Polarized ^3He Simulations - incomplete

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Why Polarized ^3He

- Nucleus of ^3He is n & 2p
- Makes ^3He approximately appear as a single neutron when polarized
- ^3He provides better access to a polarized neutron target

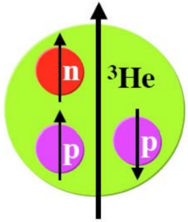

Figure: www.ncnr.nist.gov

A little background, C. Hyde (Old Dominion) previous work

- thesis work from M.Canan, presented by C.Hyde at the HallC Collaboration Meeting in January 2013
- DVCS off polarized neutron gives accces to $E_n(\xi, \xi, t)$
- ^3He target with polarization of 60%, neutron luminosity $3x10^{36} cm^{-2} s^{-1}$, beam polarization of 80%, gives measurement to 10 to 15 % precision.
- at $Q^2 = 3.05 GeV^2$, $x_B = 0.36$,in 16 days.

...more background

Previous work(s)

M.Canan estimated counting rates as function of luminosity, solid angle & Cross section, calculated at the middle of the acceptance

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Canan's Limitations and possible areas of extension

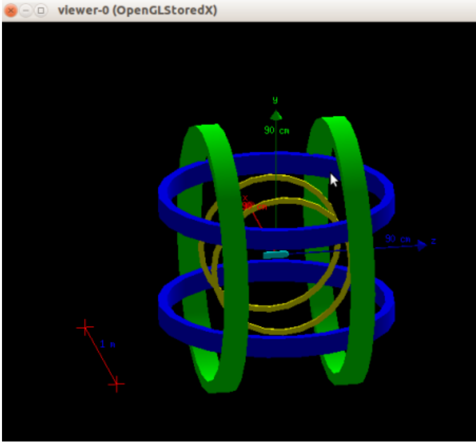
- Computation of cross section
  - Need to consider a realistic geometry, extended target and physical effects such as multi-scattering
- Need to consider Fermi motion
- flactuation of virtual q vector.

Goal

- Start off by reproducing M. Canan's result
- Introduce extended target approach & Introduce Fermi Smearing

Simulation

- Simulation is Rafayel Paremuzyan's work
- GEANT4 Simulation - actual ^3He geometry added
- Principal reaction $N(\vec{e}, e'\gamma)N$
- Events generated randomly with distributions on kinematic variables(x_B,t,Q^2,ϕ) plus radiative corrections
- Scattered electron simulated up to HMS window
- Photon is detected in calorimeter
- Missing mass used to isolate DVCS events



Input Cross sections

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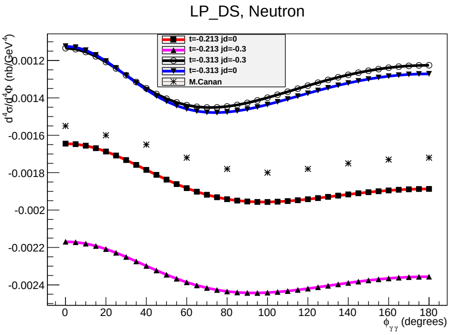
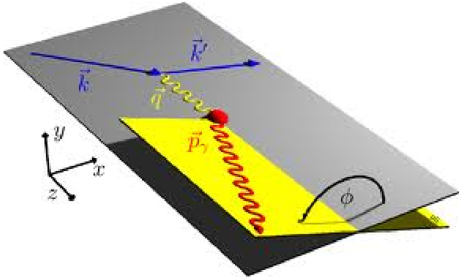
- VGG used to compute cross sections as function of E, Q^2,t,x_B, ϕ
- Beam-target spin can be Longitudinal(z) or Transverse(Tx,Ty); hence cross sections$\sigma^{++}, \sigma^{+-}, \sigma^{-+}, \sigma--$
- input cross section grid - 5 dimensional(E,Q^2,t,x_B,ϕ) with intervals $\Delta\phi = 15deg$, $\Delta x_B = 0.1$,$\Delta Q^2 = 1GeV^2$, $\Delta t = 0.03GeV^2$ and relevant Jlab beam energies.

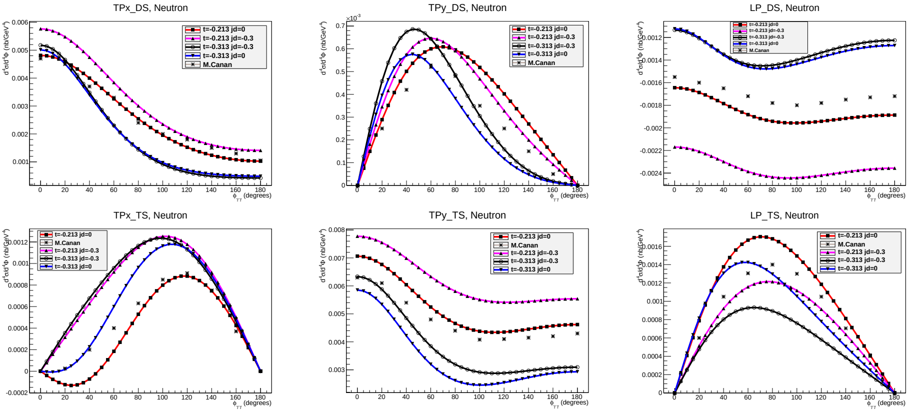
Input Cross sections Neutron; Comparing VGG result with Canan

$Q^2 = 3.05 GeV^2, K_e = 8.8 GeV, -t = 0.213/0.313 GeV^2, x_B = 0.36, Jd = -0.3/0.0$



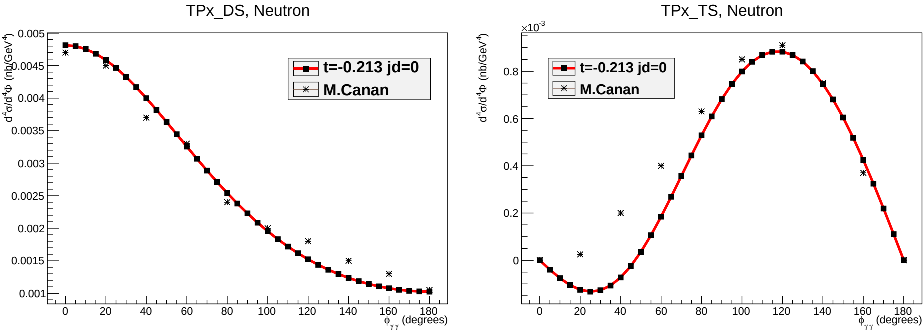


More capabilities..



...Input Cross sections Neutron::Convincing

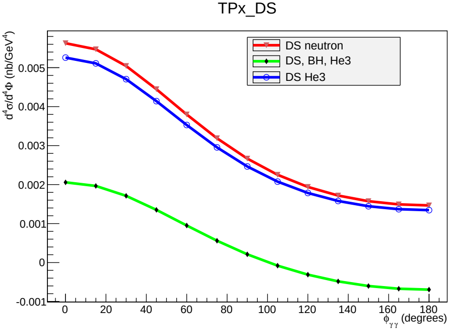
$-t = 0.213 GeV^2, Jd = 0$, reproduces Canan's result better

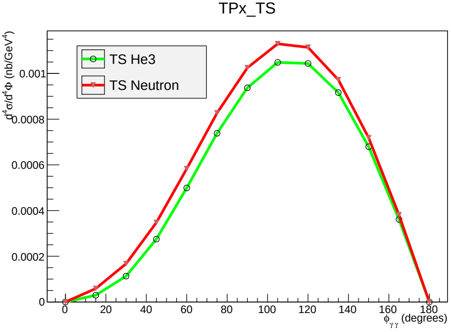


... gives confidence to compute simulation cross section grids (Proton & Neutron)

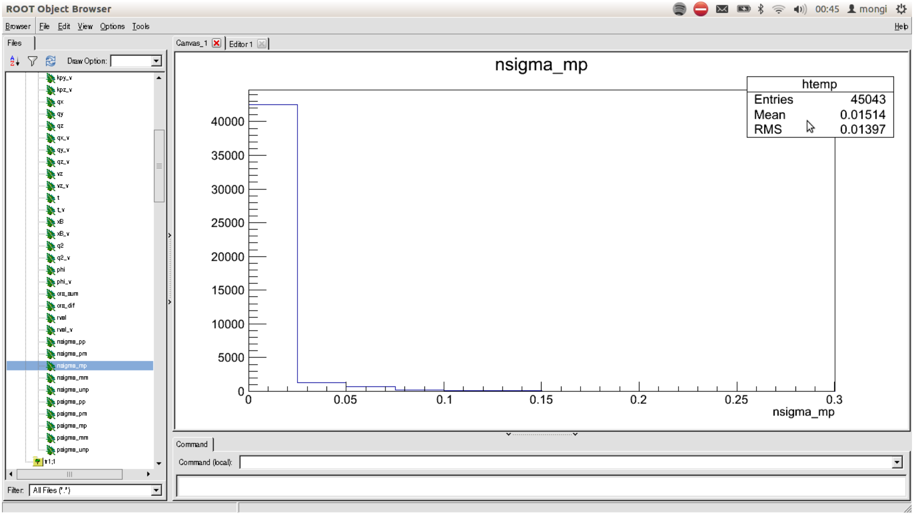
Neutron,Proton contributions in ^3He cross sections

$\Delta\sigma^{^3He} = 0.85\sigma^N - 2(0.028)\sigma^P$::we can't ignore proton contribution!





Results-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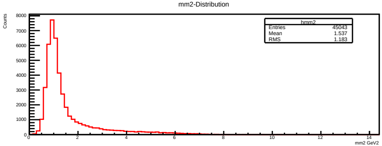
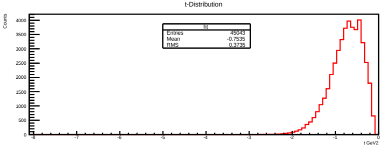
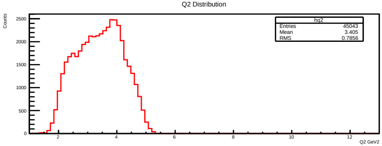
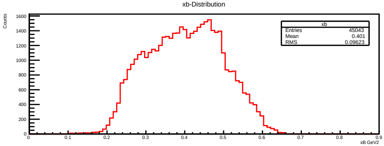
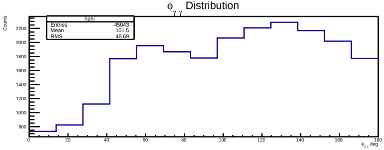
Results- kinematics over acceptance, statistics!











Results- Calculating errors/uncertainty in cross section

- DS uncertainty in each bin in ϕ calculated;$\Delta\sigma^{TS} = \frac{1}{P_t}\sqrt{\frac{\sigma_{sum}}{L\Omega}}$
- $\sigma_{sum} = \sigma^{++} + \sigma^{+-} + \sigma^{-+} + \sigma^{--}$

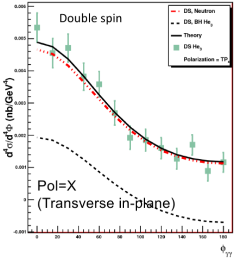


Figure: C. Hyde, DVCS January 2013 talk

Talk conclusion and future perspectives

- Work still in progress
  - increase statistics
  - Fermi motion effects
  - geometry effects
  - counting rates and uncertainities

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- On a different note, relocating to Jlab soon,to stay for atleast a year
- to carry on with project (in about a month), and
- looking forward to be engaged in upcoming experiment setups and other projects

The End, Thank you