EXPLORING THE ISOSPIN DEPENDENCE OF SHORT-RANGE CORRELATIONS WITH TRITIUM

HALL A E12-11-112 (X_{BJ}>1)

SPOKESPERSONS: J. ARRINGTON, D. DAY, D. HIGINBOTHAM, P. SOLVIGNON, Z. YE

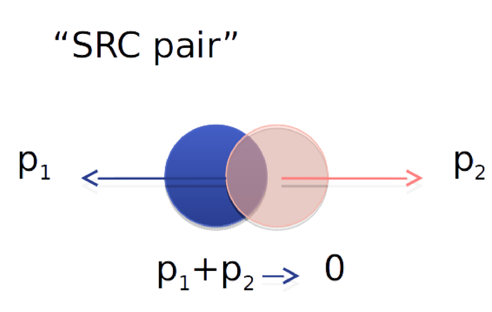
University of New Hampshire

SHUJIE LI

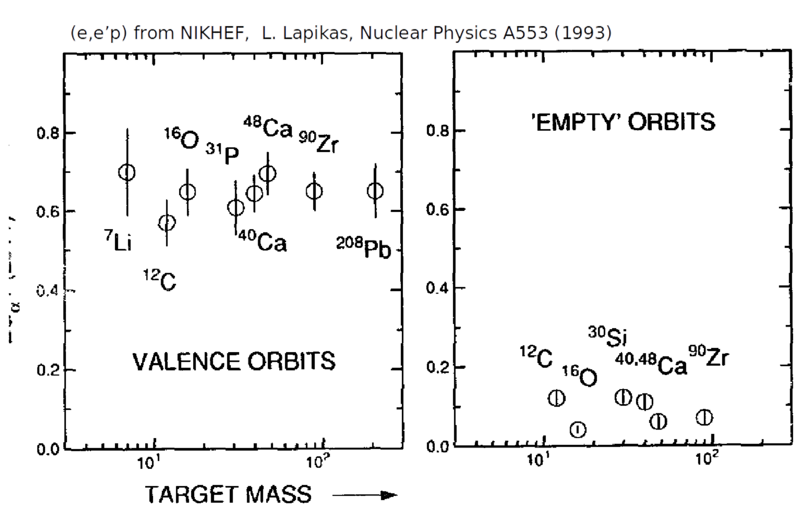
1 Short-range Correlations

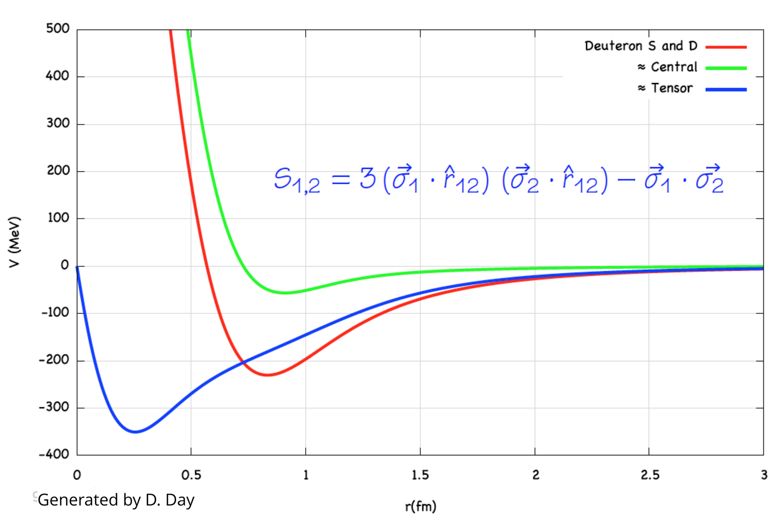
How do nucleons live in nuclei? A simple shell model assumed that protons and neutrons sit in the nuclear potential well and fill orbits up to Fermi momentum. But in low energy e'p experiments people noticed that the "closed" orbits have a probability of occupation less than 80%, and about 20% nucleons have momentum higher than Fermi level ("empty orbits").

In the Short-range Correlations (SRC) theory, the high momentum nucleons are produced when nucleons are too close to each other (<1fm) such that their wave functions are heavily overlapped and generate a strong repulsive force that provide those nucleons large back-to-back momentum.

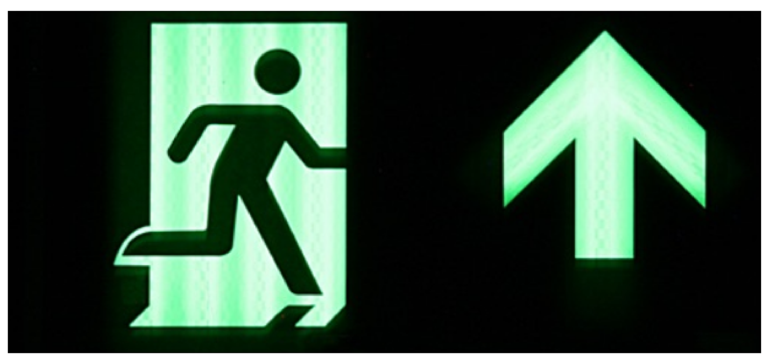


Isospin-dependence of nucleon-nucleon (2N) SRC is expected since only the Isospin 0 neutron-proton (deuteron-like) interaction has the attractive tensor term $S_{1,2}$ which makes np pairs more likely to move close to each other .

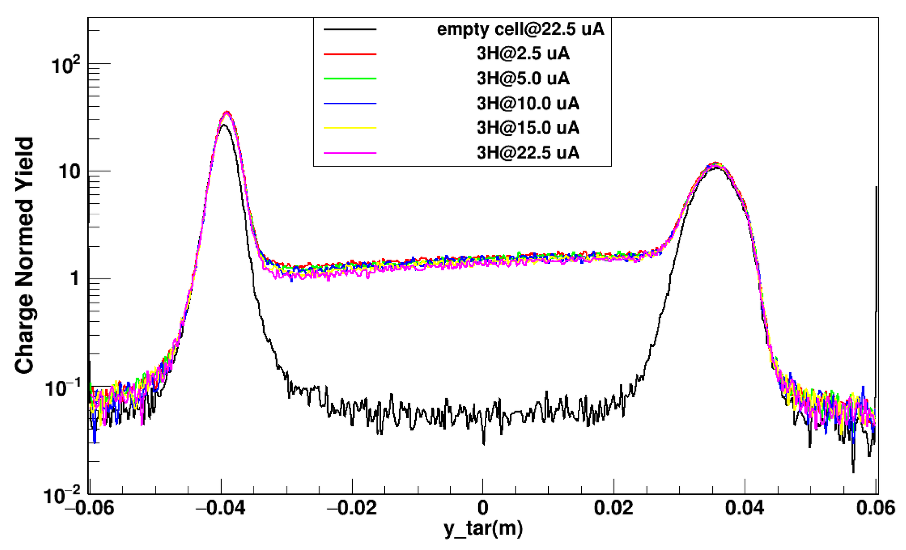


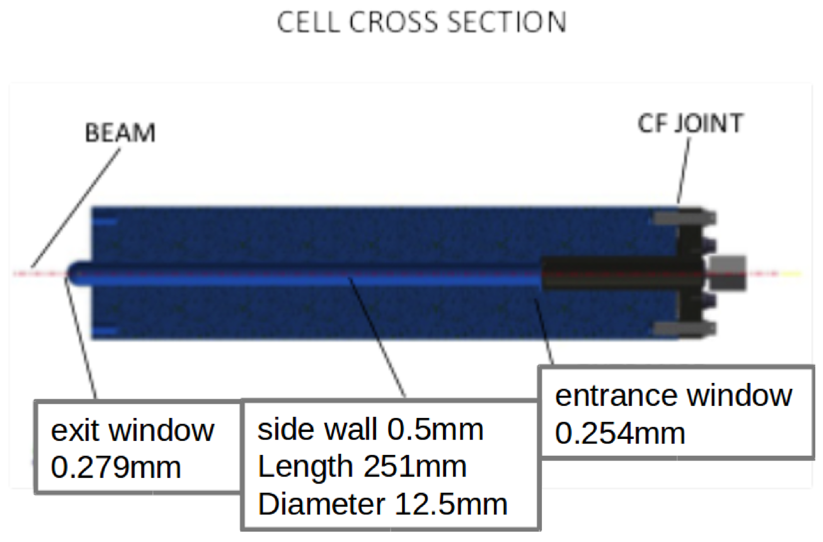


2 Tritium Target



A special aluminum cell is desigeed to hold about 1000 Ci tritium gas., while an exit sign contains about 20 Ci tritium.

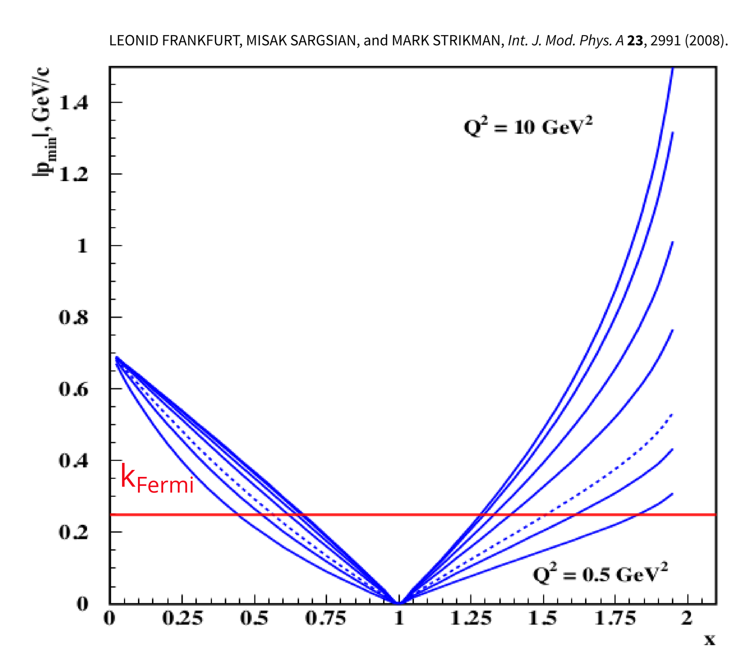


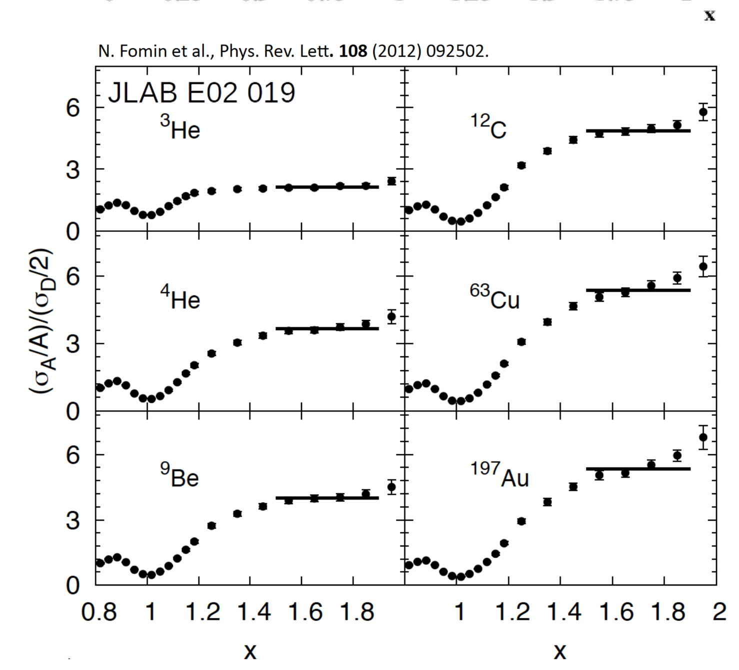


Since we have a very "thin" target comparing to the aluminum endcaps, the endcap contamination must be carefully removed in analysis by comparing to the empty cell.

Also, the density of our gas target is sensitive to the heat deposited by the beam. So the target density dependence on beam current and along the target length should also be understood.

3 Inclusive Measurement





In inclusive SRC experiments we look at electrons scattered with x_{bj}>1 kinematics to probe nucleons with momentum above Fermi level.

Previous experiments have observed plateaus of cross section ratio between various nuclei to deuterium at x_{bj}>1. The height of the plateau gives the probability of finding np SRC pairs in those nuclei.

Tritium and Helium3 are A=3 mirror nuclei. Measuring the cross section ratio of those two provides a unique change to precisely determine the isospin-dependence of 2N SRC. If all high momentum nucleons are np pairs :

$$\frac{\sigma_{^3He}}{\sigma_{^3H}} = \frac{\sigma_{np} + \sigma_p}{\sigma_{np} + \sigma_n} \approx \frac{\sigma_{np}}{\sigma_{np}} = 1$$

And If no isospin preference the ratio will be:

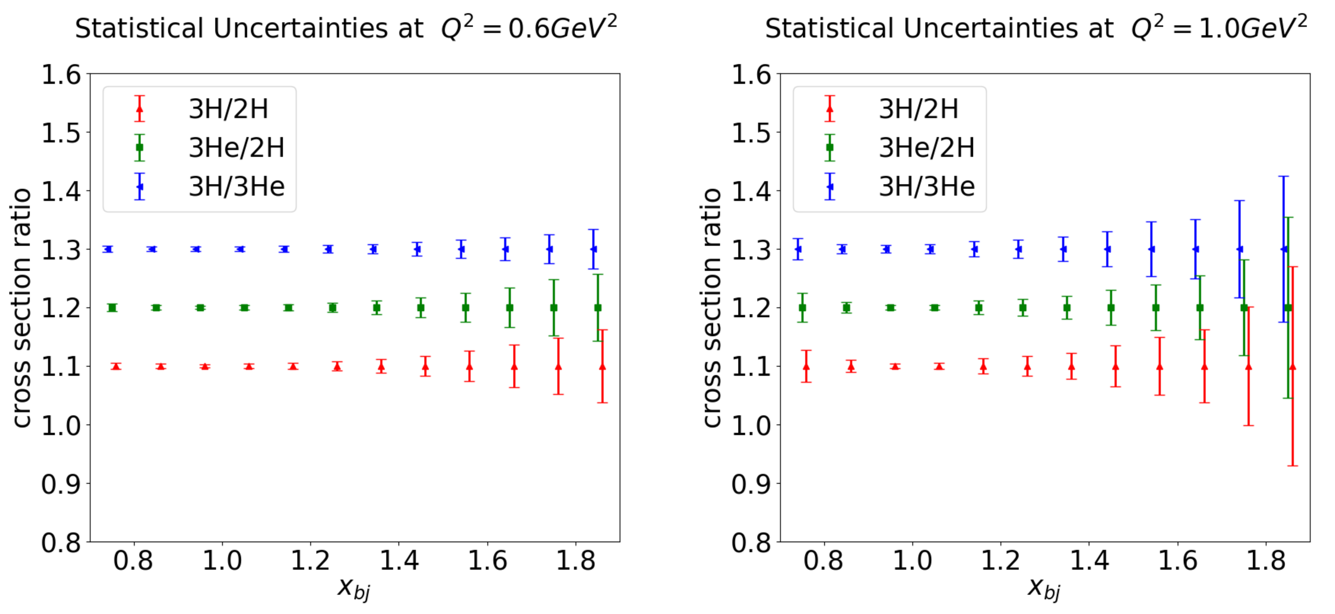
$$\frac{\sigma_{^3He}}{\sigma_{^3H}} = \frac{\sigma_n + 2\sigma_p}{2\sigma_n + \sigma_p} \xrightarrow{\sigma_p \approx 3\sigma_n} 1.4$$

4 Timeline

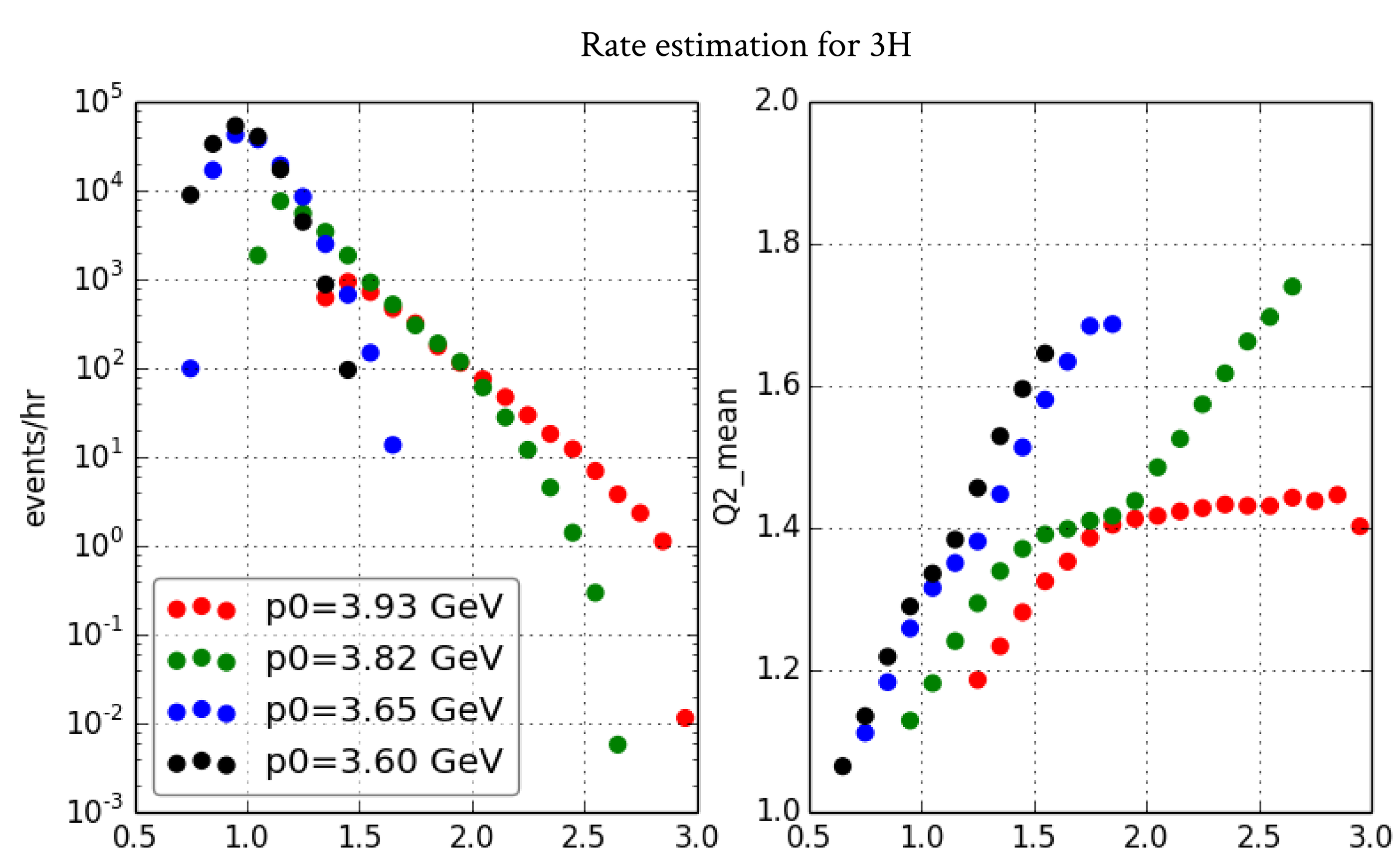
Nov 2017 — Tritiium cell arrived at JLab

Dec 2017 — Commissioning in Hall A:
Trigger test, detectors checkout, target density study, optics, etc

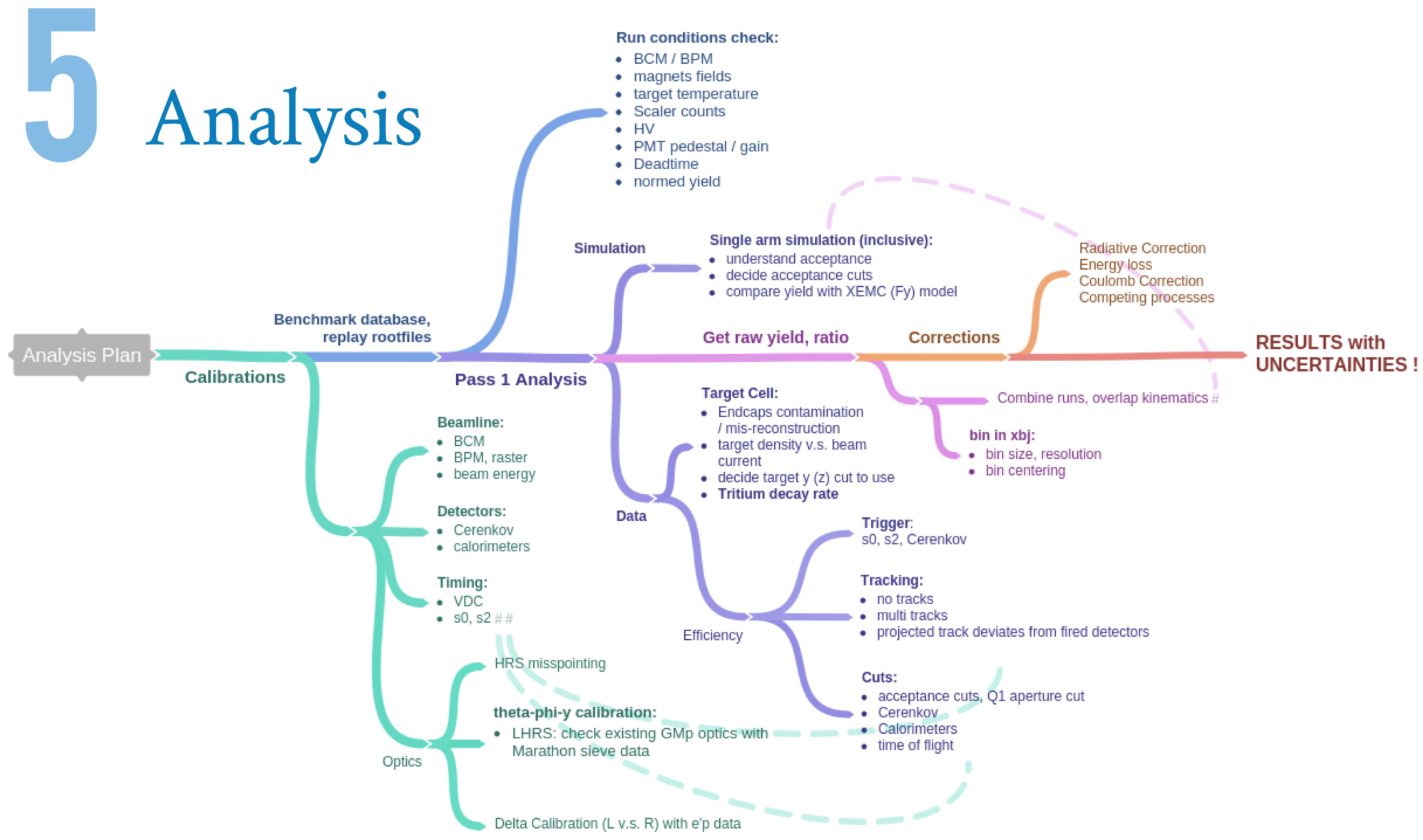
May 2018 — Q^2=0.6 , 1.0 GeV^2 x_{bj}>1 2H, 3H, 3He production data to be compared with September data to study the Q^2 dependence of 2N SRC.



Sept 2018 — 30 days of high Q^2 x_{bj}>1 measurement with 2H, 3H, and 3He has been scheduled in Hall A in Sept 2018.



5 Analysis



MORE DATA AND RESULTS ARE ON THE WAY. ARE YOU READY?

* THANKS DAVE MEEKINS, FLORIAN HAUENSTEIN, AND HALL A TECH GROUP FOR THEIR EXCELLENT SUPPORT TO THE EXPERIMENT.

Jefferson Lab — Sustainability Matters

2018 USER GROUP MEETING