Status of *W* physics at PHENIX

on behalf of the PHENIX collaboration

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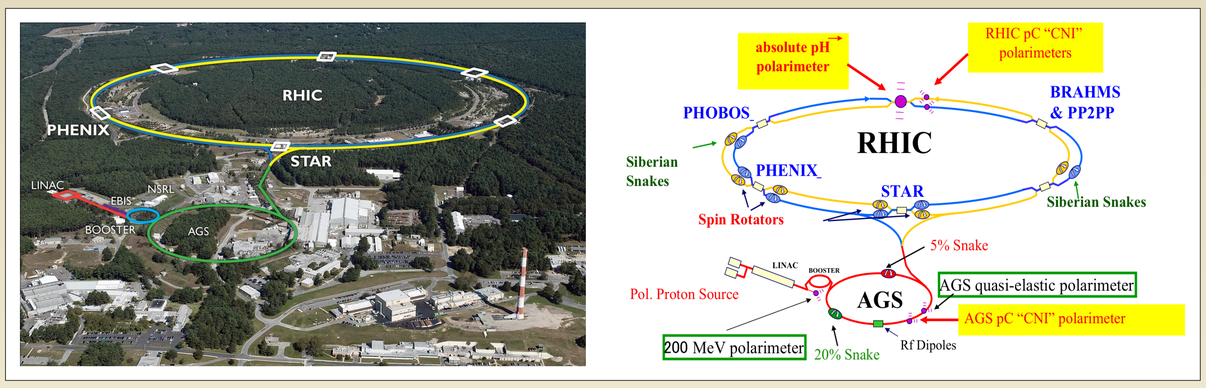
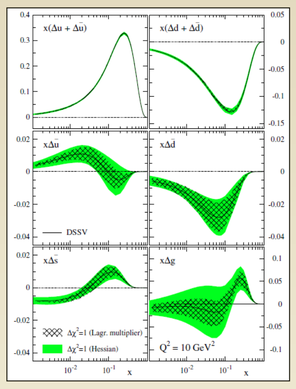
RHIC and PHENIX



- **RHIC** (**R**elativistic **H**eavy-**I**on **C**ollider) at BNL, NY, US:
  - Max. $\sqrt{s_{NN}}$ (GeV): 510 (pp) / 200 (AA)
  - Peak luminosity ($cm^{-2}\,s^{-1}$): 1.65×10^{32} (pp, Run 12) / 5.0×10^{27} (AA, Run 11)
  - The only machine capable of colliding high-energy polarized proton beams
- **PHENIX** (**P**ioneering **H**igh-**E**nergy **N**uclear **I**nteractions e**X**periment):
  - One of the two ongoing physics experiments at RHIC

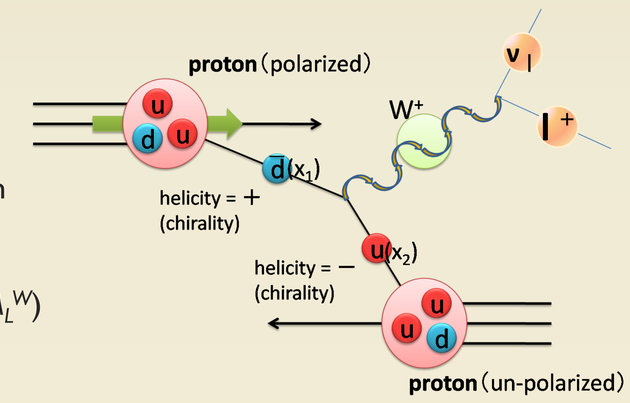
W physics at RHIC



D. de Florian et al, PRD 80. 034030 (2009)

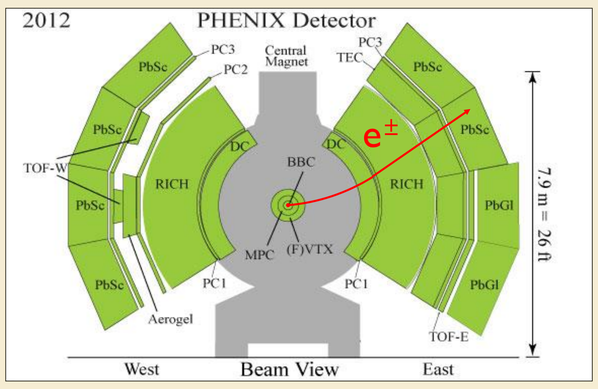
- **Motivation: full flavor separation of $< S_p >$**
  - $< S_p > = \frac{1}{2} = \frac{1}{2}\Delta\Sigma + \Delta G + L$
  - $\Delta\Sigma = \int dx\,(\Delta u + \Delta d + \Delta s + \Delta\bar{u} + \Delta\bar{d} + \Delta\bar{s})$
  - Sea anti-quark polarization $\Delta\bar{u}$ & $\Delta\bar{d}$: only known with large uncertainties due to limit of Semi-Inclusive DIS via Fragmentation Functions
- ***W* physics at RHIC:**
  - Parity violating $W^{\pm}$ Boson production by using polarized pp collision
  - Observable: Single spin asymmetry (A_L^W)

$$A_L^W = \frac{1}{P} \times \frac{N^L(W) - N^R(W)}{N^L(W) + N^R(W)}$$



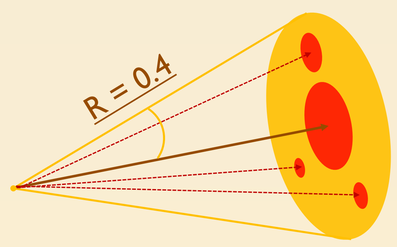
W Measurements in PHENIX

Central Arm: Hadrons, Photons and Electrons

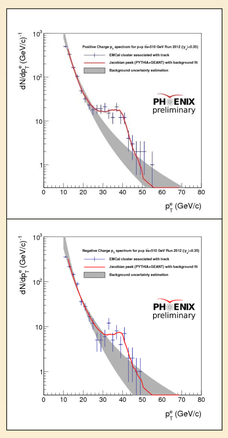


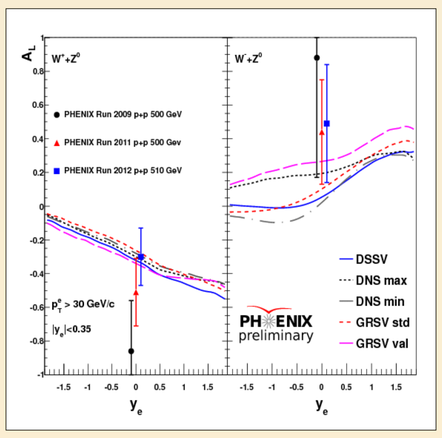
- **Acceptance:**
  - $|\eta| < 0.35$
  - $\Delta\Phi = \frac{\pi}{2} \times 2$
- **Subsystems:**
  - Tracking: DC and PC
  - Calorimetry and Triggering: EMCal
  - AxialB field: 0.78 (T·m)

- **Central arm analysis: Jacobian peak at $p_T \sim \frac{M_W}{2}$**
  I. Collect high energy $e^{\pm}$ events matched to charged track
  II. Background exclusion: relative isolation cut

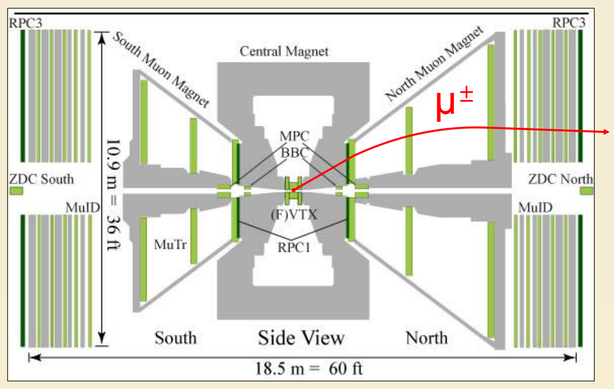


$$\frac{E_{cone} - E_{candidate}}{E_{candiate}} < 10\ (\%)$$



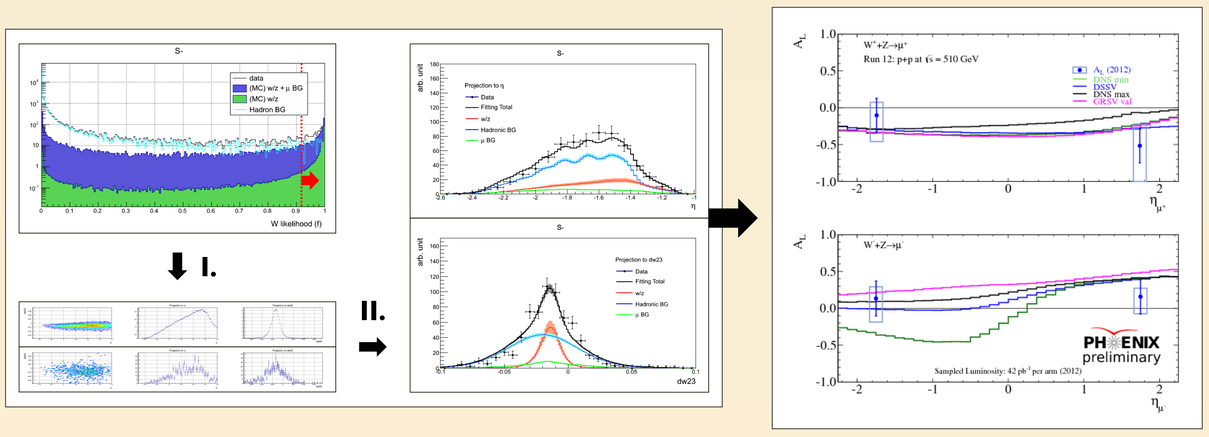


Muon Arm: Muons



- **Acceptance:**
  - $1.2 < |\eta| < 2.2$ (S) or 2.4 (N)
  - $\Delta\Phi = 2\pi$
- **Subsystems:**
  - Tracking: MuTR
  - Triggering and PID: MuID and RPC
  - Radial B field: 0.72 (T·m) at $\theta = 15°$

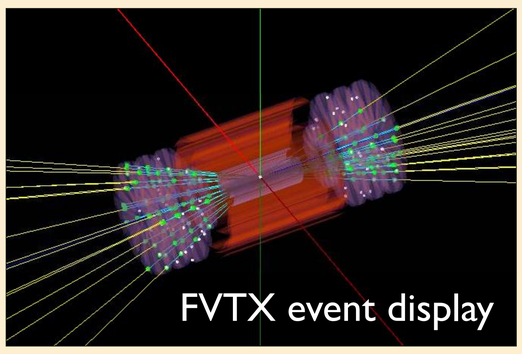
- **Muon Arm analysis: likelihood signal extraction**
  I. Pre-selection: multivariate cut using likelihood ratio
  II. S/BG ratio estimation: extended unbinned maximum likelihood fit



Conclusions and Prospects

- **Fruitful experiments of 4 years: high statistics accumulated**
- **Improved S/BG estimation with FVTX**
  - Fully commissioned and operational in Run 13
  - Improvement is possible: multi-vertex finder and isolation cut

Year	√s (GeV)	∫ *L* dt (pb^{-1})	Pol. (%)
2009	500	8.6	39
2011	500	16	48
2012	510	30	55
2013	510	~156	~54



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