Update on Run Group F

BONuS12
Preparation for readiness review

Gabriel Charles
BONuS12 will study the neutron structure using deep inelastic scattering on an unpolarized deuterium target.

- Measure the neutron structure function
- Predictions for $d/u$ when $x \to 1$:
  - $SU(6)$ 1 / 2
  - Hard gluon exchange: 1 / 5
  - Scalar diquark dominance 0

It will increase our knowledge on different topics.
BONuS12 will measure low momentum spectator protons at high angles in coincidence with scattered electrons at high Bjorken $x$.

Barely Off-shell Nucleon Structure @ 12 GeV,

$\rightarrow$ A new detector is needed to detect recoil protons below 100 MeV/c

CLAS12 will detect the scattered electrons

BONuS12: third experiment to run (currently scheduled for the beginning of 2019)

Readiness review in Spring 2017
Which detector do we need?

Choice to use a Radial Time Projection Chamber

Advantages:
- Energy threshold < 80 MeV/c
- Position resolution depends on pad size and time resolution
- Already used at Jlab: BONuS6, eg6

BONuS6 RTPC
Improvements needed

- Larger angular coverage
- New electronics
- New tracking algorithm
- Gas properties and homogeneity stability
- Better tracking
Larger angular coverage

Different design, using different size GEM foils, and tape them at the top, larger radius, longer target and detector (400 mm long)
New electronics

Working with Saclay to use the DREAM electronics
- it’s already there, we are trying to use the same cables =>
minimum work needed to change the detectors
- ALTRO is not available anymore and we have only 3200 channels
- it’s fast enough
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Work to be done:
- the firmware needs to be adapted
- a protection circuit needs to be added
- test bench being setup at ODU, first tests this or next month
BONuS6 and eg6 used global helix fit. We will use a Kalman Filter. It can handle energy losses which are not negligible for us.
Gas (1/4): introduction

Gain for previous runs.

Why is it important? Add uncertainty to the energy collected eventually.
Even if a calibration with magnetic field is necessary, we need to make sure that the calibration without B is as good as possible.

We are looking at all the aspects that could be the cause of this:
- gas composition (Magboltz-Garfield)
- gas density
- GEM gain
- electric field homogeneity: cathode foil, resistive end plates.
With Gemc, Magboltz and Garfield answer the questions:

- What is the effect of small gas composition modification?
- What is the drift time?
- What is the Lorentz angle?
- What is the best gas mixture?

For a complete test, we are implementing the RTPC in Coatjava, providing comments for the tutorials on the way.

D. Payette
Different solutions are under investigation to keep the working conditions stable: blow air at fixed temperature and pressure around the detector, calibrate the gain before, blowing gas at fixed temperature and pressure in the detector...

Gas flow simulation of the chamber => adding more inlets and outlets to ensure a more homogeneous distribution of the gas in the chamber
GEM gain: stronger constraints on the position of the GEM foils. As the detector is longer, a spacer will be added at the center. The GEM foils are segmented on one side.

**Active area:** copper + Kapton

- 429.8 for R = 70 mm
- 448.7 for R = 73 mm
- 467.5 for R = 76 mm

Kapton only area. Necessary to glue each side in top of each other.
Electric field homogeneity

Replace the cathode foil by wires

Cathode foil could have unknown wrinkles

Studies on going to understand the effect on the drift time and Lorentz angle

Cover end plates with a resistive paint to have a homogeneous electric field

Electric field is distorted at the edges if nothing is done
Conclusions

BONuS12 will provide new data at high Bjorken x to determine the neutron structure function and d/u ratio

A new RTPC is being built with a great team of motivated people as we are

Several points are being investigated to improve the previous RTPC: larger angular coverage, new electronics, gain stability, better tracking

Gemc and Coatjava are being updated with the help of Veronique, Gagik, Nathan

A test bench will be operational next month at ODU to test the DREAM electronics