Exp't E97-111: Study of SRC and $(e, e'p)$ Reaction Mechanism *via* $^4\mathrm{He}(e, e'p)^3\mathrm{H}$

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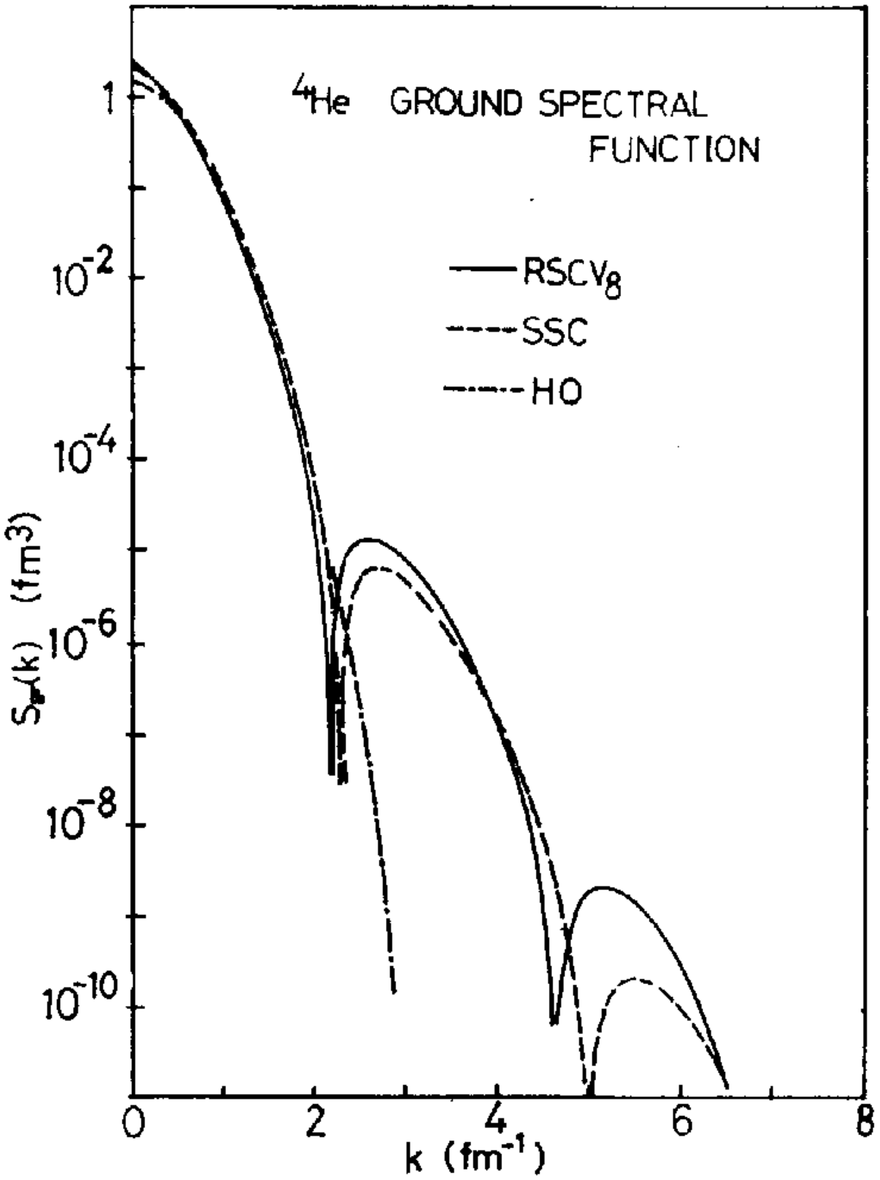
Basic Goal of Experiment

Test prediction for $^4\mathrm{He} \to tp$ momentum distribution

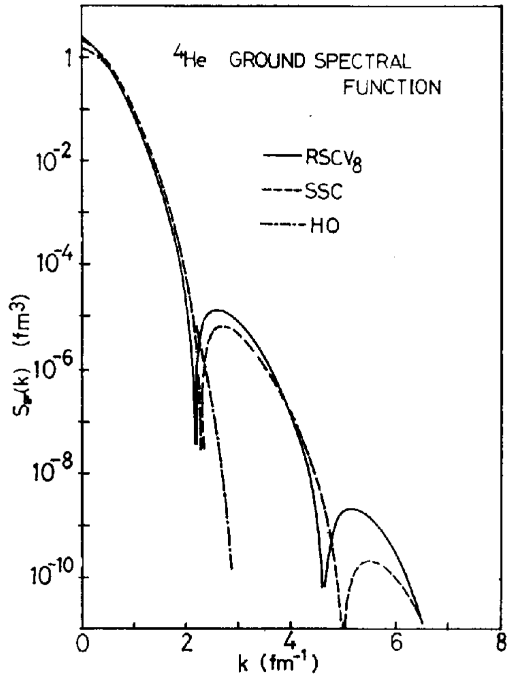


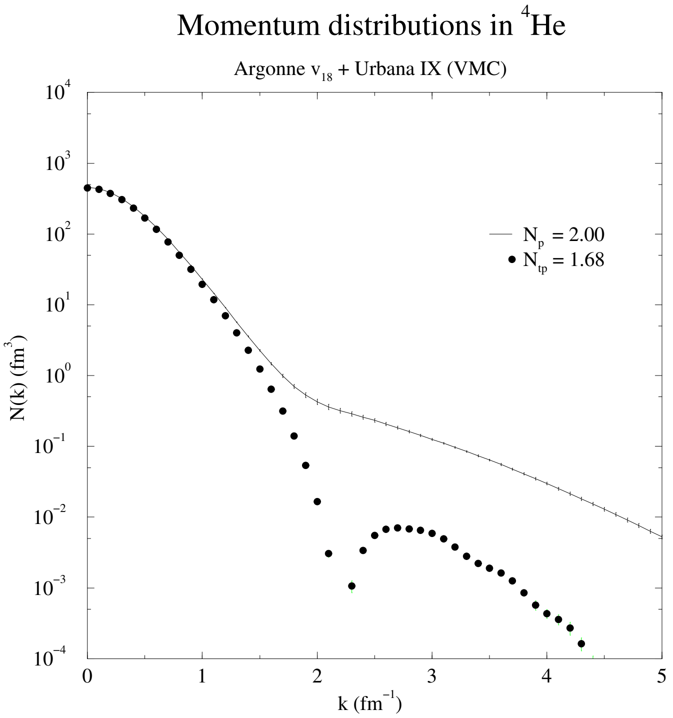
What Could Such A Test Accomplish?

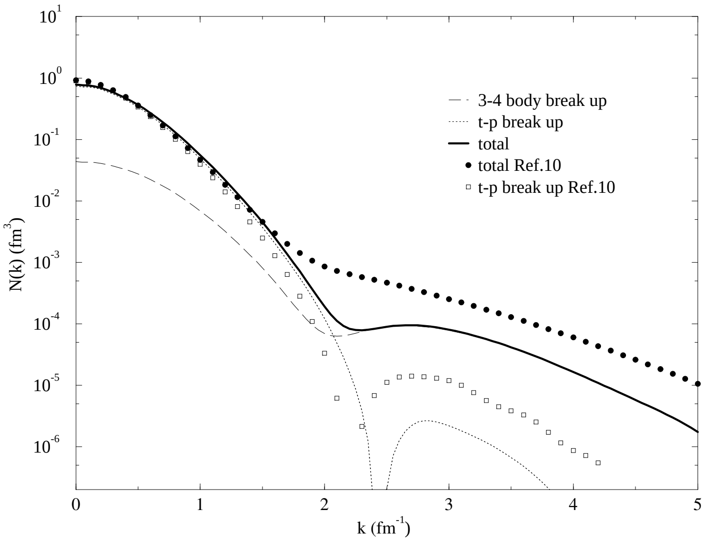
- test "universal" prediction of "complete" 4N calculations
- make a measurement sensitive to short-range particulars of both the nuclear wavefunction and the NN force
- test theoretical understanding of mechanism for $(e, e'p)$ at JLab energies

Test Universal 4N Prediction

calcs predict a minimum in $^4\mathrm{He} \to tp$ mom. dist.

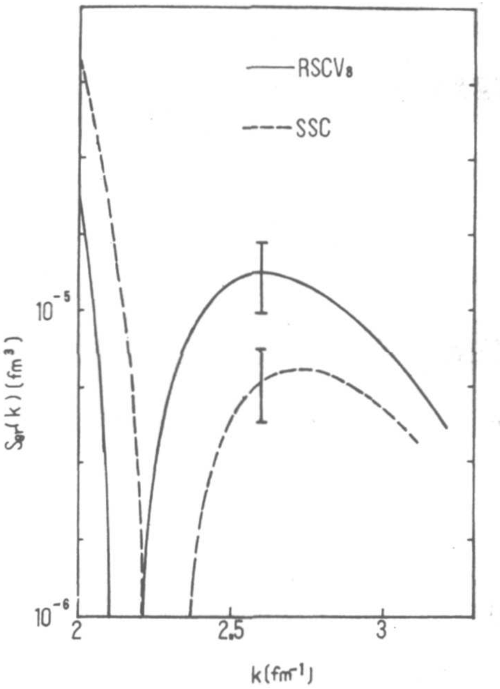


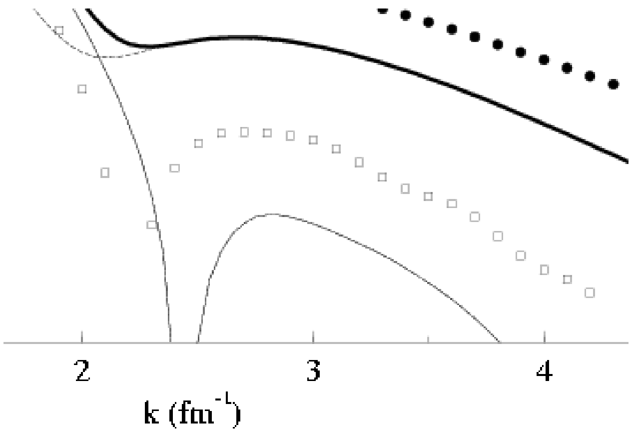




Measurement Sensitive to SR Details

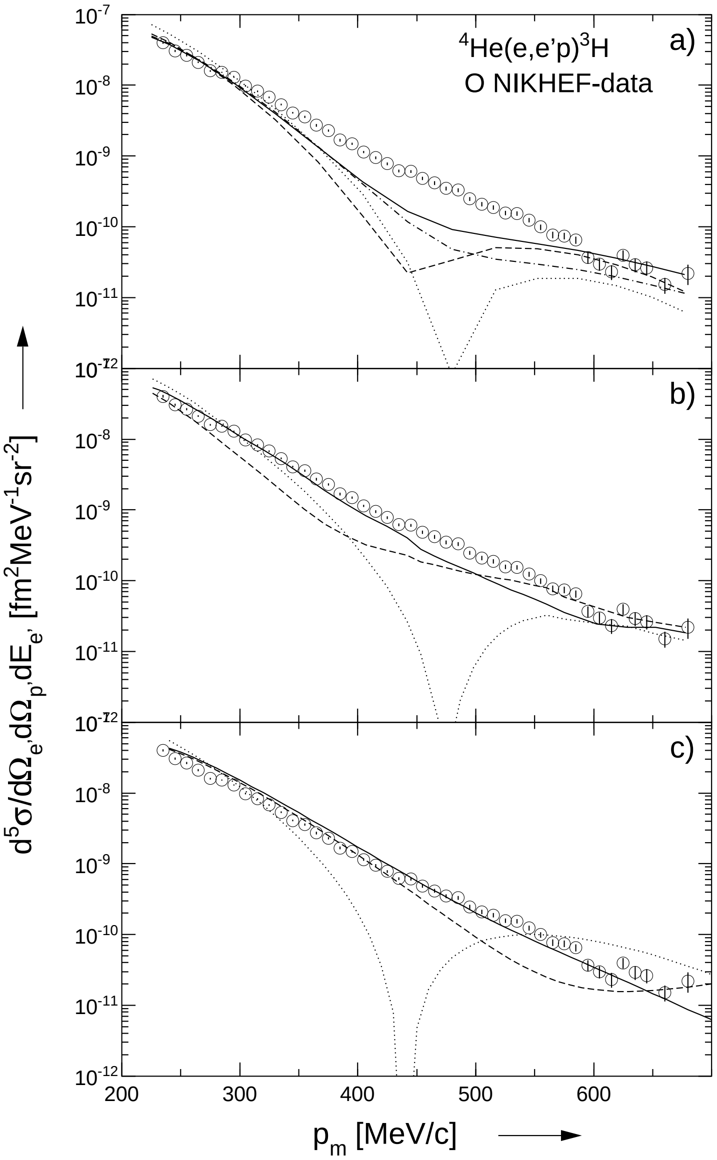
All realistic calcs agree at low momenta, but large disagreements at high momenta





Test $(e,e'p)$ Reaction Mechanism

Nothing is less than zero!



J. J. van Leeuwe *et al.*, Phys. Rev. Lett. **80** (1998) 2543

Expt. 97-111

- calculations indicate that MEC, FSI "filled in" minimum for NIKHEF exp't.

- 97-111 incorporates "best practice" in suppressing these effects:
  - parallel kinematics
  - large $|y|$ values
  - multiple Q^2 settings

- old-style constant $q\omega$ kinematics (CQΩ) retained for comparison

CQΩ electron kinematics			
Parameter	NIKHEF Data	CQΩ I	CQΩ II
Beam Energy (MeV)	525	4045	4045
Scattering Angle (deg)	49.6	14.17	20.88
Energy Transfer (MeV)	215	400	530
$\lvert\vec{q}\rvert$ (MeV/c)	401	1028	1466
Q^2 (GeV/c)^2	0.11	0.90	1.87
y (MeV/c)	220	-105	-400
θ_q (deg)	36.07	60.21	58.73

CQΩ Kinematics Detail

Here, variation of proton angle with respect to $\vec{q}$ is used to vary recoil momentum

CQΩ Detector Settings			
p_m	$p_{\mathrm{cent}}^{\mathrm{HRSh}}$	θ_p	p_p
(MeV/c)	(MeV/c)	(deg)	(MeV/c)
CQΩ I Measurement			
106.4	908.7	−61.3	923.4
356.0	908.7	−80.0	894.0
434.8	868.5	−85.0	878.0
512.4	868.5	−90.0	859.0
CQΩ II Measurement			
400.1	1059	−59.5	1066.0
425.9	1059	−64.8	1061.0
468.7	1059	−68.9	1052.0
562.1	1029	−75.3	1029.3

Parallel Kinematics Measurements

PY Kinematics Summary					
ω	$\|\vec{q}\|$	p_m	p_e	p_p	θ_p
(MeV)	(MeV/c)	(MeV/c)	(MeV/c)	(MeV/c)	(deg)
PY kinematics I Beam Energy 2445 MeV, $\theta_e = 16.83$ deg					
650	893.6	337.9	1795	1231.5	-35.6
850	1027.9	432.0	1595	1459.9	-26.7
1050	1181.0	499.2	1395	1680.2	-20.0
PY kinematics II Beam Energy 3245 MeV, $\theta_e = 18.78$ deg					
1000	1332.6	320.0	2245	1652.5	-32.8
1300	1536.9	436.2	1945	1973.1	-24.0
1500	1689.1	493.3	1745	2182.3	-19.4

Experimental Configuration

Standard Hall A Setup with two exceptions

- high-power helium cryotarget
- swapped detector packages (electron↔hadron)
- Gas Cerenkov detector added on hadron package (for *electron* PID!)
  - Eric Brown (UGA) summer project

Lots of Work To Do!

- PID for Electron Arm
- Monte Carlo, Rate Calcs for final kinematics
- Optics
  - fallout from package swap
  - possible detailed optics runs
  - collimation issue
  - pointing
- COO, ESAD, RSAD, etc.
- *No thesis student* on project at the moment; nominations accepted!
- First Experiment Meeting: June 20th 1 PM (day before CEBAF Users Group Meeting)

Lots of Recent Interest

- nucl-th/0001035 (Benhar, Nikolaev, Speth, Usmani, Zakharov) appear to claim we won't observe the minimum
- nucl-th/9909063 (Sofianos, Ellerkmann, Sandhas) appears also to claim we won't observe minimum, but not sure why
- nucl-th/9909061 (Efros, Leidemann, Orlandini, Tomusiak) can in principle calculate exact FSI in completely different way (when?)
- nucl-th/9901086 (Morita, C. Ciofi degli Atti, Treleani) study Glauber FSI in ${}^4\mathrm{He}(e, e'p)$
- nucl-th/9802041 (Guardiola, Portesi) jastrow correlation functions for ${}^4\mathrm{He}$ nuclei

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That's all!