Mott Experiment Run 1 (v4 updated 1/9/15)

1. Shift Schedule

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DAY | Goal | Shift | Mott #1 | Mott #2 | SSO |
| Tue  13th |  | O |  |  |  |
|  | D |  |  |  |
| Possible early lock-up | S | Grames |  |  |
| Wed 14th |  | O |  |  |  |
|  | D |  |  |  |
| Setup FC2 KE 5 MeV  Mott DAQ checkout  Choose 31 v. 62 Mhz | S | Grames | Suleiman |  |
| Thu 15th |  | O |  |  |  |
|  | D |  |  |  |
| Final KE 5MeV & dp/p  PMT/BCM/PITA calibration Orbit/position systematic | S | Grames | Suleiman |  |
| Fri 16th |  | O |  |  |  |
|  | D |  |  |  |
| Systematic spot size  Systematic energy spread | S | Grames | Stutzman |  |
| Sat 17th | Target thickness | O | Suleiman | McHugh | Forman |
| Target thickness | D | Poelker | Sinclair |  |
| Target thickness | S | Grames | Stutzman |  |
| Sun 18th | Target thickness | O | Suleiman | McHugh | Forman |
| Target thickness | D | Poelker | Sinclair |  |
| Target thickness | S | Grames | Stutzman |  |
| Mon 19th | Target thickness | O | Suleiman | McHugh | Forman |
| Target thickness/  Systematics | D | Poelker | Sinclair |  |
| Target thickness/  Systematics | S | Grames | Stutzman |  |

2. Shift Worker Responsibilities

* Beam Driver
  + Beam setup: gun + laser + spin + beam to Mott
  + BCM & target motion FSDs enabled
  + Vacuum levels reasonable
  + Magnet and RF setup saved
  + PITA adjusted for IHWP IN/OUT
* DAQ Driver
  + Start/Stop DAQ entering correct run information
  + Monitor event rates and maintain dead time <5%
  + Coordinate run start/stop with Beam and Analysis Drivers
* Analysis Driver
  + Runs decoded, analyzed and promptly inspected
  + Run # and information logged onto run sheets
  + Elastic events counted for IHWP=IN/OUT

3. Prep Work (now – Tuesday)

* Make a photocathode – SL5247-1 made
* Test IHA2D00 – wires & stroke good, but data file odd vs. others
* Hi-Pot IP – FE’r potted, but high again, vac readback not good
* CHL 2K cooldown – maybe early, Monday Jan 12th
* Install laser – Tue or Wed
* Test laser RF trigger – after laser installed (1V, 10ns @ RF)
* Verify beam line layout –documented below
* Build elegant deck – working
* Build qsUtility config file –documented below

4. Injector and Mott Checkout (Wednesday – Thursday)

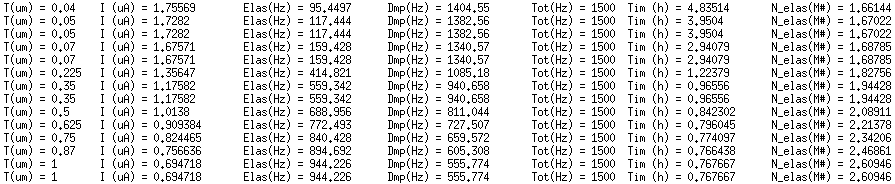
* Restore beam to FC2 @ 6.3 MeV/c
* Brief Mott tests
  + DAQ FADC/TDC synchronization
  + event separation and transmission at 62MHz acceptable
* Quad center BPMs for momentum measurement
* Test harp IHA2D00 if ready for energy spread measurement
* Scale cryounit for p=5.487 MeV/c and minimize energy spread
* Precisely measure beam momentum
* Measure beam emittance
* Measure energy spread
* Calibrate BCM to FC2

5. Mott Setup & Systematics Tests (Friday – Saturday)

* Setup good orbit to Mott
* Set PMT HV
* Set PMT energy thresholds
* Set polarization vertically
* Calibrate PITA vs IHWP IN/OUT
* Finalize orbit w/ instrumental asymmetry, TOF and spectra
* Adjust target offsets per vertical instrumental asymmetry
* Measure dump rate fraction to determine run times
* Measure dead-time vs. rate
* Measure asymmetry vs. beam current
* Measure asymmetry vs. time (stability)
* Measure asymmetry vs. spot size
* Measure asymmetry vs. energy spread

6. Target Foil Extrapolation (Saturday - Monday)

* 14 foils to study + 1 thru hole
  + spectra – with typical low ~2 MeV energy threshold
  + statistics – possibly higher ~3 MeV threshold to reduce dump events
* Deadtime
  + Semi-int mode we use w/ FADC/TDC/scalar is ~5% @ 1500 Hz
* Inelastic fraction
  + Worst case ~200 Hz/det (best case ~25 Hz/det)
  + Energy threshold will be defined to set this value
  + Time veto is tricky and too risky at 62 MHz
* Assuming I=5uA, R<1500Hz, 200Hz/det background
  + 28 hours \* 1.2 / 8 = 4-5 shifts
  + dP/P sets N\_elastic (using 1analysis cut of all 4 det)
  + Measurement of of inelastic (dump) events figures into run time



7. DAQ & Analysis Status

* Status of automating the Run + Decoding + Analysis
* Scalar analysis of BCM
* Automatic logging of analysis results (to be submitted as auto-log)
* Full analysis report:
  + Physics asymmetry
  + Detector asymmetry
  + Beam asymmetry
  + Elastic events (total from 1 sigma cut)
  + Dump events

8. Emittance Measurement Information

* Use qsUtility to scan MQJ0L02 and measure at IHA0L03.
* A config file varies MQJ0L02 while setting MQJ0L02A = MQJ0L03A = 0.
* Make sure beam transports MQJ0L02-IHA0L03 w/ those quads off.
* /cs/prohome/apps/q/qsUtility/pro/fileio/config/IHA0L03\_jmg1.xml
* Documentation:<http://opweb.acc.jlab.org/CSUEDocs/q/qsUtility/pro/doc/dataCollector_user_guide/dataCollector_user_guide.html>
* 21 K1 values (-3.0, -3.2, … , -5.8, -6.0) are good and take 45 min
* Result will be emittance and Twiss at entrance to MQJ0L02
* qsUtility assume v=c
  + BDL[G] = K1[1/m^2] \* L[m] \* E[MeV] \* 10/0.2998
  + Scale E by beta so that p=beta\*E is used instead

9. Momentum Measurement Information

* Use quad centering procedure to set BPM offsets:
  + MQJ0L02 = IPM0L02
  + MQJ0L03 = IPM0L03
  + MQD5D00 = IPM5D00
  + MQD5D01 = IPM5D01
* Quad centering Spata suggests standard dithering and then update .SOF
* Earth’s field is too strong to turn all correctors off
* Excite minimum number of correctors and record values
* p = sqrt [T\*(2m+T)] so T = 5.0 MeV => p 5.487 MeV/c
* Check me: dT/T = (T+2m)/(T+m) \* dp/p so dT/T=1.09 \* dp/p @ T=5.0
* Using spectrometer dipole MDL0L02
  + Record Hall probe field
  + Use BDL calculation on control screen

10. Beamlines

Table below lists most elements to be used

* S position is center of element in meters (good to 0.01)
* Dipole rectangular magnet is square to 0L (in=out=0 deg)
* Measurements are straight-line (no sagittal included in dipole)
* MBH0L01 is composed of two MBH correctors spaced 0.2m apart
* Contrary to injector quick reference, MBH0L03 is *in front* of ITV0L03

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **0L (0 d)** | | **2D (-30 d)** | | **3D (-12.5 d)** | | **5D (+25 d)** | |
| *ELEMENT* | *S* | *ELEMENT* | *S* | *ELEMENT* | *S* | *ELEMENT* | *S* |
| ITV0L01 | 0 |  |  |  |  |  |  |
| MBH0L01 | 0.15 |  |  |  |  |  |  |
| MBH0L01 | 0.35 |  |  |  |  |  |  |
| IPM0L01 | 0.51 |  |  |  |  |  |  |
| MQS0L01 | 0.56 |  |  |  |  |  |  |
| MQJ0L01 | 0.76 |  |  |  |  |  |  |
| MQS0L01A | 2.75 |  |  |  |  |  |  |
| MHB0L01A | 2.87 |  |  |  |  |  |  |
| ITV0L02 | 3.55 |  |  |  |  |  |  |
| MQJ0L02 | 3.81 |  |  |  |  |  |  |
| IPM0L02 | 4.1 |  |  |  |  |  |  |
| MQS0L02 | 4.14 |  |  |  |  |  |  |
| MBH0L02 | 4.3 |  |  |  |  |  |  |
| MQJ0L02A | 4.41 |  |  |  |  |  |  |
| IBC0L02 | 4.9 |  |  |  |  |  |  |
| MDL0L02 | 5.57 | MDL0L02 | 0 | MDL0L02 | 0 | MDL0L02 | 0.00 |
| MHB0L02A | 6.01 | IPM2D00 | 3.2 | MBH3D00 | 0.62 | MBH5D00 | 0.23 |
| MQS0L02B | 7.58 | IHA2D00 | 3.35 | ITV3D00 | 0.89 | ITV5D00 | 0.42 |
| MHB0L02B | 7.7 | ITV2D00 | 3.47 | COLLIM | 1.97 | MQD5D00 | 0.69 |
| MBH0L03 | 9.06 | IDL2D00 | 3.7 | ITG3D00 | 2.21 | MBH5D00A | 0.89 |
| ITV0L03 | 9.38 |  |  | IDL3D00 | 4.01 | IPM5D00 | 0.89 |
| MQJ0L03A | 9.61 |  |  |  |  | MQD5D01 | 2.08 |
| IPM0L03 | 9.93 |  |  |  |  | MBH5D01 | 2.28 |
| MQS0L03 | 9.97 |  |  |  |  | IPM5D01 | 2.28 |
| MQJ0L03 | 10.25 |  |  |  |  | ITV5D01 | 2.60 |
| IHA0L03 | 10.48 |  |  |  |  | MBH5D01A | 2.88 |
|  |  |  |  |  |  | IDL5D01 | 3.27 |