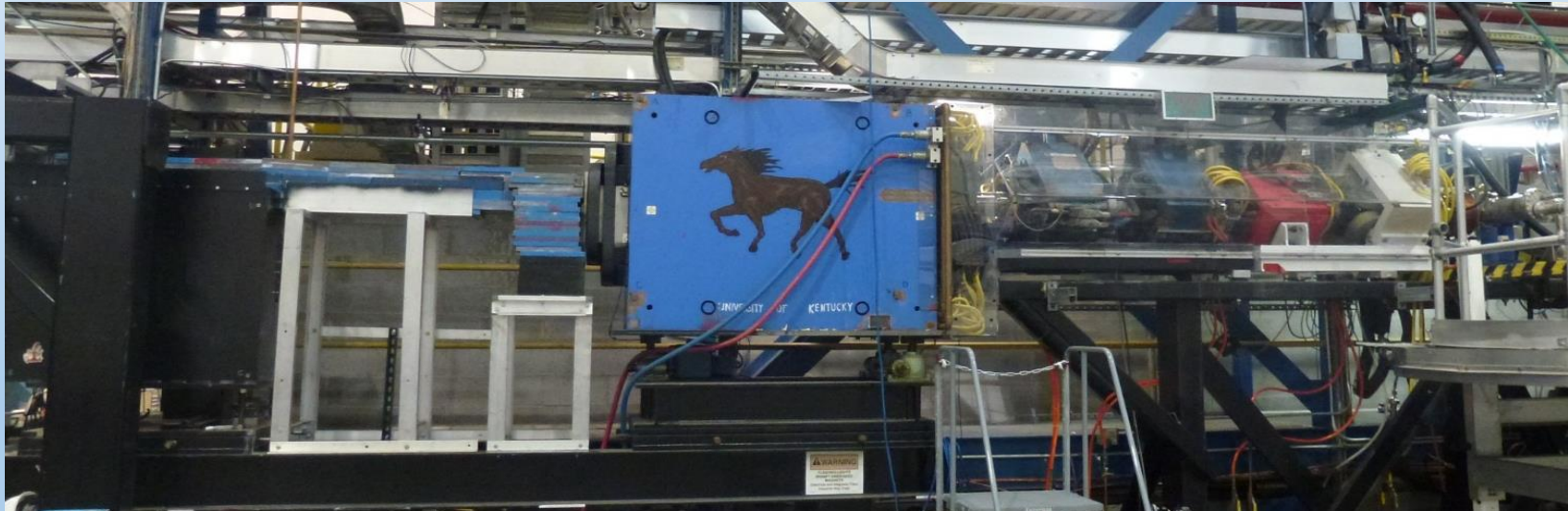
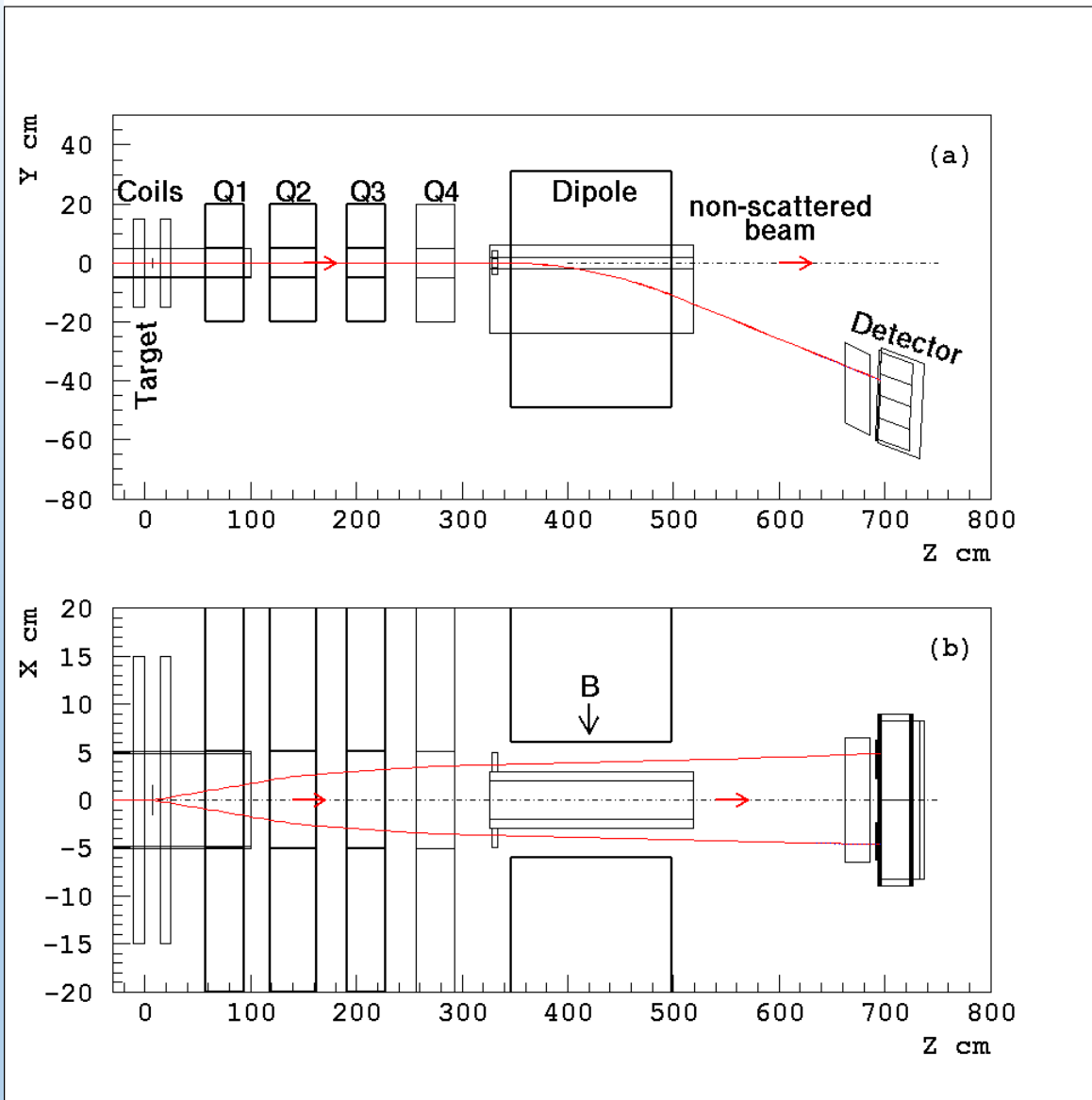


# ***Moller Polarimetry for DVCS***



***S. Glamazdin, R. Pomatsalyuk***

# Møller Polarimetry



$$\vec{e}^- + \vec{e}^- \rightarrow e^{-'} + e^{-'}$$

$$d\sigma^{Moll} / d\Omega^* =$$

$$d\sigma_0^{Moll} / d\Omega^* \times (1 + A_{Moll} \times P^b \times P^t)$$

$$A_{meas} = \frac{N^{\uparrow\uparrow} - N^{\uparrow\downarrow}}{N^{\uparrow\uparrow} + N^{\uparrow\downarrow}} =$$

$$A_{Moll} \times P^b \times P^t \times \cos \alpha^{foil}$$

$$P^b = A_{meas} / A_{Moll} \times P^t \times \cos \alpha^{foil}$$

# Møller Polarimetry

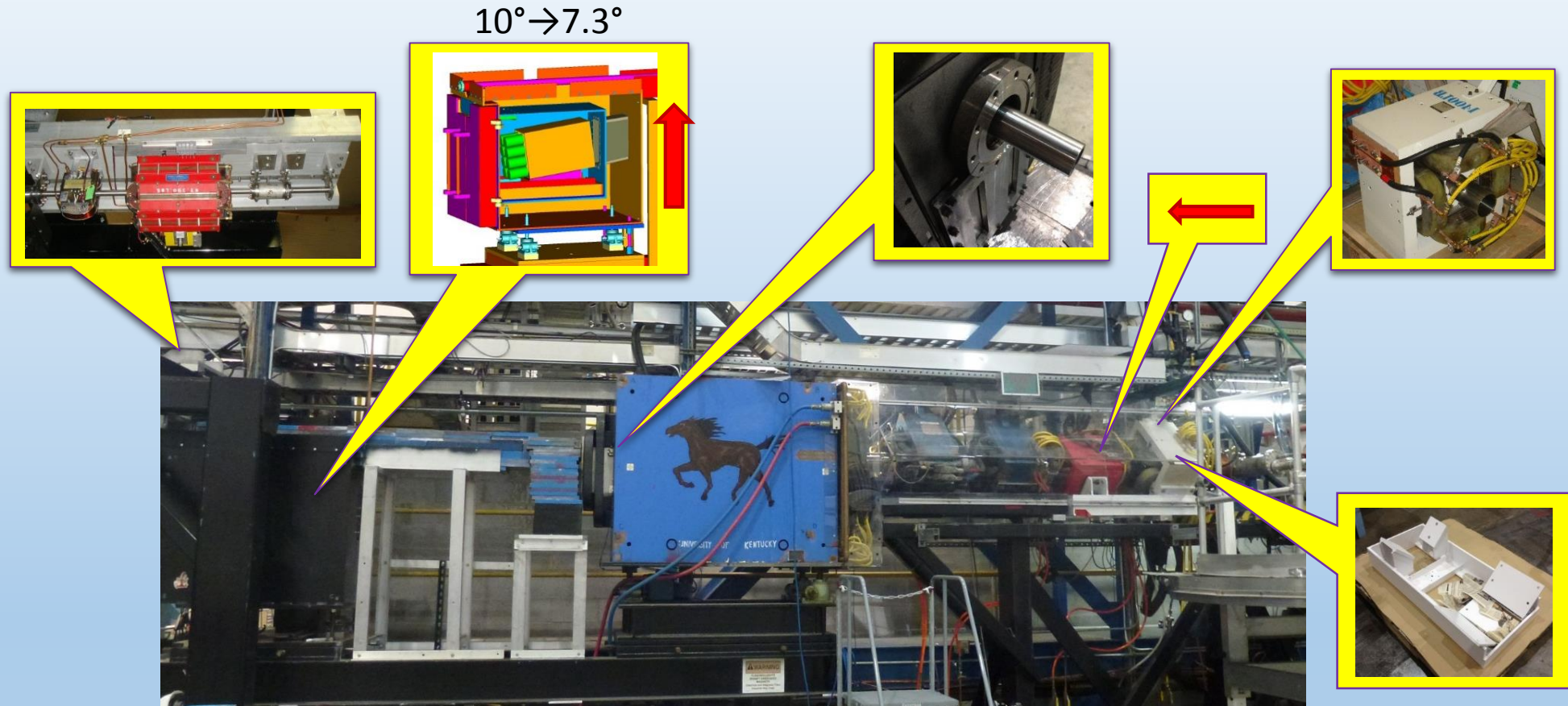
## Advantages:

- 1 - Large cross-section
- 2 - High analyzing power at  $\Theta_{CM}=90^\circ$   
 $A_{zz}=7/9$
- 3 - Particles in the final state with  
 $E \sim E_0/2 \rightarrow$  coincidence eliminates  
background
- 4 - Relatively simple

## Disadvantages:

- 1 - Invasive with solid targets
- 2 - Low effective target  
polarization  $\sim 8\%$
- 3- Beam current limit  $\sim 3\mu\text{A}$   
(target heating/depolarization)

# Moller Polarimeter Upgrade



- 1<sup>st</sup> quad shifted downstream
- New 4<sup>th</sup> quad added
- New girder for quads #1 and #4

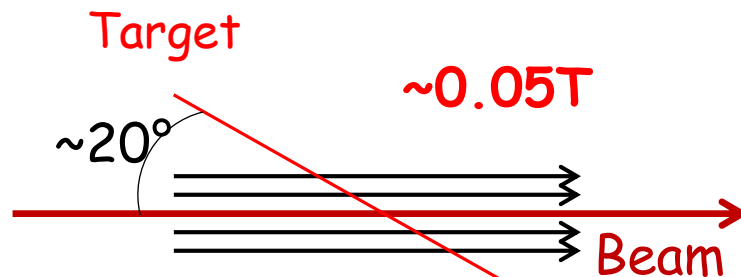
- Shielding pipe in dipole
- New detector shield box
- Reconfigured girder:  
v. corrector + quad + BCM

# Polarized Electron Targets and Techniques

## Polarized Solid Targets

- Pure Iron (99.85%-99.99%)
- Supermendur (49%Fe, 49%Co, 2%V)

In "low" field  
"tilted"



Target polarization has to be measured before using

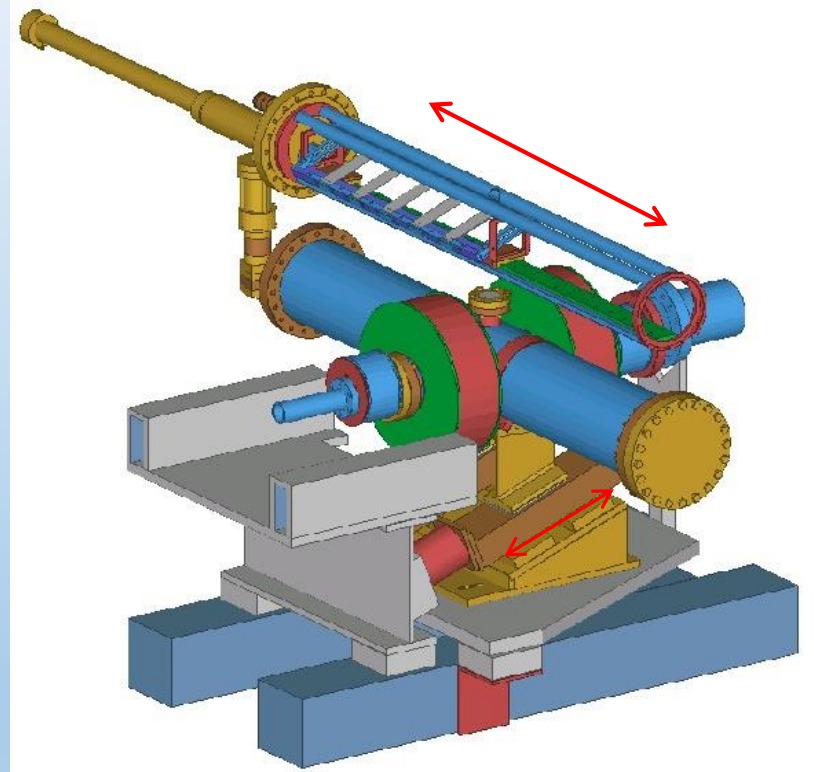
In "high" field  
"brute force"



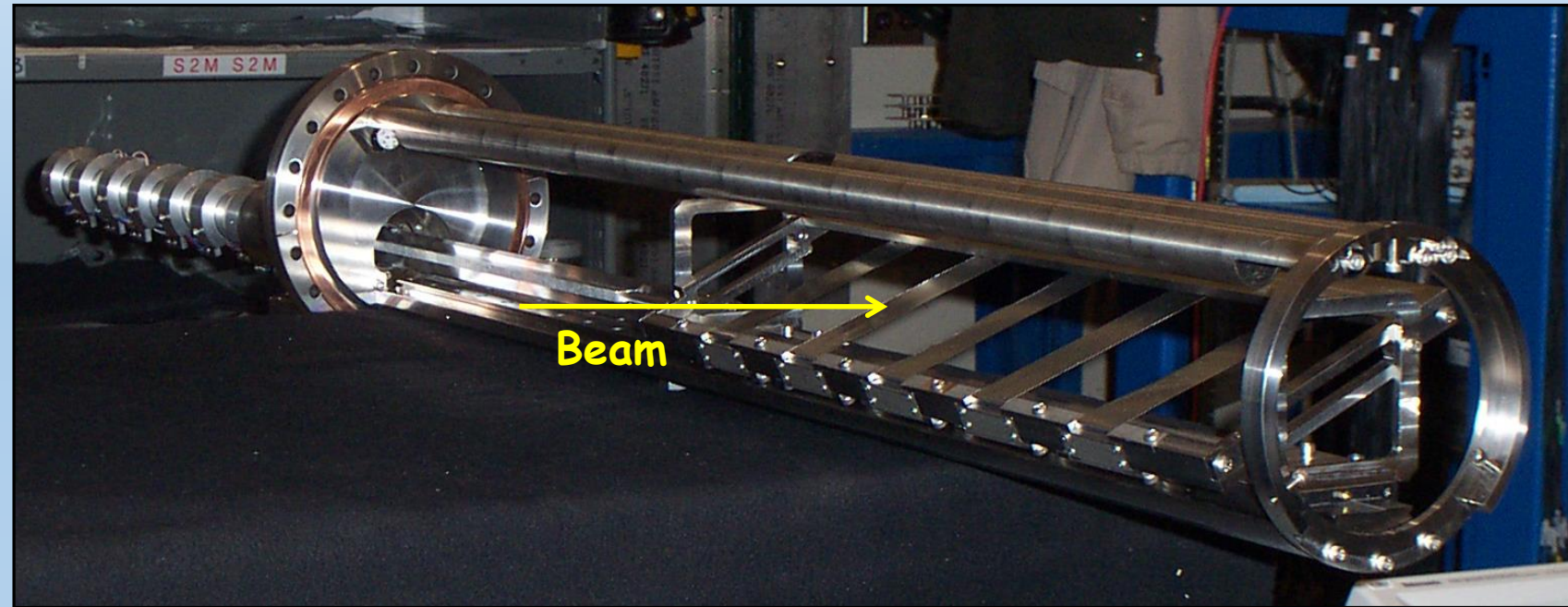
Target polarization from solid state physics

**At DVCS both "tilted" and "brute force" targets were used (unique experiment)**

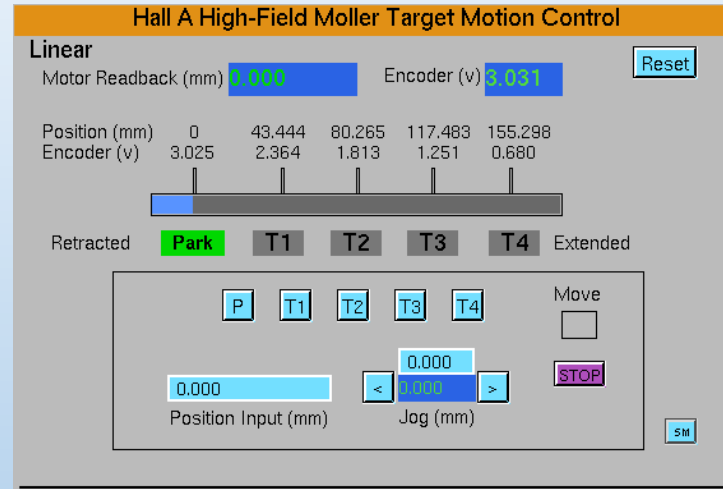
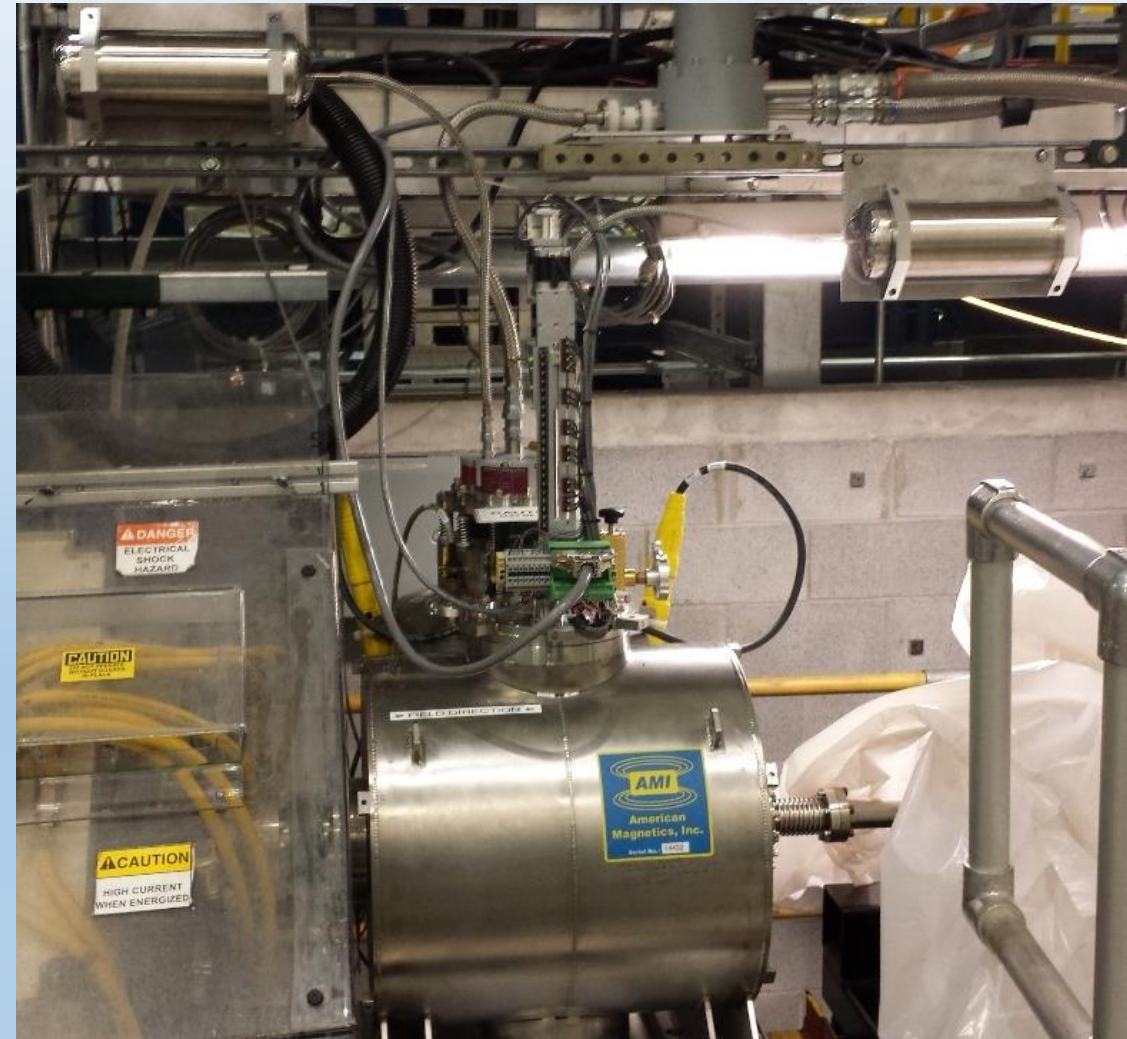
# Tilted (Low Field) Target



Position	6	5	4	3	2	1	0
Material	park	SM*	Fe	Fe	SM	SM	Al
Thickness, $\mu\text{m}$	-	6.8	9.3	14.3	29.4	13.0	16.5



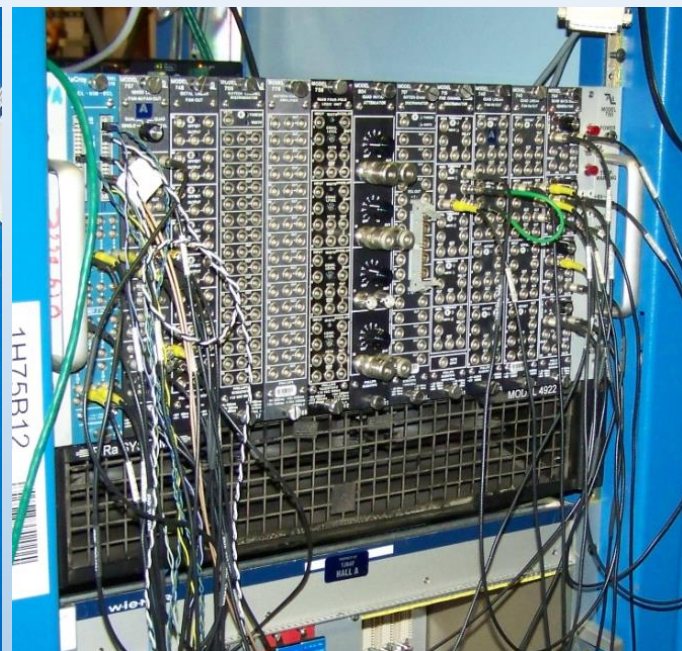
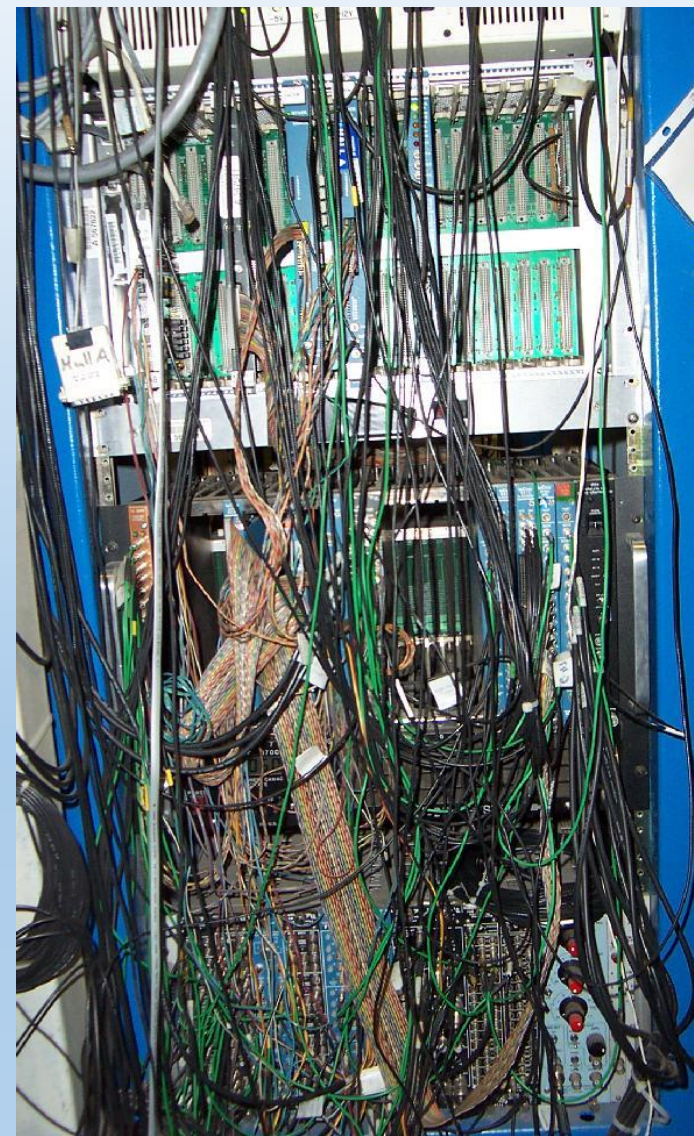
# "Brute Force" (High Field) Target



*Designed and made by Temple University*  
*Vertical translation*  
*Rotation possible but locked*  
*Targets in holder: pure iron 4 $\mu$ m, 12 $\mu$ m, 25 $\mu$ m*



# Two Moller DAQs

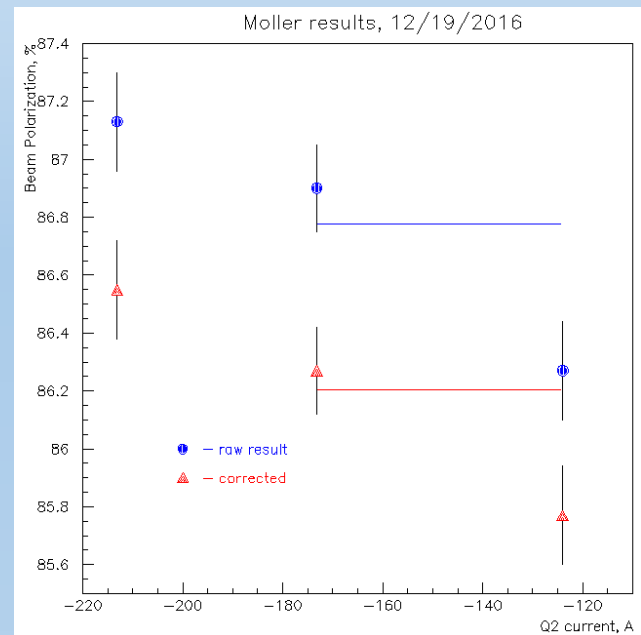
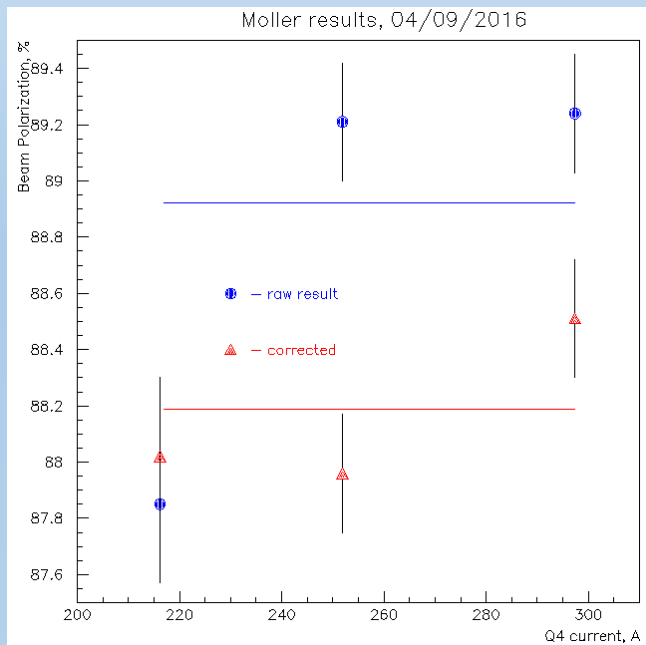
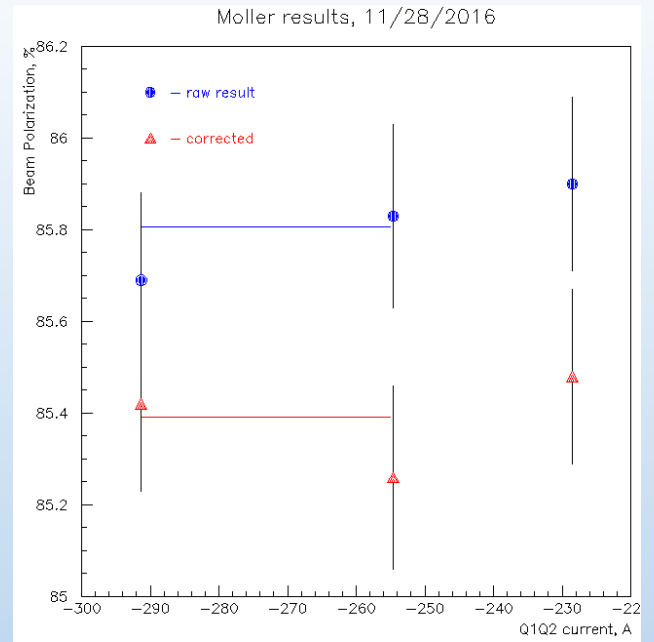
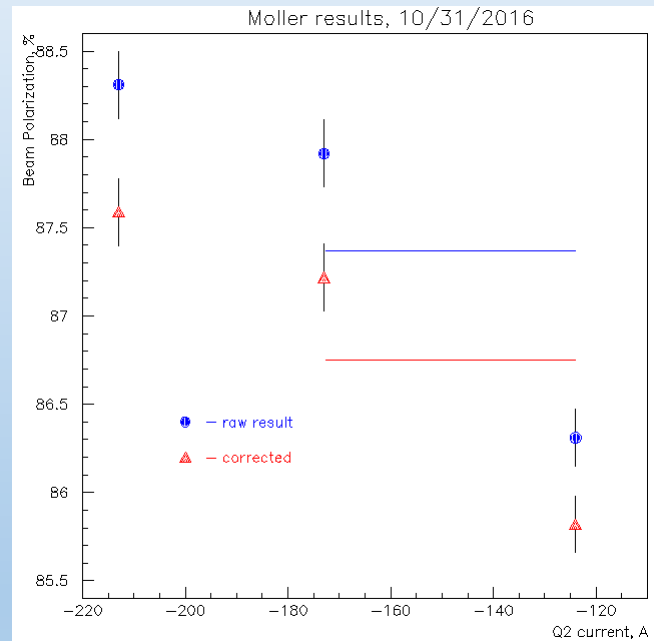
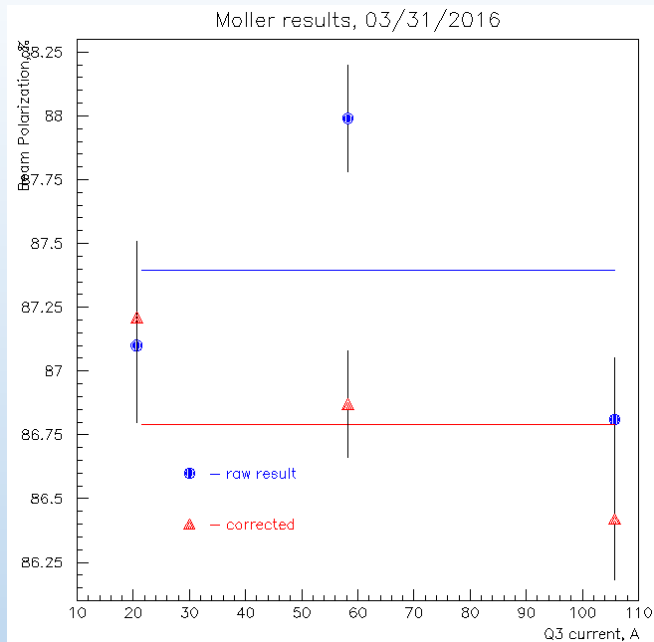


**Old DAQ – since 1997**  
**FADC – since 2010**  
**Use in parallel**  
**Both DAQs have to be upgraded**





# GEANT Corrections

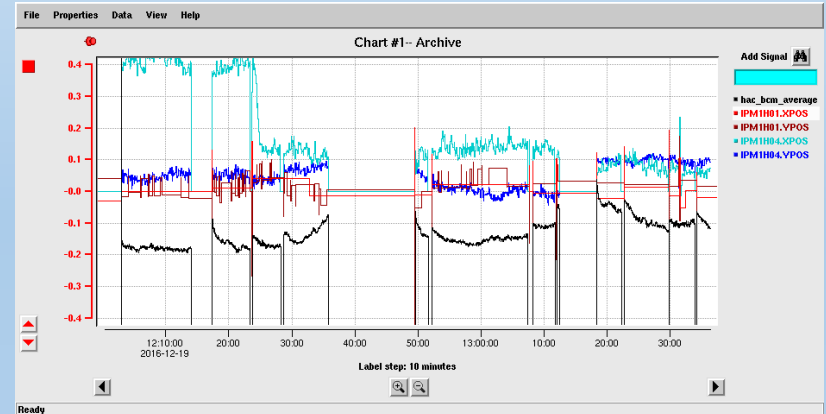
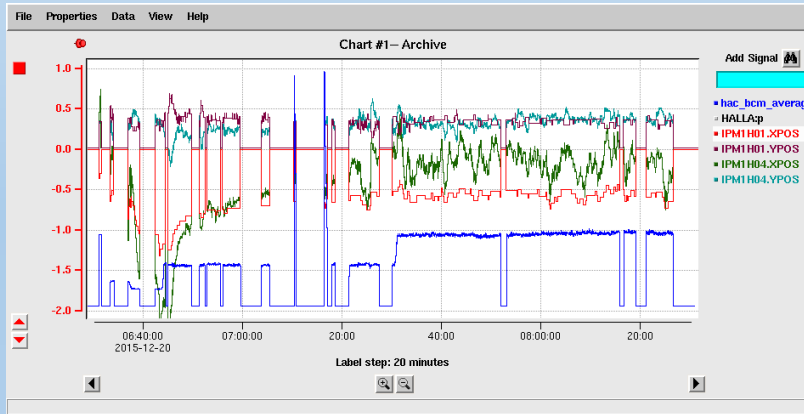
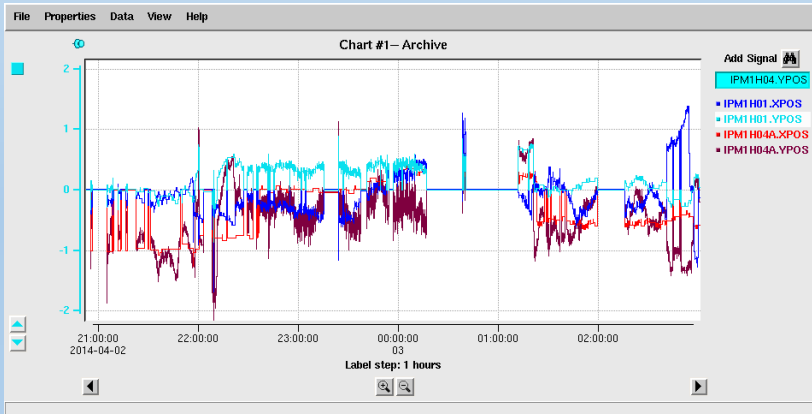
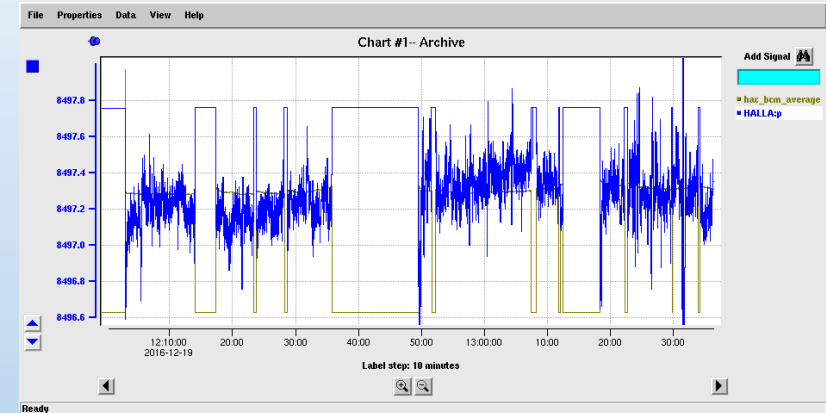
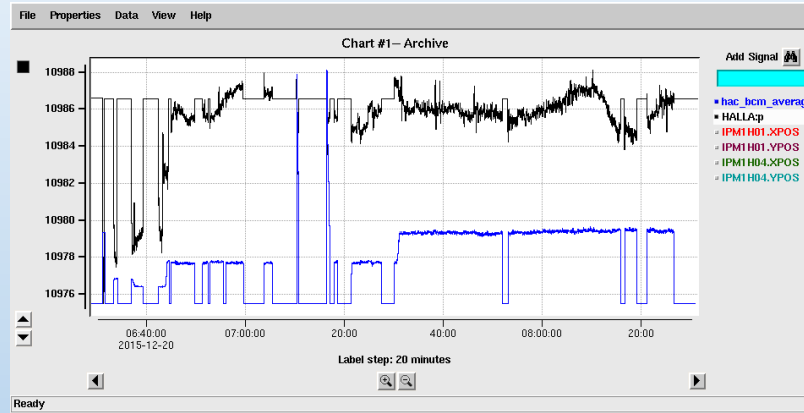
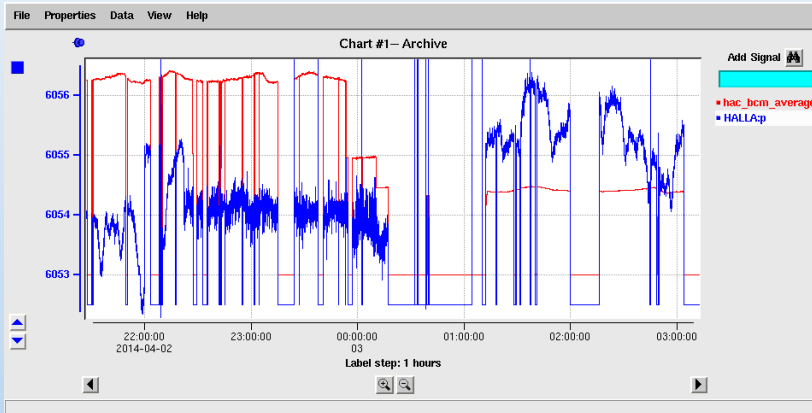


# Beam Energy/Position Stability

2014

2015

2016



Required beam position is +/-0.1mm at BPM 1H01 and 1H04

# Systematical Error Budget

Variable	Tilted	Brute force
<i>Target polarization</i>	2.0%	0.5%
<i>GEANT</i>	0.5%	0.5%
<i>Target temperature</i>	0.2%	0.2%
<i>Dead time</i>	0.05%	0.05%
<i>Background</i>	0.3%	0.3%
<i>High beam current</i>	0.2%	0.2%
<i>Stability</i>	0.5%	0.5%
<b><i>Total:</i></b>	<b>2.2%</b>	<b>1.0%</b>

# Summary of the Møller measurements for E12-114 DVCS

#	Date	Beam energy, GeV	Beam polarization, %		Error, %		Target
			Raw	Corrected	Stat.	Syst.	
1	04.02.2014*	6.064	-55.03	-	+/-0.11	-	Tilted
2	12.08.2014	7.375	+86.19	+84.58	+/-0.25	+/-2.2%	Tilted
3	03.08.2015	9.753	+80.50	+80.24	+/-0.16	+/-2.2%	Tilted
4	04.23.2015	2.056	-89.39	-89.42	+/-0.12	+/-2.2%	Tilted
5	04.24.2015	2.056	-89.78	-89.18	+/-0.16	+/-2.2%	Tilted
6	12.18.2015*	11.023	-	-	-	-	Brute force

**1. 04.02.2014 - The first measurement after the upgrade. Demonstration that all systems of the polarimeter are working. Any corrections are useless due to very bad beam position and energy stability/knowledge.**

**6. 12.18-20.2015 - New "Brute force" target commissioning. Beam polarization unknown due to unknown target angle/polarization.**

# Summary of the Møller measurements for E12-114 DVCS

#	Date	Beam energy, GeV	Beam polarization, %		Error, %		Target
			Raw	Corrected	Stat.	Syst.	
7	02.17.2016	4.477	+87.78	+86.68	+/-0.10	+/-1.0%	Brute force
8	02.19.2016*	4.477	-	-	-	-	-
9	02.29.2016*	8.837	+87.66	+86.95	+/-0.20	+/-1.0%	Brute force
10	03.31.2016	10.985	+87.40	+86.79	+/-0.14	+/-1.0%	Brute force
11	04.19.2016*	10.982	+88.92	+88.19	+/-0.13	+/-1.0%	Brute force
12	10.31.2016	8.495	+87.37	+86.75	+/-0.10	+/-1.0%	Brute force
13	11.28.2016	10.590	+85.81	+85.39	+/-0.11	+/-1.0%	Brute force
14	12.07.2016	10.591	+84.61	+84.18	+/-0.10	+/-1.0%	Brute force
15	12.19.2016	8.498	+86.78	+86.20	+/-0.10	+/-1.0%	Brute force

**8. 02.19.2016 - Beam charge asymmetry test.**

**9. 02.29.2016 - Mini spin dance.**

**11. 04.19.2016 - Beam passed through the Compton chicane.**

***Thank You  
and  
Good Luck!***