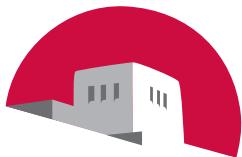


SpinFest 2013 Introduction



UNNM

Aaron Key

SpinFest (RIKEN)

July 2013

Introduction

About Me

Personal

- わたしのなまえわ・アーロン・でづ
- Likes/Hobbies: Travel, Photography, Motorcycles, Electronics/Programming

Education

- Licenciado en Física - Universidad de Granada (España, 2010)
- Ph. D. - University of New Mexico (USA, 2010-Present)



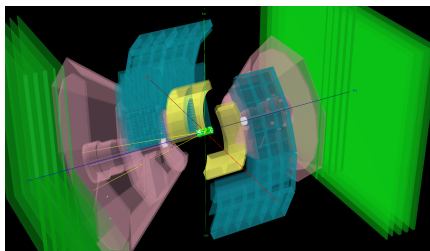
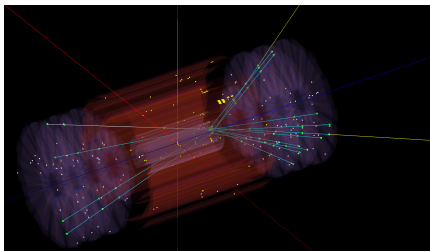
Previous Work

Where you might know me from...

FVTX

- Commissioned the FVTX in 2012 w/ Jin Huang
- “Expert GUI” control and debugging tool
- Reconstruction software:
 - Expanded tracking acceptance by adding VTX hit information ($\sim 25\%$)
 - Hough transform/STL based tracking algorithm (20 – 40x speed improvement)
 - Further expanded acceptance by introducing two hit tracking (enabled in Run13 prod.)
- Designed and implemented FPGA based luminosity monitor upgrade for Run13

I also seem to have a small obsession with 3D event displays ...



Expert GUI

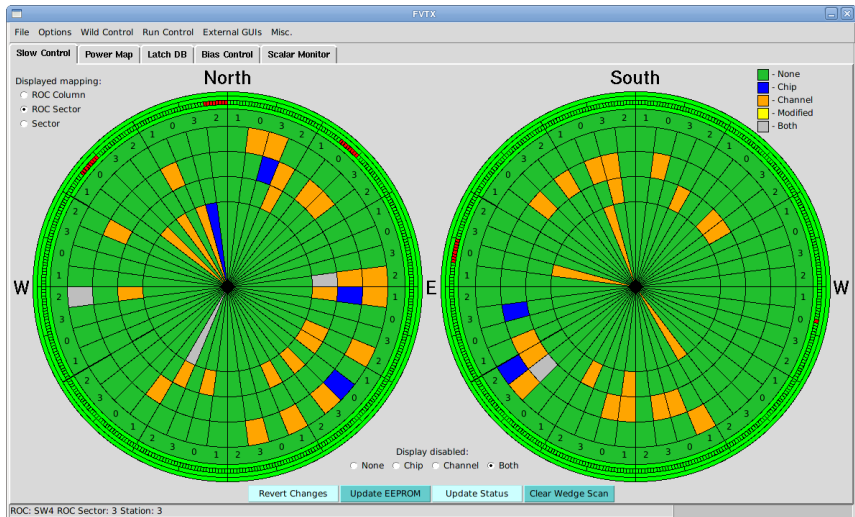
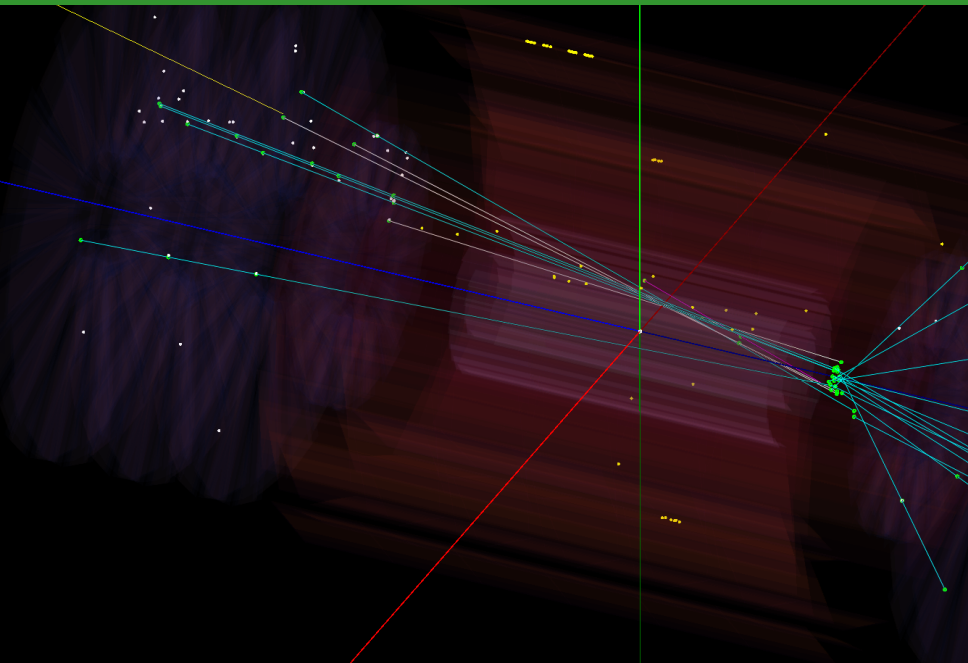
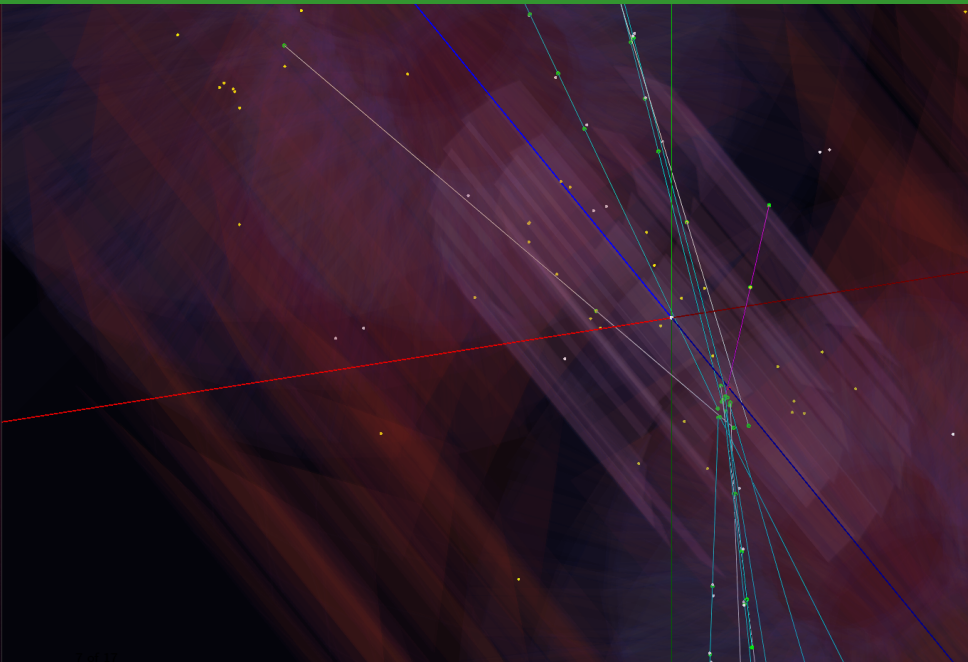
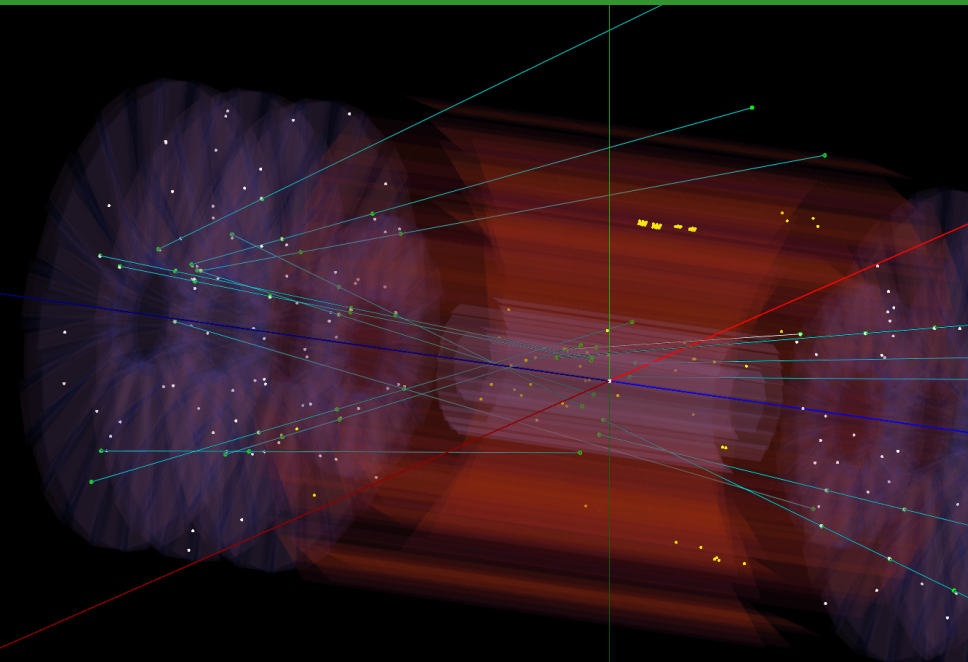


Figure: Slow Control interface to FVTX DAQ status evaluation and chip parameter management

Tracking Improvements

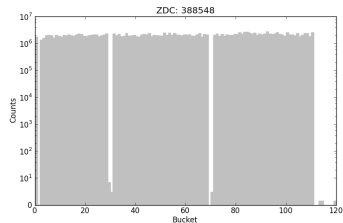
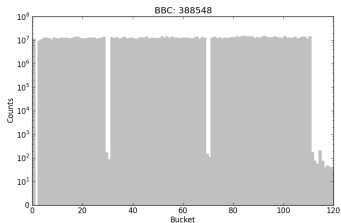
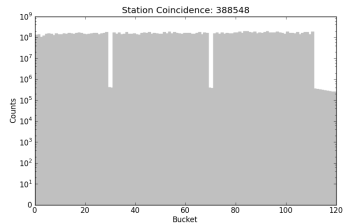
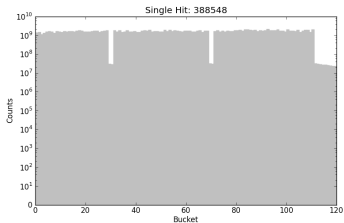






FVTX Relative Luminosity

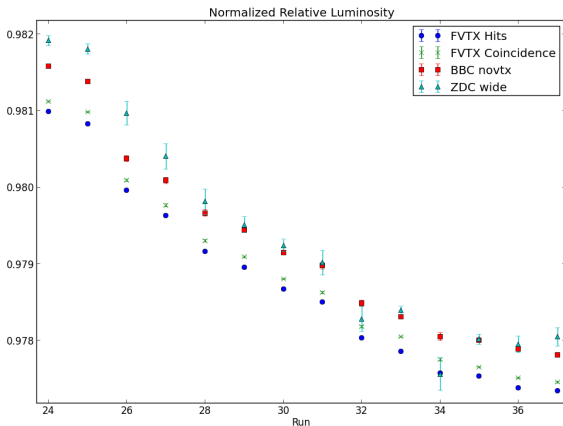
Raw Counts



Backgrounds

FVTX Single	FVTX Coinc.	BBC	ZDC
$\mathcal{O}(10^{-2})$	$\mathcal{O}(10^{-3})$	$\mathcal{O}(10^{-5})$	$\mathcal{O}(10^{-6})$

Relative Luminosity: Run13



Detail

- Star scalars are used for the ZDC and BBC information, rate corrected
- Overall very good agreement with existing luminosity detectors, no corrections!

Physics Analysis

J/ψ A_{LL} and cross section at 510 GeV

Motivation

Gluon Polarization

At RHIC energies J/ψ 's are predominantly produced through gluon-gluon interaction

Factorization for J/ψ production (LO)

$$\sigma(pp \rightarrow J/\psi X) = g(x_1)g(x_2) \otimes \hat{\sigma}^{gg \rightarrow c\bar{c}}(\hat{s}) \otimes D_{c\bar{c}}^{J/\psi} + \dots$$

Thus, the asymmetry in production is sensitive to gluon polarization

A_{LL} for J/ψ production (LO)

$$A_{LL} = \frac{\Delta\sigma}{\sigma} \sim \frac{\Delta g(x_1)}{g(x_1)} \frac{\Delta g(x_2)}{g(x_2)} \otimes \hat{a}_{LL}^{gg \rightarrow c\bar{c}}$$

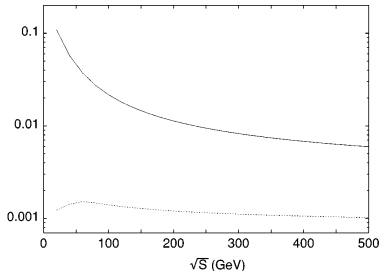


Figure: Ratios of unpolarized (solid) and polarized (dashed) $q\bar{q}$ and gg process luminosities as a function of c.m. energy \sqrt{S} at $y = 0$.
Phys. Rev. D56 7341

Motivation

Gluon Polarization

For an A_{LL} measurement to be meaningful partonic level asymmetry must be reproduced at NLO accuracy (i.e. What diagrams are involved?)

A_{LL} for J/ψ production (LO)

$$A_{LL} = \frac{\Delta\sigma}{\sigma} \sim \frac{\Delta g(x_1)}{g(x_1)} \frac{\Delta g(x_2)}{g(x_2)} \otimes \hat{a}_{LL}^{gg \rightarrow c\bar{c}}$$

The production mechanism for the J/ψ from the $c\bar{c}$ pair remains an open question

Bottom Line

- None of the models completely describe the data
- Measurement of J/ψ cross section at 510 GeV is an important intermediate data point in the production mechanism search

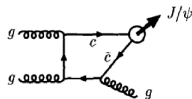


Figure: Color singlet diagrams for J/ψ production at LO (left) and from fragmentation (right)

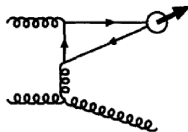


Figure: Color octet diagrams for J/ψ production at LO (left) and from fragmentation (right)

Recent Results

Global Fit: DSSV++

Data Sets

- DSSV : pDIS & RHIC '05-'06
- DSSV+ : DSSV & COMPASS
- DSSV++: DSSV+ & RHIC 2009

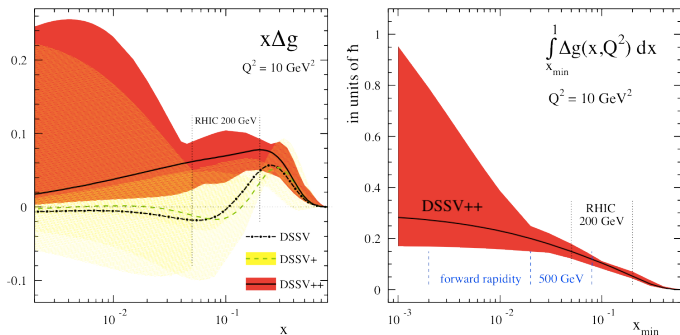


Figure: Uncertainties in $\Delta g(x)$ with (red band) and without (yellow band) RHIC 2009 data (left) and in the integral computed in the range from x_{min} to 1 (right) at a scale of 10 GeV^2 .

Current Results

J/ψ A_{LL} : Run5 & Run6

Limitations

- Run5 and Run6 measurements are highly statistically limited in comparison to the size of the asymmetry to be measured.
- Due to the nature of the detector, combinatoric dimuon pairs produce a substantial background in the J/ψ mass region that is subtracted statistically.
- FVTX can help reduce background, or at very least uncertainty in background characterization

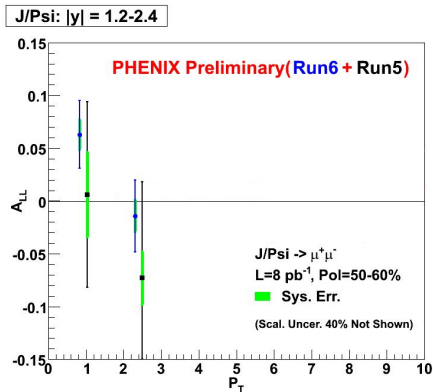


Figure: J/ψ A_{LL} as measured at PHENIX during Run5/6 in pp collisions at 200 GeV at forward rapidity. Theoretical curves shown are for outdated polarized PDFs. (unpublished)

J/ψ Cross Section

PHENIX Results

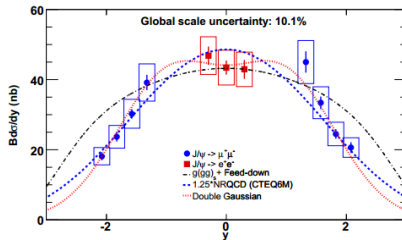
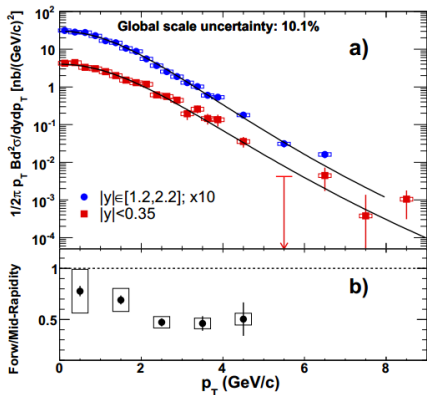


Figure: Differential cross section measurement from PHENIX for J/ψ at mid and forward rapidity for Run5 data versus transverse momentum with phenomenological fits (left) and rapidity with pQCD, NRQCD and empirical double gaussian fits (right). Adare et al., Phys. Rev. Lett., 98(23)