Møller Polarimetry in Qweak

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Jefferson Lab – Hall C

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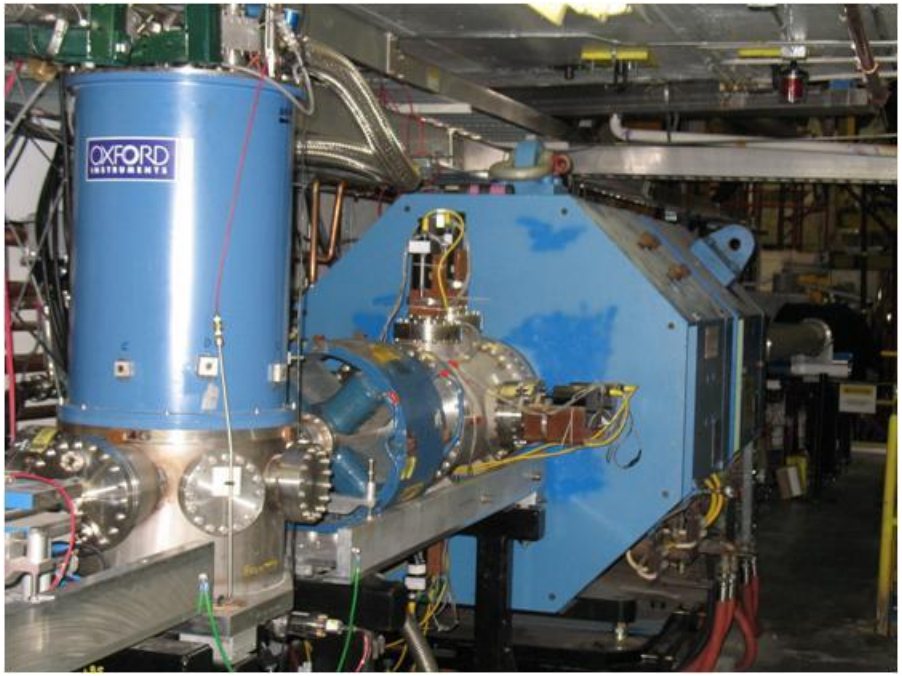

Agenda

- Qweak Experiment (overview)
- Møller background
- Møller systematics
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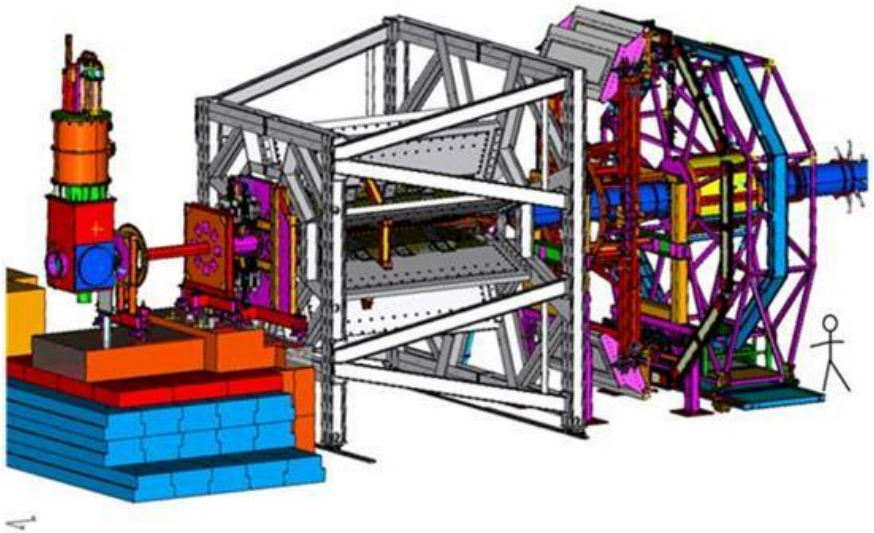
Qweak

- Parity violating ep scattering
  - Low Q^2 (~0.026 GeV^2)
  - High beam polarization



Qweak

- Parity violating ep scattering
  - Low Q^2 (~0.026 GeV^2)
  - High beam polarization
- 4% precision

Error source	$\Delta A_{phys}/A_{phys}$ contribution	$\Delta Q^p_w/Q^p_w$ contribution
Counting statistics	2.1%	3.2%
Hadronic structure	--	1.5%
Beam polarimetry	1.0%	1.5%
Absolute Q^2	0.5%	1.0%
Backgrounds	0.5%	0.7%
Helicty-correlated beam properties	0.5%	0.7%
TOTAL:	2.5%	4.1%

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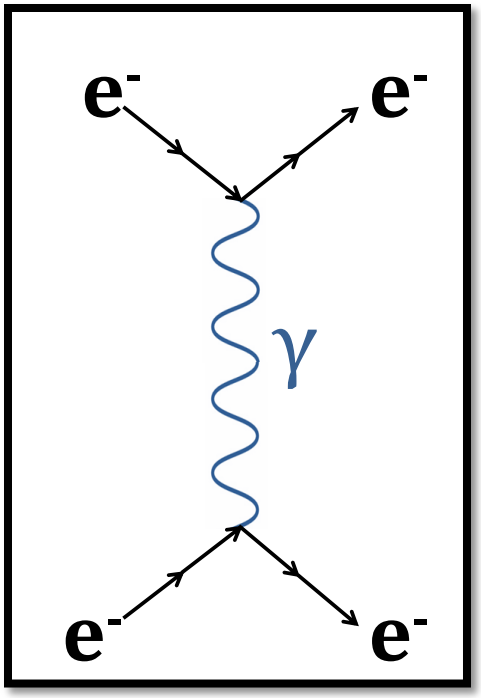
Møller polarimetry (review)

- Møller scattering
  - Electron-electron
  - Pure QED

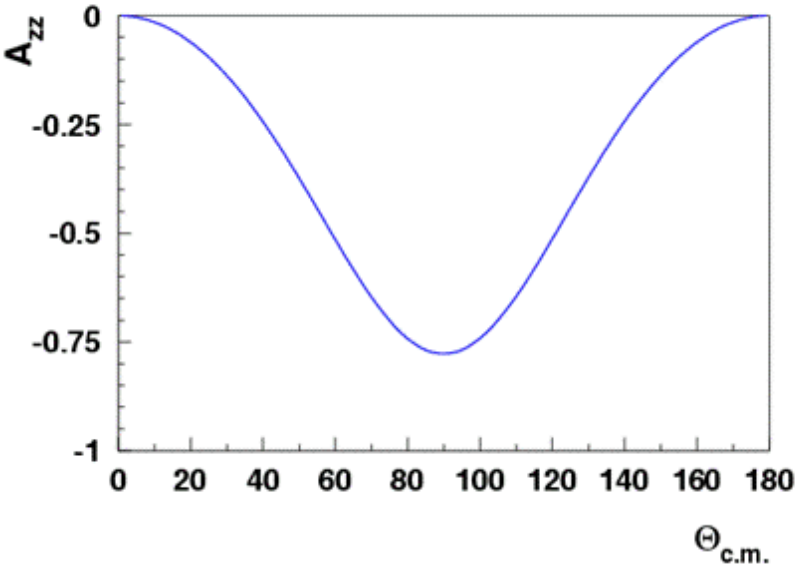


Møller polarimetry (review)

- Møller scattering
  - Electron-electron
  - Pure QED
- Measure assymetry
  - Largest at 90° (com)

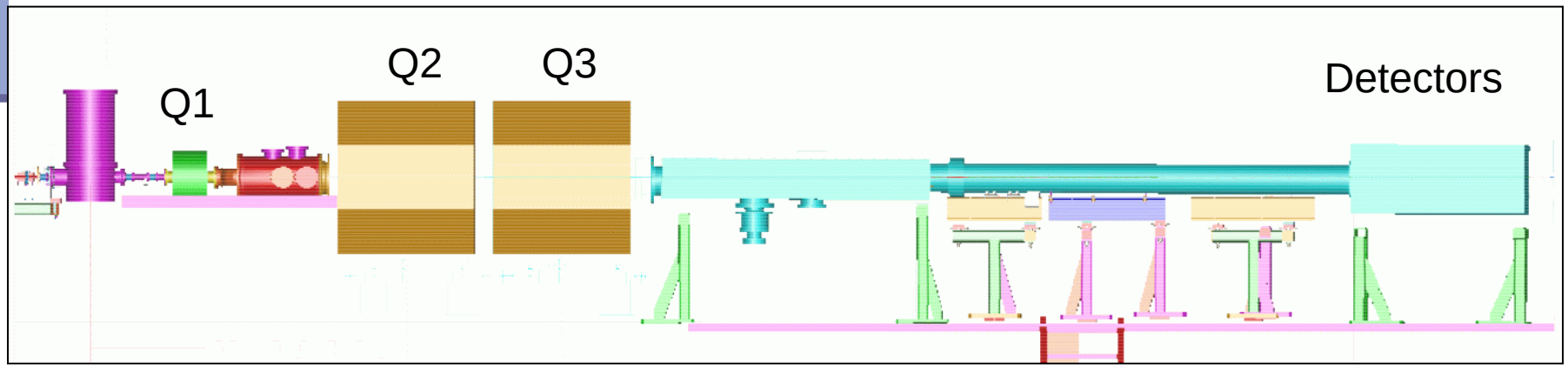
$$\frac{d\sigma}{d\Omega} = \frac{d\sigma_0}{d\Omega}\left[1 + A_{sym}\right]$$

$$A_{sym} = \frac{N^+ - N^-}{N^+ + N^-} = A_{zz(\theta)} P_b P_t$$



Møller polarimetry

- Superconducting solenoid magnet
- Iron foil
- 2 quads
- 2 detectors in coincidence



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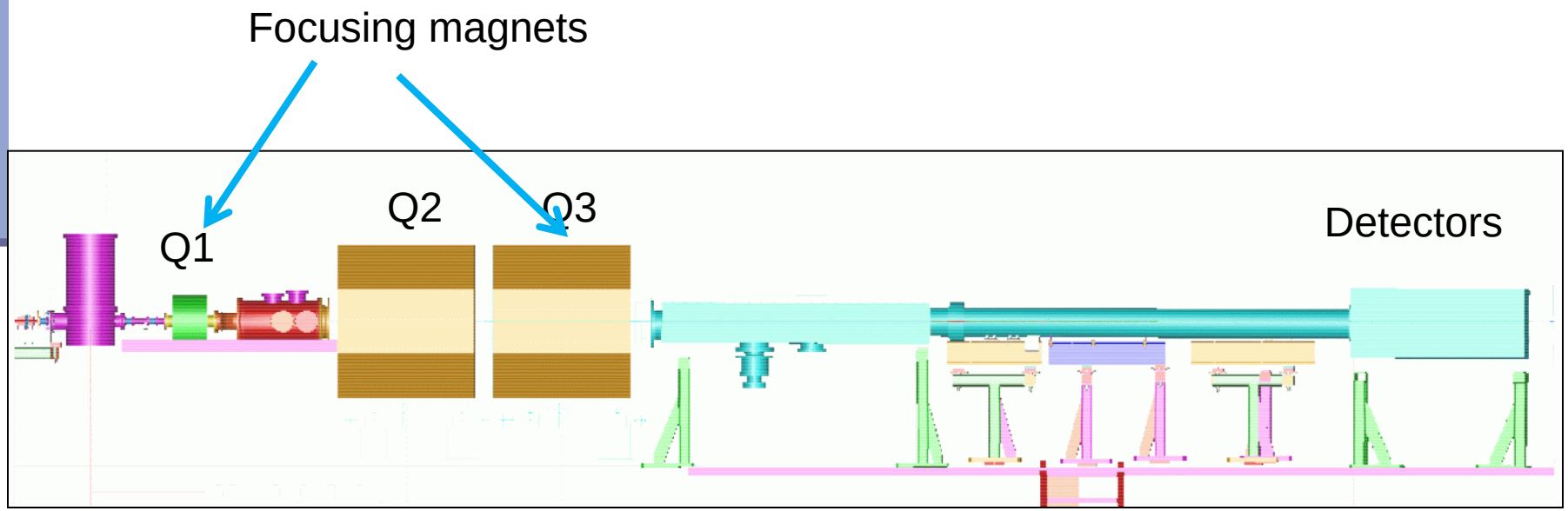

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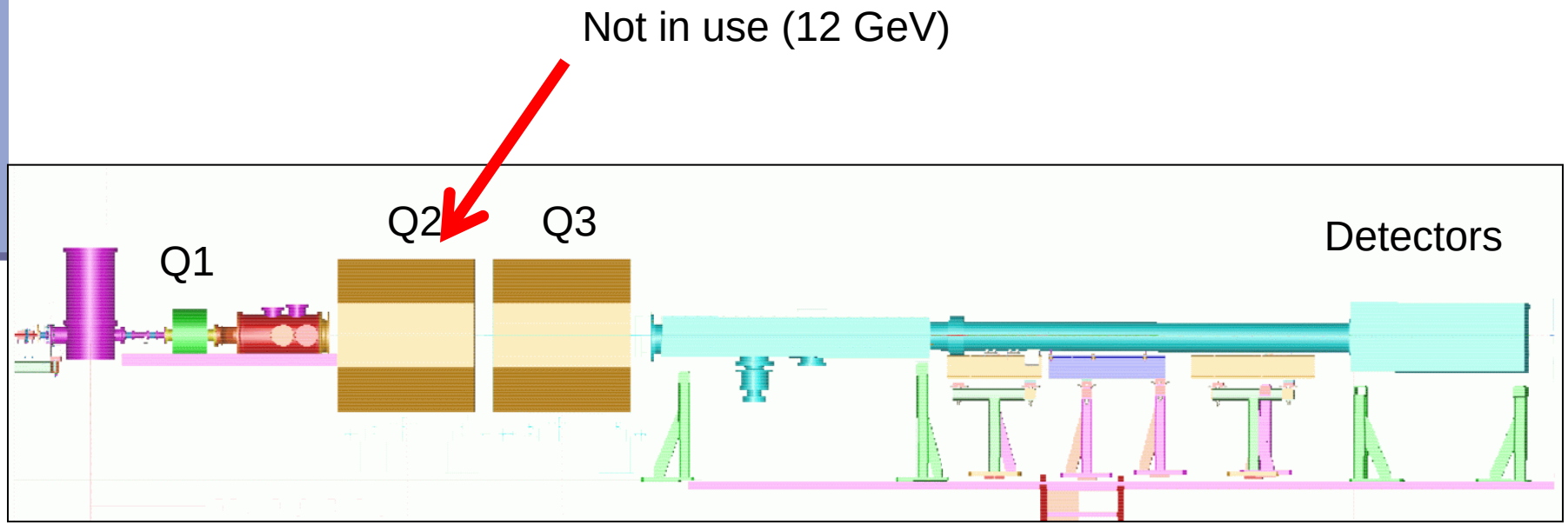

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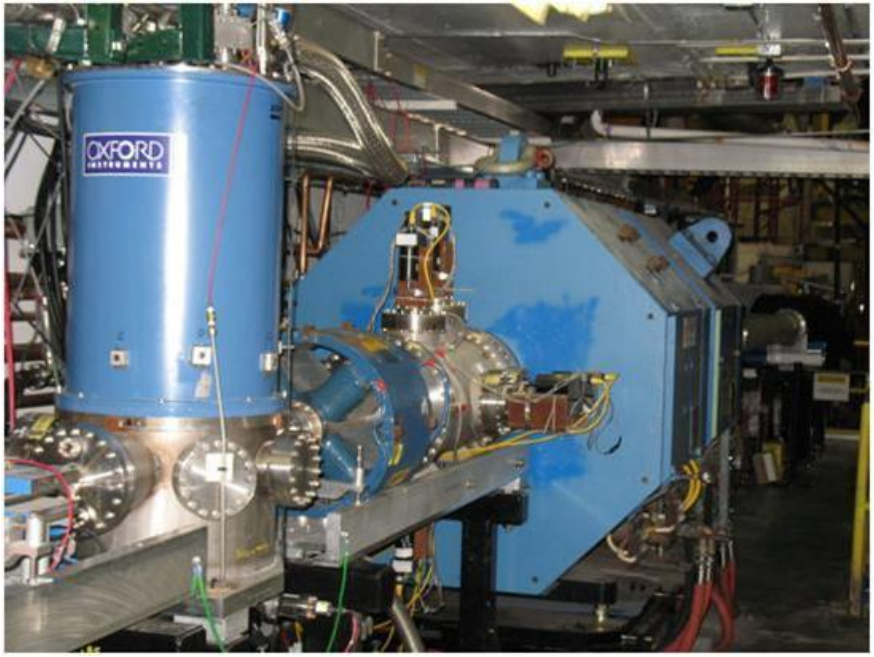
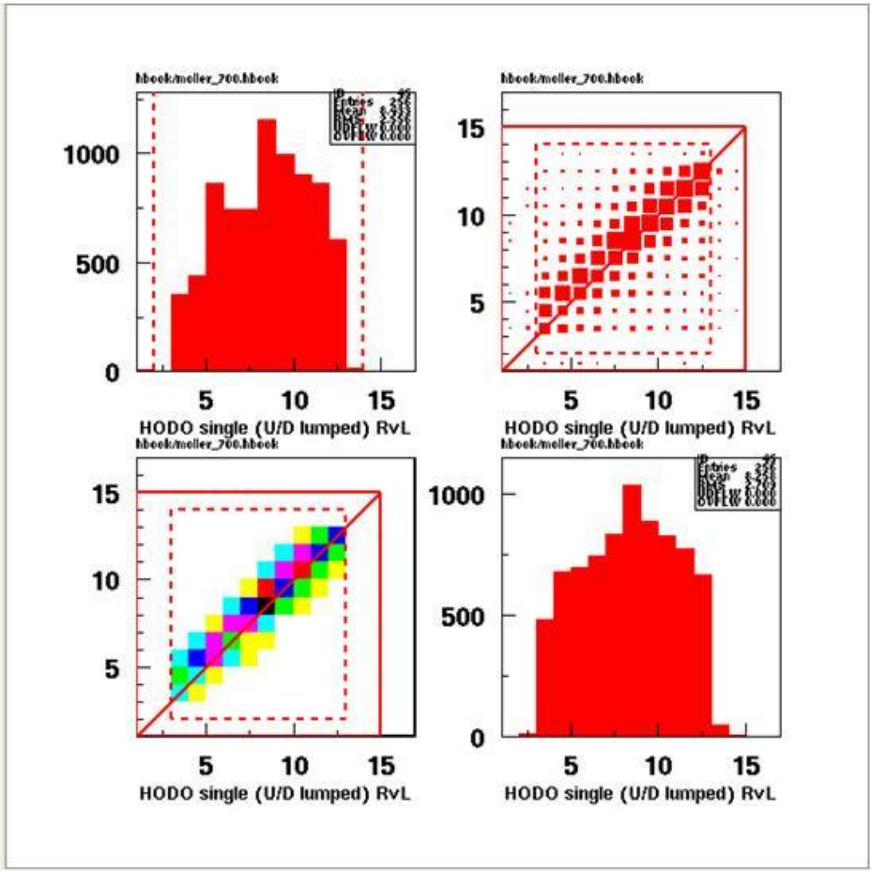


Møller polarimetry

- High rates
  - ~15 kHz
  - ~1% precision in 5 min
- Tune plot
  - Correlation



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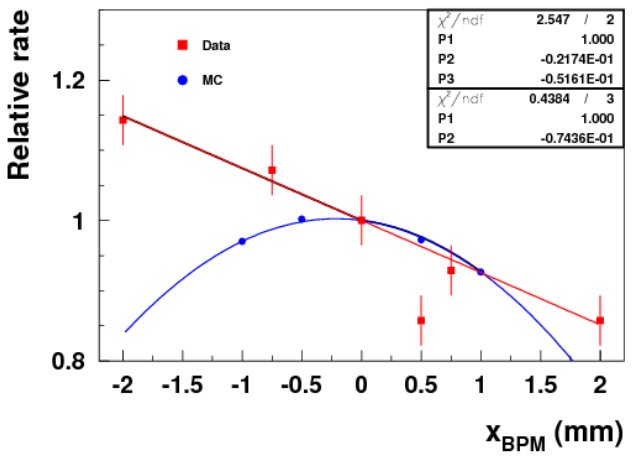
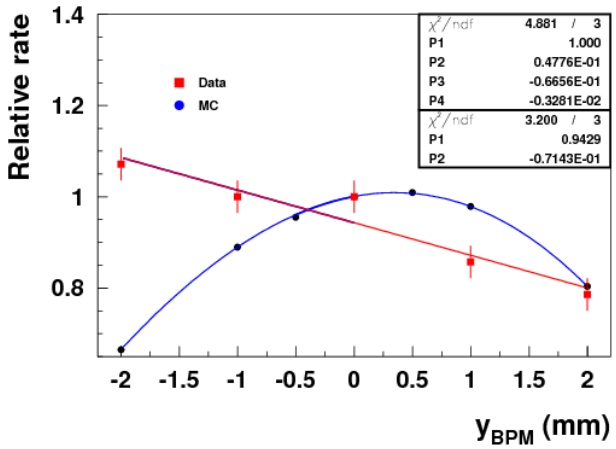
Source	Uncertainty	dAsy/Asy (%)
Beam pos x	0.5 mm	0.32
Beam pos y	0.5 mm	0.02
Beam direction x	0.15 mr	0.02
Beam direction y	0.15 mr	0.01
Q1 current	2%	0.10
Q3 current	1%	0.17
Q3 position	1 mm	0.18
Multiple scattering	10%	0.01
Levchuk effect	10 %	0.20
Collimator positions	0.5 mm	0.06
Target temperature	50%	0.05
B-field direction		0.14
B-field strength	5%	0.03
Spin polarization in Fe		0.25
Electronic D.T.	100%	0.04
Solenoid focusing	100%	0.10
Total		**0.57**

*Systematics for 1 uA.

Beam pos.

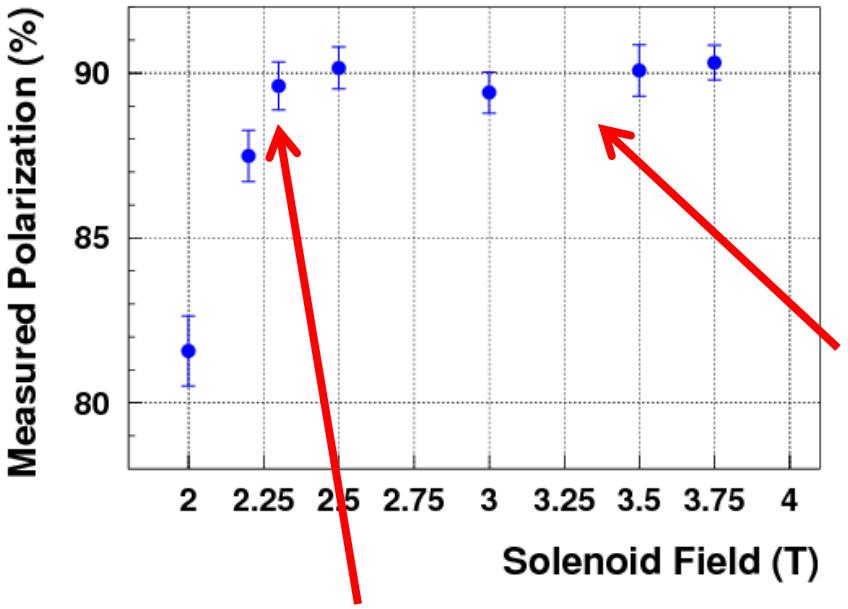
- Largest systematic
  - Solenoid blurs x/y
- Disagreements
  - No angle on target
  - Newer transport code
  - Effect of quad





Magnetic saturation

- Pure iron foil
  - saturates at 2.2T
  - At 3T, 2° “tilt” is ~0.4% change in polarization



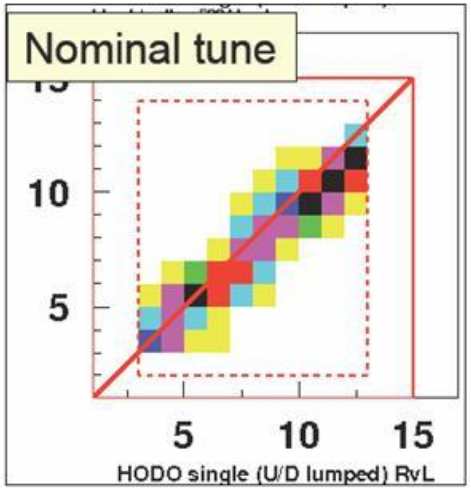
Plateau

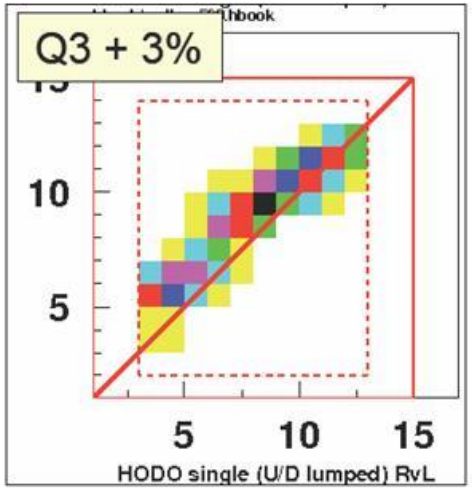
Saturation point of iron

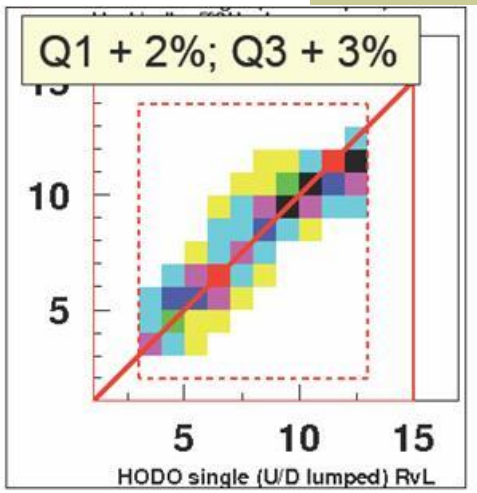
Quad tune dependence

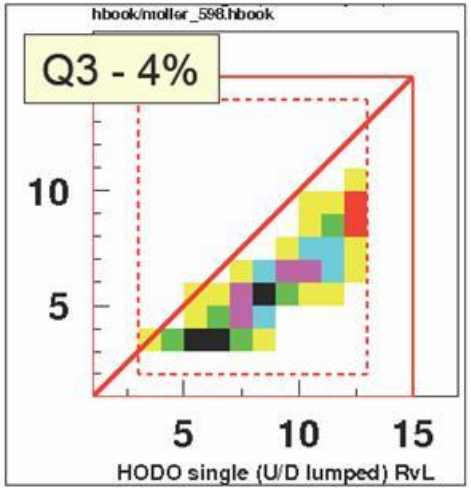
- Will quad mis-align affect polarization?
  - Could we correct it?

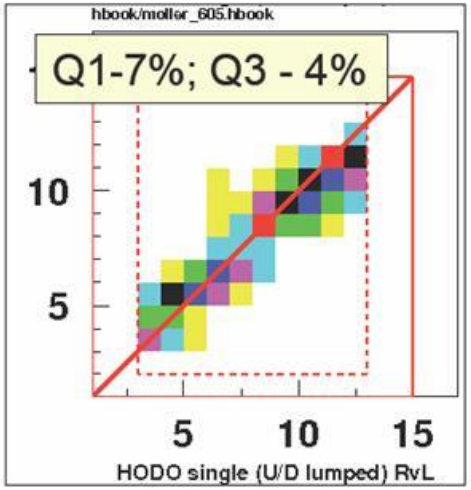
Quad tune dependence











Quad tune dependence

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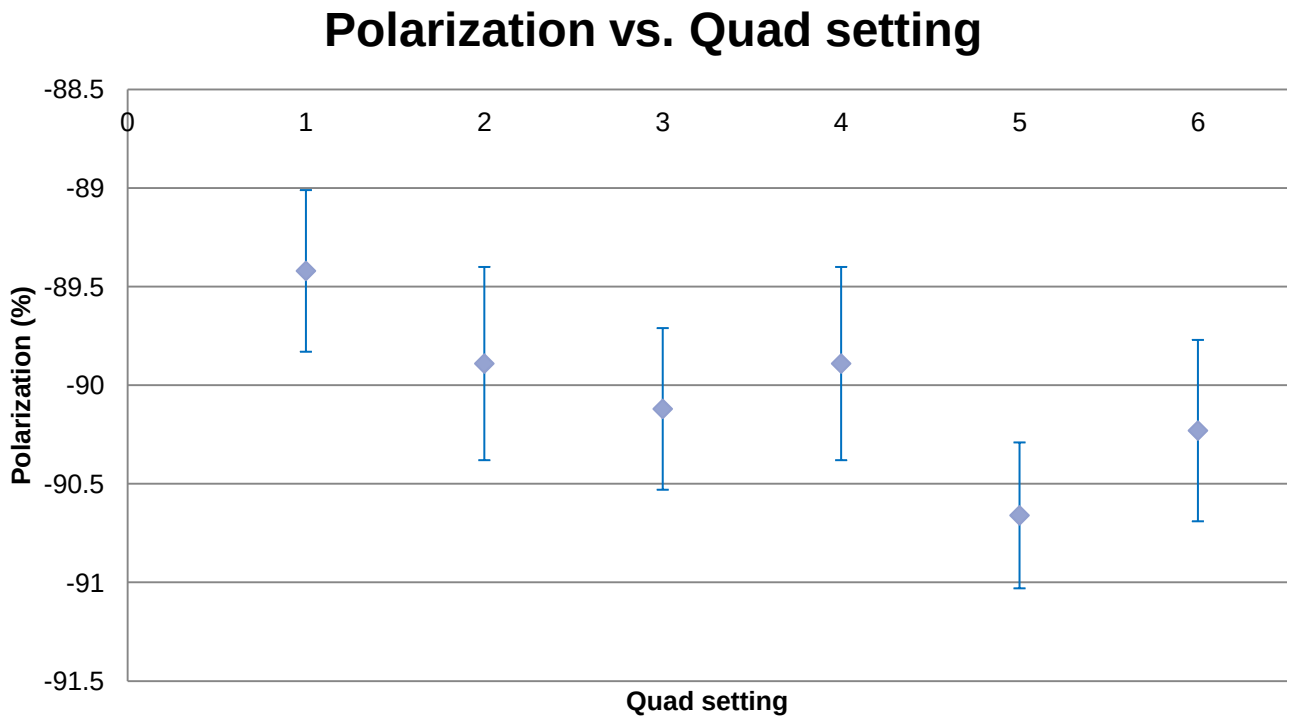
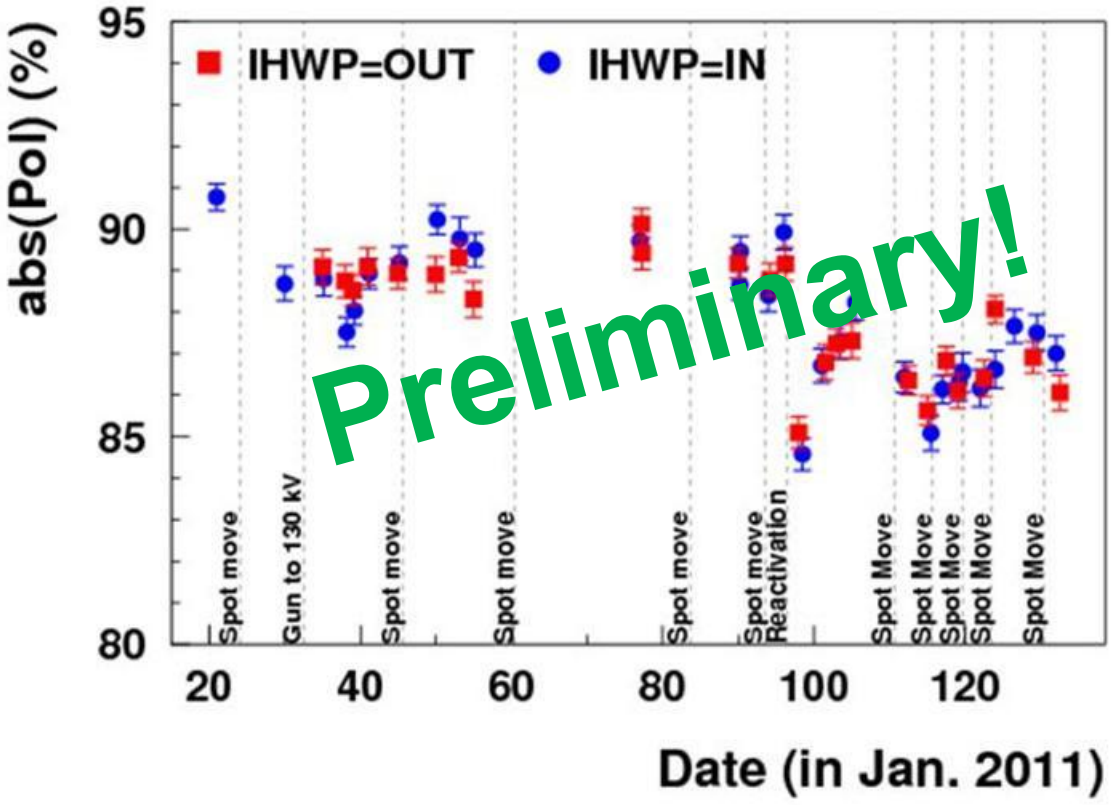


Overall


IHWP=OUT
IHWP=IN
abs(Pol) (%)
95
90
85
80
20
40
60
80
100
120
Date (in Jan. 2011)
Spot move
Gun to 130 kV
Spot move
Spot move
Spot move
Spot move
Reactivation
Spot Move
Spot Move
Spot Move
Spot Move
Spot Move
Preliminary!

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Questions?

Extra slides

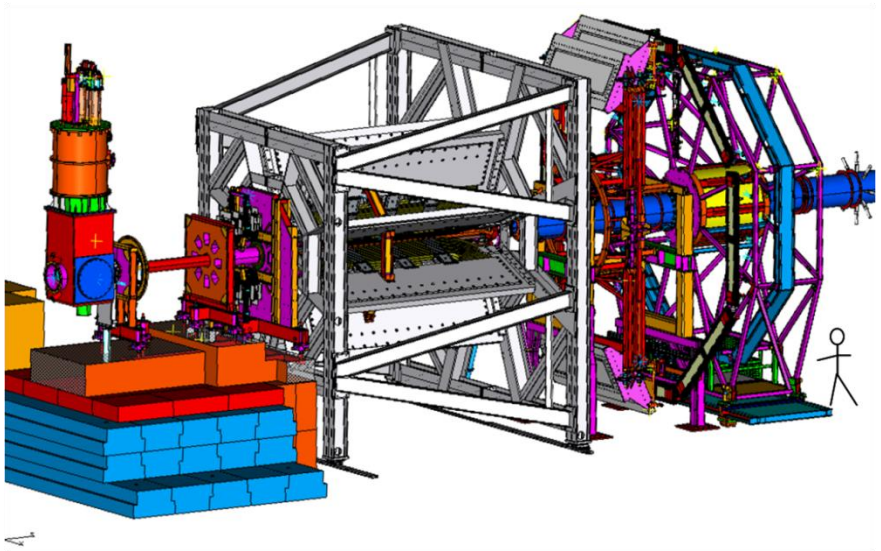
Qweak

Beam parameters

Energy:	1.165 GeV
Current:	180 μA
Polarization:	85%

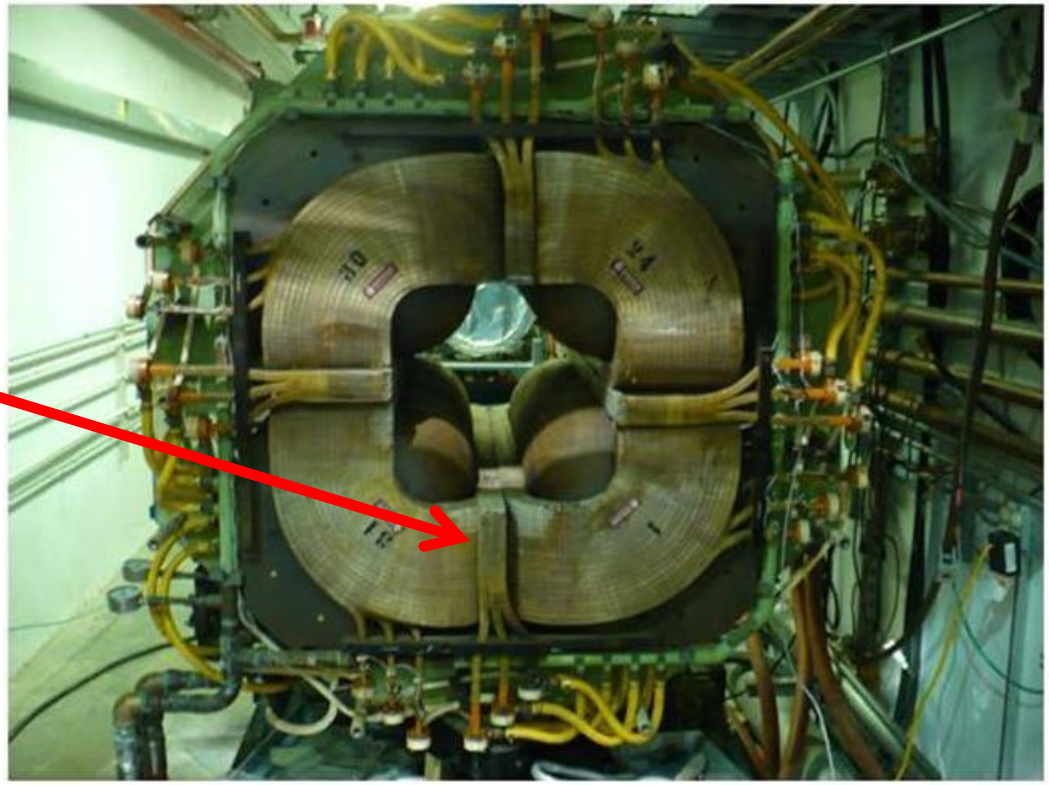
Experiment parameters

Target length:	35 cm
Hours running:	~2500
Integrated rate:	6.5 GHz



The Problem

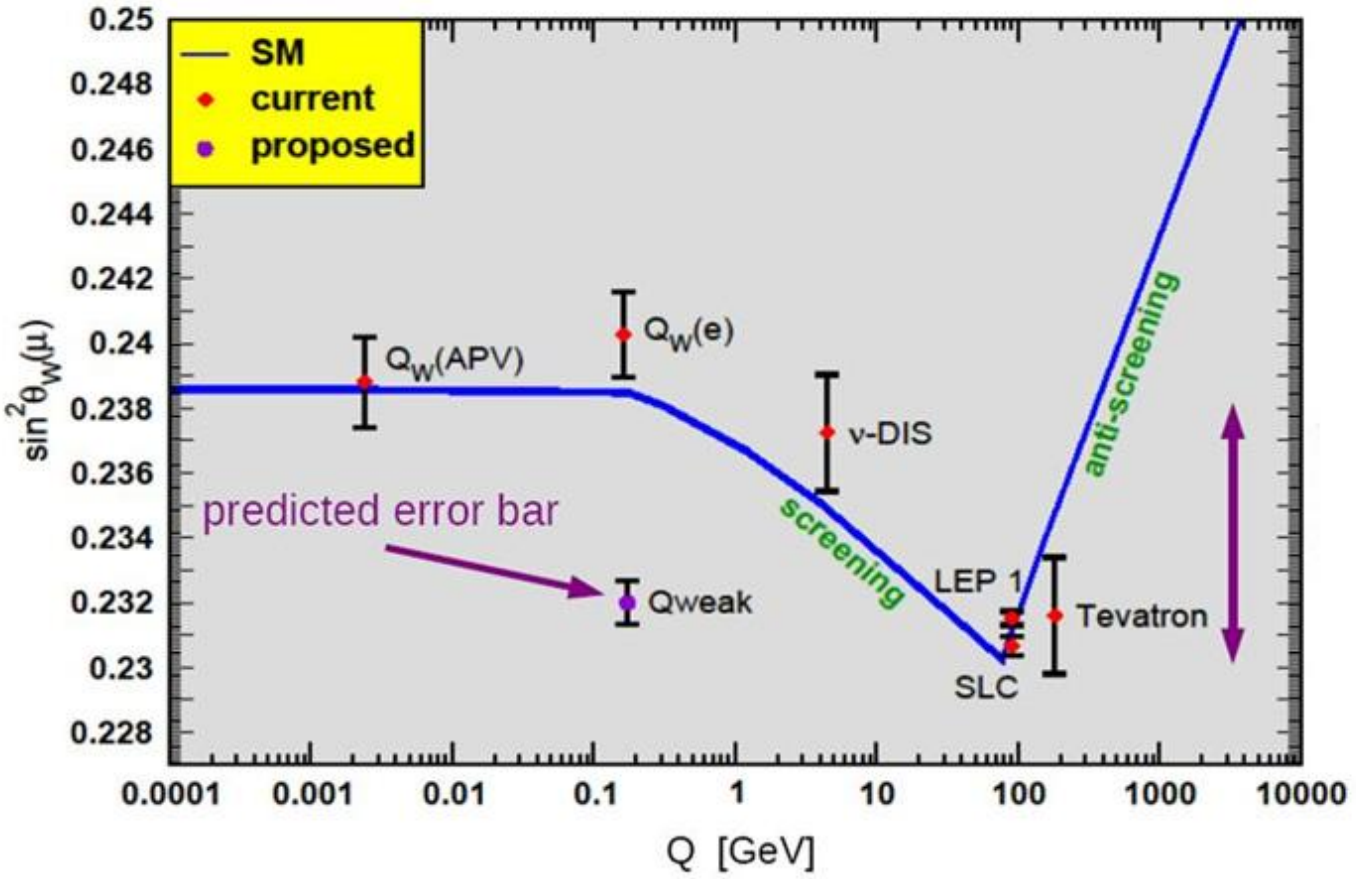
Coil “pancake”



Upstream

Disclaimer! This is a different quad with no probes attached. For educational purposes only.

SM Prediction



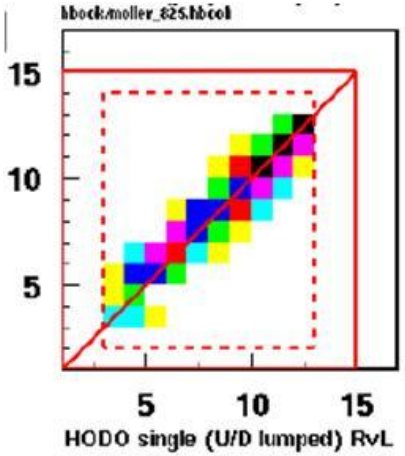
SM curve by: J. Erler, M. Ramsey-Musolf and P. Langacker

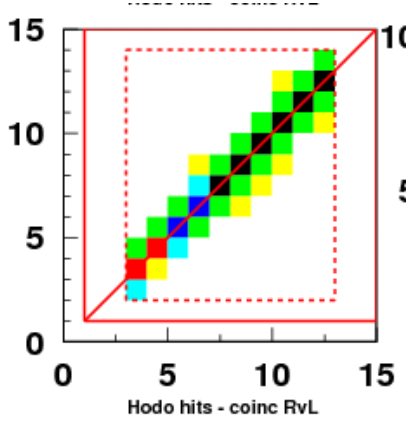
Simulation Efforts

Real tunes

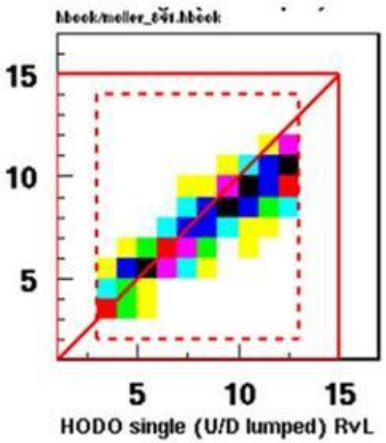
Poisson

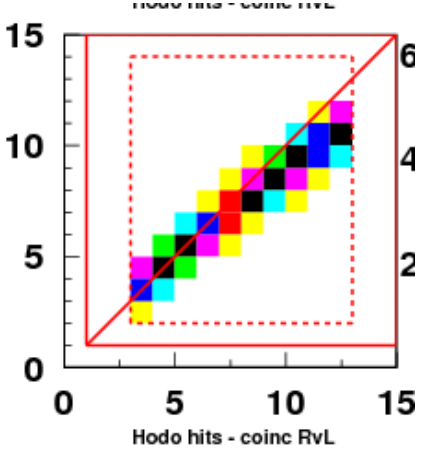
Awesome



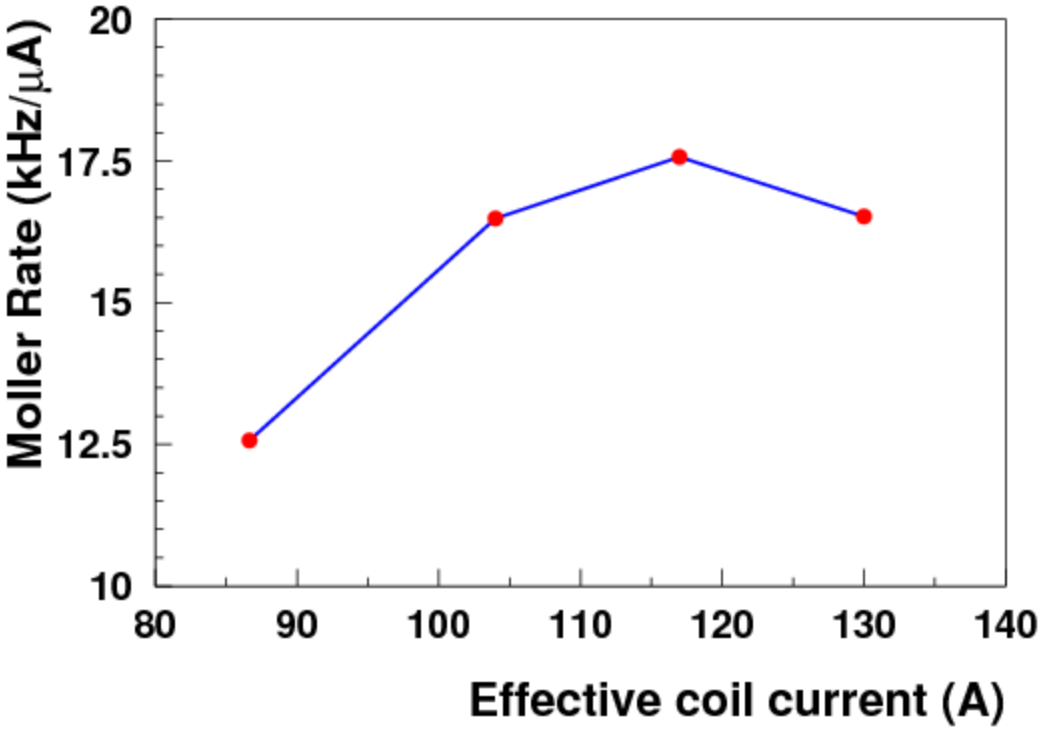


Poor





Systematics



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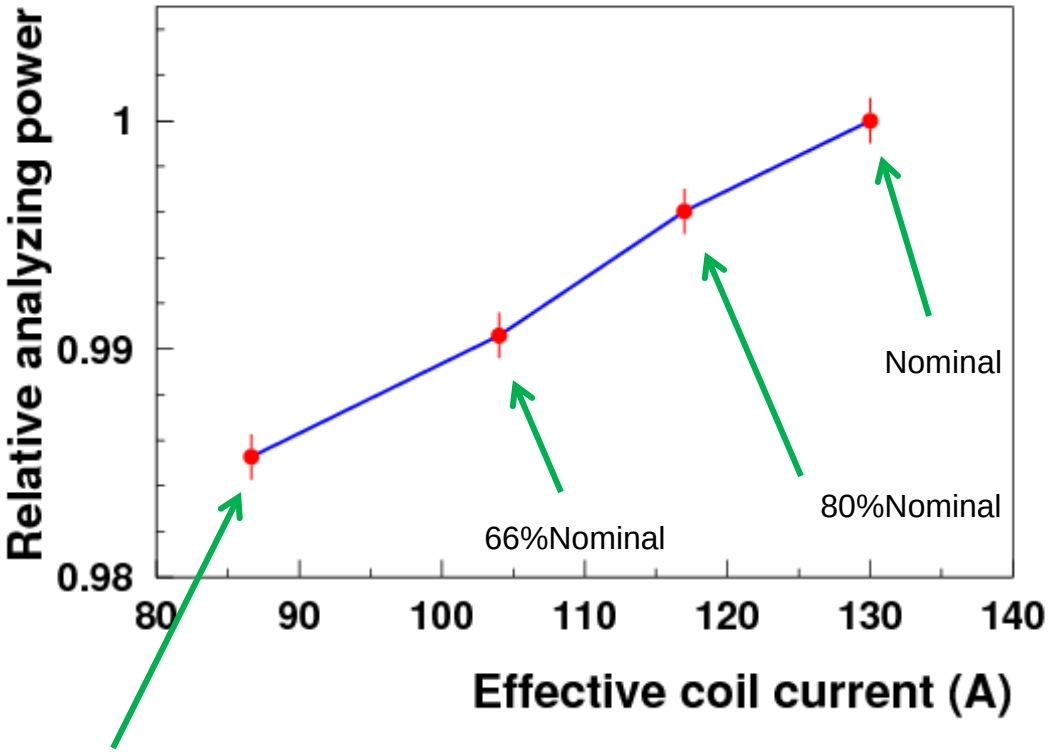
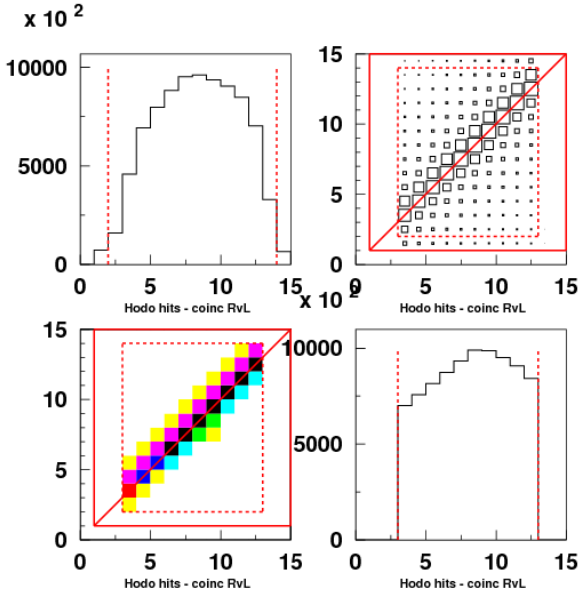
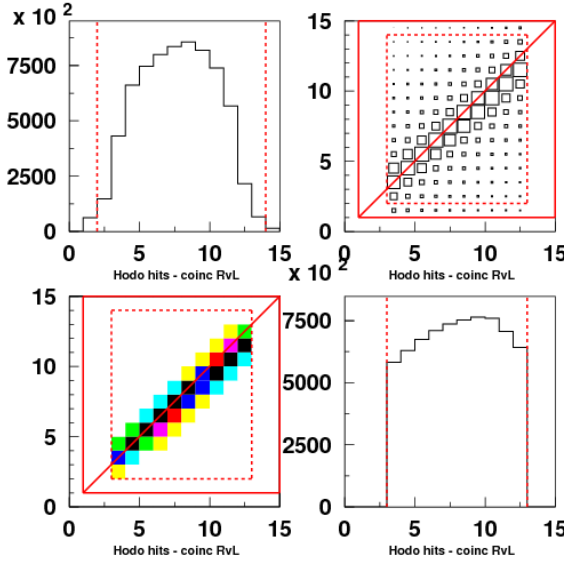


Systematics

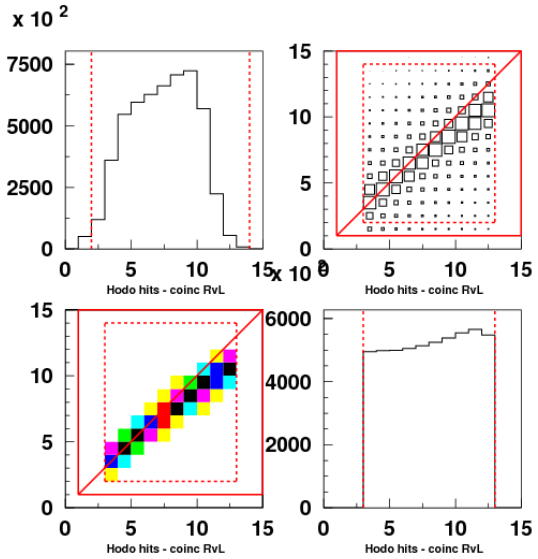
Nominal current



80% nominal



66% nominal



Looking forward