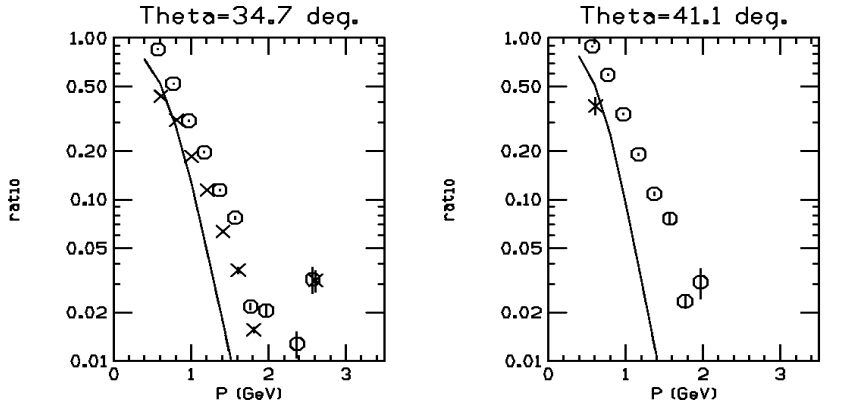
Preliminary HMS Run Plans

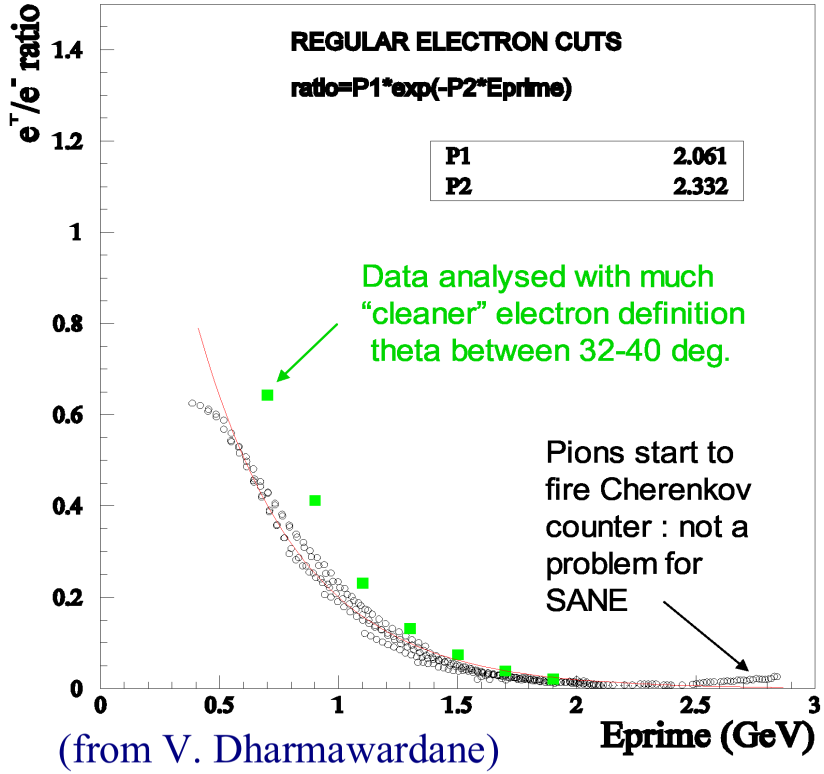
(M. Commisso Dolph & O. Rondon)

- Parallel field configuration:
  - improved estimate of target effective thickness for pair conversion
  - added 9 mm plastic forward tracker to effective radiator for pair production
    - effective radiator for SANE: 0.05 X0 (0.03 X0 without tracker)
  - included reduction of pairs background with pair veto factor:
    - run plan estimates for veto efficiency of **1/3**
  - HMS momentum settings for non-overlapping *hsdelta* intervals
- 80° field configuration:
  - estimate of run times to measure low ***x*** pair background asymmetry at HMS angle of 23° for 5% (relative) pair background systematic error.
  - errors for measuring $P_{beam} P_{target}$ using coincidence elastic asymmetry

e^+/e^- Pairs in CLAS eg1b (Parallel field)

- CLAS2004-005 note by P. Bosted on eg1b e+e- and pion backgrounds
- Relevance for SANE:
  - Model of pair production on NH_3
  - 5.7 GeV data vs 5.9 GeV SANE
  - 34.7° and 41.1° vs 40° SANE
  - E' range 0 - 3.6 GeV
- CLAS data analyzed by Vipuli Dharmawardane
  - no angular dependence
  - good 2-parameter fit to ratio
  - $f_{CLAS}(E') = e_C^+/(e_C^- + e_C^+)$
    $= P_2 \exp(-P_2 E')$





(from V. Dharmawardane)

Effective Radiator for Pair Conversion

- Use eg1b parameterization of pair rates
- eg1b effective radiator:
  - $0.014\ X_0 = z_{CLAS}\,(7/9)\,X_0 + \text{½ Dalitz}$
- Hall C effective radiator (**HMS**):
  - $0.050\ X_0 = z_{HMS}\,(7/9)\,X_0 + \text{½ Dalitz}$
- $z_{HMS} \sim 3\ z_{CLAS}$, or $e^+_{HMS} = R_{H/C}\ e^+_{CLAS}$
- Solve backgrnd. dilution $f_{CLAS}(E')$ for e^+_{CLAS}
  - Use $R_{HMS/CLAS} = 0.050/0.014$
  - $\boldsymbol{f_{HMS}(E') = R_{H/C} f_C / [1 + f_C(R_{H/C} - 1)]}$
  - v = 1 - (pair veto efficiency factor)
  - $\boldsymbol{f_{BETA}(E') = 2vR_{H/C} f_C / [1 + f_C(2vR_{H/C} - 1)]}$

Material before Cherenkov	g/cm²	X0
½ Target cell (0.6 p.f.)	0.781	0.021
Target windows**	0.195	0.008
Cherenkov windows	0.076	0.002
Cherenkov gas	0.156	0.004
Forward tracker (9 mm)	0.929	0.021
Sub Total (z BETA≈ z HMS)	1.207	0.057

Trigger: Cherenkov*BigCal

** For 80˚ run

Preliminary HMS Parallel Run Plan

- Measure background ***f*** during parallel run
- HMS DIS rates from *RSS*'s montecarlo: 1 GeV ≤ *E*' ≤ 2.2 GeV and 32°, 40°, 48°
  - rates for |*hsdelta*| ≤ 8%
  - momentum settings for non-overlaping *hsdelta* intervals
- Convert to pair rates using Vipuli D.'s eg1b parameterization
- Compute run times for 5% pair background systematic error
- Reduce pair background by a 1/3 pair veto efficiency factor

E = 5.7 GeV θ = 40° **Goal dA / A = 5%**

E' GeV	fCLAS	fBETA	fHMS	e- rate Hz	e+ rate Hz	de+/e+ (dfB/fB)	time e+ [h]	de-/e-	time e- [h]	dA_bg /A	dfB / fB
1.0	0.20	0.54	0.47	0.860	0.769	2%	0.9	4%	0.2	4%	2%
1.2	0.13	0.41	0.34	0.852	0.437	3%	0.7	5%	0.1	7%	3%
1.4	0.08	0.29	0.23	0.705	0.215	5%	0.6	6%	0.1	11%	5%
1.7	0.04	0.16	0.13	0.460	0.067	9%	0.5	11%	0.1	23%	12%
1.9	0.02	0.11	0.08	0.279	0.025	14%	0.5	16%	0.04	37%	19%

Preliminary HMS Parallel Run Plans

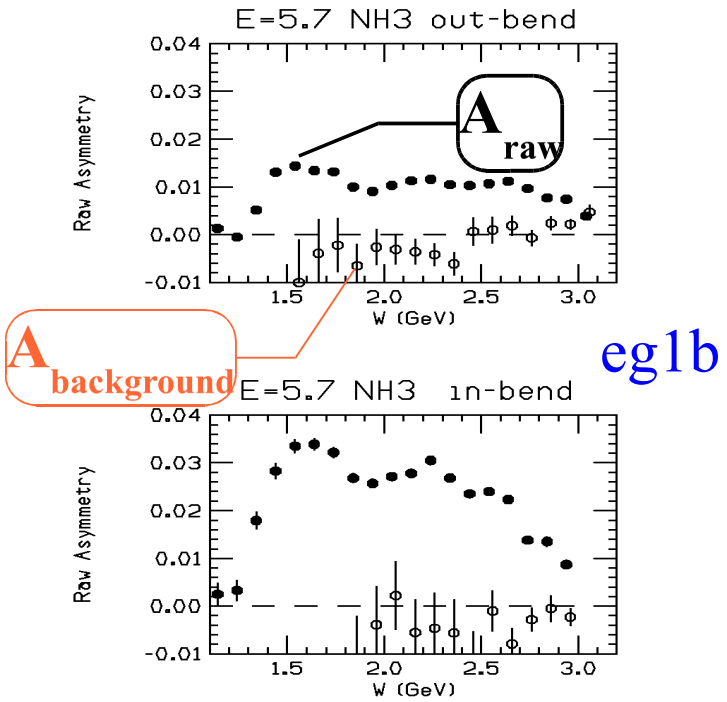
- Proposal for ***f*** during ***parallel*** run:
  - measure three angles during 4.6 GeV run: 34 h including overhead
  - measure three angles during 5.7 GeV run: 70 h including overhead
- Measure pair asymmetry at 40° at each energy: plan TBD
- Measure packing fractions
  - detailed preliminary plan for parallel and 80° configurations prepared by M. Comisso Dolph
    http://hallcweb.jlab.org/experiments/sane/mac5cx/PF3.pdf
  - highlights at end

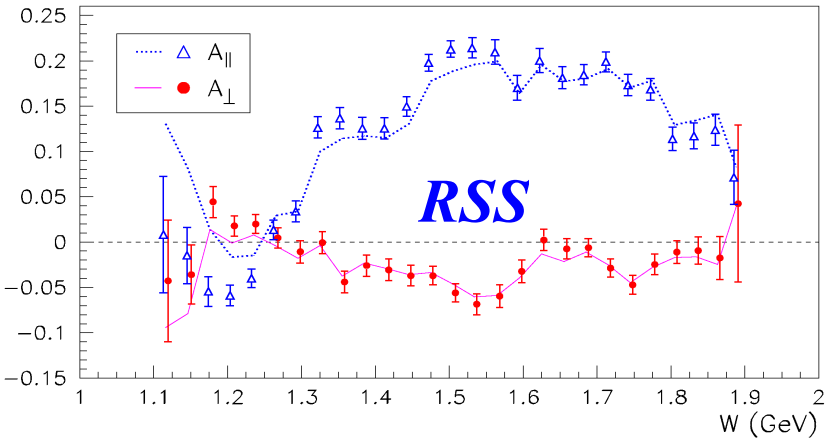
Summary of times **(FWD. TRCKR.)**

E	θ	e+ h	e- h
4.6 GeV	32˚	0.4	0.1
	40˚	2	0.4
	48˚	19	3
Total data time 4.6 GeV		22	4
Overhead		4	4
Momentum changes		15	
Time in main run plan [PAC h]		60	72
5.7 GeV	32˚	1	0.1
	40˚	3	1
	48˚	51	7
Total data time 5.7 GeV		55	7
Overhead		4	4
Momentum changes		15	
Time in main run plan [PAC h]		108	120

Background Asymmetry at 80°

- Parallel pair asymmetry A_b measured in eg1b < ~20% of DIS **A**
- Uncertainty in asymmetry < ~ 100%
- SANE asymmetry
  - $\mathbf{A_m \approx A_{DIS} f P_{beam} P_{target} = A}$
    - $\mathbf{A = (A_m - A_b f_b) / (1 - f_b)}$
  - Parallel SANE $\mathbf{A_m}$ ~ eg1b $\mathbf{A_m}$
  - 80° $\mathbf{A_m}$ < ~ 1/3 parallel $\mathbf{A_m}$
- Background 80° A_b ≤ parallel A_b
  - conservative assumption: equal
  - A_b/80° $\mathbf{A_m}$ **>** A_b/parallel $\mathbf{A_m}$





Preliminary HMS 80° Run Plan

- Measure A_b during 80° run: model expected DIS **$A(80°) \sim -0.12$; ($A_{||} \sim 0.4$)**
- DIS HMS rates from *RSS*'s montecarlo; ***E'***$(0.25 \le x \le 0.35, 23°)$
- Convert to pair rates using eg1b parameterization
  - assume 1/3 pair veto efficiency
- Compute run times for 5% pair background systematic error; $A_b \approx A_m/3$

E = 5.7 GeV θ = 23° **Goal dA /A = 5%** f=0.176 Pb=Pt=0.75 **<A DIS 80°> = -0.12**

E' GeV	x	fCLAS	fBETA	fHMS	e- rate Hz	e+ rate HMS	dAb /A (5% dA/A)	Ab	Am = ADIS f Pb Pt	t(Ab) [h]	Fixed t [h]	Smallest Ab
1.95	0.25	0.02	0.10	0.07	10.7	0.9	42%	0.004	0.012	117	50	0.006
2.20	0.30	0.01	0.06	0.04	11.8	0.5	76%	0.004	0.012	58	50	0.004
2.40	0.35	0.01	0.04	0.03	12.1	0.3	122%	0.004	0.012	36	50	0.003
										211	150	
E = 5.96 GeV												
1.95	0.25	0.02	0.10	0.07	9.75	0.78	0.42	0.004	0.012	128	50	0.006
2.40	0.34	0.01	0.04	0.03	10.73	0.30	1.22	0.004	0.012	40	50	0.004
										227	150	
E = 4.7 GeV												
1.80	0.25	0.03	0.13	0.10	14.8	1.7	29%	0.004	0.012	121	40	0.007
2.20	0.35	0.01	0.06	0.04	18.9	0.8	76%	0.004	0.012	37	40	0.004
										157	80	

Preliminary 80° HMS Run Plans

- Proposal for **80°** run:
  - measure pair asymmetry A_b at each energy at 23°, maximum usable HMS angle with field at 80°
  - 2 or 3 values of $E'(x)$
  - required time depends on pair veto efficiency

Summary of times field at 80˚

E	θ HMS	*v*	Abkgd h
4.7 GeV	23˚	0	354
		1/3	157
		½	89
Time in main run plan [PAC h]			120
			144
5.9 GeV	23˚	0	510
		1/3	227
		½	128
Time in main run plan [PAC h]			252

Packing Fractions

Eo = 4.734; E' = 2.0 GeV GeV; θ = 18°

180° field

target	e- rate [Hz]	time for 1% [h]	NH3 loads	Data runs	Total time [h]
NH3	8.8	0.4	2	2	1.5
C	7.9	0.4	1	3	1.2
C+He	10.3	0.3	1	3	1.0
				Total h	3.7

80° field

target	e- rate [Hz]	time for 1% [h]	NH3 loads	Data runs	Total time [h]
NH3	5.0	0.7	4	2	5.2
C	4.4	0.7	2	3	4.5
C+He	5.5	0.6	2	3	3.6
				Total h	13.3

Eo = 5.9 GeV; E' = 2.3 GeV; θ = 16°

180° field

target	e- rate [Hz]	time for 1% [h]	NH3 loads	Data runs	Total time [h]
NH3	9.1	0.4	4	2	2.9
C	7.8	0.4	2	3	2.5
C+He	10.5	0.3	2	3	1.9
				Total h	7.3

80° field

target	e- rate [Hz]	time for 1% [h]	NH3 loads	Data runs	Total time [h]
NH3	5.2	0.6	6	2	7.6
C	4.6	0.7	3	3	6.4
C+He	6.1	0.5	3	3	4.8
				Total h	18.8

- Packing fraction (= ammonia contents) needs to be measured for each insert cup load
  - two loads per insert
  - each load lasts about 90 beam hours; need several reloads during run
- Packing fraction is calculated from DIS yield ratios of NH3 and C disk targets

Summary of HMS time

Configuration	Beam E	Measurement	HMS time	BETA time		
				Schedule	Requested	Proposal
	[GeV]		h	h	h	h
Parallel	4.7	Packing fraction	4			
		Pairs dilution	34			
		Pairs asymmetry				
		Subtotal	38	60	84	70
	5.9	Packing fraction	7			
		Pairs dilution	70			
		Pairs asymmetry				
		Subtotal	77	120	120	100
80˚	4.7	Packing fraction	13			
		Pairs asymmetry	157			
		Subtotal	170	108	132	130
	5.9	Packing fraction	19			
		Pairs asymmetry	227			
		Subtotal	246	252	276	200

- Time for pairs dilution and asymmetry measurements is sensitive to pairs veto efficiency (1/3 assumed for table)
- Alternative ways of measuring the background asymmetry would be very helpful