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 1σ analysis cut of all 4 det)
  - Measurement of of inelastic (dump) events figures into run time

T(um) = 0.04	I (uA) = 1.75569	Elas(Hz) = 95.4497	Dmp(Hz) = 1404.55	Tot(Hz) = 1500	Tim (h) = 4.83514	N_elas(M#) = 1.66144
T(um) = 0.05	I (uA) = 1.7282	Elas(Hz) = 117.444	Dmp(Hz) = 1382.56	Tot(Hz) = 1500	Tim (h) = 3.9504	N_elas(M#) = 1.67022
T(um) = 0.05	I (uA) = 1.7282	Elas(Hz) = 117.444	Dmp(Hz) = 1382.56	Tot(Hz) = 1500	Tim (h) = 3.9504	N_elas(M#) = 1.67022
T(um) = 0.07	I (uA) = 1.67571	Elas(Hz) = 159.428	Dmp(Hz) = 1340.57	Tot(Hz) = 1500	Tim (h) = 2.94079	N_elas(M#) = 1.68785
T(um) = 0.07	I (uA) = 1.67571	Elas(Hz) = 159.428	Dmp(Hz) = 1340.57	Tot(Hz) = 1500	Tim (h) = 2.94079	N_elas(M#) = 1.68785
T(um) = 0.225	I (uA) = 1.35647	Elas(Hz) = 414.821	Dmp(Hz) = 1085.18	Tot(Hz) = 1500	Tim (h) = 1.22379	N_elas(M#) = 1.82756
T(um) = 0.35	I (uA) = 1.17582	Elas(Hz) = 559.342	Dmp(Hz) = 940.658	Tot(Hz) = 1500	Tim (h) = 0.96556	N_elas(M#) = 1.94428
T(um) = 0.35	I (uA) = 1.17582	Elas(Hz) = 559.342	Dmp(Hz) = 940.658	Tot(Hz) = 1500	Tim (h) = 0.96556	N_elas(M#) = 1.94428
T(um) = 0.5	I (uA) = 1.0138	Elas(Hz) = 688.956	Dmp(Hz) = 811.044	Tot(Hz) = 1500	Tim (h) = 0.842302	N_elas(M#) = 2.08911
T(um) = 0.625	I (uA) = 0.909384	Elas(Hz) = 772.493	Dmp(Hz) = 727.507	Tot(Hz) = 1500	Tim (h) = 0.796045	N_elas(M#) = 2.21378
T(um) = 0.75	I (uA) = 0.824465	Elas(Hz) = 840.428	Dmp(Hz) = 659.572	Tot(Hz) = 1500	Tim (h) = 0.774097	N_elas(M#) = 2.34206
T(um) = 0.87	I (uA) = 0.756636	Elas(Hz) = 894.692	Dmp(Hz) = 605.308	Tot(Hz) = 1500	Tim (h) = 0.766438	N_elas(M#) = 2.46861
T(um) = 1	I (uA) = 0.694718	Elas(Hz) = 944.226	Dmp(Hz) = 555.774	Tot(Hz) = 1500	Tim (h) = 0.767667	N_elas(M#) = 2.60946
T(um) = 1	I (uA) = 0.694718	Elas(Hz) = 944.226	Dmp(Hz) = 555.774	Tot(Hz) = 1500	Tim (h) = 0.767667	N_elas(M#) = 2.60946

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