Current Status of Experimental Requirement in Technical Document

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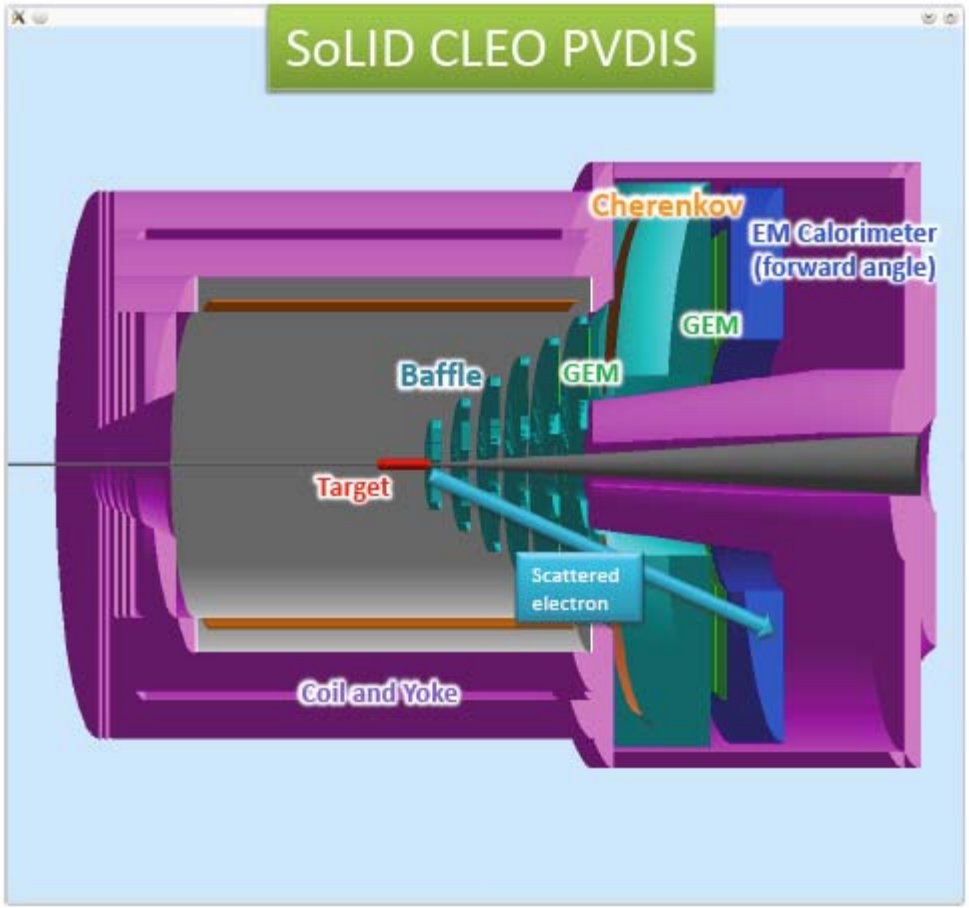
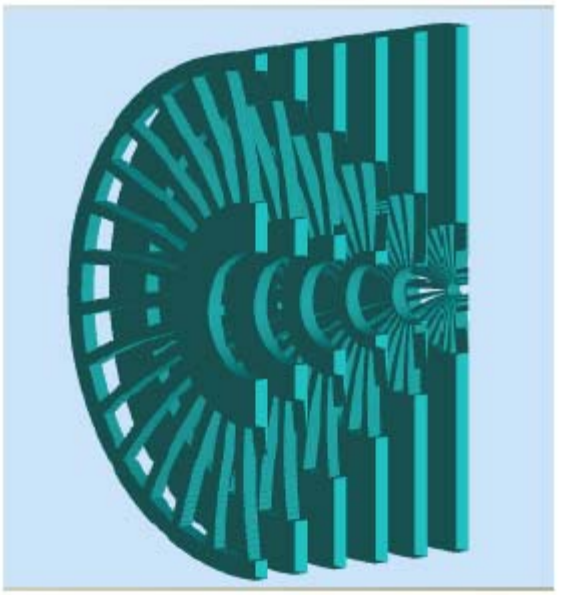
Introduction

- Consistent plots for each configuration (Zhiwen)
- Two tables summarize key features and detector requirements

- We should clarify requirements vs. limitations

SoLID-PVDIS


SoLID CLEO PVDIS
Cherenkov
EM Calorimeter
(forward angle)
GEM
Baffle
GEM
Target
Scattered
electron
Coil and Yoke



Key Information

$$A_{PV}^{phys} \sim \frac{1}{Q^2 \cdot P_{beam}} \cdot \frac{A_{PV}^{measured} - f \cdot A_{PV}^{\pi^-}}{1 - f}.$$

- Phase Space:
  - 20→35 degrees
  - 1.5 → 5.0 GeV (include 6.6 GeV running)
  - 0.2<x<0.8
  - 2 < Q^2 < 12 GeV^2
  - Luminosity 5x10^{38} LH2 1.3x10^{39} LD2
  - ~0.5% relative statistical uncertainties
- Requirements:
  - 0.4% beam polarimetry
  - <0.5% pion contamination determination
  - <0.5% Q^2 calibration
  - Baffle + radiation hardness
- DAQ rate:
  - 15 kHz x 30 sectors
  - Signal: ~ 8 kHz DIS electron per sector

Comments about requirement

- The physics requirement is straight forward
  - Should not be mixed with limitations
- See the example below:
  - Requirement: ~8 kHz DIS electron rate per sector
    - Be included in the data after L3 (to tape)
    - No direct requirement on L1 trigger
  - Limitations to be considered in the design
    - APV25: 3 sample readout → 90 kHz maximum
      - 1 Sample: 280 kHz
    - Crate data transfer limit: 20 kHz → 140 MB < 300 MB
      - 2 Crates → 600 MB
    - Iterations needed, interactions among different sub-groups

One Word about Safety Margin

- Safety margin is linked to the requirement:
  - Example: Know the pion contamination to <0.5% level
    - Assume 200:1 pion/e ratio → 2.5e-5 knowledge in rejection factor by combining calorimeter and gas Cerenkov
    - Guideline: gas Cerenkov 500:1 rejection
      Calorimeter 100:1 rejection
  - Calorimeter working group does the design
    - With **assumptions** in background rate, performance, segmentations and …, one can reach 100:1
    - The safety margin should be estimated from the evaluation of **assumptions**
    - Uncertainty of assumptions should be clearly stated and listed

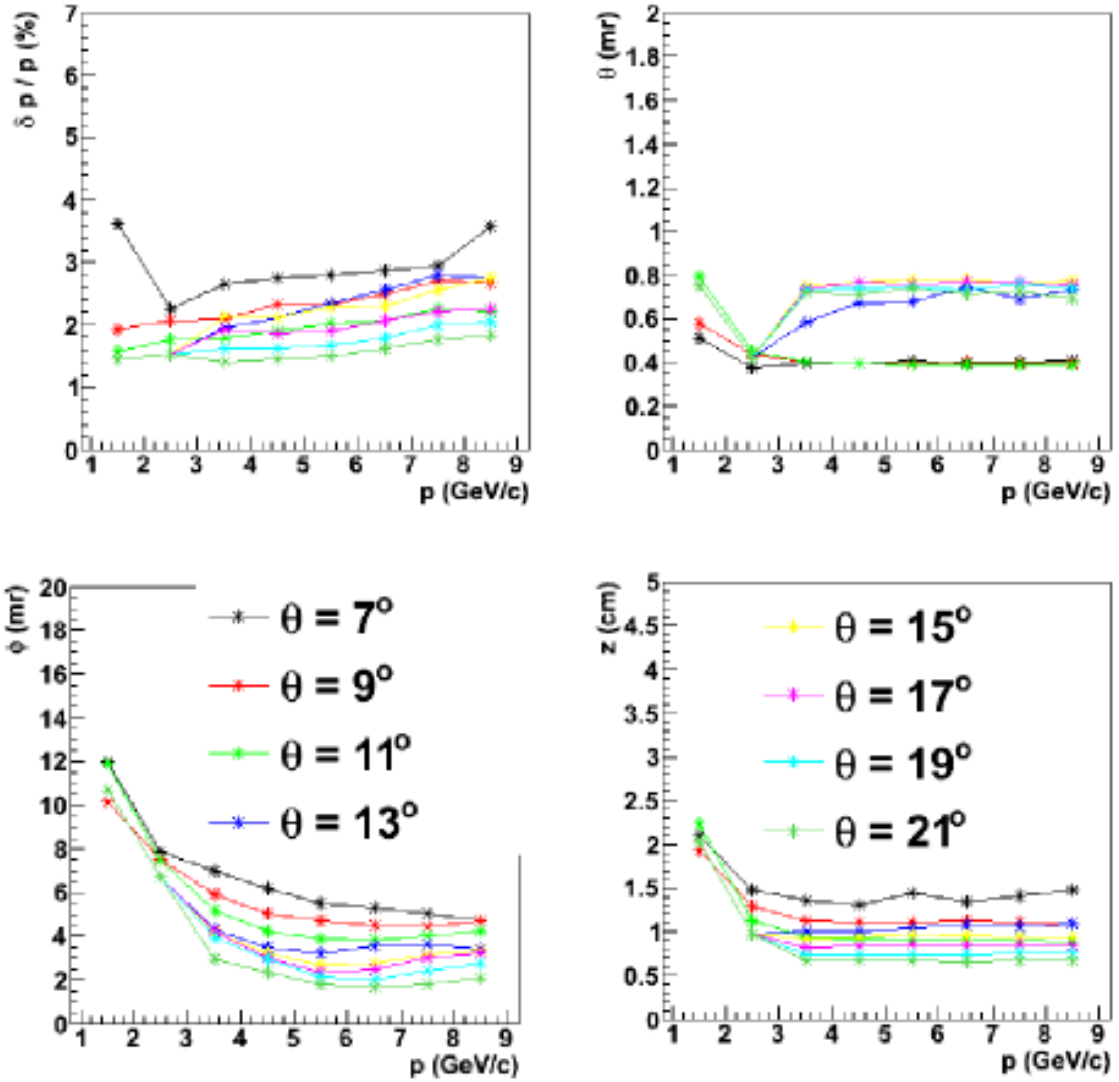
SoLID SIDIS


SoLID CLEO SIDIS
EM Calorimeter
(forward angle)
EM Calorimeter
(large angle)
GEM
Hadron
MRPC
Target
Collimator
Collimator
Scattered
electron
Coil and Yoke
Light Gas
Cherenkov
Heavy Gas
Cherenkov

Key Information

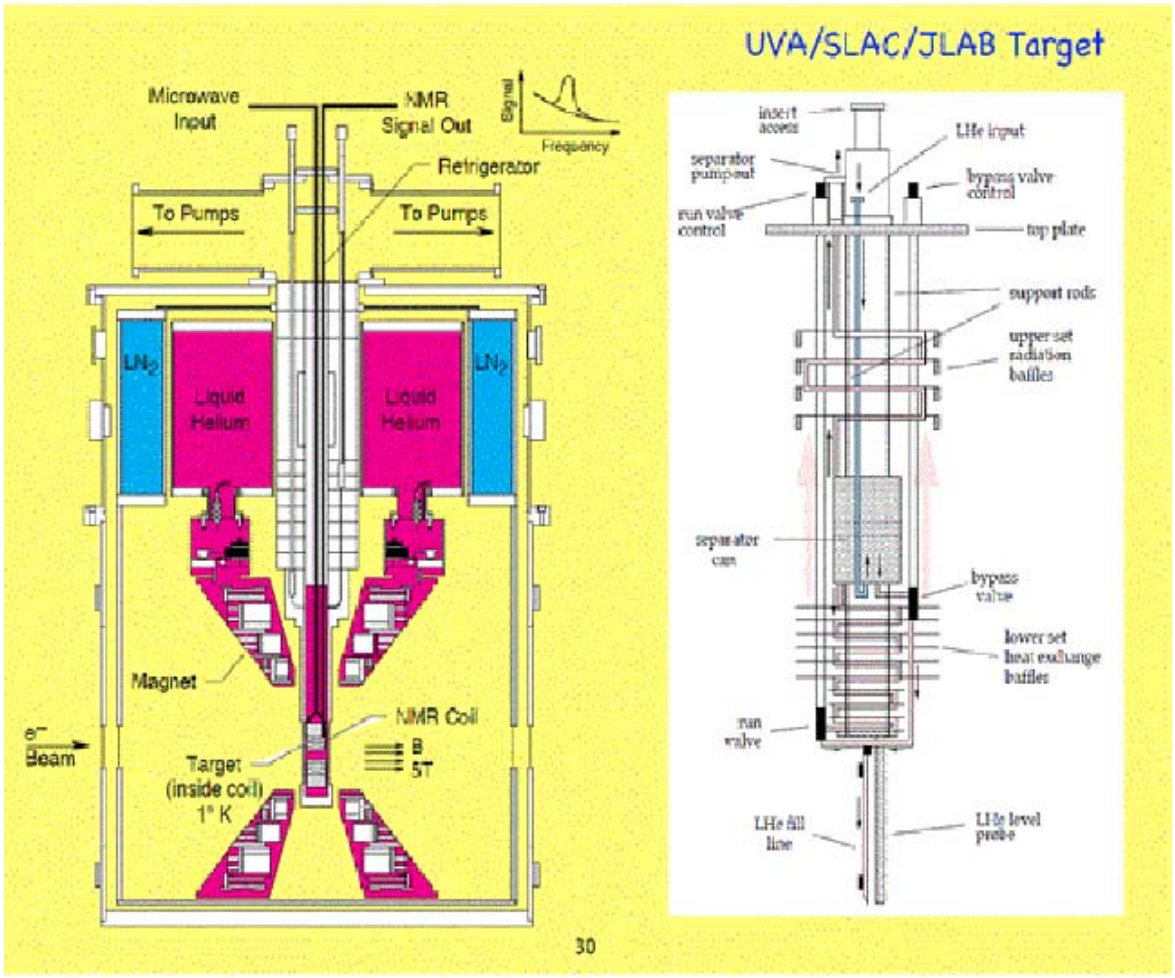
- Kinematics Coverage:
  - 0.05 ~ 0.6 in x (valence)
  - 0.3 ~ 0.7 in z (factorization region)
  - P_T up to ~ 1 GeV (TMD Physics)
  - Fixed target → Q^2 coverage 1-8 GeV^2 (~ 2 GeV^2 in ΔQ^2 at fixed x)
- Polarized ^3He Target:
  - Unpolarized ~ 10^{37} $N/cm^2/s$
  - ~ 60% higher polarization
  - Fast spin flip (<20 mins)
- PID:
  - <1% Pion contamination
  - <1% Kaon contamination
- DAQ:
  - ~ 3kHz Physics Coincidence
  - ~ 120 kHz Single
  - ~ 80 kHz Coincidence

Detector Resolution



- Include multiple scattering from target, air, and GEM chambers

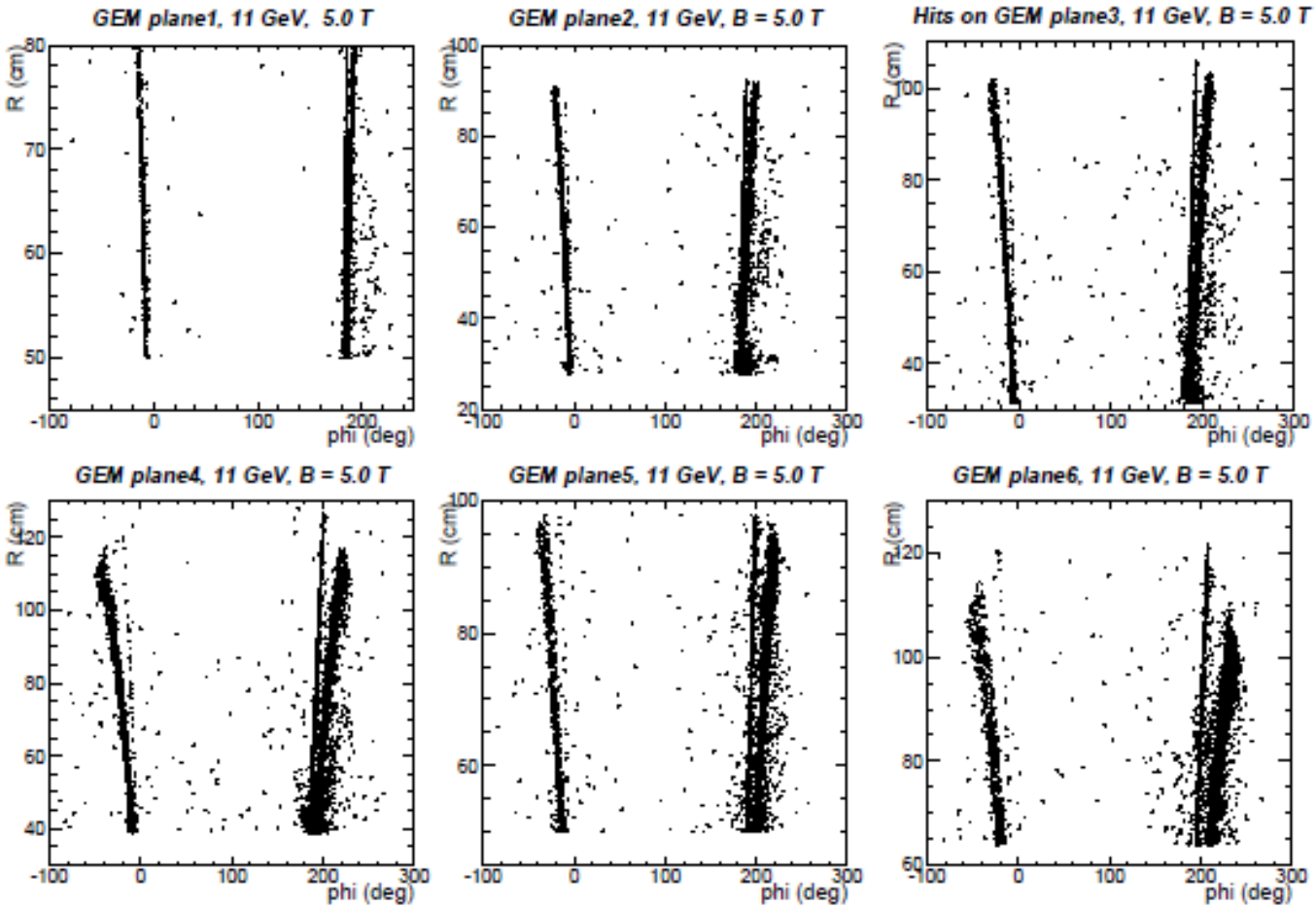
SoLID-proton-SIDIS



- Polarized NH3 Target:
  - Unpolarized ~ 10^{36} N/cm^2/s
  - ~70% higher polarization
  - **Spin flip**

Do we have a plot with better quality?

Sheet of Flames

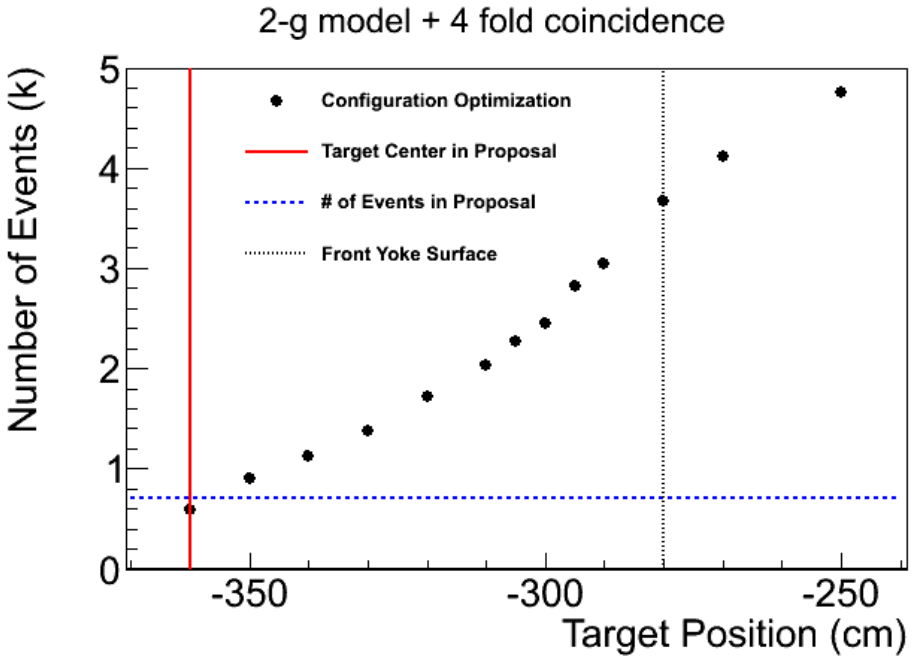


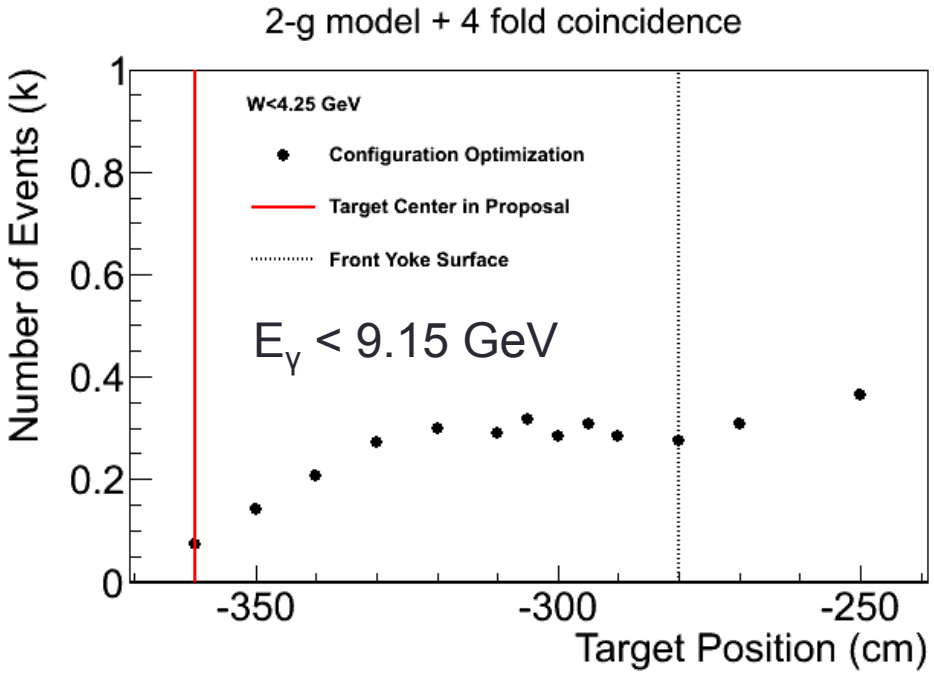
- How to better illustrate this one?
- Shielding or/and removing detectors!

SoLID J/Psi

- Similar design as SIDIS
- DAQ: **Triple Coincidence Trigger**
  - scattered electron, decay electron and decay positron from J/ψ ~ 3 kHz
  - 3 clusters in calorimeters

Configuration Optimization (Zhiwen)





CLEO configuration:

Assume J/ψ target center at -300 cm,
require ~ **4.5%** increment in GEM area
No additional changes to SIDIS configuration
Factor **of 3** increment in FOM
Potential conflict between yoke and target chamber

Program Summary

Table 1: Program Summary

Experiments	PVDIS	SIDIS-^{3}He	SIDIS-Proton	J/ψ
Reaction channel	$p(\vec{e},e')X$	$(e,e'\pi^{\pm})$	$(e,e'\pi^{\pm})$	$e+p\rightarrow e'+J/\Psi(e^-,e^+)+p$
Approved number of days	169	125	120	60
Target	LH_2/LD_2	^{3}He	NH_3	LH_2
Unpolarized luminosity ($cm^{-2}s^{-1}$)	$0.5\times10^{39}/1.3\times10^{39}$	$\sim 10^{37}$	$\sim 10^{36}$	$\sim 10^{37}$
Momentum coverage (GeV/c)	1.5-5.0	0.8-7.0	0.8-7.0	0.6-7.0
Momentum resolution	$\sim$2%	$\sim$2%	$\sim$2%	$\sim$2%
Polar angle coverage (degrees)	21-36	7.5-24	7.5-24	7.5-24
Polar angle resolution	1 mr	0.6 mr	0.6 mr	0.6 mr
Azimuthal angle resolution	-	5 mr	5 mr	5 mr
Trigger type	Single e^-	Coincidence $e^-+\pi^{\pm}$	Coincidence $e^-+\pi^{\pm}$	Triple coincidence $e^-e^-e^+$
Expected DAQ rates	$\sim$15 kHz $\times$ 30	$<$100 kHz	$\sim$10 kHz	$\sim$3 kHz
Backgrounds	Negative Pions	(e,$\pi^-\pi^{\pm}$) (e,e'K$^{\pm}$)	(e,$\pi^-\pi^{\pm}$) (e,e'K$^{\pm}$)	B-H process Random coincidence
Major requirements	Radiation hardness 0.4% Polarimetry π^- contamination Q^2 calibration	Radiation hardness Detector resolution Kaon contamination DAQ	Shielding of *sheet-of-flame* Target spin flip Kaon contamination	Radiation hardness Detector resolution

Missing anything?

Detector Summary

Table 2: Detector Summary

Experiments	PVDIS	SIDIS-^{3}He	SIDIS-Proton	J/ψ
Target	LH_2/LD_2	^{3}He	NH_3	LH_2
Length	40 cm	40 cm	3 cm	15 cm
Target Polarization	N/A	>60%	>70%	N/A
Target Spin Flip	N/A	$\leq$20 mins	$\leq$4 hours	N/A
GEM Tracking Chambers	Four chambers	Six chambers	Six chambers	Six chambers
E&M calorimeter	Forward angle	Forward + Large angle	Forward + Large angle	Forward + Large angle
Light Gas Cerenkov	107 cm long	2.04 m long	2.04 m long	2.04 m long
Baffles	Yes	N/A	N/A	N/A
Heavy Gas Cerenkov	N/A	0.9 m long	0.9 m long	N/A
MRPC (TOF)	N/A	80 ps resolution	80 ps resolution	80 ps resolution
Beam Polarimetry	0.4% determination	a few %	a few %	N/A
Target Polarimetry	N/A	$\sim$ 3%	$\sim$ 3%	N/A
DAQ	Single trigger	Coincidence trigger	Coincidence trigger	Coincidence trigger

- Missing anything?
- Geometry of Calorimeter and GEMs?