Measurement of Deuteron PVDIS Asymmetry at 6 GeV

Xiaoyan Deng
University of Virginia
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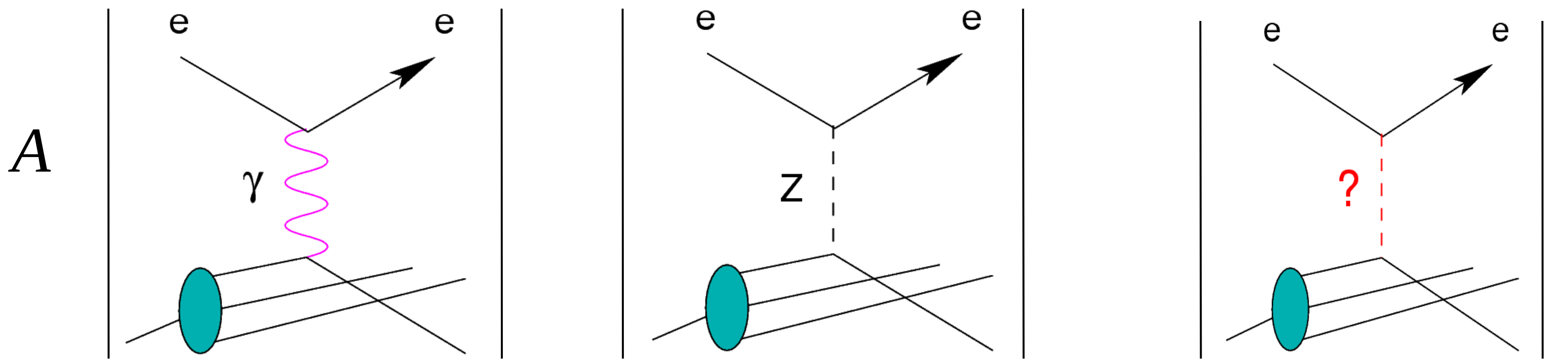
Will discuss about:

- The Physics of PVDIS
- Experimental Setup and General Summary of the Running
- Expected Results and Uncertainties
- On-Going Data Analysis – Deadtime Measurement
- Deadtime extraction from rate scan
- Deadtime extraction from the tagger data

The Physics of PVDIS at 6 GeV (E08-011)

- Measure PVDIS asymmetry on a deuterium target, A_d, at Q^2=1.10 and 1.90 GeV^2 to 2% (stat.);
  - From Q^2=1.10 can help to investigate if there are significant HT effects;
    — "Baseline" measurement for the future 12 GeV program.
  - If HT is small, from Q^2=1.90 GeV^2 can extract $2C_{2u}-C_{2d}$ to ±0.033, a factor of 7.4 improvement;
- Total request 46 days, with 13 days approved (A-), $\Delta(2C_{2u}-C_{2d})$= ±0.066.

PVDIS Asymmetries



- Deuterium:

$$A_d = (540\ ppm) Q^2 \frac{2C_{1u}[1+R_C(x)] - C_{1d}[1+R_S(x)] + Y(2C_{2u} - C_{2d})R_V(x)}{5 + R_S(x) + 4R_C(x)}$$

$$C_{1u} = g_A^e g_V^u = -\frac{1}{2} + \frac{4}{3}\sin^2(\theta_W) \qquad C_{2u} = g_V^e g_A^u = -\frac{1}{2} + 2\sin^2(\theta_W)$$

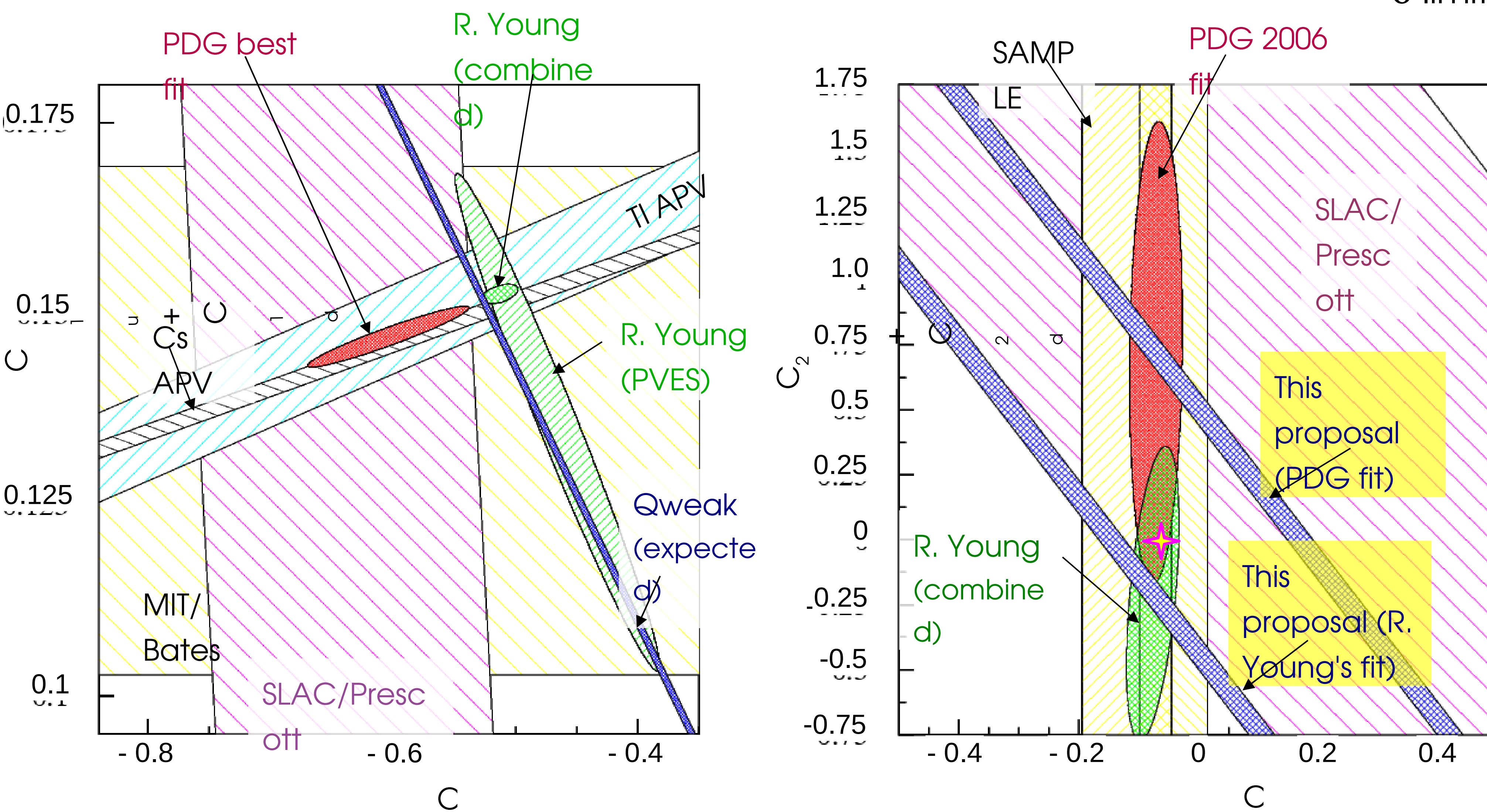
$$C_{1d} = g_A^e g_V^d = \frac{1}{2} - \frac{2}{3}\sin^2(\theta_W) \qquad C_{2d} = g_V^e g_A^d = \frac{1}{2} - 2\sin^2(\theta_W)$$

- Can extract $C_{1,2q}$ (and $\sin^2\theta_W$)– discover new physics beyond the SM
- Sensitive to: Z' searches, compositeness, leptoquarks
- Mass limit:

$$\Lambda / g \approx \frac{1}{\left[\sqrt{8}\, G_F \left|\Delta(2C_{2u} - C_{2d})\right|\right]^{1/2}} \approx 1.0\,\mathrm{TeV}$$

Current Knowledge on $C_{1,2q}$ (new)

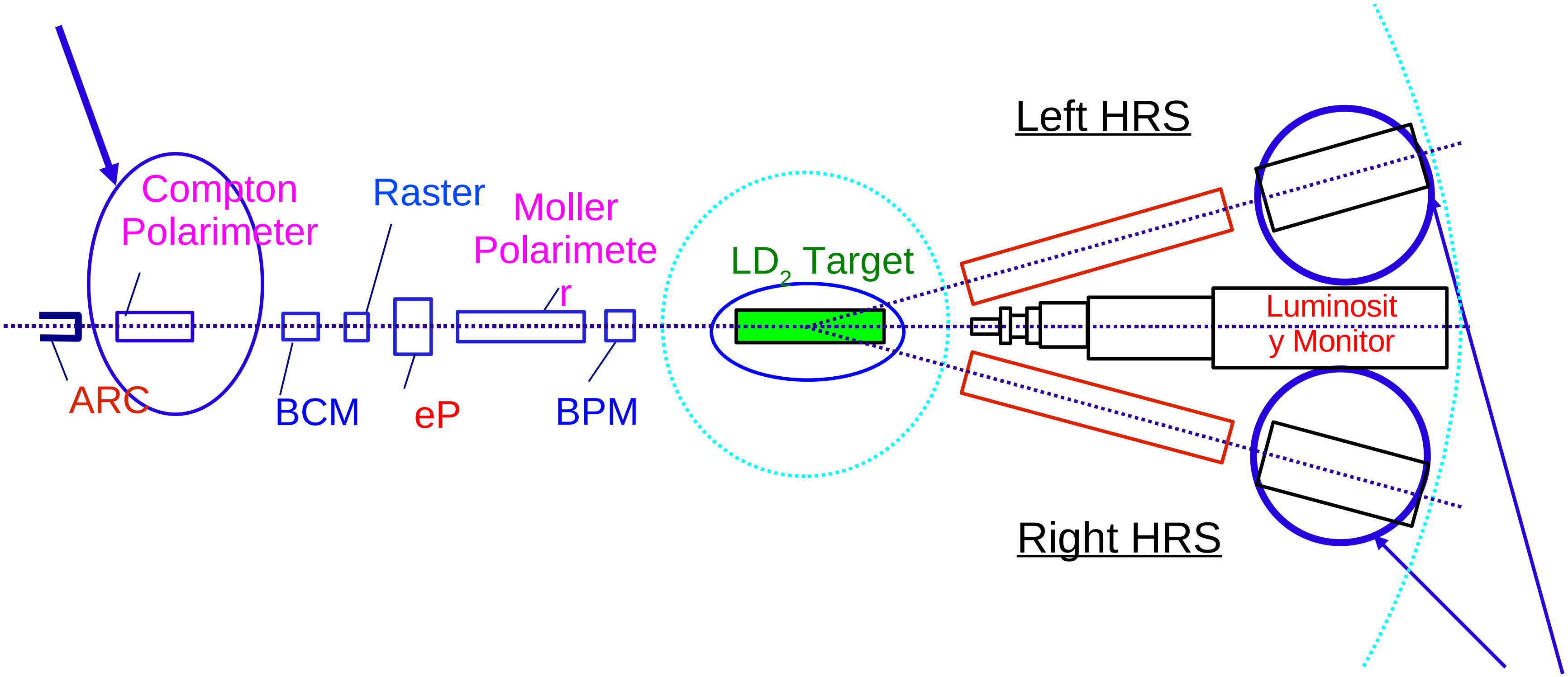
all are 1 σ limit



- Best: PDG2002 $\Delta(2C_{2u}-C_{2d}) = 0.24 \rightarrow$ factor of 7.4 improvement (same as PR05-007);

In Addition to the Standard Hall A Setup

- Expected Precision: 1~2%



- fast-counting DAQ, design goal: 1MHz; (scaler-based, partially w/ FADC)

Kinematics

Kinematics	I	II
x_{bj}	0.25	0.3
Q^2 (GeV/c)^2	1.11	1.9
E_{beam} (GeV)	6.0	6.0
E' (GeV)	3.66	2.63
θ(°)	12.9°	20.0°
W^2 (GeV)^2	4.16	5.30
Y	0.470	0.716
R_C	<0.001	0.001
R_S	0.052	0.041
R_V	0.872	0.910
A_d (measured, ppm)	-91.3	-160.7
e^- rate/HRS (kHz)	269.8	25.1
π^-/e^- ratio	0.9	6.4
e^+/e^- ratio	0.073%	0.463%
Total rate/HRS (kHz)	513.0	186.2

Expected Uncertainties on A_d

Source \ $\Delta A_d/A_d$	Q^2=1.1 GeV^2	Q^2=1.9 GeV^2
$\Delta P_b/P_b$=1%	1.0%	1.0%
Deadtime correction	0.3%	0.3%
Target endcap contamination	0.4%	0.4%
Target purity	<0.02%	<0.02%
Pion background	<0.2%	<0.2%
Pair production background	<0.2%	<0.2%
Systematics	1.36%	1.36%
Statistical	2.11%	2.09%
Total	2.52%	2.49%

now 5mil Al (was 3mil Be)

Deadtime Measurement – Before the experiment

- A scaler-based counting data acquisition (DAQ) system is used for the first time in Jlab
- Before the experiment, a series of tests have been performed to determine the new DAQ system's deadtime (will show Ramesh's one figure in the spin conference)

Deadtime Measurement – extraction from rate scan

- Ideally, $Rate = aI(1-DT)$, where $DT = aI \times \omega$, a is a positive constant related to the whole physics, and ω is the deadtime expressed in width. $BCM = bI$, then

$$Rate/BCM = aI(1-aI\omega)/bI = a/b - a^2\omega \times BCM/b^2$$

Deadtime Measurement – extraction from tagger data

Idea: a pulser signal with rate R mixed with a PMT signal was input to PVDIS DAQ. The output trigger was ANDed with the tagger giving R0 as the output. So DT=1-(1-p)R0/R, where p is a correction factor for the pileup effect. (will add a tagger diagram)