

To: Thia Keppel, Hall A Leader

From: Krishna Kumar, Bob Michaels, Kent Paschke, Mark Pitt, Paul Souder, representing the Hall A MOLLER Collaboration

Re: Near-term Hall A Beamline Instrumentation for MOLLER Development

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The MOLLER experiment will require that the electron beam properties (position, angle, intensity, and energy) be monitored with improved precision and increased redundancy to achieve its precision goals in correcting for helicity-correlated beam properties. We can make progress on these issues during the early parity experiments in Hall A and parasitically with other experiments if these pieces of hardware are installed on the beamline:

1. Three XYQ microwave cavity monitor assemblies in non-dispersive region

- These all exist (one is in the Hall A arc, while the other two have been used in Hall A before).
- Ideally, they would all be installed in the non-dispersive region downstream of the Hall A arc (two have been used there in the past). If space constraints prevent this, then - for this initial testing - two could be in the Hall (where they have been used in the past), while the third could be upstream of the Hall A arc in the non-dispersive region.
- The motivation for this request is to allow a definitive determination of the beam position measurement resolution of the cavity monitors. Three identical monitors are required for this determination. It is likely that the cavity monitor technology will be needed in order to achieve the MOLLER goal of 3 μm position resolution for 1 kHz pairs. Once this definitive measurement is made, we can assess if further improvements are needed in either the cavity hardware (ie. copper plated cavities instead of stainless steel for higher Q and signal output) or improved frontend electronics.

2. A "triplet" of cavity charge monitors located wherever convenient

- These would be three of the conventional stainless steel TM₀₁₀ cavity charge monitors (BCMs) mounted in the XYQ type "box", similar to what was done for Qweak in Hall C
- There are two motivations for this request. The first is to provide a large redundancy of charge monitors (these three in addition to the two existing BCMs and the three BCMs associated with the XYQ cavity assemblies) to definitively determine the beam charge measurement resolution. Significant improvements are needed in this area to achieve the MOLLER goal of 10 ppm for 1 kHz pairs. The second motivation is to provide a self-

contained set of nearby BCMs to study the position dependence of the charge measurement (studying this effect with widely separated BCMs is compromised by the presence of apertures that introduce the additional effect of clipping.)

3. XYQ cavity monitor assembly in the dispersive region

- This assembly would be located at the most dispersive point possible in the Hall A beamline (without displacing the existing energy measurement stripline BPM). A possible candidate for this is the XYQ cavity assembly that was part of the G0/Qweak girder that presumably won't be needed in Hall C.
- The motivation for this is to have a redundant measurement of the relative ("parity window to parity window") beam energy changes (in addition to the usual stripline BPM measurement). This has not been done before for the previous JLAB parity experiments, but this level of redundancy will likely be necessary to achieve the MOLLER goals.

In addition, we will need support for the frontend electronics associated with these pieces of hardware. For both types of monitors, frontend electronics exists to use as a starting point. But since we anticipate improvements may be needed, we will likely need consultation and support from the JLAB RF group, similar to the support that has been provided for previous cavity monitor development efforts for the parity experiments.