Moller Coil Design iteration **Ernie Ihloff**

.460 Square x .225 Hole version **15 Jan 2015**

Introduction: The baseline design for the Jefferson Lab Moller Hybrid coil has previously used a smaller 5.8mm conductor. For the latest iteration, a 11.7 mm (.46") square conductor with a 6.5mm (.255") hole is used. The same numbers of NI (turns times current) is used as well as outside coil dimensions. The goal of this iteration is to limit the water connections, simplify the coil winding and still retain the same NI used in the particle tracking calculations.

I am going to break the coils into four cross sectional areas labeled A-A, B-B, C-C, D-D. Section A-A is nearest the target and D-D is nearest the detector. I am using NI from page 19 of the Moller Experiment document.

General Conductor parameters:

Conductor size	11.7mm (.460") square	Cooling hole=6.5mm (.255")
Conductor cross section	98.6 square mm	.1529 square inches
Hole cross section	32.9 square mm	.051 square inches
Resistance		53.25 ohm/ft x 10E-6
Weight		.59 lbs/ft
Maximum Current density - J	19.6 amps/square mm	12,700 amps/square inch

Winding details:

Coil Area	Total NI	Coil NI	Turns/Amps	Power	Water flow/deltaT
A-A	7,750	7,750	4/1,938 amps	40 kW	5 gpm/30C
B-B	10,600	2,850	2/1,425 amps	10 kW	2 gpm/19C
C-C	16,860	6,260	4/1,565 amps	19.6 kW	3 gpm/25C
D-D	29,160	12,300	10/1,230 amp	25 kW	3 gpm/31.5C

Total power and water:

Total power per coil set & hybrid	94.6 kW	663 kW per total - 7 coils
Water flow per coil & hybrid	13 gpm	Use 100 gpm
Average bulk delta T coil & hybrid	27.5 C	same

Pressure drop and Velocity in coils:

A-A	B-B	C-C	D-D
243 psi (for 2 paths) (not great)	48 psi	80 psi	150 psi
15.7 ft/s (4.8 m/s)	6.3 ft/s (2 m/s)	9.5 ft/s (2.9 m/s)	9.5 ft/s (2.9 m/s)

Summary:

This approach uses larger conductors that have less turns but achieve the same NI as the baseline design. This also assumes 4 separate power supplies that power 7 coils each.

These are outstanding questions to continue with:

- Clean up calculations and write proper design document that can we widely shared
- Have the magnet advisiory committee review latest iteration
- Contact prior and new vendors and secure solid budgetary estimates
- Continue designing of coil cooling and power connections
- Integrate a proper coil support into the present coil based on Vendor prior feedback.
- Purchase or get test samples of insulation
- Possibly build a small short length prototype to test mechanical properties.
- Engineer a solution to devide up the flow paths into more parrellel paths on A-A