DC HV Studies for RGK

For the DC, we would like to take data under different conditions to study the effects of different HV settings on resolutions as well as opportunistic gathering data for high-lumi operation. The required measurements for resolutions can be separated from the high-lumi data and can be taken at different times. We estimate that all the tests will be overall 1 PAC day (2 beam days).

Resolution study: ~ 1.5 shift
Requirements:
- Hydrogen target
- 3rd or 4th pass beam (3rd pass preferred)
- Established production settings i.e. beam setup, trigger checkout, mini lumi scan done
- Electron trigger without DC roads (with roads statistics goal can be reduced)

The goal is to determine the effect of changes in DC HV settings on resolutions (tracking and physics quantities). We plan to study the improvement of track and missing mass resolution if the HV is increased in steps in different regions. The largest effect is expected for R2 drift chambers. The study requires collected data with sufficient statistics (~75M) for calibration and analysis of physics channels. The setting from RGM/C is R1=10 , R2=10 and R3=10 (10, 10, 10).

HV Settings for study:

Region 1 HV	Region 2 HV	Region 3 HV	Statistics Goal	Comment
10	11	11	75M	RGD Setting
11	12	12	75M	
10	10	10	75M	RGM/C Setting
9	10	10	75M	RGK Fall 2019 Setting
10	10	11	75M	Study effect of R3
10	11	10	75M	Study effect of R2
10	12	10	75M	Study effect of R2
11	10	10	75M	Study effect of R1
12	13	13	75M	Highest setting if possible

We estimated that 75M is about 2.5h-3h at 40nA. Therefore, the plan will take about three-four shifts to measure all the 75M runs.

Calibration and Analysis Plan:
Each run requires a good calibration for DC, FTOF and P/ECAL to ensure that the obtained resolutions of physics quantities are comparable and only effected by the DC HV and not bad calibrations. We assume that the DC alignment and P/ECAL calibrations from RGD carry over for the RGK runs. We also assume that calibrations of each DC region are independent and a calibration at a specific HV setting does not dependent on the HV setting of another region. This assumption is seen in previous calibrations at RGD at different HV. Therefore, a

T0/T2D calibrations for R1 at setting 10 should be good for HV settings (10,12,10) or (10,11,11) etc.

Initial calibrations will start with the T0s and T2D pressure dependence calibration from RGD at (10,11,11). The calibration need fast turnaround and we envision the following plan and steps:

1) Cook first run asap to calibrate FTOF/RF (expected to be completed before Christmas) and upload new constants.
2) Cook 10M events from runs (10,10,10),(9,10,10),(10,11,11),(11,12,12) to obtain T00 calibrations for each HV setting in each region. Initial T0s will be from RGD at (10,11,11).
3) Upload new T0s for each run and pressure numbers. This step should be completed before end of the year.
4) Cook 10M events from runs (10,10,10),(9,10,10),(10,11,11),(11,12,12) to obtain T2D calibrations for each HV setting in each region. Note: it could be that some settings do not need a new calibration and are already good enough.
    a. In parallel, produce mini-timeline for all runs to check calibrations from previous step (means and T00s)
5) Upload new T2D calibrations for each run based on the individual T2D calibration for each region. To be completed within first week of January.
6) Cook all runs completely with focus on runs (9,10,10),(10,11,11) and (11,12,12) first
    a. In parallel, produce timeline to check calibration.

The analysis of runs after step 6 will focus on inclusive electrons, Lambda channels and Two-pion. We expect to have scripts ready to look at these runs and check resolutions of W, missing and invariant masses to guide a decision on the HV setting for RGK.

Opportunistic High-lumi study: ~ 1h

Requirements:

- Beam operation possible up to 150nA on LH2
- LH2

The goal is to collect data to determine HV currents as a function of beam current and fill gaps from previous measurements when the HV supply was limited to 40uA HV currents. We just need EPICs for this and no DAQ. The plan is to increase the beam currents in steps of 20nA from 30-150nA (6 steps) and wait till we have a stable 30s-60s of beam. The HV current information is automatically stored and will be analyzed later together with the beam currents. In parallel, screenshots of the DC HV will be logged. For each HV setting the current scan should take about 15min. If HV trips at higher beam currents it will be kept off until the next HV setting and a logbook entry will be made.

The HV settings for this test are:

Region 1 HV	Region 2 HV	Region 3 HV
10	10	10
11	11	11
12	12	12
12	13	13

*this setting needs a careful increasement of beam currents to avoid any DC issues.