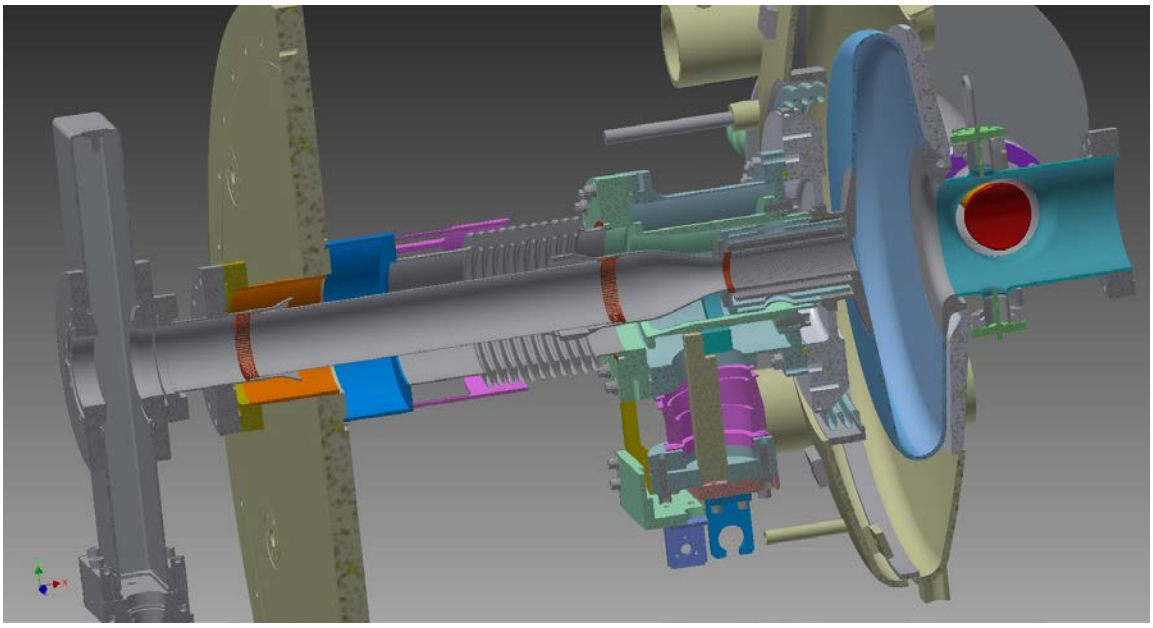
Note_4 09/24/2015 (KSS)

1) Reminder – LEReC website found here: http://www.c-ad.bnl.gov/esfd/LE_RHICeCooling_Project/LEReC.htm.
2) Discussion focused on three primary topics:
    a. The tapered beam pipe insert to replace the cathode assembly.
    b. The 18mm FPC withdrawal.
    c. New discussions on how to handle the downstream transition and HOM damper.
3) Tapered beam pipe insert:
    a. Showed latest update on proposed tapered beam pipe insert., shown here and available on the LEReC website:



    b. Much discussion on details:
        i. Much talk on Cu plating inside of beam pipe all the way back to the DC gun.
        ii. Need a thermal analysis of the heat load from the insert into the 2K cryo.
            1. General thought is that it should be low given the low thermal conductivity of the thin wall insert and the RF finger contacts.
            2. The surrounding structure is relatively cold given that the green flange has a 5K intercept.
        iii. The right side tapered part of the insert is physically part of a modified cathode structure.
            1. Clamps in place using existing clamp mechanism.
            2. RF seal to Nb pipe still TBD.
                a. SB confident on getting appropriate yield in the seal at clamping given known survey data of the existing structure.
        iv. Central straight insert is thin wall SS(type?).
            1. Relies on RF spring fingers for contact upstream and downstream.
                a. Need for give/yield is driven by a ~0.100” centerline misalignment from upstream flange to Nb pipe.
                b. Some concerns expressed even about impedance of fingers, should they be shorter, etc.
        v. Left side insert and flange assembly are new.
        vi. Discussion about how the actual insertion process would go.
        vii. Need an RF analysis (impedance/wakefield) of the proposed structure.
            1. Peter T. is swamped and cannot do it.
            2. KSS and Wencan discussion options.
    c. At this stage, the overall design concept seems pretty solid.
        i. Final discussion at next meeting to decide if Scott can go ahead and start purchasing parts for a prototype.

1. Important for working out the final design details.

4) FPC withdrawal:
    a. Scott showed a picture illustrating that the withdrawn FPC brings the pringle edge closer to the FPC O.C. than it used to be.
    b. Wencan noted that the proposed location of the 18mm spacer will introduce an impedance discontinuity in the FPC coax structure.
        i. Location is good because it avoids a complete teardown of the cryostat.
    c. Wencan will do an analysis of the impedance discontinuity and the RF fields at the new pringle tip location to see if there are any real concerns.
5) Downstream transition and HOM Damper.
    a. This was a new topic not previously discussed.
        i. Good that we broaden our view to be sure we don't miss anything.
    b. Need two things downstream:
        i. Transition from large diameter of cavity beam pipe to smaller diameter beamline.
        ii. HOM damper.
        iii. Both of these potentially impact s coordinate of the 2.1 GHz linearizer.
    c. Two HOM damper proposals:
        i. Use an existing 5-cell water cooled ferrite damper.
            1. Should be the right ID for use at the gun cavity downstream end.
            2. On the surface, would seem to involve the least amount of effort and time. TBD after more study.
        ii. Wencan proposed an elegant solution that covers HOM damping and the transition to smaller diameter beamline.
            1. A beampipe insert forming a coax line with the existing large diameter beam pipe.
                a. This shields the two bellows in the existing structure.
                b. The coax line provides an HOM path to some sort (TBD) of ferrite absorber, which is now also shielded by the new insert (the coax center conductor).
                c. Downstream end provides the taper down to the required ID (2.38" ?).
        iii. Wencan's solution requires careful analysis and design of an entirely new structure, so it is "costly" in that sense. But it also provides probably the shortest (in s) option which is good for the 2.1 GHz.
            1. Jorg says the location of the 2.1 GHz is not terribly critical tho.
    d. Wencan will start an analysis when time permits.
    e. Discussion tabled for future meeting.

Note_3 09/08/2015 (KSS)

1) Scott
    a. Discussed option of an off the shelf spacer which would add 5mm.
        i. Elected to go with custom spacer at Wencan's 18mm.
    b. Discussions on need for a special Cu conflate gasket.
        i. Do we need to worry about small gap/step in FPC outer conductor if we go with a standard conflat gasket.
            1. Ask Wencan to look at a simulation.
    c. KSS raised questions about cooling w.r.t. to coupling mechanical vibration into cavity.
        i. At ERL, we see large impulsive disturbances thought to be from FPC water hammer.
        ii. Will test at low power with limited flow to see if it makes a difference.
        iii. What is dissipation in FPCs at 50kW each?
    d. Long discussion of Scott's beam tube insert concept.
        i. Scott presented a very good first concept.
        ii. Will continue developing solution based on input from meeting.
        iii. Question raised by Dima and Alexei about need for insert at all.
            1. Sounds like a bad idea to not have the insert.
            2. Will ask Peter T. to look at wakefield simulations with and without.
        iv. Alleviate trapped volume in choke structure for final design.
        v. Move funnel closer to Nb beam pipe side (cavity side).
        vi. Important note that there's a ~0.1" offset between center lines of cavity Nb beam tube and the large diameter beam pipe / cuff at the flange end of the structure.
        vii. Need an estimate of bunch RF heating of insert, Cu gasket.
            1. Seems likely to be small.
        viii. Need estimate of heat leak from room temp side thru beam pipe insert to cavity.
            1. Insert will likely be thin walled stainless.
            2. Is an intercept needed? If so, where to put it?
        ix. Large diameter end of funnel insert mate with flange/cuff
            1. Initial concept uses longitudinal slots in insert to provide some sort of RF finger type joint between insert and cuff.
            2. Scott will continue developing idea.
    e. "Orientation" of cryostat/gun raised again.
        i. Last meeting we settled on "normal" ERL orientation, i.e.
            1. DC Gun => Cathode Insert => Cavity => FPC.
            2. Keeps FPC on high energy side of cavity.
            3. Beam pipe insert and Nb beam pipe were not seen to be limiting apertures.
        ii. Aperture remains all important.
            1. Need Jorg to provide a map of the beamline from DC Gun thru the Gun cavity.
                a. Show aperture, transverse envelope for largest amplitude and rms amplitude particles.
                b. S coordinate in meters.
                c. Label things.
    f. Gary will start process of ordering two new FPCs.
    g. Next meeting in two weeks. Likely 09/22.

Notes_2 09/08/2015 (KSS)

Sadly, I did not type up notes from Meeting 2 in a timely fashion. Here's my late transcription, subject to standard memory loss problems.

1) Wencan
    a. Need to verify that for the 18mm retracted FPC design, the gap between the pringle and the ID of the FPC outer conductor is sufficient for design field.
        i. Expect it to be so given unmodified geometry, but …
    b. Important to remember that the FPC windows are BeCu.
2) Scott
    a. Starting on basic design drawings for FPC and cathode insert modifications.
3) General schedule notes
    a. Expect beam commissioning at LEReC to start March 2018.
    b. Allow 6 months for system commissioning prior to that.
    c. Gary showed a first pass shot at a schedule which has been emailed to all.
4) HTSS
    a. Relevant to (3) as "fixing" it would take something akin to 4 months.
    b. Jorg stated that we do not need the HTSS for beam dynamics, so decision is to forgo the fix.
    c. Other modifications can be done with cryostat in place in the ERL cave.
        i. Big benefit in time and ability to test modifications.
5) FPCs
    a. Reminder that one FPC had a vacuum leak which was spray sealed.
        i. Suspicion that cause is a bad braze, or rather a braze joint with flux eating away at it.
        ii. Can't rely on that for LEReC ops.
        iii. Decided to order two new FPCs, then we have two plus a spare.
6) Wakefields from grooves on the ID of the Nb beam pipe are not thought to be a problem.

Follow up requests for the Tue 09/01/2015 meeting:

Sorry for the late e-mail. See below. This is basically a follow up to the bullet list I sent out after the kickoff meeting. To the degree possible (I realize some of things I listed will take time), if everyone involved could have the relevant materials at hand tomorrow it will help move our discussions along.

Note: "Have available" means be able to show on the projector.

Thanks.

KSS

1) Jorg
    a. Have available drawings / diagrams of the latest proposed LEReC beamline layout.
    b. Have available optics simulations for (1.a) with beta functions and relevant dispersion / bunch compression params.
2) Wencan
    a. Have available the analysis you sent re: FPC Qext modification.
        i. Nominal result from Wencan's simulation: Withdraw FPCs by 18mm.
    b. Need detailed drawings of FPC and cavity / cryostat mechanicals.
    c. Analysis of required cooling for max Phase II RF power.
3) Mike Blaskiewicz
    a. Wakefield basic result from MMB:

"Hello All, CJ gave me the specs for the ridges in the choke section and I calculated the wakes. For 100 pC and rms length 1 cm the longitudinal voltage. Looks like the derivative of the bunch shape with a peak value of 15 volts. This seems quite small to me but my intuition is not good here.—Mike"

b. Q: Who has primary responsibility for formal wakefield simulations via MWS-PS?
    i. Who's doing them for the beamline overall?

4) Joe
    a. Will someone have available both cartoons and detailed dimensioned drawings of the existing gun / choke structure and current proposed modifications?
    b. See also (2.b) above.
    c. Since we're considering a solution involving a pipe insert relying on a compression RF seal to the existing Nb "pipe" on the gun cavity:
        i. Who will verify that the innermost Nb "pipe" is suitable for this?
            1. Three obvious considerations:
                a. Is the would be mating surface flat and flush?
                b. Required compression force and stress analysis.
                    i. Safe for pipe?
                    ii. Safe for cavity?
                        1. Resulting cavity detuning?
                        2. Can we compensate?
                c. How accurately can survey, internal guides, assembly process etc. guarantee no offset and no angle of beam pipe insert vs Nb pipe?
                    i. That's to say a complete RF seal and no/minimal discontinuity seen by bunch fields on the ID of the beam pipe.
        ii. Someone should do a prelim analysis to verify this nominally doable.
            1. Mechanical analysis and then RF analysis based on mechanical results.
    d. If we go this route, I like Scott's thought that somehow the existing clamping mechanism might be used.
        i. Lots of detail to be looked at.

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From prior e-mail:

Well, more like bullet point action items than notes …

1) All
    a. Figure out required modification to convert existing cathode choke interface to a beam pipe insert interface.
        i. Seems we're off to a fine start with at least as many ideas as people in the room.
2) Jorg
    a. What is the minimum acceptable aperture required at the location of the gun cavity cathode choke / new beam pipe insert.
    b. Get drawings of the existing gun so you have access to existing dimensions. See 6a.
3) Gary
    a. Start development of an installation schedule that works backwards from required install complete and cavity ready for cold test in IR2 to start of gun conversion.
    b. Goal is to start pinning down an ERL Gun operation drop dead date, i.e. when do we need to start Gun conversion?
4) Wencan
    a. FPC modification to reduce Qext
        i. Wencan has already sent out his analysis. Looks very doable and low risk.
    b. WRT to converting from cathode to beam pipe insert, Wencan requested an arc detector and an RF pickup in the volume where the RF seal is.
5) Mike Blaskiewicz
    a. Wake field analysis including existing grooves on the inside of the Nb pipe.
6) Joe for assignment to ?
    a. Distribute appropriate drawings, cartoons, pictures of existing gun structure and proposal for modification.
7) No one yet – or I forgot who

a. HOM damper
b. HTSS
c. Warm solenoid
d. Correctors

8) General
   a. Is there an existing wiki page for LEReC RF or should I start one?
      i. For the ever changing parameter set.
      ii. Drawings
      iii. Repository for notes.