# SANE

# Spin Asymmetries on the Nucleon Experiment (TJNAF E07-003)

SANE Collaboration U. Basel, Florida International U., Hampton U., Norfolk S. U., North Carolina A&T S. U., Mississippi S.U., IHEP-Protvino, U. of Regina, Rensselaer Polytechnic I., Rutgers U., Seoul National U., Temple U., TJNAF, U. of Virginia, College of William & Mary, Yerevan Physics I.

Spokespersons: S. Choi (Seoul), Z-E. Meziani (Temple), O. A. Rondon (U. of Virginia)

Collaboration Meeting March 30, 2007 Jefferson Lab

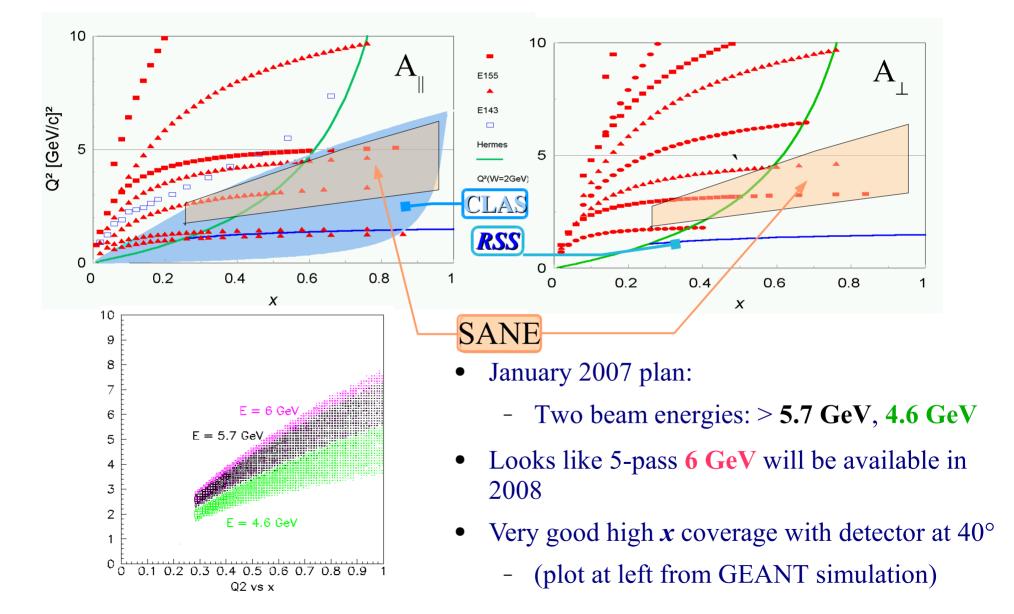
#### SANE Status - 3/2007

- PAC31 re-approved SANE (E03-109) as E07-003, with "A" rating for 27 days plus 14 calendar days of commissioning (70 days on the floor).
- Submitted Beam Request on 9/14/06
- Hall C schedule: SANE tentatively to install and run in mid-2008
- Readiness Review: tentative date last week June 2007
- In-beam tests of prototypes/partial detector assemblies planned for upcoming Hall C run period
- We welcome Jim Dunne (MS State) to SANE
  - Jim will look after the beam line
    - downstream of target: design, fabrication, installation, alignment
    - upst ream: installation (SEM, radiator for WACS) and alignment

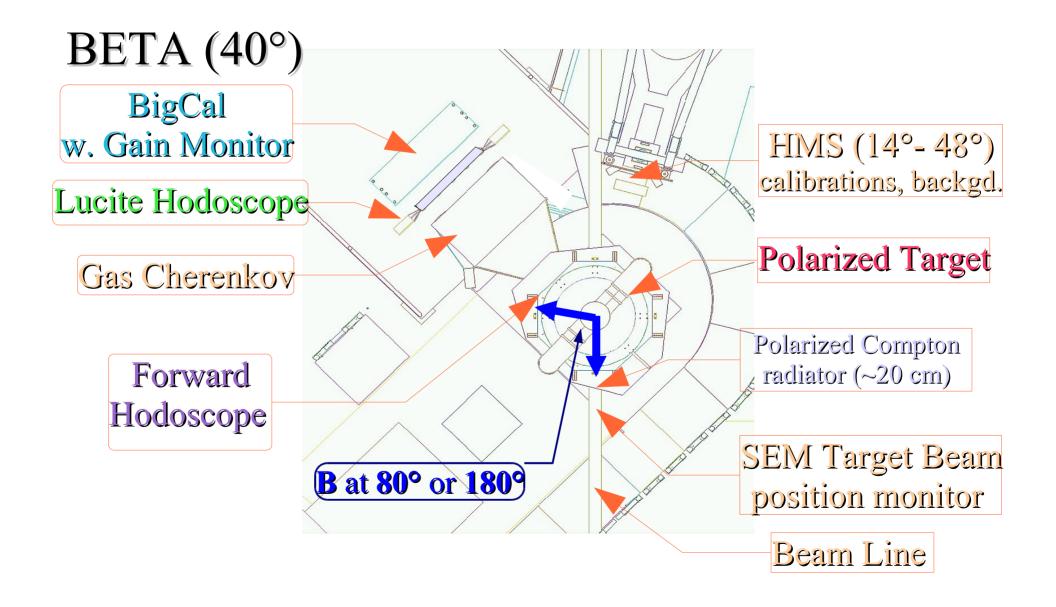
# **SANE** Physics

- Goal is to learn all we can about proton SSF's from an inclusive double polarization measurement:
  - twist-3 effects from moments of  $g_2$  and  $g_1$ :
    - $d_2$  matrix element =  $\int_0^1 x^2 (3 g_2 + 2 g_1) dx$
  - 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 inclusive spin asymmetries for two orientations of target spin relative to beam helicity (anti-parallel and near-perpendicular)
  - Detect electrons with novel large solid angle electron telescope **BETA**
- JLAB is unique facility for measuring complete transverse spin structure

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



# SANE Design



#### SANE Status - Subsystems

- BigCal
  - Operation: William & Mary, Protvino, Rensselaer, UVA, Hall C
  - Trigger: Rutgers U.
  - Gain Monitor: UVA
  - Calibration: U. Regina
- Gas Cherenkov: Temple U.
- Forward Tracking Hodoscope: Norfolk S.U., Hall C
- Lucite Hodoscope: North Carolina A&T S.U.
- Polarized Target: UVA, JLab
- Beam Line: Mississippi State U., Hall C, UVA
- Shielding design: Seoul National U.
- HMS: Yerevan P. I.
- Target Beam Position Monitor: U. Basel, UVA

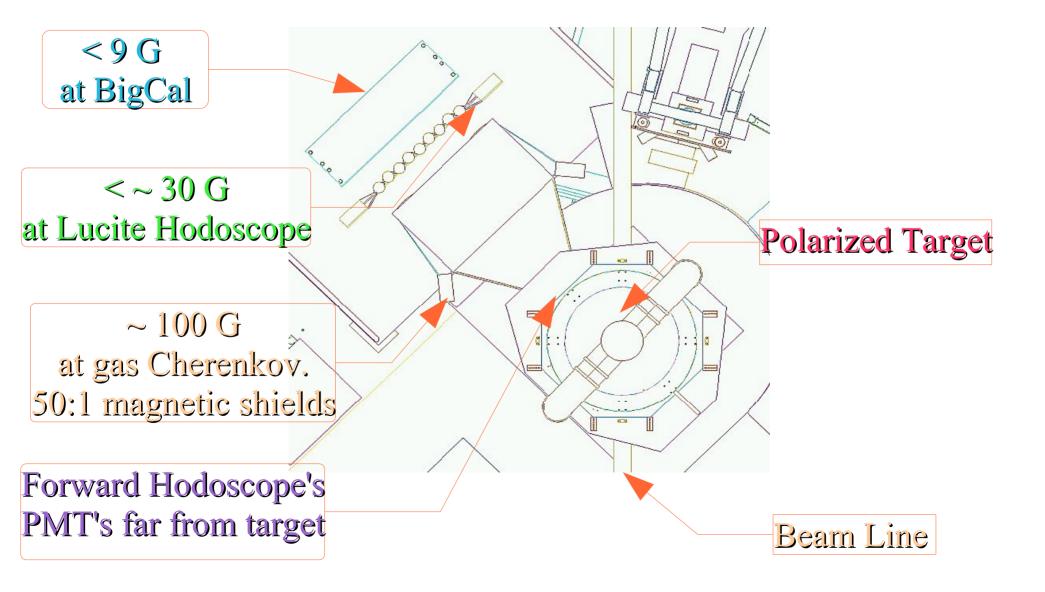
#### SANE Status – Target Items

- Target chamber (OVC) and LN<sub>2</sub> shield
  - design completed, bids for fabrication being reviewed
- Target platform design, integration with BETA's stands:
  - Hall C engineering and design group
  - Input from Temple, UVA, Hall C physics, Mississippi State.
  - M. Fowler provided 3D CAD large file of Hall C layout, available online
- Target window covers
  - M. Seely and P. Bosted will design for ease of placement/removal/access to forward tracker
- Other items details in D. Crabb's report:
  - Target material
  - Optimized tailpiece, insert and 4K shield design: existing *GEn01-RSS* system designed for downstream exit of scattered electrons

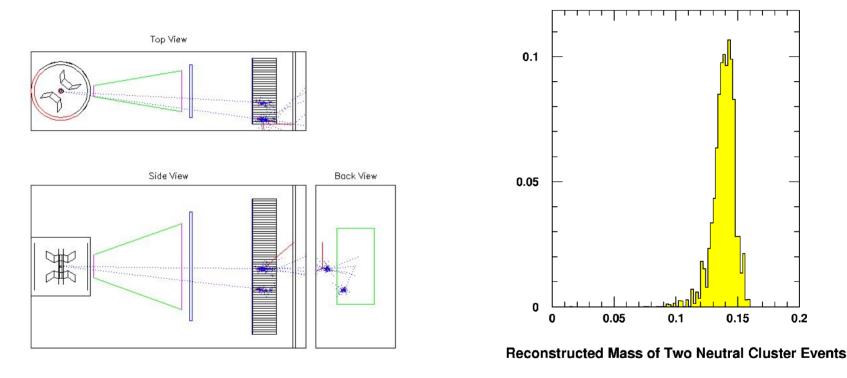
#### SANE Status – Other Items

- Backgrounds from target: positrons from  $e^+/e^-$  pair production
  - charge sign for p < 1 GeV/c will be identified with front hodoscope
  - V. Dharmawardane reviewed reference estimates, >20% rate for E' < 1.1 GeV from CLAS studies; could reduce background with software cuts
  - P. Bosted: precision  $\pi^0$  asymmetry possible with 0.7 GeV/c threshold; can be used to make pair symmetric asymmetry systematics negligible
  - HMS will be used to measure accurate pair rates: need run plan
- Update of SANE and BETA's GEANT-based simulation
  - UVA dissertation student J. Maxwell working on G. Warren's legacy code
    - Optimization studies
    - Improvement and consolidation of geometry definitions (single version for all users of BETA with polarized target)
    - Effect on resolution of proposed BigCal magnetic shield

#### TAC report: residual target field



# BigCal's neutral pion mass reconstruction



- Use  $\pi^0$  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  $\pi^0$  events in BETA: sigma ~ 10 MeV

#### Beam Time Request

2003 Request				
-	Energy	θ <sub>N</sub>	Time (ł	ו)
Production	6.0	180	100	
	6.0	80	200	
	4.8	180	70	
	4.8	80	130	
	2.4	-	10	
<b>Systematics</b>	Packing Fr	action	20	
	Mollers		21	
	Total beam	n time	551	(23 d)
Overhead	Anneals		62	
	Energy Ch	ange	48	
	Target Rot	ation	48	
	Stick Char	iges	48	
	Total Over	head	206	(9 d)
	Requested	l Time	654	(27 d)

2007 Reques				
	Energy	θ <sub>N</sub>	Time (I	h)
Calibration	2.3	off, 0, 180	47	
Production	4.6	180	70	
	4.6	80	130	rotate
	5.7	80	200	
	5.7	180	100	rotate
<b>Systematics</b>	Packing	Fraction	20	
	Mollers		21	
	Total bea	am time	588	(24.5 d)
Overhead	Anneals		62	
	Energy C	Change	48	
	Target R	otation	48	
	Stick Cha	anges	48	
	Total Ov	erhead	206	(9 d)
	Request	ed Time	654	(27 d)

**Commissioning** TAC recommended 14 calendar days

# Preliminary Run Plan

	t: 06/02/08 sh: 08/14/08						Gan				Ru Gai		Fabl	е											Pa	ge #1
•	A - ti vite N	Duration	Otest	Finish		N	lay 08					June	08			Jı	ıly 08				Aug	ust 08				Septer
?	Activity Name	Duration	Start	Finish		27	4	11	18	3 2	25	1	8	15	22	29	6	13	20	27	3	10	) 1	7	24 :	31 7
1	SANE Run	70	06/02/08	08/13/08					0	06/02	2/08	$\diamond$											<b>0</b> 8	/13/0	8	
2	Commission 2.47GeV/ (4.87?)	12	06/02/08	06/13/08	Co	ommi	ission	2.47	'Ge\	// (4.	87?)															
3	Calibration 2.47 GeV	6	06/14/08	06/19/08					Ca	alibra	ation	2.47	GeV													
4	Energy change 2 => 4 pass	1	06/20/08	06/20/08				E	Ene	rgy c	chan	ge 2 :	=> 4 p	ass	Í											
5	4.87 GeV parallel	5	06/21/08	06/25/08							4.	87 Ge	eV pai	allel												
6	Target rotation 180° - 80°	1	06/26/08	06/26/08						Т	arge	t rota	tion 1	80°-	80°											
7	Chicane alignment	0	06/26/08	06/26/08										06/26	5/08 <b>V</b>	Chica	ne al	ignme	•							
8	4.87 GeV 80 deg.	10	06/27/08	07/09/08								4.	87 Ge	V 80	deg.											
9	Energy change 4 pass => 5 pass	1	07/10/08	07/10/08							En	ergy	chan	ge 4	pass :	=> 5 p	ass									
10	? Chicane alignment (if needed)	0	07/10/08	07/10/08												07/10	)/08 🔻	? Chi	cane	align						
11	6.07 GeV 80 deg.	22	07/11/08	08/01/08										6	.07 Ge	eV 80	deg.									
12	Target rotation 80° - 180°	1	08/02/08	08/02/08												Та	rget r	otatio	n 80°	- 180	•					
13	Chicane alignment	0	08/12/08	08/12/08																	08 <mark>/12</mark>	/08 🔻	Chic	ane	alignm	e
14	6.07 GeV parallel	11	08/03/08	08/13/08														6.07	GeV p	baralle	el 📒					

#### Time Lines

	: 09/15/04 h: 08/19/08			Outl	Ru ine Gantt View:		e G	antt Tat	ole								Ρ	age #
	Activity Name	Duration	Start	Finish	2003	2004		2005	:	2006		200	7		2008		2009	
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1	- SANE	1056	09/15/04	08/18/08		09/15/04 <	<u>&gt;</u>	-								08/	18/08	
2	- BETA	921	09/15/04	03/25/08		09/15/04 <	>					_			<u> </u>	03/25/08		
3	- BigCal	623	09/15/04	03/25/08		09/15/04 <									<b></b>	03/25/08		
4	BigCal assembly	21	09/15/04	10/13/04	BigCal	assembly	L.	Pentchev										
5	BigCal tests	149	10/14/04	05/10/05	B	gCal tests												
6	Gep-III	200	06/20/07	03/25/08								Gep	III 📜					
7	- Gain Monitor	697	09/27/04	05/29/07		09/27/04							<b>0</b>	5/29/07	7			
8	Design and parts procurement	60	09/27/04	12/17/04	Design and parts pro	curement		E. Frlez				1						
9	EEL tests	30	05/08/06	06/16/06				EE	L te	sts 🗖								
10	BigCal integration	247	06/19/06	05/29/07				BigCal inte	egra	ation		i	E.	Frlez				
11	- Gas Cherenkov	857	09/15/04	12/21/07		09/15/04 <	<u>&gt;</u>							•	12/2	1/07		
12	Prototype tests	78	09/15/04	12/31/04	Proto	ype tests		O. Lukhan	in,Z	-Е. Ме	ziani	1						
13	Mechanical/optical design	109	11/01/04	03/31/05	Mechanical/opt	ical desig	n 🔳	S. Choi	i,O.	Lukha	nin	1						
14	Parts procurement	120	04/01/05	09/15/05	Pa	rts procu	eme	ent <b>ent</b>				1						
15	Tank construction	76	11/10/06	02/23/07				Tank	coi	nstruct	tion							
16	Assembly	60	02/26/07	05/18/07						As	semb	oly 🛄						
17	EEL tests	30	05/21/07	06/29/07							EEL	tests		-				
18	In-hall tests	85	08/27/07	12/21/07							In-I	hall t	ests					
19	- Forward Tracker	802	10/18/04	11/16/07		10/18/04	•							1	1/16	07		
20	Lucite tests	60	10/18/04	01/07/05	L	ucite tests		M. Khanda	aker	•								
21	Quartz procurement	40	11/01/04	12/24/04	Quartz pr	ocuremen	t 🔲	M. Khanda	ker			1						
22	Quartz tests	60	02/20/06	05/12/06				Quartz te	ests	м	. Kha	ndaķ	er,V.	Dharn	nawa	ardane		
23	Fibers on scintillator	o	08/04/06	08/05/06				08	/04/	06 PM	Fibe	ers o	n sciı	nt				
	Project Start	Finish			itical Activity Name			ource Names ource Names		Event	<u> </u>		S	art	V	Name		

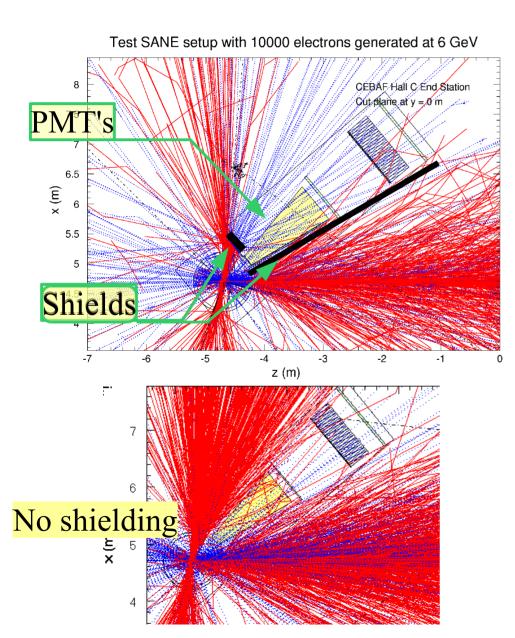
### Time Lines

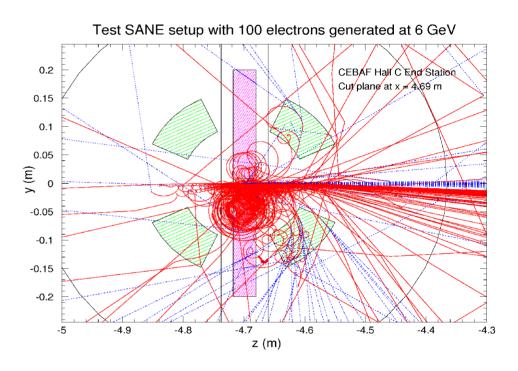
		Activity Name	Duration	Start	Finish		2003			2004		2005	2006 2007 2008 2009
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24		Final design & Parts procurem		08/07/06						Final de	sign	& Parts proc	
25		Partial construction	60	01/22/07	04/13/07						_	Partia	
26		SOS tests	60	04/16/07	07/06/07								SOS tests
27		Full construction	60	08/20/07	11/09/07								Full construction
28		GEp-III tests?	5	11/1 <b>2/07</b>	11/16/07								GEp-III tests?
29	-	Lucite Hodoscope	220	02/01/07	12/05/07								02/01/07
30		Prototype construction	90	02/01/07	06/06/07							Prototyp	
31		SOS/in Hall Tests	5	06/07/07	06/13/07								SOS/In Hall Tests
32		Frame design	110	02/01/07	07/04/07								Frame design
33		Full construction	60	07/05/07	09/26/07								Full construction
34		GEp-III test period	50	09/27/07	12/05/07								GEp-III test period
35	-	Beam line	893	09/17/04	02/21/08				C	09/17/04	<u> </u>		02/21/08
36		Chicane	5	01/16/07	01/22/07								Chicane I
37		Downstream Line design	60	03/01/07	05/23/07							Downstre	eam Line design 💻 🔤
38		Extension fabrication	120	05/24/07	11/07/07							Ex	tension fabrication
39		He bag fabrication	120	05/24/07	11/07/07								He bag fabrication
40	_	SEM	810	09/17/04	02/21/08				C	09/17/04	<b>•</b>		02/21/08
41		Ship to Basel	5	09/17/04	09/23/04			S	Ship	to Basel	L.		
42		Refurbish	250	09/24/04	09/08/05				R	lefurbish	+		
43		Ship to JLab	40	12/28/07	02/21/08								Ship to JLab
44	-	HMS	15	04/28/08	05/12/08								04/28/08 🔷 05/12/08
45		Uninstall FPP	5	04/28/08	05/02/08								Uninstall FPP
46		Reinstall base detectors	5	05/03/08	05/07/08								Reinstall base detectors
47		Cosmics runs	5	05/08/08	05/12/08								Cosmics runs I,
48	-	Shielding	712	09/17/04	06/14/07				C	09/17/04	<b>~</b>		○ 06/14/07
49		Simulations	250	09/17/04	09/01/05				Sim	nulations		<b>S.</b>	Choi

#### Time Lines

		Activity Name	Duration	Start	Finish			200	03		_	004		_	2005	;		200	6		200				2008	8		_	009		_
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50		Shield design	100	01/26/07	06/14/07													Shi	eld de	sigr	1										
51	-	Polarized Target	577	09/15/04	02/29/08						09	9/15/04	<u> </u>												<b></b>	<b>9</b> 2/:	29/08				
52		Vaccum Can Design	120	09/15/04	03/01/05			۷	/acc	um C	an	Design			S	. Taji	ma														
53		Vaccum Can Fabrication & Testir	r 180	02/28/07	11/06/07							١	/ac	cum	n C	an Fa	bric	atio	n & T	estir	ng										
54		LN2 Shield	180	02/28/07	11/06/07														LN2	Shie	eld 🚺										
55		4K Shield	180	03/20/07	11/26/07														4K	Shi	eld				B						
56		Tailpiece	120	03/20/07	09/03/07														Та	ilpie	ece	1			_						
57		Insert construction	120	04/02/07	09/14/07												Ins	sert	const	ruct	ion										
58		Material Preparation	120	09/22/04	03/08/05			P	Mate	erial P	rep	aration	<b>ا</b>																		
59		Material Irradiation	120	03/30/07	09/13/07												Ма	ateri	al Irra	diat	ion										
60		Cryogenic Controls	240	04/02/07	02/29/08												Cry	oge	enic C	ontr	ols										
61		Target Platform Design	120	12/05/06	05/21/07										Та	rget	Plat	forn	n Des	ign			_								
62		Target Platform Fabrication	180	05/22/07	01/28/08											Targ	et Pl	atfo	rm Fa	bric	atio	n									
63		Target assemby	20	11/27/07	12/24/07															Tar	get a	asse	emby	/	_						
64		EEL tests	40	12/25/07	02/18/08																	EEL	tes	ts							
65	-	Installations	110	04/28/08	08/18/08																	1	04/	28/	08		0	B/18	/08		
66		Glass anneal	5	04/28/08	05/02/08																	GI	ass a	ann	eal	Ţ					
67		BigCal	35	05/03/08	06/06/08																			Big	Cal	t.					
68		Cherenkov	5	05/28/08	06/01/08																		Che	erer	nkov	VI.					
69		Lucite	10	05/11/08	05/20/08																			Lu	cite	١,					
70		Forward tracker	5	05/23/08	05/27/08																F	orv	vard	tra	ckei	r I					
71		Target	25	04/28/08	05/22/08																	   		Tar	get						
72		Shielding	5	04/28/08	05/02/08																	1	Shi	eld	ing	T.					
73		Downstream beam line	5	04/28/08	05/02/08														0	)owi	nstre	eam	i bea	m I	ine	t.					
74		SEM	5	04/28/08	05/02/08																	1		S	ЕМ	t,					
75	+	Run	70	06/07/08	08/18/08																		0	6/0	7/08	•	0	8/18	8/08		

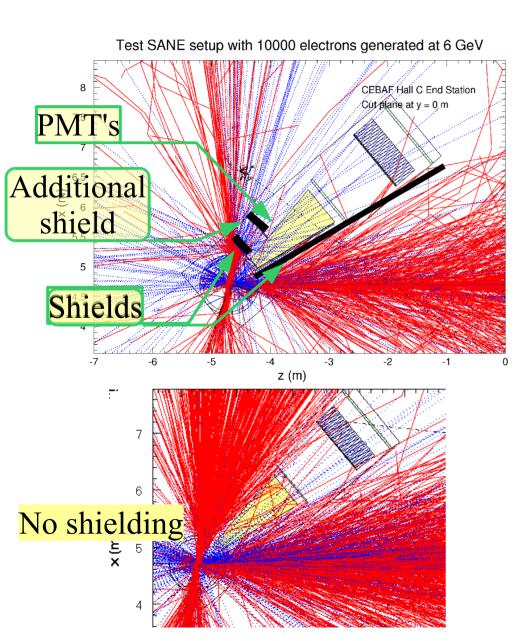
# Beam Line Background Studies (Seoul Natl. U.)

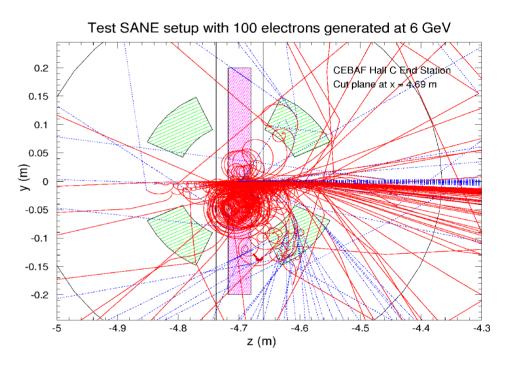




- Top and side views
- Field at 80 degrees
  - Red: electrons, Blue: photons
- .MCWORKS code (P. Degtiarenko) and BETA GEANT (G. Warren)

# Beam Line Background Studies (Seoul Natl. U.)





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

### TAC Comments

- BETA commissioning:
- all detectors expected to be fully built and tested in beam before installation
- largely parallel tasks of BigCal calibration and commissioning of others detectors
- we welcome additional recommended 14 calendar days, hope will need only part
- Installation time:
- with adequate planning can be done in 6 weeks
- multiple experiments sharing polarized target and BETA should be considered
- Five-pass beam energy >5.7 GeV and corresponding 4- and 2-pass are OK
- Rear (Lucite) hodoscope design simplified to single plane. All detectors to be finished and tested by 12/2007.
- Main trigger will be OR of Calorimeter and Cherenkov. Electronic channel and cable needs have been listed in response to TAC
- Downstream beam line engineering drawings available (from *RSS*)
- Polarized target fringe field intensity at PMT locations under control