DAQ and Regression Analysis

Bryan Moffit

College of William and Mary

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HAPPEX DAQ - Input Signals

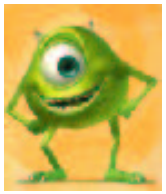
Device	*Signal Type*	*Number of devices*	*Total Required Channels*
Stripline Position Monitor (BPM)	Voltage	7+	28+
Cavity Position Monitor (BPMCAV)	Voltage	3	15
Beam Current Monitor (BCM)	Voltage	3	3
Battery (BATT)	Voltage	4	4
Luminosity Monitor (LUMI)	Current	12	12
Detector (DET)	Current	4	4

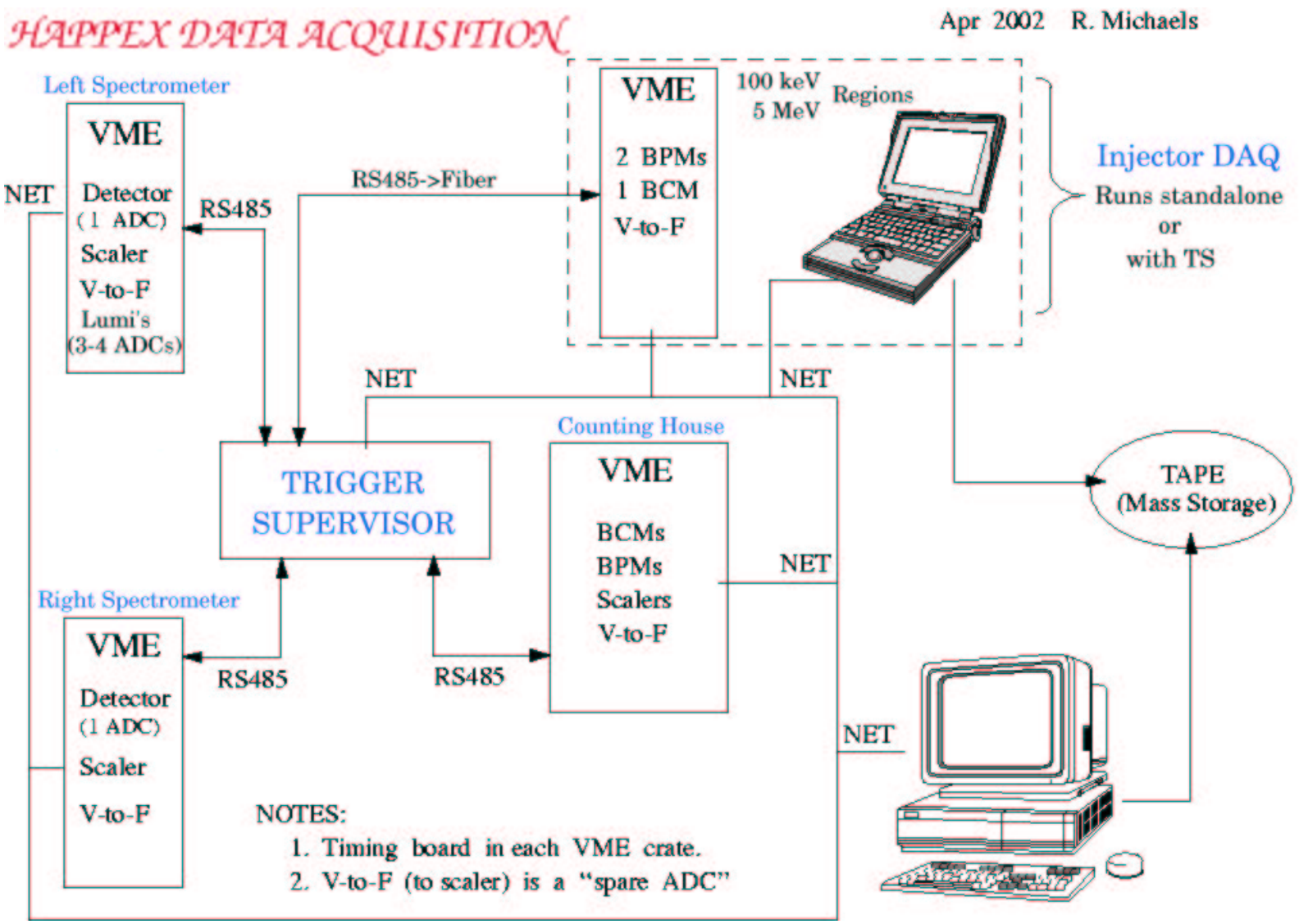
Other

Source Signals (Delayed Helicity, Pairsynch, etc..)

Three-Phase Power

HAPPEX DAQ - Components

Hardware	*Software*
MVME5100 CPU	CODA v2.2
JLab Trigger Interface	Parity Analyzer (PAN)
HAPPEX Timing Board	ROOT v3.03
Harvard-Princeton ADCs	Green Monster (K. Paschke)
SIS3801 Scaler - V/F Converter	


HAPPEX DATA ACQUISITION
Apr 2002 R. Michaels
Left Spectrometer
VME
Detector
(1 ADC)
Scaler
V-to-F
Lumi's
(3-4 ADCs)
NET
RS485
RS485->Fiber
VME
2 BPMs
1 BCM
V-to-F
100 keV
5 MeV
Regions
Injector DAQ
Runs standalone
or
with TS
NET
NET
Counting House
TRIGGER
SUPERVISOR
VME
BCMs
BPMs
Scalers
V-to-F
TAPE
(Mass Storage)
NET
Right Spectrometer
VME
Detector
(1 ADC)
Scaler
V-to-F
RS485
RS485
NET
NOTES:
1. Timing board in each VME crate.
2. V-to-F (to scaler) is a "spare ADC"

Current Work

- Trigger Supervisor (TS) implementation
  - ⋆ Success with Counting House Crate
  - ⋆ Cables laid for Spectrometer Crates (2^{nd} floor of counting house)
  - ⋆ RS485-Fiber converter tested (for Injector DAQ)
- Characterization of recently acquired ADCs
- Tests & Implementation of Voltage-to-Frequency (V/F) converters
- Automatic generation of ASCII Database for PAN
- Setup of ITS Laser Room DAQ

Immediate Future

Provide Q_A Feedback for
Spin Duality (e01-012) and GDH (e97-110)

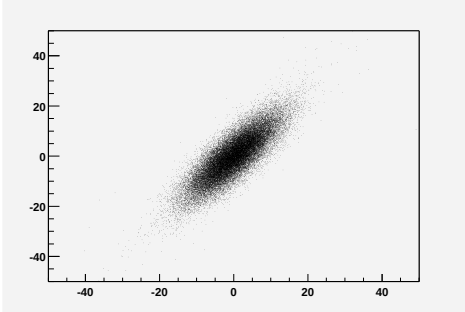
- Run Counting House and Injector DAQs (standalone or together)
  - ⋆ Automatic HALOG Entries
  - ⋆ Test TS with Spectrometer Crates
- Automatic ASCII database creation
  - ⋆ Develop MySQL database creation (R. Suleiman)
- ⋆ Online Monitoring (A. Vacheret)
- ⋆ Prompt Analysis (R. Holmes)
- ⋆ PZT Feedback Studies

● = MUST ⋆ = Parasitic

Regression Analysis

Idea: Find the slope between two monitors and subtract it.

*B*efore



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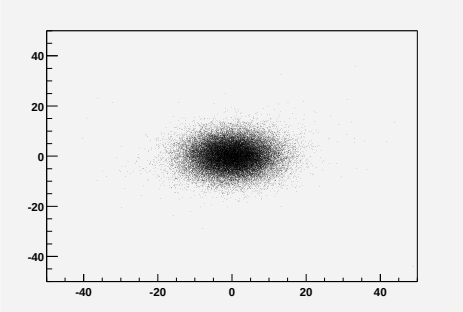


Reasons: Correct for helicity-correlated systematic effects

Compare with Dithering Analysis to estimate systematic errors

Methods: Iterative Approach

Matrix Inversion

Iterative Regression Algorithm

1. Declare Independent Variable (y) and N Dependent Variables (x_i)
2. Compute regression coefficient

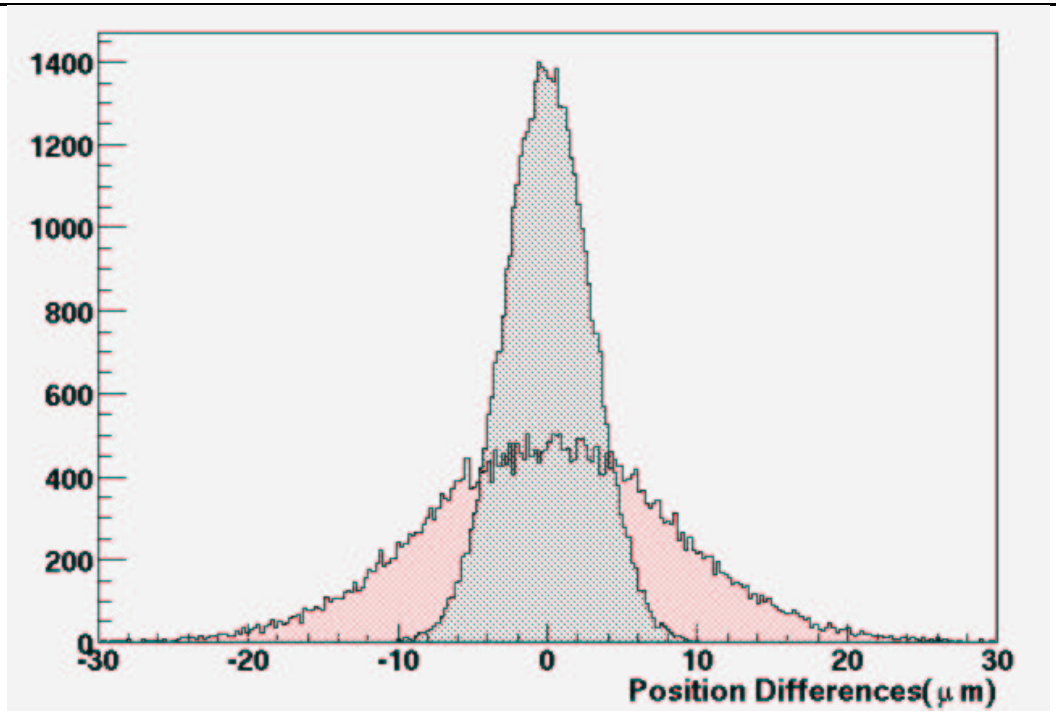
$$b_i = \frac{\sum(y - \bar{y})(x_i - \bar{x}_i)}{\sum(x_i - \bar{x}_i)^2}$$

3. Regress x_i from y

$$y_{reg} = y - \bar{y} - b_i(x_i - \bar{x}_i)$$

4. Repeat for x_{i+1} using $y = y_{reg}$

Preliminary Results - Iterative Method



IV: BPM12y DV: 8xy, 10xy, 12x

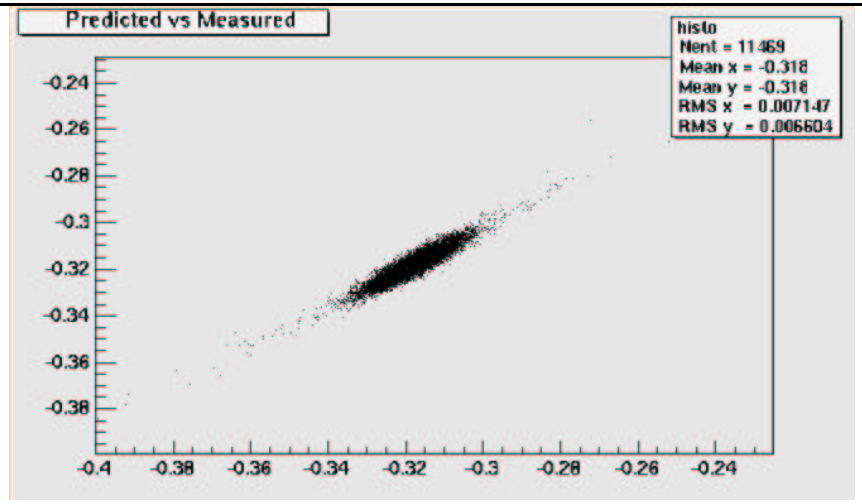
Before Regression:

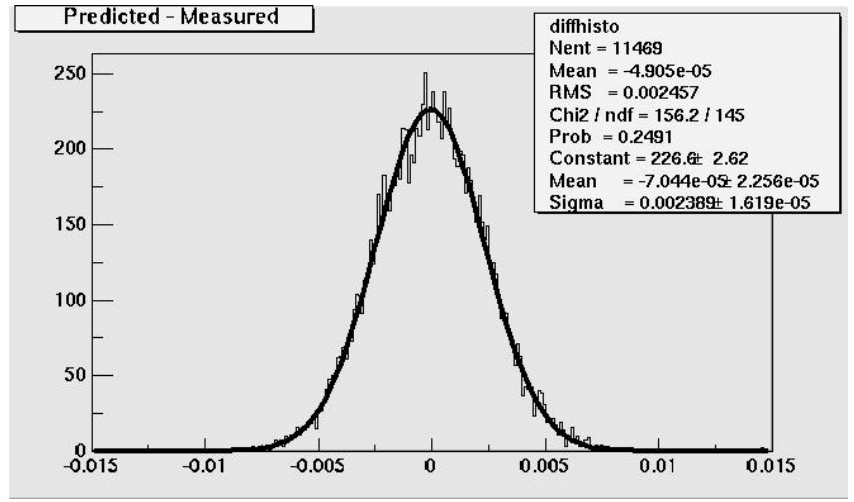
$\sigma = 8.35\mu m$

After Regression:

$\sigma_{reg} = 2.86\mu m$

Polynomial Parameterization Method





IV: BPM12y DV: 8xy, 10xy, 12x

$$\sigma_{poly} = 2.39\mu m$$

$$(\sigma_{reg} = 2.86\mu m)$$

Matrix Inversion Algorithm

1. Declare y and x_i (same as in iterative algorithm)
2. Compute vector of regression coefficients

$$\mathbf{B} = \mathbf{Y}\mathbf{X}^{-\mathbf{1}}$$

$$X_{ij} = \sum (x_i - \bar{x}_i)(x_j - \bar{x}_j)$$

$$Y_i = \sum (x_i - \bar{x}_i)(y - \bar{y})$$

3. Compute Regressed y

$$y_{reg} = y - \bar{y} - \sum_i B_i (x_i - \bar{x}_i)$$

Conclusion

- Data Acquisition
  - ⋆ Review of Signals, Hardware, and Software
  - ⋆ Overview of current/planned system
  - ⋆ Immediate Plans for the next ^{3}He experiments
- Regression Analysis
  - ⋆ Review of motivation
  - ⋆ Iterative Algorithm with results
  - ⋆ Matrix Inversion Algorithm