

# Summary of Recommendations from Magnet Advisory Group Meetings

Collated by Juliette Mammei on behalf of the group members

## **Executive Summary**

A series of informal magnet reviews was hosted by Jefferson Lab in order to guide the pre-conceptual design of the MOLLER spectrometer. No official reports were produced as a result of these meetings; feedback was provided to the Spectrometer Group during the teleconferences or via email following the meetings. A summary of the main points from the group members for each of the review is given here. The timeline of Magnet Advisory Group meetings and other spectrometer-relevant reviews is given in Appendix A. The group membership for each of the reviews is provided in Appendix B.

Special thanks is given to the MIT-Bates engineers Jim Kelsey, Ernie Ihloff, and Jason Bessuille for their help in preparing for these reviews.

## **2010 External Magnet Advisory Group Summary of Recommendations**

- don't decrease the bend radius to less than 5 times the conductor size because of back flow, eddies, and oxide build up; could result in clogging
- too many water connections to put the magnet inside the vacuum chamber - fewer turns and larger conductor
- out of plane bends will be very hard to manufacture to tight tolerances
- present the needed fields, space constraints etc. in a better way
- analyze the magnetic forces on the coils
- geometry is complicated – can separate magnets be used?
- Thermal stresses could damage insulation
- Use iron in the coils to increase the field

## **2013 External Magnet Advisory Group Summary of Recommendations**

Liked the larger conductor size, water-cooling hole, and simpler design (fewer out of plane bends)

- Water cooling needs to be addressed (extra chiller, more LCW)
- Power supply – think about how the will hybrid be powered (we have)
- Coil construction
  - No splicing
  - Deep pockets for brazing water connections

- Support it to be moved easily (assumed in the design)
- Will be labor intensive and time consuming (we assume this)
- Multiple magnets (not enough space for separate supports and water/electrical connections)
- Optics
  - Target windows (part of background, will be included in final optimization)
  - Optimized (not 100% yet)
- Forces
  - Iron may reduce the forces (not high priority right now – not a huge win)
  - Coil failure scenarios (provided to Jason)
- Cost analysis
  - Design all parameters of magnet system
  - Compare costs for long coils vs. multiple short coils (including tooling). Consider capital costs and operating expenses.

### **2015 External Magnet Advisory Group Summary of Recommendations**

The External Advisory Group members were impressed by the maturation of the design since the 2013 Magnet Advisory Group meeting, and were happy with the changes we made to address their previous concerns.

New concerns raised by the committee:

- Buckling of the vacuum box
- Cooling and length changes in the coils and supports
- Electrical failure of multiple coils (instead of just one)
- Possibility of multiple magnets to replace hybrid

### **2016 External Magnet Advisory Group Summary of Recommendations**

Prototype tests would allow some of the engineering and fabrication concerns to be addressed and it will really help with the definition of the cost and schedule for the toroid

- Try to find a multi-segment magnet that doesn't compromise the optics
  - need to show that hybrid mitigates risk more than segmented
  - start with what fits in the Hall, then show what the experiment must compromise
- Consider eliminating the negative bend
- Want to see more about the issues and solutions for the coil supports
- can mitigate Bz spikes with ferromagnets (note: optics changes because of changes in position along beamline, not stray fields )
- Beam steering - Jay - pivot check that it is less than ~10 G, also look at G4.10.2 paper on Arxiv about e- scattering
- larger conductor
  - full ANSYS with deflections
  - Check shrinkage of coils; shear stress on epoxy (different power supplies) - probably not an issue
- vacuum chamber

- buckling of vacuum chamber not an issue (~several times safety factor)
- need to model manufacturing defects
- also reversing chamber and having everything attached to bottom will be investigated

## Appendix A – Timeline for relevant Reviews

- Director’s Review – *January 2010*
- **Advisory Group Meeting – August 2010**
- Supergroup Meeting – *June 2012*
- **Advisory Group Meeting – October 2013**
- DOE Science Review – *September 2014*
- **Advisory Group Meeting – July 2015**
- JLAB Technical Review – *Fall 2015*
- **Advisory Group Meeting – October 2016**
- Director’s Review – December 2016

## Appendix B – Advisory Group Membership

### Advisory Group Meeting – *August 2010*

George Clark (TRIUMF)  
 Ernie Ihloff (MIT-Bates)  
 Vladimir Kashikhin (Fermilab)  
 Jim Kelsey (MIT-Bates)  
 Dieter Walz (SLAC)  
 Robin Wines (JLab)

### Advisory Group Meeting – *October 2013*

Dieter Walz (SLAC)  
 George Clark (TRIUMF)  
 Vladimir Kashikhin (Fermilab)  
 Steve Williamson (University of Illinois)

### Advisory Group Meeting – *July 2015*

#### External

Dieter Walz (SLAC)  
 George Clark (TRIUMF)  
 Vladimir Kashikhin (Fermilab)  
 Steve Williamson (University of Illinois)

#### Internal

Robin Wines (JLAB)  
 Al Gavalya (JLAB)  
 Jay Benesch (JLAB)  
 Roger Carlini (JLAB)  
 Stanley Kowalksi (MIT)

Kent Paschke (UVA)

Advisory Group Meeting – *October 2016*

External

Dieter Walz (SLAC)  
Vladimir Kashikhin (Fermilab)  
Steve Williamson (University of Illinois)  
Jay Benesch (JLAB)

Internal

Robin Wines (JLAB)  
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