Experimental Readiness Review for E12-06-105/E12-10-008

Nadia Fomin

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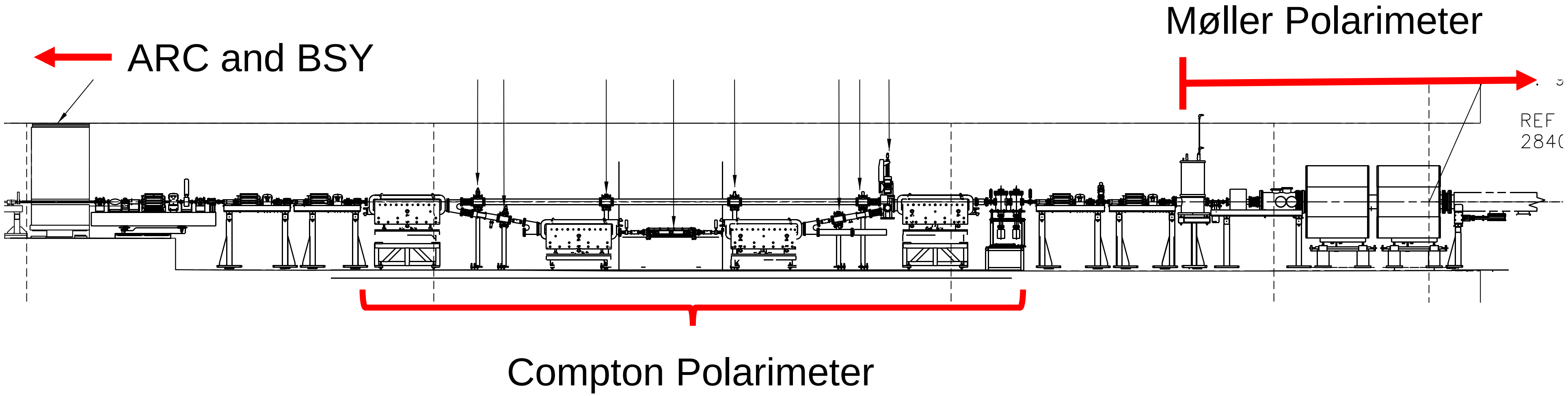
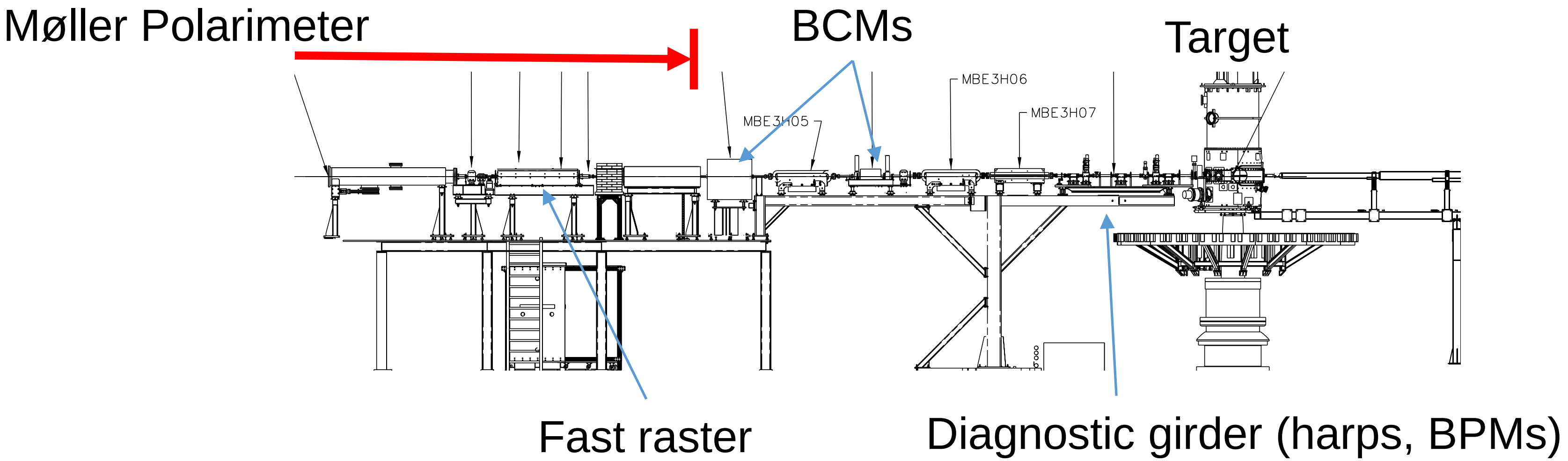
THE UNIVERSITY OF
TENNESSEE
KNOXVILLE

Charge elements to be addressed

- 1 – beamline configuration
- 2b – target ladder, EHS&Q
- 3 – manpower and responsibilities
- 4 – beam commissioning procedures and machine protection system
- 5 - Radiation

Hall C Beamline - Layout

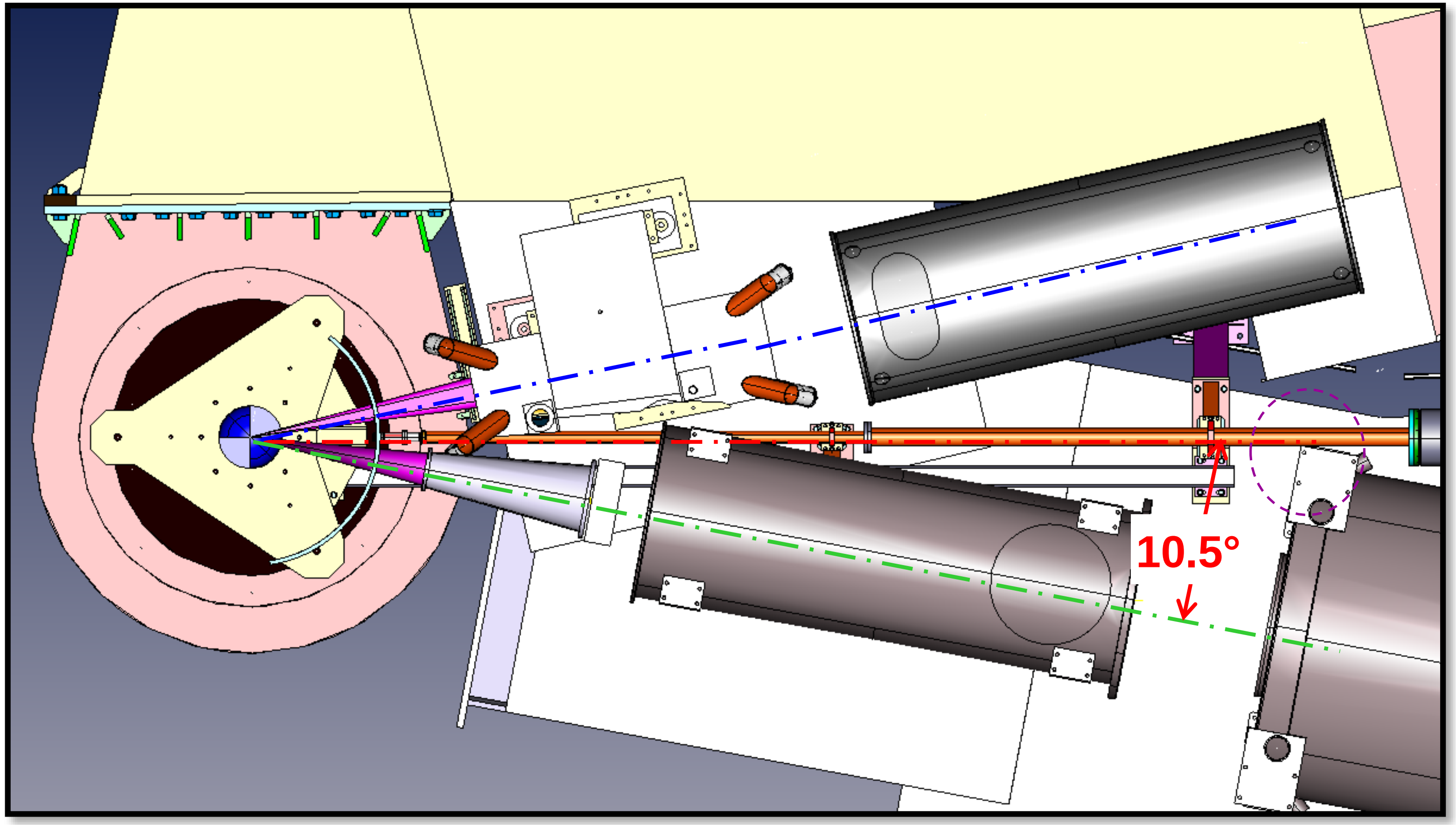




Upstream Beamline for EMC/x>1
(charge element 1)

- EMC/x>1 uses only unpolarized beam, Compton and Møller polarimeters not required
  - Møller quads used as part of nominal beamline optics
- All magnets required for beam delivery have been used and checked out as part of KPP run
- Key diagnostics required
  - BCMs (current normalization)
  - BPMs
  - Superharps (BPM calibration and beam energy measurement)
- All diagnostics are already functional and operation/precision will be thoroughly verified as part of Fall 2017 run
- *No new beamline components or procedures are required – standard Hall C 12 GeV beamline will be used*
- **Ownership: Upstream Beamline owned/controlled by Ops and Engineering**
  - Detailed responsibilities for beamline elements are enumerated in a document maintained by /Physics/Ops/Engineering: https://hallcweb.jlab.org/experiments/ERR/Beamline_Responsibilities-3.xlsx

Downstream Beampipe



- x>1 requires minimum SHMS angle of 8 degrees
- Will use “medium” beam pipe which allows HMS angle down to 10.5 degrees and SHMS angle down to ~7.5 degrees (checked May 23, 2017)
- **Downstream beampipe (up to beamdump entrance) owned by Hall C**

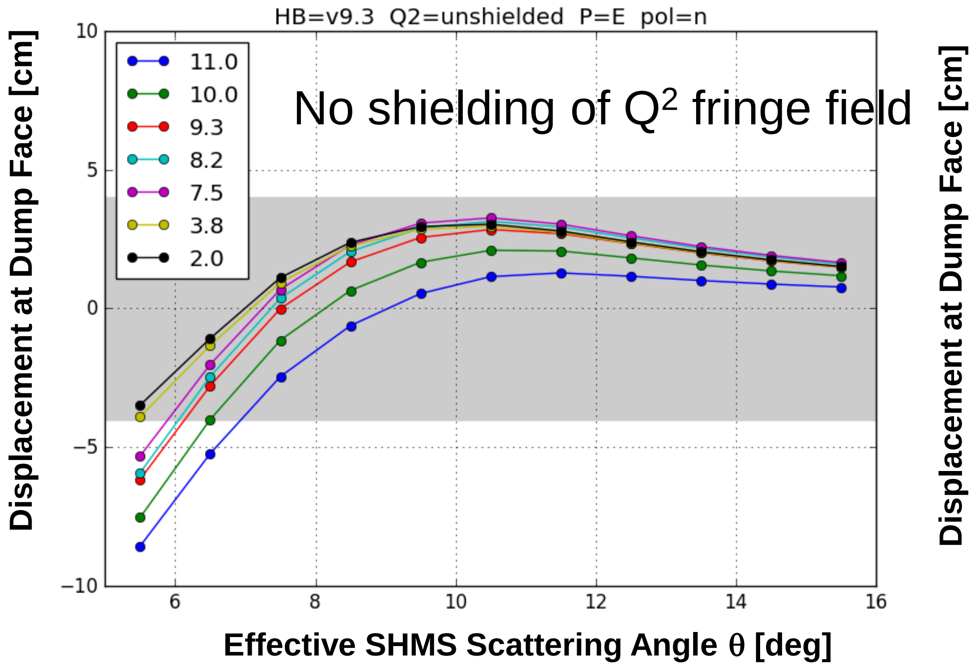
SHMS Beam steering

No problems expected due to SHMS beam steering

→ Minimum angle of 8 degrees, expected deflection at beam dump will be less than +/- 4 cm (modeled)

→ Dump steering model will be verified as part of Fall 2017 commissioning

→ Effect for EMC/x>1 settings will be directly checked downstream of target as part of beam setup procedure

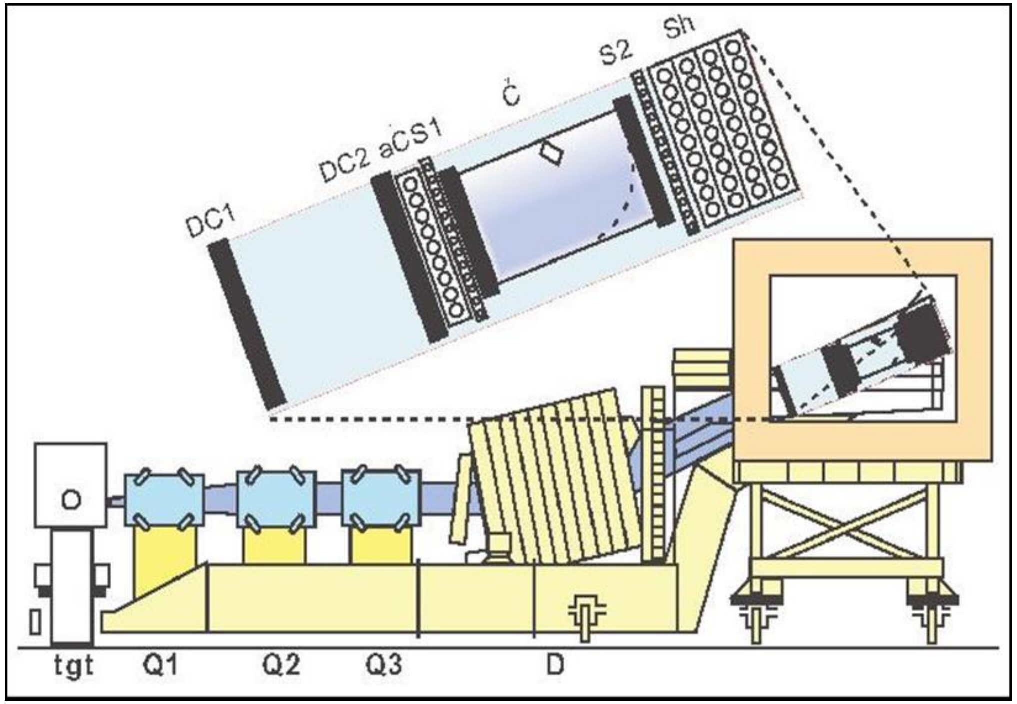


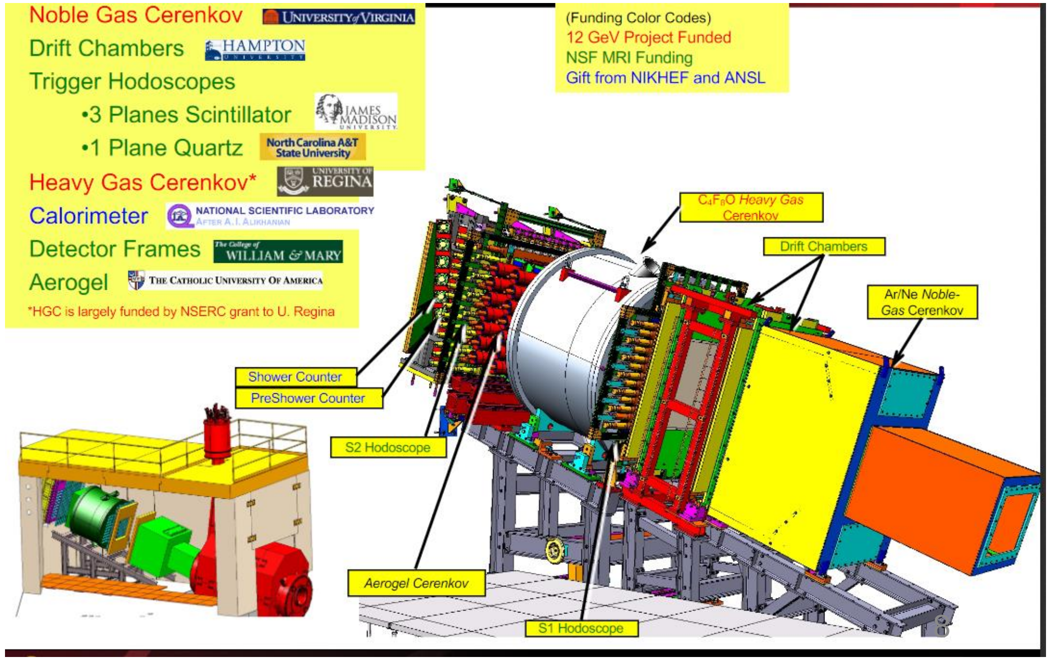
Beam commissioning procedures/responsibilities
(charge items #3 and #4)

- Operation will setup beam using standard hall beam delivery procedure (*http://opsntsrv.acc.jlab.org/ops_docs/online_document_files/MCC_online_files/HallC_beam_delivery_proc.pdf*)
- Physics (Hall C) will:
    - Check raster functionality
    - Check BCM functionality
    - calibrate BPMs with superharps
  - Machine protection system
    - standard beam loss monitors and ion chambers (in the dump tunnel, along the beamline) as in 2017 experiments

Detectors

- Standard Hall C spectrometers to be used
- **HMS configuration**
  - Tracking: 2 drift chambers (6 planes each)
  - Trigger/TOF: 4 plastic scintillator places
  - Particle ID: Gas Čerenkov and lead glass calorimeter
  - Aerogel Čerenkov NOT necessary (slides out of detector stack easily)
- **SHMS configuration**
  - Tracking: 12 drift chamber planes
  - Trigger/TOF: 3 segmented scintillator planes + 1segmented Quartz plane
  - Particle ID: Noble Gas Čerenkov, Heavy Gas Čerenkov, and lead glass calorimeter
  - Aerogel Čerenkov NOT necessary

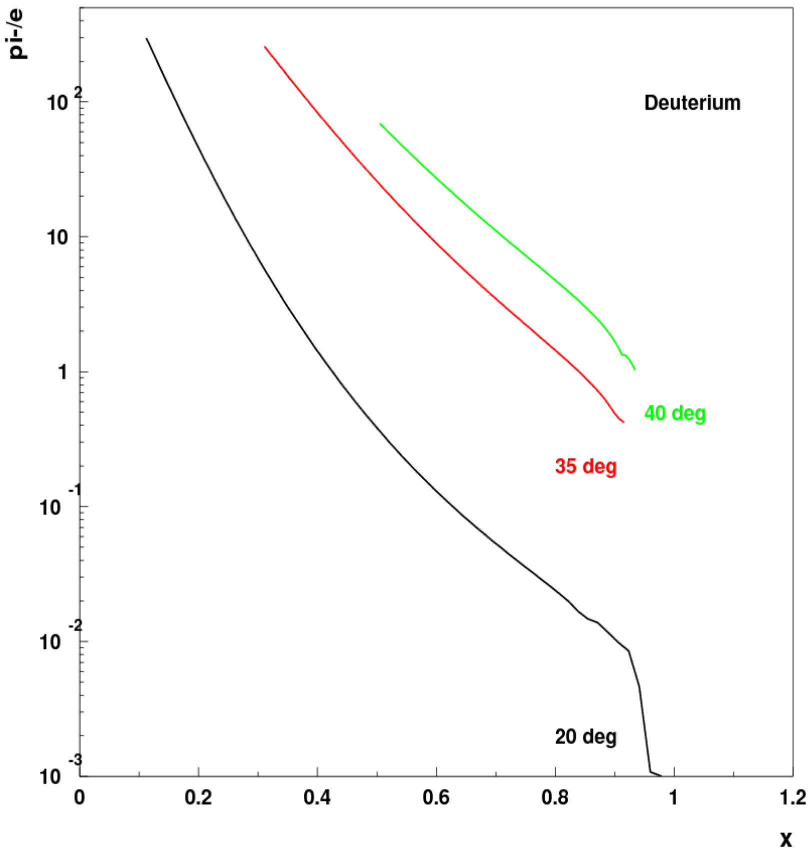


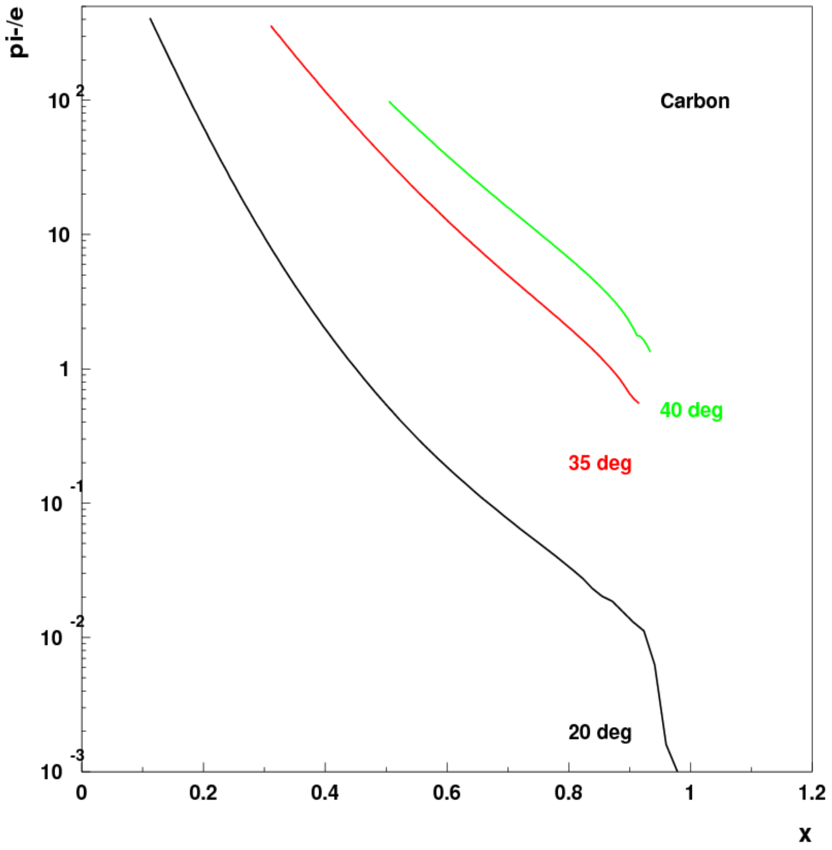


Configuration of Čerenkov detectors

- **SHMS**
  - Require robust pion rejection over a large momentum range (1.4GeV/c – 11 GeV/c)
  - Use both Čerenkov detectors
  - 0.5 atm of CO_2 in the heavy gas Čerenkov (pion rejection for low-medium momentum range)
  - Neon in Noble Gas Čerenkov provides pion rejection 6-11 GeV/c
- **HMS**
  - Highest momentum setting of 4.6 GeV/c
  - 0.5 atm of C_4F_{10} gas.
  - 6GeV data analysis shows sufficient pion rejection when combined with calorimeter cut

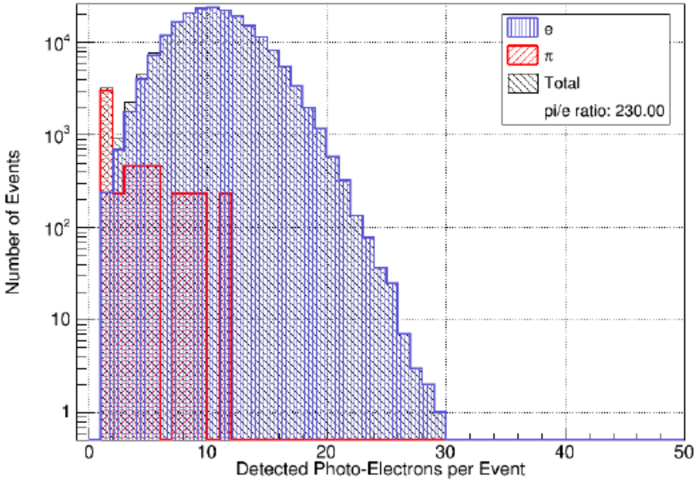
EMC: pi/e ratio



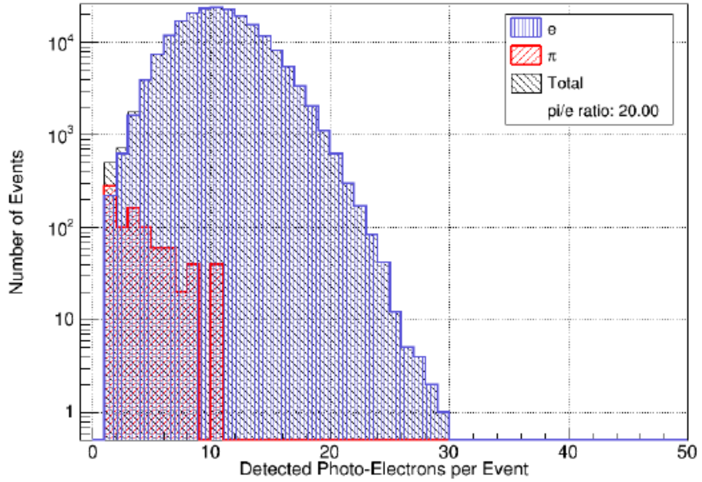


- Lowest momentum settings require pion rejection upto 300:1

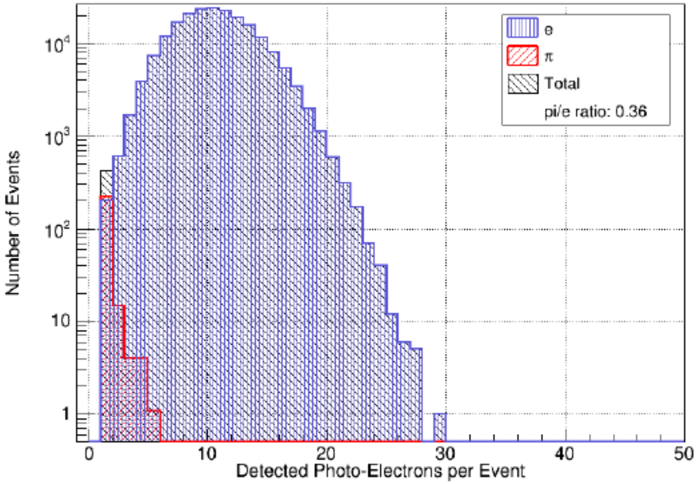
SHMS Heavy Gas Čerenkov pion rejection



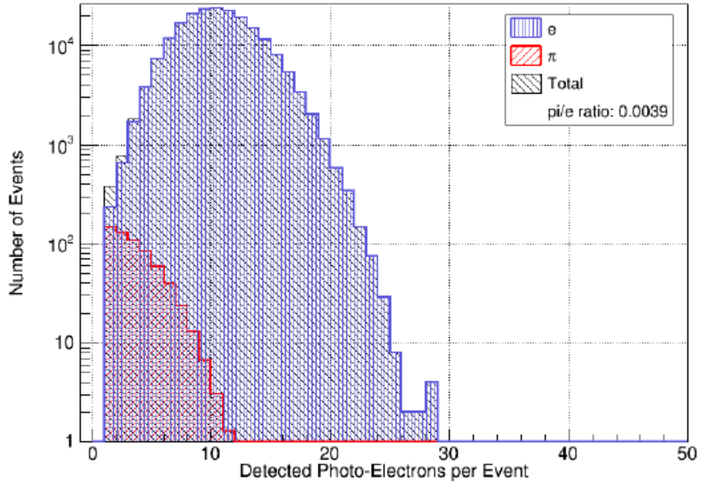
(a) CO_2 @ $P = 0.50$atm & $p = 1.5$GeV/c



(b) CO_2 @ $P = 0.50$atm & $p = 3$GeV/c



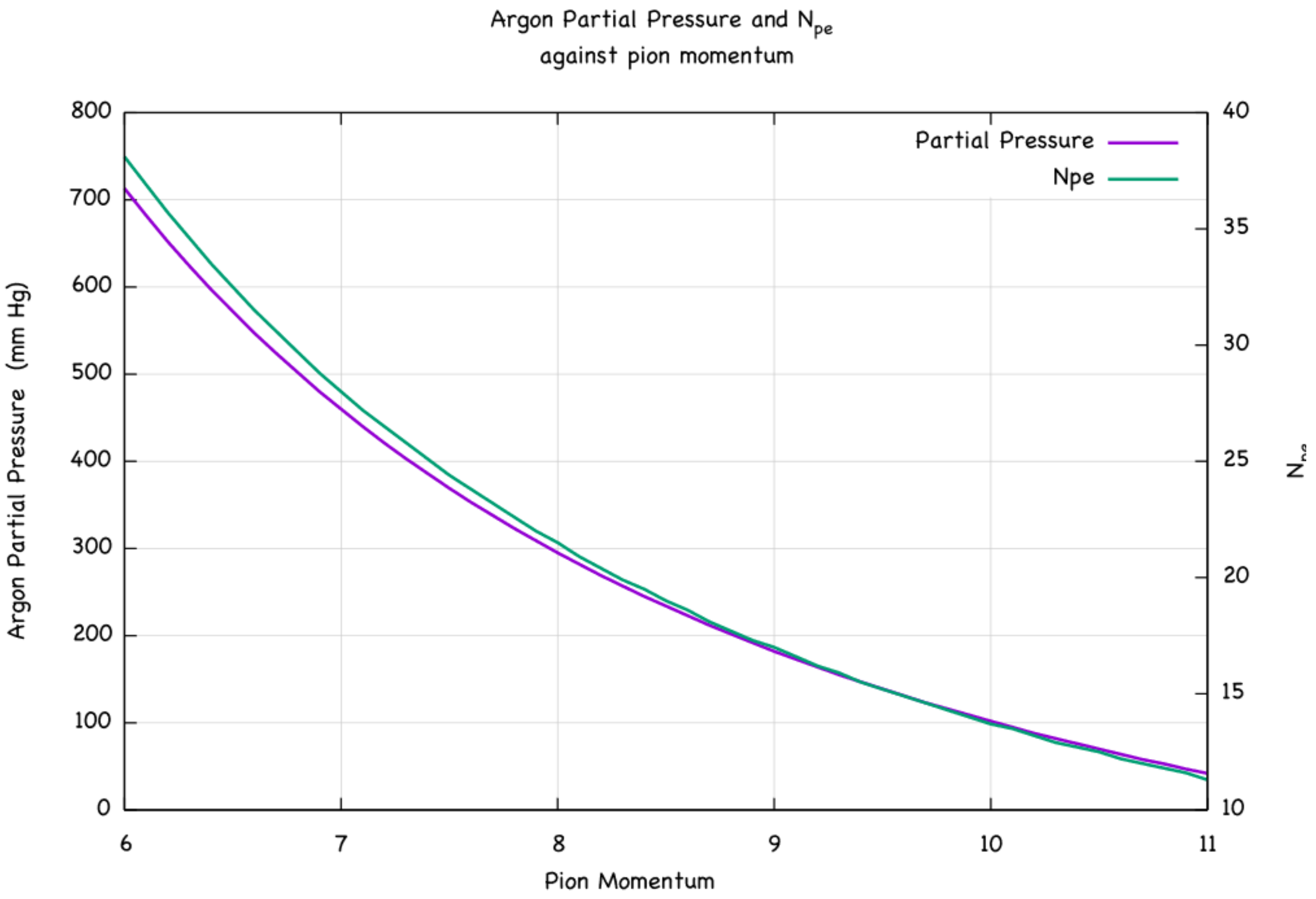
(c) CO_2 @ $P = 0.50$atm & $p = 5$GeV/c



(d) CO_2 @ $P = 0.50$atm & $p = 7$GeV/c

Aug 2016 report by G. Huber

SHMS Noble Gas Čerenkov – neon gas

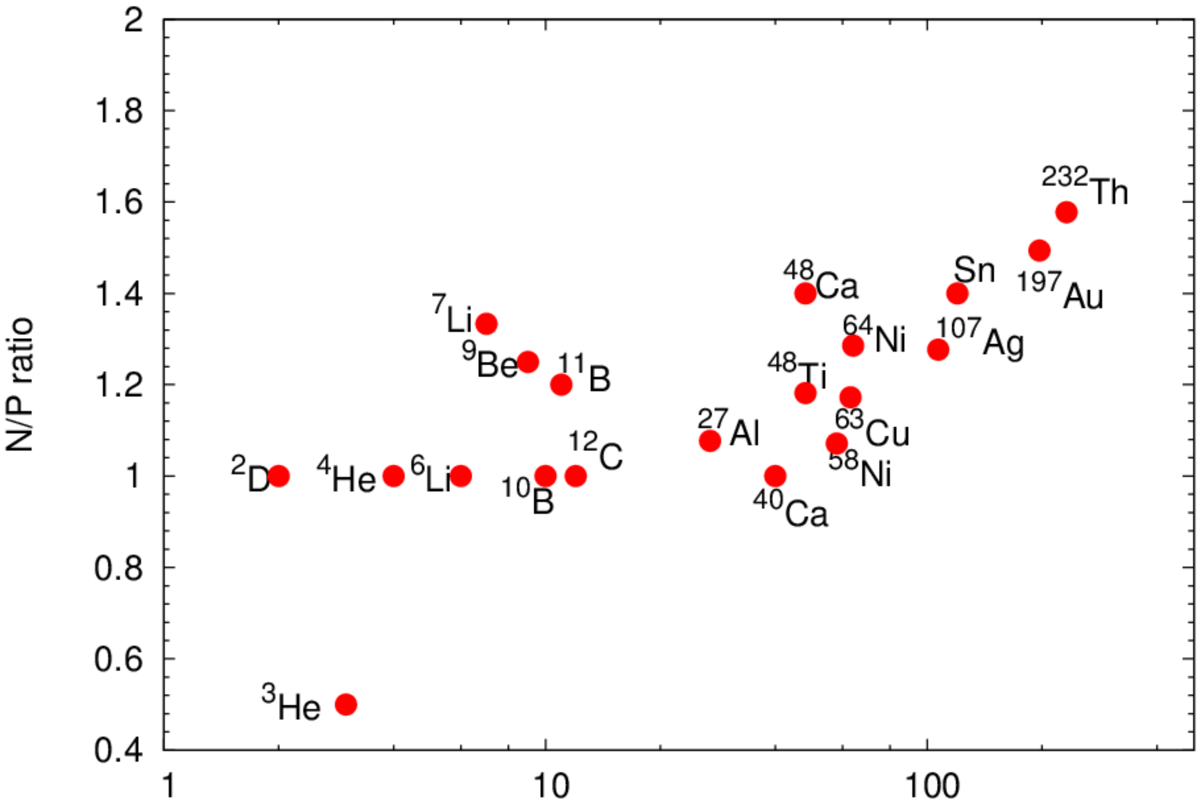


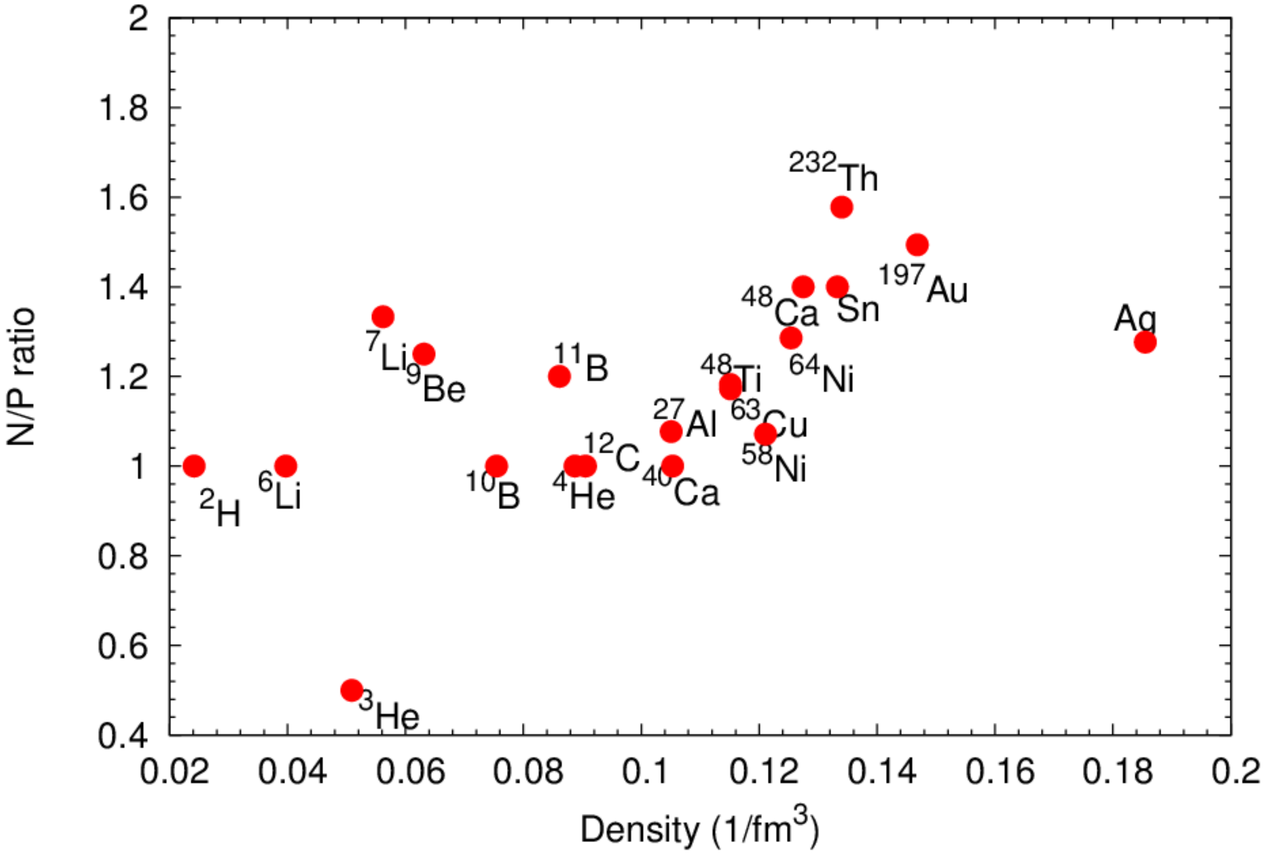
To reject pions upto 11 GeV/c, a mixture of primarily Neon is required

Experiment Commissioning Procedures

- Repeat checkout procedure used for F2p/F2d
- New calibration needed for Čerenkov due to altered pressure
- Possible update of TOF and Calorimeter calibrations
- Hydrogen elastic running

Target Choice motivated by physics impact



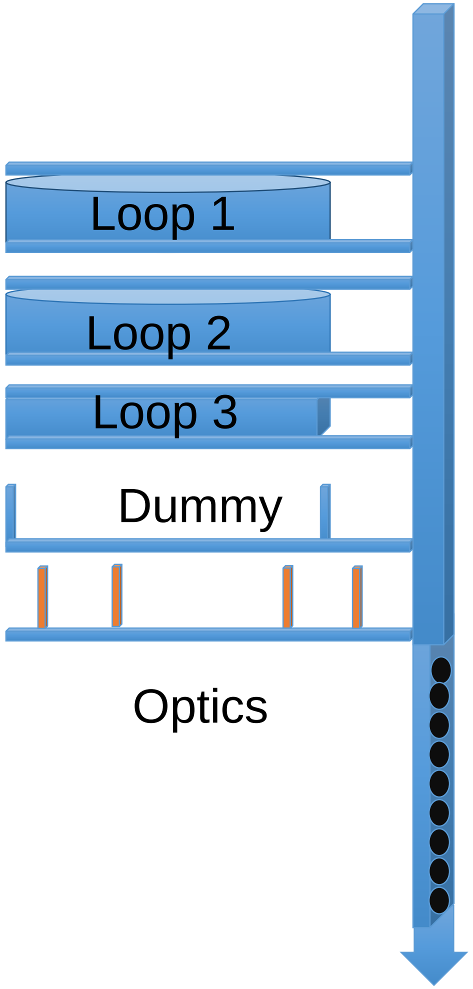


Scans across n/p, A, large range of masses and densities

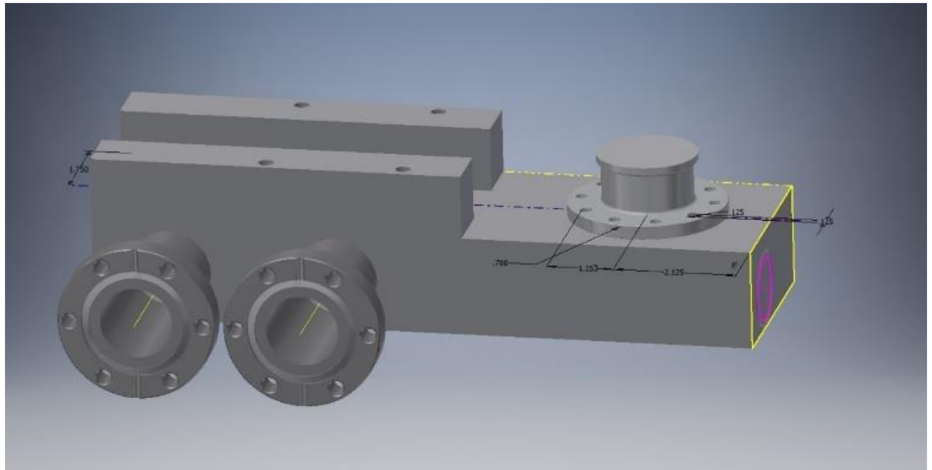
Targets – Charge item 2b

- 21 physics targets
  - 4 cryogenic targets of “stretched tuna can” design
    - H, ^{2}H, ^{3}He, ^{4}He
  - ^{48}Ca requires housing for oxidation protection
  - Natural calcium eliminates the need for oxidation protection
  - Reduced foil size allows for 23 physics targets + 1 optics
  - Target group is coordinating with industrial hygiene to confirm proper handling of solid target materials
  - Cryogenic target system covered under Target Group procedure and pressure vessel code
  - Max currents to be finalized with heat transfer calculations by Dave Meekins (earlier estimates used in Runplan)

Targets – Charge item 2b



- 2 cryogenic loops
  - H,^{2}H
  - ^{3}He, ^{4}He
- 3rd loop contains ^{48}Ca (natural calcium in place of ^{40}Ca)
- Dummy target
- Materials to be procured by Hall C/Physics (see D. Meekins' talk for details)



Loop design in progress (D. Meekins)

Radiation Budget

charge item #5

Hall: C

RADIATION BUDGET FORM

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Exp. # e-A group **rev:** 0 **run dates:** 2019 **name of liaison:** Dave Gaskell

E12-06-105, E12-10-008

setup number			18	19	20	21	22	23	
beam	energy	GeV	11.0	11.0	11.0	11.0	11.0	11.0	*totals:*
	current	uA(CW)	60.0	60.0	35.0	60.0	60.0	40.0	
exp't target	element		Cu	Ag	Sn	Au	Th	Al	
	thickness	mg/cm2	772	538	529	388	364	1100	
	dist. to pivot	m	0.0	0.0	0.0	0.0	0.0	0.0	
	Z		29	47	50	79	90	13	
	A		64	60	70	200	142	27	
add'l target 1	element								
	thickness	mg/cm2							
	dist. to pivot	m							
	Z		0	0	0	0	0	0	
	A		0	0	0	0	0	0	
cryo tgt window	element								
	thickness	mg/cm2							
	dist. to pivot	m							
	Z		0	0	0	0	0	0	
	A		0	0	0	0	0	0	
critical window	radius	cm	3.9	3.9	3.9	3.9	3.9	3.9	
	dist. to pivot	m	5.57	5.57	5.57	5.57	5.57	5.57	
scattering weighting factor			0.50	0.50	0.50	0.50	0.50	0.50	
time	run time	hours	151.2	5.04	8.88	23.52	8	76.8	1391.8
	(100% eff.)	days	6.3	0.2	0.4	1.0	0.3	3.2	58.0
	installation	hours							0
	time	days	0.0	0.0	0.0	0.0	0.0	0.0	0.0
dose rate at the fence post (run time)	method 1	urem/hr	5.45	6.96	3.86	3.91	5.82	3.96	
	method 2	urem/hr							
	conservative	urem/hr	5.45	6.96	3.86	3.91	5.82	3.96	
dose per setup		urem	824	35	34	92	47	304	4062
% of annual dose budget		%	8.2	0.4	0.3	0.9	0.5	3.0	40.62
% of allowed dose for the total time									255.66
% of allowed dose for the run time only									255.66

If > 200%, discuss result with Physics Research EH&S officer

date form issued: May 23, 2017 *authors:* P. Degtiarenko

Backups