GlueX FDC Work Short Term Plans – 2009

November 16, 2009– v3.1
(File: fdc_work.tex)

In order to better understand where we are in completing this list of goals, the following key is being used:

√	– Work completed.	(116)
X	– Work partially completed or in progress.	(30)
☐	– Work not begun.	(9)

• Circuit Boards

√ 1). Find manufacturer who can make single or double piece STB and HVTB boards.

√ 2). Finalize plans for HV segmentation.

√ 3). Develop scheme for HV attachment via baby cables to HVTB boards.

√ 4). Finalize the number and placement of the preamp board connectors.

√ 5). Finalize the ground plane layouts on the STBs and HVTBs.

√ 6). Finalize capacitor HV-rating choice.

√ 7). Finalize STB layout.

√ 8). Finalize HVTB layout.

√ 9). Complete STB circuit board drawings.

√ 10). Complete HVTB circuit board drawings.

- [x] 11). Procure circuit boards for the full-scale prototype.
- [x] 12). Develop QA test plan for circuit board certification.
- [x] 13). Carry out QA test plan on all circuit boards.

• Wire Frames

- [x] 14). Complete FEA on the final composite wire plane design.
- [x] 15). Plan out STB and HVTB lamination and alignment procedure.
- [x] 16). Complete contract with IUCF for Phase 1 and Phase 2 wire winding.
- [x] 17). Complete specification/tolerance document for the wire frames.
- [x] 18). Design full-scale composite wire frames.
- [x] 19). Construct prototype composite wire frames.
- [x] 20). Complete load test on composite wire frames.
- [x] 21). Decide if composite wire frames will represent our nominal design choice.
- [x] 22). Construct full-scale wire frames for test wind studies.
- [x] 23). Complete test winds up of to 3 composite wire frames (Phase 1a).
- [x] 24). Complete test winds of 1 additional composite wire frame (Phase 1b).
- [x] 25). Work with winding folks to make final decisions for FDC wire winding.
- [x] 26). Develop wire frame construction manual.

- [x] 27). Construct full-scale prototype wire frames.
- [x] 28). Complete winding of all full-scale prototype wire frames (Phase 2).
- [x] 29). Review tension and wire placement data for full-scale prototype planes.
- [x] 30). Document IUCF wire winding facility.
- [x] 31). Design and fabricate protective cover for the wire frames.
- [x] 32). Complete Phase 2 circuit board stuffing and clean boards.

• Cathode Boards

- [x] 33). Complete specification/tolerance document for the cathode frames.
- [x] 34). Talk to manufacturers about defects and flatness tolerances of our cathode planes.
- [x] 35). Find manufacturer who can make cathode boards with 2-μm copper thickness.
- [x] 36). Finalize design of strip layout in central portion of cathode board.
- [x] 37). Make final decision on the cathode strip pitch and strip gap.
- [x] 38). Complete preliminary layout of cathode circuit boards.
- [x] 39). Finalize the design for the cathode board panel construction.
- [x] 40). Complete cathode panel bond strength studies.
- [x] 41). Finalize cathode board in-situ tensioning and measuring system.
- [x] 42). Finalize tension choice for cathode boards.

- [x] 43). Develop non-contact flatness measuring system.
- [x] 44). Measure surface flatness of prototype cathode boards.
- [x] 45). Complete first part of cathode order.
- [x] 46). Develop electrical QA test plan for cathode boards.
- [x] 47). Carry out QA test plan for initial cathode board order.
- [x] 48). Measure cathode board strip distortions at the nominal tension on the sample cathode board.
- [ ] 49). Complete finite element analysis modeling of cathode strip distortions at the nominal tension.
- [x] 50). Modify cathode board design as necessary to account for board tension distortions.
- [x] 51). Finalize clearance about through-holes on cathode board due to tension distortions and update design drawings.
- [x] 52). Model gas flow through cathode frame to provide uniform gas distribution on both sides of the cathode planes.
- [x] 53). Finalize gas hole design (number of holes and position) in cathode frame.
- [x] 54). Complete order for remainder of full-scale prototype cathode boards.
- [x] 55). Complete QA test plan on remainder of full-scale prototype cathode boards.
- [x] 56). Finalize ground plane design between cathode planes.
- [x] 57). Develop and test the connections from the ground planes to the external ground.
- [x] 58). Decide on how to attach preamp board connectors to circuit board/frame.
- [x] 59). Prototype preamp board connection scheme to cathodes.

- [x] 60). Prepare mechanical prototype of space between neighboring cathodes to ensure there is room for making board and cable connections.
- [x] 61). Develop ground connection scheme to cathode boards.
- [x] 62). Develop cathode frame construction manual.
- [x] 63). Finalize Rohacell foam thickness in the frame.
- [x] 64). Make final decision on cathode board conductor strip thickness.
- [x] 65). Develop cathode board handling procedures.
- [x] 66). Construct complete mechanical prototype of cathode board sandwich.
- [x] 67). Modify cathode frame design based on feedback from mechanical prototype construction and studies.
- [x] 68). Finalize design and test cathode board edge cutting system.
- [x] 69). Cut cathode board edges.
- [x] 70). Construct cathode board using 5-μm Cu boards from Allflex.
- [x] 71). Construct the cathode frames and sandwiches for the full-scale prototype.
- [x] 72). Measure surface flatness of constructed cathodes.
- [ ] 73). Develop system for measuring position of strip edges for full-scale tensioned planes with 2-μm and 5-μm Cu boards.
- [ ] 74). Measure strip line edges for full-scale prototype cathode boards.
- [x] 75). Calculate and measure cathode surface deflections as a function of the applied electric fields.
- [x] 76). Procure sample of rigid-flex assemblies.

- ✓ 77). Perform QA checkout of rigid-flex assemblies.
- ✓ 78). Finalize design of rigid-flex assemblies.
- ✓ 79). Procure final set of rigid-flex assemblies for full-scale prototype.
- ✓ 80). Perform QA checkout of final set of rigid-flex assemblies.

• Preamp Boards

- ✓ 81). Finalize layout of preamp boards.
- ✓ 82). Perform final thermal simulations of preamp board with final ASIC design.
- ✓ 83). Develop preamp board QA testing plan and testing station.
- ✓ 84). Mount ASICs on prototype preamp board.
- *X* 85). Develop temperature and humidity monitoring system.
- ✓ 86). Finalize connector choices for the cathode and wire plane boards.

• General

- *X* 87). Develop cable support system outside the solenoid magnet.
- *X* 88). Develop cable support system inside the solenoid magnet.
- *X* 89). Develop mechanical prototype for cable support assemblies and finalize design.
- ✓ 90). Finalize gas inlet/outlet ports and on-chamber gas distribution system.
- ✓ 91). Prototype gas port system design.

- [√] 92). Complete design of cathode-wire frame spacer.
- [√] 93). Complete construction of cathode-wire frame spacers for the full-scale prototype.
- [X] 94). Develop rail and mounting attachments with minimal material.
- [X] 95). Complete FDC assembly drawings of nominal design.
- [√] 96). Finalize choice of signal cables to be used for anodes and cathodes.
- [√] 97). Study modifications to cables to reduce material in the active area.
- [X] 98). Finalize FDC drawing packages and sign all drawings.
- [ ] 99). How to protect the FDC packages from target failure?

• Assembly

- [√] 100). Develop the compression-tube design for the chamber package assembly.
- [X] 101). Develop FDC package assembly plans.
- [X] 102). Develop FDC system inter-alignment system.
- [√] 103). Finalize plans for HV attachment to high voltage boards.
- [X] 104). Finalize local package HV distribution scheme.
- [ ] 105). Finalize and test the cable packing scheme.
- [X] 106). Finalize the design of the FDC exoskeleton.
- [X] 107). Design the dry-air system for the chambers.
- [X] 108). Finalize the cable strain-relief plans.

- [X] 109). Make final plans for how chamber will be sighted and what external fiducials will be included.

• Electronics

- [√] 110). Measure strip-to-strip capacitance of cathode boards.
- [√] 111). Develop plans for low voltage distribution.
- [√] 112). Work to specify pulser system requirements for the flash ADCs and the TDCs.
- [√] 113). Specify the component tolerances on the preamp boards from the standpoint of strip-to-strip calibration accuracy.
- [√] 114). Develop the pulser calibration scheme for the preamp boards.
- [√] 115). Design and test the electronics cooling system.
- [√] 116). Work with U. Penn to develop the design criteria for the ASIC version with the adjustable gain and the discriminators.
- [√] 117). Specify the component tolerances on the ASICS.

• Gas

- [√] 118). Perform literature search of cathode chamber gas mixtures.
- [√] 119). Study small-scale prototype chamber performance with various gas mixtures.
- [X] 120). Decide on the gas flow rate.
- [X] 121). Finalize the design of the gas handling system.
- [√] 122). Decide on what the gas volume of the FDC will be.

- [X] 123). Decide on the final chamber gas mixture.
- [ ] 124). Study aging issues with the gas mixture finalists.
- [X] 125). Design local package FDC gas distribution system.

• Small-Scale Prototype

- [√] 126). Measure signal-to-noise levels with the $\pm 75^{\circ}$ cathodes and verify resolution calculations.
- [X] 127). Calibrate the time-to-distance relation of the wire plane with external tracks defined by the cosmic ray chambers.
- [X] 128). Quantify resolution in the wire plane.
- [√] 129). Test chamber with ASIC preamplifiers and preamp boards.
- [√] 130). Quantify ASIC dynamic range for cathodes and anodes.
- [X] 131). Calibrate scintillator hodoscope in test setup.
- [X] 132). Calibrate time-to-distance relation of cosmic ray chambers.
- [√] 133). Set up hodoscope scintillators to be in the test setup trigger.
- [X] 134). Study alcohol content in the cosmic ray chambers to optimize chamber resolution and signal-to-noise ratio.
- [√] 135). Scale up the number of chambers in the cosmic ray chamber readout in order to allow for studies of resolution vs. angle in FDC prototype chamber.
- [X] 136). Complete software for charged particle tracking – both hit-based and time-based.
- [ ] 137). Measure resolution of FDC prototype vs. track incidence angle.

☐ 138). Study the anode signal from cross talk when pulsing the cathode preamp boards.

☐ 139). Study the cathode signal from cross talk when pulsing the cathode preamp boards.

• Magnetic Field Studies

☑ √ 140). Talk to external cathode chamber experts about Lorentz angle issues.

☑ √ 141). Perform literature search for cathode chamber performance in magnetic fields.

☑ √ 142). Find a suitable test magnet and arrange for FDC chamber test.

☑ √ 143). Develop a complete test plan for the magnetic field studies.

☑ √ 144). Perform magnetic field tests.

☒ *X* 145). Analyze magnetic field test data.

☒ *X* 146). Make FDC design decisions based on magnetic field study results.

☐ 147). Produce report on details of studies and conclusions made regarding the FDC design.

• Monte Carlo

☑ √ 148). What is the required position resolution of the FDC system?

☑ √ 149). What is the required angular resolution required from the FDC system?

☑ √ 150). What is the maximum material thickness that can be employed in the active area to achieve our desired momentum resolution?

☑ √ 151). Quantify effect of the inactive annulus on the BCAL and TOF performance?

- [X] 152). What is the required number of FDC packages?
- [X] 153). What is the required number of chamber layers per package?
- [X] 154). What are the optimal z-locations of the different chamber packages?
- [X] 155). What is the size of the beam hole for cathodes and wire deadening vs. z?
- [√] 156). What is the optimal layout/orientation of the wire planes to resolve the tracks locally (i.e. within a single package)?
