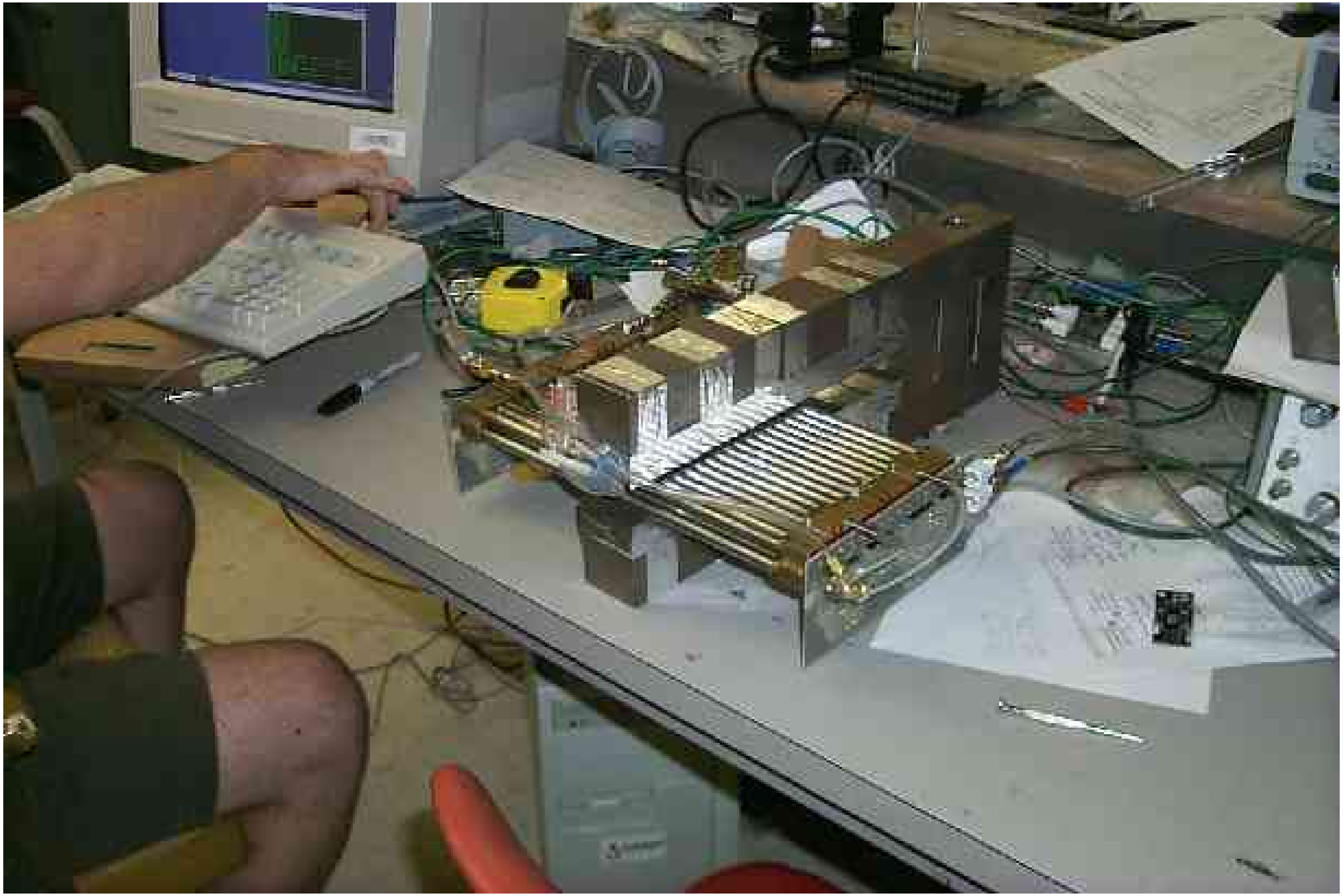
Costs for Tension Test Stand

Based on the prototype test stand we've built, we estimate the following approximate costs:

• PC with Monitor	$1000
• DAQ Card, connectors	$900
• High quality power suppy	$500
• Function Generator	$300
• Bar Code Reader	$300
• Interface electronics (minimal or in hand)	$0
• HV Power Supply – FNAL Prep	$0
Total Tension and HV test stand:	~$3000

Need four complete test stands (1/Institution, 1 additional)

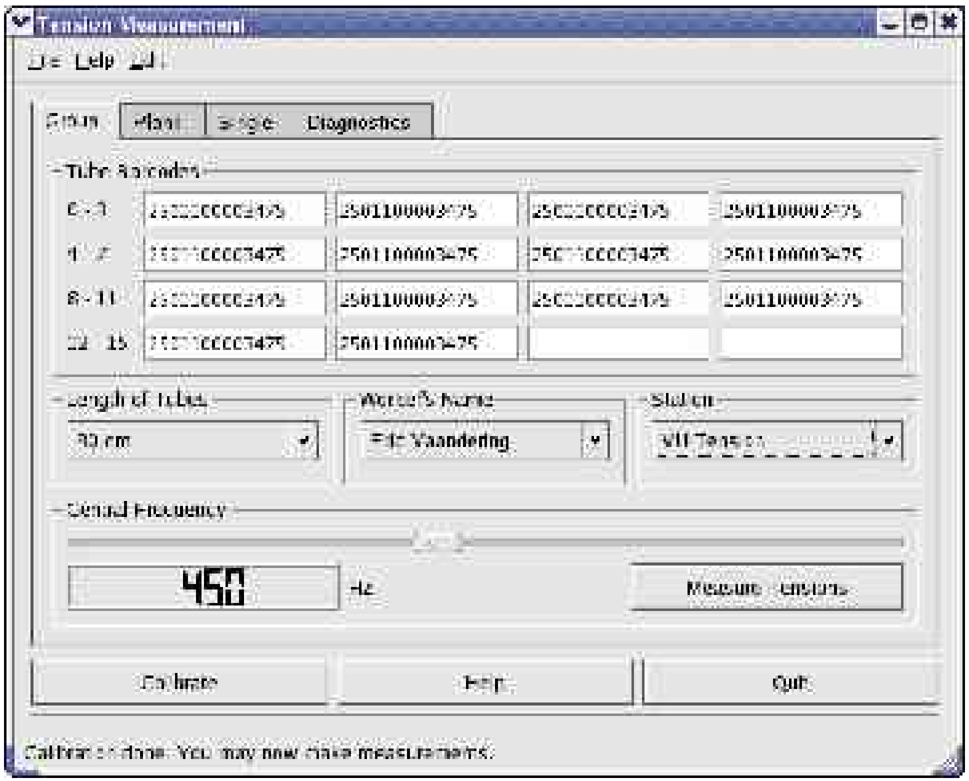
Tension Test Stand

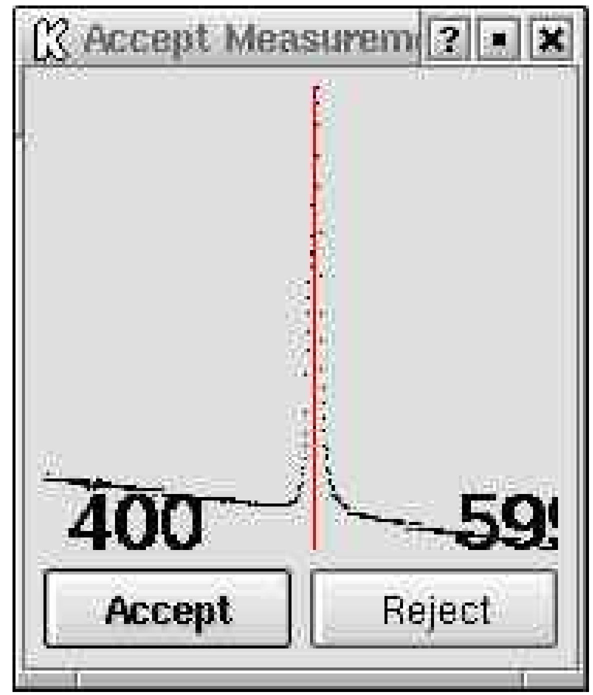


New Tension/HV Board

Tension Measurement

UI to measure tension and resonance peak for confirmation





Octant Test Stand

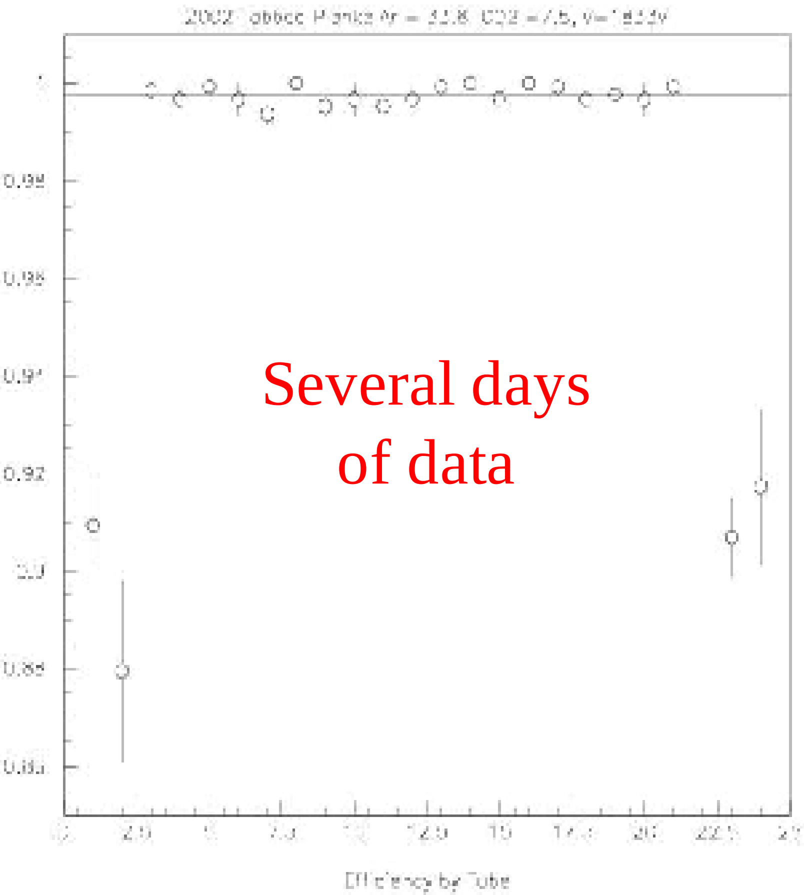
Before shipping Octants to FNAL, we want to verify system works together as a whole. We've budgeted four test-stands to verify functionality. (1 proto-type, 1 each for Illinois, Vandy, and Fermilab). Test at FNAL on arrival.

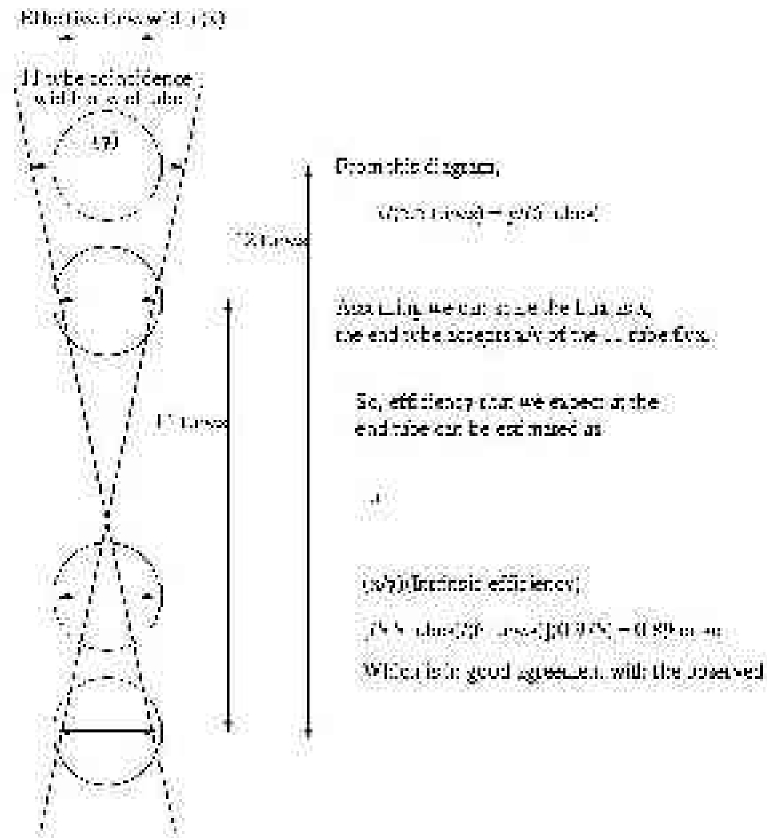
We want this test stand to be as close the real experiment environment as is feasible:

- Same HV, LV as in experiment (at very least, the same LV and connectors)
- Hanging fixture
- Cosmic Ray triggers, fake clocks
- Gas System (probably use premix, but need gain monitoring, filtering)

Efficiency with Cosmic Rays

Hanging tests allow us to determine efficiencies from cosmic rays





Octant Test Issues

- What are the testing specifications?
- Do we need a mass spectrometer for each octant test stand? (We'll soon have a better way to analyze the gas, and we' ll have test beam results and outgas study results.)
- Costs / test stand:
  - High Voltage System
    - SY 2527 Mainframe $10,348
    - Branch Controller $1,086
    - Remote Chassis $1,214
    - A3535 Unit $7,925
  - Low Voltage Power $400
  - LV/HV Cables $500
  - DAQ (Maybe DCB) & Slow control ~$3,500

Total: $24,973 ($25K in costbook) times 4 stands

Conclusions

- In the end, we will have all the information gathered during the construction phase gathered in one place
- All tubes and larger detector elements will be tracked with bar codes
- Will allow us to do correlations if problems arise (*e. g.*, a bad batch of wire)
- Easy access to data is key