Testing the Limits of the Single Particle Model in ^{16}O(e,e'p)

Status of E00102

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Hall A Collaboration Meeting
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People Involved

- Spokespersons: L.Weinstein (ODU), K.Fissum (Lund), A.Saha (Jlab), W.Bertozzi (MIT)
- Graduate Students: M.Andersson (Lund), K.Foe (ODU), J.Lopez (Madrid)
- Postdocs: J.Lachniet (ODU)

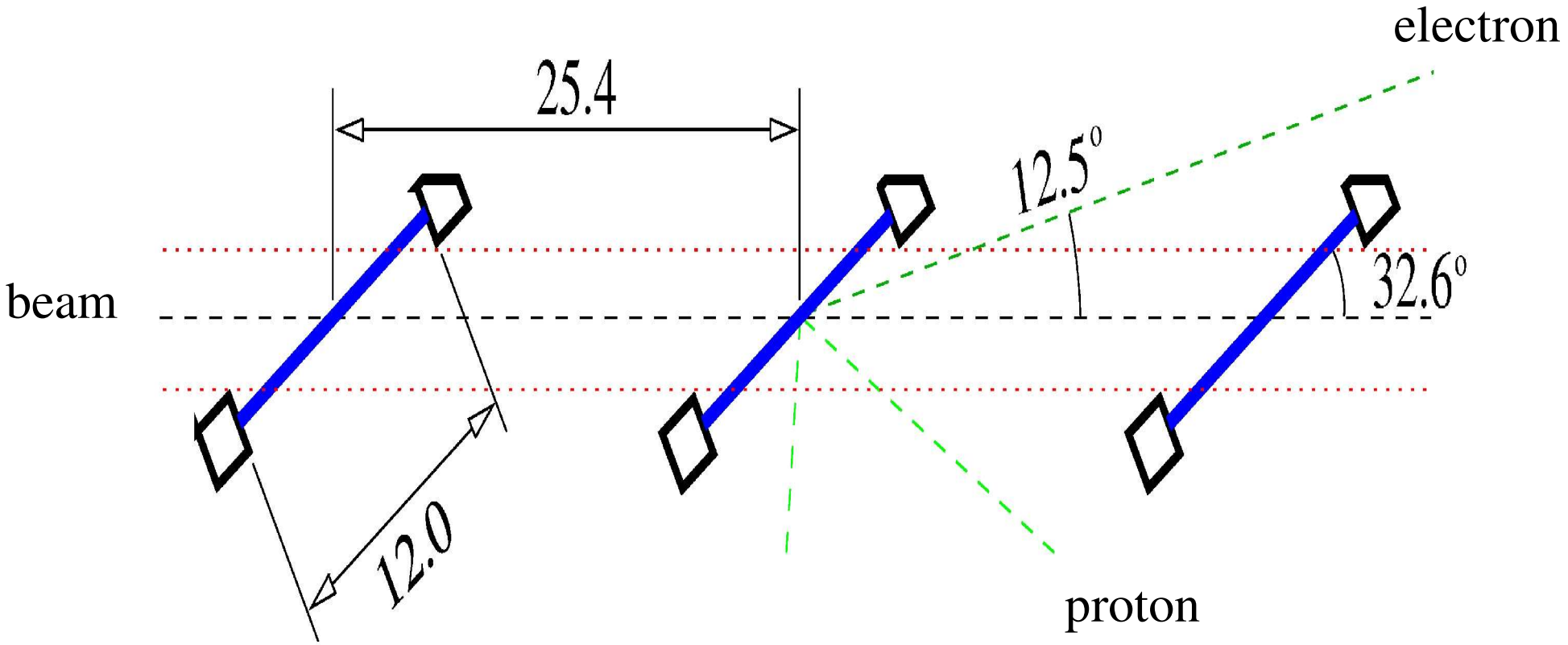
Mattias Andersson recently defended his Licentiate Thesis at the University of Lund based on the E00102 data, available at:

http://www.jlab.org/~fissum/e00102/e00102.html

Goals of E00102

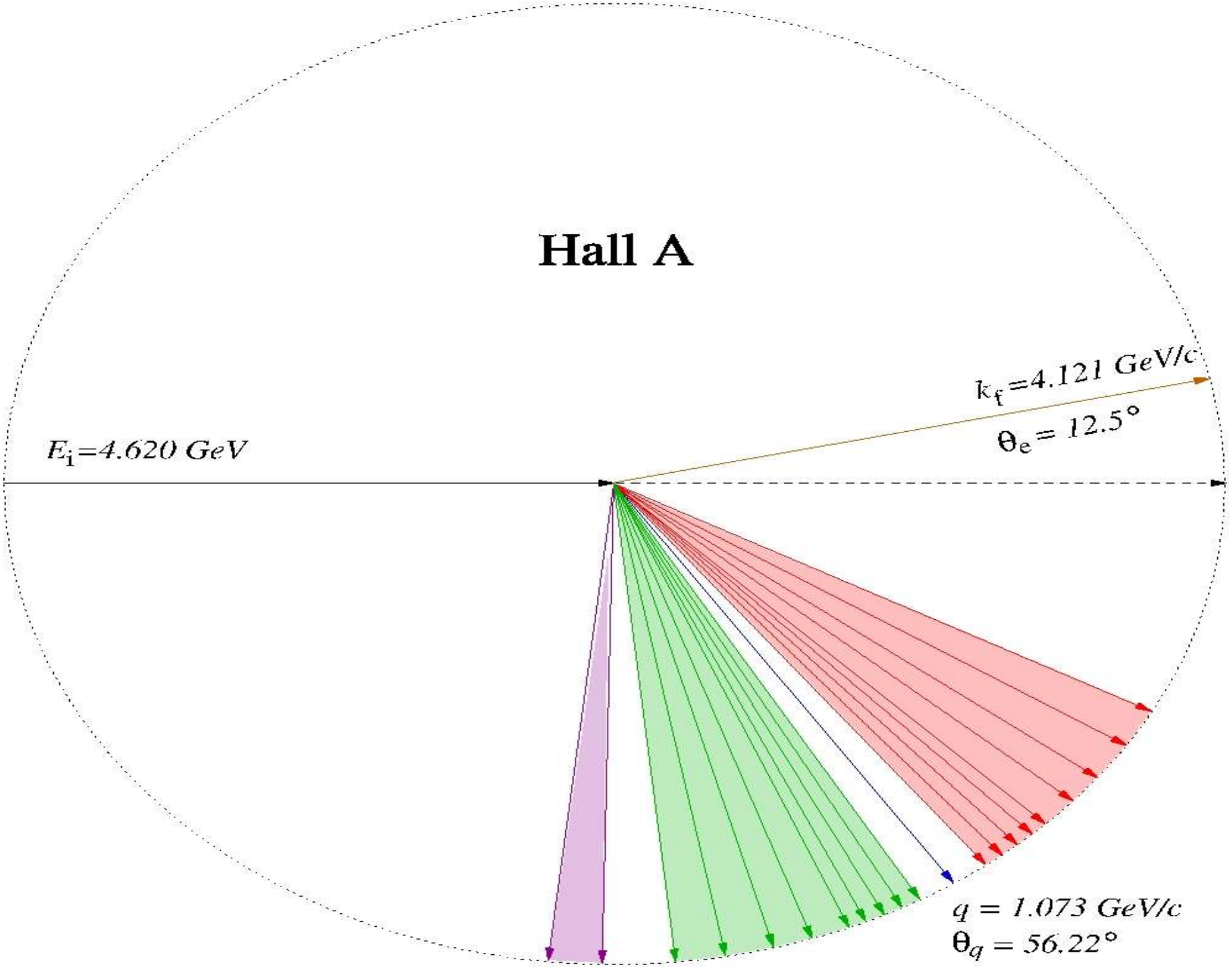
- Measurement of cross-section, R_{lt} and A_{lt} for the $^{16}O(e,e'p)$ reaction with higher precision and to higher missing momentum than in E89003.
- Determine the limits of validity of the single-particle model of valence proton knock-out.
- Determine effects of relativity and spinor distortion on valence proton knock-out using the diffractive character of the A_{lt} asymmetry.
- Determine bound-state wave function and spectroscopic factors for valence proton knockout.

E00102 Waterfall Target



E00102 Kinematic Settings

- E_0 = 4.620 GeV
- Q^2 = 0.902 $(GeV/c)^2$ {Electron angle fixed at 12.5° }
- $|\vec{q}| = 1.073\,GeV/c$
- ω = 0.499 GeV
- Emiss = 0 to 0.240 GeV {Proton angle varied between 28.27° and 96.10°}
- Pmiss = -0.515 to 0.755 GeV/c {E89003 covered Pmiss up to 0.345 GeV/c}


Hall A
k_f=4.121 GeV/c
θ_e = 12.5°
E_i=4.620 GeV
q = 1.073 GeV/c
θ_q = 56.22°

E00102 Kinematic settings

Measurement	p_{miss} (MeV/c)	θ_{pq} (deg)	θ_{p} (deg)
I−	−515	−27.95	28.27
H−	−430	−23.27	32.95
G−	−345	−18.60	37.62
F−	−280	−14.90	41.32
E−	−210	−11.20	45.02
D−	−175	−9.40	46.82
C−	−140	−7.50	48.72
B−	−105	−5.60	50.62
A−	−70	−3.75	52.47
q	0	0	56.22
A+	+70	+3.75	59.97
B+	+105	+5.60	61.82
C+	+140	+7.50	63.72
D+	+175	+9.40	65.62
E+	+210	+11.20	67.42
F+	+280	+14.90	71.12
G+	+345	+18.60	74.82
H+	+430	+23.27	79.49
I+	+515	+27.95	84.17
J+	+635	+34.87	91.09
K+	+725	+39.88	96.19

Tasks Completed

- Beam position/Beam energy calibrations.
- Optics calibration and spectrometer mispointing.
- First pass replay using ESPACE.
- Water-foil thickness measurement from ^{16}O(e,e'p) to BeO (e,e'p) yield comparison.
- Comparison of H(e,e'p) elastic yield to MCEEP simulation.
- Converted end-of-run-file information to MySQL database (host?)
- Determination of $1p_{1/2}$ cross section relative to H(e,e')

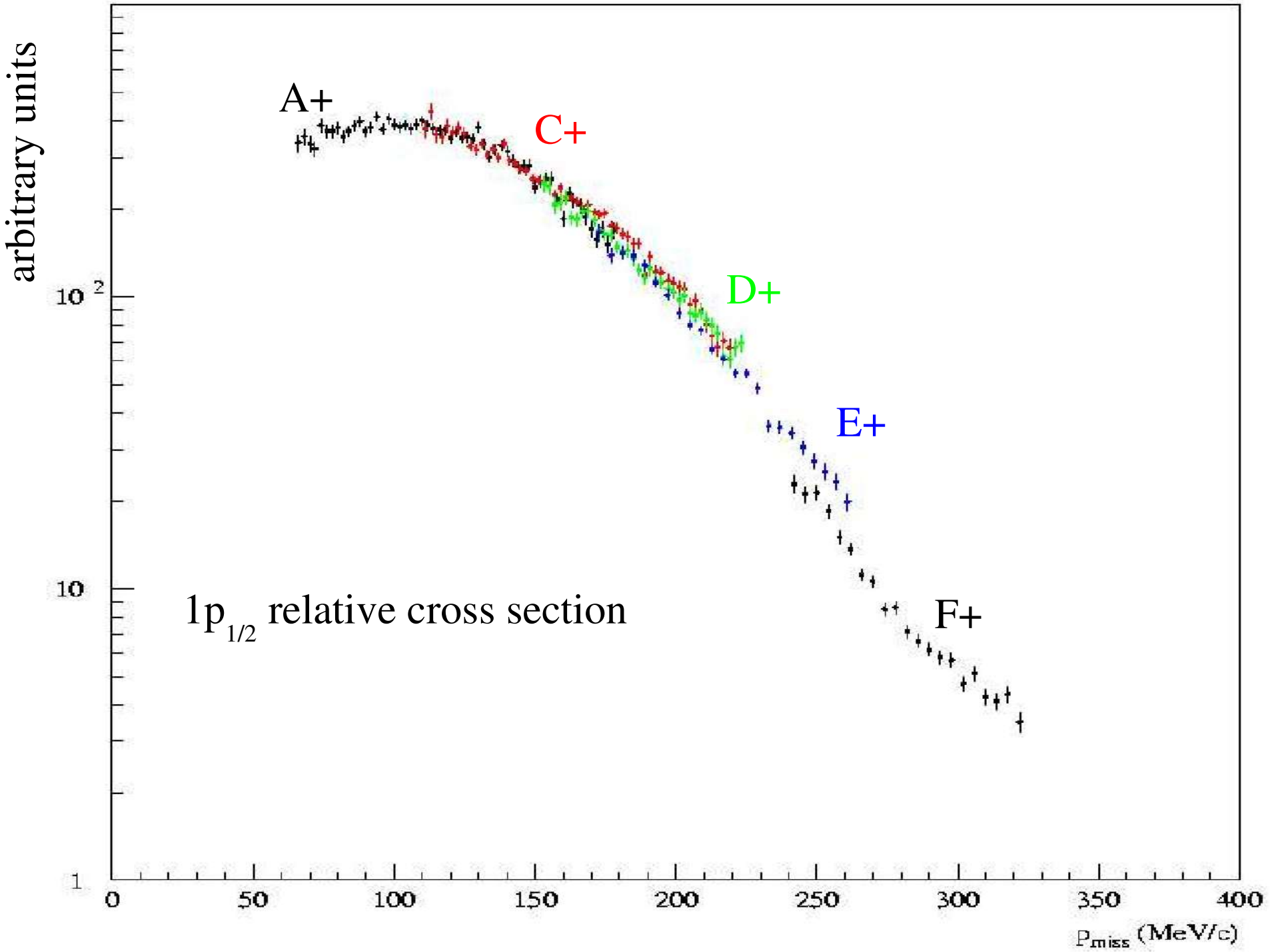
$1p_{1/2}$ relative cross section (M.Andersson)

- Determination of $1p_{1/2}$ cross section relative to H(e,e')
- Uses data in the range:

$$0 < \text{Pmiss} < 350 \text{ MeV/c}$$

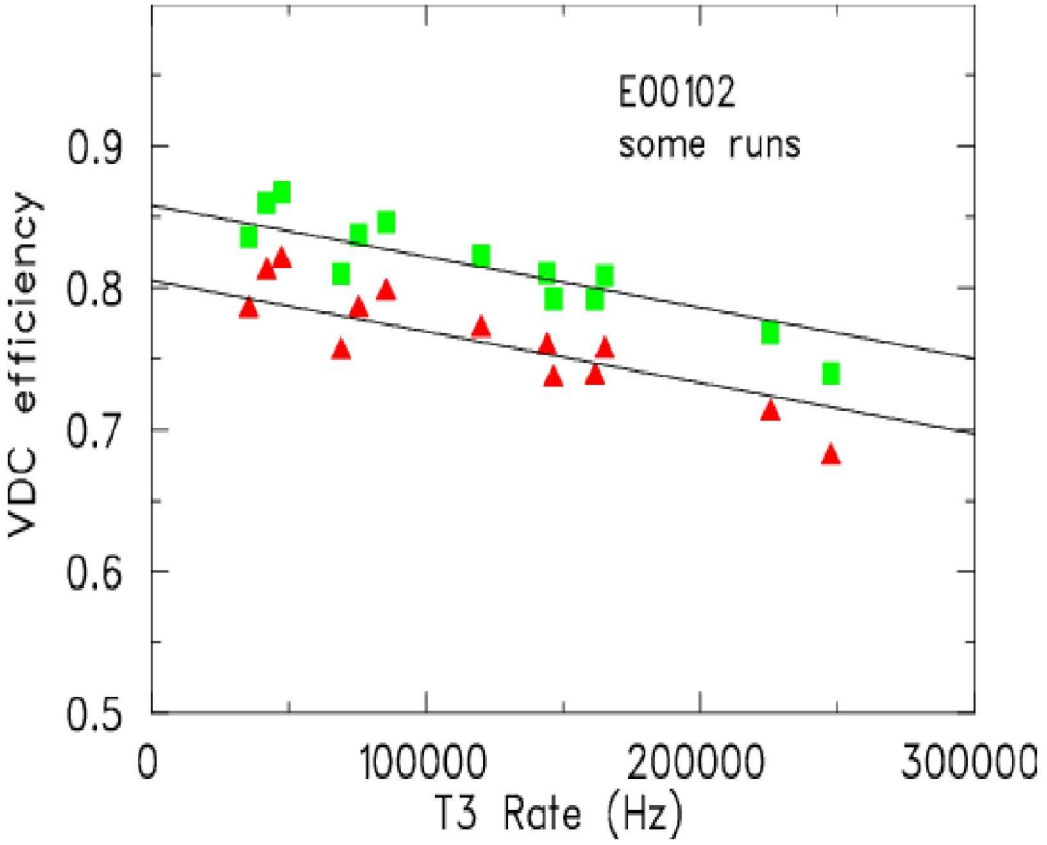
corresponding to kinematic settings A+,C+,D+,E+,F+

- Pmiss bins are 2 MeV/c for A+ through D+, 4 MeV/c for E+,F+
- Only central foil was used.
- Acceptance cuts: ± 50 mr in θ and ϕ, $\pm 3.5\%$ in δp
- Statistical uncertainty is 7% or less. Systematic uncertainty estimated at $\approx 5\%$.


arbitrary units
10 2
10
1
A+
C+
D+
E+
F+
1p1/2 relative cross section
0
50
100
150
200
250
300
350
400
pmiss (MeV/c)

Work in progress

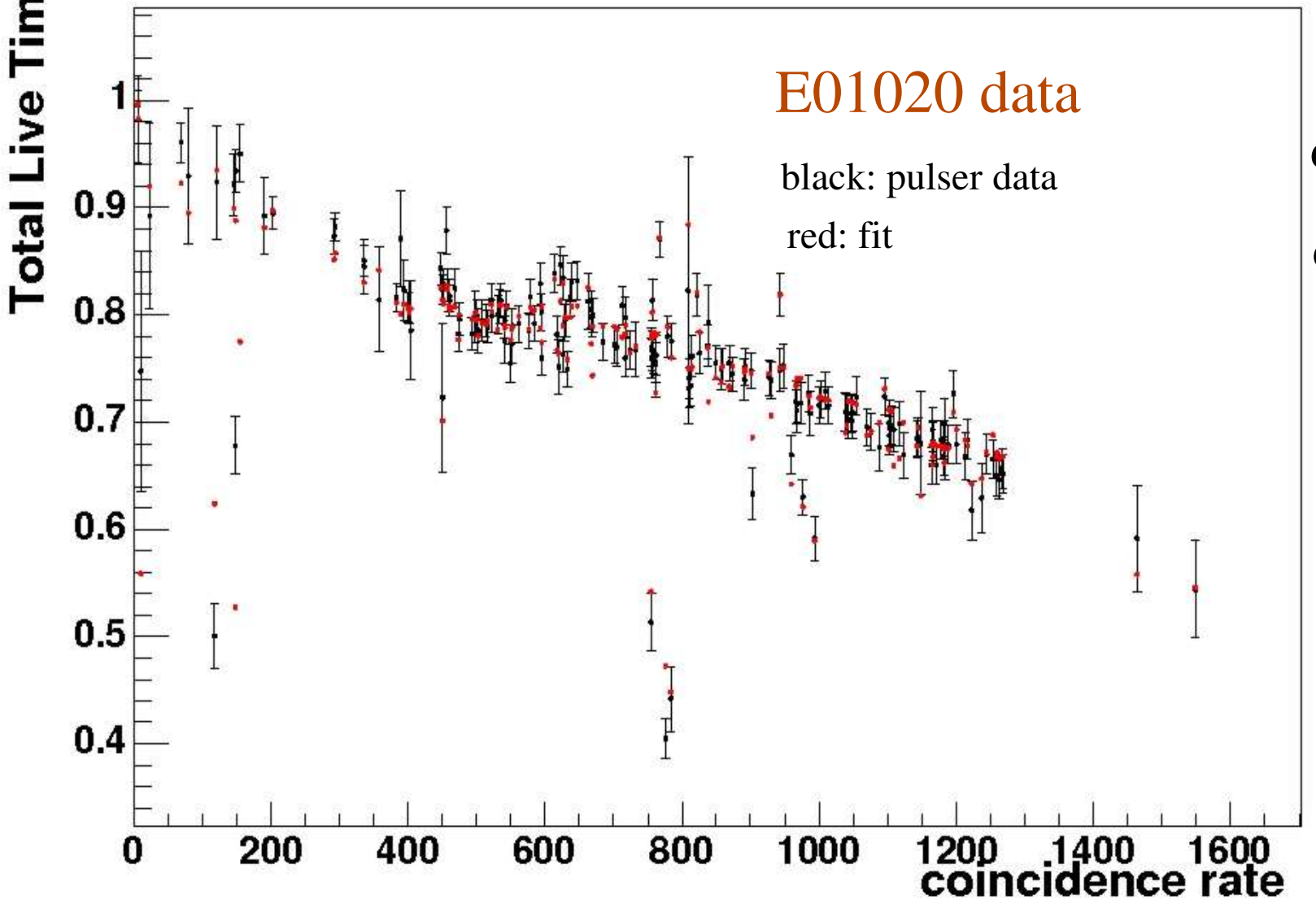
In conjunction with the E01020 analysis...



- VDC tracking/firing efficiency
- Trigger efficiency
- Determination of electronic deadtime from pulser data

Larger than expected electronic deadtimes are seen in both E01020 and E00102 data sets.

Simple linear fit minimizing: $\chi^2 = \sum_{i=1}^{N} \left(\frac{TLT_i - (1 - CDT_i) * (1 - d_1 * R1_i) * (1 - d_3 * R3_i)}{\sigma_i} \right)^2$



E01020 data

black: pulser data

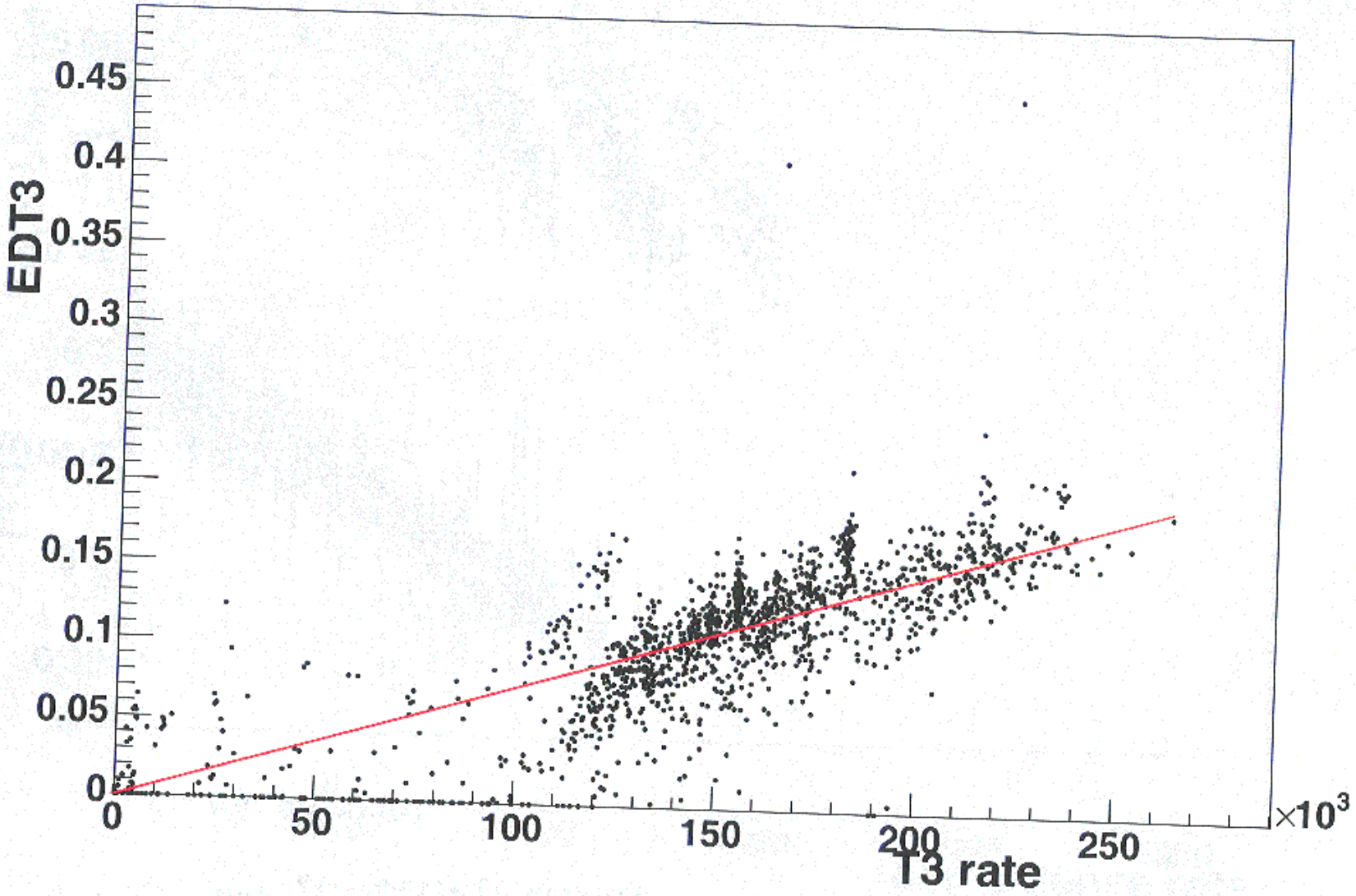
red: fit

d1 = 595 ns

d3 = 726 ns

See Comments, Page 3

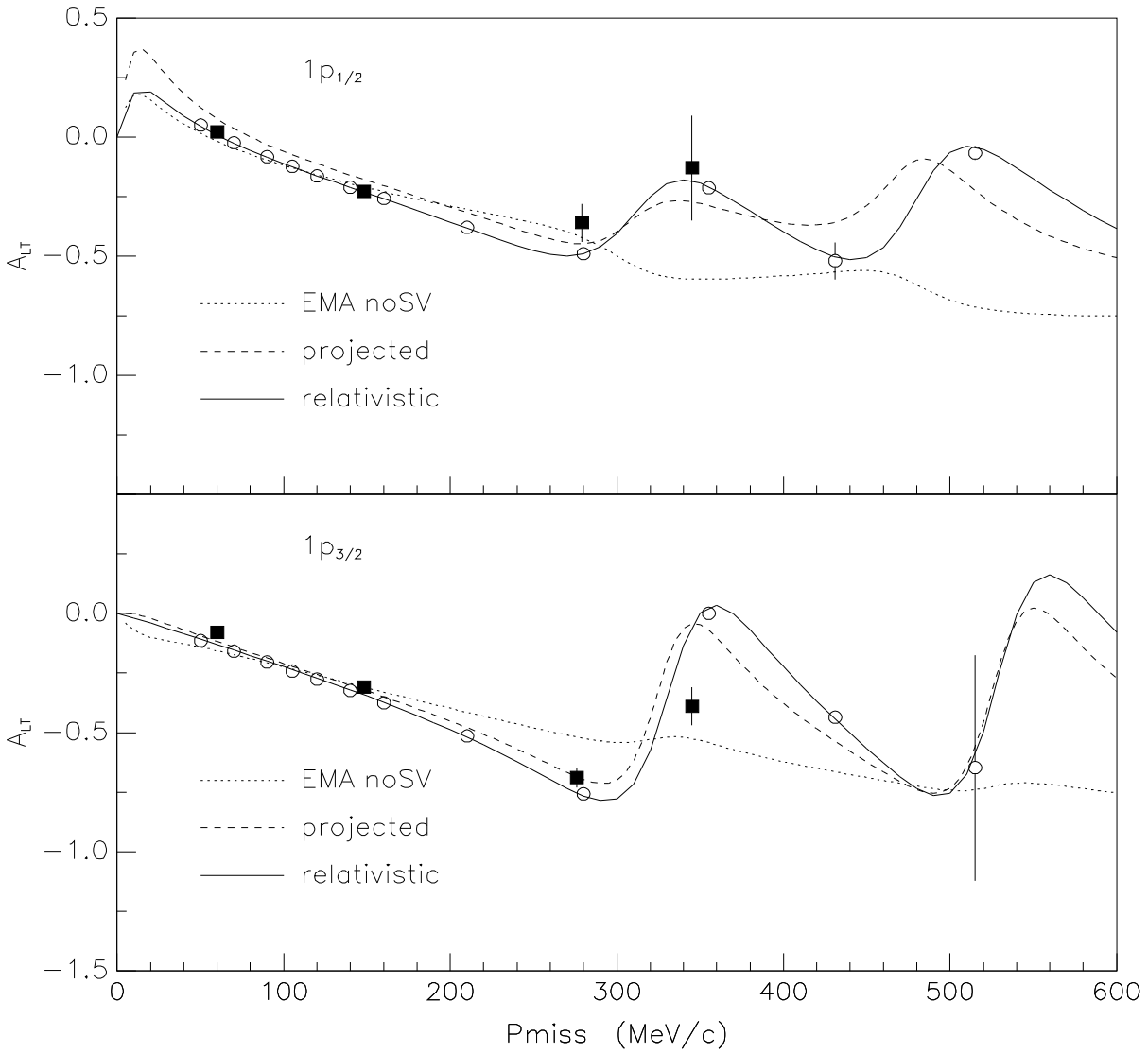
E00102 data



Work in progress

- J.Lopez visiting Lund for simulation work.
- Udias model being implemented in MCEEP (Udias,Lopez,Fissum).
- Development of T0-based estimate of deadtime.
- ROOT-based replay of data set (still having some issues converting optics database from ESPACE).
- Focal plane relative effficiency.
- Comparison of H(e,e') cross-section measurement to world data.

Projected A_{LT} for Proton Knockout from $1p_{1/2}$ and $1p_{3/2}$-states of ^{16}O



- o Anticipated data points from E00-102
- ■ Data obtained from E89003

Compared to calculations by Udias *et al.*