AMERICAN REGIONAL TEAM (ART) RECOMMENDATION FOR THE FOCUS OF EFFORTS WITH RESPECT TO SUPERCONDUCTING FINAL DOUBLET DEVELOPMENT

Based on the materials presented below, discussed at a meeting of July 22, 2010, M.Anerella, T.Markiewicz, B.Parker, A.Seryi and P.Wanderer suggest the following

RECOMMENDATION:

At present time, the efforts at BNL will focus on ILC-like prototype of SC FD. The work on ILC-technology-like ATF2-compatible SC FD will be ***deferred without prejudice***, so that in half a year or a year time scale we can come back to the discussion of the development of ATF2-compatible SC FD.

The delay will allow several ongoing developments to converge, in particular:

- Predictive capabilities of FEM models, which may connect ILC FD and ATF-compatible FD, would be investigated and clarified;
- Synergy with Super-B, including for measurements of magnetic center with coils, and possibilities of performing this work under US-Japan framework will be investigated;
- A detailed plan of construction, funding and study, without beam, and as an added benefit, with beam, of the ATF2-compatible FD will be developed;
- The operation of ATF/ATF2 beyond 2012 will be determined, based on the entirety of its potential scientific program

BACKGROUND INFORMATION

ATF2 is a unique international facility. ATF2 has so far produced 6 PhDs in accelerator physics and another 6 PhDs are in preparation. The discussed program of ATF2 after 2012 include CLIC-proposed ultra-low beta* for 20nm beam, a photon-collider photon facility, a test-bed for quantum electrodynamics experiments, a possible place for SC FD development and experiments and will likely include other experiments.

At the present moment, there is no decision yet about operation of ATF2 after 2012. At present, operation of ATF2 is supported by KEK, in full accordance with a spirit of ICFA recommendation. Studies at ATF2, hardware development and support, are largely supported by international collaborators. At this moment, a different mode of support of the operation is being discussed. It may take about a year for KEK and for the involved International Collaboration to come up with a decision about operation after 2012. The decision about ATF2 operation after 2012 would need to be made based on the entirety of its potential scientific program.

The above recommendations are based on discussions at June 2010 Annecy meeting [1], devoted to SC FD, and on the follow-up discussions.

In our discussion we made a comparative examination of the possible scenarios and analyzed their pros and cons. This facilitated convergence on a recommendation.

Considering limited resources, the realistic choices are the following:

- A: focus now on ILC SC FD prototype, postpone the ATF2 SC Quad;
- B: continue ATF2 SC quad, do not increase the emphasis on ILC SC Quad;

(There is also an option C: to enhance work on ILC SC FD and also continue ATF2 SC quad. The option C is difficult, from financial point of view, and will be ignored in our discussion below.)

Assuming that a choice will need to be made between either "A" or "B", let us discuss the prerequisites, possible outcomes, pros and cons of a particular decision.

Follow with "A":

- Prerequisites:
    - need FEM results showing that cold mass supports as designed have chance to be sufficiently stable with expected excitation spectrum (prior to

the final design, a FEM analysis will be performed to determine the natural vibration frequencies and, if necessary, modify the design to reduce them);

- Possible outcomes:
  - demo of long winding;
  - demo of field quality;
  - demo of quench performance;
  - demo of cold mass stability, measured from outside by interferometer (this measurement is likely)
  - demo of coil stability, measured by mounting 4.5 Hz geophones to the coil support tube inside the helium vessel, at the junction of the SD0 and QD0 coils.
  - measurement of field center stability with coil, likely complicated and polluted by air to vacuum & cold bore transitions (this measurement is under discussion);
- Pros:
  - study focused on ILC-relevant quad. Test will provide data on the performance of the several technologies (e.g., low heat leak cryostat, coil and cold mass supports, service cryostat for push-pull rapid changeover) needed in the magnet system. The test data will make it possible for optimized versions of these components to be incorporated into the EDR ;
  - comparison of interferometer and geophone measurements of stability.
- Cons:
  - It is not clear, at this moment, if we can confirm low systematic error by comparing interferometer measurements of cold mass with measurements of magnetic field center by coil inside of the cold bore;
  - recent considerations of "universal FD" with split QD0 coils and shifted SD0 into between QD0 coils (to allow low E operation) will need to be further studied and may become a baseline in a year or so from now – it may affect the FD mechanical design;

        - however, a very large portion of the information gained in a system test of QD0 would be useful even if the optics were changed to a split QD0; a very large fraction of the equipment (e.g., cryostat, service cryostat) would also be reused;
    - no system test of magnet with beam and beam monitoring and control elements, the prototype would not be intended for beam operation, and some important issues may be never revealed;

Follow with "B":

This path is split into two subsections, highlighting the added beneficial information that would be obtained by testing the magnet system in a beam (B-2).

- Prerequisites:
    - need to develop the study plan with coils, etc. (without beam);
    - FEM model capability need to be developed to allow prediction of ILC-FD performance based on ATF2-SC-FD and other (BEP-C, etc.)
        - In the past, it has been found that it is difficult to accurately model the vibration of complex systems (e.g., effect of cryogenic system), so a system test of the ILC QD0 with the service cryostat is also necessary;
    - for B-2, need to make sure that design is compatible with potential installation at ATF2 beamline;
- Possible outcomes:
    - demo of field quality;
    - demo of long coil (coming from a limited-scale ILC FD test);
    - demo of (short) cold mass stability measured by interferometer;
        - the support system is not the same as that of the ILC QD0, which reduce the value of this test; however, the test can be done with 2K, so the cryo-connection and excitation would be the same;
    - demo of magnetic center stability measured by coil in warm bore (not in the

present budget);

- Possible additional outcomes if B-2 pursued:
  - confirmation of field stability measured with beam;
  - development of beam tuning techniques with use of fixed correctors;
  - overall system test of SC FD integration into operating beamline;
- Pros:
  - It may be possible to relate the interferometer-measured cold mass motion with directly coil-measured field motion;
- Additional Pros (if B-2 is pursued):
  - system test in a beamline may reveal unknown issues;
  - installation on beamline may enable or facilitate other goals like low-beta;
- Cons:
  - work is focused on ILC-similar but not exactly on ILC design (support of cold mass inside cryostat similar, support of magnet inside of the helium vessel is not the same);
- Additional Cons (if B-2 is pursued):
  - installation of SC FD on the beamline may affect other ATF2 goals;
  - availability of ATF2 beamline for beam test is not clear;

REFERENCES

[1] Materials of the meeting devoted to SC FD and its synergy with Super-B, June 14, 2010, Annecy, http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=4562