SANE

Spin Asymmetries on the Nucleon Experiment

(TJNAF E07-003)

SANE Collaboration

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Readiness Review
July 2, 2007
Jefferson Lab

SANE Readiness Review

- Overview of SANE's physics
- SANE kinematics and CEBAF energy: Impact on statistics
  - Beam time
  - Energies vs polarization
- SANE layout and BETA detector
  - Readiness Summary
  - BigCal calibration
  - Polarized target
  - Beam line
  - Beam line background rates and shielding
- Manpower
- Safety documents
- Simulation and reconstruction software

SANE Physics

- Measure proton spin structure function $g_2(x, Q^2)$ and spin asymmetry $A_1(x, Q^2)$ at four-momentum transfer $2.5 \le Q^2 \le 6.5$ GeV² and Bjorken x $0.3 \le x \le 0.8$

REPORT TO THE NUCLEAR SCIENCE ADVISORY COMMITTEE

2011	Measure the lowest moments of the unpolarized nucleon structure functions (both longitudinal and transverse) to 4 GeV^2 for the proton, and the neutron, and the deep inelastic scattering polarized structure functions $g_1(x, Q^2)$ and $g_2(x,Q^2)$ for x=0.2-0.6, and $1 < Q^2 < 5$ GeV^2 for both protons and neutrons.

- **SANE meets or exceeds DOE 2011 Milestone for Proton Spin Structure**
  - **SANE takes data no later than 2008**
- **JLAB is unique facility for measuring complete transverse spin structure**

SANE Physics

- Learn all we can about proton SSF's from inclusive polarized measurement:
  - twist-3 effects from moments of g_2 and g_1: $d_2 = \int_0^1 x^2 (3\, g_2 + 2\, g_1)\, dx$
  - comparisons with Lattice QCD, QCD sum rules, bag models, chiral quarks
  - Study x dependence (test nucleon models) and Q^2 dependence (evolution)
  - Exploration of "high" x region: A_1's approach to $x = 1$
  - Test polarized local duality for final state mass $W > 1.4$ GeV
- Method:
  - Measure anti-parallel and near-perpendicular spin asymmetries
  - Detect electrons with novel large solid angle electron telescope **BETA**

Transverse Spin Structure Function

- Polarized longitudinal structure function has simple parton model interpretation

$$g_1(x) = \sum e_i^2 \Delta q_i(x), \quad i = u, \bar{u}, d, \bar{d} \ldots$$

- g_2 is combination of twist-2 and twist-3 components:

$$g_2(x,Q^2) = g_2^{WW}(x,Q^2) + \bar{g}_2(x,Q^2)$$

$$= -g_1(x,Q^2) + \int_x^1 g_1(x',Q^2)\frac{dx'}{x'} - \int_x^1 \frac{\partial}{\partial x'}\left[\frac{m}{M} h_T(x',Q^2) + \xi(x',Q^2)\right]\frac{dx'}{x'}$$

- *W*andzura-*W*ilczek g_2^{WW} depends on g_1; h_T is twist-2 chiral odd transversity
- ξ represents quark-gluon correlations (twist-3)
- Transition from free partons to interacting quarks and gluons

Transverse Spin Structure Sum Rules

- OPE: moments of $\boldsymbol{g_1}$, $\boldsymbol{g_2}$ related to twist-2 ($\boldsymbol{a}_N$), twist-3 ($\boldsymbol{d}_N$) matrix elements.

$$\int_0^1 x^N g_1(x,Q^2)\,dx = \frac{1}{2}\boldsymbol{a}_N + O(M^2/Q^2), \qquad N=0,2,4,\ldots$$

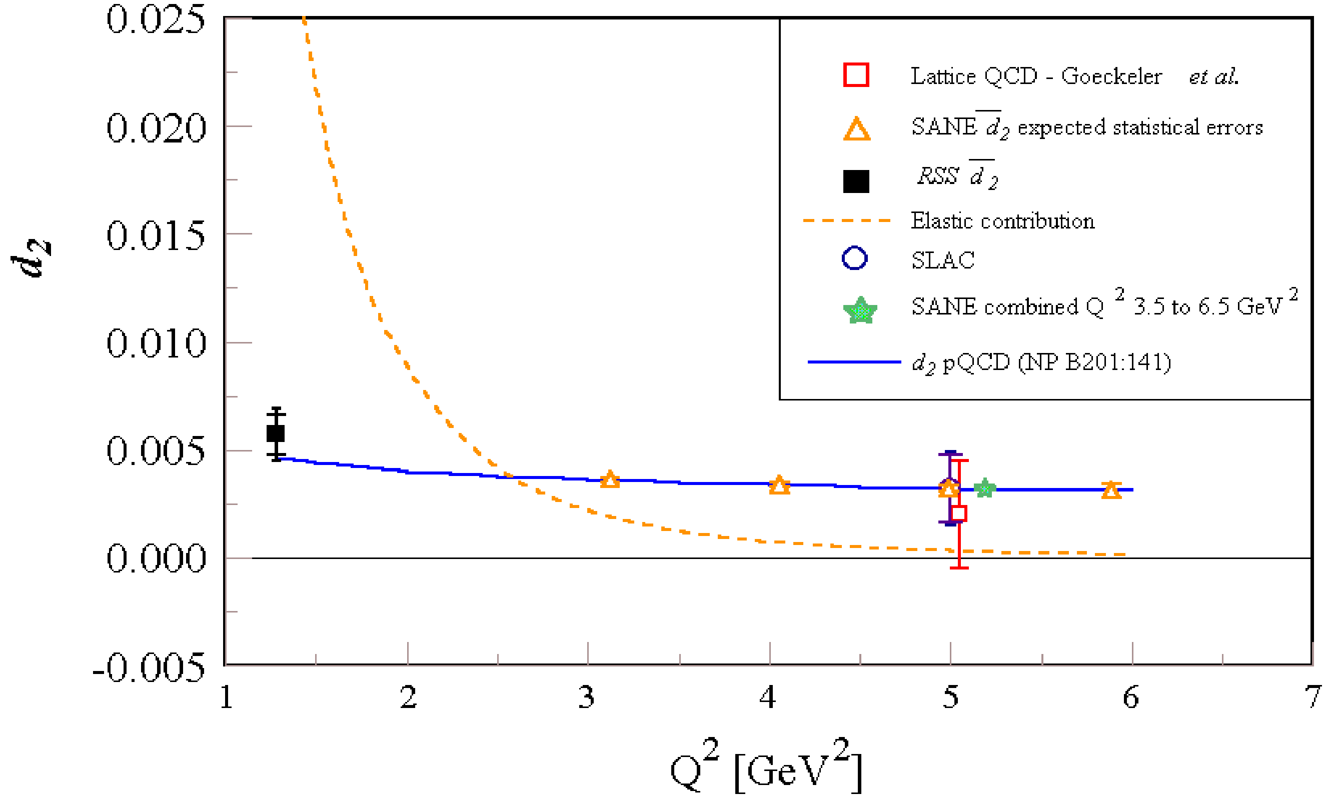
$$\int_0^1 x^N g_2(x,Q^2)\,dx = \frac{N}{2(N+1)}(\boldsymbol{d}_N - \boldsymbol{a}_N) + O(M^2/Q^2), \qquad N=2,4,\ldots$$

- $\boldsymbol{d}_N$ measure twist-3 contributions (related to for $m << M$ and $\boldsymbol{h}_T$ not too large.)

$$\boldsymbol{d}_2(\boldsymbol{Q}^2) = 3\int_0^1 x^2 \overline{\boldsymbol{g}}_2(x,Q^2)\,dx = \int_0^1 x^2(2g_1 + 3\boldsymbol{g}_2)\,dx$$

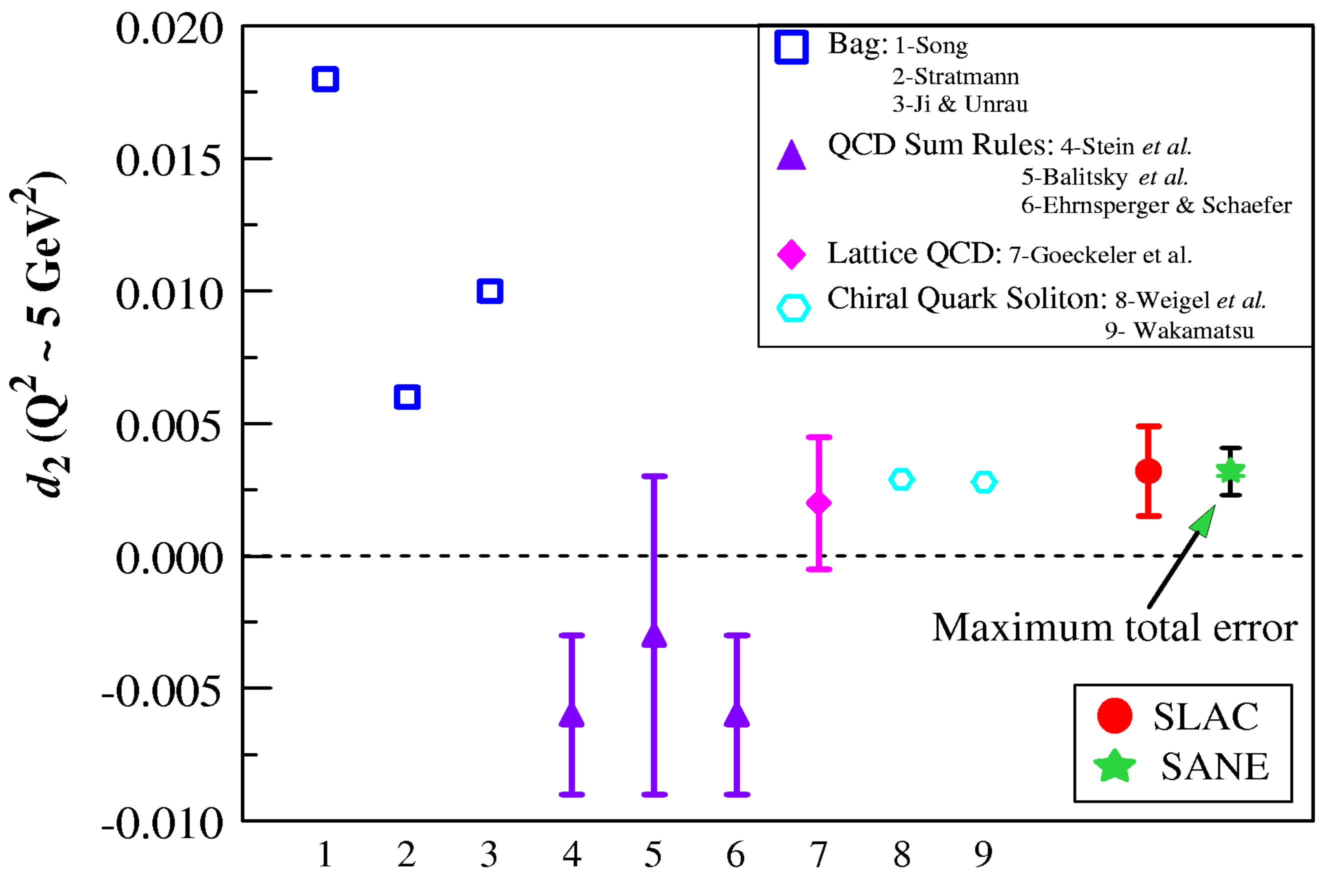
  - Burkhardt-Cottingham $\qquad \int_0^1 g_2(x)\,dx = 0$
    - not from OPE
  - Efremov-Leader-Teryaev $\qquad \int_0^1 x(g_1^V(x) + 2g_2^V(x))\,dx = 0$
    - valence quarks combining with $\boldsymbol{g}_{2,1}^{\,n}$ from Hall A

SANE Expected Results

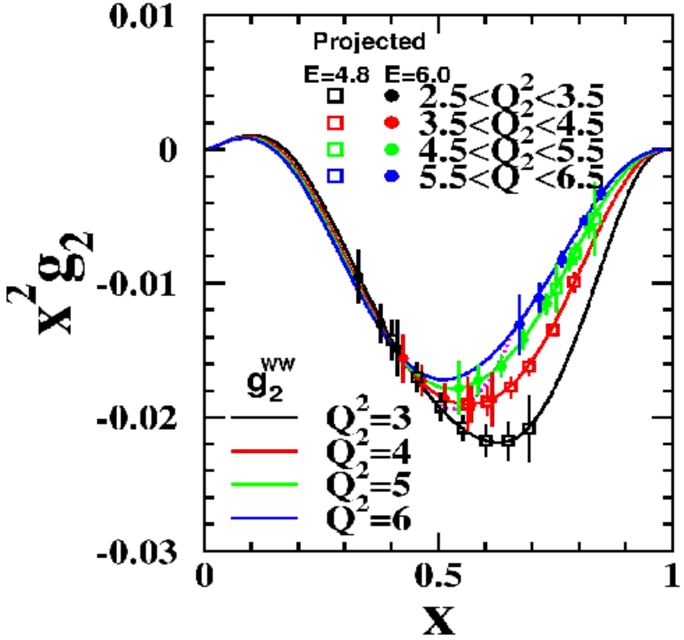


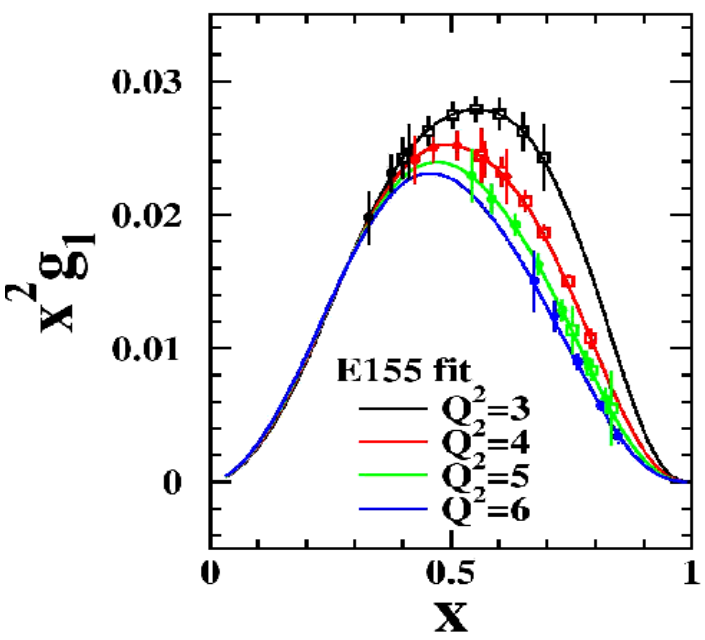
- SANE expected errors for $\overline{d}_2 = \int_{xmin}^{xmax} x^2 (2g_1 + 3g_2) dx$
  - $\delta\overline{d}_2/d_2(Q^2 = 3\text{ GeV}^2) = 4\%$, $0.29 < x < 0.85$
  - $\delta\overline{d}_2/d_2(3.5\text{ to }6.5\text{ GeV}^2) = 2.5\%$, $0.41 < x < 0.96$

SANE Expected Results (Ia)



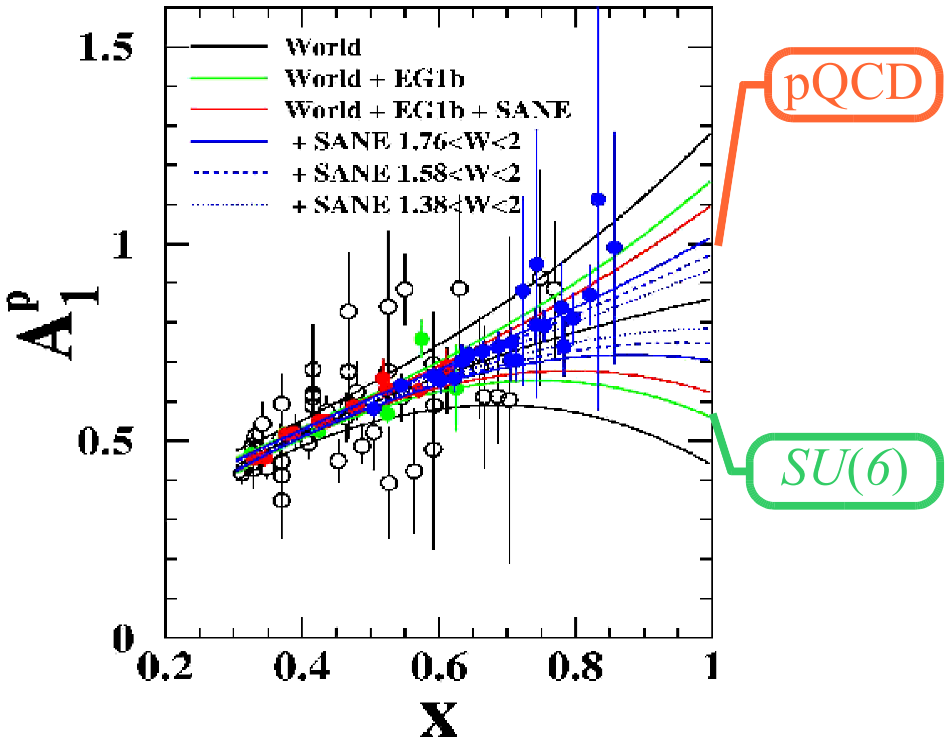
SANE Expected Results (II)

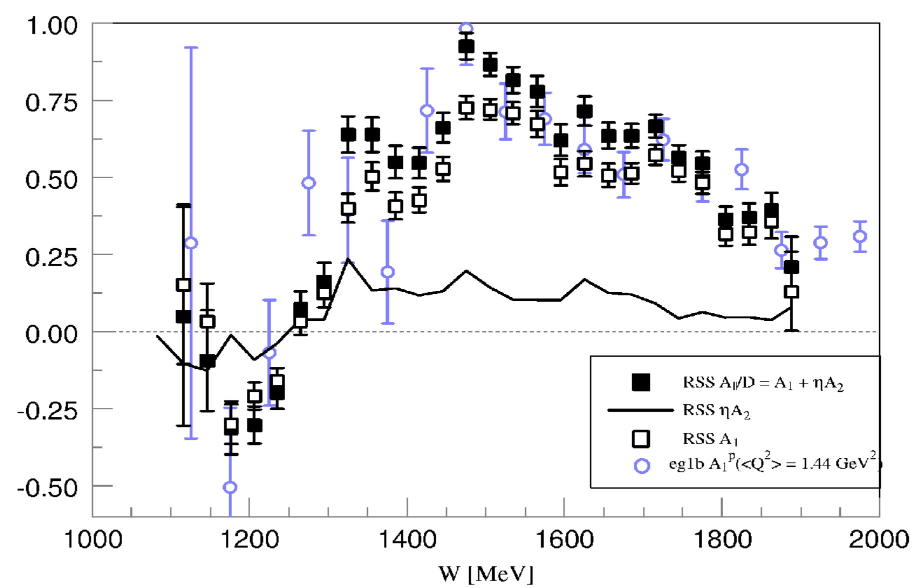




- ***x*** dependence at constant $\boldsymbol{Q^2}$ and $\boldsymbol{Q^2}$ dependence at fixed ***x*** (illustrative binning)
- data are concentrated in the region most sensitive to $\boldsymbol{x^2 g_{2,1}}$
  - (estimates based on 75% beam and target polarization and 85 nA beam current)

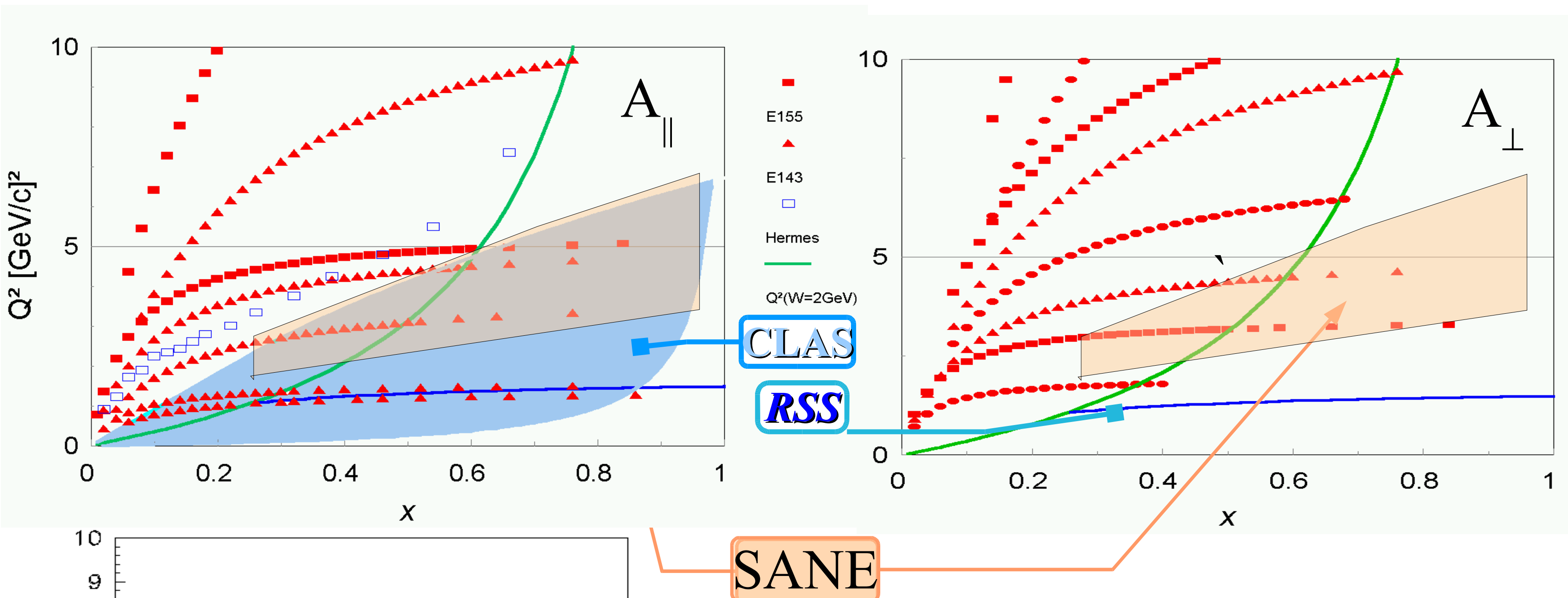
SANE Expected Results (III)

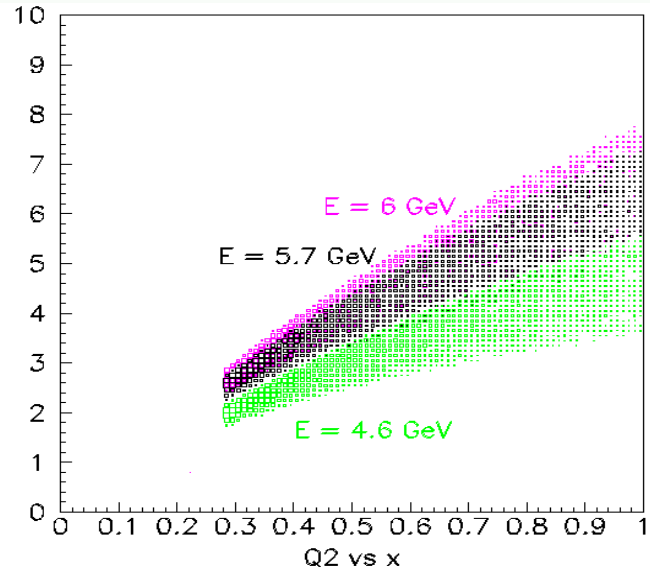




- Constrain extrapolations of A_1^p to $x = 1$ within +/- 0.1 (using duality)
- Both $\mathbf{A}_{\parallel}$ and $\mathbf{A}_{\perp}$ are required to get accurate, model-free $\mathbf{A}_1$: $\mathbf{A}_2 > 0$
- SANE's measured $\mathbf{A}_2$ will contribute to improve world's $\mathbf{A}_1$ data set

World data on $A_{\parallel}$, $A_{\perp}$ and SANE kinematics

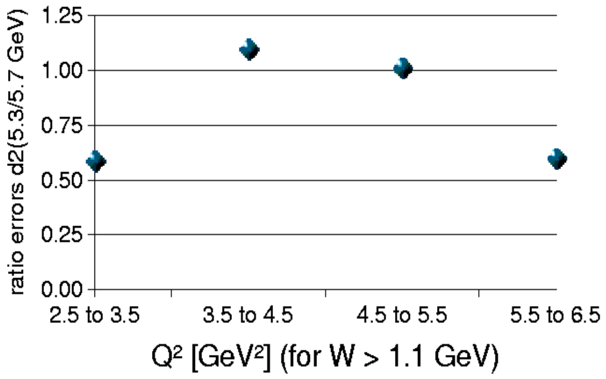




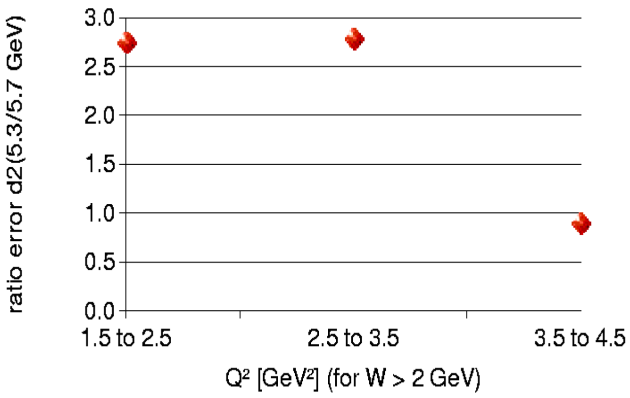
- Two beam energies: **6 GeV**, **4.8 GeV**
  - (small loss if **5.7 GeV**, **4.6 GeV**)
- Very good high ***x*** coverage with detector at 40° (plot from BETA's GEANT simulation)

Beam Energy < 6 GeV

Exp.	$\langle Q^2 \rangle$ GeV^2	xlo	xhi	statistical error d2bar	
SANE 6 GeV	3.12	0.28	0.74	3.6%	
	4.07	0.39	0.95	2.4%	
	4.89	0.50	0.96	3.4%	
	5.91	0.64	0.93	6.7%	
SANE 5.7 GeV	3.12	0.29	0.85	3.1%	
	4.06	0.41	0.96	2.2%	
	4.99	0.53	0.96	4.0%	
	5.89	0.69	0.92	10.0%	
SANE 6 GeV	5.23	0.39	0.95	2.2%	Mean of top 3 Q^2 pts.
SANE 5.7 GeV	5.19	0.41	0.94	2.4%	"



5.3 vs 5.7 GeV beam



Beam Time

	Energy	θ_N	Time (h)	
Calibration	2.4	off, 0, 180	60	(Full and ½ field)
Production	4.8	180	70	
	4.8	80	130	Target rotation
	6.0	80	200	
	6.0	180	100	Target rotation
Systematics	Packing Fraction		20	
	Mollers		21	
	Total beam time		601	
Overhead	Anneals		62	
	Energy Change		48	
	Target Rotation		48	
	Insert Changes		48	
	Total Overhead		206	

Commissioning 14 calendar days

Total 70 calendar days

Energy vs Polarization

Hall	# of passes	Energy (MeV)	optimized	Color Code
Linac		1170.27		Optimal setting based on maximum pola selected halls
A	5	5917.18	*	Optimal setting based on maximum pola minimized pain
B	5	5917.18	*	
C	2	2406.37		

Source Angle	Theta-A	Theta-B	Theta-C	Pol-A(%)	Pol-B(%)	Pol-C (%)	Figure o Merit
0.00	63.90	61.10	7.28	94.84	-95.13	-64.27	0.9499
5.00	63.93	61.13	7.31	97.24	-92.08	-57.34	0.9470
10.00	63.95	61.16	7.33	98.91	-88.33	-49.99	0.9377

SANE 4.8 GeV: magic 4-pass energy
Halls A and B 5.9 GeV: magic 5-pass energy (below)

SANE 2.4 GeV (calibration): no beam polarization;
Halls A and B 5.9 GeV: magic 5-pass energy (above)

Hall	# of passes	Energy (MeV)	optimized	Color Code
Linac		1170.27		Optimal setting based on maximum polar
A	5	5917.18	*	Optimal setting based on maximum polar
B	5	5917.18	*	
C	4	4746.91	*	

Source Angle	Theta-A	Theta-B	Theta-C	Pol-A(%)	Pol-B(%)	Pol-C (%)	Figure of Me
0.00	63.90	61.10	35.98	94.84	-95.13	99.85	0.9663
5.00	63.93	61.13	36.01	97.24	-92.08	99.95	0.9648
10.00	63.95	61.16	36.04	98.91	-88.33	99.29	0.9564

Energy vs Polarization (II)

Hall	# of passes	Energy (MeV)	optimized	Color Code
Linac		1170.27		Optimal setting based on maximum polarizati selected halls
A	5	5917.18	*	Optimal setting based on maximum polarizati **minimized pain**
B	5	5917.18	*	
C	5	5917.18	*	

Source Angle	Theta-A	Theta-B	Theta-C	Pol-A(%)	Pol-B(%)	Pol-C (%)	Figure of Merit
0.00	63.90	61.10	58.30	94.84	-95.13	58.22	0.8453
160.00	64.79	61.99	59.19	-78.28	99.94	-82.52	0.8742
162.04	64.80	62.00	59.20	-80.45	100.00	-80.45	0.8745
162.01	64.80	62.00	59.20	-80.42	100.00	-80.48	0.8745

Linac		1200.00		Optimal setting based on maximum polarization to
A	5	6067.50	*	Optimal setting based on maximum polarization an
B	5	6067.50	*	
C	5	6067.50	*	

Source Angle	Theta-A	Theta-B	Theta-C	Pol-A(%)	Pol-B(%)	Pol-C (%)	Figure of Merit
0.00	65.52	62.65	59.78	6.47	-45.95	77.71	0.5226
5.00	65.55	62.68	59.81	15.14	-53.51	82.90	0.5763
10.00	65.58	62.71	59.84	23.70	-60.67	87.46	0.6296
15.00	65.60	62.74	59.87	32.07	-67.37	91.35	0.6810
20.00	65.63	62.76	59.89	40.21	-73.55	94.55	0.7295
25.00	65.66	62.79	59.92	48.03	-79.18	97.03	0.7744
30.00	65.69	62.82	59.95	55.49	-84.20	98.77	0.8150
35.00	65.72	62.85	59.98	62.53	-88.58	99.76	0.8507
40.00	65.74	62.87	60.01	69.10	-92.29	99.98	0.8811
45.00	65.77	62.90	60.03	75.13	-95.29	99.45	0.9059
50.00	65.80	62.93	60.06	80.60	-97.57	98.16	0.9247
55.00	65.83	62.96	60.09	85.45	-99.11	96.13	0.9375
60.00	65.85	62.99	60.12	89.65	-99.89	93.36	0.9440
62.65	65.87	63.00	60.13	91.61	-100.00	91.60	0.9449
62.67	65.87	63.00	60.13	91.62	-100.00	91.59	0.9449
65.00	65.88	63.01	60.14	93.17	-99.92	89.88	0.9442

No magic 5-pass energy at 5.917 GeV.
SANE needs 75% effective, or >90% rotation factor.
Only 5-pass magic energy is 4.23 GeV

In-hall polarization improves with energy > 5.917 GeV

SANE Layout

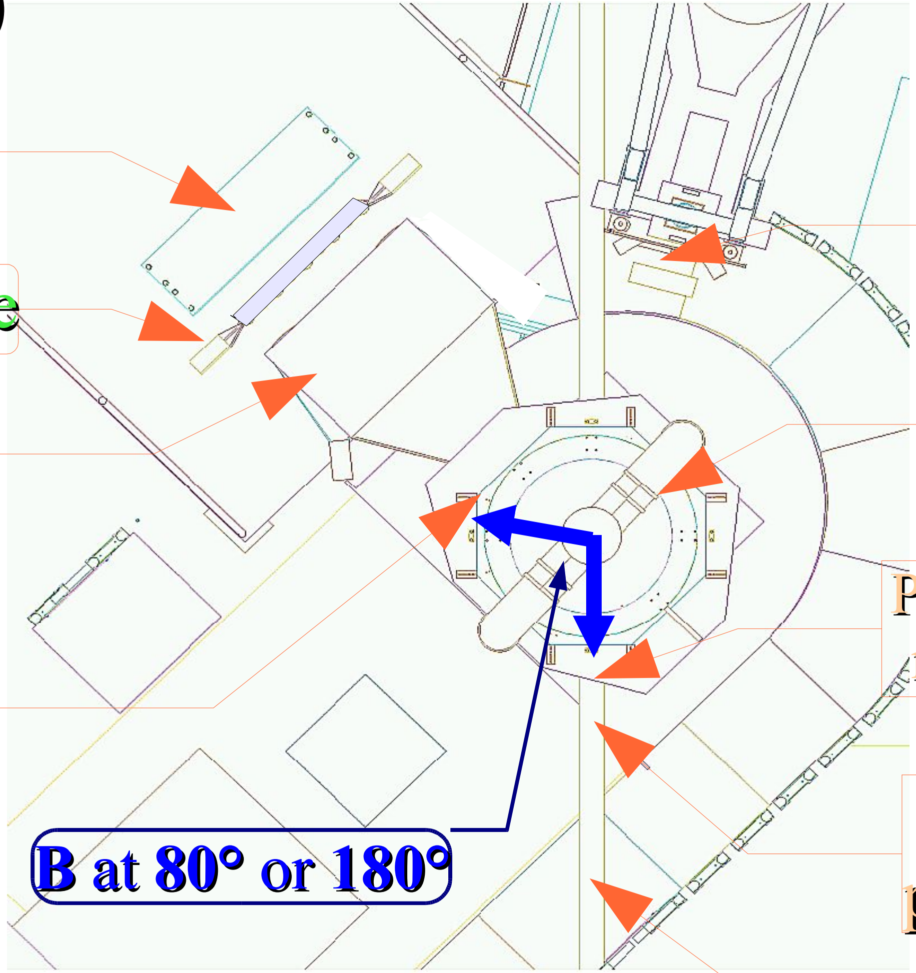
BETA (40°)

BigCal
w. Gain Monitor

Lucite Hodoscope

Gas Cherenkov

Forward
Hodoscope



HMS (14°- 48°)
calibrations, backgd.

Polarized Target

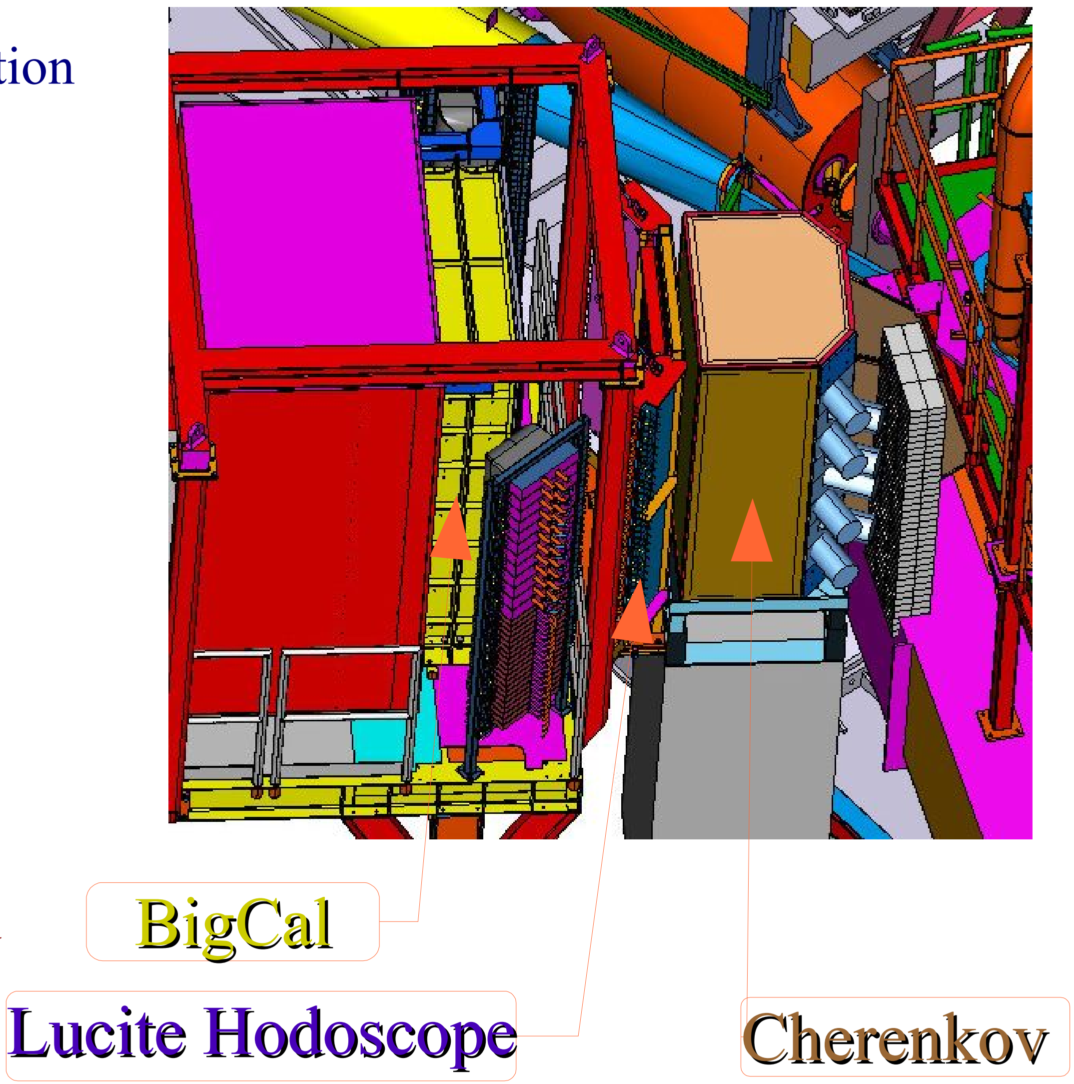
Polarized Compton
radiator (~20 cm)

Target Beam
position monitor

Beam Line

Big Electron Telescope Array - BETA

- **BigCal** lead glass calorimeter:
  main detector, being built for *GEp-III*.
- **Gas Cherenkov**: additional pion rejection
- Tracking **Lucite hodoscope**
- Tracking fiber-on-scintillator **forward hodoscope**
- BETA's characteristics
  - Effective solid angle = 0.194 sr
  - Energy resolution $5\%/\sqrt{E(\mathrm{GeV})}$
  - 1000:1 pion rejection
  - vertex resolution ~ 5 mm
  - angular resolution ~ 1 mr
- Target field sweeps low E' background
  - 180 MeV/c cutoff

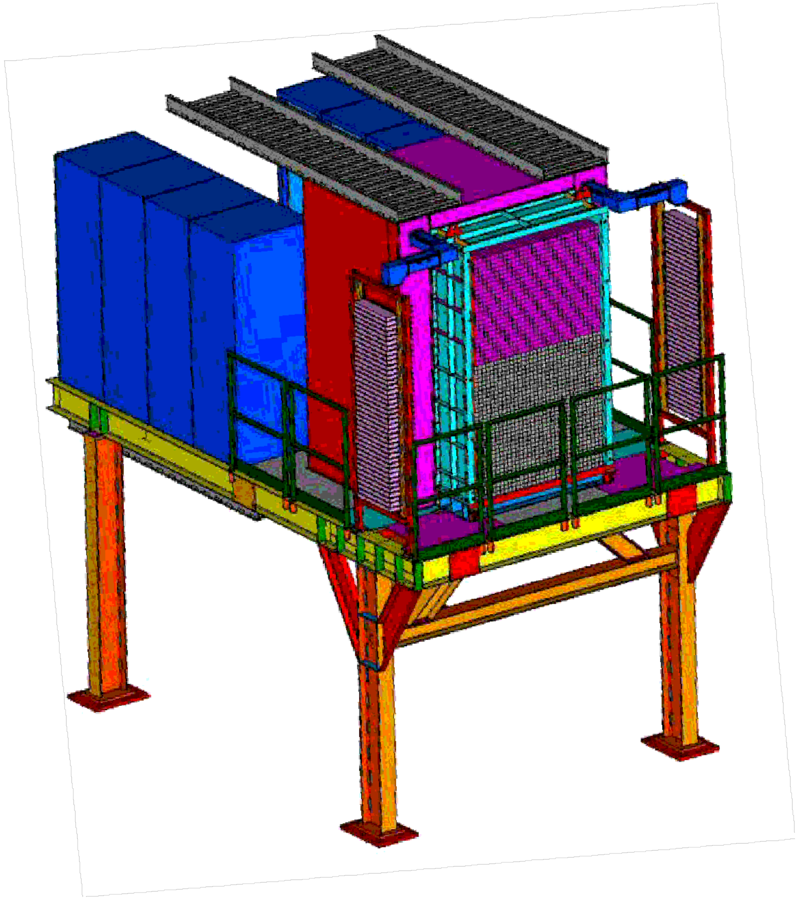


Readiness Summary

Subsystem	Parts		Construction/Assembly		Tests		Preparation for SANE		
	In hand	On order/procurement	Prototype/design	Full	Lab	In Hall	Conditioning	Repairs	Other
BigCal	All			Ready	Completed	Fall '07	UV Glass anneal		
Gain Monitor		Lucite plate	Tested	Fall '07	Completed	Fall '07	Visual inspection	Plate change (?)	
Cherenkov	Tank, PMT's, Mirrors (arrive from CERN Jul. 07)	readout electronics	Tested	Sept. 07	July-Aug. 07	Fall '07			Alignment
Lucite tracker	prototype bars	arrive end of July 07	Tested	Aug.-Dec. 07	Jan.-Feb. 08	Spring 08			Alignment
Forward tracker	All		Tested	July-Sept.07		Fall '07			Alignment
Target	Magnet, refrigerator, microwaves, NMR, pumps, ammonia	OVC Can, inserts		Oct '07	Nov. -Dec. 07	June '08			Installation June '08
Target platform	GEn-01/RSS platforms			June '08					Preinstall pumps, control platform Jan-Feb. '08
Beam line	Upstream girder/chicane, rasters, BCM's, BPM's, SEM (ready at Basel)	Downstream extension & He Bag: Design complete Aug. 07; Order in Fall 07		June '08	Slow raster: Summer 07; Check low current BPM's	June '08			Preinstall in-hall dump Jan-Feb. 08
Beam line shielding		Simulations/Design completed Aug. '07 Order in Fall 07		June '08					Installation
HMS						June '08	Restore standard package		Cosmic tests
Trigger/DAQ	All BigCal modules, Cherenkov will use spare	HKS programmable logic as backup		Fall '07		Fall '07			
Online reconstruction	BETA simulation		Track reconstruction	Feb. '08	March-May 08	June '08			

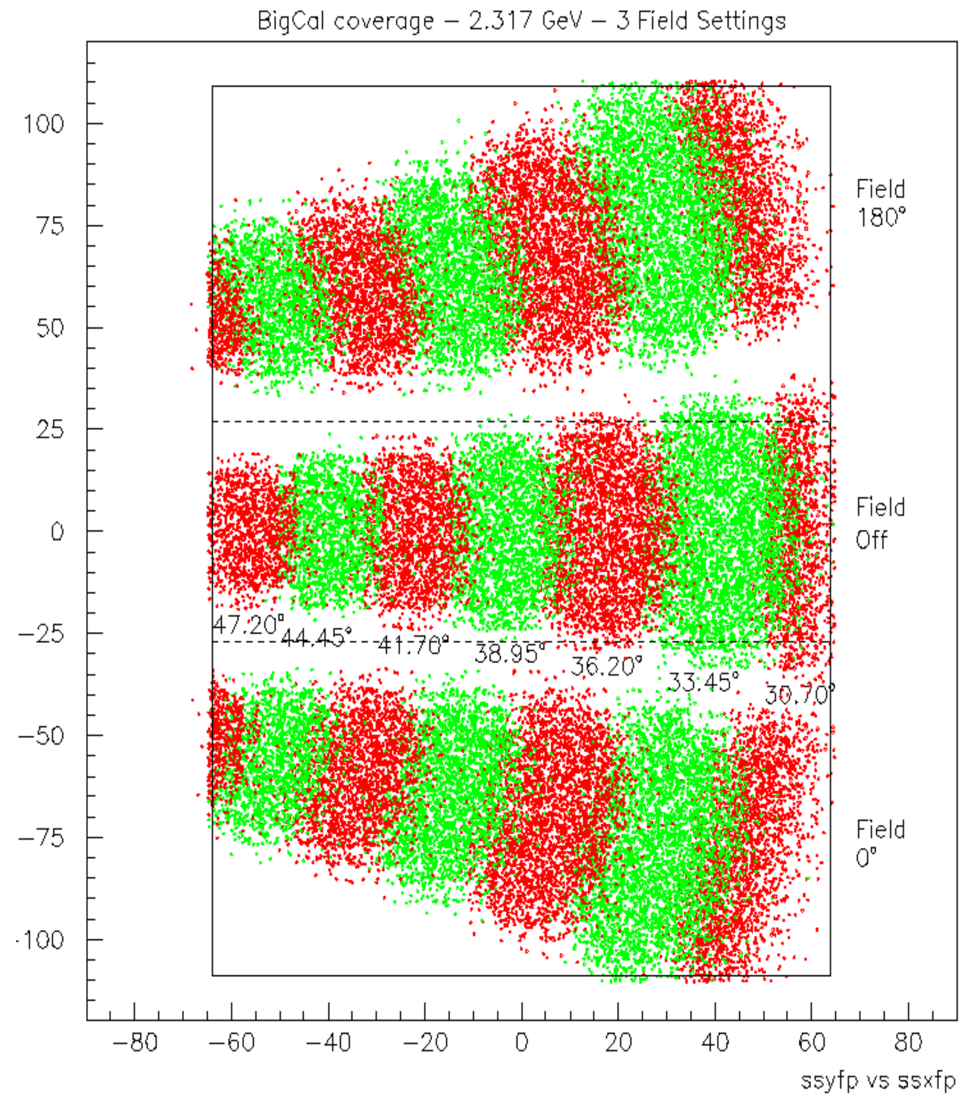
SANE Subsystems (I)

- BigCal Calorimeter for ***GEp-III*** (M. Jones):
- Device ready for installation in Hall
- Extensive calibration with *ep* elastics:
  - SANE is inclusive experiment
  - on-line monitoring with π^0 reconstruction
  - Lucite plate gain monitor
- Needs glass annealing for SANE
- SANE collaborators plan taking shifts during *GEp-III* to gain BigCal experience
- Basic BigCal Trigger for SANE (P. Bosted):
  - AND *GEp-III* BigCal Trigger with Cherenkov OR
  - Backup solutions if higher than expected rates are available



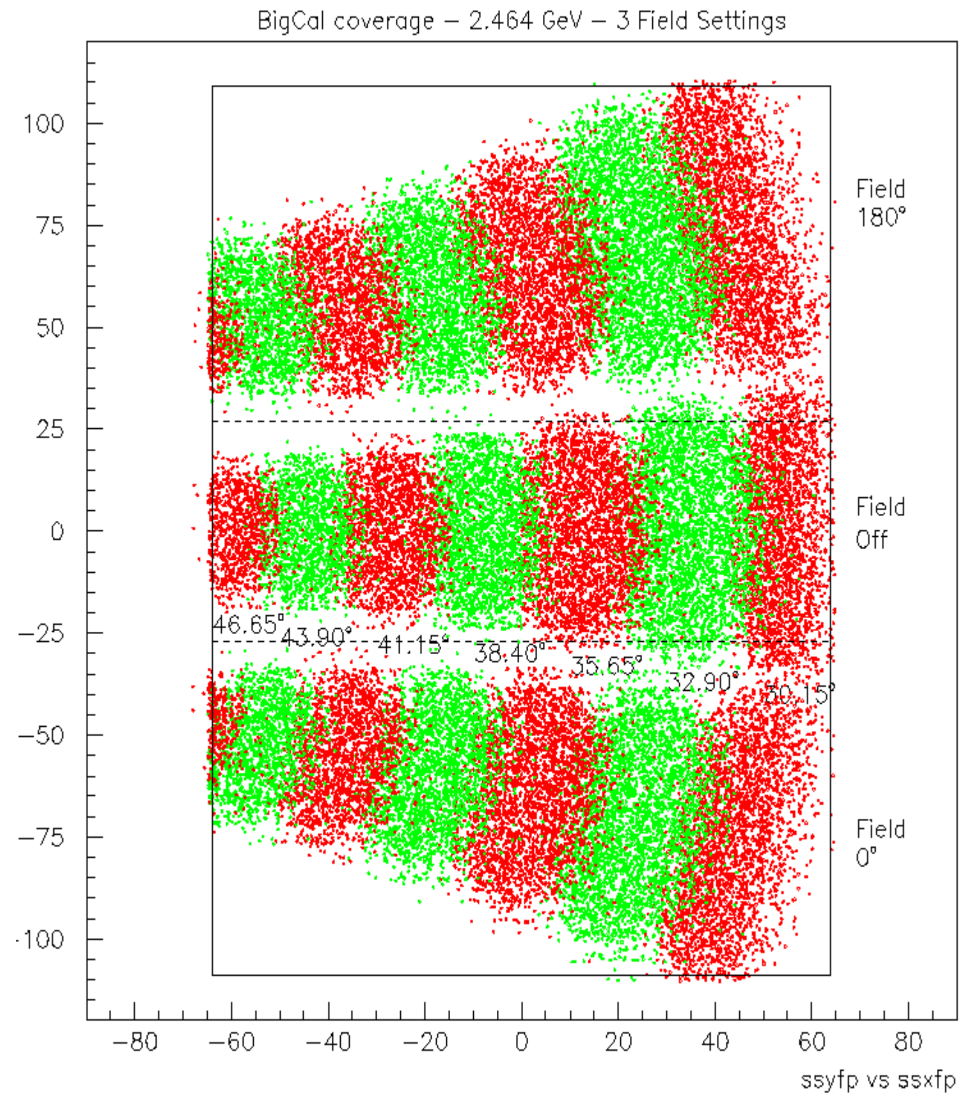
Elastic Calibration (i)

- BigCal Energy Calibration:
  - *e+p* elastic coincidences with *p* detected in HMS, NH_3 target, 1 μA
  - one pass with target field off
  - two passes with full field on, pointing in opposite directions along beam, two passes with ½ field on
  - 2-pass, 2.32 GeV beam; no deflection
  - 90% coverage of BigCal (5 passes; 75% with 3 passes)
    - 52 h (5 passes, 100% efficiency) 33 h (3 passes); ≤ 5% statistics
- Continuous π^0 mass reconstruction



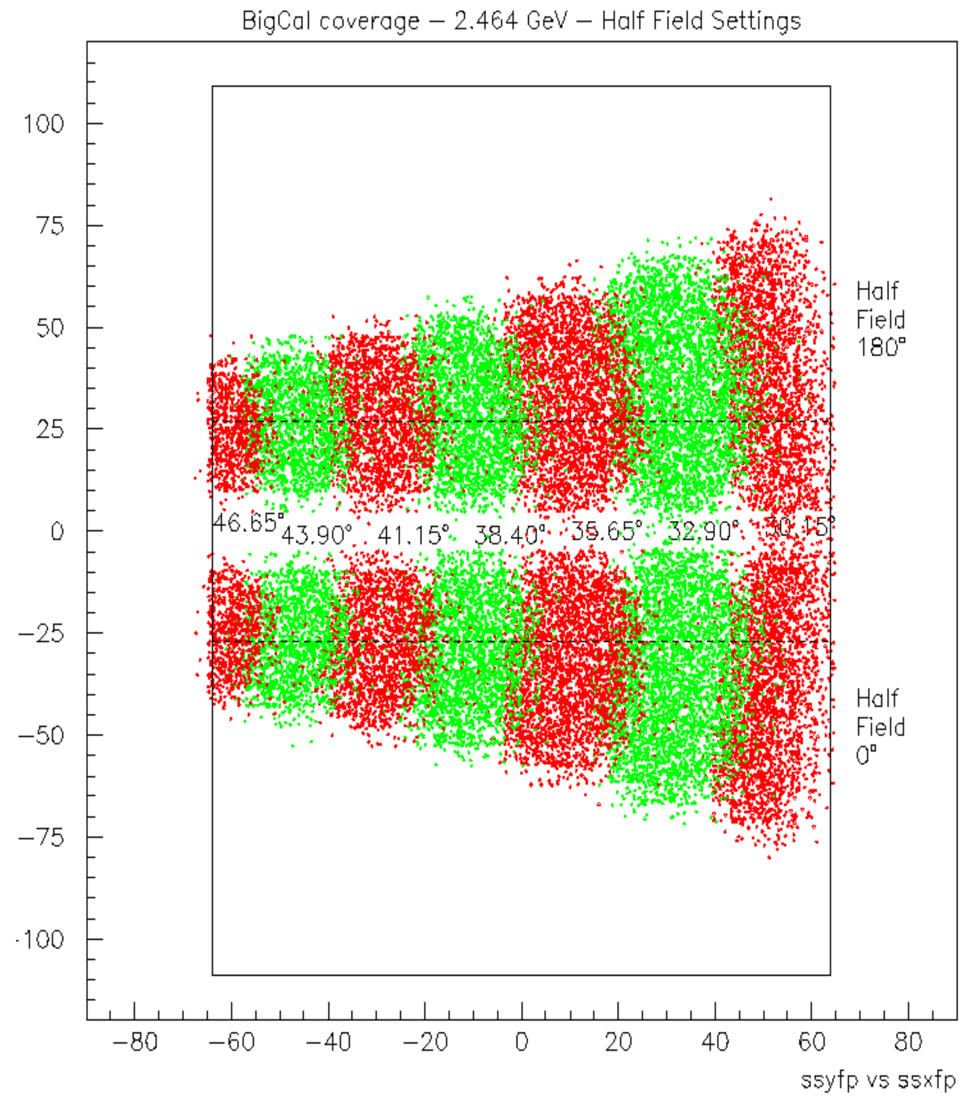
Elastic Calibration (ii)

- BigCal Energy Calibration:
  - *e+p* elastic coincidences with *p* detected in HMS, NH_3 target, 1 μA
  - one pass with target field off
  - two passes with full field on, pointing in opposite directions along beam, two passes with ½ field on
  - 2-pass, 2.46 GeV beam; no deflection
  - 90% coverage of BigCal (5 passes; 75% with 3 passes)
    - 60 h (5 passes, 100% efficiency) 36 h (3 passes); ≤ 5% statistics
- Continuous π^0 mass reconstruction



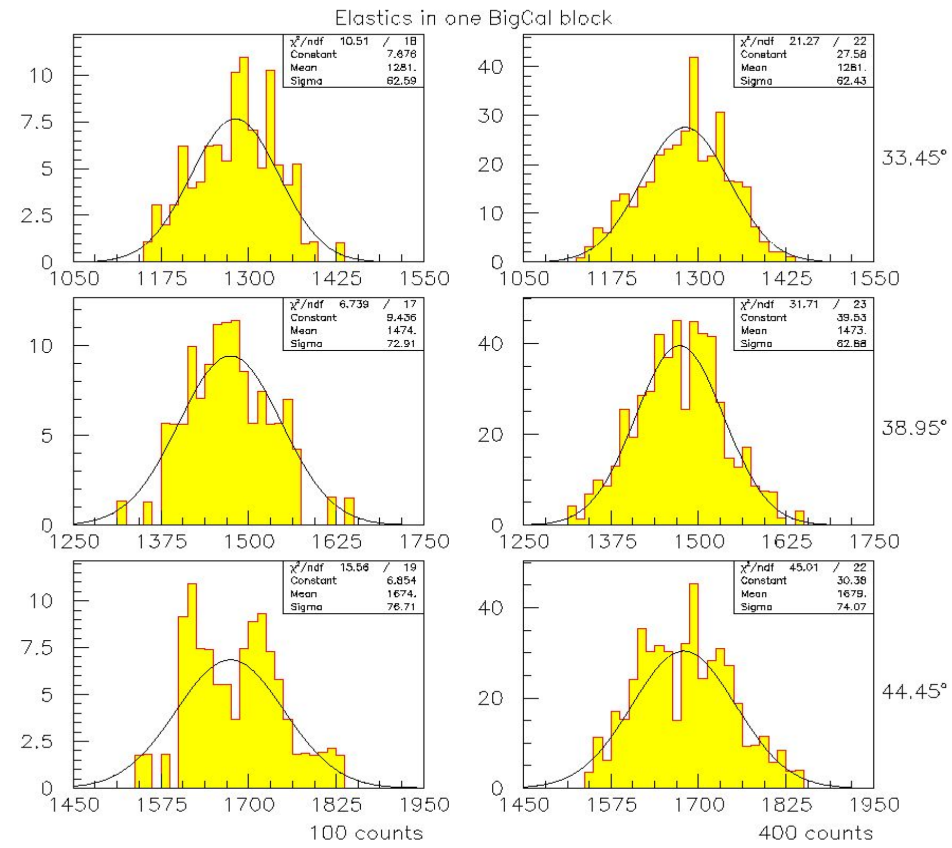
Elastic Calibration (iii)

- BigCal Energy Calibration:
  - *e*+*p* elastic coincidences with *p* detected in HMS, NH_3 target, 1 μA
  - one pass with target field off
  - two passes with full field on, pointing in opposite directions along beam, two passes with ½ field on
  - 2-pass, 2.46 GeV beam; no deflection
  - 90% coverage of BigCal (5 passes; 75% with 3 passes)
    - 60 h (5 passes, 100% efficiency) 36 h (3 passes); ≤ 5% statistics
- Continuous π^0 mass reconstruction

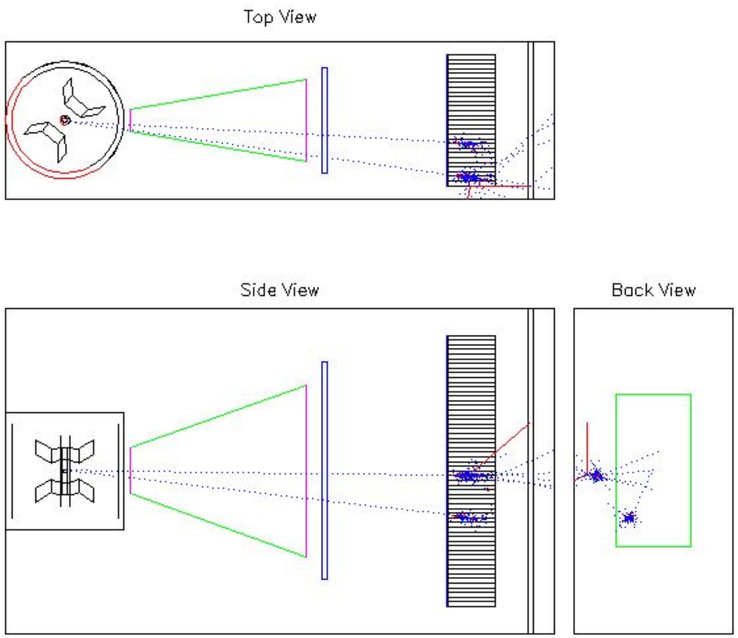


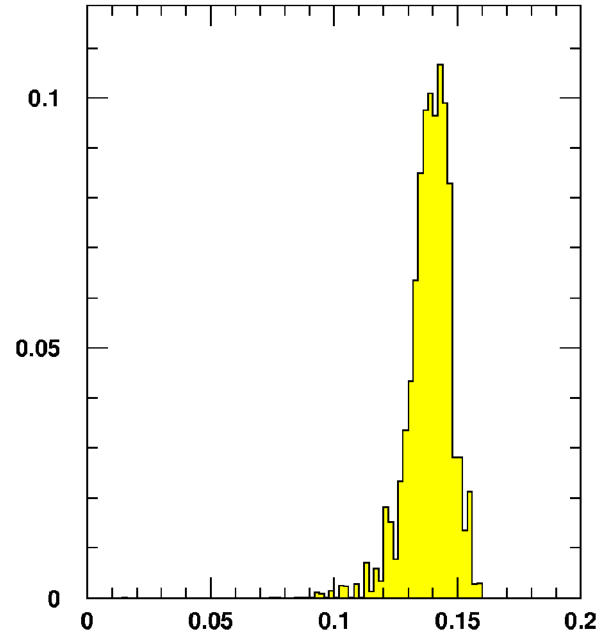
Elastic Calibration (iv)

- BigCal Energy Calibration:
  - *e*+*p* elastic coincidences with *p* detected in HMS, NH_3 target, 1 μA
  - one pass with target field off
  - two passes with full field on, pointing in opposite directions along beam, two passes with ½ field on
  - 2-pass, 2.46 GeV beam; no deflection
  - 90% coverage of BigCal (5 passes; 75% with 3 passes)
    - 60 h (5 passes, 100% efficiency) 36 h (3 passes); ≤ 5% statistics
- Continuous π^0 mass reconstruction



BigCal's neutral pion mass reconstruction



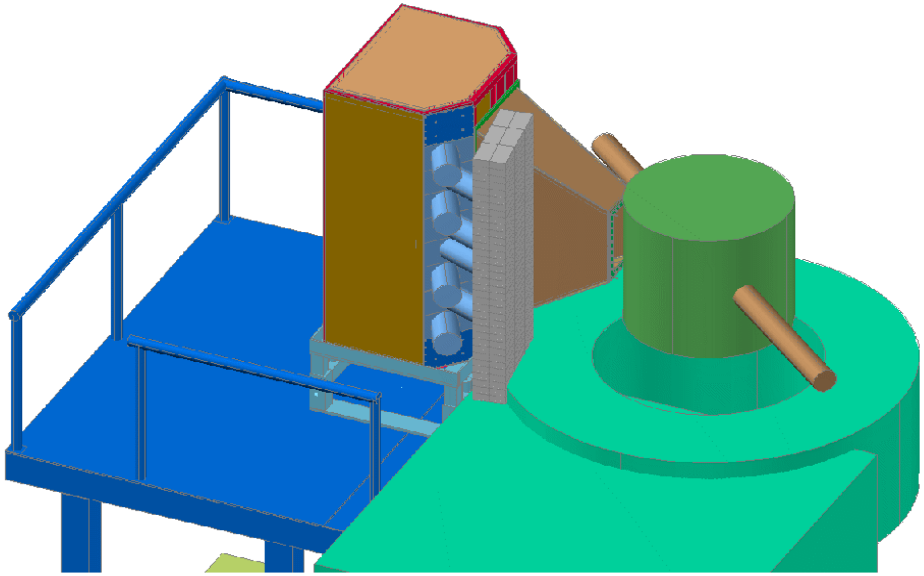


Reconstructed Mass of Two Neutral Cluster Events

- Use π^0 mass reconstruction to continuously calibrate BigCal and
  - calibrate blocks not covered in *e+p* elastic procedure (~10%)
  - measure asymmetry with >0.7 GeV/c threshold to control the pair symmetric background
- GEANT simulated π^0 events in BETA: sigma ~ 10 MeV

SANE Status - Subsystems (II)

- Temple U.'s modular design of gas Cherenkov (Z-E. Meziani):
  - eight mirrors coated at CERN: 80% UV reflectivity
  - eight 3" PMT's plus spare on hand
  - shielded for 50:1 magnetic field reduction
- Frame built by Alpha Tool (NJ) delivered
- Used only Temple's grant funds



SANE Status - Subsystems (III)

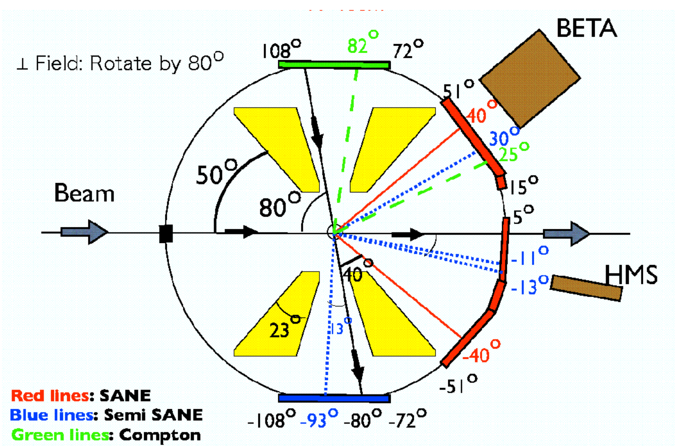
- Forward tracking hodoscope
  - Next to target OVC, much improved tracking resolution vs. reference design
  - covers full BETA solid angle with small device (40 cm x 22 cm)
  - charge sign separation for momenta < 1 GeV/c, background rate ~ 10 kHz/bar
  - Wavelengh shifting fibers glued on 3 mm scintillator bars
    - 73 vertical bars (*x*-coordinate)
    - 2 planes of 133 horizontal bars (*y*-coordinate, ½ bar width overlap)
  - Readout by five 64-anode PMT's (Hamamatsu H7546B), on hand
    - All 339 TDC channels available; all 370 bars on hand
    - Ribbon cables on hand, signal cables on order
  - Prototype tested, full device tests Fall 2007.

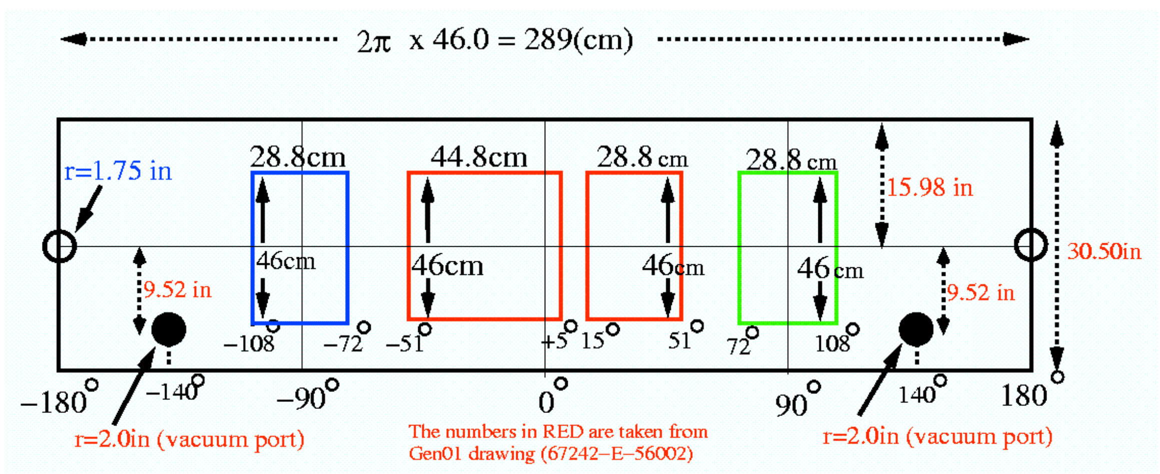
SANE Status - Subsystems (IV)

- Lucite Hodoscope
  - 28 80(L) x 6 (W) x 3.8 (T) cm^3 horizontal curved bars with angled ends
    - all bars, light guides on hand by end of July 2007
  - Sixty 2" PMT's (at both bar ends) on hand, shields on order
  - Need 56 electronics channels (TDC, discriminator, ADC, HV, cables)
  - Frame in fabrication
  - Prototype tested in Spring 2007, construction 07-12/2007
  - In beam tests March 2008

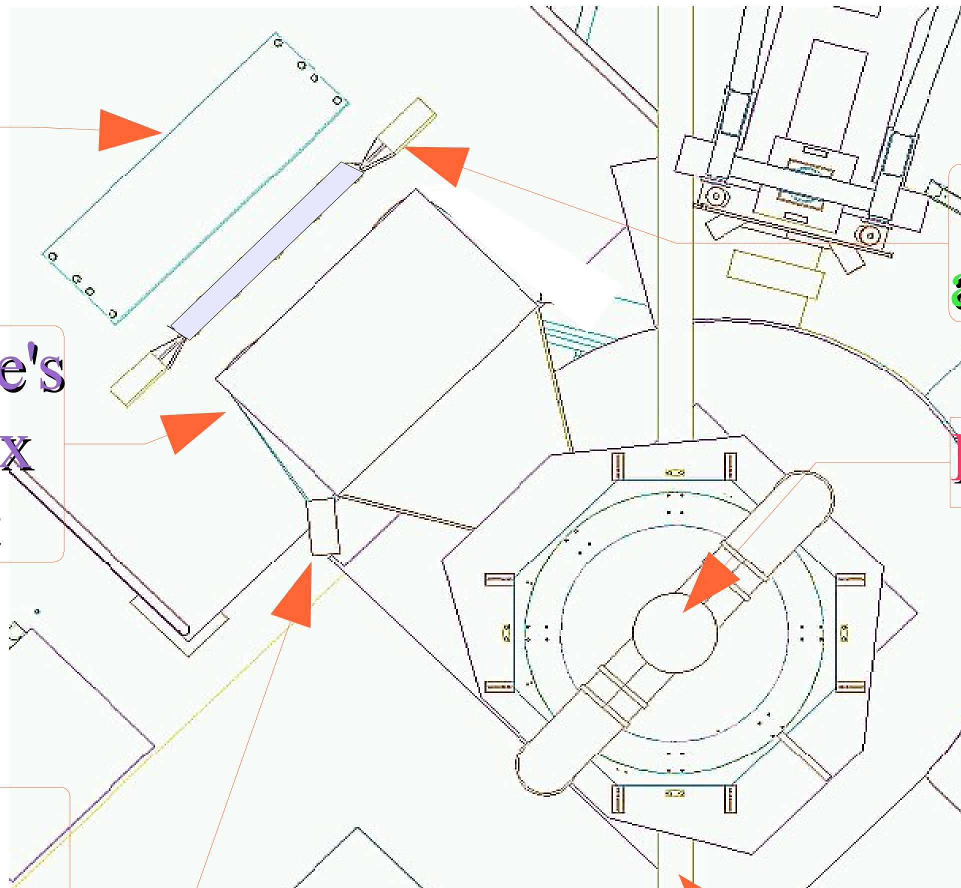
SANE Status - Subsystems (V)

- Polarized target (D. Crabb):
  - multi-use outer vacuum can (OVC) in fabrication (SANE, Semi-SANE, WACS)
  - Nitrogen shield in fabrication
- 4 months fabrication, Lab tests, 6 weeks installation in Hall
- Target window covers: M. Seely and P. Bosted will design for ease of placement/removal/access to forward tracker
- Target material: On hand (some irradiated past week)
- Optimizing tailpiece, insert and 4K shield design





Residual Target Field



< 9 G
at BigCal
Iron Shield Box

Forward Hodoscope's
PMT's in shield box
> 2m from target

~ 100 G
at gas Cherenkov.
50:1 magnetic shields

< ~ 30 G
at Lucite Hodoscope

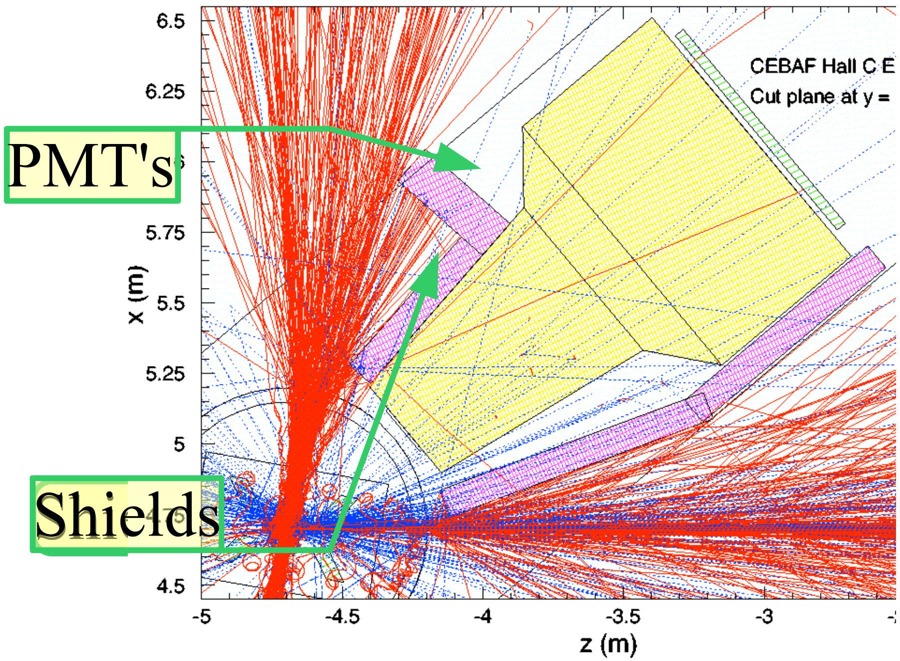
Polarized Target

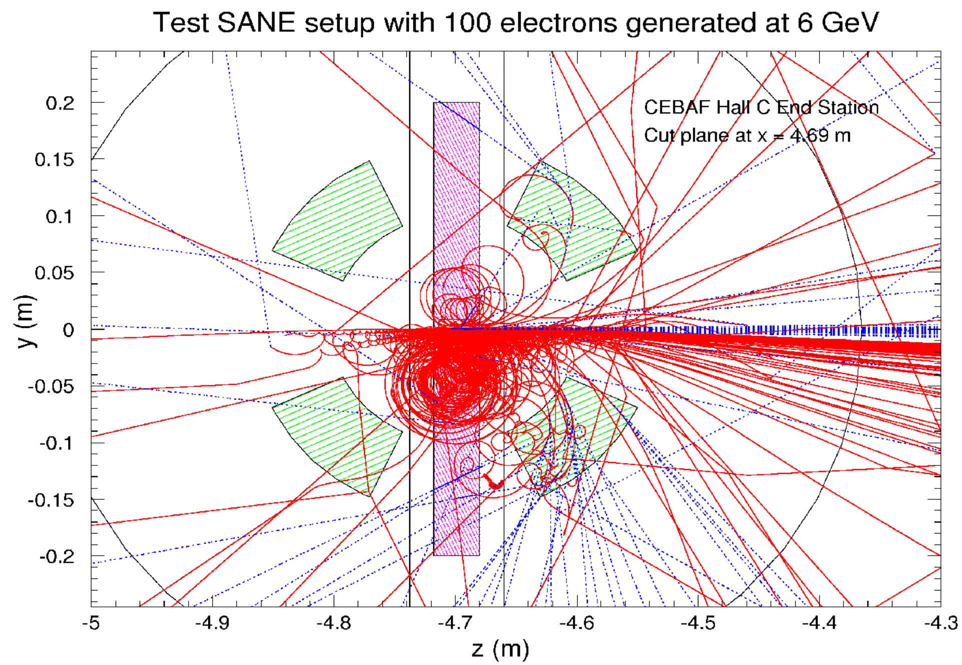
Beam Line

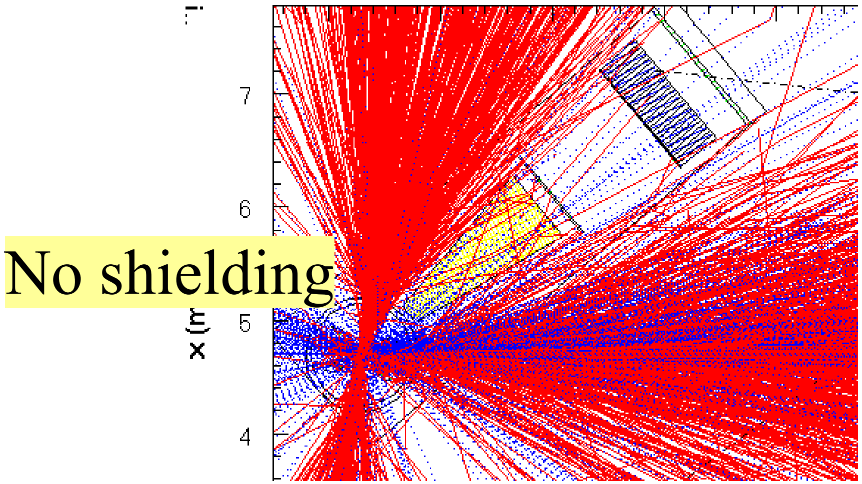
SANE Status - Subsystems (VI)

- Upstream beam line:
  - Girder with chicane
  - Rasters: fast and slow
  - BPM's and BCM's
  - Target Beam Position Monitor (Secondary Emission Monitor):
    - needed to determine beam raster position (1 cm radius spiral)
    - refurbished at U. Basel, ready to ship.
  - Radiator for WACS
- Downstream beam line:
  - He gas bag plus short beam pipe section
  - minimal modification of E-01-006 (*RSS*) design
  - In-hall beam dump as in GEn-01 and *RSS*

Beam Line Background Studies





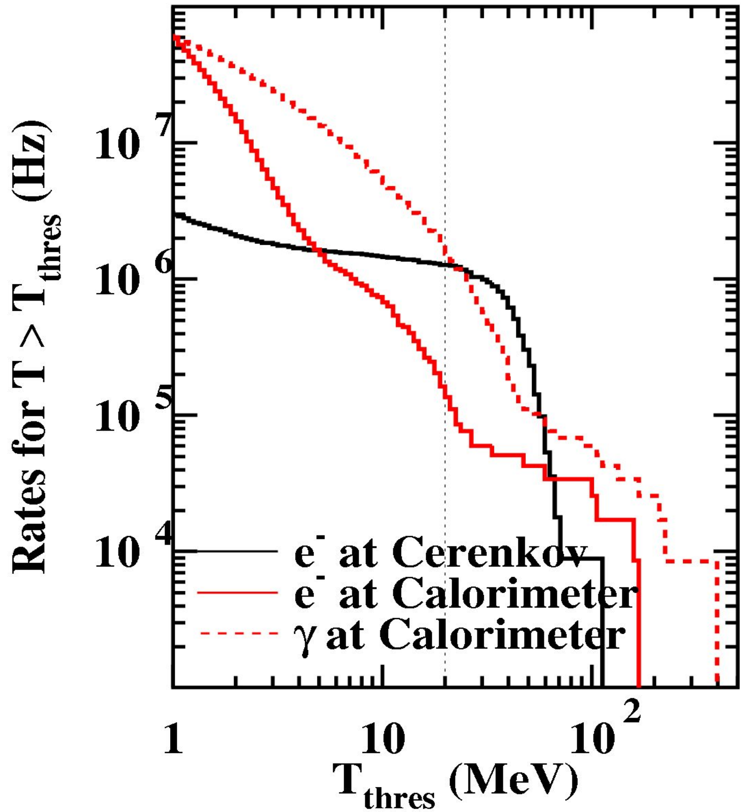


- Top and side views
- Field at 80 degrees
  - Red: electrons, Blue: photons
- .MCWORKS code (P. Degtiarenko) and BETA GEANT (G. Warren)

Beam Line Background Studies

Beam line background studies using simulation package of Pavel Degtiarenko.

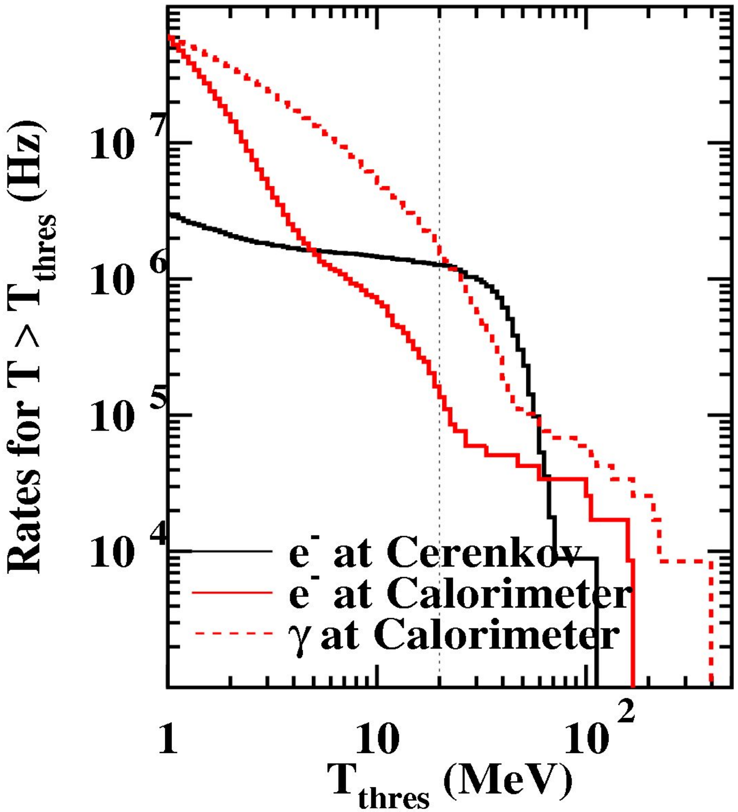
- *Parallel field:* no problems with BETA at 40°.
- *Transverse field:* a large fraction of electrons escape pathologically into BETA:
  - expect at most 200 kHz/PMT for Gas Cerenkov.
  - Pileup, trigger rates, detector rates all remain manageable.
  - These numbers are conservative... will probably have a reduction of at least 2 in Cerenkov rates.



Beam Line Background Studies

As a result of background in transverse mode:

- increase online CAL threshold to 900 MeV to bring trigger rate < 1kHz. *No impact on physics*.
- Slightly increased pileup: 0.8% above 10 MeV, but 0.01% above 50 MeV.
- Increased accidentals between gas Cerenkov and CAL: < 5%, *but uncertainty in correction will be <0.5% of true rate.*



Rates in BETA

All Rates in kHz

Gas Cerenkov (> 20 MeV)				
Field	E	e^-	π^-	Trig
180	4.8	28.1	242.0	30.5
80	4.8	1590.0	223.0	1592.2
180	6.0	25.3	255.0	27.9
80	6.0	1510.0	236.0	1512.4

Calorimeter (> 900 MeV)				
E	e^-	π^-	π°+N	Trig
4.8	0.3	1.0	7.2	8.5
4.8	0.3	1.0	7.1	8.4
6.0	0.3	1.1	8.1	9.5
6.0	0.3	1.2	8.0	9.4

BETA Trigger Rates

E	True	Accd	offline A/T
4.8	0.38	0.03	0.0%
4.8	0.38	1.34	0.5%
6.0	0.39	0.03	0.0%
6.0	0.39	1.43	0.5%

SANE Manpower: Collaboration

Initial	Name	Institution
J.	Jourdan	BASEL
M.	Kotulla	BASEL
I.	Sick	BASEL
E.	Brash	CNU
E.	Jensen	CNU
A.	Marsh	CNU
W.	Boeglin	FIU
S.	Dhamija	FIU
P.	Markowitz	FIU
J.	Reinhold	FIU
I.	Albayrak	Hampton
E.	Christy	Hampton
C.	Keppel	Hampton
V.	Tvaskis	Hampton
P.	Bosted	JLab
J.-P.	Chen	JLab
V.	Dharmawardarne	JLab
R.	Ent	JLab
D.	Gaskell	JLab
J.	Gomez	JLab
D.	Higinbotham	JLab
M.	Jones	JLab
D.	Mack	JLab
G.	Smith	JLab
B.	Wojtsekhowski	JLab
S.	Wood	JLab

Initial	Name	Institution
J.	Dunne	MSU
A.	Ahmidouch	NCAT
S.	Danagoulian	NCAT
C.	James	NCAT
M.	**Jones**	**NCAT**
S.	Vilayoung	NCAT
M.	Khandaker	NSU
F.	Wesselmann	NSU
P.M.	King	Ohio
J.	Roche	Ohio
A.M.	Davidenko	Protvino
Y.M.	Goncharenko	Protvino
V.I.	Kravtsov	Protvino
Y.M.	Melnik	Protvino
V.V.	Mochalov	Protvino
A.	Vasiliev	Protvino
C.	Butuceanu	Regina
G.	Huber	Regina
V.	Kubarovsky	RPI
R.	Gilman	Rutgers
X.	Jiang	Rutgers
S.	Choi	Seoul
Ho-young	**Kang**	**Seoul**
Hyekoo	Kang	Seoul
Byungwuek	Lee	Seoul
Yoomin	Oh	Seoul
Jeongseog	Song	Seoul

Initial	Name	Institution
A.	Lukhanin	Temple
W.	**Armstrong**	**Temple**
Z.-E.	Meziani	Temple
B.	Sawatzky	Temple
M.	Bychkov	UVA
M.	Commisso	UVA
D.	Crabb	UVA
D.	Day	UVA
E.	Frlez	UVA
K.	Kovacs	UVA
N.	Liyanage	UVA
V.	Mamyan	UVA
J.	**Maxwell**	**UVA**
J.	Mulholland	UVA
D.	Pocanic	UVA
O.	Rondon	UVA
K.	Slifer	UVA
L.C.	Smith	UVA
L.	Pentchev	W&M
S.H.	Cowell	Witwatersrand
M.M.	Dalton	Witwatersrand
G.	Mbianda-Njencheu	Witwatersrand
A.	Asaturyan	Yerevan
A.	Mkrtchyan	Yerevan
H.	Mkrtchyan	Yerevan
V.	Tadevosyan	Yerevan

19 institutions - 76 confirmed names

2 PhD students - 2 MS students

SANE Manpower: Subsystems

Subsystem	Component	Manager	Experts	Institution
BigCal				
	Operation	L. Pentchev		William & Mary
			M. Jones	Hall C
			Protvino	Protvino
			Yerevan	Yerevan P. I.
	Trigger	R. Gilman		Rutgers U.
			X. Jiang	Rutgers U.
			P. Bosted	Hall C
	Gain Monitor	E. Frlez		UVA
	Calibration	G. Huber		U. Regina
			O. Rondon	UVA
Gas Cherenkov		Z-E. Meziani		Temple U.
			B. Sawatzky	Temple U.
			O. Lukhanin	Temple U.
Forward Tracking Hodoscope		M. Khandaker		Norfolk S.U.
			P. Bosted	Hall C
			C. Butuceanu	U. Regina
Lucite Hodoscope		A. Ahmidouch		North Carolina A&T S.U.
			S. Danagoulian	North Carolina A&T S.U.
Polarized Target		D.G. Crabb		UVA
			D.B. Day	UVA
			K. Slifer	UVA
			M. Seely	JLab
			C. Keith	JLab
			G. Smith	Hall C
Beam Line		J. Dunne		Mississippi State U.
	Raster		Chen Yan	Hall C
	BCM		D. Mack	Hall C
	Target BPM -SEM		M. Steinacher	Basel
			UVA	UVA
Shielding design		S. Choi		Seoul National U.
			H-Y.Kang	Seoul National U.
HMS		H. Mkrtchyan		Yerevan P. I.
			Yerevan	Yerevan P. I.
			Hall C	Hall C
			C. Keppel	Hampton
Moller		D. Gaskell		Hall C
			Hall C	Hall C
BETA Simulation		J. Maxwell		UVA
			O. Rondon	UVA

Shift and Run Coordinator Staffing

- Run duration: 70 calendar days
  - 3 staff/shift
  - 630 workers-shifts
- Expect 53 of 75 collaborators to be shift workers (9 experts only, 9 grad. students, 4 undergraduates)
  - standard 10 shifts load
    - 530 worker-shifts
  - 9 graduate students 12 shifts ea.
    - 108 additional shifts
- M. Khandaker to be shift czar
- Shift load assigned per institution
  - each institution distributes shifts

- Run coordinators
  - Rotation: once/week
  - 10 weeks run
- 8 confirmed or likely coordinators identified
  - senior staff or associates with polarized target experiment experience
- Need 3 more (one relief)
  - Target operators (TO):
  - need 210 TO shifts
  - 50 UVA student shifts, 70 expert shifts
  - need to train 9 additional operators

SANE Safety Documents

- Existing polarized target COO and ESAD for ***RSS*** (E-01-006) and ***GEn*-01** (E93-026) to be updated
  - include current version of Hall C base equipment material
  - add safety assessment for BigCal from ***GEp*-III** (E04-109)
  - new safety assessment for Cherenkov, Lucite Hodoscope and Forward tracker
  - update polarized target for new platform configuration
- Existing RSAD document for ***RSS*** is base for SANE RSAD
  - almost identical beam energy, luminosity, beam deflections, beam line
  - preliminary radiation budget submitted with Beam Request (9/14/2006), on file
- Additional shift directives, run coordinator duties, manuals to be updated from ***RSS*** documents

Simulation and Reconstruction Software

- Existing GEANT simulation of BETA being updated to include hodoscopes
- Reconstruction software reconstructs energy deposited in blocks, coordinates of cluster
- Track reconstruction code from detector coordinates in forward tracker, Lucite hodoscopes in development
- Existing *GEp*-III BigCal code (reconstruction and simulation) will be used, looking into integration in common package
- Off-line code will be based on simulation reconstruction package

SANE Status - 7/2007

- Thirteen collaboration meetings since 11/2003, latest on 3/30/2006
- Submitted Beam Request on 9/14/06
- Hall C schedule: SANE tentatively to install in 5/2008, start in 7/2008
  - Time lines show adequate lead time for 2008 run

SUMMARY
Steady progress over 4 years
Can install in 8 weeks by end of GEp-III
Dedicated and diligent collaboration + full Lab support = Success
SANE is pioneering spin physics with large non-magnetic detectors