Boiling Studies Run Plan, BEAM Energy 10.549 GeV

March 2023

1 Target Boiling Studies (part 1)

Prescale GUI settings for deuteron d$(e, e'p)$ luminosity scan

COIN DAQ		
TRIGGER	PRE-SCALE	TARGET RATE
PS1 (SHMS-3/4)	-1	- -
PS2 (SHMS-ELREAL)	-1	- -
PS3 (HMS-3/4)	-1	- -
PS4 (HMS-ELREAL)	-1	- -
PS5 (SHMS-ELREAL x HMS-3/4)	-1	- -
PS6 (HMS-3/4 x SHMS-3/4)	0	- -
EDTM Target Prescale Rate	- -	10 Hz

Change kinematics back to P_m=120 MeV/c setting to do a luminosity scan.

- Check SHMS is set to -8.55 GeV/c, 12.2 deg.
- Set HMS momentum to +3.0523 GeV/c, 38.63 deg (will need to cycle HMS magnets to MOL)
- Ensure target is set to 10 cm LD2
- From previous measurements at this setting, DAQ T6 rates were 48 Hz @ 35 μA, but after analysis cuts (except Q^2), the good $(e, e'p)$ rates were 16.5 Hz, therefore, to scale to **X** beam current, good $(e, e'p)$ (@ **X** μA) = 16.5 Hz $\times$**X** $\mu A/35\mu A$

1.1 LD2 @ 10 μA:

1. Request MCC to deliver 10 μA beam current
2. Start a run for $\sim$ 40 min. of beam-on-target to collect at least $\sim$ 10k good $(e, e'p)$ events.
3. When the run ends, execute Execute: `./run_deut_prod.sh deep <run_num>` to begin full replay

1.2 LD2 @ 20 μA:

1. Request MCC to deliver 20 μA beam current
2. Start a run for $\sim$ 20 min. of beam-on-target to collect at least $\sim$ 10k good $(e, e'p)$ events.
3. When the run ends, execute Execute: `./run_deut_prod.sh deep <run_num>` to begin full replay

1.3 LD2 @ 30 μA:

1. Request MCC to deliver 30 μA beam current
2. Start a run for $\sim$ 15 min. of beam-on-target to collect at least $\sim$ 10k good $(e, e'p)$ events.
3. When the run ends, execute Execute: `./run_deut_prod.sh deep <run_num>` to begin full replay

1.4 LD2 @ 40 μA:

1. Request MCC to deliver 40 μA beam current
2. Start a run for $\sim$ 10 min. of beam-on-target to collect at least $\sim$ 10k good $(e, e'p)$ events.
3. When the run ends, execute Execute: `./run_deut_prod.sh deep <run_num>` to begin full replay

1.5 LD2 @ 50 μA:

1. Request MCC to deliver 50 μA beam current
2. Start a run for $\sim$ 8 min. of beam-on-target to collect at least $\sim$ 10k good $(e, e'p)$ events.
3. When the run ends, execute Execute: `./run_deut_prod.sh deep <run_num>` to begin full replay

1.6 LD2 @ 60 μA:

1. Request MCC to deliver 60 μA beam current
2. Start a run for $\sim$ 7 min. of beam-on-target to collect at least $\sim$ 10k good $(e, e'p)$ events.
3. When the run ends, execute Execute: `./run_deut_prod.sh deep <run_num>` to begin full replay

1.7 LD2 @ 70 μA:

1. Request MCC to deliver 70 μA beam current
2. Start a run for $\sim$ 6 min. of beam-on-target to collect at least $\sim$ 10k good $(e, e'p)$ events.
3. When the run ends, execute Execute: `./run_deut_prod.sh deep <run_num>` to begin full replay

2 Target Boiling Studies (part 2)

Prescale GUI settings for luminosity scan using SHMS (e-) singles

COIN DAQ		
TRIGGER	PRE-SCALE	TARGET RATE
PS1 (SHMS-3/4)	-1	- -
PS2 (SHMS-ELREAL)	TBD	2000 Hz
PS3 (HMS-3/4)	-1	- -
PS4 (HMS-ELREAL)	-1	- -
PS5 (SHMS-ELREAL x HMS-3/4)	-1	- -
PS6 (HMS-3/4 x SHMS-3/4)	-1	- -
EDTM Target Prescale Rate	- -	10 Hz

NOTE: Only enable T2 (e- singles) trigger, and monitor the trigger rates to ensure they are below $\sim$2 kHz. This should be done while accelerator delivers desired beam current. If target rate exceeds $\sim$2 kHz, then set target rate to 2000 (in units of Hz), press return, then click Save on the pre-scale GUI. If target rate is <2000 Hz, then leave trigger un-prescaled. This check should be done before starting a run at the start of every setting.

- Prior to starting the luminosity scan, check SHMS NGCER, pre-Shower LO, pre-Shower HI scaler rates and increase hardware thresholds on these pre-triggers accordingly such that they are NOT $\sim$ 1 MHz with no beam. Expert will do this part.
- the **lumi** option in the analysis script: `./run_deut_prod.sh lumi <run_num>`, applies general acceptance and PID cuts, and integrates over the SHMS momentum acceptance, δ_{SHMS} from -10 to 22 %) to get total (e, e') singles counts.

2.1 LD2 @ 10 μA:

1. Set SHMS to -4.0 GeV/c, 20.0 deg
   Should NOT need to cycle magnets, as going down in momentum.
2. Update the `DBASE/COIN/STD/standard.kinematics` with the new settings
3. Request MCC to deliver 10 μA beam current
4. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
5. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
6. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.2 LD2 @ 15 μA:

1. Request MCC to deliver 15 μA beam current
2. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
3. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
4. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.3 LD2 @ 25 μA:

1. Request MCC to deliver 25 μA beam current
2. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
3. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
4. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.4 LD2 @ 35 μA:

1. Request MCC to deliver 35 μA beam current
2. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
3. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
4. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.5 LD2 @ 40 μA:

1. Request MCC to deliver 40 μA beam current
2. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
3. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
4. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.6 LD2 @ 45 μA:

1. Request MCC to deliver 45 μA beam current
2. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
3. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
4. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.7 LD2 @ 55 μA:

1. Request MCC to deliver 55 μA beam current
2. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
3. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
4. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.8 LD2 @ 65 μA:

1. Request MCC to deliver 65 μA beam current
2. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
3. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
4. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.9 LD2 @ 70 μA:

1. Request MCC to deliver 70 μA beam current
2. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
3. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
4. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.10 C12 @ 15 μA:

1. Request MCC mask the target and change to C12.
2. Update the `DBASE/COIN/STD/standard.kinematics` with the new settings
3. Request MCC to deliver 15 μA beam current
4. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
5. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
6. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.11 C12 @ 30 μA:

1. Request MCC to deliver 30 μA beam current
2. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
3. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
4. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.12 C12 @ 45 μA:

1. Request MCC to deliver 45 μA beam current
2. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
3. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
4. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.13 C12 @ 60 μA:

1. Request MCC to deliver 60 μA beam current
2. Start a run for $\sim$ 5-30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
3. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take
4. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay

2.14 Al dummy @ 40 μA:

1. Request MCC mask the target and change to Al. dummy
2. Update the `DBASE/COIN/STD/standard.kinematics` with the new settings
3. Request MCC to deliver 40 μA beam current
4. Start a run for $\sim$ 30 min. of beam-on-target to collect at least $\sim$ 100k good (e, e') events
5. During mid-run, execute: `./run_deut_sample.sh lumi <run_num> <evt_num>` to estimate good (e, e') rates and project how long the run will take (when script asks for target input, enter LD2 to analyze it as if it were deuterium)
6. When the run ends, execute: `./run_deut_prod.sh lumi <run_num>` to begin full replay (when script asks for target input, enter LD2 to analyze it as if it were deuterium)