MOLLER Tasks List – Version 7 – May 14, 2018

Subsystem	Task	Description	Status	"Owner" (if more than one, primary contact designated by *)	Relation to Director's Review Report	Estimated Completion Date
Target	Window design	Optimization of wall thickness, mechanics	Silviu working on it	Silviu	Page 15: Recommendation: "Pursue a more realistic, detailed cell window design and check/refine with CFD."	
Target	Target Chamber	Cost-benefit analysis comparing the E158 chamber with one purpose-built for this target	Silviu working with JLab's target group	Silviu*, C. Keith	Page 16: Recommendation: "Perform a cost-benefit analysis for the target scattering chamber, comparing the E158 chamber with one purpose-built for the proposed MOLLER experiment."	
Detectors	Radiation hardness of detector components	Investigate which detector components need radiation testing and carry out 50 MRad test	Michael and Dustin devise a plan. Status: Initial list being established.	Dustin	Page 12: "…, all components in the scattered beam envelope should show negligible damage up to 50 MRad."	
Detectors	Main detector stand mechanical assembly	Engineering design of lightweight support structure to hold main integrating detectors	Enquire with SU if engineer Lou Buda is available? Not yet started.	KK	Page 12: "Mechanical design of the support systems for these detector elements is notional."	
Detectors	QC plan for main detector quartz	Devise plan to evaluate robustness of main detector quartz(Redundant with "radiation hardness of detector components")	Michael and Dustin to devise a plan? Not yet started.	Dustin	Page 12: Recommendation: "Conduct radiation damage tests to at least 50 MRad to qualify fused silica for use in the thin detector."	
Detectors	LG assembly event	Investigate the background from	SBU group: Nearly	KK	Not explicitly mentioned.	

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	signals.	particles moving through the light guide assembly. This combines simulations and beam tests of primarily scintillation and Cherenkov generation in the LG.	completed.			
Detectors	Quartz, PMT and LG assembly soft photon background signals.	This combines simulations and beam tests of soft photon background in the quartz detector assembly. This is the dominant detector background.	U. of Manitoba group working on this. Should have fist results soon.	Michael	Not explicitly mentioned.	
Detectors	Thin detector module geometric design and mechanical assembly design	Design of the thin quartz detector geometry and mechanical assembly, incorporating quartz, LG, and PMT	Advanced state of progress. We have a well tested suitable geometry (multiple prototypes have been tested with beam), but still need to decide on materials and structure of the mechanical assembly.	KK	Not explicitly mentioned.	
Detectors	Shower-Max module mechanical assembly design	This task incorporates the physical design and prototyping of the shower max detector, as well as the associated mechanical mounting structure.	Advanced state of first prototype design, including mechanical assembly.	Dustin	Not explicitly mentioned.	
Detectors	PMT base electronics	Develop PMT base design through multiple prototype cycles	Started to revise initial Mainz prototype.	Michael	Not explicitly mentioned.	
Detectors	Preamplifier design	Develop preamp design through multiple prototype cycles	Started to develop new preamp design, based on QWeak design.	Michael	Not explicitly mentioned.	
Detectors	Integrating ADC design	Develop the integrating ADCs for all integrating mode detectors in the experiment.	Operational design criteria have been established. Candidate ADC and FPGA	Michael	Not explicitly mentioned.	

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			chip/architecture have been identified. Initial discussion regarding readout architecture and protocol completed.			
Target/ Simulation	O-ring radiation load	Determine neutron and EM flux, and neutron dose at clamshell O-ring	Rakitha (LaTech) working on it. Expect results in one month (Rakitha Priority 1)	Rakitha	Page 15: Recommendation: "Calculate the radiation load on nearby scattering chamber components for the purpose of estimating the o-ring and vacuum pump and gauge lifetimes."	
Simulation/ General	Radiation impact	Irradiation from moves in and out of the beamline and during storage	Need to develop working FLUKA simulation and benchmark with remoll simulation. Simulation development on going, will take couple of months for first results. (Rakitha Priority 4)	Rakitha	Page 15: Recommendation: "It will be important to assess the effect of irradiated beamline components on the plans to move the experiment in and out of the beamline."	
Simulation/ General	Radiation impact	Optimize shielding for MOLLER apparatus	LaTech working on target region and SBU (Cameron) working on downstream shielding. Detector shielding has some dependence on this item Expect results in one month (Rakitha Priority 2)	Rakitha	Page 11: "Complete the shielding studies around the beam dump to ensure there is no excessive noise in the main MOLLER detectors."	
Spectrometer /Simulation	Material Irradiation/Activation	Quantify radiation load and activation of primary components	Rakitha (LaTech) working on it, Juliette will tabulate materials,components and	Juliette* ,Rakitha	Page 8: "An evaluation of material irradiation and activation vs experimental	

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			regions to be evaluated. Depends on complete FLUKA simulation to get this results. Simulation development on going, will take couple of months for first results. (Rakitha Priority 5)_		time needs to be developed so that a plan can be developed for access/handling."	
Spectrometer /Simulation	Radiation load on hybrid toroid nose	More careful evaluation of local radiation load to determine survival of epoxy	Rakitha (LaTech) working on it. Feedback from Juliette and MIT engineers on epoxy specification. Analysis on going and expect results in one month. (Rakitha Priority 3)	Juliette*,Rakitha	Page 9: Recommendation: "The potential effects of radiation damage on the epoxy-potted spectrometer magnet coils should be assessed."	
Simulation: 1	PMT double-differences	Using Qweak experience, evaluate upper limit to possible systematic from A_T in thin quartz and shower-max	UVa group has agreed to work on this over the next few months Dep: {4}	Ciprian*, Kent	Page 11: Recommendation: "Carry out full Monte-Carlo studies of the Mott-scattering in the full MOLLER geometry."	
Detectors: 2	Main detector geometries	Optimize the ring radial and azimuthal dimensions to optimize background asymmetry correction determination and systematic	UVa group working on this; Ciprian in process of reproducing Yuxiang's work; then start optimizing	Ciprian	Page 11: Recommendation: "Adjust the quartz detector segmentation to optimize the resolving power relative to the dominant backgrounds, …"	
Detectors/ Simulation: 3	Shower-max splashback	Estimate possible background in main detector PMTs from shower-max splashback	SBU undergraduate and graduate students will work on this Dep: {2}	KK*, student	Page 11: Recommendation: "Splashback from the Shower Max Detector should be simulated to see the impact on the Thin Dectector ring signals."	

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Detectors/ Simulation: 4	PMT backgrounds	A comprehensive estimate of all backgrounds at the main detector PMTs	Manitoba and SBU to improve these estimates; Sakib will work on this Dep: {2}	Juliette*, Sakib	Not explicitly mentioned.	
Detectors/ Simulation: 5	Detector Shielding Optimization	Figure out the configuration of heavy-Z and light-Z shielding required in front of and around the PMTs to minimize soft background	SBU will work on this after shielding geometry optimization is complete	KK*, Cameron	Not explicitly mentioned.	
Detectors/ Simulation: 6	Slit scattering background	A comprehensive note summarizing the elimination of all 1-bounce sources and the leading 2-bounce sources	To be assigned once further progress is made on other background tasks? Dep: {2,3,4; 5}	KK*, student	Not explicitly mentioned.	
Detectors/ Simulation: 7	Crosstalk evaluation	Evaluate impact on specific detector measurements of background from other detectors	Main source is lightguide background from primary flux. SBU undergraduate project Dep: {2,4}	KK*, student	Page 11: Recommendation: "Cross-talk between detector regions due to showering in the support structure of the Thin Detector should be simulated."	
General/ Simulation: 8	Radiative corrections for all physics processes	Incorporate radiative corrections for e-e and inelastic e-p scattering	Seamus and Yury to devise a plan of action	Seamus*, Yury	Page 4: "State-of-the-art radiative corrections should be included in the simulation of both "Moller" and "background" events,…"	
Pion/ Simulation: 9	Muon pair production	Muon pair production in the target might be significant for pion detector asymmetry measurements	Wouter is working on it; use MadGraph5 generator but need to translate generator output for remoll compatibility {No dependencies} (3 weeks) --experienced researcher project	Wouter	Page 11: Recommendation: "The impact of mu+mu- pair production in the target on the pion detector asymmetry measurements should be simulated."	

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Pion/ Simulation: 10	Beam dump background impact	beamdump backgrounds may affect some detectors	Pion group is looking at impact on pion detector Dep: {Implement hall A geometry based on PREx (Rakitha project—not listed)} (6 weeks) --undergrad project	Wouter	Page 11: Recommendation: "Simulations of the combined apparatus and hall are needed, for example, to assess backscattering backgrounds from the dump in the pion detectors."	
Simulation/ Pion: 11	Hyperon background estimation	Strategy to evaluate the hyperon background using the full suite of detectors	Pion and simulation groups should coordinate this task and build on Konrad's previous work Dep: {2, pion wall and shower-max geometry, 5, baseline pion det. design and implement Hyperon generator (new tasks –not listed)} (12 weeks) -- summer project	Wouter	Not explicitly mentioned.	
Simulation/ Tracking: 12	Optics Collimator for Q2	Simulated Q2 analysis and the use of tracking and special collimation	David and Seamus should devise a plan, building on Rupesh's previous work	Seamus*, David	Not explicitly mentioned.	
Target/ Tracking	Solid Targets	Determine the list of solid targets based on various physics requirements	David A. and Seamus to lead a group to study this?	Seamus*, David	Page 15: Recommendation: "Specify the number, location, and beam current requirements for all solid targets."	
Spectrometer	Tolerance analysis	Based on physics requirements to control systematics	Juliette working on it	Juliette	Page 8: "A systematic study of possible tolerance requirements needs to be developed, …" (related to recommendation on page 10; "sensitivity analysis"	

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Spectrometer	Impact of environmental variations	Evaluate potential variation in performance and impact on physics requirements over time	Juliette and MIT to strategize and evaluate?	Juliette	Not explicitly mentioned.	
Spectrometer /General	Floor loading	Map of floor loading to evaluate possible impact on physics performance	MIT to collaborate with JLab engineering?	Juliette	Page 9: "…a"baseline" layout is needed that is compatible with existing floor loading…"	
Tracking/ General	Downstream beamline and supports	Mechanical design of downstream beamline satisfying physics requirements	Sandesh (designer) working on it, important input for 1-bounce evaluation	David, KK*	Not explicitly mentioned.	
Polarized Beam/ Detectors	Large Angle Monitors	Based on Qweak experience, devise locations for monitoring background asymmetries	Mark has agreed to run a taskforce for this	Mark*, Kent	Not explicitly mentioned.	
Polarized Beam/ Detectors	New Pockels cell	Test the new (RTP) Pockels cell and extract polarized beam.	This is in progress by UVa group and lab.	Kent*	Page 7: Recommendation: "Test the new Pockels cell and extract polarized electron beam."	
Polarized Beam/ Detectors	BCM noise level	Demonstrate the noise level of the beam monitors in combination. In particular, continue to investigate the sources of noise in the BCMs including, but not limited to, that from the local oscillator.	Parts of this already being addressed by PREX/CREX preparations. Remaining needs for higher frequency data-taking to be evaluated.	Mark*, Kent	Page 7: Recommendation: "Demonstrate the noise level of the beam monitors in combination. In particular, continue to investigate the sources of noise in the BCMs including, but not limited to, that from the local oscillator."	
Polarized Beam/ Monitoring	Beam disperson	Is dispersion on target a problem for the design?	Mark and Kent to understand question and strategize.	Mark*, Kent	Page 11: Recommendation: "A specification for allowable residual dispersion at the target should be determined."	

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General	Staged running plan	Strategy for multiple year runs with assembly/disassembly	KK, Mark and Kent will review plan	Mark, KK*	Page 6: Recommendation: "A run-plan that addresses the interleaving of counting and flux measurement modes and (other) needs for data dedicated to systematic uncertainties should be developed.	
General/ Spectrometer	Fringe field impact	Evaluate possible background from fringe fields in the primary beam path	Juliette working on this, will involve Jay when appropriate	Juliette	Page 11: Recommendation: "The specification for alignment and symmetrization of the spectrometer coils should include clean transport of nearly 1 MW of the main beam along the beamline."	
General	2-loop theory calculation	Evaluate systematic error in theory prediction	KK to work with theorists to evaluate status and plan	KK	Page 6: Recommendation: "We recommend that the relevant two-loop calculations be completed within the next three years."	
Tracking/ General	Mechanics of GEM tracker assembly	Engineering input for GEM "wheel" and rotation assembly and remote control	Will need engineering/designer input, KK to chase	David*,KK	Not explicitly mentioned.	
General	Implications of Qweak final achieved errors	Evaluate the implications of the Qweak achieved errors for the MOLLER projected errors	Mark and David will review and develop a report in consultation with others as needed	Mark*, David	Suggested to be added by lab management.	
Spectrometer	Prototype coil testing			TBD	Suggested to be added by lab management.	
Simulation	Beam dump	Estimate impact of Hall A beam	Task will be discussed at	TBD: Simulation group	Suggested to be added by	

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	background estimate and shielding requirements	dump modifications on MOLLER and determine any related shielding requirements	an upcoming simulation meeting.		lab management. Page 11: Recommendation: "Complete the shielding studies around the beam dump to ensure there is no excessive noise in the main MOLLER electronics.	
General	Rapid online analysis	Develop plan for rapid online analysis including dithering corrections	Initial discussions were done in Dec. 1, 2017 teleconference convened by Paul King	Paul K.	Page 7: Recommendation: "Rapid analysis feedback should be pursued to ensure the level of near-publication quality results…"	
General	Technical risk assessment	Develop a technical risk assessment for achieving the stat/syst. error goals	Initial work done for director's review close-out; need to complete	Mark*, Juliette	Page 6: Recommendation: "The technical risk assessment, using accepted technological readiness levels, for reaching the stated statistical and systematic uncertainties should be completed.	
Polarized Beam	Required Beam Asymmetries	Develop document that details how we evolve from the nominal 12 GeV beam parity table to our goals	Need to organize; suggested at Mar. 28, 2018 teleconference	Kent*, Mark		
Spectrometer	Multi-loop spectrometer option	Document the pros and cons of this option for the spectrometer	Need to organize; suggested at Mar. 28, 2018 teleconference	Juliette		
Spectrometer /Simulation	Air/vacuum simulation studies	Determine impact of air (or helium) vs. vacuum in charged particle transport		Ciprian		