SANE Analysis Review

- Goals:
  - Share the work of the Analysis Team with the Collaboration at large
  - Get comments and feedback to make improvements or corrections, as needed
- Projection:
  - Present partial SANE results at APS Spring 2012 meeting Invited Session B12 on Longitudinal and Transverse Structure of the Nucleon

SANE Collaboration Meeting

JLab

Feb. 27, 2012

O. A. Rondon - *INPP - UVA*

SANE Data: BETA

- Collected about 55% of 80° data and 35% of 180° data, relative to the proposal's figure of merit - FOM by the end of the run, 3/16/2009.
- The FOM was based on
  - <beam Pol.> = 0.75; <target Pol.> = 0.75; <beam I> = 85 nA

Setup	Run hours at proposal FOM		Proposal hours	Fraction Run/Proposal	
	uncorrected	corrected for dead time and good run		uncorrected	corrected
4.7 GeV 80 deg part 1	59.1	39.0			
4.7 GeV 80 deg part 2	43.3	33.7			
4.7 GeV 80 deg	102.4	72.7	130	0.79	0.56
5.9 GeV 80 deg	142.8	112.5	200	0.71	0.56
5.9 GeV para	38.2	33.4	100	0.38	0.33
4.7 GeV para	28.7	25.0	70	0.41	0.36

SANE Data: HMS

- Collected Elastic *e-p* coincidence (*p* in HMS, *e* in BETA) at 80° target field
- Collected inclusive Inelastic and Elastic asymmetries at 80° and 180° field
- Took C and C+He data for packing fraction and dilution factor

HMS data

Setting	Runs	HMS_p	HMS_theta	Q2	W	Wmin	Wmax
5.9 80	87	3.1	15.4	1.313	2.196	2.044	2.337
	5	3.57	22	3.067	1.478	1.143	1.751
	173	4.17	22	3.583	0.738	elastic	1.253
	16	4.4	15.4	1.864	1.353	0.959	1.656
5.9 para	16	2.2	16	1.006	2.611	2.521	2.698
	31	3.1	15.4	1.313	2.196	2.044	2.337
4.7 para	17	2.2	16	0.806	2.196	2.092	2.295
	45	3.2	20.2	1.862	1.375	1.087	1.612
4.7 80 part 2	16	2.2	16	0.806	2.196	2.092	2.295
	39	3.585	22.3	2.536	0.702	elastic	1.152
4.7 80 part 1	6	1.6	18	0.741	2.452	2.383	2.52
	1	1.65	18	0.764	2.428	2.356	2.499
	94	2.2	16	0.806	2.196	2.092	2.295
	52	2.7	16	0.989	1.924	1.776	2.06

SANE Analysis Tools

- Data reduced to CERNLIB ntuples (equivalent to the DST's of lore)
  - Dedicated Analyzer and GEANT3 codes
  - Replayed data stored at /lacie on UVA's octavian server
  - BETA: separate Calibration (1st pass) and Physics (2nd pass) ntuples
  - HMS: physics ntuples
- SANE wiki has all other Analysis inputs at
  - https://hallcweb.jlab.org/experiments/sane/wiki/index.php/Inputs_for_Analysis
  - included are
    - Run database; Beam Pol. per run; Target pol. per run; Packing fractions; … (maintained by J. Maxwell)
- Also on the wiki:

Year	Meetings	Reports
2009	21	38
2010	47	115
2011	44	123
2012	7	25
	119	301

Outline of Analysis Procedure

SANE Analysis beakdown

Goals:

- DIS spin structure functions g_1, g_2, moments, matrix elements
- Elastic form factors ratios
- Spin asymmetries in the resonances

Stages:

- Charge normalized, dead time (and pion, e+/e- pairs corrected for spin structure) electron yields for each helicity: $Y^{+} = N^{+}/Q^{+}$, $Y^{-} = N^{-}/Q^{-}$
  - BETA events
    - Detector energy and position calibrations
      - BigCal for spin structure and form factors:
        - cluster identification, position, timing
      - Cherenkov, Lucite and Tracker for spin structure
        - timing alignments, x position (Lucite)
    - Tracking from BigCal to target through target field
    - pair background identification with Tracker for spin structure
    - Quality control:
      - run list database, run selection (online run sheets, hclog, channel archive)
      - beam position studies (raster cuts for 80° data if time cuts, tracking to target does not clean up background, ...)
      - charge corrected yields
      - kinematics binning
  - HMS events
    - reconstruction with target field
      - parallel
      - 80°
- Raw count or yield asymmetries $A_{raw} = (Y^{-} - Y^{+}) / (Y^{-} + Y^{+})$
- Measured asymmetries A_{para}, $A_{80} = A_{raw} / [\, f\,(pf^{'})\, P_b\, P_t\,]$; $A_{elastic}$
  - Off-line beam polarization by run periods – Moller and status of half-wave plate
  - Off-line target polarizations run by run
  - Packing fractions pf and dilution factors f by target cup – only for spin structure
    - HMS C, C+He target runs, helicity independent NH_3 data
    - comparison with mc_hms_single montecarlo
  - Combine single arm 4.7 GeV 80° and 5.9 GeV 80°, same for parallel
- Background asymmetries
  - e+/e- dilution and contamination
  - radiative corrections
- Physics asymmetries
  - A_1, $A_2(A_{para}, A_{80})$
    - BETA DIS data:
      - combine measured asymmetries, including out-of-plane angle factors, R unpolarized structure function
      - fit and extrapolate to $x = 1$
    - HMS resonances data: fit A_1, A_2 with resonant shapes, compare to *RSS*
  - $A_{elastic}$: extract form factor ratio at two momentum transfers
- Spin structure functions g_1, g_2
  - Combine with F_1 unpolarized s.f.
    - BETA
      - $g_1, g_2\,(x)$ at constant Q^2: Nachtmann moments, matrix elements, models, pQCD
      - $g_1, g_2\,(Q^2)$ at fixed W or x: evolution, global fits
    - HMS DIS data: extend *RSS* DIS range to lower x; improve extrapolation errors

Underlined: potential thesis topics

Outline at http://hallcweb.jlab.org/experiments/sane/general/hms/SANE_analysis.pdf

Analysis Team

- UVA
  - H. Baghdasaryan (Lead)
  - N. Kalantarians (BETA d.f.)
  - J. Maxwell (UNH postdoc)
  - J. Mulholland (UVA postdoc)
- Hampton
  - A. Liyanage (Elastic FF)
- JLab
  - M. Jones
- Mississipi State
  - L. Ndukum (pion asymmetry)
- Seoul National
  - H. Kang (HMS inelastic, p.f.)
- Temple
  - W. Armstrong (Cerenkov, BETA)
- Also contributed
  - E. Christy, M. Kohl, (A. L. advisor), Hampton U.
  - D. Gaskell, JLab (Beam pol.)
  - S. Choi, Seoul (H.K. advisor)
  - Z. Meziani, Temple (W. A. advisor)
  - D. Day, O. Rondon, UVA (J.M. & J.M. advisors)

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