

Drell-Yan Production at PHENIX

Status and Plan

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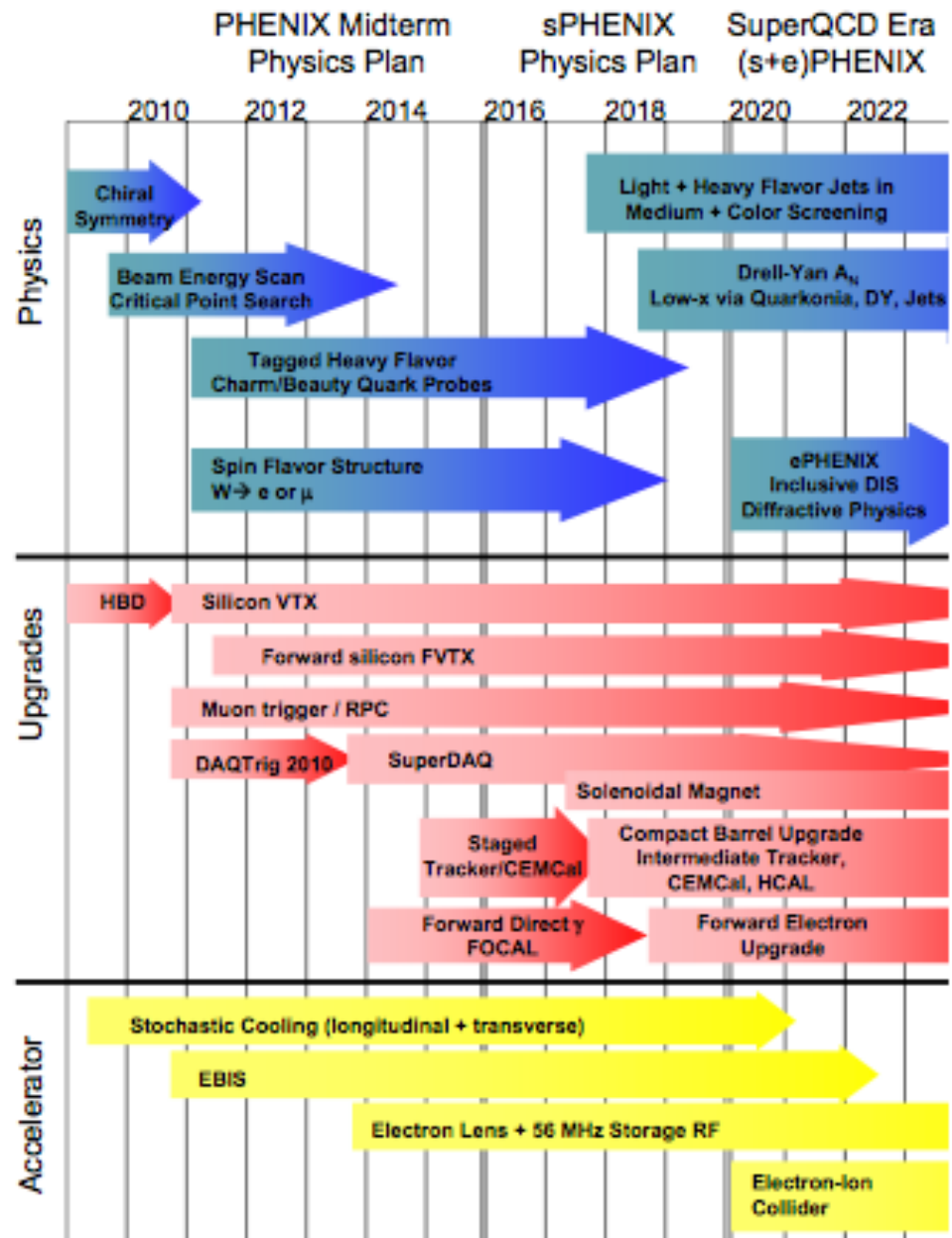
Abstract:

We present the current status and plan for Drell-Yan measurements at PHENIX for next decade. Initial feasibility studies of Drell-Yan production have been carried out with the soon available central and forward vertex upgrade detectors in the dielectron and dimuon channels. Significant luminosity, order of 250 pb^{-1} , is required in order to test and confirm the sign change (or not) in transverse single spin asymmetry (TSSA) in Drell-Yan production in the forward muon arm coverage. In the next five years, PHENIX will carry out Drell-Yan measurements at least to benchmark the cross sections in the PHENIX central electron and forward muon arms covered rapidity ranges from the expected high luminosity longitudinally polarized 500 GeV p+p collisions as well as from transversely polarized 200GeV p+p runs.

Beyond the next 5 years, we have identified new areas of investigation related to the fundamental properties of the sQGP, and to transverse spin physics, that require major new detector capabilities. PHENIX has an ambitious upgrade plan to significantly improve physics capability in the very forward region. The proposed sPHENIX detectors will replace the current PHENIX central magnets with a compact solenoid; in the forward direction, one of the current muon arm (south arm) will be replaced with a new large-acceptance forward spectrometer ($\eta=2\sim 4$) with excellent PID for hadrons, electrons, and photons and full jet reconstruction capability. This will enable us for the future eRHIC physics also. Drell-Yan production and asymmetry will be studied in the di-electron channel in a very forward rapidity range that goes beyond the current PHENIX muon arm coverage where significant TSSA A_N is expected. Detailed MC simulation work with sPHENIX is underway to study the experimental sensitivity to TSSA in Drell-Yan production.

The Timeline

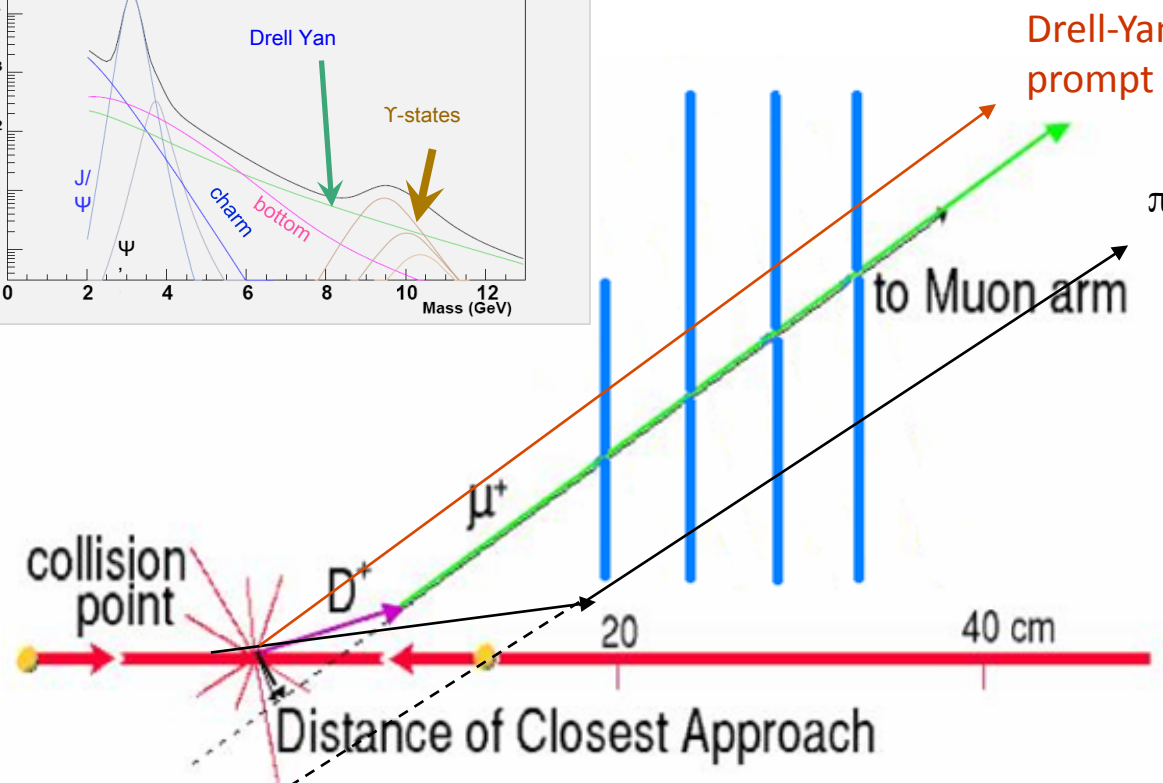
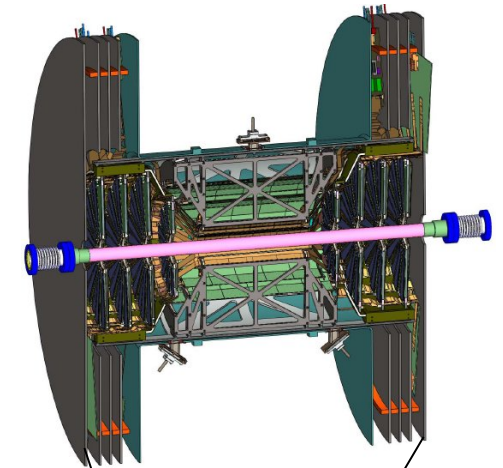
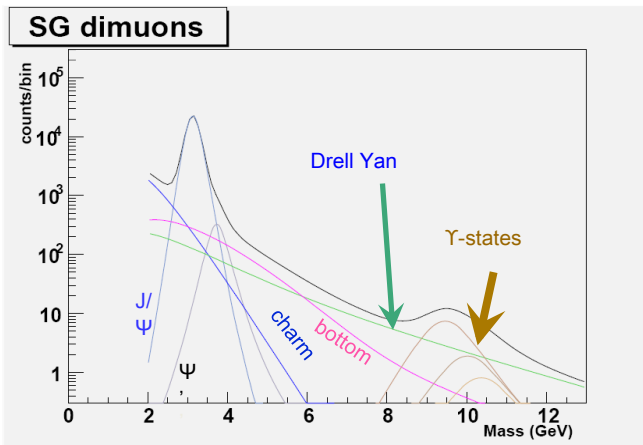
- 2011-2018
 - PHENIX w/upgrades
 - VTX/FVTX
- 2018-20XX
 - sPHENIX
 - Also ready for eRHIC physics



2011-2015: PHENIX Silicon VTX Detectors

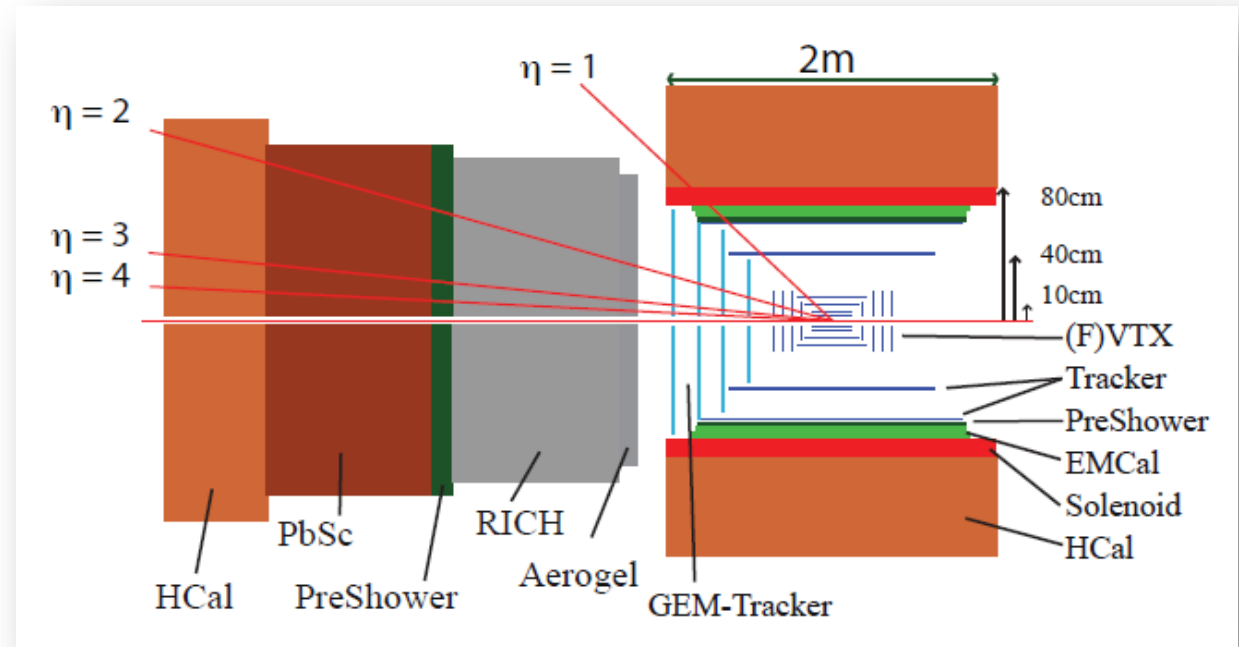
– upgrade on going, will be completed in 2011

- Precision Charm/Beauty Measurements
- $B \rightarrow J/\psi$, Drell-Yan, ψ'



2018+: sPHENIX Forward Detectors

- Optimized for high energy electrons/photons
 - $2 < \eta < 4$
 - e/photon ID
 - Hadron PID
 - eRHIC ready
 - e+p
 - e+A
 - DY via dielectons @ very forward rapidity

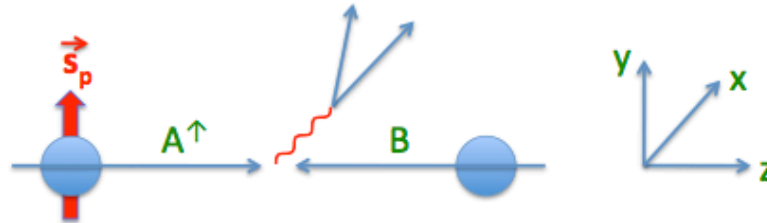


- TRACK has a momentum resolution of $\Delta p/p \approx 2\%$.
- RICH has an electron efficiency of 94% for $p > 10 \text{ GeV}/c$.
- EMCal has the resolution of the current PHENIX PbGl: $5.95\%/\sqrt{E} + 0.76\%$
- HCAL has the resolution: $50\%/\sqrt{E} + 5\%$ (similar to CMS or LHCb)

Predictions for Drell-Yan process at RHIC

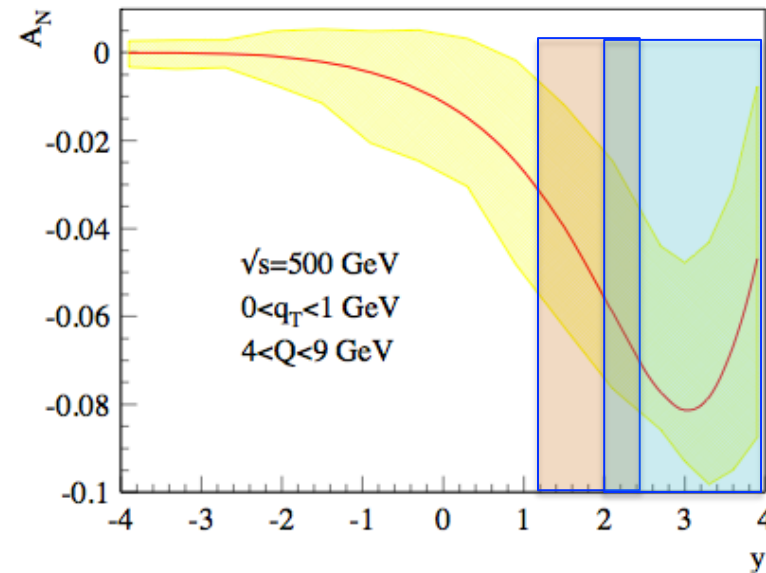
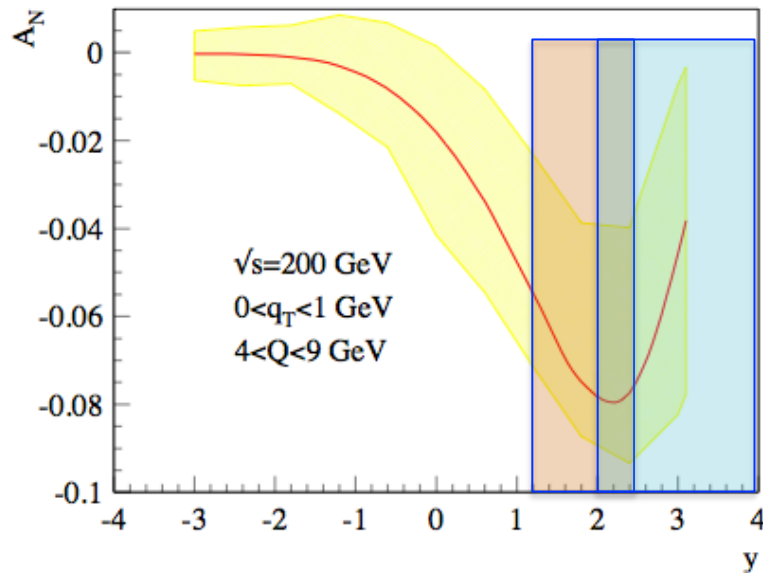
- Reverse the sign of Sivers from SIDIS and make predictions for Drell-Yan production at RHIC

Kang-Qiu, PRD81, 2010



$$A_N \propto \frac{4}{9} \Delta^N u + \frac{1}{9} \Delta^N d < 0$$

- A_N @large rapidities
- PHENIX:
 - $-1.2 < y < 2.4$
 - dimuons
- sPHENIX :
 - $-2 < y < 4$
 - dielectrons



Summary and Outlook

- Drell-Yan is a powerful tool complimentary to the DIS for exploring parton structures in nucleons and nuclei.
- PHENIX VTX/FVTX upgrades make Drell-Yan measurements possible
 - Central arms via electrons
 - Forward muon arms
 - Some asymmetry measurements (Boer-Mulders alike) possible from upcoming high luminosity longitudinally polarized pp @500GeV
- Possible Test of Drell-Yan A_N sign change @200GeV and @500GeV after longitudinal W program, likely after 2017 with forward muon arms
 - much improved luminosity needed
- sPHENIX upgrade (2018+)
 - Extend the coverage to very forward rapidity $\eta = 2\sim 4$
 - Test sign change in Drell-Yan A_N via di-electrons at very forward rapidity where significant asymmetry expected
- Explore small-x saturation physics at forward rapidity in p(d)A