

# 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

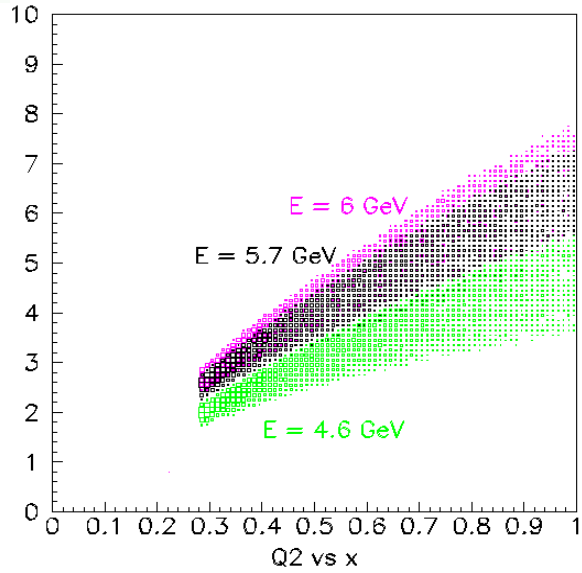
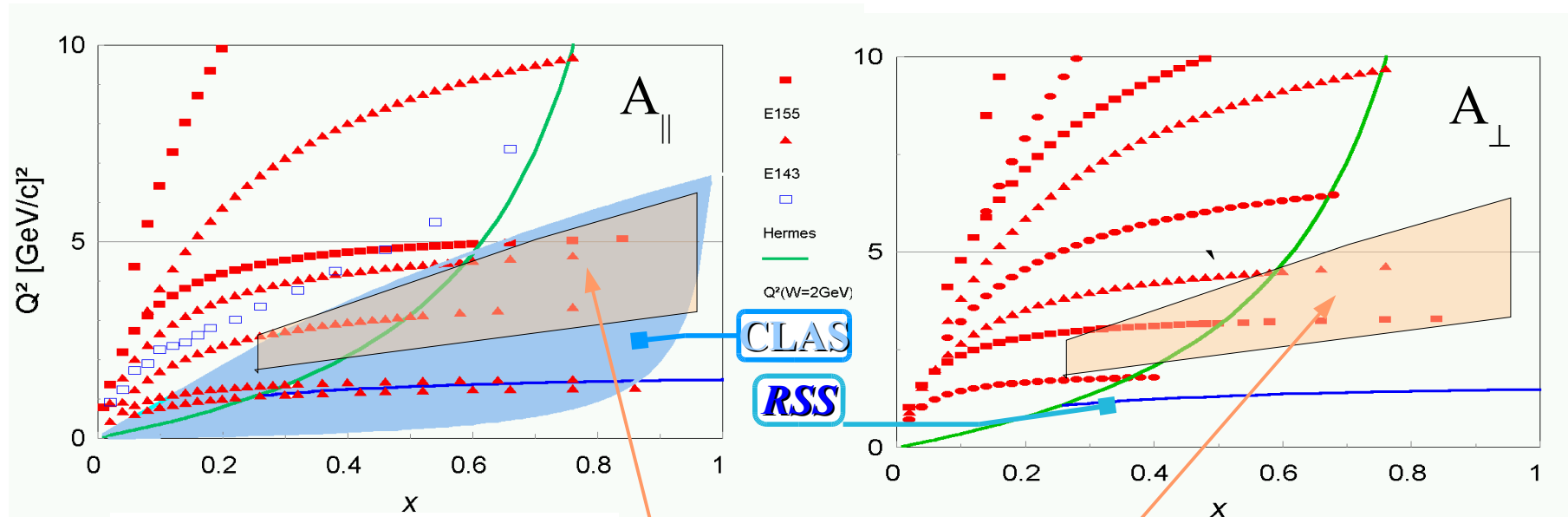
# SANE Status - 3/2007

- 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
    - upstream: 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**

- January 2007 plan:
  - Two beam energies:  $> 5.7$  GeV, **4.6 GeV**
- Looks like 5-pass **6 GeV** will be available in 2008
- Very good high  $x$  coverage with detector at  $40^\circ$ 
  - (plot at left from GEANT simulation)

# SANE Design

BETA ( $40^\circ$ )

BigCal  
w. Gain Monitor

Lucite Hodoscope

Gas Cherenkov

Forward  
Hodoscope

**B at  $80^\circ$  or  $180^\circ$**

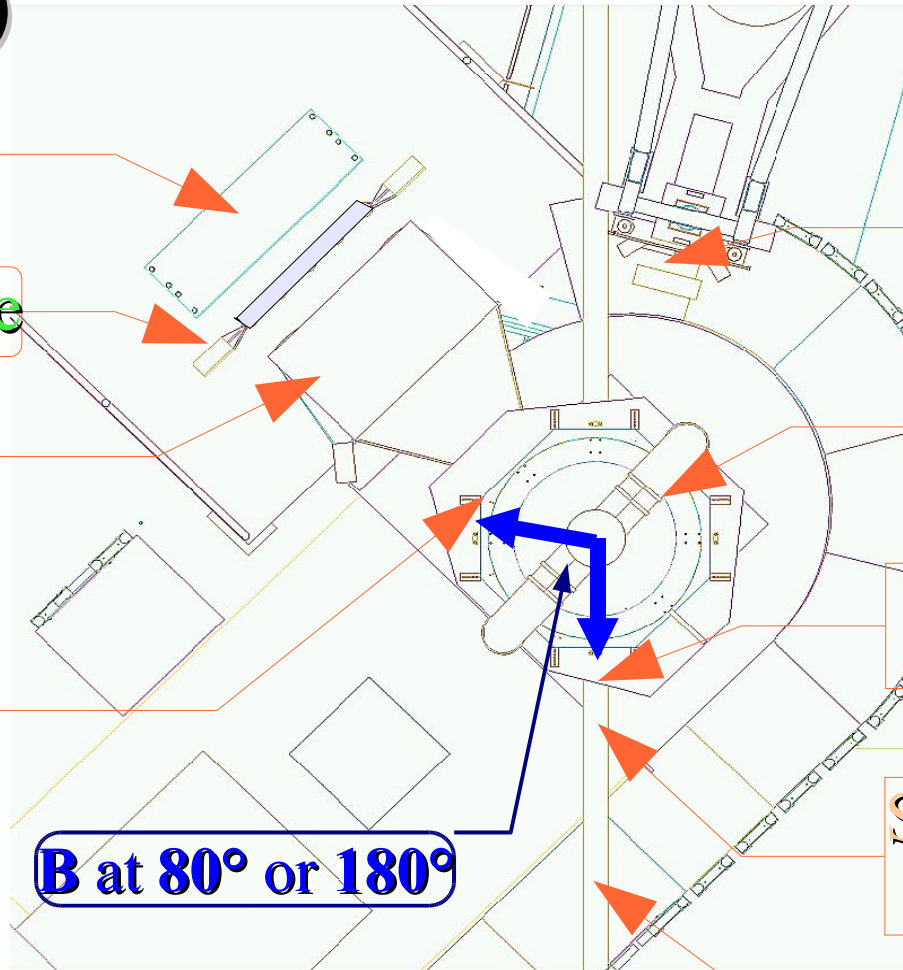
HMS ( $14^\circ - 48^\circ$ )  
calibrations, backgd.

Polarized Target

Polarized Compton  
radiator ( $\sim 20$  cm)

SEM Target Beam  
position monitor

Beam Line



# 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

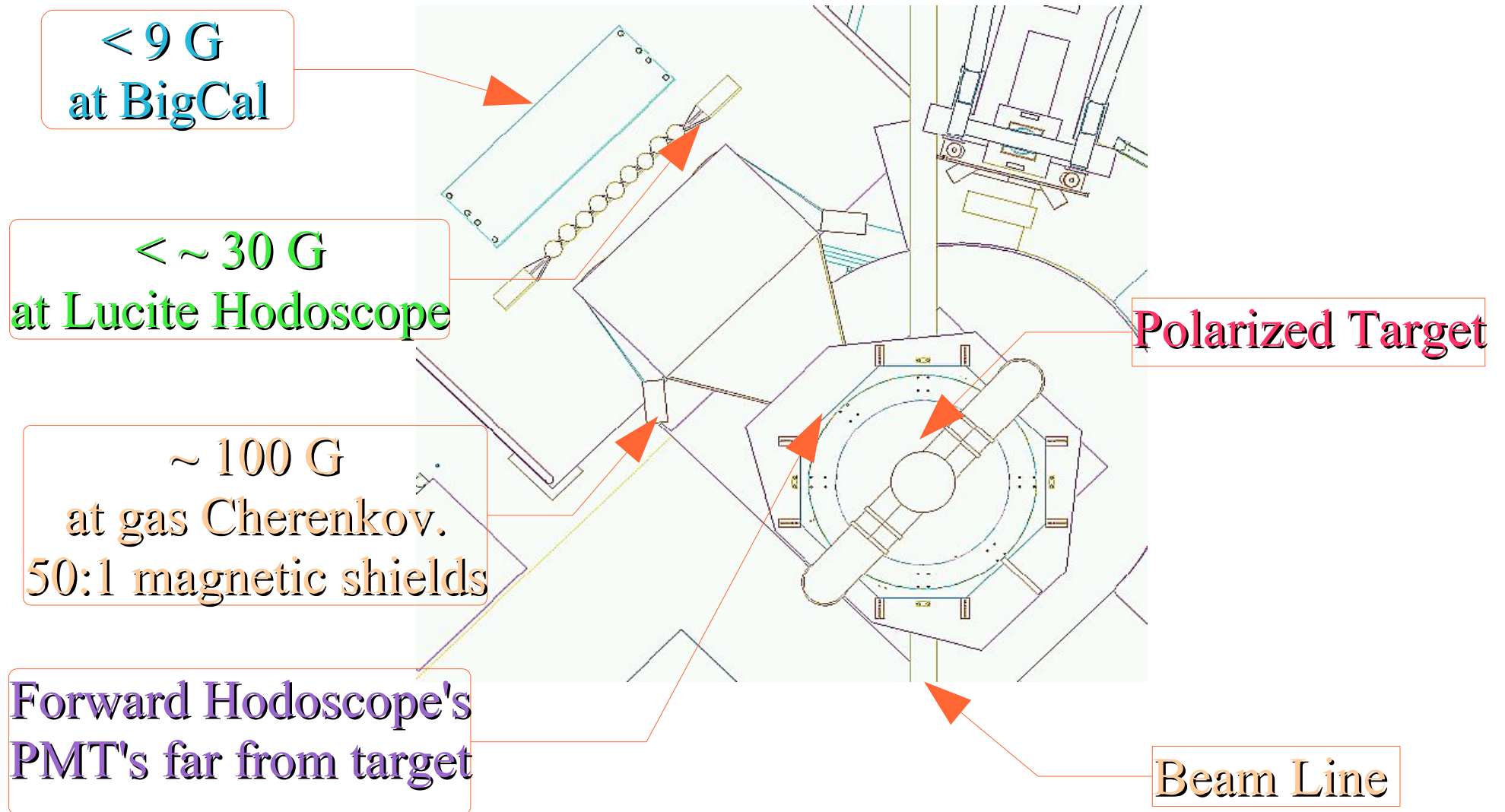
- Target chamber (OVC) and LN<sub>2</sub> shield
  - design completed, bids for fabrication being reviewed
- Target platform design, integration with BETA's stands:
  - Hall C engineering and design group
  - Input from Temple, UVA, Hall C physics, Mississippi State.
  - M. Fowler provided 3D CAD large 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

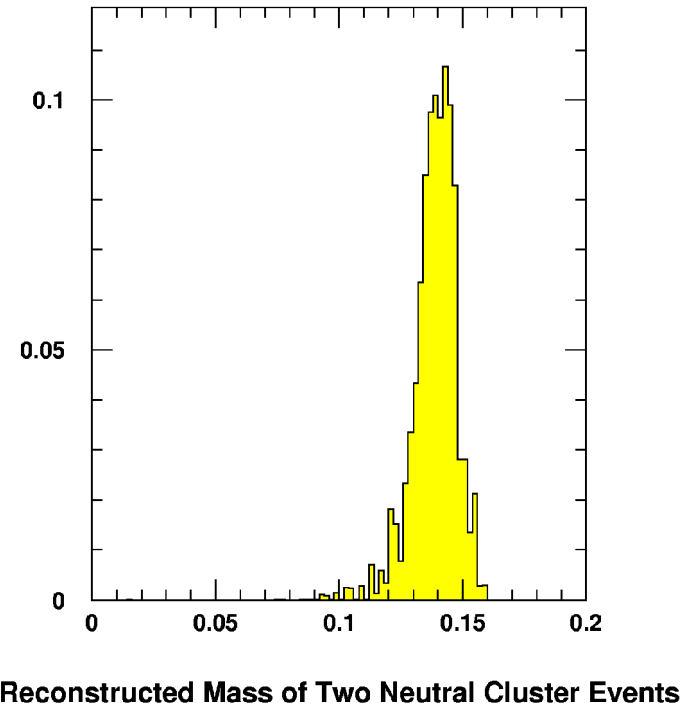
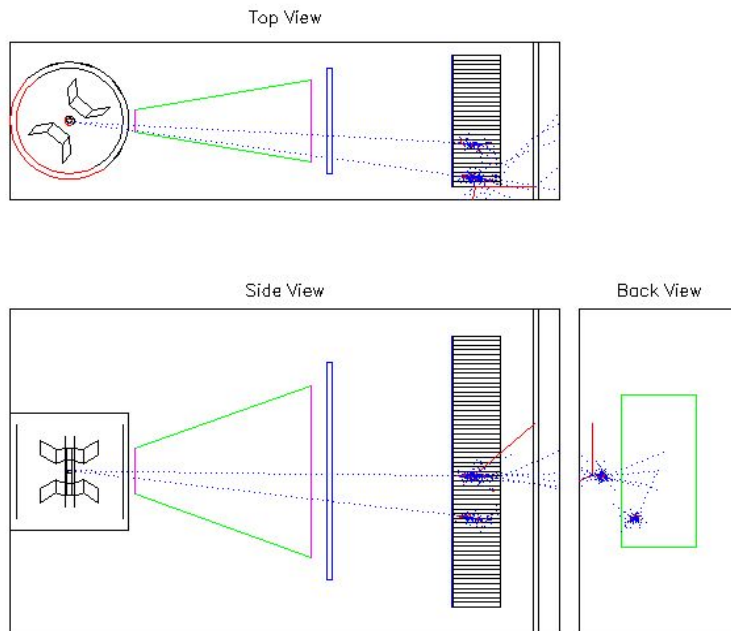
- Backgrounds from target: positrons from  $e^+/e^-$  pair production
  - charge sign for  $p < 1$  GeV/c will be identified with front hodoscope
  - V. Dharmawardane reviewed reference estimates,  $>20\%$  rate for  $E' < 1.1$  GeV from CLAS studies; could reduce background with software cuts
  - P. 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 ( $\sim 10\%$ )
  - measure asymmetry with  $>0.7$  GeV/c threshold to control the pair symmetric background
- GEANT simulated  $\pi^0$  events in BETA:  $\sigma \sim 10$  MeV

# Beam Time Request

## 2003 Request

	Energy	$\theta_N$	Time (h)	
<b>Production</b>	6.0	180	100	
	6.0	80	200	
	4.8	180	70	
	4.8	80	130	
	2.4	-	10	
<b>Systematics</b>	Packing Fraction		20	
	Mollers		21	
	Total beam time		551	(23 d)
<b>Overhead</b>	Anneals		62	
	Energy Change		48	
	Target Rotation		48	
	Stick Changes		48	
	Total Overhead		206	(9 d)
Requested Time		654	(27 d)	

## 2007 Request

	Energy	$\theta_N$	Time (h)	
<b>Calibration</b>	2.3	off, 0, 180	47	
<b>Production</b>	4.6	180	70	
	4.6	80	130	rotate
	5.7	80	200	
	5.7	180	100	rotate
	Packing Fraction		20	
<b>Systematics</b>	Mollers		21	
	Total beam time		588	(24.5 d)
	<b>Overhead</b>			
Anneals		62		
Energy Change		48		
Target Rotation		48		
Stick Changes		48		
Total Overhead		206	(9 d)	
Requested Time		654	(27 d)	

**Commissioning** TAC recommended 14 calendar days



# Time Lines

Start: 09/15/04  
Finish: 08/19/08

Run

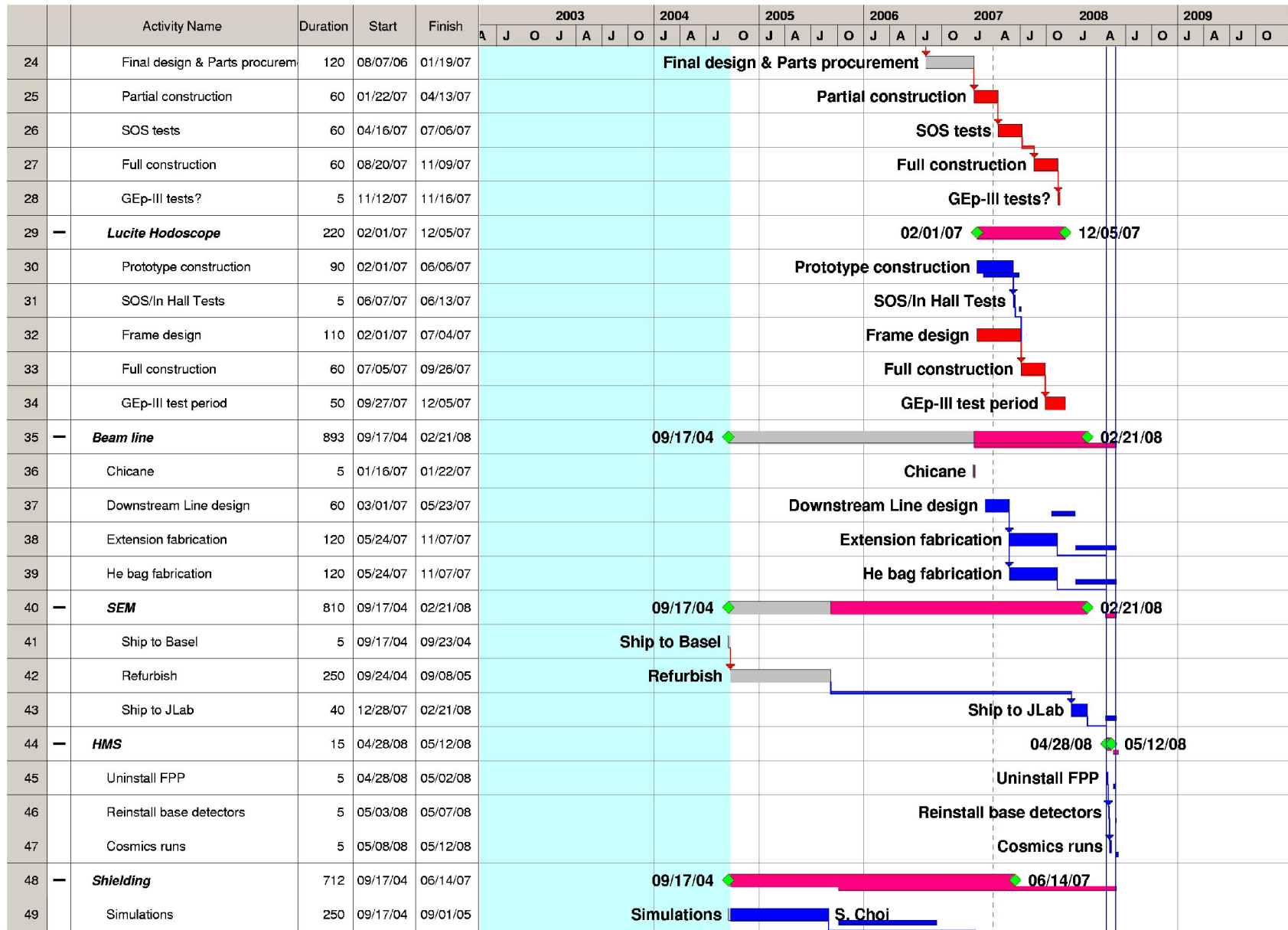
Page #1

Outline Gantt View: Outline Gantt Table

Activity Name	Duration	Start	Finish	2003			2004			2005			2006			2007			2008			2009		
				A	J	O	J	A	J	O	J	A	J	O	J	A	J	O	J	A	J	O	J	A
1 - <b>SANE</b>	1056	09/15/04	08/18/08	09/15/04 → 08/18/08																				
2 - <b>BETA</b>	921	09/15/04	03/25/08	09/15/04 → 03/25/08																				
3 - <b>BigCal</b>	623	09/15/04	03/25/08	09/15/04 → 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	BigCal tests																				
6 Gep-III	200	06/20/07	03/25/08	Gep-III																				
7 - <b>Gain Monitor</b>	697	09/27/04	05/29/07	09/27/04 → 05/29/07																				
8 Design and parts procurement	60	09/27/04	12/17/04	Design and parts procurement E. Frliez																				
9 EEL tests	30	05/08/06	06/16/06	EEL tests																				
10 BigCal integration	247	06/19/06	05/29/07	BigCal integration E. Frliez																				
11 - <b>Gas Cherenkov</b>	857	09/15/04	12/21/07	09/15/04 → 12/21/07																				
12 Prototype tests	78	09/15/04	12/31/04	Prototype tests O. Lukhanin,Z-E. Meziani																				
13 Mechanical/optical design	109	11/01/04	03/31/05	Mechanical/optical design S. Choi,O. Lukhanin																				
14 Parts procurement	120	04/01/05	09/15/05	Parts procurement																				
15 Tank construction	76	11/10/06	02/23/07	Tank construction																				
16 Assembly	60	02/26/07	05/18/07	Assembly																				
17 EEL tests	30	05/21/07	06/29/07	EEL tests																				
18 In-hall tests	85	08/27/07	12/21/07	In-hall tests																				
19 - <b>Forward Tracker</b>	802	10/18/04	11/16/07	10/18/04 → 11/16/07																				
20 Lucite tests	60	10/18/04	01/07/05	Lucite tests M. Khandaker																				
21 Quartz procurement	40	11/01/04	12/24/04	Quartz procurement M. Khandaker																				
22 Quartz tests	60	02/20/06	05/12/06	Quartz tests M. Khandaker,V. Dharmawardane																				
23 Fibers on scintillator	0	08/04/06	08/05/06	08/04/06 PM Fibers on scint																				

Project Start → Finish Critical Activity Name Resource Names Event Start ▼ Name  
 Subproject Start → Finish Non Crit. Activity Name Resource Names

# Time Lines

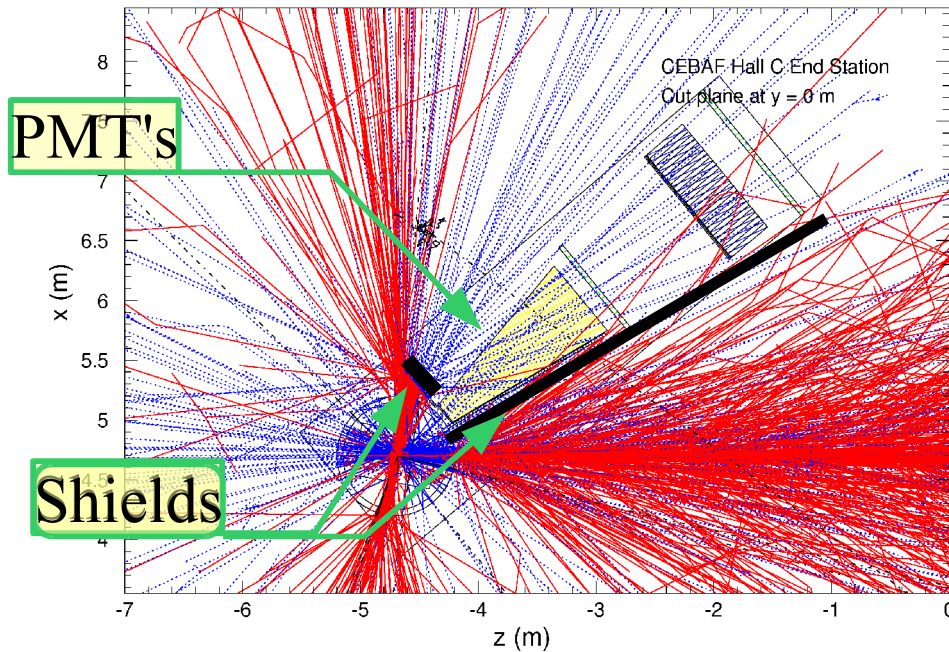




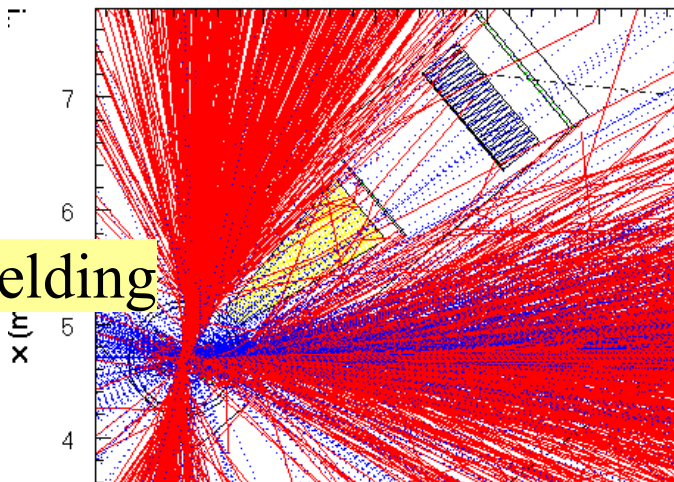
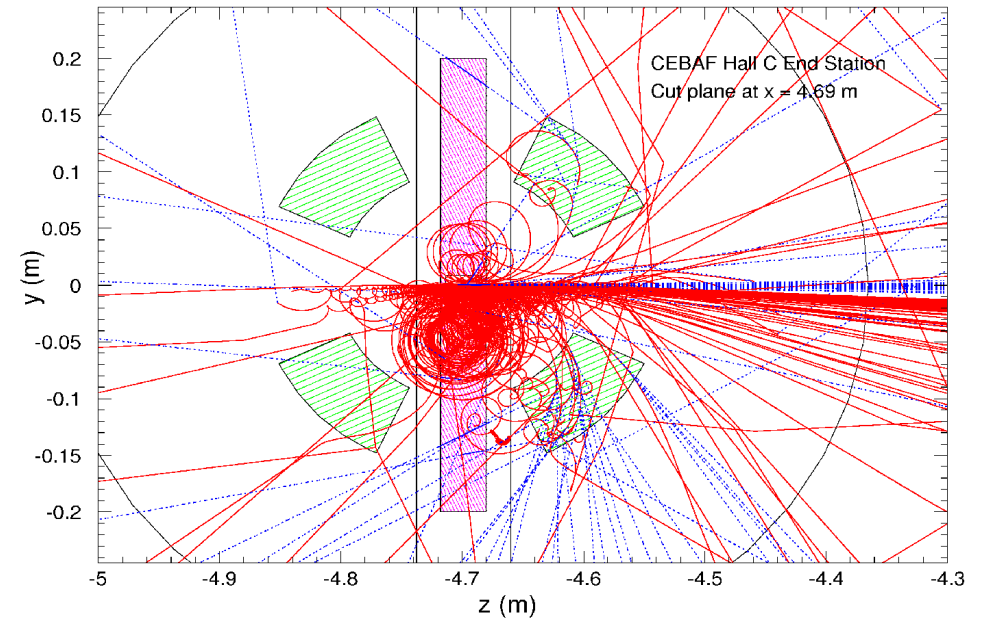


# Beam Line Background Studies (Seoul Natl. U.)

Test SANE setup with 10000 electrons generated at 6 GeV



Test SANE setup with 100 electrons generated at 6 GeV

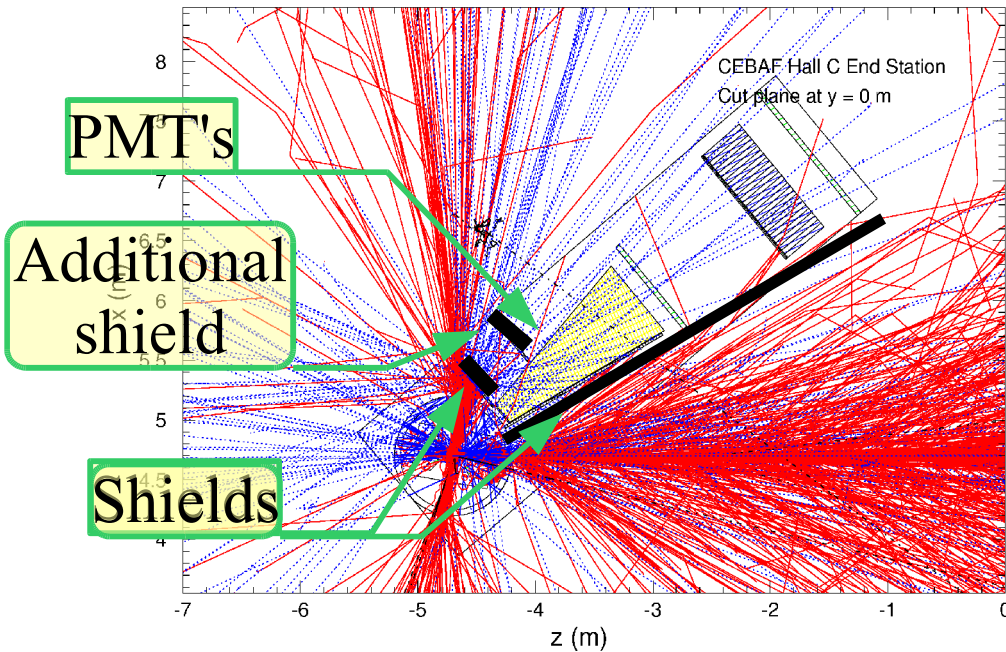


- Top and side views
- Field at 80 degrees
  - Red: electrons, Blue: photons
- .MCWORKS code (P. Degtiarenko) and BETA GEANT (G. Warren)

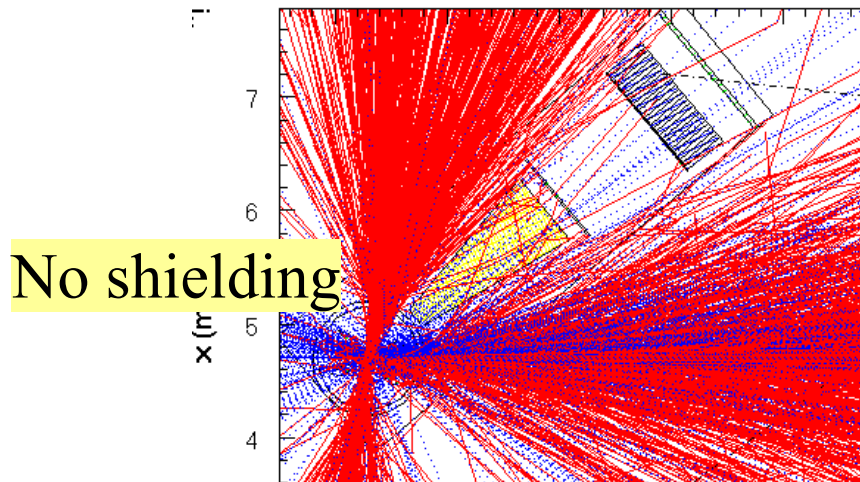
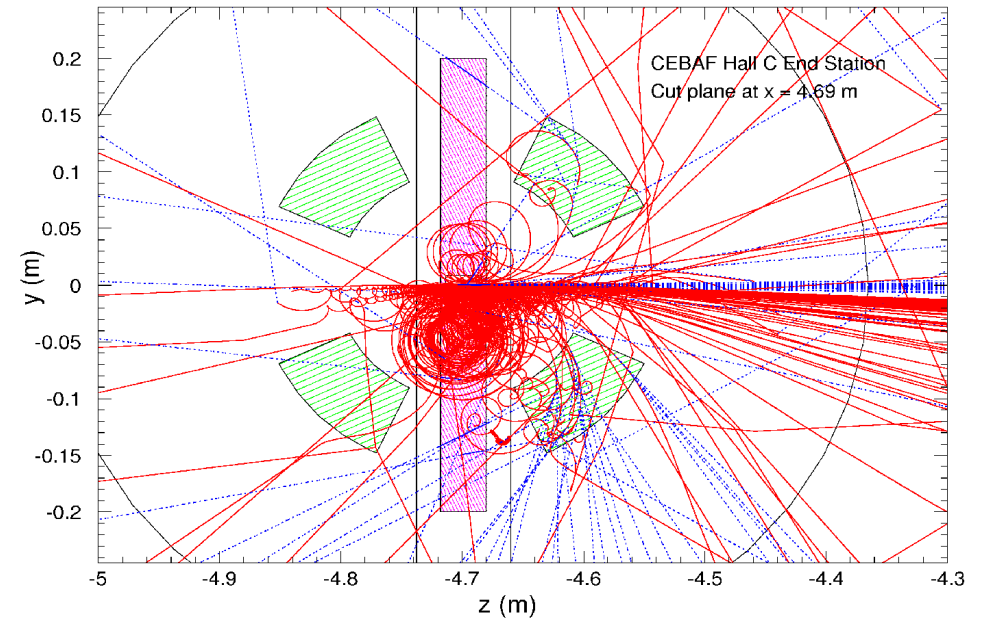


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# TAC Comments

- 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